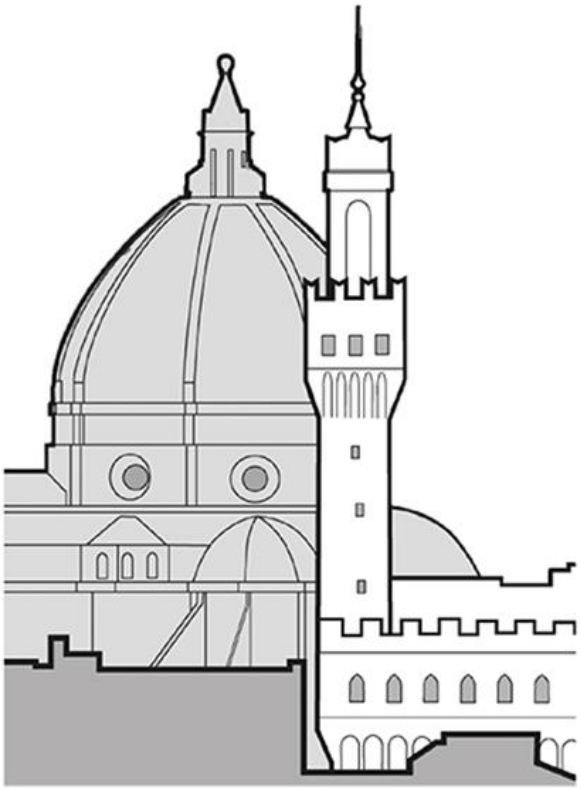
Electronic Imaging & the Visual Arts

EVA 2018 Florence

PROCEEDINGS
Editor: **Vito Cappellini**



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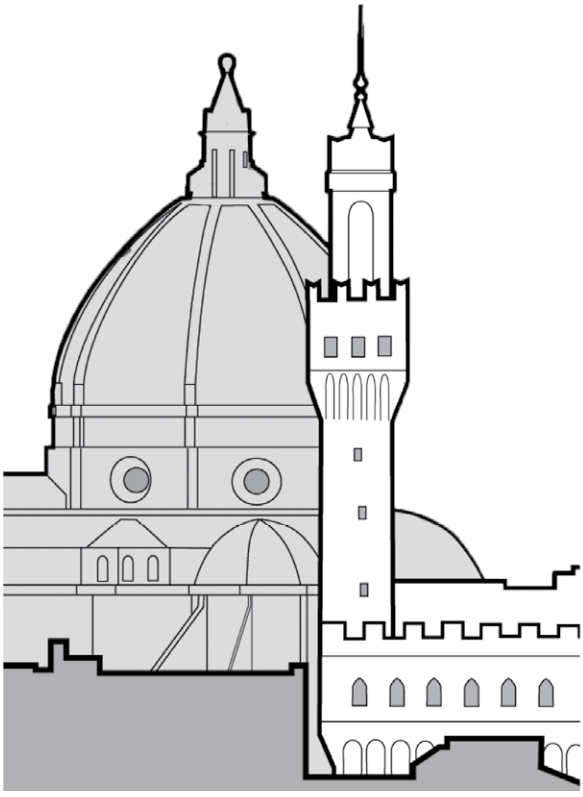

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EVA 2018 Florence

9-10 May 2018

edited by
Vito Cappellini

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PROGRAM

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Electronic Imaging & the Visual Arts

'The Foremost European Electronic Imaging Events in the Visual Arts'

Forum for Users, Suppliers & Researchers

The key aim of this Event is to provide a forum for the user, supplier and scientific research communities to meet and exchange experiences, ideas and plans in the wide area of Culture & Technology. Participants receive up to date news on new EC and international arts computing & telecommunications initiatives as well as on Projects in the Visual Arts field, in archaeology and history. Working Groups and new Projects are promoted. Scientific and technical demonstrations are presented. Technology and Art Exhibitions are promoted.

Main Topics

- 2D – 3D Digital Image Acquisition
- Leading Edge Applications: Galleries, Libraries, Archaeological Sites, Museums & Historical Tours
- Mediterranean Initiatives in Technology for Cultural Heritage: Synergy with European & International Programmes
- Integrated Digital Archives for Cultural Heritage and Contemporary Art
- Management of Museums by using ICT Technology: Documentation, Access, Guides & Other Services
- The Impact of New Mobile Communications on Cultural Heritage and Modern Arts Area
- Cloud Networks
- Semantic Webs
- Ontology Systems
- Human - Computer Interaction for Cultural Heritage Applications
- Copyright Protection (Watermarking & Electronic Commerce)
- Cybersecurity
- Culture and *e-government*
- Activities and Programmes for *e-learning*
- Digital TV and films
- 3D Developments and Applications in the Cultural Heritage Area
- Virtual Galleries and Exhibitions
- Digital Music
- Digital Theatre
- Cultural Tourism & Travel Applications
- Impact of Culture in the Smart City
- Art and Medicine

WHO SHOULD ATTEND

THE CULTURAL SECTOR: The Visual Arts Community including Museums, Libraries, Archaeological Sites, Educational Institutions, Commercial Galleries and Dealers, Auction Houses, Artists & Collectors

THE HI-TECH INDUSTRY SECTOR: Multimedia Systems, Image Acquisition & Analysis, Data-bases, Display & Printing, ICT Industry, Telematics & Systems Manufacturing, On-line Information Services

MEDIA & RELATED SECTORS: Publishing, Press, Film, Television, Photography, Printing, Advertising, Graphics Design, Consumer Media

IMAGING SYSTEMS RESEARCHERS: Imaging Systems, 3-D Acquisition, Reconstruction & Representation Systems, Information Sciences

TOURISM & TRAVEL SECTOR: Tourism Agencies & Operators, Travel Agencies

THE GOVERNMENT SECTOR: Ministries of Culture and other Institutions involved in Cultural Heritage, Ministries of Industry, Education, Research and Science, Regional Governments

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SeSa s.p.a.

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Thursday, 10 May

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Venue:

Hotel Pierre
Via De’ Lamberti, 5 - 50123 Firenze
Tel. +39 055 216218 Fax +39 055 2396573
E-mail: pierre@remarhotel.com
http://www.hotel-pierre-florence.com/

Special reservations for rooms are provided (please use code EVA18)

WORKSHOP

ROOM A

WORKSHOP INNOVATION AND ENTERPRISE – INNOVAZIONE E IMPRESA
(Italian Language)

9,30 – 13,00
Chairman: Enrico Bocci, Vice-Presidente Confindustria Firenze, Firenze

Technological requirements in the Cultural Heritage field are outlined and opportunities for Italian Enterprises and SME's working in the field, using new technologies, are presented.
Regional and National Applied Research Programs in Italy are described.
Activities by National Organizations and Firms working in the area of Telecommunications, Informatics, Environment and Infomobility are presented.
Funding by European Commission is considered, with particular reference to multimedia and telematics for Cultural Heritage. Special consideration is given to the EC Plan HORIZON 2020.
Initiatives regarding the "know-how" transfer from Research Organizations to the Industrial Sector are described, in particular to create Start-Ups and new Enterprises.
Organizations and Companies present their activities and experiences.

Invited Speakers:
- *Andrea Arnone, Pro-Rettore al Trasferimento Tecnologico e Presidente di CsaVRI, Università degli Studi di Firenze*
- *Laura Castellani, Responsabile del Settore Infrastrutture e Tecnologie per lo Sviluppo della Società dell'Informazione, Regione Toscana*
- *Paola Castellacci, VAR GROUP*

Speakers include:
- *Stefano Cinquini, TELECOM ITALIA*
- *Renzo Zampini, INFOCAMERE*
- *Andrea Calistri, SAPAF Srl, Firenze*
- *Riccardo Bruschi and Luca Bencini, T.T. TECNOSISTEMI, Prato*
- *Andrea Sbandati, CISPEL, Confservizi TOSCANA, Firenze*
- *Gianluca Vannuccini, Servizio Sviluppo Infrastrutture Tecnologiche, Comune di Firenze, Firenze*
- *Francesco Mati, Piante MATI, Pistoia*
- *Claudio Tasselli, Qu.In. Srl, Calenzano, Firenze*
- *Franco Guidi, NEUMUS, Firenze*
- *Massimo Canalicchio, Mentor Incubatore di Firenze, Firenze*
- *Marco Cappellini, CENTRICA Srl, Firenze*

Closing:
- *Cecilia Del Re, Assessore Sviluppo Economico, Comune di Firenze, Firenze*

13,00 Lunch Break

ROOM A

CONFERENCE

Wednesday, 9 May

Chairmen: *Vito Cappellini, University of Florence*
Enrico Del Re, University of Florence

14,15 *Opening:* *James Hemsley,*
EVA Conferences International
Enrico Vicario,
Director of Department of Information Engineering – University of Florence
Gabriele Gori,
General Director Fondazione Cassa di Risparmio di Firenze
Paolo Castellacci,
President GRUPPO SESA

15,30 Coffee Break

ROOM A

15,45 **SESSION 1 – STRATEGIC ISSUES**
Chairman: *Paolo Blasi, University of Florence, Florence, Italy*

"Interactive Image Reconstruction from its Incomplete, Irregular and Imprecise Fragments"

Bahar Taşkesen[1],
A G Constantinides[2]
[1]Middle East Technical University, Turkey
[2] Imperial College London, U.K.

"At the Intersection of Art, Architecture and Archaeology: 3D Virtualization and Contemporary Heritage"

Herbert D. G. Maschner[1],
Victor Manuel Lòpez-Menchero Bendicho[1],
Miguel Ángel Hervás Herrera[2], Jeffrey Du Vernay[1], Aurelia Lureau[1,3], James Bart McLeod[1]
[1] Global Digital Heritage, St Petersburg, Florida, U.S.A.
[2] Baraka Arqueólogos SL, Ciudad Real, Spain
[3]Université Paris – Panthéon-Sorbonne, France

"Is three better than two?
A study on EEG activity and imagination abilities in 2D vs 3D stimuli"

Claudio Lucchiari,
Maria Elide Vanutelli,
Raffaella Folgieri
Department of Philosophy,
Università degli Studi di Milano,
Milan, Italy

"A Scientific Method for the Attribution of Paintings with application to Leonardo's Mona Lisa twins"	J. F. Asmus[1], Vadim Parfenov[2] [1]Department of Physics & Center for Advanced Nanotechnology, University of California, CA, U.S.A. [2]Department of Quantum Electronics and Opto-Electronic Devices, Saint Petersburg Electrotechnical University Saint Petersburg, Russia
"Use of Multimedia and Virtual Reality Technologies to Represent Russian Cultural Heritage"	Nikolay Borisov[1,2], Artem Smolin[2,1], Vera Slobodyanuk[1,2] [1]Dept. of Information Systems for Arts and Humanities, Saint Petersburg State University [2]Dept. of Graphic Technologies, Center for Design and Multimedia, ITMO University Saint Petersburg, Russia

ROOM A

17,15 **SESSION 2 – NEW SCIENCE AND CULTURE DEVELOPMENTS & APPLICATIONS**

Chairman: *Edoardo Calia, Istituto Superiore Mario Boella (ISMB), Torino, Italy*

"*Homo Technologicus* comes of Age: An Ongoing Evolution"	Giuseppe O. Longo University of Trieste Trieste, Italy
"Cognitive stages in rational thinking - toward human technology"	Mika Laakkonen Faculty of Social Science, University of Lapland Lapland, Finland
"A new Compact VNIR Hyperspectral Imaging System for Non-Invasive Analysis in the FineArt and Architecture Fields"	M. Picollo[1], A. Casini[1], C. Cucci[1], J. Jussila[2], M. Poggesi[1], L. Stefani[1] [1] Nello Carrara Institute for Applied Physics of the Italian National Research Council (IFAC-CNR) Florence, Italy [2] SPECIM, Spectral Imaging Ltd. Oulu, Finland

"The place of inspiration of the Flemish Triptych by Rogier van der Weyden. A contribution of the *landscape busting* to one of the *vexata quaestio* of the Sicilian history"	R. Franco Società Italiana di Geologia Ambientale Gangi, Italy
"The Cultural Heritage of tomorrow: should we put a limit to the influence that new technologies have on culture and design?"	Gianpiero Alfarano, Erika Lascialfari DESIGN CAMPUS, University of Florence Calenzano - Florence, Italy
"The use of the intelligent cutting guide PERSEUS during Total Knee Replacement"	Lawrence Camarda[1], Antonio D'Arienzo[1], Michele D'Arienzo[1] [1]Orthopaedic and Traumatology Department, University of Palermo Palermo, Italy

Thursday, 10 May

ROOM A

9,30 **INTERNATIONAL FORUM ON "CULTURE & TECHNOLOGY**
Chairman: Vito Cappellini, University of Florence, Florence, Italy

The structure of the FORUM is presented.
Actual developments and perspectives are outlined, regarding *Culture* and *Technology.*

- Cooperation Groups
- Proposed Projects
- Funding Opportunities
- European Commission Plans

Opening:

- Eugenio Giani, President Consiglio Regionale, Regione Toscana, Italy

Speakers Include:

- Cristina Acidini, President Accademia delle Arti del Disegno, Florence, Italy
- Edoardo Calia, Research Director, Istituto Superiore Mario Boella, Turin, Italy
- Alberto Del Bimbo, Director Centro per la Comunicazione e l'Integrazione dei Media, University of Florence, Florence, Italy
- Veronica Elena Bocci, Coordinator DITECFER, Pistoia, Italy
- David Feldman, *Vice President, THE MONA LISA FOUNDATION, Zurich, Switzerland*
- Monica Carfagni, Full Professor of Industrial Engineering, University of Florence, Florence, Italy
- Carlo Francini, Florence Municipality, Florence, Italy
- Paolo Zampini, Director of Conservatorio di Musica Luigi Cherubini, Florence, Italy
- Emiliano Degl'Innocenti, DARIAH-IT National Coordinator, Consiglio Nazionale delle Ricerche, Italy
- Francesco Bellini, University of Rome "La Sapienza" and Research Director of EUROKLEIS, Rome, Italy
- Francesca Gemma, Aracne editrice int.le, Rome, Italy
- Giovanni Gasbarrone, CIU Confederazione Unione delle Professioni Intellettuali, Responsabile Lazio, Italy

11,45 Coffee Break

12,00 **SESSION 3 – NEW TECHNICAL DEVELOPMENTS & APPLICATIONS**
Chairman: *Andrea De Polo Saibanti, Fratelli Alinari IDEA Spa, Florence, Italy*

"Latest Innovation on Capturing Historical Photographic Ethereogenous Material: The Alinari Experience"	Andrea De Polo Saibanti Fratelli Alinari IDEA SpA Florence, Italy
"International Standardization of FTV"	Masayuki Tanimoto Nagoya University and Nagoya Industrial Science Research Institute Nagoya, Japan
"4D Ray-Space and Ultra-Wide Area FTV"	Masayuki Tanimoto[1], Hirokuni Kurokawa[2] [1]Nagoya Industrial Science Research Institute, Nagoya, Japan [2]University of Aizu Aizu Wakamatsu, Japan
"Digital innovation & Technological explosion *The New Challenges of the Security Management"*	Franco Guidi, Giancarlo Caroti Neumus SrL Florence, Italy
"New Trends of 3D Technologies and Copyright Protection"	Vito Cappellini[1], Francesca Uccheddu[2] [1]University of Florence and INN-3D Italy [2]INN-3D and Department of Industrial Engineering-University of Florence and INN-3D Srl Italy

13,15 Lunch Break

ROOM A

14,40 **SESSION 4 – CULTURAL ACTIVITIES – REAL AND VIRTUAL GALLERIES AND RELATED INITIATIVES**
Chairman: *Jeanette Zwingenberger, Université Paris 1 Panthéon-Sorbonne, Paris, France*

"Museo Nazionale del Bargello"	Ilaria Ciseri Museo Nazionale del Bargello Florence, Italy

"Resisting a Total Loss of Digital Heritage Web 2.0 – Archiving & Bridging Thesaurus for Media Art Histories"	Oliver Grau Department for Image Science, Danube University Krems, Austria
"The extraordinary role of the imaging techniques in the conservation and valorization of Cultural Heritage"	Mauro Matteini ICVBC – C.N.R. Florence, Italy
"Technology and theatrical tradition in art exhibitions: "Earlier Mona Lisa" in Shanghai"	Jean Paul Carradori, Qing Li Shanghai International Interior Design Festival Europe area
"Renaissance Experience: Florence and Uffizi"	Marco Cappellini, Paolo De Rocco, Paolo Romoli Centrica Srl, Murate Idea Park Florence, Italy
"Smarticon: A Digital Eco-System for Cultural Heritage. Iconographic Convergences in Art and in World Religious"	Sara Penco Start up "Sapere Project" Rome, Italy
"Some Reflections & Questions on Emerging Forms of Digital Photo-Libraries"	James R. Hemsley Birkbeck College London, U.K.
"Contemporary Art Creation and Exhibitions"	Paola Imposimato Studio Creazioni di Design e Arti Grafiche e Pittoriche, Florence, Italy

16,40 Coffee Break

ROOM A

16,55 **SESSION 5 – ACCESS TO THE CULTURE INFORMATION**
Chairman: James Hemsley, EVA Conferences International, U.K .

"Creative perception, decoding of hidden images, contextualisation and interactive learning process"	Jeanette Zwingenberger Université Paris 1 Panthéon-Sorbonne Paris, France
"Instant Architecture: Hosted Access to the Archivision Research Library with Built-In Image Management & Presentation Tools"	Maureen Burns[1], Andreas Knab[2] [1]Archivision Associate & IMAGinED Consulting Los Angeles, U.S.A. [2]Owner vrcHost LLC Miami, Florida, U.S.A.

*"*Maximizing Metadata: Embedded Metadata Tools"	Marcia Focht Department of Art History, Binghamton University Binghamton, New York, U.S.A
"Il Piccolo Masaccio e le Terre Nuove. Creativity and Computer Graphics for Museum Edutainment"	Valentina Zucchi[1], Antonella Guidazzoli[2], Giovanni Bellavia[2], Daniele De Luca[2], Maria Chiara Liguori[2], Francesca Delli Ponti[2], Federica Farroni[2], Beatrice Chiavarini[2] [1]Museo Terre Nuove San Giovanni Valdarno, Italy [2]Cineca Bologna, Italy
"Canals, Cities, Museums, Libraries & Photography: A Reconnaissance Study of Regent's Canal, London"	Graham Diprose[1], Christina Hemsley[2], James R. Hemsley[3] [1]Photographer, Author & Lecturer London, U.K [2]Digital Consultant & Photographer London, U.K [3]Birkbeck College London, U.K.
"3D Visualization: Revealing Imagery Space by Technological Parameter"	Nina Sosna Department of Visual Anthropology, Institute of Philosophy Moscow, Russia
"A Techno Social Collaborative Platform to Manage Optimize and Crowdfund Cultural Heritage Initiatives"	F. Spadoni[1], F. Tariffi[2], R. Rossi[1], S. Lusso[2] [1]Rigel Engineering S.r.l. Livorno, Italy [2]Space S.p.A. Prato, Italy

SPECIAL EVENT

Wednesday, 9 May: 19,00 - 22,00

Visit to *Art Collection* of FONDAZIONE CR FIRENZE

EXHIBITION

ROOM B

Wednesday 9 May: 11,00 - 18,00

TECHNICAL EXHIBITION

Augmented Virtual Reality Projects-Realizations and 3D Digital Technologies will be presented with Technical Demonstrations.

Documentation on TECHNICAL EXHIBITION will be available.

Thursday 10 May: 10,00 – 18,00

ART EXHIBITION

Organizer and Coordinator: Riccardo Saldarelli, Presidente della Sezione Artisti della ANTICA COMPAGNIA DEL PAIOLO (Presidente Anna Bini)

Riccardo Saldarelli has given very important Contributions to “Digital Art”, since 1970. He will present many of his Paintings, regarding in particular “Digital Art” Creations, by using large Digital Displays. Also Giusy Celeste and Jannette Rutsche will present their “Digital Art” Works.

Paintings of other Artists will be also shown.

At 16,30 Franco Samoggia (Sezione Scienze), introduced by Riccardo Saldarelli, will present his Book “IL VIZIO DI LAVORARE”, making also reference to a special Medal - created by Riccardo Saldarelli – which has travelled on a “Spacecraft”.

Documentation on ART EXHIBITION will be available.

For information on the EXHIBITION:
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STRATEGIC ISSUES

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Interactive Image Reconstruction from its Incomplete, Irregular and Imprecise Fragments

Bahar Taşkesen,[1] A G Constantinides[2]

[1] Middle East Technical University, Turkey
[2] Imperial College London, U.K.

1 Introduction

The aim of this paper is to present a novel method as an adjunct to a human/expert for assembling unknown images from their fragments. Reassembling an image from its partial and eroded or decayed constituent fragments is of great importance in variety of fields, such as forensics, failure analysis, anthropology, archaeology and art reconstruction. It is a common task, indeed, in archaeological research and artefact preservation. Reassembly from archaeological fragments is a much more involved problem in comparison to other fields due to the following reasons. The number of randomly mixed fragments is normally huge, the fragments are mostly corrupted, irregular, and frequently with uncertain and eroded boundaries. In archaeology the process of assembling may not be required to produce a complete solution. Indeed, it may be required to produce a series of possible options and even partial solutions which the archaeologist would appraise subject to a range of archaeological and often unquantifiable constraints. We propose such a method for archaeological images.

This paper is organized as follows. Prior work related with our proposed method is shared in Section 2, while detailed explanation of the proposed method is presented in Section 3. Finally, this paper ends with the conclusion part in the Section 4.

2 Related Work

The fact that reassembly of an unknown image manually from its irregular and very often eroded fragments is very time-consuming task, motivates researchers to design automated systems [1], [2], [3], [4]. The algorithms produced are usually built upon several subsystems which generate reliable or accurate scores between fragments. Although, these algorithms show great success in specific cases, they have, so far, limited success in reassembling incomplete images with vast numbers of eroded pieces automatically.

For 2D matching the algorithms proposed so far can be divided into two categories: a) colour based methods, and b) geometry based approaches. Colour based methods use the colour information present in the fragments and mainly at the boundaries [4], [5], [6], [7]. These algorithms are mostly efficient, but they fail when only the mean of the colour intensities belonging to a fragment is taken, or only when the boundary of the pair of fragments is considered. Geometry based approaches assemble the fragments by matching the boundary curves of the fragment pairs [8], [7], [9], [10]. The geometry based approaches can accurately match the adjacent pairs if there is no corrupted or eroded geometry at the broken parts of the fragments. Since the fragments of interest in our case have exposed to the natural elements, perhaps for thousands of years, it is inevitable that the edges of the pieces are eroded/corrupted, and their geometry is thereby destroyed. Moreover, the geometry based approaches are relatively slow as compared to other methods and they can fail in their search to lock at a local minimum of the objective function.

The latest research published focussed on initially finding matches between the fragments by checking the patterns at the boundaries of adjacent fragments. This pattern alignment is enhanced by several methods which can be listed briefly as follows, a) by using the colour information [11], b) by describing fractured edges using the new 'ribbon' idea [12], c) by normal maps [13]. These methods have great success when the features of the fragment pairs are significantly different. We construct an integrated approach with the above-mentioned methods, in which mostly the boundary correlations between the potential pairs dominate the matches. Matching scores are derived and the scores between the potential pairs are adjusted with each of the several algorithmic iterations in a graph based approach.

3 Proposed Method

Our proposed method is not meant to replace the experts' (in our case the archaeologist's) skills and knowledge but rather to be an aid and an additional tool. This aspect is incorporated in the structure of the algorithm. In our approach we support the most likely match with periodicity check, line continuity and inner layer correlation all of these terms are explained in this paper below. At the end, the most meaningful match is selected as decided by the expert/archaeologist. The method is explained in the following subsections which cover formulation of the problem, border and boundary extraction, score assignment, decision unit and score rearrangement.

Formulation of the Problem

Given the set of fragments $G = G_i$ of the image (I), we wish to find the most likely match between fragments. In the composition of the image I each fragment is identified by its pixel boundary vector B_i, $i = 1...N$, where N is the total number of available fragments. The image (I), has more fragments than N, such that some of the fragments are lost, however, only N number of fragments are accessible. Because of the possibly of imprecise, eroded or corrupted boundaries we also check the inner layers. A layer is a sequence of pixel values once or several times removed off the boundary of a given fragment. Hence, each fragment is defined by its boundary matrix for each layer, B_{ij}, where j is the layer number *1...ly*, and ly is the maximum layer number. To locate the maximum correlation exactly in the whole boundary matrix of the fragment we also detect the corners (C) of a fragment and divide the boundary vector into borders (sub-boundaries) F_k, where $k = 1...C$, $F_k \subset B_{ij} \subset G_i \subset I$, as shown in the Figure 1.

Another reason for dividing the boundary matrix into borders is the fact that each boundary matrix is huge compared to the likely correct matched pairs. This result in vast and unrelated parts of the boundary matrix. These unrelated parts decrease the correlation between correctly matched pairs and give misleading results subsequently. To avoid these problems, we prefer to check the relatively small but reasonable portions of the boundary vector/matrix borders as explained in the following subsection.

Border and Boundary Extraction

As already mentioned, each fragment is defined by its boundary and related borders for the layer of interest. To extract the boundary of the image we transform the image into binary (for instance the fragment is all white and the background is black), by knowing that the photographic image of each fragment is acquired at a constant colour background. The structuring element disk with the distance from its origin (r) proportional to the intended layer number is used for morphological erosion operation. We simply take the difference of the binary images after two consecutive erosion operations, with r set equal to the desired layer number, *ly* and *ly -1*. Then we obtain the raw boundary vector, without corner indicators.

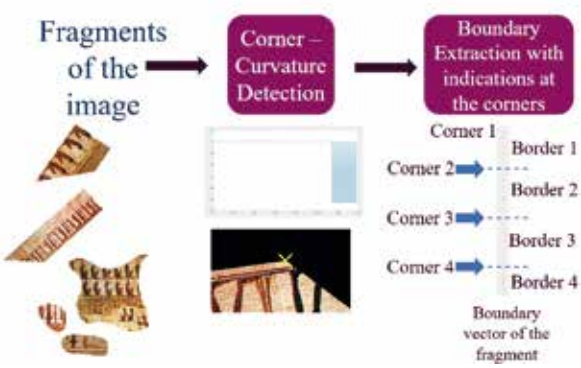


Figure 1: Border Extraction and Boundary Gathering as a Vector Processes Block Diagram

Commonly used and well-known functions for corner detection work well if the fragment is close to rectangular in shape with corners at approximately right angles. However, when we have a fragment with other form as in Figure 2a these methods fail and produce false corner alarms, such as in Figure 2b. This is essentially due the fact that we are working in the discrete domain where there are no continuous lines. As a result, when we zoom in the one portion of the fragment as in Figure 2b. Hence for the corner detection purposes we designed our own specific algorithm.

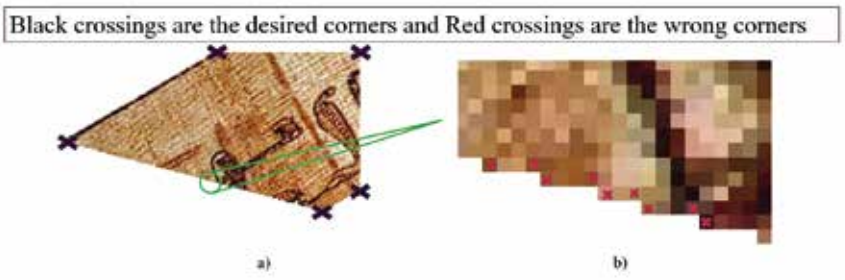


Figure 2: a. Fragment Sample with the desired corners b. Closed portion of the fragment and the corners detected with the current algorithms

We obtain a slope plot by using the boundary coordinates as in Figure 3. Corners are checked both from periodicity of the slope vector in Figure 3 within the boundary vector, and maximum-minimum slopes in a local area of corner.

In digital world, a line can be defined by its slope period shorter than its size, meaning that each line has a periodic behaviour that determines its starting point to end point slope. The line cannot follow same the same slope at each consecutive point as it can be seen at Figure 2(b), however it follows a period throughout the line. The proposed corner detection algorithm is designed based on this claim. If we assume that a boundary vector is taken, and its slope between two cascaded points are calculated, this brings a slope vector (s) of that boundary as it can be seen at Figure 3. Initially, enough data points (m1) depending on the least border size that is investigating, are taken from the boundary slope vector. After that, period of this data array (s(1)…s(m1)) is calculated, the calculated period of this line is less than its size (m1). Later on, the data is accumulated from "*s"* vector one at a time, and period of the accumulated data array (s(1)…s(m1), s(m1+1), s(m1+2)…s(m2)) is calculated. Moreover, if the calculated period is still less than the size of the array (m2), then this indicates that "s(m2)", belongs to the line. On the other hand, if the period is equal to the size of the array (m2) than this indicates that the line might be following another direction, starting from m2. This doubt about m2, that whether it is a corner point, or not, is overcome by accumulating the rest of the s vector size at a time, and its corresponding period, as it is done until m2 point. Furthermore, if they are equal in every time, then this indicates that slope vector is aperiodic after m2, and it is unique. After m2 is marked as a corner, the algorithm is iteratively computed for the *s'* vector, which corresponds to [s(m1+1), s(m1+2)….s(end)].

Within the local area next maximum-minimum and the previous maximum-minimum slope values are checked and the detected corner is verified. This approach is also supported by the local standard deviation calculations of the differences at boundary's x values and y values. Peaks in the sliding standard deviation vector over the slope vector indicate a possible corner. These two checks, supports the proposed corner detection algorithm for the worst cases that it might fail.

Corner extraction results for an ideal fragment is shown in Figure 4(a), and corners for a fragment with curves can be found at Figure 4(b). We put an indicator (*NaN* in our case) for the detected corners in the boundary vector. Hence, we obtain a single vector to represent each G_i.

Score Assignment

We used a dynamic graph based approach to track the relations between fragment pairs, and their corresponding borders. We basically use a cross correlation metric to determine the weights in the dynamic score graph.

Cross correlation calculated from the equation 1, where c_{y1y2} is the sample covariance function calculated from 2 and s_{y1}, s_{y2} are corresponding sample standard deviations of the time series y_{1t} and y_{2t} at lags k = 0, ±1, ±2, … calculated from equation 3. μ_{y1} and μ_{y2} are the sample means of the time series.

$$r_{y_{1y_2}}(k) = \frac{c_{y_1y_2}(k)}{s_{y_1}s_{y_2}} \quad k = 0, \pm 1, \pm 2, .. \quad (1)$$

$$c_{y_{1y_2}} = \begin{cases} \frac{1}{T}\sum_{t=1}^{T-k}(y_{1t} - \mu_{y1})(y_{2t,t+k} - \mu_{y2}) \ if \ k = 0, 1, 2 \ldots \\ \frac{1}{T}\sum_{t=1}^{T-k}(y_{2t} - \mu_{y2})(y_{1t,t+k} - \mu_{y1}) \ if \ k = 0, -1, -2 \ldots \end{cases} \quad (2)$$

$$s_{yi} = \sqrt{c_{y_iy_i}(0)}, c_{y_iy_i}(0) = Var(y_i) \quad (3)$$

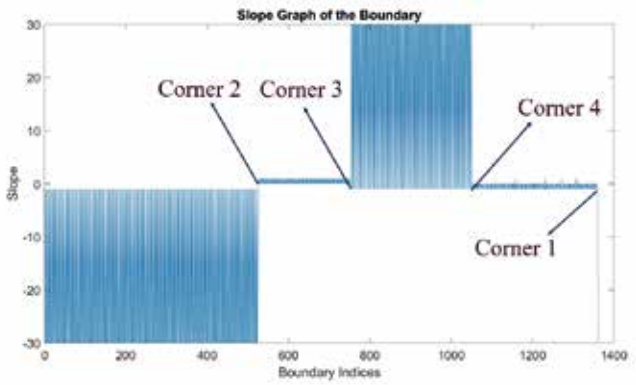
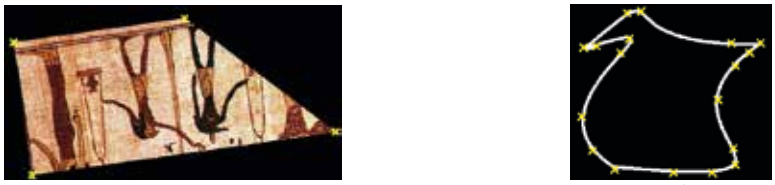


Figure 3: Slope Plot of the Consecutive Points at the Boundary of a Fragment

Initially, the scores are calculated over the first layer. Elimination with a predetermined threshold is performed and most likely solutions are gathered. With this knowledge of the most possible matches, we supervise the inner layer correlations. However, the correlations at the inner layers are relatively small as it can be seen at the Figure 5. As a result, the threshold that eliminates the wrong matches and indicates frame borders of the image, (at the frame borders of the overall image I, we do not expect any match) is decreased. The whole idea is represented in the Figure 6.



(a) (b)

Figure 4: Corner detection for the non-ideally shaped fragment and for the ideally shaped fragment

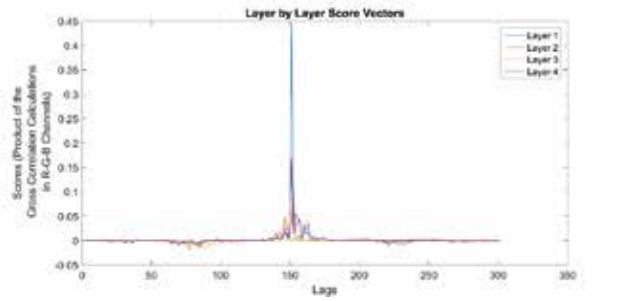


Figure 5: Layer by Layer Score Vector Plot

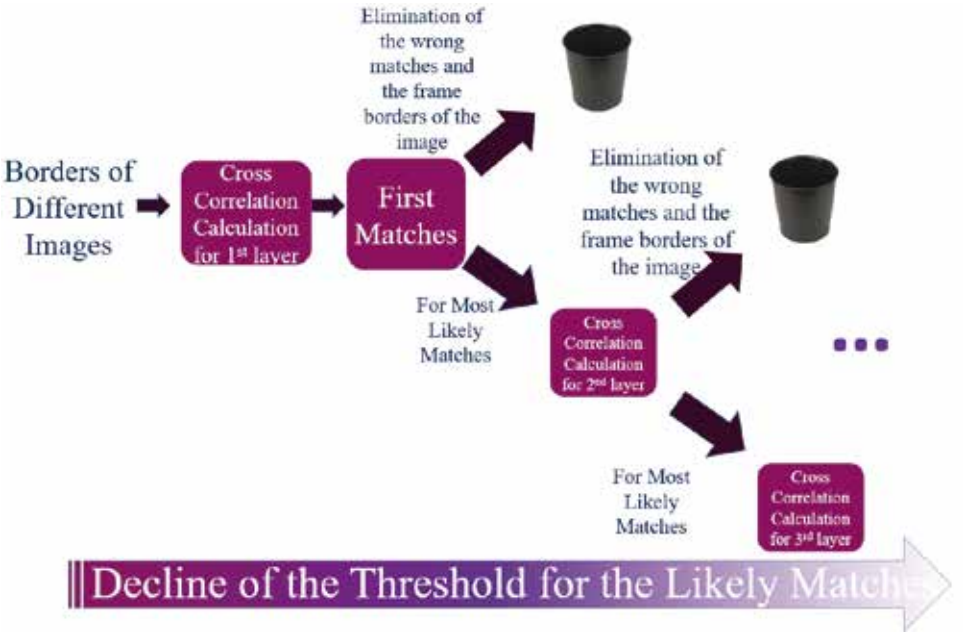


Figure 6: Block Diagram of the Proposed Method

Interpolation

At the inner layers the size of the corresponding border vector is smaller (fewer samples). This reduction in the length of the inner layers (pixel changes in the layer 1 to layer 3 cross correlation calculation) results in changes of the maximum correlation location within the two corresponding borders. To overcome this problem, the smaller border vector is linearly extrapolated |layer1 - layer2| times. Here, layer1 is the layer number of the first border and layer2 is the layer number of the second border.

Calculation of the Cross Correlation in 3D

Cross correlation is calculated between each fragment pairs at the desired layer (j). Especially, in each fragment pair (a1 and a2), all F_ks of the related Ba_1j and Ba_2j. However, since RGB colour space intensities are used throughout the work presented, three dimensional vectors are obtained for the boundary vectors. The cross correlations between the corresponding channels of the border vectors are calculated. (red channel of a1 - red channel of a2) Then, each cross-correlation vector for red, green and blue for the related pair at the predetermined layer are multiplied and to yield a score vector. Since, the orientations of the fragments are unknown, the cross correlations should be

controlled in two directions. First, the cross correlation is calculated in the same manner as the borders located in the boundary vector, and then one of them is reversed and then the cross-correlation calculation is performed again.

Storage of the Data

Five-dimensional arrays are used to store the scores, and for the graph theory applications, implication tables are constructed. The 3D illustration of the array is shared in Figure 7. In the score array, 2nd dimension is used to construct the implication table. In the 3rd dimension, the cross-correlation multiplication in R-G-B channels vector (score vectors) are stored. The 4th dimension is used to store the score vectors layer by layer. To be more specific, if ly is the last layer that is going to be used, then 4th dimension simply constructs the score vectors for the following combinations: 11, 12, 13… 1ly; 21, 22,...,2ly;ly1,ly2,...lyly. As mentioned earlier, the score vector is calculated first with the same locations of the borders vectors as they are in their boundary vectors and secondly, with one of the border vector is flipped. Hence, another 5th dimension is created for the same implication table, scores vector and layers in which one of the border vector is reversed.

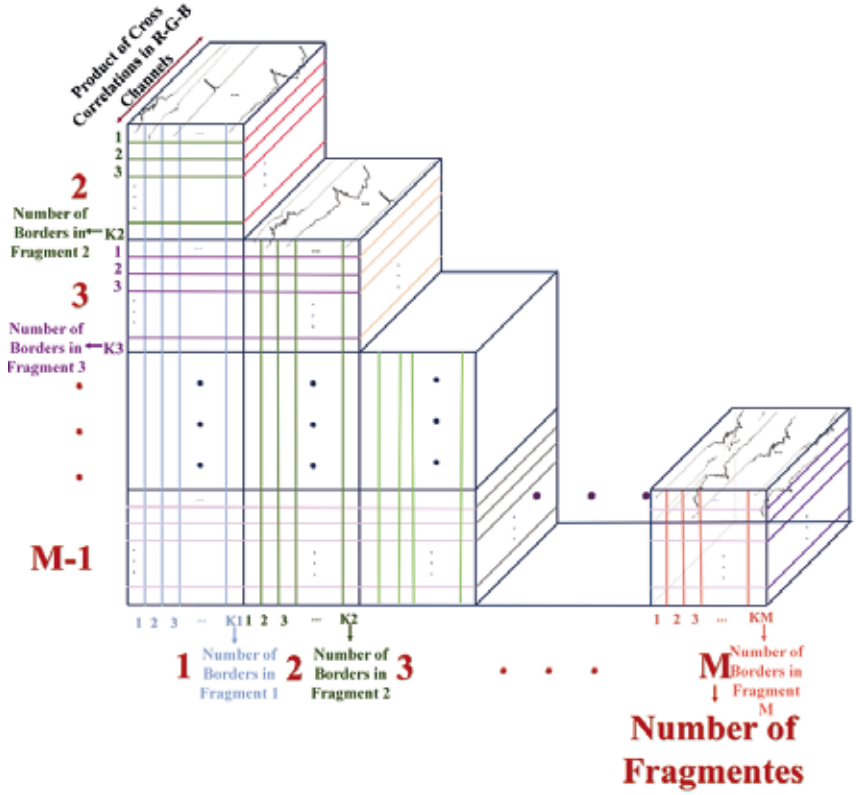


Figure 7: 3D Score Array Illustration

Periodicity of the Lines

The periodicity of lines detection is also used as a metric which strengthens the score between two fragments. This signals that there is a tight correlation between the boundaries of two fragments. The detection is accomplished by checking the scores vector (product of cross correlations in R-G-B channels). When there are symmetrical peaks around the maximum point, as in Figure 8(a), it can be deduced that precise shifts (amount of the period) of the vectors results in again high correlation, which can be

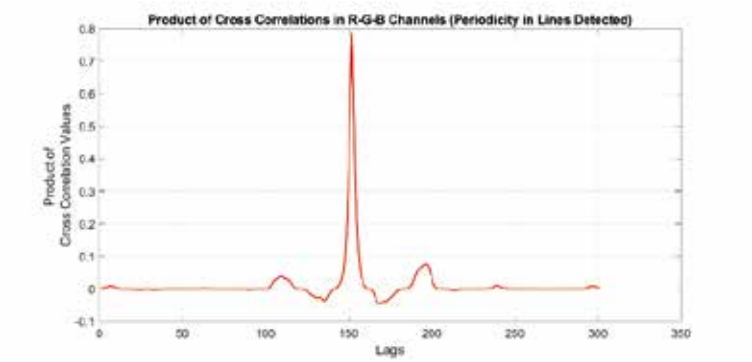
seen at the Figure 8(b). Then, after periodicity detection, the score between the related fragments is increased exponentially.

Decision Unit and Score Rearrangement

The score assignment initially starts automatically. First, the orientation of the vectors of interest are decided by checking the maximum values of the scores vector calculates between the 1st layers of the fragments. The correct orientation (whether the vector is reversed in the boundary vector, or not) although the fragments are not matched at all, yields higher acme among the score vector than the uncorrected orientation of the two border vectors. Subsequently, we also encode the correct orientation of the vectors to the scores array.

The designed algorithm iteratively goes over the layers up to the predetermined ly (maximum number of layers to be used) as it is illustrated in the Figure 8 for the most likely matches. The peak value of the score matrix in each layer is checked by the threshold and the shape of the score matrix is also considered as a decision metric. Mostly for the correct matches, the score vector shows an impulsive behaviour around the principally correlated locations of the border vectors. Moreover, at the inner layers of the score vector, it is expected that the impulsive behaviour will continue with a lower peak, but with the almost same principal location as it can be seen at Figure 5. However, for the wrong matches this impulsive behaviour is not observed.

The algorithm presents the most likely matches to the expert/archaeologist after the steps shown in Figure 6, starting from the furthest correlated fragments. Knowledge of the context, such as the archaeological excavation environment, historical cognisance and human intelligence here take place and decide whether the proposed match is correct or not. With this decision the scores are re-adapted and if the given match by the algorithm is rejected the corresponding score becomes *NaN,* and not used again.



(a)

(b)

Figure 8: Plot of the score vector (a) and the periodic lines that we detected by our algorithm(b)

4 Conclusion and Future Work

In this paper we presented a novel interactive image reconstruction algorithm. Our method consists mainly 3 parts. First, we extract the boundary vector and the corners of the fragments. Secondly, we construct a graph based on the correlation between the inner boundaries of the fragments. Afterwards, the expert/archaeologist is introduced to contribute to the process and to control the proposed algorithmic matches. Our results from initial trials show that the correct matches are determined.

Although our study is only a small step, we believe that this model will insert another insight, and will be useful for the construction of future image reassembly algorithms. In the future, the 3D space orientation of the fragments can be added as a metric for the matches of fractured pairs. Moreover, this method can be applied to the complex data-sets with imprecise boundaries and locally corrupted 3D fragments.

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AT THE INTERSECTION OF ART, ARCHITECTURE AND ARCHAEOLOGY: 3D VIRTUALIZATION AND CONTEMPORARY HERITAGE

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Abstract – We are at a global transition where disciplines from art to computer engineering intersect in the realm of global digital heritage. This has been facilitated by the development of desktop high-speed computing, inexpensive photogrammetry software, and digital photography. These technologies, and the tools to make them useful both in the lab and on the web, require the appropriate integration of technical skill, artistic license, archaeological background knowledge, and architectural realities.

INTRODUCTION

The documentation of archaeological sites, historic buildings, museums, museum collections, works of art, and other cultural heritage resources using 3D acquisition techniques is now mainstream practice in most areas of the world. The growing prevalence of on-line resources and inexpensive software have allowed students, amateurs, and many professionals the ability to collect data and create 3D models of a wide range of subjects, places, and landscapes. Photogrammetry in particular, has democratized the participation in 3D model development, and nearly every student of digital heritage, every laboratory and university with an interest in heritage, and every local, regional, and national government is now participating. With a complete photogrammetric kit, including DSLR camera, UAV, computer and software, now available for less than $5000, indeed, the basic acquisition of 3D data through photogrammetry has been truly democratized.

But moving beyond basic acquisition and processing into the realm of archaeological analyses, architectural reconstruction, and conservation: the science we can create from these data, requires a much larger investment. As Dr. Fabio Remondino (FBK) has recently argued so cogently, oftentimes the data collected by those not professionally trained, and the subsequent 3D models, are not useful for further analyses [1]. Problems of scale, camera settings, software settings, computing power, analytical training, and basic photographic skills are all important, but the lack of clear documentation of these attributes is equally problematic making them less useful for comparative analyses and conservation efforts [2, 3].

For many technical analyses, especially in conservation and architecture, more sophisticated data are needed. Terrestrial laser scanners, UAV-based LiDAR and high-resolution photogrammetry, and the computing power to process and preserve those data are far beyond the possibilities (and finances) of most individuals and labs, and require a significant amount of training. But spatial accuracies and geographic controls approaching 1-10 mm are not possible using basic photogrammetric kits when we try to digitize large monuments and sites. These technologies, and the tools to make them useful both in the lab and on the web, require the appropriate integration of technical skill, artistic license, archaeological background knowledge, and architectural realities. They also require a rigorous and detail workflow to produce results that are verifiable, accurate, and useful for further analyses [4].

DISCUSSION

At Global Digital Heritage, nearly 50 years of combined experience has created a workflow that has solved the problems of quality acquisition, data processing, visualization, and data access. But this is a dynamic process. Our methods integrate terrestrial and aerial photographs, terrestrial and aerial LiDAR, GIS, Google Earth, and other geospatial data and imagery. As new algorithms, software, hardware, and ideas are created, these are integrated into the workflow to create new opportunities for digital heritage and archaeology. Our general workflow has proven useful in many areas of our work (Figure 1). These are then transformed into videos, virtual reality, architectural drawings, orthophotos, and virtual reconstructions. Lastly, these are served on the web as raw data, as research tools, as sources of scientific analysis, and as the art of archaeology and architecture. Resulting from this work, we present three brief examples.

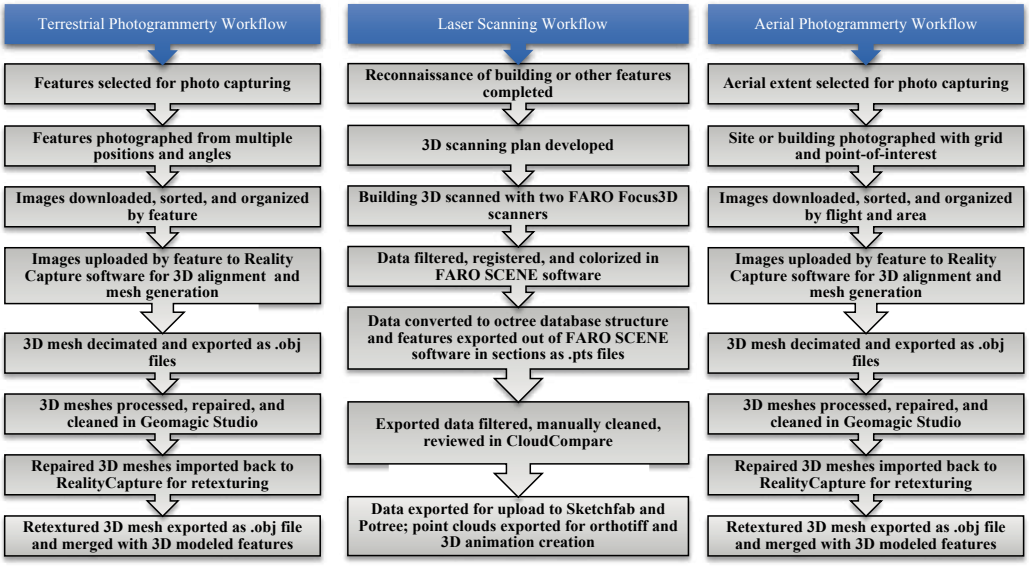

Figure 1. the Global Digital Heritage workflow.

The first is the integration of terrestrial laser scanning and aerial photogrammetry at the Castillo de Los Vélez, in Mula, Murcia, Spain. This is a late Medieval castle built on the ruins of a massive Islamic fortification. Our goal here was to create an accurate model for the community of Mula so that they could begin the restoration and make plans for making the castle accessible to the public. This project required the integration of 227 terrestrial laser scans of the interior, and 2900 photos of the exterior to create the integrated model of the complete structure (Figure 2).

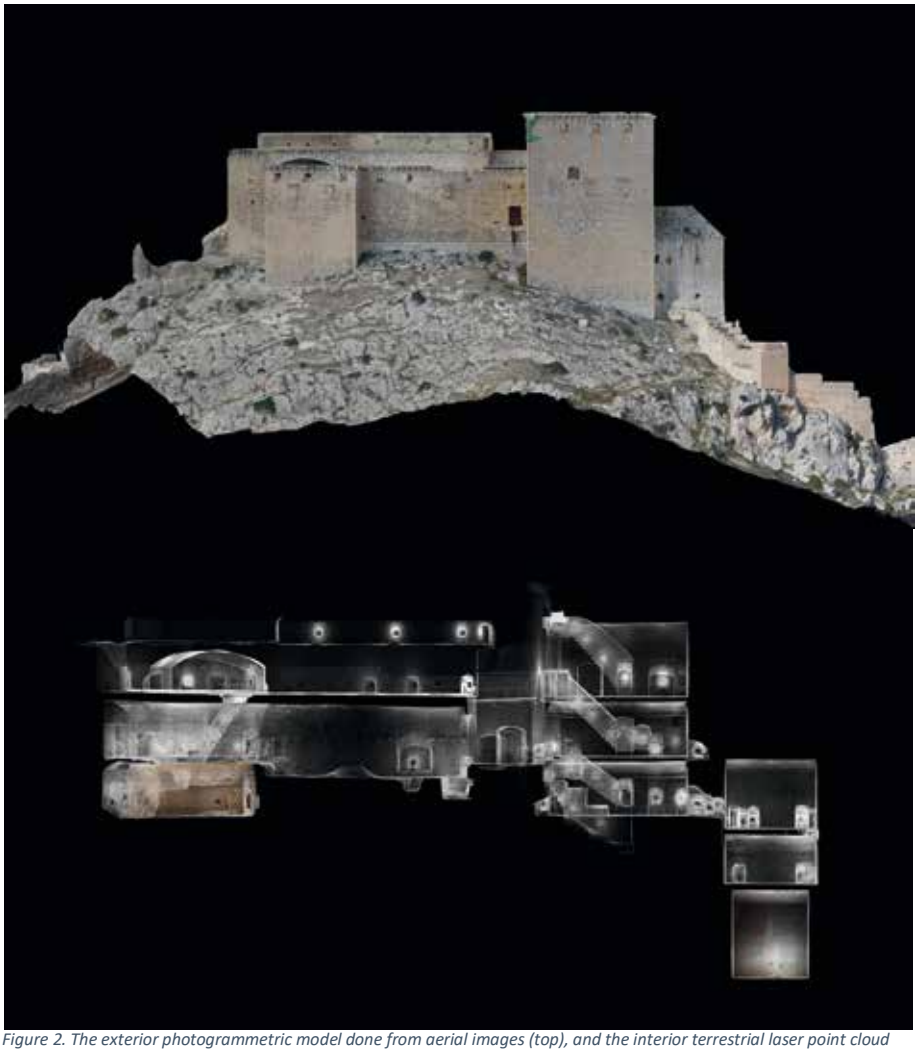

Figure 2. The exterior photogrammetric model done from aerial images (top), and the interior terrestrial laser point cloud (lower) done with Faro laser scanners.

Our second example is the Medieval castle of Alhama, also in Murcia, Spain. While 108 scans and 2450 aerial photos were done here in order to create a result much like the site in Mula discussed above, here we used an additional technology. DStretch is a rapid image enhancement software used for paintings, originally designed to detect and document rock art [5,6]. In this example, high resolution photos were taken of poorly visible paintings on the walls of the Medieval tower. Using DStretch, these paintings become vivid and accessible to researchers (Figure 3).

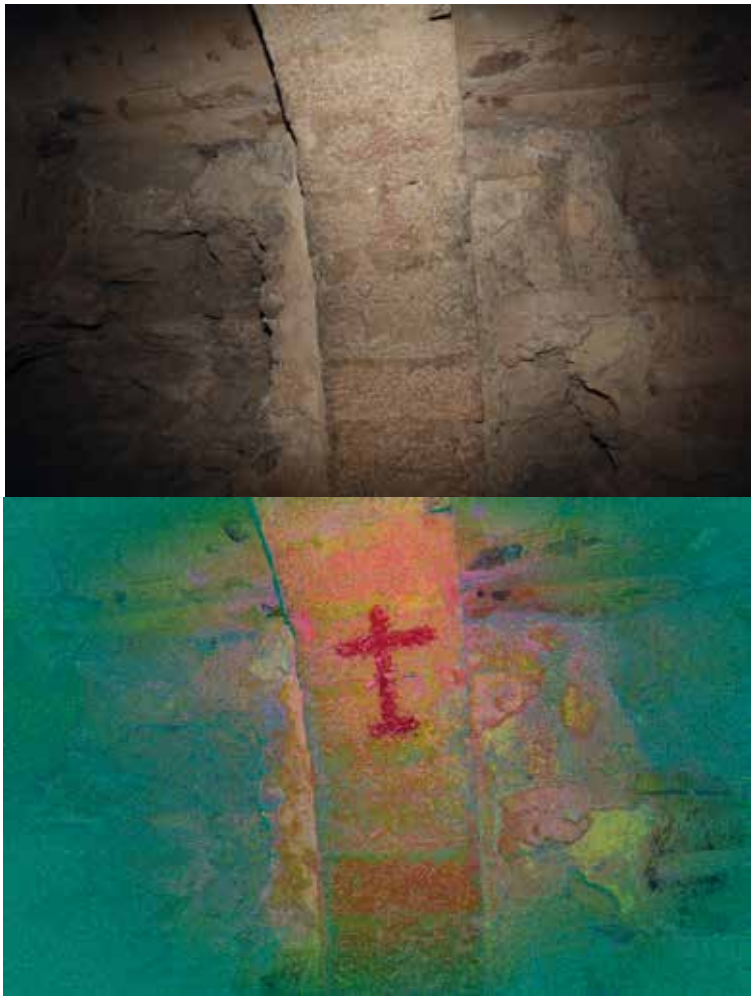

Figure 3. Christian art on the walls of the tower of the Castillo de Alhama, in Alhama de Murcia, Spain. DStretch was used to enhance the digital images .

In a third example, we are scanning Roman archaeological features within the Museo Arqueológico Los Baños in Alhama de Murcia, Spain. In this example we scanned an archaeological excavation preserved in the museum, and then completed the 3D model. This is an example of fine-tuning the output in order to create a powerful visualization of the features, and then upload the data to online presentation (Figure 4).

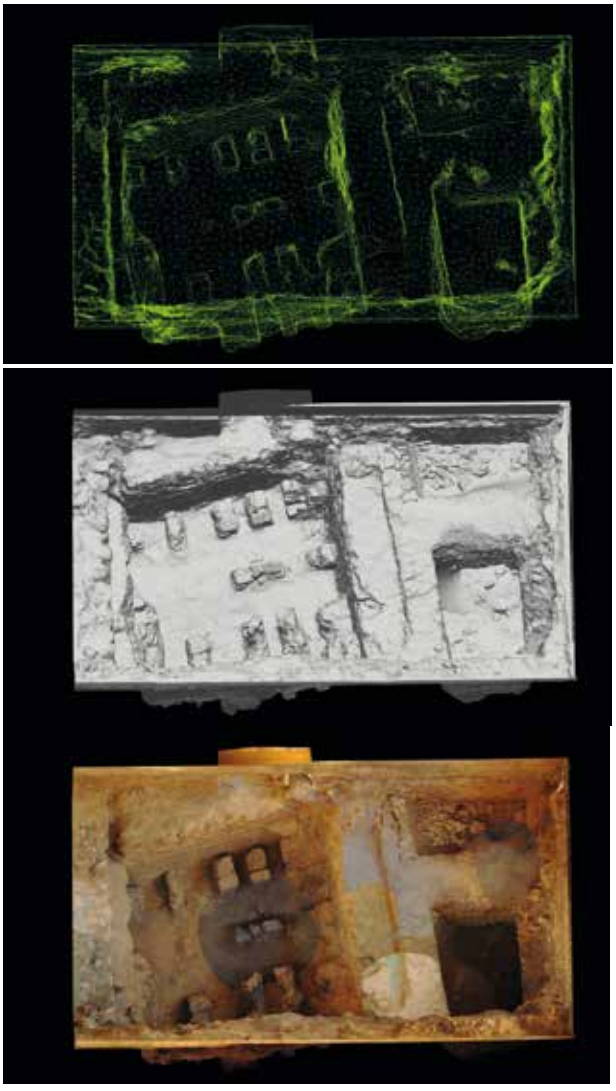

Figure 4. Figure 4: Model creation for a portion of the Roman Bath in Museo Arqueológico Los Baños in Alhama de Murcia, Spain. Top – wire-frame mesh; center – un-textured mesh; lower – textured mesh.

SUMMARY

Global Digital Heritage (GDH) is a not-for-profit, private research and education organization dedicated to documenting, monitoring, and preserving our global cultural and natural heritage. We use digital visualization, 3D virtualization, geospatial informatics, and open access solutions to provide digital data and 3D models to governments, regional institutions, museums, local scholars, and the public. A key element of our mission is the democratization of science-we make all data freely available to the world in support of cultural heritage, heritage management, education, public access, scientific research, and to support of the digital humanities.

We believe that many nations, local and regional museums, and universities have specific and spectacular places, monuments, and museum collections that are critical to the global scientific agenda. While these are often recognized for their heritage value, they are underutilized in science and research because of distance or because the scientific community does not know they exist.

We use virtualization technology to digitize entire collections, entire museums, and entire archaeological and paleontological landscapes. We make virtual repositories available to any student, any child, any scientist or any enthusiast anywhere in the world at any time. We create online analytical tools to democratize education and research through global analyses and exploration. Our virtual repository approach allows for the scientific analyses of places, monuments, and collections on a global scale, and provides a means to highlight the importance of those collections to their communities.

In the face of an increasingly hostile world, a global landscape where conflict and natural disaster are destroying our shared heritage at an accelerating rate, we provide 3D digital services to document and preserve places and specimens critical to our global heritage. We do this for free. We then return all of the data and results to the host institution or regional/local authorities who can do anything they wish with the materials.

ACKNOWLEDGEMENTS

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IS THREE BETTER THAN TWO? A STUDY ON EEG ACTIVITY AND IMAGINATION ABILITIES IN 2D VS 3D STIMULI

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Abstract – Real and virtual are often considered terms in reciprocal opposition, but the boundaries between the two are blurred. The main goal of our study consists in answering the question whether the presence of a third dimension (3D) is a fundamental step of the virtual toward the real world, and if it causes some difference in the neural activity of the spectator [8]. Also, the possibility to consider real what is virtual will be discussed [6, 7].

INTRODUCTION: AIMS AND MOTIVATION

"Real" and "virtual" are often used as opposed terms but, even if they are still divisible, the boundaries between the two are blurred. The properties of reality that cannot be reproduced by the virtual world are increasingly diminishing, in a path that will lead the virtual to cross the real and, perhaps, to overtake it.

The term "virtual" has been used since ancient ages and derives from the word "virtue": by definition, it is something that could exist but has not yet been realized, but which has the virtue of being realized. Lately, the term was adopted by scholastic philosophy to indicate what exists in power and is able to actualize (for example, the tree is virtually present in the seed). The reference here is to the Aristotelian philosophy, where one of the categories of being, that of change, was related to the passage between potentiality and act [1, 13].

Now, we are witnessing the reverse process: the virtualization of an object as the consequence of a creative process in which a piece of reality is transformed and coded by means of electronic systems. This way, the starting object is still recognizable, but transformed in its natures, being recoded in a secondary format. For instance, a chair placed in front of us, but displayed by a monitor, is no longer made of wood, but of numbers; it has the appearance of something you can sit on, but you cannot interact with, you can only watch it and think about its cognitive and behavioral potentialities [11]. Indeed, to understand the basic principles of how 3D technology works, it was necessary to understand how vision can create the effect of depth that allows us to locate objects in three dimensions. This is attributable to the specific anatomy of vision: in fact, humans have two front eyes with an interpupillary distance of about 65mm. Then, the brain operates on the two different images, to elaborate a coherent and unitary interpretation of what a person is actually seeing.

The history of 3D technology has a remote beginning, still linked to photography. An example was already present at the Great Exhibition of 1851: by using a stereoscope (an invention by D. Brewster), a photo of Queen Victoria was shown in 3D instead of the conventional 2D format of pictures and paintings. Here, something more than a simple perspective effect was presented: it was the real recreation of human vision.

The first film projected was "The Power of Love" that exploited a traditional strategy to create the 3D experience. Indeed, two images were superimposed on the screen, so that they become staggered with a "double" effect. Then, special glasses must be used to divide the images. In fact, the problem is to make the individual eyes perceive only one image as it was in the old stereoscope. At the beginning, this phenomenon was obtained with the glasses, called anaglyphs, with a green

and a red lens (then cyan and red for better performance). In fact, they allowed the eye covered by the red lens to see only the projection that was not excluded by the filtering of the colored lens.

Obviously, the notable disadvantage of this technology was the very poor color rendering. At present, the most widespread alternative, thanks to effectiveness and low cost, are polarized light glasses: this technology exploits the polarization of light to separate the image to be sent to the right eye from that meant for the left eye. The lenses are orthogonally meshed (one vertical or one horizontal) and the image is filtered and received independently from the two eyes.

The major flaw of this technology is that the two images are projected simultaneously on the screen and must therefore share the resolution. In other words, the final image will have a resolution equal to half of the projected one. In addition, some subjects experience headaches of varying intensity after a prolonged vision. Finally, it is necessary to keep the head straight; otherwise, the retina of the lenses would no longer coincide with the polarization of the image. Indeed, if the images are not correctly filtered, an annoying "double effect" occurs.

Also, there are active glasses that, through an internal battery, perform the required processes to dissociate the images of the screen. They are called "shutter glasses" because they are based on the same shutter principle of cameras. The lenses of these glasses are composed of liquid crystals that alternately blur at a very high speed (up to 300 times per second); the image projected on the screen is synchronized with the frequency of lenses opening and closing, in order to send a specific signal to each eye.

In any case, the virtual 3D has now "invaded" the space of the real 3D: what we see is no longer limited to that fictitious space that is the monitor or the cinema screen, but moves towards the viewer, thus acquiring a spatial dimension [16]. In fact, when we watch a 3D movie, the effect of depth is not only created towards the "inside" of the screen (like a perspective effect of a Renaissance painting), but some objects extend completely outside the plane to which the screen belongs [2, 3].

This kind of images also become solid in a geometric way. The viewer of this three-dimensional projection has the feeling that the object is within reach. When the visual involvement is optimal, he reacts as if he could touch and interact with the object [4].

A feature of real objects that is lost in their transposition into two dimensions is corporeity, which is the perception of the object observed as an opaque body with its own mass. One thing is to see the 2D image of a stone, another to see that same stone in 3D. In both cases, the object is familiar and therefore we could attribute it an estimate of weight. However, being in front of this object in three dimensions gives us additional information that, with a standard format, we would not have. Certainly, not everyone (neither the spectators, nor the directors) appreciates this increase in information and the related change in perception, perhaps because the main purpose of a movie is not to interact with objects and/or people, but to be captured by a story in a fantastic world.

OBSERVATION AND BRAIN ACTIVATION

The observation of an action performed by others triggers in the observer the same neural networks, as if we were in the first person to carry out the action. This evidence paved the way for the idea that action observation could be used as an effective way to learn or improve the performance of a specific motor skill. A particular type of "observation" was already successfully applied in the world of sport and rehabilitation. In fact, by using motor imagination, it is possible to visualize the movements and involve the motor areas that will then be activated during the execution of the same movement [9, 12].

However, this requires a high level of concentration on the body part of the subject. The person must imagine himself performing specific actions and therefore its application could be difficult, especially when the motor imagination is applied for clinical purposes. In fact, it is not always possible to ask patients, often in suffering conditions, to carry out this concentration effort. It is also impossible for therapists to verify if the subject is visualizing the movements in the correct way and

accompanying them in the rehabilitation process. The observation of actions seems a simpler and more easily applicable method.

A recent study by Gatti and colleagues [10] highlighted how action observation treatment (AOT) is more effective than motor imagery when it comes to learn a complex motor task. The study focused on the learning phase of the movement and, although the neural structures involved were the same, it is believed that the visuo-motor system is activated in a deeper way when observing the action. In fact, the ventral premotor cortex receives visual inputs and it is stimulated by a visual signal rather than by the will to visualize movement while it is not present.

In addition, during action observation, the subject has a model that performs the action correctly. Conversely, motor imagination must rely only on his ability to recall exactly the relevant motor representation and to mentally develop the movement correctly [5]. The results of the study also showed greater accuracy in the execution of the movement by the subjects who had followed the AOT program.

In the present study, we aimed at answering the following questions: Is the use of three-dimensionality in video a fundamental step of the virtual towards the real? Does this lead to some difference in the level of cortical and peripheral activation of a spectator? Moreover, some possible applications of AOT in clinical practice are desirable [15].

THE EXPERIMENT: MATERIALS AND METHODS

Participants

Twenty man between 20 and 60 years-old participated in the experiment (M=32.6 years). All participants were right-handed with normal or corrected-to-normal visual acuity. Exclusion criteria were: left-handedness, the presence of any neurological disorder or cognitive impairment, visual disorders, a previous surgery at the left knee or pre-existing motor impediments (such as hemiparesis, lumbar sciatica). No payment was provided for subjects' performance and they gave informed written consent to participate in the study.

Stimuli and procedure

After taking place on a comfortable chair in a dimly lit room, two videos, identical in their contents, were proposed to participants, both in 2D and 3D presentation. Videos comprised a target condition, in which leg movements were displayed, together with two control conditions, in which arm movements or naturalistic neutral scenes (N) were proposed. In detail, the extension movement of the left leg (L) and the flexion movement of the left arm (A) performed by a male actor were used. Each different content was presented four times, in a randomized order. The video cuts lasted one minute, and were assembled in randomized sequences, for a total of 12 minutes for each modality (2D vs. 3D): four minutes of G, four minutes of B, and four minutes for N. The order of vision of 2D and 3D movies was also random (see Fig. 1). The videos have been filmed with constant artificial light (280 lux). During the experimental phase, changes in the muscular tone (electromyography, EMG) and in the cortical activity (EEG) were measured.

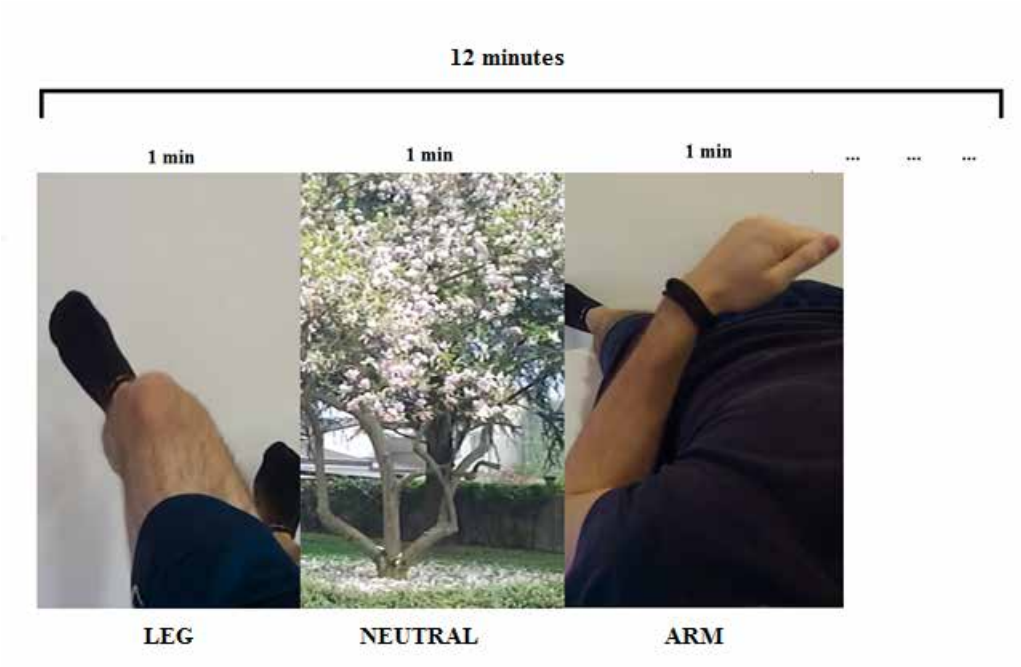

Fig. 1: Display of stimuli presentation with Leg (L), Arm (A), and Neutral (N) conditions presented in a randomized order.

EEG recording

EEG signal was acquired by using a MindCap XL Headband (Neurosky). The tool consists of an elastic band with due electrodes: the active one was positioned over Fp1, and the reference electrode over Fp2. Also, a clip to be attached on the left earlobe was present. The system was battery powered and the signals were sent via Bluetooth to a computer that recorded them through the NeuroView software. The sampling frequency was 512 Hz for the filtered signal and 7 Hz for the Power Spectrum reporting the frequency of all brain waves with a range of 4 Hz (Delta 0-4 Hz, Theta 4-8 Hz, Alpha 8- 12 Hz, Beta 18-22 Hz, GammaLow 28-32 Hz, GammaHigh 38-42 Hz) (see Fig. 2).

Fig. 2: MindCap XL Headband positioned over Fp1.

EMG recording

Muscular activation involves the action of muscles and nerves, which is triggered by very small electrical currents. Measuring the electrical activity in muscles and nerves can be useful for Human-Computer Interaction, control, biofeedback and many other applications. The sensor is capable of performing electromyography (EMG) measurements using bipolar surface electrodes (plus a ground lead), and monitors the muscle activation.

EMG signal was acquired by using BITalino (Plux Wireless BioSignals SA) and OpenSignals as acquisition software. BITalino is wireless bluetooth device that can collect different biosignals. The EMG signal was collected with a sampling rate was 250.

RESULTS

The power of each EEG band was submitted to different repeated-measures ANOVAs with video content (3 levels: L, A, and N) and modality (2 levels: 2D, 3D) as repeated factors. A significant Content effect has been found with respect to Alpha waves ($F_{1,2}=6.04$; $p<0.01$). Post-hoc comparisons showed that Alpha levels during the observation of leg movements were significantly lower compared to arm motion videos and neutral natural scenes. No significant differences were found between arm and neutral scenes (Fig. 3).

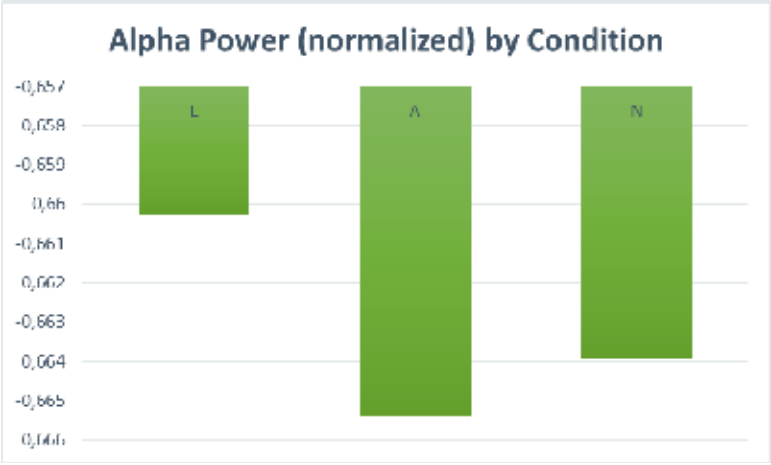

Fig. 3: Alpha Power (normalized values) while viewing Leg (left), Arm (centre), and Neutral (right) movies.

No significant differences were found with respect to the projection mode (2D and 3D) even if constant trends were found: during 3D projections higher power values were recorded, than those found in the 2D video. Moreover, no significant differences were found for peripheral measures.

DISCUSSION AND CONCLUSION

The present work aimed at exploring the brain and peripheral correlates during the vision of 2D vs. 3D scenarios depicting specific body movements with rehabilitative purposes.

A significant result was found for video content in the alpha range, with lower values during observation than arm and neutral. Alpha waves are typically linked to the functioning of the medial cortex. The areas that lie between the prefrontal areas up to the parietal lobe constitute the so-called "default system", and are intended to manage the cognitive system in the absence of a particular high level engagement. Thus, when a subject is engaged in a task that is not particularly challenging, these areas become dominant and lower the frequency of the areas that are not involved in the current task. On the other hand, when there is a relevant cognitive task, this default system loses its synchronization value and the various structures related to the task raise. This interpretation is supported by a study conducted by Mo and colleagues [14] in which the activity of Alpha waves was recorded for short intermittent periods with eyes closed and open showing how, on average, the intensity of the oscillations of Alpha (8-12 Hz) decrease in the tasks in which attention is focused on the outside, as could be the observation of images.

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A Scientific Method for the Attribution of Paintings with application to Leonardo's Mona Lisa twins

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Introduction

The attribution of great paintings is one of the most important activities in modern museum work. The attribution of an artwork is the result of authentication – a procedure for the confirmation of its authenticity. The main task in authentication is to find material evidence by which it is possible to indisputably acknowledge the experts' conclusions about the authorship and the painting's time of creation. The author's signature, the dates and monograms left by artists on the front or back of the picture, as well as accompanying inscriptions and historical information on the provenance of the work are among such proofs. Unfortunately, the influence of the environment, adverse storage conditions and the consequences of radical restoration intervene in the structure of the painting and often lead to these proofs disappearing.

Furthermore, in many paintings, the artist's signature is actually absent. In such situations, it is necessary, in order to remain objective, to use natural-scientific approaches, including various optical and physical methods for studying the structure of the painting. However, despite the availability of a wide range of contemporary analytical research methods, they do not always prove to be effective enough to obtain the necessary information. In fact, the determination of the composition of the paint layers and the dating of a painting's support (by means of carbon dating and dendrochronological analyses), even combined with research results by art history experts, does not always allow for its attribution to the hand of a certain artist. Hence, the need to develop a new scientific method for studying paintings, which provides information that cannot be obtained with the use of traditional research methods, and which avoids subjective opinion.

In recent years, numerous computer methods based on the analysis of optical images obtained with the aid of digital photography have appeared in the field of the authentication of artworks. Most methods of computer analysis serve as a means for studying the visual characteristics of an artist's brushstrokes. Till now this information has been used to study paint layers and style. However, since in most cases the technique of applying the paint is highly individual for each artist, it can be considered as a "fingerprint". How to extract and analyse this "fingerprint"? The mathematical methods of processing a digital picture ("quantification") include the statistical method of a wavelet analysis, the support vector method, the fuzzy clustering method, etc., which are all used to analyze the brushwork technique [1] – [4]. In some cases, these methods are combined with analysis methods from other scientific fields, e.g. biometrics and medicine [5]. In this article, a scientific method for the comparative analysis of paintings is described, which employs intensity histograms of their digital optical images being the extraction of this "fingerprint". The possibilities provided by this method are illustrated by a case study of two paintings by Leonardo da Vinci.

Basic principles of histogram analyses in paintings

When creating a picture, an artist often applies a huge number of brushstrokes to a canvas , a panel or another support. The resulting painting surface thus acquires specific spatial and spectral characteristics that can be

identified for the analysis of the individual painting technique of the particular master. The brushstrokes of each artist, as a rule, have a certain length and direction, as well as a viscosity of the paint particular to this master. They result from the texture of the brushes, the speed of the hand movements, the particular features of the color palette, as well as from the pigment mixing techniques and the use of glazing.

In light of this, one of the possible ways of studying the properties of an artist's painting technique is to analyze the histograms from digital images of the paintings. Any amplitude histogram (another name for the intensity histogram) of a digital optical image is a function (graph) of the statistical distribution of the image elements of various intensities, in which the horizontal axis indicates the brightness level and where the relative number of pixels with a specified brightness value are plotted on the vertical axis (a typical histogram is shown in Figure 1).

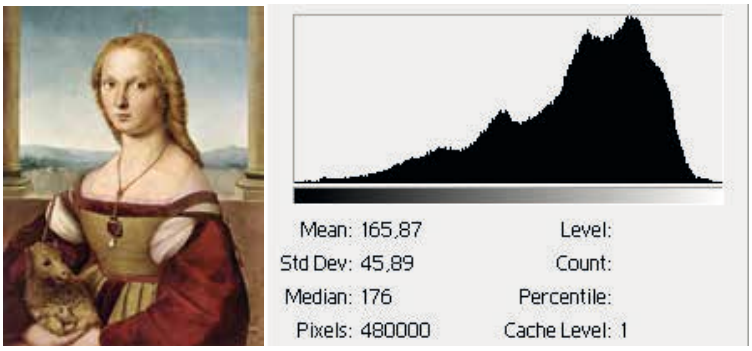

Fig. 1. **"**Young Woman with Unicorn" by Raphael (c. 1505-1506; Galleria Borghese in Rome) and **histogram of digitized image of face of woman**

The histograms from the digital images of paintings can be considered as the artists' "fingerprints", as mentioned above. This is connected with the fact that the histograms display a unique distribution of light and dark shading reflecting the style of each master. In fact, the analysis of pictures with the use of histograms is a quantification of their *chiaroscuro*, meaning "light and darkness", and it refers to the technique of painting that is characterized by a sharp contrast of light and dark tones. This technique serves to convey contrasts, often quite dramatic, in a painting. The term *chiaroscuro* should also be understood as the general character of the distribution of light and dark tones throughout any pictorial image. In the opinion of many art historians (including K. Clark and C. Pedretti [6], [7]), the analysis of the chiaroscuro feature plays the most important role when comparing the paintings of different great masters, since in the process of creating the works each artist develops the dance of "shadows" that is peculiar to him, and which is a unique individual characteristic of his painting technique. Thus the scientifically extracted histogram of the digital image of a painting is the identity of an individual artist's "fingerprint".

As a rule, chiaroscuro is a result of the blending of the color saturation and albedo from one region of a painting to the adjacent zones. Under the traditional subjective approach of the attribution of paintings, the art expert evaluates a picture visually (without any use of analytical methods). The properties of the spatial blending and contrasts of light and shade are the main features that are taken into consideration to establish the authorship of the artist's works and to determine forgeries or copies. This visual impression is correlated in the expert's mind with his memory of impressions of similar authenticated works by the same artist. As a result of this comparison, the expert gives his/her conclusion. Obviously, the analysis of the intensity histogram of the digital image of the picture, will allow the experts to conduct a more objective examination with the aid of mathematically precise data.

Method of the analysis of pictures through intensity histograms

Regarding the technical aspects of a histogram analysis, in all the typical formats of digital optical images, the pixels range over 256 intensity levels (their values can vary from 0 to 255). Currently, many computer digital image-processing programs incorporate special functions that allow us to obtain reliable histograms. Using the histogram "intensity" option, we can then count and plot the number of pixels (in the whole image or an individual region) for each of the 256 intensity levels. The graphical dependence of the quantification (the number of pixels) on the intensity level is known as an amplitude or intensity histogram.

When paint pigments are blended uniformly, the luminosity of the picture image can vary widely (from bright-light to very dark tones). In this case, the gradient in the luminosity distribution of the individual pixels from the highest to the lowest intensity values will be uniform (there will be no discontinuities or abrupt transitions in the distribution of the histogram). It should be added that each intensity histogram is characterized by two basic mathematical parameters: mathematical mean and standard (mean-square) deviation. When analyzing the artists' brushstrokes, the most important characteristic from these two parameters is the standard deviation. Therefore, when a painting is being examined by means of an analysis of the histogram of its digital image, one should not only compare the form of the distribution, but also take into account the value of this standard deviation. Paintings created by the same artist should obviously have a close similarity in terms of the painting technique, and consequently, their histograms should be similar to each other according to these two criteria. This is key to a comparative analysis of paintings based on a quantitative exposure of the artist's style through amplitude histograms.

In order to obtain more precise results when comparing histograms, it is advisable to convert the color image to a grayscale (that is, to a black and white image). The results can be more accurate if a comparative analysis of the histograms from color images is carried out in different spectral bands (separately in the red, blue, and green ranges).

It should be understood that histogram analysis is specifically a method of *comparative* analysis, i.e. comparing the painting under examination to others which have already accepted attributions. It is important to bear in mind that the painting techniques can change throughout an artist's life. Therefore, some differences in the characteristics revealed through histograms can be explained by the evolution of the artist's style and technique. It is also important to take into account that artists with little or no chiaroscuro technique may not manifest themselves in the individual histogram features of the digital images of their pictures.

As shown in research studies [8], [9], the works of those masters with a very delicate painting technique most often have very distinctive features in the histograms. An excellent example is Leonardo da Vinci. Leonardo is well known for being the first to apply the technique of sfumato (from the Italian *sfumare*, meaning "to evaporate like smoke"). This term denotes a manner of painting that is marked by fine shading which softens the outlines of figures and objects, and even allows the artist to convey the air that envelopes them. It was discovered in the course of recent research involving Leonardo's paintings that this effect was achieved by applying brushstrokes with a thickness of several micrometres, and that the total thickness of the paint layer often did not exceed 30-40 micrometres.

It is important to note that in portrait painting, analyses of histograms are the most effective when comparing facial characteristics. The subject of such a histogram analysis is best as a comparison of the parts of the paintings depicting human faces, for the face is the key element in the composition of a portrait. It is known that great masters often involved their assistants and apprentices in the performance of their work. However, the depictions of the faces in portraits were, as a rule, executed by the masters themselves. Consequently, a histogram

analysis of the facial images is the most reliable way to establish if works being compared belong to the hand of the same master.

Comparative analysis of the Leonardo paintings "Mona Lisa" and "Isleworth Mona Lisa"

As a clear illustration of what can be achieved by the histogram method, we present the results of a comparative analysis of the paintings Mona Lisa" and "Isleworth Mona Lisa". The composition of the "Isleworth Mona Lisa" is very similar to the famous "La Gioconda" displayed in the Louvre (Figure 2). According to many painting experts [10], [11], it is an earlier version of this subject, and it therefore is also often referred to as the "Earlier Mona Lisa".

Fig. 2. Left : Louvre "Mona Lisa"; Center: "Isleworth Mona Lisa"; Right: "Young Woman" (c. 1504) by Raphael

Like most Leonardo paintings, the certainty of its early provenance is not absolute, but historical documents lead us to conclude the existence of two original Mona Lisa paintings in the early 16th century – one in the French Royal Collection now in the Louvre Museum, and one with side columns that Raphael copied in a 1504 sketch (Figure 2) which was listed in the estate of his servant Salai. That latter painting is acknowledged by many experts today as the "Isleworth" or "Earlier Mona Lisa". This painting also fits Vasari's description of being unfinished and must be the seminal work which generated all the copies we have today with columns.

Most of the important detailed scientific research of the "Isleworth Mona Lisa" (including X-rays, UV- and IR-ray examinations, studies of the pigments with the aid of spectral methods, radiocarbon analysis and others (see the details in [12])) has been carried out during the last 10 years.

From this research, it was found out that all the pigments and the ground of the picture are identical to the materials used in the early 16th century by Italian artists and by Leonardo himself. Besides this, following carbon dating tests of the support, the approximate time of the creation of painting was determined to be between 1492 and 1652 with highest probability between 1493 and 1525. New studies were carried out by the authors of this article with the aid of a comparative analysis of the digital images of both paintings.

In 1989, following his extensive and successful work on the attributions of Rembrandt self-portraits, on the instigation of Dr. Kenneth Clark, one of the authors (John Asmus) received a special invitation to study in depth the Louvre "Mona Lisa" including a complete day alone with the famous artwork. He carried out a computer "restoration" of the Louvre "Mona Lisa", which revealed an idea of the original appearance of the portrait – without the dark yellow varnish and the craquelure webs that lie over the image [14]. This was soon followed by an

invitation to examine the "Isleworth Mona Lisa". As the results of these studies Asmus became widely known as a top scientific expert on brushtroke technique and identification.

During the first stage of the research on the detailed studies of digital images of both paintings and their comparisons were conducted. The proportions and arrangement of the key elements in the composition of both paintings showed that the "Earlier Mona Lisa" could not be a copy of the Louvre painting since the pictures differ significantly from each other in terms of the proportions of the images and in many other fundamental matters of construction. In addition, their main axes (the axes that can be aligned along the eye line (horizontally) and the hairlines section (vertically) do not coincide (see Figure 3) (for details, see [15]). When comparing the intensity histograms from the images of both paintings the very first results proved to be astonishing. The character of the distribution and the main parameters of the histograms (mathematical mean and standard deviation) in the areas of the face were almost identical in both pictures (Figure 4). Consequently, if the histograms of the digital images are the "fingerprints" of their authors as proven in the experience with the Rembrandt portraits, we can draw the conclusion on the basis of the experimental data that the faces of the "Isleworth Mona Lisa" and the Louvre "Mona Lisa" would most likely have been created by the same artist.

Fig. 3. Comparison of geometrical features of images of the Louvre "Mona Lisa" (left column) and "Isleworth Mona Lisa" (right column)

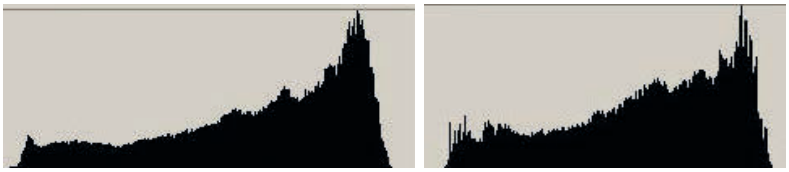

***Fig.4*. Histograms of digitised images of the Louvre "Mona Lisa" (*left*) and "Isleworth Mona Lisa" (right)**

To give such a conclusion a more solid ground, supportive analysis of the histograms of digital images from the most famous copies of "Mona Lisa" was undertaken. These include: 1. The "Mona Lisa" from the Prado Museum in Madrid (Spain) considered to be the earliest copy of the Louvre "Mona Lisa"; 2. The "Mona Lisa" from the Museum in Oslo (Norway) dating from the 17th Century; 3. The "Mona Lisa" from the Walters Art museum

(USA), attributed to Simon Vouet (1590-1649); 4. The Reynolds "Mona Lisa" (private collection, UK) and 5. The "Mona Lisa" Flemish school (private collection, UK) dating from the XVI and XVII centuries, respectively,

All of the portraits listed here are shown in Figure 5. The study of the histograms of their digital images showed that they all have significant differences that make them distinct from the histogram of the Louvre "Mona Lisa" (Figure 6 shows some of the histogram distribution characteristics).

Fig. 5. From left: Prado "Mona Lisa", Walters "Mona Lisa", Flemish "Mona Lisa", Reynolds **"**Mona Lisa" and Oslo "Mona Lisa"

In the data comparison shown in Figures 4 and 6, it is demonstrated that the histograms of the digital images of all the copies are distinctly different from the histograms of both the Louvre "Mona Lisa" and the "Isleworth Mona Lisa" (they differ not only in the distribution characteristics of the histograms, but also in their basic parameters). This significantly distinguishes the "Isleworth Mona Lisa" from the copies of "Mona Lisa". However, in order for the attribution to be even more accurate, we also compared the histograms of the individual features of the faces in all the portraits (eyebrows, eyes, nose, mouth, chin, etc.).

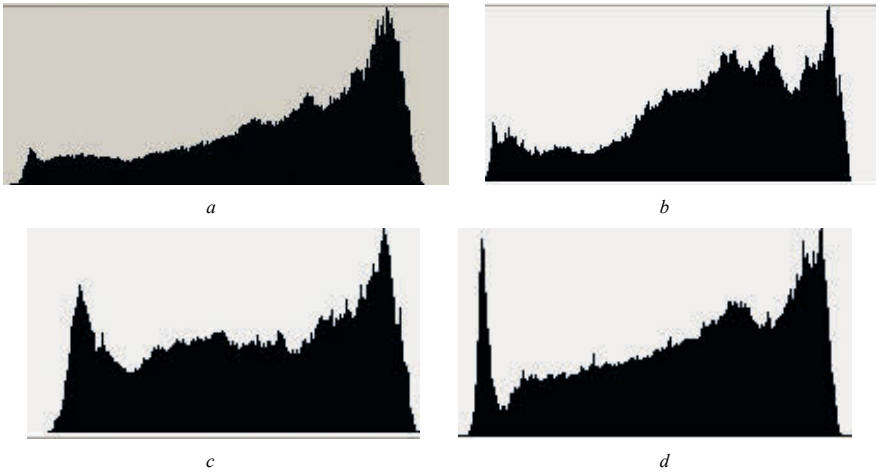

Fig. 6. Histograms of digitised images of the Louvre Mona Lisa (*a*) and its copies: with The National Gallery (Oslo) (*b*), with The Walters Art museum (*c*) and with Prado museum (*d*)

According to Morelli [16], studying the details of the art form allows us to reveal the specific character of the individual style of each master. Morelli was convinced that the artist's personality manifested itself in small details, since both the artist and the imitator displayed the individual features of their painting technique by a natural stroke, rather than in a neat signature which is applied consciously in both cases. This is due to the fact that while painting the details, the artist becomes relaxed and acts intuitively. Consequently, an analysis of the individual parts in paintings with a similar composition may reveal the distinctions in the techniques of different artists most clearly.

In addition, a comparison of the histograms of the images of all the above-mentioned works was carried out in different spectral bands (in the blue, green, and red ranges). Some of these histograms are shown in Figure 8.

a *b* *c*

Fig. 7. Histograms of digitised images of Reynolds Mona Lisa (*a*), Louvre Mona Lisa (*b*) and "Isleworth Mona Lisa" (*c*)

As can be seen from the graphs in Figures 4 and 7, in all cases, there is a very good correlation between the histograms of the "Isleworth Mona Lisa" and those of the Louvre "Mona Lisa". This similarity becomes particularly remarkable if the histograms of these two portraits are superimposed on each other (see Figure 9).

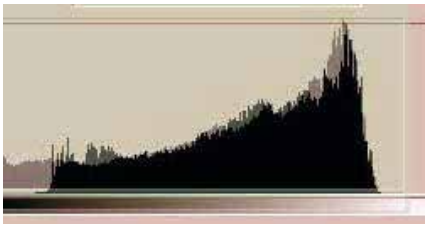

***Fig. 8*. Result of matching of histograms of digitized images of faces (in the field of nose) appeared on paintings "Isleworth Mona Lisa" and Louvre Mona Lisa** (background is histogram of "Islweworth Mona Lisa")

On the contrary, the comparisons of the histograms from the Louvre "La Gioconda" and its copies in similar studies indicate many apparent differences. The same result is demonstrated in a 3D-diagram (Figure 9). It shows the normalized values of the standard deviation of the histograms of the Louvre "Mona Lisa" (LML), the "Isleworth Mona Lisa" (EML), the copies from the Prado museums and the Oslo museum, and the copy executed by the Flemish painter. On the three axes in the diagram, the values of the standard deviation of the histograms from all these pictures in the regions of the nose, mouth and eyes are plotted. The graph clearly displays that the Louvre "La Gioconda" and the "Isleworth Mona Lisa" have the best correspondence in the standard deviation.

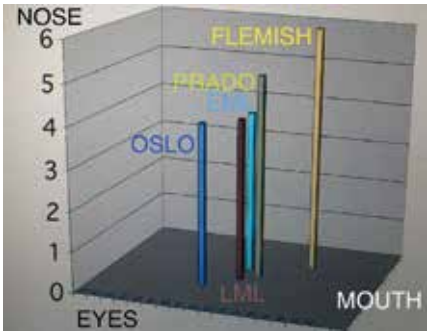

Fig. 9. 3-D plot of the statistical variances of three regions (eyes, noses, and mouths) of five *Mona Lisa* paintings (Louvre and Earlier/Isleworth versions as well as the Prado, Oslo, and Flemish copies)

Thus, based on the results of careful retracted studies of digital optical images of the Isleworth and Louvre "Mona Lisa" paintings, we can conclude that the faces in both works were created by the same artist.

Conclusion

In this article, a computer method for the comparative analysis of paintings is described, which could be useful for making the final decision on the attribution of paintings in those controversial situations when traditional methods of examination do not work or where there is a disparity in the subjective opinions of experts. It is worth mentioning that this approach was recently applied by the authors to the study of Rembrandt's self-portraits, where it showed the highest degree of efficacy. The results of that work will be published in a separate article, but it should be noted here that there is a clear correspondence between the results of the authors' research and the data on the attribution of Rembrandt's self-portraits, which were obtained in his paintings with the aid of technical and technological studies, and by an art examination conducted within the framework of the international Rembrandt Research Project [17].

Finally, it is important to say that the success and the further progress of this approach will depend entirely on the creation of an extensive histogram database of the properties and statistics of the most famous artists' works, which are recorded as a result of detailed studies. This may lead to more precise conclusions about the final attributions of the paintings on which art historians' opinions currently differ. It will provide a scientific method which may eventually be accepted as the most credible and popular way chosen by museums and collectors for the attribution of great artworks in light of its obvious objectivity.

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USE OF MULTIMEDIA AND VIRTUAL REALITY TECHNOLOGIES TO REPRESENT RUSSIAN CULTURAL HERITAGE

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Preservation of the cultural heritage in digital form and its presentation in the Internet using multimedia and virtual reality technologies is a priority activity of the Center for Design and Multimedia of the ITMO University. In recent years, the Center has implemented a number of projects in this field with the support of the Foundation for Humanities.

The projects are aimed at creating a Multimedia Information Systems for various cultural monuments of the North-West of Russia. Among them are: “Architectural Ensemble of the Solovetsky Monastery in the Period of Its Highest Prosperity (XVI-XVII Centuries)” (http://solovky.ifmo.ru), "Architecture and art complex Theodore town in Tsarskoye Selo as an example of Russian style" (http:// russianstyle.ifmo.ru /). In each project, multimedia and virtual reality technologies to give the most complete representation of the object of cultural heritage.

In the XVth century the Solovetsky Monastery was the spiritual, cultural and political center of the Russian North, playing a crucial part in the emergence of the economy and maritime practices of Pomorye region. The Solovetsky Monastery features some remarkable monuments of ancient Russian architecture – Assumption Church (1552-1557), Cathedral of Transfiguration of Our Savior (1558-1566), gatehouse Annunciation Church (1601). Virtual reconstruction provides an opportunity to get acquainted with the original appearance of Solovetsky Monastery XVI - XVII centuries.

Fig. 1. A general view of the Solovetsky Monastery (XVI-XVII Centuries) -3D reconstruction

Russky Gorodok was built in Tsarskoye Selo, an imperial residence outside St. Petersburg, in 1913-1918 by the order of Nicholas II. The main idea was to visualize the history of Russian art and architecture in the 12-17th cents., to give the people from the metropolitan, largely European city of St. Petersburg an opportunity to appreciate the authentic Russian Style. From the very start, Fedorovsky Gorodok was informed by certain virtuality, for the idea was to create an entity that had never existed before, yet would absorb the elements of the authentic artistic lexicon on one hand, and the most advanced contemporary technologies on the other.

Fig. 1. A general view of the Russky Gorodok -3D reconstruction

We used various virtual reality technologies to fully represent reconstructed monuments in multimedia information systems. Among them:

- Virtual excursions via video 360 as in present time and in reconstructed reality. Video 360° of historical attractions is a unique opportunity for users to see the main sights at any time with effect of presence
- Interactive maps with active points thanks to which the user is able to learn about the architecture and have access to virtual tours shooting in format video 360 and additional historical information.
- Video films (in standard format and in video 360 format) telling about the architecture and the history of cultural monuments.
- Interactive 4D-excursions that allow you to combine virtual tours, shot with the help of 360 video at the present time, with interactive excursions in the historically reconstructed virtual reality with the option of moving from 360° video to 3D reconstruction format and back at all the key points.

This work was supported by the project “Multimedia information system "Architecture and Art complex Theodore Town in Tsarskoye Selo as an Example of Russian Style" ” (Grant №17-04-12034, Russian Foundation for Humanities)

NEW SCIENCE AND CULTURE DEVELOPMENTS & APPLICATIONS

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HOMO TECHNOLOGICUS COMES OF AGE AN ONGOING EVOLUTION

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Abstract

Biological evolution intertwines with cultural (today mainly technological) evolution, whose mechanisms are partly Lamarckian, to beget a bio-cultural evolution. Technological tools are produced by man to modify the environment and to get information about it. In turn instruments exert a feedback on man converting him into *Homo technologicus*, a bio-technological symbiont subjected to a continuous transformation. Nowadays such transformation has become deliberate and intentional, and aims at two kinds of target: therapy and enhancement (to repair or to improve natural capabilities or to generate new ones). Enhancement obtained through the use of technology opens the post-human perspectives. However, man has always been post-human, since he has always been hybridized with plants, animals, food, medicines, drugs, and, today, machines; and has always been altered and strengthened by artificial processes. This continuity makes the post-human concept les shocking, since it inserts the post-human into the flow of a natural-cultural evolution; on the other hand it bestowes the full responsibility of his own evolution upon man. Actually while man has always been post-human, only today he is fully aware of this by virtue of the overwhelming power and speed of technological development. Such novel awareness propounds dramatically the serious ethical problems generated by this new progresses. On the other hand most post-humanists are more interested in the enhancement of cognitive capabilities than in the social and ethical aspects.

Cognitive stages in rational thinking - toward human technology

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"Cogito ergo sum" (French: Je pense, done je suis; I think, therefore I am), Rene Descartes

ABSTRACT

The main idea behind this research paper is that modern information and communication technology could be better made to serve human beings, if we could specify more precisely the process of human thought and action.
The cognitive stages of rational thinking has been studied from the user interface and product point of view but there does not seem to be any generally accepted model for the dynamics involved in cognitive stages in literature.
In addition, a few studies have investigated the cognitive stages in rational thinking process from human centric point of view, i.e. how the skills are actually learned.

INTRODUCTION

First, I shall provide short historical preview of between human thinking, learning and performance.
Jean Piaget (1896-1980) believed that the process of thinking and the intellectual development has two on-going processes: assimilation and accommodation. There is assimilation when a child responds to a new event in a way that is consistent with an existing schema. The schema describes as pattern of thought or behavior that organizes categories of information and relationships amount them. There is accommodation when a child either modifies an existing schema or forms an entirely new schema to deal with a new object or event. DiMaggio [6]. It seems that the accommodation in modern society is becoming more important than assimilation.
Alan Turning (1912-1954) was pioneer in the development of theoretical computer science. The Turing test is a test, developed by Alan Turing in 1950, of a machine's ability to exhibit intelligent behavior equivalent to, or indistinguishable from, that of a human. Turing proposed that a human evaluator would judge natural language conversations between a human and a machine that is designed to generate

human-like responses.

Human performance by Fitts & Posner (1967) was a textbook designed to introduce students to a new field of psychology. The field involved the quantitative measures of human capacities to perceive, attend, reason and act.
First, Fitts &Postner (1967) outlined a theory of learning involveda) cognitive, b) associate and c) autonomous stages. In a cognitive phase during which the performer develops a mental picture and fuller understanding of the required action to form an executive program, an associative phase during which the performer physically practices the executive program learned in the cognitive phase and an autonomous phase during which the performer learns to carry out the skill with little conscious effort.
Second, Fits, described a quantitative theory of human movement control. The time to begin a movement was related to the uncertainty of the event and the compatibility of the codes relating stimulus to response, which the rate of movement was function of the information it generated.
Stuard Card [4] and his colleagues proposed the first stimulation of a user for HCI in 1983 (GOMS), where a designer could evaluate an interface by simulating how users perceive, think and act when completing tasks. Subsequent models (such as ACT-R) extended this modeling to consider factors such errors and learning. However models become difficult to use and extend. To aid practitioners, mathematical simplifications such as KLM and GLEAn and interactive modelling environments (like CogTool and Distract-R) were developed, but these were not combined with algorithms that could generate designs. Oulasvirta [14]
Nowadays, in the field of cognitive science, researchers has focused to study human thoughts using neuroscience i.e. neural imaging to discover cognitive stages of rational thinking. For instance multi-voxel pattern recognition techniques combined with Hidden Markov models has be used to discover the mental states that people go through in performance a task [1,2]. However, most of the cognitive science experiments are still conducted in laboratory settings.
In the year 2018, Alan Turning test is still failed by all intellectual personal assistance such as Apple's Siri, Amazon's Echo and Samsung's Bixby. Therefore, to continue Alan Turnings work and to develop more human like intellectual personal assistance, we need to focus our effort to study more deeply the interaction and human thinking models in the context of most developed artificial intelligent applications (Siri, Echo, Bixby) and robotics such as Watson Pepper.

1.1. COGNITIVE MODELS OF LEARNING

Here I shall present four cognitive models of learning i.e. cognitive stages of rational thinking when the human is taking a new artifact in use.
Anderson & Fincham [1,2] introduced the Adaptive Control of Thought-Rational (ACT-R), which is a cognitive architecture: a theory for simulating and understanding human cognition. Researchers working on ACT-R strive to understand how people organize knowledge and produce intelligent behavior. As the research continues, ACT-R evolves ever closer into a system which can perform the full range of human cognitive tasks: capturing in great detail the way we perceive, think about, and act on the world.
Anderson & Fincham [1,2] conducted a study that looked at the cognitive stages participants engaged in when solving mathematical problems. These stages included encoding, planning, solving and response. The study determined how much time participants spend in each problem solving stage when presented with mathematical problem. Multi-voxel pattern recognition analysis and Hidden Markov algorithms models were used to determine participants' problem solving stages. The combined method identifies both the mental states and how their duration vary with experimental conditions. Result of the study showed that the time spend in the planning stage was dependent on the novelty of the problem. The time spend in the solving stage was dependent on the amount of computation needed to produce a solution once a plan is devised. Lastly, the time spent in the response stage was dependent on the complexity of the response required by the problem.

Encoding → Planning → Solve → Response

Figure 1. Cognitive stages with participants solving mathematical problems. Anderson & Fincham [1,2]

Anderson & Fincham [1,2] states that discovery of encoding, planning, problem solving, and responding states was not surprising and was anticipated in a previous cognitive model for the task. However, there were a number of surprising aspects of these states not anticipated:
At the end, according to Anderson & Fincham [1,2] memory has the ability to encode, store and recall information. Procedural memory, made of productions. Productions represent knowledge about how we do things: for instance, knowledge about how to drive bicycle. At each moment, an internal pattern matcher searches for a production that matches the current state of the buffers. Only one such production can be executed at a given moment. That

production, when executed, can modify the buffers and thus change the state of the system i.e. change the behavioral model of human being.
The second Elliott et al. [10] cognitive model of learning found that the process of cognitive thinking is linear with the following causalities: a) transparency of operations, b) transparency of purpose, c) accommodation and d) accomplishment.
In other words, transparency of operations and transparency of purpose lead to a sense of accommodation and finally to the sense of accomplishment. In addition, the poor transparency of operations and purpose lead to increased effort and longer task completion times. In other words, transparent design minimizes cognitive demand on the users [16]
The third one is Gagne's et al. [7] cognitive model of learning, which includes: the motivation (expectancy), apprentice (attention, selective perception), acquisition (coding, storage entry), retention (memory storage), recall (retrieval), generalization (transfer), performance (responding) and feedback (reinforcement) phases.
Gagne's et al. [7] model of learning is described in psychological and cognitive science point of view. Gagne's et al. [7] model of learning is linear and it emphasis the role of motivation in learning process. The users expectancy i.e. presumptions toward the task or artifact is seen important element, which effect positively or negatively the other phases of learning.
The forth cognitive model of learning is presented by Laakkonen (2007) involve six phases: 1) information search, 2) data collection, 3) knowledge management, 4) knowledge form, 5) knowledge build and 6) result of action. In learnability perspective: information search and data collection phases are the most demanding and most time consuming, when taken the new technological artifact in use.
In the table 1 the four cognitive models of learning is presented and phases of learning are compared.

Table 1. Cognitive models of learning (phases) by Gagne et. al [7], Elliott et al. [10], Laakkonen [12] and Anderson & Finchman [1,2]

Gagne et al. [7]	Elliott et al. [10]	Laakkonen [12]	Anderson & Finchman [1,2]
reception (gaining attention)	transparency of operation		
expectancy (motivation, learning objectives)			
retrieval (recall of prior learninq)			Encoding

selective perception (apprentice, presenting the stimulus)	transparency of purpose	Information search	
sematic encoding/storage entry (acquisition, providing learning guidance)		Data collection	Planning
responding (eliciting performance)	accommodation	Knowledge manaqement	Solving
reinforcement (providing feedback)		Knowledge form	
retrieval (assessing performance)		Knowledge build	
retention (memory storage)			
transfer (enhancing generalization)	accomplishment	Result of action	Response

In Elliott et al. [10] model the transparency of operations is directly related to the efficiency of a user interface that allows users to find, understand and then use rapidly and easily the functions of the user interface to complete a task or sub-task. In addition, transparency of operations refers to concept guessability used by Dix et al. [5], Bruijn et al. [3]. They define guessability as an indication of intuitiveness, i.e. how obvious the operations are that can be performed by users who have no experience with the device and have not received any earlier instructions. Bruijn et al. [3] use the term guessability as synonym for learnability.

Transparency of purpose means that users should be able to imagine the end product at any point during its use. However, it would be beneficial if transparency of purpose is understood and seen before the interaction process and not during it. The third phase of cognitive model of learning, accommodation is more related to the concept of easy-to-use than it is to easy-to-learn. The forth phase is very close to the concept of usefulness, which is separate concept from that of learning.

What are the differences and similarities between Anderson & Fitchman (2013) structure of thoughts and Laakkonen [12] theoretical model of learnability? The cognitive model of learning is non-linear and learning dynamics occur inside the six phases. The dynamic means that in every phases of learning has their own dynamics. For instance in information search phase user is moving towards and away from the right solution i.e. the process is not linear it is circulated and iterative. In addition, the six phases do no follow any given path.

Information search and data collection phases by Laakkonen

[12] can be related to Anderson & Fitchman (2013) encoding phase. Knowledge management is related to Anderson & Fitchman (2013) planning phase; however planning phase occurs already before the new artifact are taken in use. Knowledge form and knowledge build phases are related solving phase and result of action refers to Anderson & Fitchman's model's response phase.
In addition, it needs to be emphasis that knowledge management phase [12] needs to be investigate more detailed, because in that phase new knowledge is implemented to internal patterns "buffers" of human mind. Knowledge form and knowledge build phases are related to productions system and result of action refers to "change the style of system i.e. change the human behavior model. (see Anderson & Fitchman [1,2] and Laakkonen [12]

At the end, the theory by Fitts & Postner [8] emphasizes that a user has to "know what" before "know how" when interacting with the user interface. In addition, the assumptions of human towards a program are very close to Gagne's motivation (expectancy) phase of learning [10].

CONCLUSIONS

The information technology key research areas such as: digital health technologies, artificial intelligent, big data, internet of things, block chains, autonomous driving, robotics, augmented reality, identification technologies, cybersecurity are affecting human thinking, behavior and habits in their daily lives.
Understanding human thinking is crucial if we want to, create technologies, which correspond and satisfies the human needs. It is not only question of passive adaptation of human beings; it is question of human beings accommodation and assimilation in modern information society.

How can human behavior and thinking models be more deeply understood? We should study more detailed: a) human being primitive behavioral models (instincts, autonomous behavior, habits), b) deep emotions (falling in love, fear, betray, abuse), c) collect empirical research data from different user groups, artifacts, environments and task settings (train, metro, airport, hospital, home, work place, shop etc.) d) investigate organizational behavior and e) create new research methods (creative art methods). Nevertheless, it needs to be remembered that due to cultural differences, humans' backgrounds, perspectives and motivations, humans' interpretation of the wicked problem varies greatly case by case. (Pavie & earthy 2014, 5).

The rational and emotional minds are not separate units. Therefore, we also need to study instincts and deep emotions of human being.The rational cognitive thinking models cannot purely explain by human behavioral and habits. We need to be able to better understand human being primitive behavioral models (instincts). The primitive behavioral models are not distinguished. For instance intuitiveness could be explained more detailed if we could understand what part of our behavioral is based on instincts. The Card et al. [4] used the concept information scent in this context. As animals rely on scents to indicate the chances of finding prey in current area and guide them to other promising patches, so do humans rely on various cues in the information environment to get similar answers. Human users estimate how much useful information they are likely to get on a given path, and after seeking information compare the actual outcome with their predictions. When the information scent stops getting stronger (i.e., when human no longer expect to find useful additional information), the humans move to a different information source. Maybe investigating animal behavioral model we could understand the human primitive behavioral models and we could create more convenient products and services, which respond our needs.

At the moment, the methodical development of human thought and action research has focused in neuroscience. Beside of that we need to create new research methods. The creative art and agile design thinking methods has not been implied to rational cognitive research settings before.

At the end, research problems are becoming more complex and more holistic view of different research disciplines are needed. The technological, neuropsychological, HCI-research and cognitive communities of sciences presents different models of cognitive thinking. Similarities and differences has been identified in this paper.

The futurologists has focused to extrapolate present political, economic, society and environmental trends on attempting to predict future trends. During the recent years, the discipline has put more and more focus on the examination of social systems and wicked problems to be able to draw the future scenarios. Maybe futurologist could also help cognitive science to predict and form more holistic picture of human thought and action.

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A NEW COMPACT VNIR HYPERSPECTRAL IMAGING SYSTEM FOR NON-INVASIVE ANALYSIS IN THE FINEART AND ARCHITECTURE FIELDS

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Abstract – A new compact Specim IQ hyperspectral camera working in the 400-1000 nm range has been launched on the market. Its use in the investigation of different artworks and under diverse environmental conditions will be presented.

INTRODUCTION

Presently, the study of the materials constituting artworks and archaeological objects can be performed using invasive and/or non-invasive approaches [1]. Preliminary non-invasive approaches are always necessary at the beginning of the study and/or investigation of a work of art, or before initiating any conservation procedure on valuable objects, in order to assist curators and conservators in their decision-making process. Non-invasive methodologies are mainly performed by investigating small (spot size or 1-D technique) and wide (2-D technique) areas, and are focused on the diagnosis, study and conservation of, as well as on the access to, objects of art. Among the imaging techniques a very important role is played by Infrared Reflectography (IRR) and Vis and NIR hyper-spectral imaging (HSI) techniques [2-5]. The former enables the visualization of details underneath the visible surface of a painting, exploiting the partial transparency of the painted layer when subjected to IR radiation. HSI, in addition to the IRR information, provides a spectral and colorimetric characterization of the entire painted surface.

For more than a decade, a number of studies and research projects have been devoted to customize hyperspectral imaging techniques to the specific needs of conservation and applications in museum context [5]. In view of that, HSI has nowadays reached the stage of mature technology and is ready to its large-scale applications. Hence, a novel concept of hyperspectral camera - featuring compactness, lightness and good usability - has been developed by Specim, Spectral Imaging Ltd. (Oulu, Finland), a company in manufacturing products for hyperspectral imaging. The camera, model Specim IQ, is proposed as new tool for novel applications in the field of Cultural Heritage. The novelty of this device relies in its reduced dimensions and weight and in its user-friendly interface, which make this camera handier and reasonably priced than conventional hyperspectral instrumentation. The camera operates in the 400-1000nm spectral range and can be mounted on a tripod. It can operate from short-distance (tens of cm) to long distances (tens of meters) with different spatial resolutions [6]. These technical features furtherly extend the possibility of applications of HSI to new typologies of artworks, both indoor and outdoor, from large-size wall paintings, ceilings, decorative elements and inscriptions to façade of historical buildings and monuments, as well as inspection small details of interest selected on the surface of almost flat objects.

The imaging system, presented on November 30th 2017 in Helsinki, has been tested before its forthcoming official on the market by IFAC-CNR Applied Spectroscopy research group laboratories. In the present communication, some of the first applications to different artworks and under diverse environmental conditions of one of the Specim IQ portable camera prototypes are reported.

Specim IQ camera: technical information

The Specim IQ has been designed to provide a full hyperspectral tool with required features for making hyperspectral imaging possible on different kind of environments (Fig. 1). It differs from other hyperspectral cameras on the market by integrating the hyperspectral sensor with additional color cameras, replaceable data storage and batteries, data acquisition and processing electronics, and an optimized operating system and user interface into a single portable housing. The integrated color cameras support the spectral camera usage by making it possible to direct and point the camera with standard viewfinder image as well as adjust the manual focus of the spectral camera with a normal camera image. By removing the need for additional computers, cabling, power supplies and software, it enables the users to exploit this novel technology in an easy and straightforward way. The rechargeable batteries and standard 32 GB SD memory card for the image data allow approximately 100 measurements to be made with camera without the need to recharge or change the storage media. The operating system is designed in a way that it will guide the user to consider the necessary camera adjustment and data quality validations, without a need to go into details of the hyperspectral imaging technology details. The target on the system design has been to enable users, not familiar with hyperspectral imaging, to successfully start using it in their applications.

Fig.1 - Specim IQ hyperspectral camera

The hyperspectral data acquisition with Specim IQ can be made both outdoor and indoor conditions, with Sun light or artificial, broadband illumination. Depending on the application field, both LED and halogen-based illuminations can be used. In addition to the Specim IQ and possible illumination, a reflectance reference targets are needed to correct the effect of the illumination and ambient environment effect from the data, and make the measurements made in different conditions comparable with each other's. Like majority of the hyperspectral cameras, Specim IQ does not provide the image with full spectral content with single snapshot, but the hyperspectral image is acquired by making a line-scan over the target area. The camera is designed in a way, that there is no need to move the camera or target, but the image scanning is performed with internal mechanisms. Due to image collection by scanning, the process takes in normal conditions from seconds upwards, so it is recommended to use Specim IQ with a standard tripod.

The camera visualizes the hyperspectral data immediately after the measurements and the user has possibility to add metadata to the measurement. It is also possible to use the bundled Specim IQ Studio software to create material identification models for the hyperspectral data. These can be installed as applications to the Specim IQ, and when operating the camera with an application, the camera will also process the data and provide the processing results visualization for the user. In addition to the bundled software, the hyperspectral image data format is compatible with majority of the other hyperspectral data processing software's available in the market.

The Specim IQ covers the 400 – 1000 nm spectral range and provides 7 nm spectral resolution with 3.5 nm spectral sampling – suitable for majority of the materials having spectral response in this wavelength range. The resulting image from Specim IQ is 512 x 512

pixels, with all the pixels containing 204 spectral samples. The camera saves both unprocessed and processed data and the single measurement is approximately 300 MB (Table 1).

Table 1 Technical specifications of the Specim IQ hyperspectral camera

Wavelength band	400 – 1000 nm
Spectral resolution FWHM	7 nm
Spectral bands	204
Image resolution	512 x 512 pixel
F/number	1.7
Peak SNR	> 500:1
Data recording time	~ 1 s – 260 s (Depending on the illumination level)
Object distance	150 - ∞ mm
FOV	40 deg
FOV at 1 m	0.5 x 0.5 m
Camera interface	USB Type-C
Data format	SPECIM Dataset with ENVI compatible data files
Size	207 x 91 x 126 mm
Weight	1.3 kg
Operational temperature	+0°C - +40°C
Operational humidity	< 95% non-condensing

Specim IQ camera: case studies

The first case-study was performed at the Stefano Scarpelli painting conservation studio on the 19th century canvas painting "Saint Catherine carried by the Angels on Mount Sinai" (Santa Caterina trasportata dagli Angeli sul monte Sinai, 49.6 cm x 67 cm, private collection) by the Austrian painter Karl von Blaas (1815 - 1894).

Fig. 2 VNIR Specim IQ camera during the acquisition of the hyperspectral imaging data.

The data acquired were used to identify some of the pigments used by the artist and to map their distribution over the region of interest by using the spectral angle mapper (SAM)

procedure that is incorporated in the software uploaded in the camera itself (Fig. 2). It was found, for instance, that the pigment used for depicting the blue and bluish areas was Thénard's blue (also known as cobalt blue) pigment, an important synthetic pigment used by artists since the 19th century. In Figure 3 is reported the image that appeared in the screen of the camera in which it is reported on the blue right sleeve of the angel the pixel from which the reflectance spectrum, reported in the graph at the right, was extracted. The absorption features in the 500-700 nm range and the whole spectral shape of this spectrum made it possible to identify the blue pigment as cobalt blue [7].

Fig. 3 image displayed in the Specim IQ back screen with reported the reflectance spectrum of the selected pixel.

Afterwards, the areal distribution of this pigment was mapped using the SAM procedure with a wide tolerance thresholding option selected from the set maximum angle (in radians) area by using the SAM mask tool, as reported in figure 4.

Fig. 4 distribution map of the pigment cobalt blue (in white) on the imaged area of the painting using the SAM procedure of the software of the camera and as reference the spectrum selected in figure 3.

Subsequently, it was tested the usability of the Specim IQ camera for remote acquisitions on outdoor large size painted surfaces, hardly to reach because of their location, such as one of the painted lunette in the Sant'Antonino cloister of the San Marco Museum in Florence [6]. This cloister has been decorated with mural paintings by different artists over three centuries starting from the 15th century. In the 17th century, a cycle of lunettes depicting scenes from the life of Sant'Antonino, who was responsible for the rebirth of the monastery and an important figure for the Dominicans monks. The investigated lunette is located in the upper part of the north wall of the cloister and was painted by the Florentine painter Fabrizio Boschi (1572-1642)(Fig. 5).

Fig. 5 VNIR hyperspectral camera during measurements in the Sant'Antonino cloister at the Museum of San Marco, Florence.

Finally, the imaging system was tested on a 15th century Florentine illuminated book of the Biblioteca Medicea Laurenziana in Florence [8]. Some of the miniatures of the book have been attributed to Beato Angelico, although the manuscript attribution is still subject of investigations.

The data acquired on the easel- and wall-paintings as well as the illuminated manuscript evidenced the noteworthy potentialities of Specim IQ camera in the Cultural Heritage application field. Moreover, its use makes it possible to extend the use of hyperspectral imaging technique to new categories of artworks or artworks /archeological objects located in unfavorable environments, which result difficult to be investigated with the most traditional models of hyperspectral devices.

Summary

From the first data acquired with the first release of the Specim IQ compact hyperspectral camera it was found that this camera is a perfect imaging device for preliminary, quick diagnostics on different typologies of 2D polychrome artworks and in different environments. The performances of the Specim IQ camera in terms of spatial resolution and spectral interval coverage indicate that this device cannot be considered as a substitute of high-precision hyperspectral instrumentation specifically tailored for applications on paintings, especially when high-quality image documentation is required. However, it can be considered as an ideal tool to complement other analytical techniques and to guide the decision making process in planning diagnostics campaign which encompass a multi-analytical approach.

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THE PLACE OF INSPIRATION OF THE FLEMISH TRIPTYCH BY ROGIER VAN DER WEYDEN. A CONTRIBUTION OF THE *LANDSCAPE BUSTING* TO ONE OF THE *VEXATA QUAESTIO* OF THE SICILIAN HISTORY

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ABSTRACT
One of the greatest masterpieces of Flemish art of global importance has been analyzed, through geological and geomorphological evidence, in order to identify the 'hidden landscapes' depicted within it. The conclusions of this study suggest that the views may be Sicilian. This fact is particularly important as it is believed that the masterpiece was imported into Sicily, but the history of its origin is not yet well known, indeed, it is still under discussion. Reasonably, therefore, in the light of the results achieved, the possibility that it has been realized on the island itself can be seen.

INTRODUCTION

A manuscript of the XVIII century defines the painting of «cossì bella sottile artificiosa, et meravigliosa fattura, che par non da mani humane ma angeliche depinto» («so beautiful subtle studied, and astonishing workmanship, that was painted by angelic hands, not human» [1]. It is undoubtedly the masterpiece of a Flemish artist. At the beginning the painter, active in the XV century, was considered anonymous. From Friedländer [2] on, he was defined as 'Meister mit dem gesticketen laub', 'Maitre au feuillage en brodeire', that is 'Master of the embellished foliage'. The traditional assignments of the work – except for the most ancient and remote to Dürer or Van Eych – have always swung among Memling, Hugo Van der Goes and, more unanimously, Rogier Van der Weyden, pseudonym of Rogier de la Pasture [3,4,5,6,7].

In the central panel the Virgin with Baby Jesus on her knees is depicted, she is seated on the throne under a sort of fabric baldachin. There are four angels next to her. In the side panels Saint Katherine of Alexandria and Saint Barbara are illustrated seated and in meditative attitude. Both of them carry the attribute of their martyrdom (fig.1).

Recently the Triptych has been at the centre of a futuristic project, the "l'Iperion_Ch.it", through which it has been possible to analyse the work with cutting-edge technologies, to better guarantee the renovation and preservation. In the same project there are also involved the mosaics of Pompei, the paintings by Pollok at the Guggenheim in Venice and the altarpiece of Saint Bernardino by Piero della Francesca, kept in Milan.

The story of this masterpiece is covered by mystery. As far as seventeenth-eighteenth-century sources show, in the wake of a lost manuscript, it has been handed down its unlucky arrival in Polizzi. Indeed the precious work was delivered from Luca Giardino, captain of a ship survived to a storm, to a monk that he met when he arrived in Palermo. The monk immediately brought it to Polizzi through a series of other exciting vicissitudes [8].

Apart from the really surprising dimensions (162x237 cm), the masterpiece confirms that at the beginning of the sixteenth century even in Sicily and in the Madonie there was a predilection for the Flemish painting from noble environments, court and ecclesiastics.

The execution of the work, oil on durmast wood, is very accurate and painted in great detail. Everything is made with mastery: the embroidery of the dresses, the carvings of the throne, the nestled gems, the flora, even the scroll with the musical notation that refers to the well-known Ave Regina by the English composer Walter Frye [9].

METHODS AND RESULTS

In the study the new discipline of the *landscape busting* has been applied. It represents the avant-garde in culture, connecting the geology-geomorphology with the human-artistic disciplines in a relation of synergy. This scientific-cultural original cross method can pave the way to surprising results in research, scientific divulgation and fruition *en plein air* of the artworks.

This approach was first studied by the researchers who traced back the "invisible landscapes" by Piero della Francesca in Montefeltro between Marche and Romagna [10]. These places are the backdrop of the well-known "Gioconda" (Monnalisa) by Leonardo da Vinci in the Valmarecchia [11]. The same approach was also found in the landscape of the famous "Crocifissione" by Antonello da Messina kept in Anversa, which has been identified into the Stretto di Messina [12].

The method used to identify the landscape in the painting by Rogier van der Weyden is based on the observation of both the pictorial work and the real view. The technical analysis has been followed by a bibliographic research that has allowed the finding of a particular perfectly dated cartography. Its study has permitted to verify and compare the landscape of that time with the elements of the area recognised in the painting.

In this very detailed representation of the Triptych of the 'Gran Signora' (big Lady), there is also a small but peculiar landscape detail, which is painted in the central altarpiece, behind the two angels that play the flute and the lute. It is a characteristic relief that, after a careful observation, can be identified with "Monte San Calogero", geologically part of the mountains of Termini Imerese. It is the background of Polizzi in North-West direction. The comparison between this detail represented in the painting and the picture taken from the central square of the village shows that the two profiles match each other from a morphological point of view (fig. 2).

Indeed, undoubtedly both reliefs raise themselves isolated from a valley and present a truncated conic form with an indented summit (white dotted arrows). In particular, on the right side for the observer, both of them exhibit a small tooth (white dotted arrow). The similarity is more evident if the photo is compressed. The compression was already known with Piero della Francesca and Leonardo da Vinci and it was a technique that allowed to capture an extended landscape in a painting. Leonardo often used it in a complex way to paint the "Gioconda" (Mona Lisa). Even the bluish color of this detail suggests the lithology of the impressive massif, formed of limestone and dolomite originated in the Mesozoic. Under the geological point of view "Monte San Calogero" is a big anticline, broken by normal faults, arising towards North with relevant displacement [13]. One of them is well put in evidence in the painting (red dotted line).

Moreover, two *skylines* can be noticed faraway. The first is a tabular upland (yellow dotted line), which seems leant on the right side of the mountain and probably represents "Monte Pellegrino" with the extremity of "Monte Gallo". Both belong to the so-called "Monti di Palermo" (mountains of Palermo). The second, imperceptible, wears away towards the left (yellow dotted line): it is "Monte Catalfano", which dominates the city of Bagheria.

The landscape continues in the right side of the painting, where there are other details that can further confirm its real location. Behind Saint Barbara, seated and covered by a dark red mantle with a palm in her hand, it can be noticed the architectural perspective belonging to the Flemish world and to the descriptivism typical of the sumptuous painting of the Netherlands of the second fifteenth century. The Flemish city with its noble palaces, towers, entrance door, lies on a series of morpho-stuctures, which look like some little hills. It can seem a chance, but this detail is shown a few years later (1548) in another pen and watercolour drawing. It is kept in Rome in the "Angelica" Library and it stylises the city of Polizzi Generosa [14]. On the right side, indeed, it can be seen the castle with its towers, the walls and the entrance door to the city: coincidentally, everything lies on a series of small mountains (fig. 3).

Looking for documentary proofs from the past, it has been very helpful the observation of paintings by minor painters who worked in Polizzi Generosa. Among these there was Joan Matta, the 'nobilis' Mata, de Matta, Mat, Matt, Matth. As recent documents attest, in the first twenty years of the sixteenth century he moved from the Reign of Valençia to Polizzi. He was surely attracted by

the booming economic conditions of the city, that guaranteed him private and public orders for long time [15]. The mentioned work is the "Compianto sul Cristo morto con i santi Sebastiano e Caterina d'Alessandria" (that is the "Grief on the dead Christ with the Saints Sebastiano and Caterina of Alessandria"), at the moment kept in the Church of Saint Girolamo (fig. 4). It was realised around the third decade of the XVI century. At the top, on the right, it shows a small mountain made bluish by the truncated conic shape. From there, two jagged mountains raise, probably separated by a line of fault. Could it be a further reference to "Monte San Calogero"? We like to think it is.

DISCUSSION AND CONCLUSIONS

After these assertions, it is obvious to wonder some questions. Is it possible that the Flemish author of the Triptych knew Polizzi Generosa? Could the painting have been realised *in loco*? Is it possible to track the name of the author among the Flemish artists who travelled in Sicily? These are unavoidable questions and to find an answer is not easy. We can only make hypothesis, even though they are not proved by evident proofs. On the other hand, the whole history of the Triptych is mysterious, from the name of its author to its arrival in Sicily. However, this does not alter its importance. Certainly, the art of the fifteenth century found out the 'real' in its wider meaning. In most of the north countries a religious sensitivity spread out: it looked for a closer relationship between God and the human being, such that it encouraged the identification with the divinity. This different spirituality was one of the reasons that pushed the artists towards a figurative more realistic research, which paid attention to the details of the daily life. The backgrounds of the Renaissance works were not pure invention or result of the big evocative power of the artists. They were, instead, fascinating real landscapes, known by everyone. Therefore, analogously to the Italian contemporary painters, also the Flemish ones showed an interest more and more marked for the reality and the naturalistic representation.

In addition, the characteristic and happy geographic position of the main Flemish cities stimulated the trade with the other European cities. As a result, there was an increase of the business travels, along with the study, work and pleasure ones. Merchants, bankers, diplomats, cartographers, scientists, masters in every art began to move from a place to another [16].

To remain in the context of our analysis, many historical documents, for instance, tell that Van Eyck travelled a lot on behalf of the duke Filippo III. It is known the one in 1428-1429 in Portugal to portray Isabella, Filippo's fiancée, but also other diplomatic expeditions. In addition, in his paintings there are naturalistic elements that show his knowledge of the landscape and of the typical colours of the Mediterranean world. The representation of the bluish mountains in the background of some of his well known paintings let think about a possible trip in Italy [17].

It is then legitimate to believe that other famous names, like Van Eyck, left the Flanders to explore different places, following caravans that moved for business reasons or because called by the Royal European Houses or simply for craving for knowledge.

Hence, it is very likely that famous painters went to the inner parts of Sicily and here accepted commissions and left works of great perfection. The backgrounds were very accurate landscapes connected to emotions so intense to be represented in a painting, as a memory of that sweet upset which went through the soul and arrived to the mastery of the painter. Such hypothesis could be related to the Triptych of Polizzi Generosa, with its "Monte San Calogero" at the horizon. It could have been painted *in loco* by a Flemish artist arrived in the island during one of his trips. Or it might have been sketched on a notebook and then realised in homeland, going through memories and spontaneous feelings, whose intense taste could still be perceived.

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Fig. 1. Rogier van der Weyden (attributed), Triptych of Polizzi Generosa, XV century (© Antonio Schimmenti Photography).

Fig. 2. Comparison between the particular of the Flemish Triptych and the calcareous massif of Mount San Calogero (© Antonio Schimmenti Photography).

Fig. 3. Detail of the right door of the Flemish Triptych compared with a watercolor drawing of 1548, kept in Rome in the Angelica Library, and depicting the city of Polizzi Generosa.

Fig. 4. Joan Matta, Lamentation over the Dead Christ with Saints Sebastian and Catherine of Alexandria, XVI century.

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The cultural heritage of tomorrow: should we put a limit to the influence that new technologies have on culture and design?

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Technological and digital innovation is becoming more and more rapid and pervasive in its use and diffusion by tapping an ever-wider spectrum of processes.
These new generation technologies are increasingly integrating themselves and integrating various *cultural heritage* areas, such as the conservation, enhancement, and enjoyment of cultural heritage, and find applications in various projects such as increased reality, the *Internet of Things* and digital manufacturing.
This leads to new forms of musealization, fruition and dissemination of artistic and cultural heritage, in which the technological components make the difference and give the cognitive and emotional experiences a very important role; consequentially it is characterized a guest who is increasingly expected to be the protagonist of this cultural experience and not a passive spectator.

First of all, we are faced with an enhanced web, capable of modifying cultural aspects thanks to its content and the power of the media, from which we get a continuous exchange of information.
This ongoing flow leads the user to address the digital culture on three levels of time:
- BEFORE: "*before fruition*" the user is informed, having access to a news archive of any kind, ranging from those directly provided for example by the museum, to those of other users who evaluate their experience, comment and express opinions.
For example, if we decide to visit a museum, we can get information from two macrochannels: directly from the official website, where we will find detailed information on

timetables, fares and collections details, or from reviews and opinions channels such as Trip Advisor or channel company.
In this case we will have other information that we would not find on "classic" channels, such as what works deserve absolutely to be seen, as they liked most to users who have already gone to the same museum.

- DURING: "*during enjoyment*", that is, all that digital set of actions that the user performs directly when they receive the information. The use of interactive maps, smartphone apps, audio guides, increased reality, Li-Fi systems; all times when the user feels involved in the path and experience he is facing.
When we are in the museum or sometimes on the internet site we can immerse ourselves in virtual and interactive experiences that help us understand the work better and more deeply while guiding us along the way.

- AFTER: "*after fruition*", the user re-submits contents, comments, reviews and experiences to the web, as if he was still enjoying the work, giving new imput to users who are still beginning to enjoy.
Concluded the cultural experience we are now accustomed to "sharing", making public what we did, what we saw and how we felt to see it. By emulation or passion for the protagonist, nowadays most people use social, and even those who do not, by social status will be brought to tell their own experience that will be heard and shared with many.

So doing is fueling an acceleration of the irreversible phenomenon that culture produces; that is, a spiral loop that is self-feeding and pushes itself further: thanks to culture and with culture, another culture is created.
If the phenomenon exists for so long, today there is an implementation of speed.
A way to produce culture different from the one practiced until recently, driven by new technologies and users that can not be controlled. This results in the creation of a spontaneous communication in which the originality and truthfulness of the information is not known. Just refer to the scandalous expansion of *Fake News*. In addition to veracity, the manipulation of information has largely focused on attention for speculative purposes. The case of the scandal that invested TripAdvisor on "bought" reviews is a significant indicator.

The risk is to get to a point where only the "macro elements" of our cultural heritage will be known or those who will have a "sponsor" with greater influence. In the field of fashion, for example, this trend has already come into play with the entry of *Fashion bloggers*, *Ambassadors* and *Influencers*, so we could easily suppose, without even a great effort, that this could happen in other cultural areas.

As is well known, virtual and multimedia languages can thus have a revolutionary impact. Thanks to the unlimited ability to tell stories, the ability to rebuild the worlds and objects lost today is becoming available, plus the ability to enjoy it enthusiastically and emotionally. They can also support the documentation by creating digital, 2D and 3D archives that are useful to the entity that manages them, as well as stimulating new stimuli of interest and public affection for cultural goods. Digital archiving guarantees the indelible preservation of the work spontaneously triggering actions of care and safeguarding, knowledge and enhancement.

This abundance of digital data, as it creates new scenarios of new perceptual knowledge, crumbles the expectations that we have been accustomed to having in the near to the not yet known. Everything happens before it is lived.
Until recently, to see a work of art we had to go to a certain city, in a particular museum, and we did not know what was waiting for us, as it would have been to see it close, while now we can see it on the screen of our pc in very high resolution to the slightest detail, so in that sense you lose the surprise in having it really in front because somehow we have already seen, already experienced, we have already created an opinion about it.

The new opportunities that cultural institutions now have, increasingly require more information technology to better exploit cultural heritage.
Digital manufacturing can in fact be used in integrative restoration, digital reconstructions and the creation of high-definition models, in tactile alternatives for disabled and children, and also in museum merchandising. Through the 3D survey, it is possible to create digital archives in three dimensions of artefacts, artefacts and artworks for use both for dissemination purposes, such as the development of 3D online museums, as well as tourist applications and integration to cultural enjoyment. The use of this type of technology was initially limited in the useby high-cost and low-performing devices for the scholars,

while the general public has had a difficult approach due to the low availability of intuitive tools that they stopped using ease of use and immediate accessibility to real-time navigation.

However, the evolutionary acceleration of these technologies has allowed a widespread ramification of the success of these IT tools, making it easier to access and approach any level of use whether it is for researchers and operators in the industry, whether they are users concerned. An evolution that allows an ever-expanding dissemination of cultural heritage.

In this new perspective, Design plays a significant role. The 3D digital medium holds sensitive potential in terms of beneficial or disadvantageous relaunches for the dissemination of cultural heritage.
If digitization allows conservation and facilitation in propagating the value of the artwork, at the same time the problem of ease of counterfeiting is evident.
The copyright protection is, in fact, one of the most delicate issues for the 3D printing industry especially with the advent of mass 3D.
We could make a comparison with what happened a few years ago in the music world. After all, a .stl file is a kind of .mp3 of the objects. With the advent of this type of file, the music industry has been invested by a real tsunami that has left behind its pros and cons. Looking at the positive, we've come to an extreme usability of music content, but have also had negative consequences, such as ever-expanding digital piracy.
Such a scenario is reappearing with the advent of massive 3D printing, and it will not be enough to hide behind the idea that engraving a CD is much easier than printing objects in 3D because at the time, even for CD playback, we did not even take this easy access to music content for granted.

A very important and relevant issue is that of digital file protection, especially in the field of *cultural herritage* or design.
An increasingly emerging need to avoid counterfeiting of works and models, which will be increasingly subject to faithful reproduction of the original. As is known about this trend, highly innovative solutions have been developed and are still being studied but not yet

sufficient to contain or avoid counterparts which are acceptable to support the contribution of technological emancipation to knowledge and protection of cultural goods.
The contradiction between preserving, protecting, guarding and counterfeiting demands also implicitly impacts the use of digital technologies in designing new objects.
3D modeling assists each design phase up to the real simulation with the three-dimensional automated printing of the object itself. This allows you to have enormous possibilities of formal expression through digital tools that accelerate the process of visualization of an idea and make it even easier for the isometric control already visible in the virtual field before it materializes. That's the role of digital modeling assumes a value that asks distinction of identity as it happens in the authenticity of a work of art.
Both a monument and a design object need to be protected. The artwork and design object that can be circulated on the web, available to anyone, need more protection.
It follows that in order to benefit from digital technologies, it is necessary to increase the awareness of the type of use of computer tools and how to preserve their autoriality in every step of the dissemination.

Particularly with regard to Design, we can notice the deficiencies of this awareness caused by two major factors.
The first as a result of the diffusion of IT technologies in the project culture that enable 3D modeling a more direct and facilitated approach to the preview of the product to be achieved. The second factor, however, concerns the subconscious subjection that computer tools allow those who, enticed by their performance, do not absorb their potential but undergo such process facilitation.
The problem is that the tool is also predominant on the vision of the shape of things. These are the features, commands and tools of the program that dictate the form, not the design idea of the designer. In the academic sphere, this trend is very rampant, especially in those who, aspiring to the profession of designer, still do not know how to fully use these tools, which should remain the same, without becoming overwhelming on the final aspect of the product.
To illustrate this trend we could make a comparison between these new tools and the classic designer tool, pencil. If we take a pencil and try to draw circles, we will certainly find more difficulty than drawing simple curved lines, but that does not mean that we will exclude circles from our projects; we will only have to refine the technique.

Today, however, we see many young designers approaching these new technologies with a "surrender" attitude: they do not even try to draw shapes that they know they do not know how to model. As a result, everything flattens into definable shapes with very few simple commands, such as extrusion, creating products that do not represent the research for a formal idea of the designer, but the degree of software usage skill with which they were generated.

Gaining ingenuity, subtlety, or simple adaptability to the facilitating potential of the instruments, however, gives a fundamental consideration of how to deal with a future strategy.
Technological innovation opens up and raises new perspectives, but at the same time only a very strong sensitivity to awareness of what we have and what we can do to facilitate the exchange between ways of acting and ways of thinking.
A new focus that will distinguish between what we identify as a cultural heritage and what, through technology, makes us cultured with new skills with which we use computer resources.

The use of the intelligent cutting guide PERSEUS during Total Knee Replacement

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Abstract

Sub-optimal post-operative anatomical and mechanical alignment has been described as a cause of Total Knee Arthroplasty (TKA) revision. In fact, mechanical alignment exceeding ± 3 has been reported to increase the risk of early failure following TKA. For this reason, alignment guides have been developed to improve the accuracy of femoral and tibial cuts during surgery. Recently, it has been introduced a new system (PERSEUS) that aim to help surgeons during bone cuts, reducing the complexity of conventional alignment and sizing tools.

PERSEUS system is an intelligent cutting guide, powered by gyro sensors, that allows surgeon to perform perfectly aligned resections with less effort and morbidity, compared to conventional instrumentation for TKA. It enables to perform bone resections without using intramedullary rods, reducing the risks of a more invasive surgical approach and ensuring the optimal final limb alignment. With the use of a disposable sensor and a touchscreen interface (IPAD), the surgeon could verify the correct placement of the cutting-guide relating to the femur. During surgery, the real-time cutting plan can be approved or declined or modified, according to the choice of the surgeon. This system appears to be less risk and more safety if compared to other Computer Navigation Systems. Further, it avoids risks related to intramedullary nail and it is easier to use, increasing confidence in surgical decision. From January 2016 to March 2018, we treated 15 patients affected by knee osteoarthritis using the Perseus System. After post-operative CT evaluation, correct placement of the tibial and femoral component was obtained in all cases.

NEW TECHNICAL DEVELOPMENTS & APPLICATIONS

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LATEST INNOVATION ON CAPTURING HISTORICAL PHOTOGRAPHIC ETHEREOGENOUS MATERIAL: THE ALINARI EXPERIENCE

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Abstract

Digitization requires today high skill and great experience in order to achieve ultimate level of digitization results. Time is money and efficiency to get the best output qulity requires a proper fine-tuning set-up and proven workflow. This paper is about the experience developed by the Alinari Archives in Florence, Italy, on creating possibly the ultimate state-of-the-art digitization solution for the cultural heritage sector. Today digitization has evolved quite a lot. Thanks for the latest technical advances, slow scanners and digitization systems available in the mid of the 90's have been replaced by faster, more powerful and with higher technical specifications. It is however important to specify that between 1999 and 2007, the market was offering specific dedicated scanners for 35mm and small films, such as film scanners, drum scanners and flat bed scanners, capable to capture very high details and information in the highlights (ie. sky) and shadow (ie. dark areas like the shade of a building). Those systems had a dynamic range (capacity to capture all level of color/gray scale information) up to 4,8. Today technology has become better in terms of scanning speed, maintenance and software management. However in many cases, prices have increased dramatically, and most important, the market has lost high end dedicated scanners for small film and 35mm slides. With the market monopoly of digital imaging, starting in the mid of 2000, those

scanners have lost market share and since 2010 no vendors offer any high solution for those type of media.

The study analysis various solutions available in recent years and also thanks to the experience developed by Alinari in the last 15 years around best practice on digitization, providing latest reccomandations related to the current solutions available in the market.

International Standardization of FTV

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Abstract – FTV (Free-viewpoint Television) is visual media that transmits all ray information of a 3D space and enables immersive 3D viewing. The international standardization of FTV has been conducted in MPEG. The first phase of FTV is multiview video coding (MVC), and the second phase is 3D video (3DV). The third phase of FTV is MPEG-FTV, which targets revolutionized viewing of 3D scenes via super multiview, free navigation, and 360-degree 3D. After the success of exploration experiments and Call for Evidence, MPEG-FTV moved MPEG Immersive project (MPEG-I), where it is in charge of video part as MPEG-I Visual. MPEG-I will create standards for immersive audio-visual services.

1 INTRODUCTION

FTV (Free-viewpoint Television) [1]-[8] is visual media that transmits all ray information of a 3D space. FTV was developed based on ray-space representation [9]-[12].

FTV is the ultimate 3DTV, with an infinite number of views, and ranks at the top of visual media. FTV enables users to view a 3D scene by freely changing the viewpoint, as we do naturally in the real world. FTV is a natural interface between humans and the environment. It is also an immersive media that enables a realistic VR experience and revolutionizes 3D viewing.

FTV was proposed to the Moving Picture Experts Group (MPEG) in 2001 [13]. Since then, the MPEG has been developing various FTV standards. Multiview video coding (MVC) [14] is the first phase of FTV and enables efficient coding of multiple camera views. 3D video (3DV) [15] is the second phase of FTV and enables viewing adaptations and display adaptations for multiview 3D displays. MPEG started the third phase of FTV [16] in August 2013. This is MPEG-FTV, which targets immersive viewing of 3D scenes via super multiview, free navigation, and 360-degree 3D (360 3D) video. MPEG-FTV moved to MPEG-Immersive project (MPEG-I) [17] in January 2017 and it has been in charge of video part as MPEG-I Visual.

In this paper, international standardization of FTV is described.

2 HISTORY OF FTV STANDARDIZATION IN MPEG

The MPEG has been developing FTV standards since 2001. The history of FTV standardization in MPEG is shown in Fig. 1. In 2001, FTV was proposed to the MPEG, and the 3D audio visual (3DAV) activity started. In 3DAV activity, many topics, such as omnidirectional video, FTV, stereoscopic video, and 3DTV with depth information, were discussed. According to the results of the call for comments from the industry, discussion converged on FTV and MVC [14] starting in March 2004.

MVC is the first phase of FTV and targeted the coding of multiple videos. The MVC activity moved to the Joint Video Team (JVT) of the MPEG and International Telecommunication Union Telecommunication Standardization Sector (ITU-T) for further standardization processes in July 2006. MVC was completed in March 2009. MVC does not have a function for view generation.

The MPEG started 3DV as the second phase of FTV in April 2007. 3DV is a standard for multiview 3D displays [15]. View generation was introduced into 3DV to increase the number of views for multiview 3D displays. The 3DV activity moved to the Joint Collaborative Team (JCT)-3V for further standardization processes in July 2012, and 3DV was completed in June 2016.

In August 2013, the MPEG started the third phase of FTV, MPEG-FTV [16], which targets immersive 3D viewing by enhancing the function of view generation. MPEG-FTV moved to MPEG-I [17] for further standardization in January 2017.

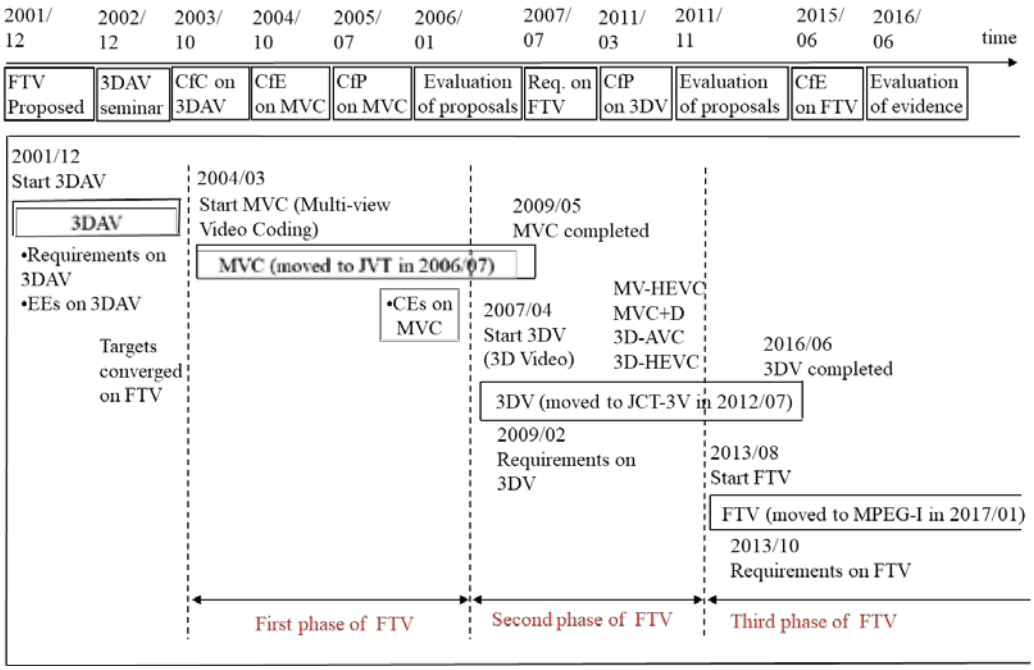


Fig. 1 History of FTV standardization in MPEG.

3 FTV FIRST PHASE: MVC STANDARD

The framework of MVC is shown in Fig. 2. MVC targets efficient coding of multiview video. In MVC, the number of input views is the same as output views. The view-generation function of FTV is not included in MVC.

Multiview video data have a high correlation among views. This redundancy can be removed by interview predication. It can also be done by using a motion compensation method that is widely used to remove temporal redundancy in conventional video coding. MVC applies motion compensation-like prediction to not only time and but also view directions.

MVC was standardized as the extension of H.264/MPEG4-AVC [18]. The MVC standard was adopted by Blu-ray 3D.

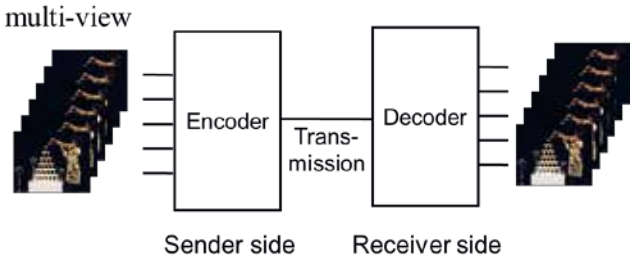


Fig. 2 Framework of MVC.

4 FTV SECOND PHASE: 3DV STANDARDS

The framework of 3DV is shown in Figure 3. View synthesis was introduced into 3DV, which sends a small number of views and generates a large number of views at the receiver for multiview displays. A multiview and multi-depth set is jointly compressed and sent to the receiver, and intermediate views are synthesized from views with the assistance of depth information at the receiver. 3DV enables display adaptation and viewing adaptation [19].

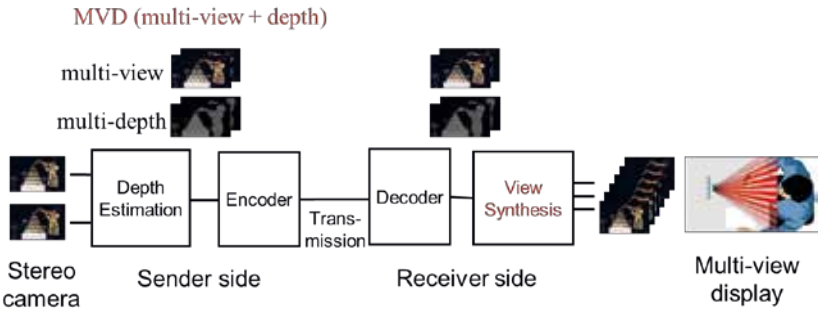


Fig. 3 Framework of 3DV.

The FTV reference model, as shown in Fig. 4, was defined to develop the 3DV standard [20], and 3D warping is used for view synthesis of 3DV. View synthesis by 3D warping is sensitive to error in depth information. Nagoya University provided Depth Estimation Reference Software (DERS) [21] and View Synthesis Reference Software (VSRS) [22], as shown in Fig. 4. It also provided various test sequences such as pantomime, champagne_tower, kendo and balloons.

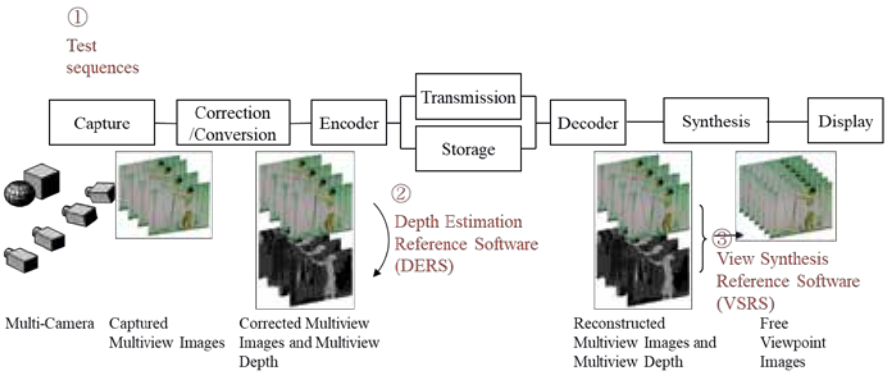


Fig. 4 FTV reference model and Nagoya University's contribution.

The data format of 3DV is Multiview plus Depth (MVD). Coding standards such as MVC+D, 3D-AVC, MV-HEVC, and 3D-HEVC were developed [23]. Here, MVC+D is a depth-extension of MVC, 3D-AVC is AVC-based MVD joint coding, MV-HEVC is HEVC-based MVC, and 3D-HEVC is HEVC-based MVD joint coding.

Global View and Depth (GVD) [24] can be used as an alternative data format. GVD is a compact version of MVD and is obtained by removing the interview redundancy of MVD.

5 FTV THIRD PHASE: MPEG-FTV/MPEG-I

5.1 Motivation and Background

In 2010, the 2022 FIFA World Cup Japan Bid Committee planned to deliver the excitement of the soccer stadium to the world via FTV. It aimed to revolutionize the viewing of the soccer game by super multiview and free navigation. Super multiview realizes very realistic 3D viewing of the scene, and free navigation realizes a walk-through or fly-through experience of the scene. This became a strong motivation for the third phase of FTV.

5.2 Framework of FTV

Based on the above motivations and background, the framework of MPEG-FTV was created, as shown in Fig. 5 [25]. FTV has three types of application scenario [26]. The first is super multiview (SMV) with a high number of views and high density for super multiview displays. The second is a single view with freely changing viewpoint for free navigation (FN) in a wide area. Users can enjoy realistic 3D viewing and walk-through/fly-through experiences in 3D scenes. The third is 360 3D video with a wide FoV.

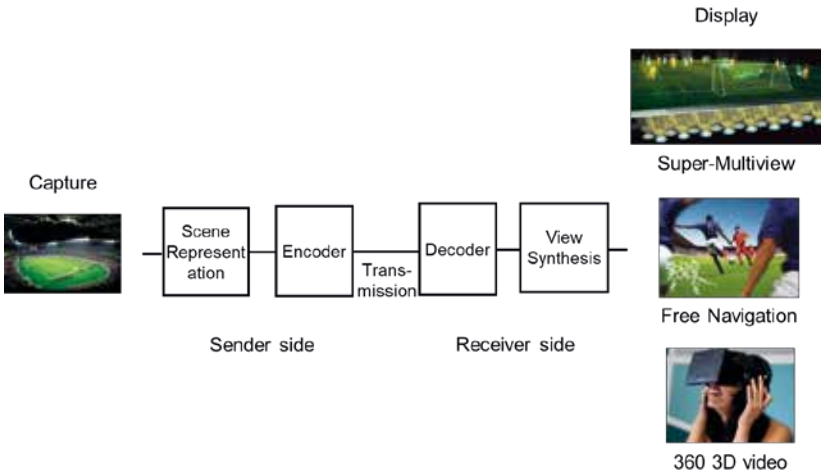


Fig. 5 Framework of MPEG-FTV.

5.3 Call for Evidence

After a series of exploration experiments on FTV [27], the MPEG issued a Call for Evidence (CfE) on FTV [28] in June 2016. CfE is a procedure before a call for proposals to show evidence of a new technology that is better than currently available standards. FTV software used for the CfE is described in [29]. Submissions were collected for SMV and FN application scenarios, as shown in Figs. 6 and 7, respectively, in February 2016. Results evaluated in June 2016 showed clear evidence of the new technology [30].

FTV test material and software developed in MPEG-FTV are summarized in [31] and [32], respectively.

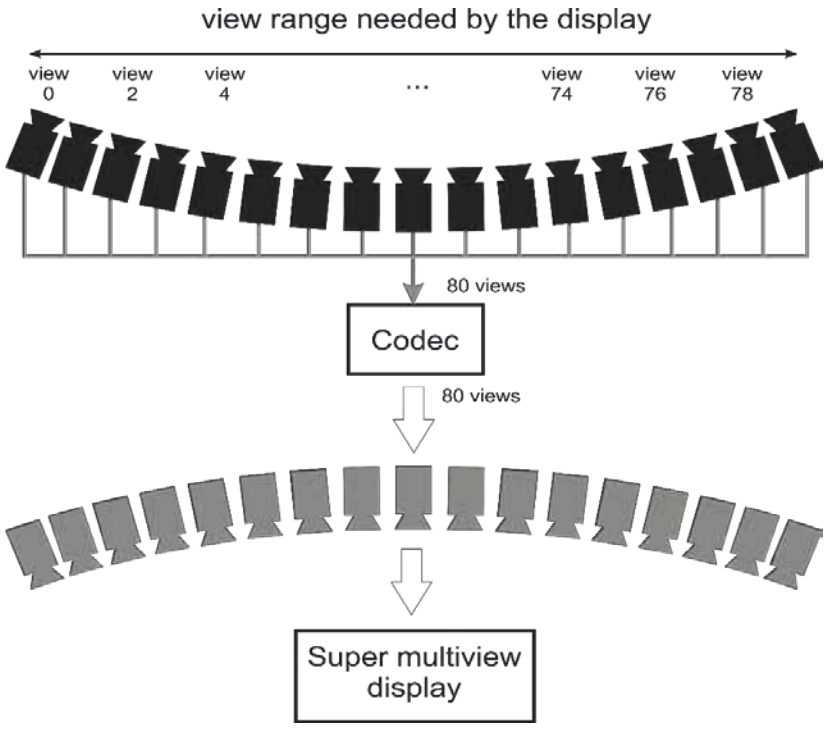


Fig. 6 Super Multiview (SMV) application scenario for the CfE [28].

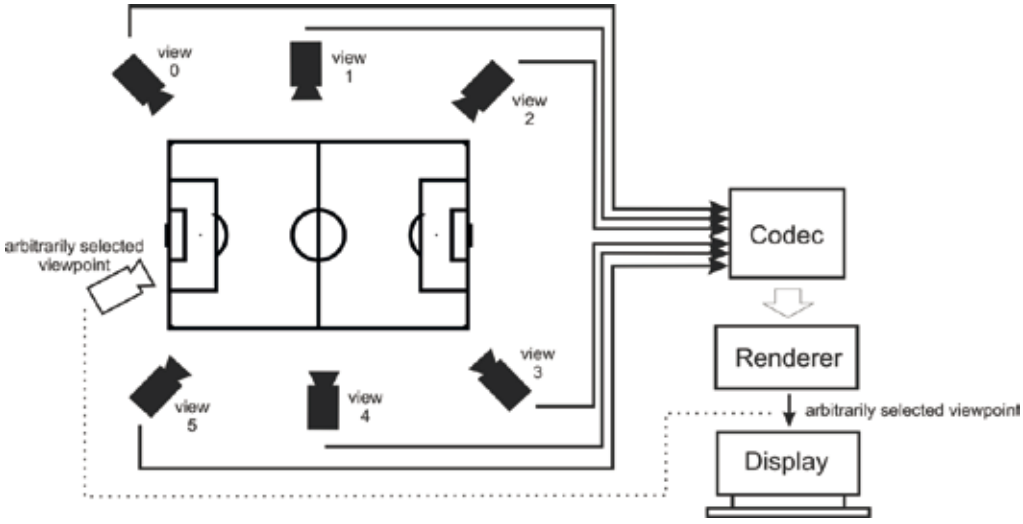


Fig. 7 Free navigation (FN) application scenario for the CfE [28].

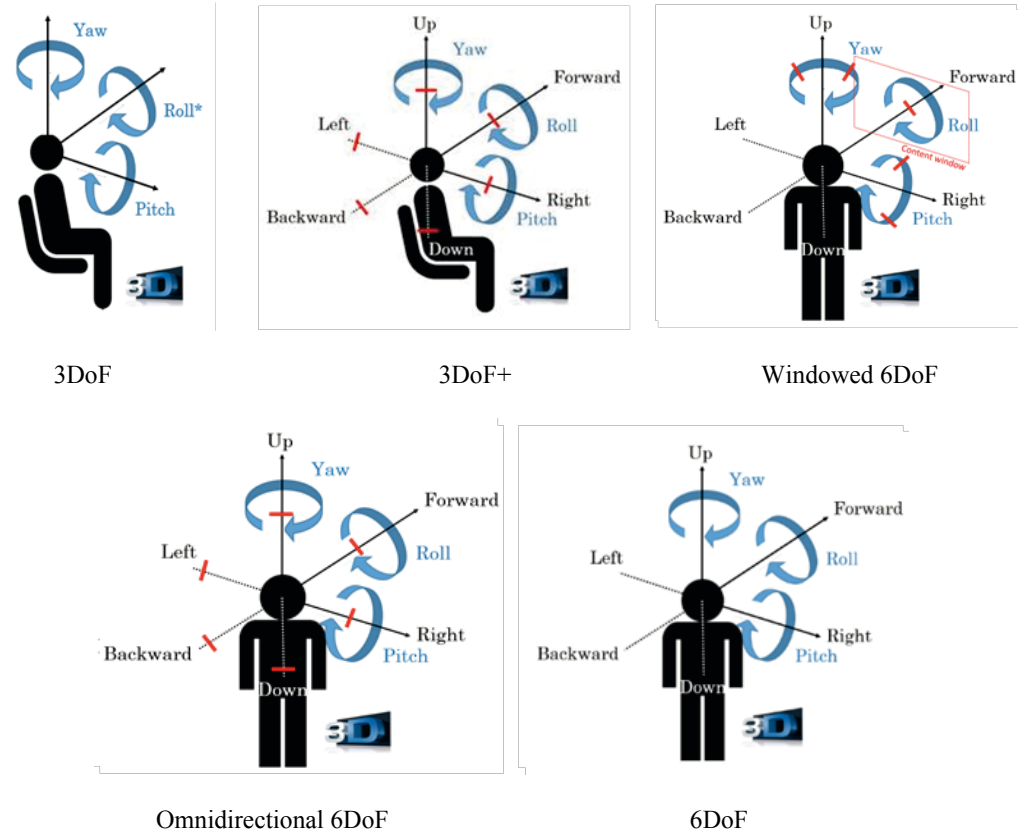
5.4 MPEG-I

MPEG-FTV moved to MPEG-I in January 2017. MPEG-I was established by integrating the FTV, light field, point cloud, and 360 video ad hoc groups. MPEG-I will create standards for immersive services. MPEG-FTV is in charge of the video aspects of MPEG-I. All application scenarios, requirements, test material, and software for MPEG-FTV were transferred to MPEG-I.

MPEG-I will use various technologies, such as FTV, light field, point cloud, 360 video, and 3D audio, to build immersive services. Therefore, the MPEG has structured MPEG-I as a suite of standards focusing on specific technologies. The five parts to MPEG-I are as follows [33]:

•Part 1 – Technical Report on Immersive Media
•Part 2 – Application Format for Omnidirectional Media
•Part 3 – Immersive Video
•Part 4 – Immersive Audio
•Part 5 – Point Cloud Compression

MPEG-I standards will be developed according to the stages of immersion shown in Fig. 8 [33]. The stages of immersion are categorized by degrees of freedom (DoF), which denotes the number of independent parameters used to define movement of a viewpoint in 3D space.



3DoF 3DoF+ Windowed 6DoF

Omnidirectional 6DoF 6DoF

Fig. 8 Stages of Immersion in MPEG-I [33].

For example, 3DoF is three rotational and unlimited movements around the X, Y, and Z axes. 3DoF has a fixed viewpoint and no translational movements along the X, Y, and Z axes. A

typical use case is a user sitting in a chair looking at 3D 360 VR content on an HMD, as shown at the most left in Fig. 8. On the other hand, 6DoF is 3DoF with full translational movements along the X, Y, and Z axes. A typical use case is a user freely walking through 3D 360 VR content displayed on an HMD, as shown at the most right in Fig. 8.

3DoF+, windowed 6DoF, and omnidirectional 6DoF are stages in between. 3DoF+ is 3DoF with additional limited translational movements along the X, Y, and Z axes. Windowed 6DoF denotes 6DoF with constrained rotational movements around the X and Y axes (pitch and yaw, respectively) and constrained translational movements along the Z axis. Omnidirectional 6DoF denotes 6DoF with constrained translational movements along X, Y, and Z axes.

6 CONCLUSION

MPEG has been creating various standards on FTV. In the first phase of FTV, MPEG developed the MVC standard. In the second phase of FTV, MPEG developed the MVC+D, 3D-AVC, MV-HEVC and 3D-HEVC standards. The current third phase of FTV is MPEG-FTV. MPEG-FTV targets revolutionized viewing of 3D scenes via super multiview, free navigation, and 360-degree 3D technologies. MPEG-FTV developed test material, reference software, and evaluation methods for them. After the success of the exploration experiments and Call for Evidence, MPEG-FTV moved to MPEG-I and has been in charge of its video part. MPEG-I will create standards for immersive services based on the stages of immersion.

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4D Ray-Space and Ultra-Wide Area FTV

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Abstract –Ultra-wide area FTV is an FTV with very wide viewing zone where motion parallax is realized. 4D orthogonal ray-space is analyzed and applied to ultra-wide area FTV. Ray-space of "a group of rays through one point" is derived in 4D orthogonal ray-space. It is extended to obtain ray-space captured by linear arrangement cameras. View generation of ultra-wide area FTV needs rays that are not captured by real cameras. These rays are synthesized by interpolating the captured ray-space so that the intersections of the captured ray-space and the ray-space of rays emitted from a light source have the same color.

1 INTRODUCTION

FTV (Free-viewpoint Television) [1]-[8] is visual media that transmits all ray information of a 3D space and enables immersive 3D viewing as if we were actually there. Omnidirectional FTV is an FTV with very wide field of view (FOV), that is 360-degree FOV. Ultra-wide area FTV is an FTV with very wide viewing zone that gives motion parallax. FTV was developed based on ray-space representation [9]-[12]. 4D ray-space is needed for immersive 3D viewing with full parallax.

We proposed two types of ray-space, orthogonal ray-space and spherical ray-space. Orthogonal ray-space is used for linear and planar camera arrangements and spherical ray-space is used for circular and spherical camera arrangements. 4D spherical ray-space was analyzed and applied to omnidirectional FTV [13]. In this paper, 4D orthogonal ray-space is analyzed and applied to ultra-wide area FTV. Ray capture and view generation in 4D orthogonal ray-space are presented.

2 4D ORTHOGONAL RAY-SPACE

2.1 4D Orthogonal Ray-Space of Rays through One Point

Fig. 1 shows the definition of orthogonal ray-space. As shown in Fig. 1, one ray is expressed by intersection (x, y) and direction (θ, φ) on a reference plane. Therefore, one ray is expressed by one point in 4D parameter space (x, y, θ, φ). This parameter space is 4D orthogonal ray-space. Each point in the 4D ray-space has an intensity f of the ray. Therefore, f is expressed as $f(x, y, \theta, \varphi)$.

Here, "a group of rays through one point" is considered as shown in Fig. 2. This concept is used for ray capture, view generation and ray synthesis as shown in Fig. 3. Fig. 3(a) shows ray capture by a real camera, and view generation by a virtual camera collecting rays through one point. Fig. 3(b) shows ray synthesis. If the surface of an object is a diffusion surface, one point on the surface emits rays with equal magnitude. Therefore, if one ray is known, other rays can be synthesized.

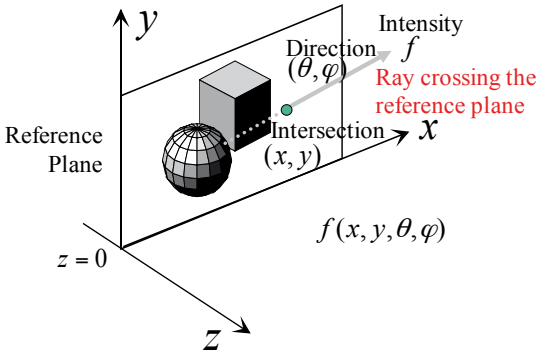

Fig. 1 Definition of orthogonal ray-space.

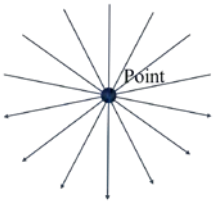

Fig. 2 Concept of "a group of rays through one point".

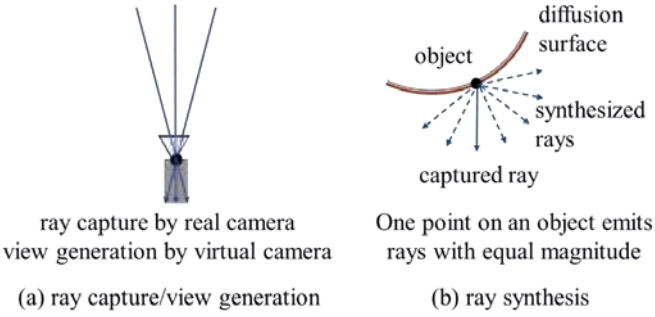

Fig. 3 Ray capture, view generation and ray synthesis by using the concept of "a group of rays through one point".

x and y of a ray with direction (θ, φ) through a point P(X, Y, Z) are given by

$$x = X - \tan\theta Z \qquad (1)$$

$$y = Y + \frac{\tan\varphi}{\cos\theta} Z \qquad (2)$$

(1) and (2) give the 4D orthogonal ray-space (x, y, θ, φ) of a group of rays through one point. By changing θ and φ, this group of rays forms a plane in (x, y, θ, φ) space. To visualize it, (x, y, θ) space with fixed φ and (x, y, φ) space with fixed θ are considered in the following.

From (1) and (2), the following equations are derived.

$$1 + \left(\frac{x - X}{Z}\right)^2 \qquad (3)$$

$$1 + (tan\theta)^2 = \left(\frac{y - Y}{Ztan\varphi}\right)^2 \qquad (4)$$

For fixed φ, (1), (3) and (4) give the top view, front view and side view of (x, y, θ) space, respectively. The top view is a straight line with slope $-Z$ and both the front and side views are hyperbolic curves in (x, y, $tan\theta$) space. Therefore, a group of rays through one point forms a hyperbolic curve in (x, y, $tan\theta$) space with fixed φ as shown in Fig. 4. Three examples of hyperbolic curves for $\varphi > 0$, $\varphi = 0$ and $\varphi < 0$ are shown.

For fixed θ, (1) and (2) form a straight line in (x, y, $tan\varphi$) space as shown in Fig. 5. Three examples of straight lines for $\theta > 0$, $\theta = 0$ and $\theta < 0$ are shown.

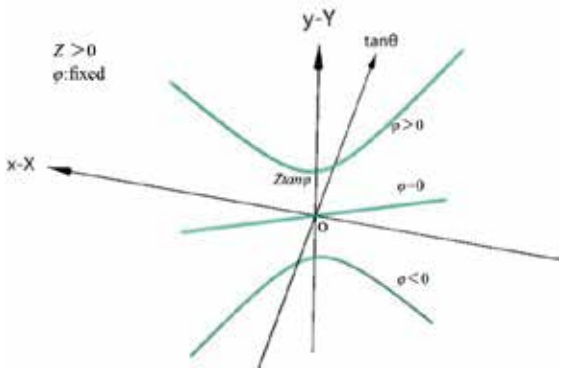

Fig. 4 Rays through a point P(X, Y, Z) form a hyperbolic curve in (x, y, $tan\theta$) space with fixed φ.

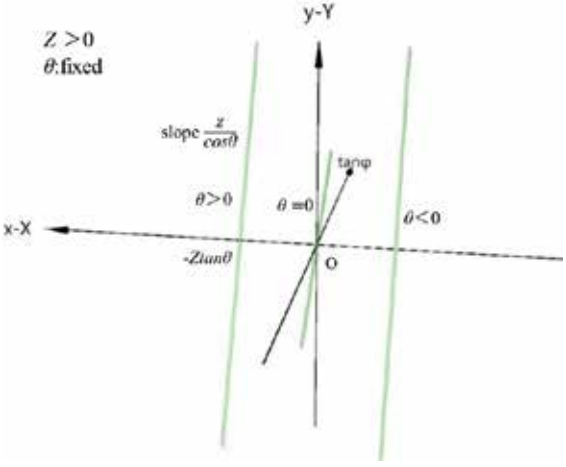

Fig. 5 Rays through a point P(X, Y, Z) form a straight line in (x, y, $tan\varphi$) space with fixed θ.

2.2 4D Orthogonal Ray-Space Captured by Linear Arrangement Cameras

Let arrange many cameras on a line that is set on the xz-plane (y=0) and parallel to the x-axis. When an omnidirectional camera at P(X_c, 0, Z_c) on the line captures a ray with direction (θ, φ) as shown in Fig. 6, x and y are given by

$$x = X_c - tan\theta Z_c \qquad (5)$$

$$y = \frac{Z_c}{cos\theta} tan\varphi = Z_c tan\varphi \sqrt{1 + tan^2\theta} \qquad (6)$$

(5) and (6) give ray-space captured by linear arrangement cameras.

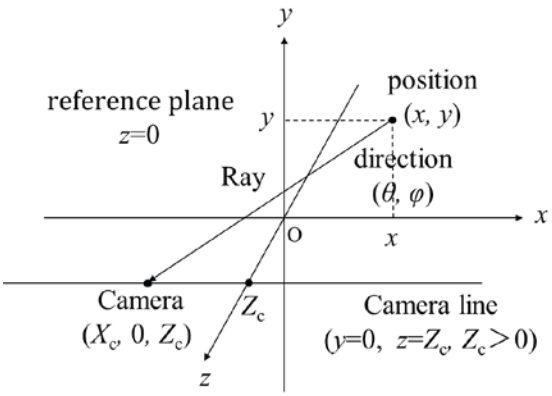

Fig. 6 Ray capture by linear arrangement cameras

By varying X_c, (5) and (6) form a hyperbolic cylinder in (x, y, $tan\theta$) space with fixed φ as shown in Fig. 7. They form a plane in (x, y, $tan\varphi$) space with fixed θ as shown in Fig. 8. The expressions of the hyperbolic cylinder and the plane are given by

$$y = Z_c tan\varphi \sqrt{1 + tan^2\theta} \quad \text{for any } x \qquad (7)$$

and

$$y = \frac{Z_c}{cos\theta} tan\varphi \quad \text{for any } x \qquad (8)$$

respectively.

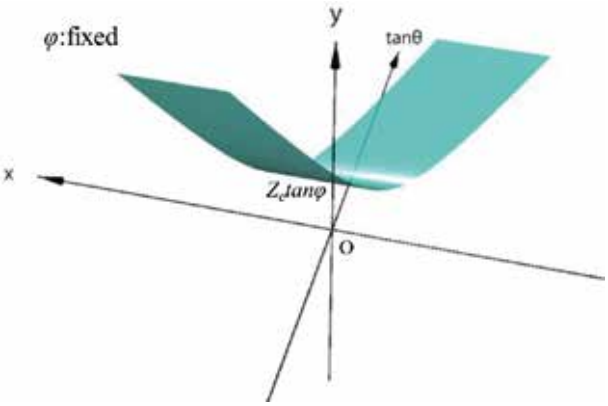

Fig. 7 Ray-space in (x, y, $tan\theta$) space with fixed φ captured by linear arrangement cameras.

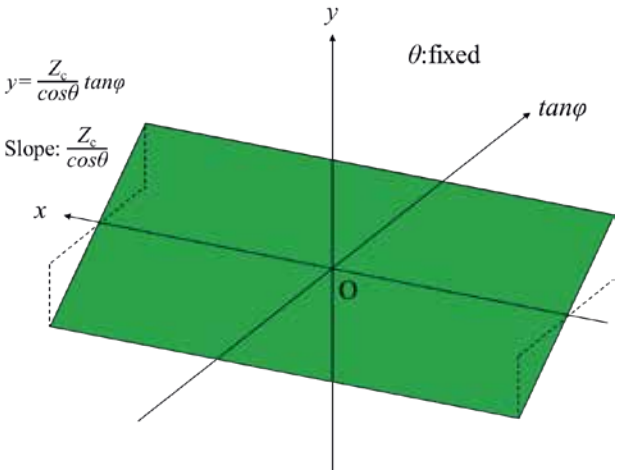

Fig. 8 Ray-space in (x, y, $tan\varphi$) space with fixed θ captured by linear arrangement cameras.

3 VIEW SYNTHESIS FOR ULTRA-WIDE AREA FTV

4D orthogonal ray-space is applied to ultra-wide area FTV [11]. Ray capture and synthesis for ultra-wide area FTV is shown in Fig. 7. Rays are captured by many cameras on a line (y=0, z=Z_c) and virtual camera views are synthesized from the captured rays. Let one of the rays captured by a virtual camera be (x_0, y_0, θ_0, φ_0). This ray is synthesized because it is not captured by real cameras. When z of the light source of this ray is assumed to be Z, the position (X, Y, Z) of the light source is determined. This light source emits rays in various directions. Let ray-space of the emitted rays be (x, y, θ, φ).

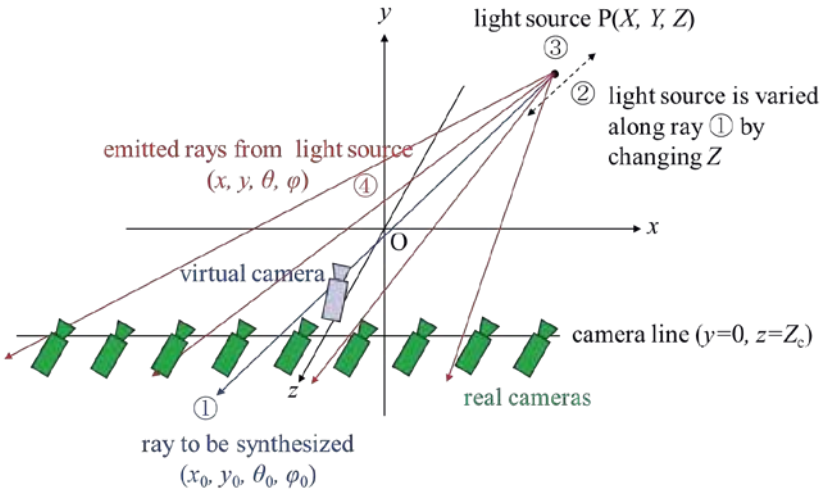

Fig. 9 Ray capture and synthesis for ultra-wide area FTV.

Some of emitted rays are captured by the real cameras. These rays are given by the intersection of emitted and captured ray-spaces. Fig 10 shows captured ray-space, emitted ray-space and their intersection in (x, y, φ) space with fixed θ. The intersection is given by

$$(x, y, \tan\varphi) = (X - Z\tan\theta, \frac{Z_c Y}{Z_c - Z}, \frac{Y\cos\theta}{Z_c - Z}) \qquad (7)$$

Many intersections are obtained by varying θ. Fig. 11 shows the trajectory of this intersection. It is on a horizontal plane of $y = \frac{Z_c Y}{Z_c - Z}$. When Z is correct depth, the intersections have the same color. This color is given to the ray $(x_0, y_0, \theta_0, \varphi_0)$.

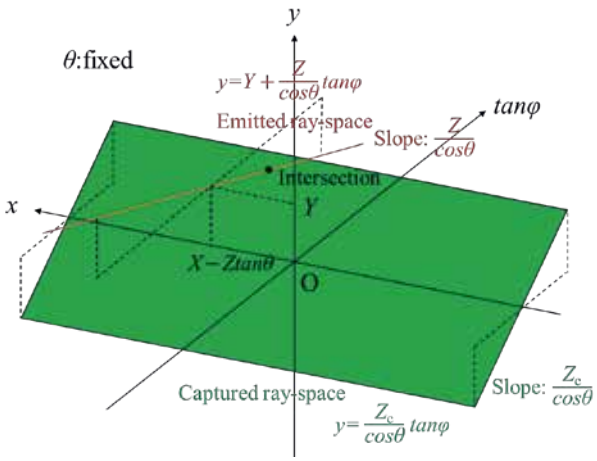

Fig. 10 Captured ray-space, emitted ray-space and their intersection in (x, y, φ) space with fixed θ.

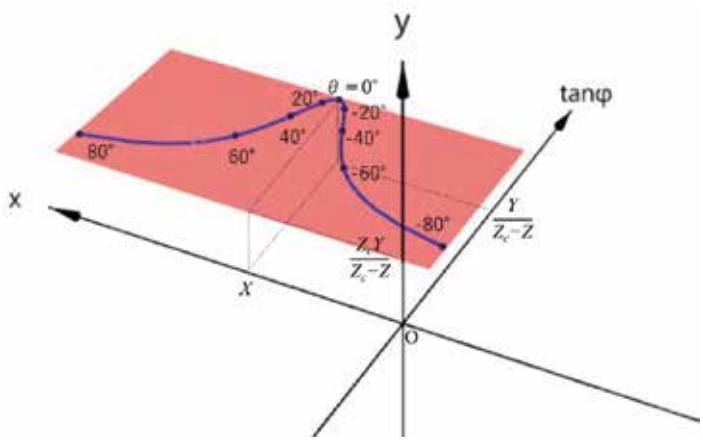

Fig. 11 Trajectory of the intersection of captured ray-space and emitted ray-space in (x, y, φ) space by varying θ.

The process of this ray synthesis is summarized in the flowchart of Fig. 12.

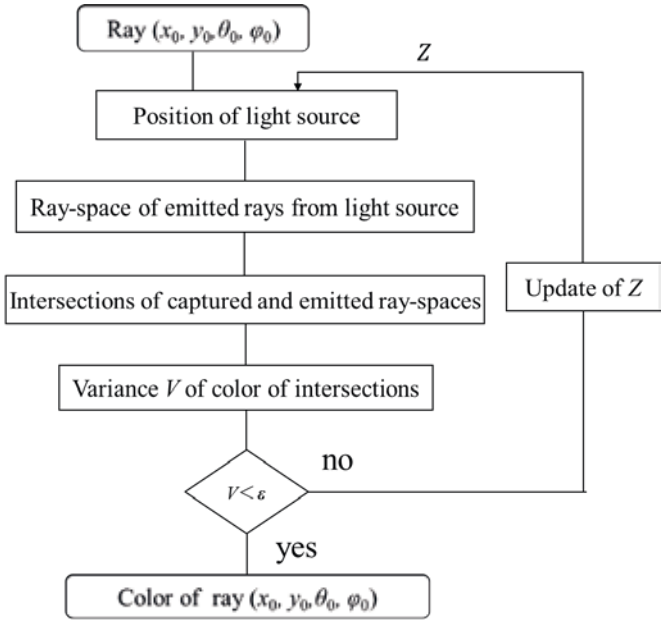

Fig. 12 Flowchart of ray synthesis.

4 CONCLUSION

Ultra-wide area FTV with full parallax is realized by 4D orthogonal ray-space processing. Ray-space of "a group of rays through one point" is derived in 4D orthogonal ray-space. It is used for ray capture, view generation and ray synthesis. Ray-space of "a group of rays through one point" forms a hyperbolic curve in ($x, y, \tan\theta$) space with fixed φ and a straight line in ($x, y, \tan\varphi$) space with fixed θ. By varying the camera position along a line, ray-space captured by linear arrangement cameras is obtained. This ray-space forms a hyperbolic cylinder in ($x, y, \tan\theta$) space with fixed φ and a plane in ($x, y, \tan\varphi$) space with fixed θ.

Rays for view generation of ultra-wide area FTV are synthesized by interpolating the captured ray-space using the concept of "a group of rays through one point". It is done so that the intersections of the captured ray-space and the ray-space of rays emitted from a light source have the same color.

ACKNOWLEDGEMENTS

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Digital innovation & Technological explosion
The new challenges of the Security Management

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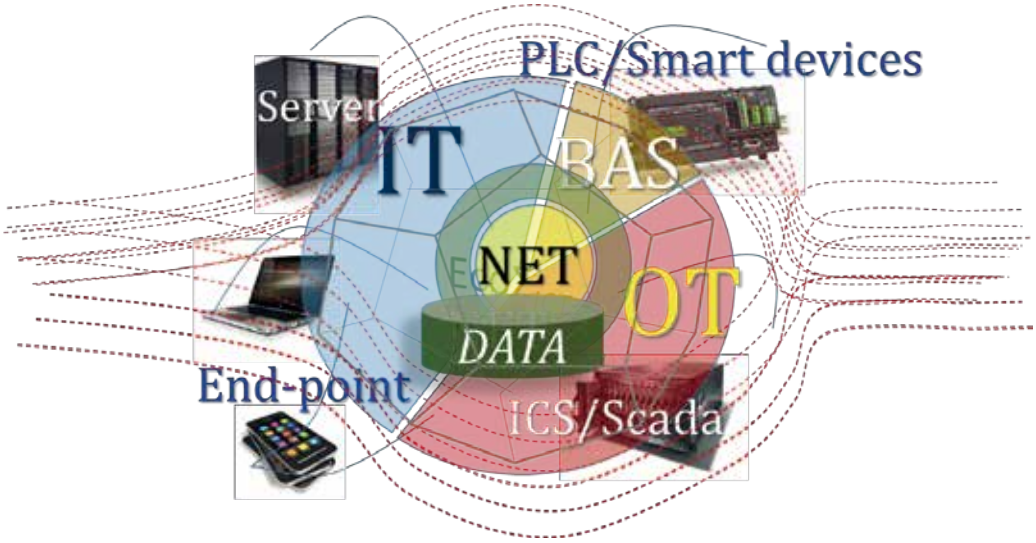
Cyber Ecosystem always more complex

Digitization become deeply embedded in each strategy, as nearly all businesses and activities have been slated for digital transformations.

The technological revolution has the intensity of a tsunami: the traditional ICT systems move to complex digital ecosystems. Operational Technology (OT) such as industrial control systems and elements of smart grids such as smart meters, vehicles, and smart buildings are all examples of innovative enterprise.



Several new assumptions have to be made about the cyber environments, because of their evolution over the years:

- Modern networks are very large, very interconnected, and run both ubiquitous protocols and proprietary protocols. Therefore, they are often open to access, and a potential attacker can

attach with relative ease, or remotely access, to such networks. Widespread IP internetworking increases the probability that more attacks will be carried out over large, heavily interconnected networks.

- Computing systems and applications attached to these networks are becoming increasingly complex. In terms of security, it becomes more difficult to analyze, secure, and properly test the security of the computer systems and applications; it is even more so when virtualization is involved. When these systems and their applications are integrated in large networks, the risk to computing dramatically increases.

Warning: «Cyber space» interacts with «Reality»

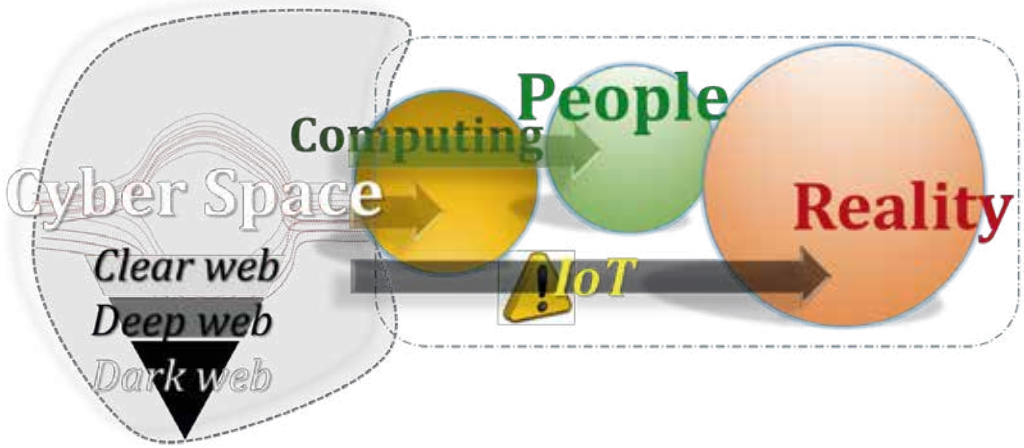
Smart devices, machine-to-machine (M2M) communications and cloud-based services, among many other technologies, are advancing the next-generation of networked societies.

Digital technology and internet connectivity, are being systematically integrated into all verticals of the private and public sectors, offering significant advantages like productivity, speed, cost-reduction and flexibility.

In the cyber environment it's increasing the role of the Cyber-Physical Systems (CPS), whic refer to the seamless integration of computation and networking with physical processes, possibly with humans in the loop.

In these systems, embedded computers and networks monitor (through sensors) and control (through actuators) the physical processes, usually with feedback loops where physical processes affect computations and vice versa.

A key point in these systems is the control of physical processes from the monitoring of variables and the use of computational intelligence to obtain a deep knowledge of the monitored environment, thus providing timely and more accurate decisions and actions.



The growing interconnection of physical and virtual worlds, and the development of increasingly

sophisticated intelligence techniques, has opened the door to the next generation of CPS, referred to as "smart cyber-physical systems" (sCPS).

A new family of risk factor arises, however, from the possible short-circuit between the cyber space (and its cyber-threats) and the controlled real world, cutting off altogether people's intervention.

Trust challenges for the success of digital projects

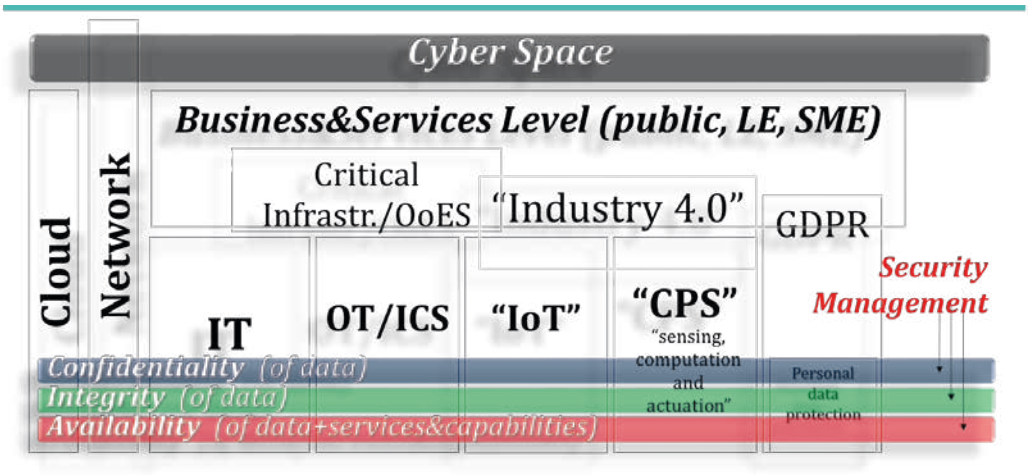
Establishing and maintaining a secure computing environment is obviously mandatory, but it's increasingly more difficult as networks become increasingly interconnected and data flows ever more freely.

In such scenario, one methodological approach calibrated and not generalist became unavoidable.

Security … Common issue!

Cybersecurity became an essential requirement when living in a digital world.

The number of data breaches and the level of cyber-attacks suffered by organizations around the world increases almost daily, making it imperative that every organization have an effective cybersecurity program in place.



The develop of one cyber&information security management strategy and the relative governance actions are now key topics for to ensure data protection, asset defence, system resilience and overall continuity and capabilities of business processes and services.

How to cope the digital risk in the digital era

As the global digital revolution takes hold and proliferates into our economies, societies and governments, the potential for information to be electronically tampered with and controlled is real.

Digital and technology risk is a term encompassing all digital enablements that improve risk effectiveness and efficiency—especially process automation, decision automation, and digitized monitoring and early warning.

In particular, small companies quickly moving to digitalization, often unwittingly open the door to attackers through a variety of unsecure practices. Small enterprise security policies that don't quell missteps such as employee downloads of unauthorized software, rogue Wi-Fi installations, and password sharing will actually promote such behaviors.

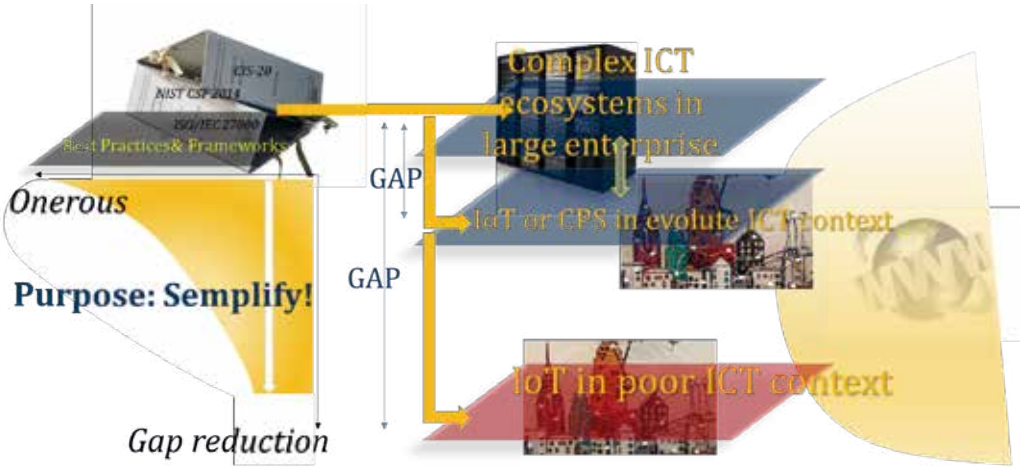
Therefore, already tested models of reference are necessary, but unfortunately these have very difficult management characteristics and heavy effort for the SME target.

To overcome the Adoption/Execution Gaps

The needs of protection for the large or small networks are essentially the same, but the framework for action must to be adjusted, to response to very different operational conditions.

For to determine the risk factors, the step is to perform a risk assessment on the organization's "cyber presence" in the ecosystem, by looking at information assets, interdependencies with other organizations, threats (including insider threats), vulnerabilities, cybersecurity controls, and security testing activities, including business continuity/disaster recovery and reconstruction capabilities.

This means examining those factors that affect the extent of the organization's control over its ecosystem and the means by which that control can be exercised.



- The solution of using more famous structured models requires an unsustainable effort for small but very digitized organizations (for example, robotised SME), creating a very big "gap" for a practical application.

- Moreover, some good practices that can give an added-value to new digital projects, require intervention by the market players who operate upstream of the deployment and are therefore not governable by the customer. Many of the vulnerabilities in IoT/CPS devices could be mitigated through recognized security best practices, but too many products today do not incorporate even basic security measures; other contributing factors include a lack of incentives for developers to adequately secure products, since they do not necessarily bear the costs of failing to do so, and uneven awareness of how to evaluate the security features of competing options.

Best practices too much «expensive»

The most famous best practices and the most common standards (including certifiable schemes) need staff and resources almost always absent in small organizations.

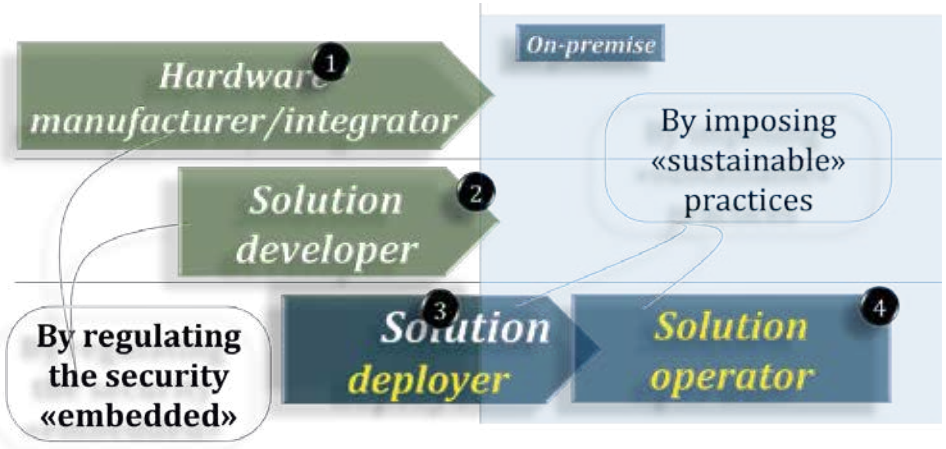
The perspectives ...

- **Quick-win and simple and low-cost practices and techniques**
- **Act on overall "life cycle" of the innovative technologies**

In the light of all this, it is unavoidable it and almost mandatory to direct efforts, at the same time, towards two areas of action:

i) By working on the frameworks, for to implement "sustainable" practices and simplify the controls for implementation to technologies, people and business processes (and/or obtain them, effective and cheap, like managed services from specialized third parties, where advantageous and practicable) in less staffed companies.

ii) By introducing a regulatory schema, imposing a minimum common framework for all market players, to incorporate the baseline security controls from the beginning of the life of technological components and devices (security is to be evaluated as an integral component of any network-connected device). An active role is here hoped and expected from the national Authorities, for to create a contribution with security certification, at least for to be considered trustworthy those standalone certified devices (before integration in a real computing environment).



NEW TRENDS OF 3D TECHNOLOGIES AND COPYRIGHT PROTECTION

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SUMMARY

In the last years, in the manufacturing sector, there has been an increasing diffusion of digital technologies, so that the term *Digital Manufacturing* emerged. These technologies have entailed an impact at the corporate level, through the necessary reengineering process, and socially, making the customer the protagonist in the production of their purchases and enhancing their creativity. This change occurred in response to the reduction of the life cycle of products and to the need to meet the requirements of its customers in the best way.

3D printing is an innovation which, together with digital technologies, has enabled the diffusion of digital manufacturing, facilitating the transition from the paradigm of *mass standardization* to that of *mass customization*. The expiration of some *patents* related to print has encouraged the diffusion of additive manufacturing; now it is increasingly used by consumers and enterprises. Since its birth, it has been applied for *prototyping*, while in recent years also for the production of products and spare parts. The sectors where it is most widespread are the rail and automative transportation, the aerospace, the medical and the artistic ones, with relevant feedback in the Cultural Heritage field.

3D printing is considered a *disruptive* innovation because, encouraging the sale of files instead of a sale of items, it can optimally solve economic and social problems that have been emerging in recent years. It is considered a technology with strong growth, but it may encounter obstacles in its expansion due to the problems concerning the *protection* of *intellectual property*: file sharing can encourage the spread of non checked 3D files and then it leads to the free *duplication* of digital objects and the consequent violation of *intellectual property*. A natural consequence may be the failure to control the authenticity of the files, and then the risk is reflected in the spread of *counterfeit* and uncontrolled goods. The lack of

specific legislation to protect file properties further aggravates the threat of the *illegal us*e of the same.#Currently the use of *3D watermarking* and e*ncryption* of data is an used solution to this problem, although an action at national and European level which protects the dissemination of unauthorized files is still desirable and new more *robust* and *safe protection tools* are required.

Let us consider in more details the 3D printing with protection of 3D data (3D Digital Models) activating them at local or remote sites.
Indeed when objects are copied without permission, there is a distinct possibility of *infringing* third party rights.
Unauthorised commercial production of products by 3D printing may constitute an act of *legality infringement* by the user of the printer.

Whilst it seems clear that the manufacture of a whole patented product, for instance by a plastic laboratory equipment, will constitute *patent infringement*, the position regarding the manufacture spare parts and their incorporation into patented products, regardless of whether they were produced by 3D printing or by traditional manufacturing methods, is not as clear-cut.

Copyright gives a bundle of rights to the *rights owner* (usually the *creator* or the *creator's employer*) to prevent other people from copying (*anti counterfeiting*), using or exploiting their works (works which involved *intellectual creation*).
In response to the growing emergence of 3D file sharing and the intellectual property risks therein, the research community are developing methods to *protect* digital data from being mistreated.
These include, for example, mechanisms such as *Technological Protection Measures* and *encryption software*. There are a range of access control technologies used by those (manufacturers, publishers, rights holders) who wish to protect an asset through limiting the use of the information or digital device. This protects rights holders from having their intellectual property or digital assets copied or converted without permission and is typically applied to music and films. These technologies have to be developed however in conjunction with all printer manufacturers under a mandate that ensures printers to have the *correct decryption protocols* and software to stream legitimate 3D files. It also allows for enforceable liability warranties to be created, giving consumers the confidence that content of high quality or providence can be 3D printed.

On this line applied research activities are developed by a new START-UP INN-3D, created in the framework of the large Firm SESA GROUP in Empoli (Florence), to define and implement new *Software Tools* enabling the Protection of 3D Products and in particular of 3D Digital Models. A *prototype* has been developed and tested, using digital marking and special security *tools* to ensure the *safe transfer* of the 3D Digital Model from the *Creator* (*Owner*) to the final *User* (at local and remote sites). A new *Patent* has been proposed.

These new developments of 3D Data Protection will have a big increase in the near future, in connection also with a reduction of prize of 3D printers (which is expected as a result of *patent expiries* and technological progress).

CULTURAL ACTIVITIES – REAL AND VIRTUAL GALLERIES AND RELATED INITIATIVES

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MUSEO NAZIONALE DEL BARGELLO

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The Museo Nazionale del Bargello is the first National Museum of Italy situated since 1865 in the Palazzo del Podestà, one of the oldest buildings in Florence, begun in the mid-thirteenth century to host the *Podestà* and the *Capitano del Popolo*. In 1574 the palace was transformed into a jail, becoming the gloomy fortress where the "Bargello", the "chief" of police imprisoned criminals and traitors. During 3 centuries the Palace was a prison, but in 1858 restorations begun, thanks to the discovery – on July 1840 - of the portrait of Dante Alighieri, the greatest italian poet, painted by Giotto in the *Podestà*'s chapel. He is depicted in profile wearing his typical hat and long red robe, in a crowd of spectators looking at "Paradise". In 1865 when the palace was ready to host the first Italian National Museum, with masterworks from the medicean collections, later increased with bequest of famous private collections by Louis Carrand, Costantino Ressman and Giulio Franchetti.

The Bargello is today one of the most important museum of sculpture and decorative arts in the world, with Renaissance masterpieces by Brunelleschi, Donatello, Verrocchio, Desiderio da Settignano, Michelangelo, Della Robbia, Cellini, Giambologna; it also hosts wonderful collections of weapons, ivories, textiles, medals, seals, majolica and paintings. Since many years the Bargello stages international exhibitions, often in cooperation with other European and American museums.

RESISTING A TOTAL LOSS OF DIGITAL HERITAGE WEB 2.0-ARCHIVING & BRIDGING THESAURUS FOR MEDIA ART HISTORIES

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Abstract - While Media Art has evolved into a critical field at the intersection of art, science and technology, a significant loss threatens this art form due to the rapid technological obsolescence and static documentation strategies. Addressing these challenges, the Interactive Archive and Meta-Thesaurus for Media Art Research is developed to advance the Archive of Digital Art. www.digitalartarchive.at Through an innovative strategy of 'collaborative archiving,' social Web 2.0, 3.0 features foster the engagement of the international Media Art community, and a 'bridging thesaurus' linking the extended documentation of the Archive with other databases of 'traditional' art history facilitates interdisciplinary and transhistorical comparative analyses.

As a valuable solution to challenges in the documentation, indexing and research of Media Art, the Interactive Archive and Meta-Thesaurus for Media Art Research (AT.MAR) has been developed as an innovative strategy for 'collaborative archiving' [1]. Supported by the Austrian Science Fund (FWF), and conducted at the Department of Image Science, AT.MAR is an advanced conception of the Archive of Digital Art (ADA) [2]. Formerly called the Database of Virtual Art, this pioneering archive for works at the intersection of art, science and technology celebrated its fifteenth anniversary in 2015 [3]. ADA was established as a collective project in cooperation with renowned international Media Artists, researchers and institutions for the integration of a sustainable exchange between artists, experts and users. Comprehensive and open access, ADA is a costfree database.

HARD HUMANITIES: MEDIA ART HISTORIES & IMAGE SCIENCE

Over the last five decades, Media Art has evolved into a significant contemporary field. It encompasses art forms produced, modified or transmitted by means of the very digital technologies that are fundamentally revolutionizing our world—as well as how we perceive and interact with images—through globalization, the Internet, social networks, Web 2.0 and 3.0, and on. Unlike with painting or sculpture, graphic printing or even photography, Media Artists make use of emerging technologies that originate from a scientific, military or industrial context not only as their media, or image carrier, but have this technology as their explicit image-subject as well [4]. Thus, Media Art can take highly disparate forms, and includes such genres as bio/genetic, database, digital animation, game, glitch, installations, nanotechnology, net art, telepresence, and virtual reality.

Image Science (Bildwissenshaft in the German tradition), and its sister discipline, Visual Studies, encourages a ‚reading' of artistic images that is interdisciplinary, as is essential with Media Art. This approach presupposes that scientific work with images must include their definition, archiving and a familiarity with a large quantity of images. Though there have been a number of historic forerunners to the image science method, most frequently cited as the discipline's ‚father' is Aby Warburg. Famously intending to develop art history into a "Laboratory of the cultural studies of image history" that would widen the field to „images

[...] in the broadest sense", by including many forms of images in his iconic Mnemosyne image atlas of 1929, Warburg redefined art history as medial bridge building [5] .Yet, definitions of the image such as those by Gottfried Böhm, James Elkins and W.J.T Mitchell [6] have become problematic in the context of the interactive, immersive, telematics and generative digital image. These challenges have fueled interidisplinary debate as to the status of the image with protagonists such as Andreas Broeckmann, Oliver Grau, Erkki Huhtamo, Martin Kemp and Barbara Stafford [7].

Through the study of MediaArtHistories in the discourses of Media Art the most immediate socio-cultural questions of our time are investigated: from body futures and media (r)evolution, to environmental interference, finance virtualization, and surveillance culture. While the critical lexicons of classical art history are relatively fixed, the classifying language of Media Art is defined with dynamic terminologies that are continually in flux, or so-called 'floating signifiers.' Thus, the forums and catalysts for Media Art rhetoracy take place in a vibrant knowledge ecosystem reported in: collaborative projects for database documentation supported by institutional and social agencies; international festivals with peer reviewed awards and globally publicized interviews; and new literatures published by leading scientific and university presses [8]. Yet, despite such worldwide recognition, programmes for documenting the 'art of our times' continue to be met with serious challenges within the memory institutions of our societies. As Media Artworks frequently have functionalities across variable media substrates, and these constituted by the latest technologies as well as characterised by a rapid obsolescence, the work of Media Artists complicate both object-oriented preservation methods as well as static indexing strategies. Consequently, artworks originating even just ten years ago can often no longer be exhibited. As debated since the 1990s, museums rarely include Media Art in their collections, and those that do struggle to sustain finance, expertise, and technology for the preservation of artworks through strategies such as migration, emulation, and reinterpretation [9]. Further, that Media Artists engage the most contemporary digital technologies leads to the production of artworks that are necessarily "processual," ephemeral, interactive, multimedia-based, and fundamentally context-dependent [10].

Since the turn of the Third Millennium, there has certainly been evident promotion of conferences, lexicons, and platforms in the endeavour to document Media Art. It is specifically the subject of the MediaArtHistories conference series, which with its premier in 2005 represented and addressed the many disciplines involved in the then emerging field [11]. A number of preservation projects have also been established. While many continue to exist online, each either lost key researchers, had funding expired, or was eventually terminated [12]. And as recently expressed in an international declaration [13], signed as of 2016 by more than 450 scholars and leading artists from 40 countries, there is an urgent need to create a stable international platform of interoperable archives. Yet, even with such progress in the study of Media Art, programmes for documenting this 'art of our times' continue to be met with serious challenges within the memory institutions of our societies. Indeed, it is no exaggeration to state that we continue to be threatened with a significant loss of this critical art form, both in the archives of art history and for future scholarship.

MEDIA ART (R)EVOLUTION AND THE ARCHIVE OF DIGITAL ART

Since the year 2000, ADA is one of the most complex research-oriented resources available online as a platform for both scientific information and social communication. Hundreds of leading Media Artists are represented by several thousand documents, with more than 3,500 articles and a survey of 750 institutions of media art also listed. Besides the artists, there are also more than 250 theorists and media art historians involved in making ADA a collective archiving project (Fig. 1).

Fig. 1. Archive of Digital Art, screenshot (detail, Community Light-Box) <https://www.digitalartarchive.at/nc/home.html>, accessed 4 March 2018.

Because of the singular structure of the art form, a defining strategy for the Archive of Digital Art is that of an "expanded concept of documentation" [14]. The documents on ADA that represent the artists there archived include: biographical and bibliographic information about the artist, their inventions, awards, and statements; exhibitions, and publications; graphic images of the installation of the artwork; digital images of individual artworks (exhibited, in process, and in all its varying iterations); information on the software and hardware configuration; technical instructions; type of interface and display; video documents (interviews, presentations, symposia); references and literature about the artists; information about the technical staff; institutions; and copyright.

A system of online community membership for ADA allows artists and scholars to upload their own information, with a gate-keeping policy that the ADA advisory board reviews applicant qualifications and makes member selections. The system offers a tool for artists and specialists to individually upload information about works, people, literature, exhibits, technologies, and inventions [15]. Over the last fifteen years some 5,000 artists were evaluated, of which 500 fulfilled the criteria to become a member of the ADA. From the beginning, the long-term goal of the project was not simply the documentation of festivals, awards or similar events, but a scientific overview with the respective standards of quality. Members have to qualify with at least five exhibitions or articles about their work, or, alternatively, can be suggested by the board.

DOCUMENTING MEDIA ART: IMPLEMENTING 2.0, 3.0 FEATURES

For the Archive of Digital Art (ADA), the first online collective archive that is both scholarly and social in either art history or media studies, documentation and access are not understood as static concepts, but as a process that integrates a continuous exchange between users, scholars and artists. With an open access policy that provides users with an active role and that supports accessibility, ADA is more likely continue to be an up-to-date as well as a lasting resource. An essential aspect of its Interactive Archive and Meta-Thesaurus for Media Art Research (AT.MAR) was thus to transfer ADA into a Web 2.0 environment and open it up on the 'retrieval-side' by making the data available and easier to share for users, and on the 'archivist-side' by allowing contributions of diverse individuals in order to facilitate a collaborative and more balanced preservation practice. Newly innovated ADA features support the group engagement and foster motivation. A messaging system and "News" section allow archive community members to interact with peers and announce upcoming events. Contribution monitoring and a function for colleague 'following' provide updates on the research and activities of other Archive members. And collaborative processes of peer-reviewing and content curation, integrate the member community's decision-making and agenda setting into ADA itself. Contributions can be seen in the "Works" section of every scholar and artist on ADA, where the Archive features enable members to collect "Descriptions and Essays" about their artworks, as well as information on "Technology," "Literature," and "Exhibition and Events." A process of peer-review performed by the ADA member community guarantees the quality of these contributions, with all the "Latest ADA Updates" visible to members on the homepage after login. Individual contributions, once peer-reviewed, are automatically referenced and made accessible to all users, whether ADA community member or online visitor to the Archive. Contribution visibility is measured not only in web links, page hits, and citation statistics, but also exemplified by the above described peer assessments internal to the ADA, in a disciplinary as well as interdisciplinary networking that builds the standing of Archive members within their international professional community.

Members also engage in selecting a monthly-featured artist or scholar, a profile about who is published on the ADA homepage, social media, and through web newsletters. This "Featured Artist/Scholar" introduces ADA visitors to artists and scholars distinguished by their peers; allows Archive members to commemorate achievement within the discipline or recognition within the community; and supports active participation in content direction. Additionally, ADA's "Light Box" (Fig. 1) feature is both scholarly and social. Promoting the comparative analysis of Media Artworks on the Archive, this tool permits community members to assemble individual arrangements from the extended documentation of images, texts, and videos on ADA. These "Selected Items" can then 'enlarge' and 'overlap' so that relevant image details can be compared and analyzed. Textual notes can be added and "Exhibitions" saved on a visual pin board of "My Screens" for further research. These "Light Box"-based exhibitions of ADA content by community members are then publishable as an "Online Exhibition," visible to all users, and accessible for a wide variety of applications from scientific or art-based research, to science, education and public outreach. ADA promises many potential affordances as an online collaborative archive, including expanding data beyond that which any single institution or even cross-institutional research team could

compile; increasing the high quality of data that originates directly with artists and scholars in the field of media art; cultivating the various viewpoints of the global community that contributes to the archive; and developing this scholarship through a system of checks and balances by Archive community members. Features such as "Works" contribution and peer review, "Featured Artist/Scholar of the month, and "Light Box" peer review all enhance the interpersonal relationships of ADA community members and foster exchange.

INDEXING MEDIA ART: THE BRIDGING THESAURUS

Keywording is bridge building! And for the 'bridging thesaurus' of the AT.MAR project, the intent to establish a linguistic framework that allows for the classification of the aesthetics, subjects and technologies of artworks, directs the process of individual concept and term selection. To achieve a comprehensive overview of the knowledge domain of Media Art, but also a manageable one, this vocabulary is kept limited to around 400 terms. This constraint increases the usability of vocabulary terms and insures an accuracy for indexing practice, which is particularly crucial with ADA as it the community members themselves who carry out a significant part of the indexing. Central to the construction of the ADA controlled vocabulary is the logical concept of terminology structure based on a classification strategy that will allow users to index various levels of meaning relevant to the Media Art knowledge domain. In relation to other vocabularies, ADA "Keywords" have a unique hierarchical schema based on a categorical triad of 'aesthetics', 'subject', and 'technology'. This top-down distinction of categories allows for the contextual specification of vocabulary as well as for the conceptual analysis of these levels by users: ***Aesthetics*:** In accordance with the dominant understanding of Media Art in the scholarly literature, and 'relatives' of this field such as digital or electronic art, the 'aesthetics' category encompasses a broad scope of terms ranging from phenomenological observations such as 'immaterial' to ontological qualities such as 'site-specific' and 'object-oriented'. ***Subject*:** The 'subject' category encompasses iconographic terms established in art history and Media Art Histories, as well as concepts that enable both descriptive and interpretative approaches to the subject of works. In regards to term quantity, this category is the most comprehensive [16]. The 'subject' category includes 13 subcategories like: 'Body and Human', 'Entertainment and Popular Culture', 'Magic and Phantastic', 'Media and Communication', 'Nature and Environment', 'Technology and Innovation', 'Power and Politics', 'Psychology and Emotion', 'Religion and Mythology', 'Science and Knowledge'. ***Technology*:** The 'Technology' category was adopted from that originally developed for the Database of Virtual Art (DVA), which later became the Archive of Digital Art, and enhanced by subcategorization 'interface' and 'display,' as well as terms encompassing 'traditional' image-carriers such as 'painting', 'print' or 'book'. The Resources of terms and concepts used in the development of AT.MAR and which define the very foundation of this controlled vocabulary, include (1) 'traditional' art history vocabularies as well as (2) Media Art databases, (3) festivals, and (4) literatures:

(1) The 'traditional' art historical vocabularies cited were those most widely accepted scientific tools used for the description, linkage, and retrieval of images in art history. These included Iconclass, an alphanumeric classification scheme designed for the iconography of art; the Art and Architecture Thesaurus (AAT) and the Warburg-Index, an index of iconographical terms.

(2) Databases were selected for AT.MAR, includine The Dictionnaire des Arts Médiatiques, GAMA keywords, the vocabulary of the Daniel Langlois Foundation, and Netzspannung. Each of these vocabularies reflects the explicit practical affordances and implicit ideological assumptions of the institution that advanced it.
(3) Further, as festivals are central to the media art scene as forums and catalysts for the contemporary discourses and innovative technologies of media art, the project team took account of an international range of festival materials such as official publications and professional interviews. Festivals reviewed included, among others, Ars Electronica; Dutch Electronic Art Festival; European Media Art Festival; Festival Internacional de Linguagem Electrônica; Inter-Society for the Electronic Arts; Microwave Festival, Transmediale..
(4) Research literature was evaluated on the basis of its indexes, that 'map' the most valuated topics in the field. Important innovations such as, 'interface' or, 'genetic art' were considered along with keywords that play a role in traditional arts— such as 'body' or 'landscape'— with a bridge-building function.

FUTURE MEDIA ART RESEARCH: THE GÖTTWEIG COLLECTION

To support the cross-cultural, inter-disciplinary, and trans-historical comparative analyses of the Media Artworks on ADA, the keywords of its 'bridging thesaurus' are further applied to artworks from other social contexts and historical periods. Through AT.MAR, ADA is now linked with the Göttweig Abbey Graphic Collection (Fig. 2). Göttweig Abbey, founded in 1083, holds 30,000 prints as well as a library of 150,000 volumes in one of the most comprehensive private collections of mostly Renaissance and Baroque engravings. With acquisitions first recorded in 1621, the collection was systematically expanded during the Abbotship (1714–1719) of Gottfried Bessel. In cooperation with Göttweig, the Department of Image Science conducted the digitization of the collection [17].

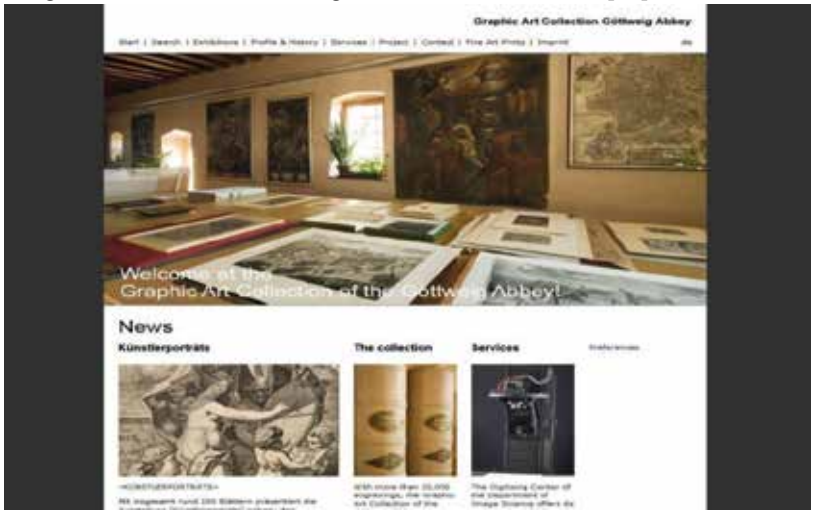

Fig. 2. Göttweig Monastery Graphic Art Collection Online, screenshot, <http://www.gssg.at/>, accessed 4 March 2018, © Department for Image Science.

The graphic and textual works of the online Göttweig collection, document subjects from the 'representation of knowledge' and 'history of science,' to 'architecture' and 'fashion,' 'optics'

and ‘panorama.’ Thesaurus keywords navigable as “Hierarchical,” “Alphabetical,” and “As Cloud” , support and stimulate users to bridge the ‘traditional’ artworks and the Media Art of ADA, providing complex image resources for a richer analysis of Media Art (Fig. 3).

Fig. 3. Media Art Research Thesaurus, screenshot
(detail, comparative analysis), accessed 4 March 2018.

CONCLUSION

The innovative methodology developed through the AT.MAR project will foster the documentation, indexing and research of Media Art on the Archive of Digital Art in a context of multiple histories of art, science and technology. Thesaurus categories in aesthetics, subject and technology bridging ‘traditional’ art forms with Media Art support the tracing of hybrid qualities in these artworks, as well as historical correspondences and conflictions. Through collaborative visual tools that include a Light Box and semantic links, a global community of artists and scholars may conduct research and perform clustering analysis or comparative study. That the thesaurus connects Media Art with art history, and neither isolates these fields from one another nor includes only contemporary terminology, increases the usability of the Thesaurus for the humanities. For the future of ADA, further goals are to document works within a context of complex information and, at the same time, allow users to find specific information readily. Beyond using analysis using the Briding Thesaurus, which shows, for example, virtual and immersive art’s reminiscences to its predecessors in the panorama and laterna magica, Media Art documentation should also include questions of gender, track the movement of technical staff from lab to lab, technical inventions pertaining to art, as well as public and private funds allocated to research. By advancing from a one-way deposit of key data to a proactive process of knowledge transfer, the archiving of Media Art becomes a resource that facilitates research on Media Art for academics, experts, and students.

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[17] See <www.gssg.at>.

THE EXTRAORDINARY ROLE OF THE IMAGING TECHNIQUES IN THE CONSERVATION AND VALORIZATION OF CULTURAL HERITAGE

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Introduction

In recent decades, modern technologies have pervaded every activity of Cultural Heritage with an incredibly growing pace. All the areas have benefited from that, starting with **knowledge** (with the availability of increasingly sophisticated archaeometric analyses), **conservation** (within the activities of diagnostics, restoration, preventive conservation, monitoring), f**ruition** and **valorization** (through the multimedia-ICT and the lighting techniques), **security** and s**afeguard** (thanks to a variety of electronic sensors implemented against theft, vandalism, environmental degradation, catastrophic events, transport damage), to d**ocumentation** (with the precious digital imaging systems) and **archiving** (with the databases and the software to access the archives of documents and images).

A new generation of specialists have emerged that have adapted their specific skills to the needs of CH, professional figures who find employment in museums, in art and restoration exhibitions, in public and private scientific laboratories, in the archives of CH. The Cultural Heritage, traditionally considered a land of humanistic knowledge and competence, has become a context of interaction, integration, meetings, comparisons between art historians, architects, archaeologists, restorers, together with chemists, physicists, biologists, geologists, engineers, technologists, to the full advantage, in the broadest sense, of the CH.

The Imaging techniques

Among a so wide variety of new technologies involved in this new mega-system, here we want to focus to the *imaging* techniques.

The introduction of *Film Photography*, in the early decades of the 19th century, although initially only in black and white, introduced a real revolution. Now works of art could be not only observed, drawn, painted, but recorded in an objective document, stable, ready to be easily examined by several specialists, in the same time as well as in a successive moment.

Documentation, diffusion of images, possibilities of comparison have expanded as never before. With the development of *Color Photography*, towards the end of the same century, the photographic document has grown furthermore in accuracy of reproduction: color is a fundamental parameter for works of art and paintings in particular, although treatises of art history have continued for decades to illustrate figures in black and white, probably for cost reasons.

In the final part of this paper, we will come back to photography with the topic of the *digital images*, to explore the enormous potentiality of this photographic technique developed in later times.

Among the variants of photography, the *Raking Light Technique* is worth of a special attention. Micro and macro deformations of the surface, induced by degradation processes active along centuries, resulting in swelling, flecking, loss of material, formation of lacunas, efflorescence and other similar alterations, inevitably have affected any ancient artifact. With a photograph taken in raking light, any alteration of the object surface is amplified; its location and the extent of the phenomenon are highlighted.

Raking Light Photography is equally useful for studying the techniques of execution, in a painting, for instance, thickness and orientation of the brushstrokes; in a fresco, the so called *'day's works'*.

Under the Optical Microscope, thanks to magnification, imaging offers the expert an extremely powerful tool to enter within the constitutive material of an artifact, revealing a quantity of information on morphology, colors, sequence of layers in the *Cross section* of a sample. Finally, with the advent of the

Scanning Electron Microscopy, *SEM*, (3rd decade of the 20th century), the study of the surface morphology sample has reached the highest levels.

At the end of the 19th century a new extraordinary *imaging* technique is invented: *Radiography*. Not only the external appearance of an object can be documented, as it had always been, but its interior too, revealing material structures inaccessible to the eye. X-rays, a radiation with infinitesimal wavelengths ($\lambda \approx 10 - 10^{-3}$nm), much shorter than the visible light ($\lambda \approx$ 700 nm/red - 400 nm/ violet), competitive with the atoms size (about 0,1nm), allow to cross solid bodies, depending on their thickness and composition.

In the second decade of the 19th century (1916-18) some more advanced museums begin to radiograph art-objects in a systematic way. Discoveries follow each other in an enthusiastic way: unthinkable artist's *pentimenti* are brought to light, multiple paintings overlapped on the same panel or canvas are revealed, internal pivots are identified inside wooden statues.

Radiography is the first major ascending step in the world of *diagnostic imaging*. Once undertaken, this new road will be expanded with the use of even more penetrating radiations, *gamma rays* with wavelengths in the range $<10^{-3}$nm, but above all with greater energy.

They are capable of crossing much larger thicknesses than those of panel paintings, and materials much more compact than wood: i.e. metals, stones. This opens the way to identify and locate elements inside bronze, marble, stone sculptures, to measure thicknesses, identify joints, welds, diagnose the presence of internal cracks and other discontinuities; practically, the possibility of acquiring a wide range of information both on the structure of artefacts and their state of conservation.

Going even further in the ability to penetrate very thick structures, in very recent years a decidedly futuristic application has appeared: the use of ultra-high energy radiation, made of *Muons*, subatomic particles with a charge similar to that of electron and mass about 200 times higher. Muons are highly unstable particles with a very short life time, that, however, can reach the earth's surface coming from the atmosphere boundaries, originated from cosmic rays. Recently they have been successfully employed looking for new internal chambers in the Pyramid of Cheops. They are going to be applied to the Dome of the Florence Cathedral in search of possible internal metal chains.

Going back to more accessible technologies, other radiations close to the visible range, overlook the art world: the *Ultraviolet* ($\lambda \approx$ 400nm - up to the XR), in use since the 2nd decade of the 20th century, and the *Infrared* ($\lambda \approx 0.7\mu$m - 0.4mm), from the 3rd decade of the same century.

Also these radiations are recorded on photographic film. They subdivide in a number of specific techniques according to the *taking* conditions (source of the radiation, filters to select the source, types of film to record the images, etc.).

The *Ultraviolet* is distinguished in *Reflected UV* and *UV Fluorescence*. A reflected UV image is directly recorded on the film while in the second case the fluorescent visible image excited by UV is recorded. *Reflected IR* is quite similar to *Reflected UV*: the reflected IR image is recorded on a special film. Initially, various types of black and white films were used, the only available at the beginning of these experiences. For decades the availability of only black and white films has been a limiting factor that penalized the above techniques, especially *UV Fluorescence* which manifests as a color image. As soon as *Color Photography* became available it was possible to record in their fullness the specific fluorescence-colors depending on the nature and the age of the materials of the object.

Later on (over the 70s of the 20*th* century) *false colors infrared films* were introduced, capable of mutating an Infrared-Red-Green image (Blue is excluded by a filter) in a 'false' Red-Green-Blue image. Thus, a new technique was born, the *Infrared False Colours*.

The use of these 4 techniques is based on the specific way UV and IR radiation interact with the constituent materials of the objects, which is different from that of light. By comparing the UV or IR images with those obtained with common light, very important information, although not foreseeable a priori, can be

acquired on the nature of materials and figures not visible or not differentiable by eye.
But there is a further possibility. Depending on wavelength, the infrared radiation can penetrate more or less into matter. This makes it possible to differentiate in a painting, also materials (or figures) located below the paint layer, such as preparatory drawings, *pentimenti*, etc..
Starting from the '80s, with the development of opto-electronic technologies, photographic films were replaced by cameras, powerful instruments, able to go beyond the visible, in the infrared region. In this range some of the surface paint layers become more transparent. This is how *Infrared Reflectography* was born, initially realized with cameras and later, with more sophisticated Laser-Scanners in the Visible-Infrared region. *IR Reflectography* and *IR-VIS Laser Scanners* are today the techniques of excellence to explore the hidden layers of a painting, especially the preparatory drawings, with striking results that have unveiled the evolution of an artist in his creative activity.
With the VIS/IR Laser Scanner it was possible to reproduce the *IR-False Color-Photography* with a precision that amazes. But today, IR-False-Color can also be realized with some *special digital photo-cameras*. In an analogue way also a *Digital False-color-Ultraviolet* technique has been implemented.
We started this extraordinary path of technological innovations applied to Cultural Heritage with *Film Photography*. This technique, this period, are now almost extinct. Digital Photography has penetrated in any context. Phones, tablets, digital cameras of recent generation are available to all, at affordable prices. Taking digital photographs is nowadays a diffuse practice. The advantages are too many and too suggestive. You can take photos at will, evaluate, discard the badly-done, save the good, perfect your takes with software that allows you any processing, finally archive on digital supports without space problem; if you want, you can print your photos with excellent colour renditions.
To complete this overview we want now to come back to the normal digital photografy but that at an excellence level, the so called High Definition Digital Photography (HDDPh), which can only be realized with professional equipment by specialized operators. The role of this special digital Photography has been remarkable, not only for storing the reproductions of the art-objects in Museums archives (which other document, if not a HDDPh, could be more accurate and reliable?) but also as a powerful tool for studying artworks at disposition of art-historians, archaeologists, architects. Sitting comfortably in their office, they can examine their images on a monitor, enlarge them at will, highlight any figurative or material detail undetectable by other means: in practice, a boundless possibility of study.
In the field of conservation, not to mention the ease of documenting a restoration in progress in all of its steps, or monitoring the evolution of the state of an artefact post restoration, we want to focus here on a powerful application, rich in promising developments: the *Virtual Digital Restoration*. I am well aware, from personal experience as well, how this approach is still considered with prudence by experts (art-historians, etc.). The hesitation, which I consider unfounded, comes from idea that it could become competitive with the 'real' restoration. On the contrary, let's think about the advantages that this availability could offer a public or private restoration organism. For instance, once the canonical operations (cleaning, consolidation, filling) were finished, it would be possible to simulate in advance a series of possible solutions for the final step of restoration, the so-called aesthetic restitution, without intervening on the object with choices that, in retrospect, might be not the most appropriate. This not only valid in the restoration area but for example for deciding the way to expose an artwork in a Museum, or for setting an exhibition, and so on. A variegate opportunity, about which it is convenient that the stakeholders reflect seriously, to evaluate, without prejudices, the undoubted advantages.
To illustrate adequately each of the numerous *imaging technologies for C.H.* developed in the last few decades, a treatise would be needed. With the present contribution we tried to give, at least, an overview about the crucial role they are playing today in favour of conservation, knowledge and valorization of Cultural Heritage

Technology and theatrical tradition in art exhibitions: "Earlier Mona Lisa" in Shanghai

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ABSTRACT
Light is the connection between objects and human being and it assures visual perception. Changing light the colours and the feeling of painting change.
The new lighting source (Led) offers many advantages and also a wide variety of different lighting spectrum not expected in the past years.
But, very import to know the "language" of visual art.
Wrong light can damage the quality and the aspects of the artwork.
A Important recent research (2015) by National Research Council inside the laboratory of Opificio delle Pietre Dure in Florence have investigate the changing of perception with the different light [1]

"Sant'Agostino nello studio"
Sandro Botticelli

This painting ware lighted with different type of led source: Ra 84 3000 K and 4000 K, Ra 98 3000 K and 4000 K, Ra 92 3500 K and 4200 K.
For the test 25 people are invited : experts in art and other professional skills.

The preference were for the lighting sources with Ra 84 and not Ra 98 as expected.
In the Ra 84 the presence of red is more inside the spectrum and the incarnate and other details were more impressive.
What is the Ra? [2]
The colour rendering index (CRI) defines the ability of a light source to identify colours, and is measured on a scale of 1 - 100.
On this scale a rendering of 1 is monochromatic light, and a rendering of 100 is natural sunlight, so you can think of the scale as a measure of the quality of light produced by the source.
For example, have you ever stood under an old street light at night and wondered why the colour of a car or your wheelie bin doesn't seem the same as it does during the day? Although the lamp used in the street light gives off a lot of light, the CRI is very low so the appearance of any colour is transformed.
What does it mean?
Lighting is not an exact science.
It is not enough to study the correct quantity of light, its Ra, and its qualities.
There is a deeper relationship in the act of vision and its reaction to a work.
Importance of the visual experience.
Each work has its own specific character.
The luminous reading of a painting should have the ability to recreate the original atmosphere, the luminous climate present at the creation of the work.
Importance to analyse the psychophysics of vision.
Obviously there are different schools of thought but also related to different types of works of art.
The light in the museum is like the light for the stage: it creates a experience.
For example the lighting designer Scott Rosenfeld [3] in the «Colour Field Gallery» of the Smithsonian American Art Museum in Washington: «Our objective when lighting our modern galleries, especially the one dedicated to Colour Field painting, is to help artworks appear as a natural extension of the white wall. The lighting should subtly ‚pop' works off the wall without making them look ‚spot lit'. If the relationship between the wall and the work is perfect, it will appear almost to float on the wall.»
The paintings of the Renaissance are differents, tells stories, every painting is full of symbolic references, in many painters light reveals the truths and transports the spectator into his world.
Interesting exhibition have analysed these relationships : "In luce, storia arte e simbolismo dell'illuminazione " [4] was set up by the conservator of the Ethnographic Museum, Tiziana Ribezzi, with the collaboration of Lucia Stefanelli from the State Archive of Udine and Lucio Fabi (2015)
The Earlier Mona Lisa exhibition [5] in Shanghai hit me a few years ago (2015) in this logic of research and attention to lighting.
The whole exhibition is focused on the scientific and historical path of the discovery of the painting, a long visual and interactive journey.
In the last room, we enter, in a dark room containing the painting.

The exhibition is transformed: from a scientific event to a theatrical event.
The visitor is suddenly transported into a theatrical experience.
The painting slowly comes alive, slowly unveiling (about 2 minutes) all the elements of the artistic composition.
The EMT European Museum Technology with the Senior Engineer Dieter Colman have designed a complex lighting system with:
24 LED's, dimmer controlled by DMX (the dmx 512 is a light control protocol)

and dozens of Precision beam (microspot) from 5 – 60 degrees with the possibility of adjusts pan, tilt, spot and flood (CRI 97 3000K)

All products are LUXMAN.

With a Netswitch device the lighting and the animation starts automatically in the morning and stops automatically at night. This also allows local people to use a phone or tablet or laptop to turn on the lighting (with the animation) for a private showing outside exhibition opening times.

The images show the lighting sequence.

I would like to conclude with a quote from Marcel Duchamp: "It is the spectators who make the painting"….An interesting reflection.

Fig.1

Fig.2

Fig.3

Fig.4

References:

[1]"How the Visual perception of artworks changes with lights " Elisabetta Baldanzi e Alessandro Farini September 2015
[2] What is the colour rendering index? from General Lamps Buckinghamshire United Kingdom
[3]Scott Rosenfeld Smithsonian American Art Museum in Washington
[4]"In Luce, arte e simbolismo dell'illuminazione"mostra of the Ethnographic Museum of Udine curator Tiziana Ribezzi
[5]Mona Lisa exhibition Shanghai 2015

REINASSANCE EXPERIENCE: FLORENCE AND UFFIZI

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ABSTRACT

This paper presents "Renaissance Experience: Florence and Uffizi", the evolution of "Uffizi Virtual Experience - da Giotto a Caravaggio", the immersive and interactive digital exhibition created in Italy, which has brought to Milan the masterpieces of the Florence Uffizi Gallery with high-resolution digitized images during 2016.

"Renaissance Experience: Florence and Uffizi" has been produced by VirtuItaly, a Centrica innovative startup spin off company, which conveys a new approach to edutainment, where cultural recreation is achieved through an immersive educational and entertaining experience.

"Renaissance Experience: Florence and Uffizi" has been opened January 20th 2018 in Leipzig, at Kunstkraftwerk, a post industrial location that since 2016 is devoted to immersive art. It will be possible to experience this exhibition in Leipzig till August 2018.

The paper describes this new digital exhibition, technologies involved and dwells upon the technological, sociological and cultural aspects of this new way of presenting and promoting cultural heritage in our society.

SMARTICON: A DIGITAL ECO-SYSTEM FOR CULTURAL HERITAGE. ICONOGRAPHIC CONVERGENCES IN ART AND IN WORLD RELIGIONS

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Abstract

The recovery of the history of humanity goes through the comprehension of ancient testimonies handed down to us in artistic representations.

The innovative tool par excellence is the technologies.

Smarticon is an Italian patent for method in charge of studying historical analysis (originated from the morphology of the concept), of examining the phenomenology analysis (which results in the typology and exceeds it) and to the comparative research (which allows to arrive at the hermeneutics).

The comprehension of the transitory meaning of each event is entrusted to the historian who, by recomposing the phenomena, is also able to codify the ***comparative*** meanings.

INTRODUCTION

Globalization in the world of art: needs and solutions

With the rooting of a mentality increasingly oriented towards globalization, the need to adapt to modern times also consolidates in the world of culture.

The communication "towards an integrated approach to Cultural Heritage for Europe" (European Commission Brussels, 22.7.2014 COM (2014) 477 final: ec.europa.eu/culture/policy/culture-policies/cultural-heritage_en.htm), has underlined how the Cultural Heritage sector assumes strategic relevance also from an intersectoral point of view and how such peculiarity is able to nourish new areas and *business* models that harbinger employment and professional growth.

These new models also represent the instrument of excellence to promote sustainable development, the strengthening of scientific and technological bases and social cohesion.

To achieve the aims, the fundamental need is to create an ***eco-system*** that is able to create a pole of convergence between synergies of different nature, which also *interact* with those belonging to different cultures.

In fact, innovation and development are stimulated by *comparison, sharing, integration, implementation and modulation between* different *competences and systems*.

The *eco-system* represents the essential prerequisite in order to create the conditions for the competitiveness of the Cultural Heritage industry and for the pursuit of strategic objectives.

Smarticon: method for the enhancement of Cultural Heritage both from a historical and economic point of view.

To create an *eco-system* dedicated to the Cultural Heritage sector means to enable a platform for the organization and fruition of the ***assets*** and ***resources*** from which *knowledge and enhancement* arise.

It is a fundamental condition that the conservation of Cultural Heritage derives both from the point of view of *preservation of the material* that constitutes the good, and from the point of view of the recovery of information that derive from the *cognitive heritage* recovered by experts and attributable to the artifact in question.

Through the harmonization of the cognitive heritage it will be possible to access to the comprehension of the complex scenario from which the good originates and aspire to its *codification and enhancement* under the ***historical, iconic and economic aspect***.

The Cultural Heritage projected towards a planetary humanism

"*Apparently, the criticism* (intended as interpretation and evaluation, the round is an explanatory insert of the writer) *opposes to the comment* (intended as exegesis, erudition: a set of principles and criteria aiming to the coding of the original), *as the analysis of a visible form to discover a hidden content. But being such a form the one of a representation, the critics can not analyze the language if not in terms of truth, exactness, property or expressive content".* (M. Foucault, Le mots et les choses, Paris 1966; it: *Le parole e le cose*, Milan 1967, p.95).

The coding of the message expressed in the art object will allow us to examine the multiplicity of "*languages*" that determine its individual forms of expression.

Apparently without reciprocal connections, they will reveal the rhetoric of a plurality of interconnections that testify how man's nature places the human being at the centre of a planetary humanism, where the space between the ethnic and social differences assumes an almost trifling value.

The non-obvious relationships will be revealed through the analysis of the *tropes*, that is, of the different relationships that the "words" of a "discourse" may assume within the same representative content.

The eco-system thus conceived will re-evoke the truth and the balance of things, until it re-establishes the *virtues of the discourse* and highlights the *concomitances* between apparently different cultures.

Religions in the world

The great historian Arnold Toynbee highlights that there is no culture or civilization that has abstained from any form of religious belief.

Therefore the nature of the human being is that of the *homo religiosus* which resulted in traditions that have demonstrated not only the need for "*truth"*, but also the ambition to pursue that "*germ of eternity"* that dwells in each of us.

Victor Hugo wrote: "*We must say it and say it again, it is not a need for novelty that torments the spirits, it is a need for truth; and it is immense"*.

In fact, the numerous forms of religious expression testify the common prospect of generating hope in man and of projecting his soul towards the research of absolute Truth, the harbinger of eternal salvation.

The religions of the world, therefore, can be compared to the trunk of a millennial tree from which many ramifications and new sprouts arise, which however are nourished by the same *lifeblood*.

Nathan Söderblom (1866-1931) Lutheran archbishop, theologian and historian of religions, focused on the experience of Man who interprets the divine through the multiplicity of religious experiences that, on the basis of our concept of *"religious globalization",* can be interpreted like the ramifications of our tree.

The comprehension of this complex scenario therefore lies in the definition, interpretation and related application which derives from the analysis of the *tropes*.

One of the aspects that makes essential the need to valorise Cultural Heritage consists in the *comprehension* and, therefore, the codification of how the *homo religiosus* has interpreted, for example, mana, that spiritual power, that "... vital force intrinsic in things for which they flourish, grow and bear good fruits. "(V. Grottanelli, *Ethonologica, L'uomo e la civiltà*, III, Milan 1965, p.404). This force represents the perception of a reality that goes beyond the one of this world, from which the divine sentiment originates. It is worth remembering, then, with Mircea Eliade, one of the greatest historians of the religions of all time, that "through the experience of the sacred, the human spirit has grasped the difference bet-

ween what is revealed to be real, powerful, rich and meaningful, and what is devoid of these qualities: the chaotic and dangerous flow of things, their apparitions and their fortuitous disappearances empty of meaning ... In short, the 'sacred' is an element in the structure of consciousness, and not a stage in the history of consciousness itself. At the most archaic levels of culture, *living as a human* being is in itself a *religious act*, because feeding, sexual life and work have sacred value". (*Histoire des croyances et des idees religieuses*, Paris 1976; tr.it. *Storia delle credenze religiose*, Florence 1979, page 7).

In the context, the artistic expression plays a fundamental role, since it represents the "*language*" through which these ideals were expressed and thanks to which today we get reminiscence.

Nevertheless it is reasonable to affirm that iconography in artistic representations interprets the critical aspect of the concept to which it refers; but also the *comment related to the encoding of the content* hidden in the artifact, to which is entrusted the task of passing on (through the *representation*), t*he language of truth, of accuracy and the expressive content* of a past era.

In this complex scenario Smarticon arises as a *scientific method* in charge of the "*hierarchical*" ordering of the information and its relative coding.

It is from this synergy that the *ecosystem of cultural heritage* comes to life and nourishes itself, projecting itself towards a planetary humanism, aspiring to that innovative reorganization of knowledge which represents the fundamental passage to trace the *iconographic parallelisms* and socio-cultural meeting points between different civilizations: the comprehension of the transitory propaedeutic meaning to the encoding of ***comparative*** meanings.

Paradoxically, it is almost "accessory" how a god is idealized; because the essential point of the question of the religions in the world is how mediation leads to eternal salvation and how to convince oneself that this condition corresponds to the truth of things. From this point the search for evidence that may lead to testify, in tangible form, the belief in a religious phenomenon, arises.

The religious message in art: parallelisms and iconographic convergences between the sacred and the profane

A considerable quantity and variety of Cultural Heritage, through the symbolism intrinsic in the artefacts of art, interprets the *religious phenomena* of every age.

The research for the divine is the foundation that joins man in the religious experience, which transcends the earthly life and which nourishes the spirit through the hope of eternal salvation.

Therefore, in the modalities of interpretation of the *religious phenomenon*, the *patrimony of humanity* is materialized, which it expresses itself and is handed down through the communication tool par excellence: *the iconographic symbolism in the artefacts of art*.

This awareness imposes a great challenge: to be able to face the need to perceive by intuition and grasp the "*truth*"; as the codifing of "*languages*" implies the comprehension of the modalities through which *homo religiosus* of every age deals with, interprets and solves the enigmas of life and the disappointments of the human soul.

However, the theoretical concepts get exponentially complicated in the moment in which arises the need to translate the theoretical passage into the concreteness of the image; since iconography is not always explicit and, very often, the allegorical meanings are hidden behind ancient customs that are forgotten today.

Smarticon allows to arrive to the comment intended as an analysis of the visible form, aimed at *discovering the content* hidden in the artefact through the discovery of connections recovered with the *analysis of the tropes*.

Renaissance art, for example, testifies how *homo religiosus* has been able to translate into exquisitely profane background themes, profound Christian concepts: because it is through the beauty and harmony of forms that one reaches the supreme "reasoning" which is proper to the idea of divine perfection.

The Christian message contained in them can be codified through the comparison of *symbolic correspondences.*

The hermeneutics of language in art with a profane background can also be interpreted through the comparison of the ***hierophany*** (presence and revelation of a sacred or divine element) which expresses, through the artistic representation, *the power of the good that overtakes the forces natural*.

For this reason, the hierophany intrinsic in the representation of an object of art becomes a pretext to express the ***supreme theophany***, as a sensitive manifestation of divinity.

Hermeneutics has the task of unveiling the comprehension of the "latent" message, conceiled beyond the image and hidden behind the "occulting veils" of time.

In art, both sacred and profane, the hierophany coincides with the *symbol* that interprets the role of an instrument in charge of expressing a *revealing concept* that, in religion, transcends from the human dimension to flow into the *myth* that connects man (fragile and corruptible) with the world of *divine perfection*: that supernatural universe so excellently represented in the nature proper of *legends* and *myths*.

These arguments offered a great variety of choices. An example for all is the struggle between a superior and an inferior principle (divine and animal world) personified by "*Mars tamed by Venus"* or "*the monsters*" encountered by Hercules during his fatigues. Both expressed the continuous tension of the human soul suspended between *virtues and vices*: man, tending towards good, was incapable of aspiring to perfection and was often threatened by the danger of falling back towards the irrationality dictated by the instinct.

Here it is not possible to exhaustively discuss the examination of the potentiality of the method and the synergies that can arise from its constant implementation.

Therefore, below, we will limit ourselves to illustrate two examples that explicit how it is possible to make the research of **comparative meanings** between apparently unconnected cultures, emerge.

Iconographic convergences. The Mandala and the hyperuranion: micro and macro cosmos, meditation and transcendence

The geometric forms of the mandala, the cosmograms, represent the passages and the respective rituals of the meditation path as well as the testimony of man's ability to crush evil and reach enlightenment and eternal salvation: concepts also reaffirmed in the Yamantaka depicted in the act of crushing a buffalo under his feet, which interprets the ambivalent identity of destroyer and destroyed.

The Mandala

In Sanskrit the word "mandala" means circle or cycle.

Originally the meaning coincided with that which possesses the essence (la) and the totality (manda).

The mandala is a diagram that shows the structure (and unity) of micro and macrocosm of the inner and external world. Its configuration represents the path to achieve **illumination**.

The basic structure is shaped as a temple (or palace) with a door on each of the four sides. The transcendental inhabitants appear at the centre of the composition and each detail occupies a space respecting a precise ritual, which translates into a *meditation* exercise.

The hyperuranion

According to the Neoplatonists, the world was organized in concentric spheres, whose extremes were Hyperuranion intended as the divine world and matter, understood as an animal world.

One of the most exhaustive artistic interpretations of these concepts is in the illustration of the Earth at the centre of the Creation in Martin Luther's Bible dated1545.

Thanks to the philosophical speculation, the most noble and elected spirits can experience happiness and reach the knowledge of the true after death. Man, endowed with reason, can choose whether to rise to the divine world or descend to the animal world, or even keep himself in an equidistant balance. This choice is accomplished through the *mediation* of love and beauty.

If we compare the iconographic interpretation proper of the mandala with the engraving that represents the hyperuranian in Luther's Bible, we can realize how the two exegeses reveal and highlight irrefutable coincidences in the collocation of the figure of the man interior within the cosmos.

In fact, hyperuranian is that metaphysical dimension merely spiritual described by Plato.

In this place, without space or time, the immutable and perfect ideas reside and they can only be reached by the intellect and precluded to all that is earthly and corruptible.

Even in the Mandala the transcendent inhabitants, engaged in meditation, search for the way that will lead them to divine enlightenment and salvation.

These passages, although subordinated to various reinterpretations, explicit the same concept with a certain coherence: *the mystical experience is communion with the mystery beyond any visible or sensible form*. It is differentiated and subordinated not only according to the social and cultural environment from which it draws its origins but, above all, according to the metaphysical and philosophical influence proper to the context in which it is generated.

The Supreme Lord, Saviour of Heaven and Creator of all things, will therefore open the doors to Paradise rather than to Nirvana; to the Indian Brahman (source of mystic salvation and explanation of the world) rather than to the Shang-ti of the classical chinese sources or to the Ahura Mazda of the Iranian Hvarenah, where its power and its splendor symbolize the nature of the Mazdean cult.

Even the Islamic religion, apparently far from the concepts of religion that unite humanity towards the sharing of eternal illumination, bases its proper belief on the same presuppositions. The latter will distance itself from the usual observance of the religious traditions in the rest of the world because of the *modalities* of interpreting loyalty to the Koran and to the Prophet Muhammad: namely to intend how the State of Medina should represent the absolute model of every Islamic state to which one should submit. This concept also represents the knot that explicits the conflict between traditionalist Muslims or fundamentalists and reformist or secular Muslims.

The Earth at the centre of Creation
in an illustration of the Luther's Bible 1545

Tibetan Mandala

The role of light in religions: parallelisms between oriental and western iconography.

The importance of light as a divine source represents the main iconographic link between different cultures and interprets the representation of the supreme entity.

Over the centuries, references to the image of God have been shaped according to a multiplicity of socio-cultural "rules", however the presence of light as a divine source has remained the "ontological" principle by antonomasia.

In the East the anthropomorphic image of Buddha appears around the 1st century AD in northern India and its rich iconography refers predominantly to spiritual enlightenment that will guide the devoted in his path of faith.

The interpretation of the divine in the source of light, then, is shared in the mind of every human being, shaping itself in the specific context that will personalize the vision subordinating it to a specific supreme entity.

Just think that of the halos of the saints, which are found in the pre-Christian depictions of the gods of the Olympus, in the Hellenistic funerary stele as a deference to the world of the afterlife and that were handed down by the Buddhist empire Kushan, to Mithraism, to the pharaohs: a common reference to numerous religious phenomena. The halo reproduces the image of the sun as a source of light, of life and as a symbol of the achievement of eternal salvation and of the truth thanks to meditation and faith. It also is reflected in the celestial phenomena, in the metaphysics of light (the first form of material reality that constitutes the essence of everything), in the zodiacal signs and much more.

Detail Vajrabhairava Mandala
Yuan dynasty (1271–1368)Metropolitan Museum New York

Saint Michael and the dragon
Raffaello Sanzio, Louvre Paris

Divine illumination, meditation and overcoming the fear of death from the East to the West

The *Buddha Yamāntaka* and *St. Michael who crushes the devil*.

The characteristic iconography of Yamāntaka portrays him with the head of a buffalo, symbol of Yama, death. The antaka, instead, means “exterminator of death” (an common aspect to all the Buddhas, since they interrupted the cycle of rebirth: samsara).
Yamāntaka interprets the awakening from death, the achievement of salvation and immortality, to which one can arrive only after having followed the path of meditation and wisdom through the journey of the Mahayana practitioner, to the point of reaching *enlightenment*.
Yamāntaka symbolizes the overcoming of fear for death because this figure simultaneously impersonates death and rebirth (the eternal salvation). It ends up by "exorcising" the perception of fear and allows it to be metabolized as an intrinsic and concrete existence generated exclusively by the “*ignorance*” of earthly conventions: *enlightenment destroys death*.

The sword, in fact, the customary attribute of the Yamantaka, alludes to the defeat of ignorance.

In Western art the legends, mostly medieval, which tell the stories of the saints sauroctoni (murderers of scary dragons), are very frequent. Just to mention, first of all, St. George, but also Teodoro, Silvestro, Margherita, Marta (who tamed him). The legend of the Archangel Michael who fought against the apocalyptic dragon was also very flourishing.

Vajrabrabhairava Mandala
Yuan Dynasty (1271-1368)
New York, Metropolitan Museum

Detail
Vajrabhairava Mandala

Paolo Uccello
Saint George and the dragon, 1464 about.
National Gallery London

The hair of Buddha

Some coincidences, influences and iconographic are evidences in the representation of manufactured goods in Eastern and Western art.

An example of philosophical and artistic parallelism is expressed in the comparison between the image of Buddha and a bust of a Roman general in porphyry, of the 2nd century AD. kept at the Borghese Gallery in Rome.

The ushnisha and the urn are the most important attributes (the laksana) that refer to the spiritual perfection of the Buddha as a cosmic man (mahapurusa) and are those protuberances on the head and between the eyebrows.

The image of this Roman general, who has his hair gathered in an oriental hairstyle, alludes to the value of the Roman leader and it exalts the virtues of supreme wisdom.

Comparisons between the image of Buddha and the bust of a Roman general of the 2nd century AD kept at the Galleria Borghese.

We thank professor Marco Bussagli, teacher enrolled in the graded list of the first band at the Academy of Fine Arts in Rome for the validation of hypotheses and the rereading of the text.

SOME REFLECTIONS & QUESTIONS ON EMERGING FORMS OF DIGITAL PHOTO-LIBRARIES

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I would like to reflect here on the hyper-growth of some new forms of photo-libraries: microstock photo agencies with global reach and innovative business models, in which 'micro' refers to the amount of money paid to photographer contributors for each electronic photo by these 'middlemen'. This means cents rather than the hundreds or even thousands of dollars photo rate which an established photographer can charge:

'-- *a way that amateur and professional photographers can sell their photos, earning a* (very small*) commission from each photo sold. Millions of photos are licensed for use via microstock, some of the biggest names in the stock photography business operate their own microstock photo libraries*,' [1]

Microstock photography is often termed micropayment photography. Some microstock-photographers make considerable money using microstock agencies, e.g. Yuri Arcurs. Many others aspire to this happy state: for example, Shutterstock reports over 100,000 contributors. Photographers often use more than one microstock agency, but the business models are often criticised due to the low payments. It is highly competitive.

The microstock business is also extremely competitive at the inter- company level as well as the intra-company (photographer) one. Considering the former now, this is noticeable from their respective on-line profiles aimed at both their markets [e.g. advertising] and their photographer suppliers. The field has consolidated considerably despite its youth and attracted interest from very large companies from inside and outside the photo library fields. For example, Getty Images acquired iStock, a top microstock agency, in 2006. Even more striking was the takeover of Fotolia by Adobe at a reported price of $800 million [2]. Other current leaders include Alamy and Shutterstock. It is instructive to consider the historical situation in 2007 [3] and the changes since then. Now some questions

Could the rapid progress of the sector - including continuing tough Darwinian struggles between the top stock photo and microstock agencies (whether they stay separate business (sub) sectors or continue to merge) and the rise of new ones - affect the remaining independent European heritage photo-libraries, including small privately-owned ones? The situation may remind some of us of the fierce debate in the mid-1990s regarding the apparently imminent monopolisation of electronic rights over many of European cultural heritage top images by Microsoft/Corbis, IBM et al. At that time another emerging threat seemed palpable: giant Japanese companies, such as Hitachi and Toppan Printing, acquired valuable arts image rights from top European museums and galleries including the Uffizi; Japanese admiration of the Impressionists as well as the Renaissance fuelled their efforts. The perceived US and Japanese threats informed and stimulated the creation and development of Europeana, providing a valuable portal for numerous European Heritage institutions which is

still blossoming today (currently just over 50 million records) facilitated by the European Commission.[4]. Perceptions of these commercial Japanese and US challenges faded and a good case can be made that the Japanese interest was positive for both sides, e.g. between Italy, Florence, the Uffizi, and Japan. Are there lessons which may be relevant and useful for Europe regarding the possibility of future Chinese entry into this scene; i.e. could large Chinese tech companies such as Alibaba and Tencent [5] lead a new charge from Asia by acquiring European cultural rights? Might large Indian hi-techs do the same? Should Europeana, as well as leading European cultural and historical photo-libraries such as Alinari, be seen as major cultural heritage bulwarks against such new forms of image libraries from outside Europe and North America? Could this perhaps be the case regarding Social History (as well as Fine Arts) looking forward two, three and more generations? 'Early Twenty-First Century' collections may then well seem a valuable part of human History – as '1968' and the 'Swinging Sixties' seem to many of us now. Could there be constructive, if sometimes tense, co-habitation and even fruitful cooperation?

A related topic of considerable interest is the aesthetics of art photography. A current major exhibition at the National Portrait Gallery in London on the '*Victorian Giants: The Birth of Art Photography'* in the mid- and late 19th century provides an interesting view of this [6]. In this regard Stocksy United Photography, a recent start-up by Bruce Livingstone (founder of iStock), is interesting since their claimed USPs (Unique Selling Points) include: 'curating' their 'authentic' offerings, a co-operative ownership structure and a 'fair pay' philosophy to a relatively limited number of photographer artist partners [7]. Do the existing agencies contest this view? Their own quality controls appear to be increasingly rigorous. Will 'microstock agencies' continue to be (largely) demarcated from 'stock agencies'? In any case, the so-called 'photo wars' appear likely to continue.

Let us now briefly explore the broader context: the hypergrowth of the electronic-based Image Culture continues as indicated by the emergence of electronic image-based enterprises such as Flickr, Instagram and Google Photos with hundreds of millions of images --- even billions. Moreover, we are now no longer surprised by the apparently inexorable global growth of the Internet, smart phones with cameras, social media and the corresponding FANG behemoths (Facebook, Amazon, Netflix, and Google/Alphabet.) joining Apple, IBM, Microsoft and others in the top Technology business ranks with the Chinese, led by Tencent and Alibaba increasingly present [5]. However, some observers have even deeper and broader concerns regarding some of the latest trends. Sir Tim Berners Lee, the 'Father of the Web' while working at the European CERN, gave cause for thoughtful reflection recently on the Web's 29th Birthday [8]. He pointed out that 'over half of the world's population is now connected' but that nonetheless, as well as grounds for celebration, should be regarded with cautious: in addition to the well-marketed benefits the results include increasing threats. Another example of a perceived threat is in the field of public broadcasting: even large national European Public Service Broadcasters such as the BBC [and presumably RAI] are now being increasingly challenged by digitally streamed films from Netflix and Amazon, with very significant content production budgets, coupled with the trend of increasing numbers of [especially young] people to get their news from their smartphones and computers rather than newspapers, magazines and TV sets. At the time of writing, the Facebook and Cambridge Analytica furore arouses great concern. Could the area of contemporary photo-libraries be affected by such concerns?

It is hoped that this short paper will help to stimulate debate and research studies on the intriguing topic of new photo-sources and the vibrant scene of photography.

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Thanks are due to Christina Hemsley, who first drew my attention to the Microstock phenomenon before the first phase of the joint exploratory research study reported in the Graham Diprose et al paper in these Proceedings. Graham's knowledgeable views have enriched these reflections as have my memories of Andrea de Polo's deep and comprehensive photography papers presented over the years at EVA Florence and elsewhere. My thanks also to Vito Cappellini for the kind invitation to contribute a short paper and his unflagging energies and inspiration for the EVA Conferences across Europe and internationally.

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CONTEMPORARY ART CREATION AND EXHIBITIONS

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Contemporary Art is evolving on different lines. Among many other ones, two important ones are: Classic Art and Abstract Art.
In the Classic Art line, of particular interest is the Renaissance style, where the Artist is taking inspiration by Renaissance Art or following some connected guidelines in the scenes and Human Figures representation.
Our Art Production is following this line.

The Classic Art connection in our Art-Works is based on some main following characteristics:

- represented scenarios (landscapes, Human Figures);
- structure of the Paintings (borders, geometry, etc.);
- colours used in the Paintings;
- harmony of the composition;
- perspective properties.

We have painted many contemporary Art-Works and organized several Art Exhibitions on religious topics and other ones, such as connected to music, dance, theater.

The same inspiration was impressed in the many Banners (Palios), now 70, we realized for many Municipalities in Italy to celebrate their History Origin and Evolution [1].

Our activities are also covering industrial applications, in particular with creative design and paintings for the *fashion area*.

[1] P. Imposimato "A Cultural Tradition in Italian Towns: The Banners for Yearly Historical Reenactments", Proceedings of EVA 2017 FLORENCE, Firenze University Press, Florence, p. 125, May 2017.

ACCESS
TO THE CULTURE INFORMATION

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Creative perception, decoding of hidden images, contextualisation and interactive learning process

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I propose a new approach to art history applying multimedia. My proposal is focused on the Piazza della Signoria as an example of cultural heritage and as a tool for research and communication. How can we create meaningful participation within the city, discover the Piazza della Signoria, learn about history, and share the experience? The aim is to decipher the public space and to learn and see it by opening the traditional relation between object and spectator through interactive involvement by finding the hidden image, the secret message, and understand the story behind it.

The Enigma of the Piazza della Signoria in Florence

The Renaissance sculpture displayed in this public space form an impressive outdoor museum commissioned by either the Republican or the Medici families. Each of these figures is a tool for propaganda. The tour reveals the Piazza della Signoria in Florence as the theatre of a political and erotic stage. The actors are the monumental sculptures: *Judith and Holophernes* by Donatello, *David* by Michelangelo, the *Fountain of Neptune* by Ammannati, *Hercules and Cacus* by Bandinelli, *Perseus* by Cellini, and the *Rape of the Sabines Women* by Giambologna. Theses sculptures are interacting like in a performance where each artist tries to outdo the others. Every figure of this forum incorporates a narrative dimension bringing together several temporalities involving representations of the Old Testament, heroes of ancient Greco-Roman mythology, and the mortals: the sovereigns of Florence.

My aim is to analyze the positioning of these sculptures and their interactions within this historical space: the Piazza della Signoria, the platform of political and civic life in the city. In the 16th century, the L-shaped piazza was enlarged by the Palazzo della Signoria and the Palazzo degli Uffizi within a perspective where the sculptures serve as both guardians and focal points: each gaze interacting with one another.

There is a specific point of view exposing theses protagonists through a totally different

context. An ambiguous sensuality characterizes the colossal *David* by Michelangelo in the courtyard's midpoint as well as Cellini's *Perseus* beheading the Medusa, which dominates the public area from the Loggia dei Lanzi. The figures seem to be petrified by Medusa. I will reveal how through a specific angle they conjure their destiny.

INSTANT ARCHITECTURE: HOSTED ACCESS TO THE ARCHIVISION RESEARCH LIBRARY WITH BUILT-IN IMAGE MANAGEMENT & PRESENTATION TOOLS

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Abstract - The Archivision Research Library is a collection of 100,000 digital images of art and architecture professionally photographed by a trained architect. It documents the built environment--from ancient monuments to cutting-edge contemporary constructions--with extensive, standardized descriptive metadata. Archivision is accessible for research and teaching through a web-based application--a dedicated hosted instance of MDID--with vrcHost LLC delivering full services and technical support: installation, integration, and maintenance. This combination provides not only instant access to Archivision, but also to sophisticated tools for managing images using an open source media management system to discover, aggregate, study, and present digital media.

INTRODUCTION

In today's technology-filled world, we are surrounded by art and architecture, often spontaneously snapping and sharing the images that capture our attention. Yet, seeing the built environment through the eye of an architect is a singular experience. The Archivision Research Library of 100,000 digital images does exactly this [1], with the added bonus of also providing extensive descriptive information and seamless hosted access in the Madison Digital Image Database [2]. MDID provides sophisticated tools for managing this inspiring vision of the built environment using a freely distributed, open source media management system to discover, aggregate, study, and present digital media, while vrcHost LLC delivers full hosted services and technical support [3]. This summary explores the depth and breadth of Archivision and demonstrates the utility of accessing the digital images in MDID for research, study, and teaching.

ARCHIVISION

The Archivision Research Library contains over a 100,000 digital images of world architecture, urban design, gardens, landscapes, archaeological sites, and art in museums and public places, professionally shot by Scott Gilchrist, photographer and trained architect (Bachelors and Masters Degrees in Architecture) [Figure 1]. The collection has been meticulously built over the last 25 years capturing the architectural world, from ancient monuments to cutting-edge contemporary constructions.

One of the strengths of the library is the completeness of the visual documentation of any given architectural work, from overall views to exacting details. For example, Archivision holds 295 images of Sagrada Familia in Barcelona, showing exterior and interior views as well as fascinating details [Figure 4]. Similarly, for a sculpture example, there are 51 images of Cellini's 'Perseus with the Head of Medusa' in Florence [detail in Figure 5]. What also separates the Archivision material from the casual shots many of us take as we travel is the mesmerizing quality of the images, this detail of the San Francisco Federal Building by Thom Mayne of Morphosis (102 images) and an interior view of the Monastery of Sainte-Marie de la Tourette by Xenakis and Le Corbusier (242 images) are good examples [Figure 2].

Then, there is the extensive descriptive metadata that is applied to each architectural or artistic work. For example, standardized terminology like Deconstructivist, government office buildings, precast concrete, galvanized steel, perforated steel panels, architecture and city planning, etc. are all used to describe Mayne's Federal Building mentioned above [Figure 3]. The descriptive metadata follows the VRA Core data standard for the description of images and works of visual culture [4] and Archivision staff can provide clients with this metadata in Microsoft Excel, Core 4 XML, and RDF with linked open data. For structured terminology, the Getty Vocabularies provide authoritative information to insure efficient online search and retrieval [5]. Expansive information from resources such as Grove Art Online is added to the description field for research and study purposes [6].

Archivision is a growing collection with 9,000 new images and descriptions added annually. Intended for use primarily in educational contexts, the Archivision Research Library can be licensed to own in perpetuity, allowing it to be added to any existing digital collection or preservation repository, either by individual modules or in its entirety. Or, it can be accessed through subscription or hosted services. Many institutions cannot or do not want to load the images and metadata locally, therefore Archivision partners with vrcHost LLC to make the collection accessible and usable for research, study, and teaching through MDID, a web-based application with great functionality (extended information below). In this way, the Archivision content can be instantly accessed through a dedicated hosted instance of MDID with vrcHost LLC delivering full services and technical support, such as installation, integration, and maintenance. MDID provides sophisticated tools for: managing the Archivison collection of digital images, studying art and architecture, and presenting a variety of digital media in educational contexts.

MDID and vrcHost

MDID is a freely distributed, open source web application originally developed at James Madison University in Harrisonburg, Virginia, and now supported mainly by vrcHost LLC. MDID is a digital media management system with sophisticated tools for discovering, aggregating, and presenting digital media in a wide variety of learning spaces [Figure 4]. The project started in 1997 in response to increasingly digital curriculum requirements within JMU's School of Art and Art History. It evolved over time into a cross-disciplinary instructional application used at several hundred institutions in the United States and around the world. It is freely available for download from the Internet under an open source license.

MDID has support for audio and video, flexible metadata structures, a rich and robust discovery interface, granular access controls, PowerPoint compatibility, support for composite objects, and novel presentation mechanisms that run on most operating systems. It ships with a companion application, the MediaViewer, used primarily in mediated classrooms to display slideshows (groups of ordered images), featuring intuitive zoom and pan controls, intelligent navigation, image caching, catalog data display, and support for dual monitors or projectors for high resolution image comparison [Figure 5].

Andreas Knab at vrcHost started offering commercial support for locally hosted instances of MDID and the hosting of fully managed MDID instances in 2013. This service saves institutions from the worries of installing and administering a server and application software, allowing users at educational institutions to concentrate on their immediate tasks of collection curation, lecture slideshow creation, or research and study. The partnership with Archivision pushes this even further by preloading the application with a large number of high resolution art and architecture images accompanied by rich descriptive metadata.

CONCLUSION

European institutions are encouraged to join the over 200 existing clients worldwide who are finding the Archivision Research Library to be a key educational resource. Hosting in MDID is highly recommended for instant access and the use of powerful tools that enhance research, teaching, and the study of art and architecture. This collection, curated by a trained architect and professional photographer, provides an inspiring vision of the built environment and access to many other associated art works. People want to get their information online and this Archivision/vrcHost collaborative wants to contribute to the development of digital libraries for current and future learners.

FIGURES AND TABLES

Figure 1 - Archivision Research Library Web Site

Figure 2 - Sample Archivision Images - San Francisco Federal Building (left) and Monastery of Sainte-Marie de la Tourette (right)

Title:	San Francisco Federal Building
View:	Northwest corner (7th Street and Stevenson St.), viewed from 7th street, short end wall of tower with fire escapes and solid panel cladding in irregular shape
Creators:	Morphosis (American architectural firm, founded early 1970s); Thom Mayne (American architect, born 1944)
Date:	2003-2007 (creation)
Style/Period:	Deconstructivist; Twenty-first century
Location:	site: San Francisco, California, United States
Location Note:	90 7th Street on the corner of Mission and 7th streets
GPS:	+37.779167-122.411944
Measurements:	605,000 ft2 (area)
Materials:	precast concrete; galvanized steel; glass; wood; perforated steel panels
Work Types:	buildings; public buildings; government office buildings
Description:	Thom Mayne of Morphosis designed the building using a juxtaposition of gray concrete walls, perforated metal panels, and custom, faceted wood ceilings. The building was designed to be a 'green' building consuming less than half the power of a standard office tower and was the first Federal Building to be certified under LEED criteria (although it only rated silver). It was the first naturally ventilated office building on the west coast since the advent of air conditioning. However the building has been criticized as being dysfunctional for its employees, with inadequate thermal comfort, lighting and acoustics. In addition, in an attempt to promote exercise, a skip stop elevator system was designed that only stops every 3 floors, requiring able-bodied workers to walk up or down to reach their desired floor. This caused most of the workers to use those elevators designed for the disabled which stop at every floor, leading to overcrowding. The design's nonfunctional use of extended, folded metal sun shading at ground level, which in the opinion of some are purely for aesthetic effect, required extensive galvanized steel bracing, and added millions in materials and fabrication costs into the project. (Source: Wikipedia; http://en.wikipedia.org/wiki/Main_Page)
Classification:	Architecture and City Planning
Image Rights:	© Scott Gilchrist, Archivision, Inc.
Vendor ID:	1A1-MAYNE-FBSF-A84
MDID Identifier:	91427
Archivision Set:	Archivision Addition Module Twelve
Collection:	Archivision Module 12
Record created:	Oct. 15, 2017
Last modified:	Oct. 15, 2017

Figure 3 - Archivision Descriptive Metadata for the San Francisco Federal Building

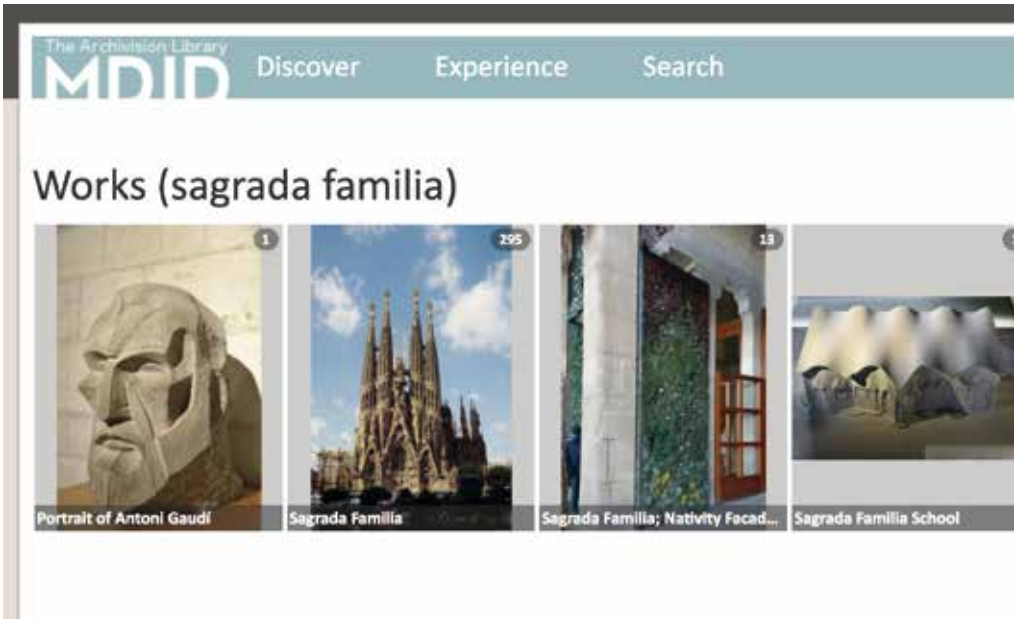

Figure 4 - MDID Works Overview Screen

Figure 5 - Image Comparison in the MDID MediaViewer

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MAXIMIZING METADATA: EMBEDDED METADATA TOOLS

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INTRODUCTION

Archives, libraries, museums, businesses, and individuals have fully embraced the digital era and a proliferation of digital assets abound. The challenge is creating, managing, storing, and sharing these assets. Metadata is information that helps overcome this challenge. It is data that provides definition, descriptions, and context, all set into a structure that describes how the data itself is arranged. Metadata helps us understand and organize our digital assets. It can answer questions, such as (but not limited to) who, what, where, when and how. Metadata can be used to add value to your work by adding standardized information that will aid in structuring, organizing, discovering, and sharing your digital assets.

WHAT IS METADATA?

Metadata is a structured way of describing an information resource. It can be simple or complex, depending on your needs. The metadata discussed in the following paper pertains to cultural heritage objects, but metadata can and should be created for anything that can be digitized or classified or organized: online catalogs, search engines, books, magazines, newspapers, video, music, and so on.

The following table obtained from the American National Information Standards Organization (NISO) summarizes the various types of metadata succinctly. [Table 1] NISO explains it thus: Descriptive Metadata is used to find or understand a resource. Technical, Preservation, and Rights metadata (all considered "administrative" metadata) are primarily used for the management of files. Structural metadata details the relationships of parts of resources to one another, and markup languages integrate metadata for structural or semantic features within content. [1] [Figure 1]

Metadata has an underlying structure to it. There are ELEMENTS (such as title, subject, etc.). In the example above, "Creator" has a value of "Green, Ruzzie, United States, American, 1892-1956" and the element "Date" has a value of "1941" and so on. STANDARDS, (a group of elements approved by professionals) are developed in response to the group need. For example, the Dublin Core Metadata Element Set (DCMES) is a schema used to describe digital and physical resources that has become a minimum standard in many archives and libraries. [2] Other metadata standards, like the Darwin Core, are specifically geared to items that relate to biology and can be viewed as an extension of the Dublin Core for biodiversity information. [3] The VRA Core (the standard chosen for this example), developed by the Visual Resources Association and hosted by the Library of Congress, contains other expanded elements to more adequately describe works of visual culture and the images that document them. [4] Those who work with collections of digital assets should choose the standard that most closely aligns with the nature of their materials, or customize, if need be. A SCHEMA conveys the underlying structure, that combination of elements and standards, the relationships between elements, and the rules for use and syntax for the values. The SCHEMA is often the markup language that the end users do not see, but allows the metadata to be machine-readable. For example, XML and RDF are common markup languages. [5]

WHAT IS EMBEDDED METADATA?

We understand that Metadata helps describe our digital assets. What then, is embedded metadata? Embedded metadata is created using a process that converts text into code and adds that information about an asset directly into the digital file itself. These metadata bytes are stored just like the image bytes are stored. Many of the digital files we use every day already have metadata embedded in them. Cameras and scanners automatically embed metadata such as date, time, and device settings. Music files, e-mails, texts, web pages, and more are all packed with metadata; the 'key to functionality of the systems holding the content, enabling users to find items of interest, record essential information about them, and share that information with others". [6]

Researchers, archivists, curators, and educators often have knowledge and data the go far beyond the automatically stored metadata attached to their digital images, but need to find efficient ways to add this value. Depending on the nature of the materials and the schema a person wishes to follow, there are different types of data that can be added to describe those digital files. This additional information about the objects, people, and places described in an image or audio file can be embedded. It is important to take the time to decide what information you want to add, and then to be consistent in your application. [7] Additionally, administrative metadata can be quite useful to manage images, such as telling users who owns the image and how it can be used. This information can also be embedded.

Not only digital images can have embedded metadata inserted; it can be done to digital videos, audio files, and PDF's. Embedding metadata into a file allows the descriptive information to travel with the file across file formats and software applications. When you embed data into your digital file, it will sit alongside the already automatically generated embedded information, for example technical metadata from a camera, and you will be able to search for it and view it on your computer. Improving your digital files discoverability and accessibility is a key advantage to embedding metadata. Conducting a search on your own computer, in a database, or other online collection can typically involve the data embedded in the files.

Embedded metadata helps reduce the difficulty of finding an image or audio file on your computer, no need to recall a lengthy URL or scratch your head trying to remember the original source to cite when using or publishing your images. Ensuring that those who might wish to use your images are informed about copyright constraints and provided with contact information is easier than you might think, since this type of data can be easily embedded. Embedded metadata enables functionality that streamlines and enhances your research and presentations by making images, video, and audio files searchable and sharable, with easy to identify content, sources, and rights.

TOOLS FOR EMBEDDEDING METADATA

There are many tools out there that can be used to embed metadata: Corel Paintshop, Apple Photos, ACDSee, Lightroom, Photoshop Elements, and more. They were all developed to work with an image caption standard called IPTC, which is the global standards body for the news media providing the technical foundation to allow for sharing information about images in a structured, consistent way. [8]

There now are tools available that will allow you to improve workflow, build upon work that has already been done, and eliminate the need to slavishly enter information more repetitively, saving time and money. Three such tools were developed by the Visual Resources Association, a multi-disciplinary organization dedicated to furthering research and education in the field of image and media management. [9] These tools were designed to work in Adobe Bridge and can be used to create and manage embedded metadata, making your workflow much more efficient. Although most Adobe products are now only available by paying for a subscription called Adobe Creative Cloud, Bridge can be downloaded for free once you create an account. [10]

VRA METADATA PALETTE

The first tool is a custom XMP palette, which allows you to embed data into your digital files. Knowing that those who deal with material culture have a need for more description, especially when data about the object depicted is needed rather than just data about the image itself, the Visual Resources Association developed a tool that will allow for richer data using IPTC and the VRA Core. [11] We call it the VRA metadata palette. This tool allows you to easily enter data into a digital file, carefully separating out information about the artwork or object depicted from the image data, while also allowing for the addition of administration data (which is useful for archivists and librarians, or anyone handling projects with multiple workers and roles). Data can be entered one digital file at a time, or in batches when some information holds true for all in the group, such as source or copyright. [Figure 2]

The palette utilizes the Getty Vocabularies Linked Data Service, which includes: the Union List of Artist Names, the Thesaurus of Geographic Names, and the Art and Architecture Thesaurus. [12] Using such authorities, structured terminology compliant with international standards, helps create metadata that is easily searchable and more discoverable. Institutions use metadata standards, authorities, and controlled vocabularies for two primary reasons; quality control and interoperability. The controlled vocabularies most commonly used for image and cultural object cataloging are those provided by the Getty Vocabulary Program. In the example above, the user can search the Getty ULAN for the architect "Leon Alberti", select his name, and the rich metadata (name, nationality, role, dates, etc.) are automatically added, along with authority reference ID's, which are useful for preparing your data for use in linked data environments. [Figure 3]

I've used the VRA palette to quickly record data for images taken from books and journals on loan. It could just as easily be used by researchers in the field or anywhere order needs to be imposed on files before information is lost and identification becomes difficult. Students with minimal training can search for names and terms and then copy accurate information into the file. The information stays with the file until it is uploaded into a database, added to a website, sent to a publisher, or so on.

Once this detailed data is entered and ordered using the VRA Core standard, the summary section will fill this data into IPTC and Dublin Core fields, manually, or automatically (see below). Populating the IPTC metadata allows for almost all systems to discover and display the embedded metadata. [Figure 4]

VRA METADATA EXPORT/IMPORT TOOL

The second VRA tool allows for importing or exporting digital file data to and from spreadsheets (perfect for all those digital humanities projects). Using the VRA Export/Import tool allows the user to export all of the data from single files or groups of files into spreadsheets. These spreadsheets can be manipulated and put into data sets, used to populate databases, and so on. By the way, the reverse is true, you can also take spreadsheets of data, import them, and embed thousands of files in one fell swoop. I've used the import/export tool many times. When I purchased high quality images from Archivision, they came with a spreadsheet of rich and complete descriptive metadata. I embedded that data into the images using the Import tool before I loaded them into my online database. Now when a user downloads one of the images, the data travels with the image. This makes it easier for my patrons to search for specific images they have downloaded, as well as keep track of the detailed information about each file, with no effort on their part. Here is another example; I scanned over 9,000 slides from Binghamton University Theatre Department productions. Using a spreadsheet they had produced with information about each production, I was able to import and embed that information into all the files in just minutes. Then, using the VRA palette, we added copyright and contact information, as well as standardized subject terms. Next, we exported the improved data into a spreadsheet that we used to populate data in the JStor Forum, where the images

were then stored and published. [13]

The beauty of these tools can be found in their back-and-forth utility and flexibility: creating data, exporting data, importing data, updating data, and more. This gives you the freedom to work in whatever sequence or on whatever platform you prefer and, it allows you the option to change your mind down the road.

VRA METASHOTPPT

The last VRA tool is called the MetaShotPpt. It quickly allows for the creation of Powerpoint presentations in which digital images and embedded metadata automatically load into the slides. Simply open the tool, select a folder of embedded images, select desired options, and then click "Create PowerPoint". It just takes moments. Nothing has to be retyped, saving time and ensuring accuracy. [Figure 5]

CONCLUSION

Embedded metadata is so useful, and the time and effort it takes to create and embed data yields returns to the end user—saving time, increasing accuracy, and providing long term accessibility. The VRA tools are easy to use and free to download from http://metadatadeluxe.pbworks.com/w/page/20792238/FrontPage, along with guides for embedded metadata and easy to follow YouTube tutorials. [14]

All of this is made possible because of the power of embedded metadata, which makes digital images independent, self-defining, sharable, flexible and portable.

FIGURES AND TABLES

Metadata Type	Example Properties	Primary Uses
Descriptive metadata	Title Author Subject Genre Publication date	Discovery Display Interoperability
Technical metadata	File type File size Creation date/time Compression scheme	Interoperability Digital object management Preservation
Preservation metadata	Checksum Preservation event	Interoperability Digital object management Preservation
Rights metadata	Copyright status License terms Rights holder	Interoperability Digital object management
Structural metadata	Sequence Place in hierarchy	Navigation
Markup languages	Paragraph Heading List Name Date	Navigation Interoperability

Table 1. Table obtained from the American National Information Standards Organization (NISO)

Figure 1. Example of an image and associated metadata elements

WORK

Agent	Francesco Talenti (Italian architect, ca. 1300-1370); Giovanni Rucellai (Ita
Title	Santa Maria Novella
Date	1458-1470 (façade) (alteration); ca. 1246-1399 (creation)
Style/Period	Medieval; Renaissance
Cultural Context	Italian
Work Type	architecture
Material	marble
Technique	construction (assembling)
Measurements	
Location	
Description	The second design commissioned by Giovanni Rucellai, the spectacular gr
Subject	buildings; religious buildings; churches
Inscription	
State/Edition	
Relation	
Text Reference	
Source	Grove Art Online; http://www.groveart.com/

Figure 2. Screenshot view of Adobe Bridge with VRA palette open

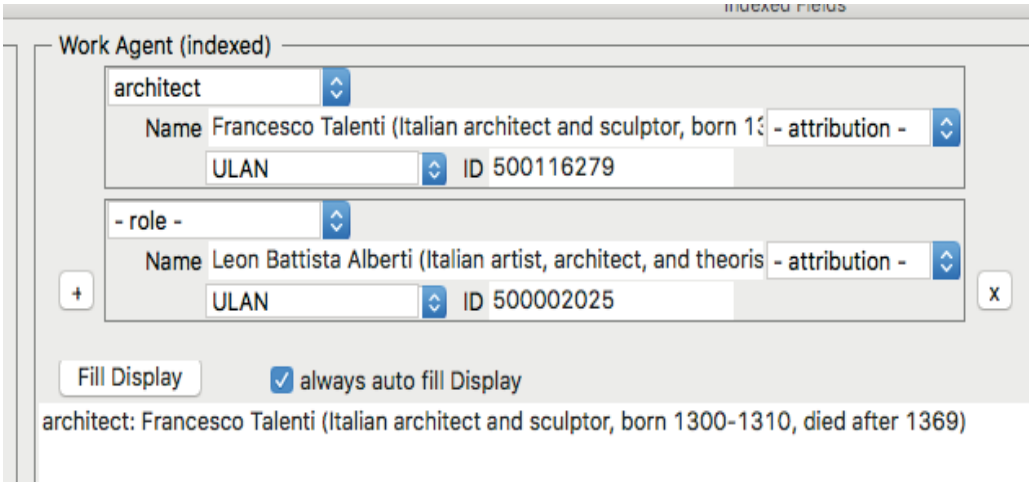

Figure 3. Screenshot of the VRA palette showing the links to the controlled vocabularies

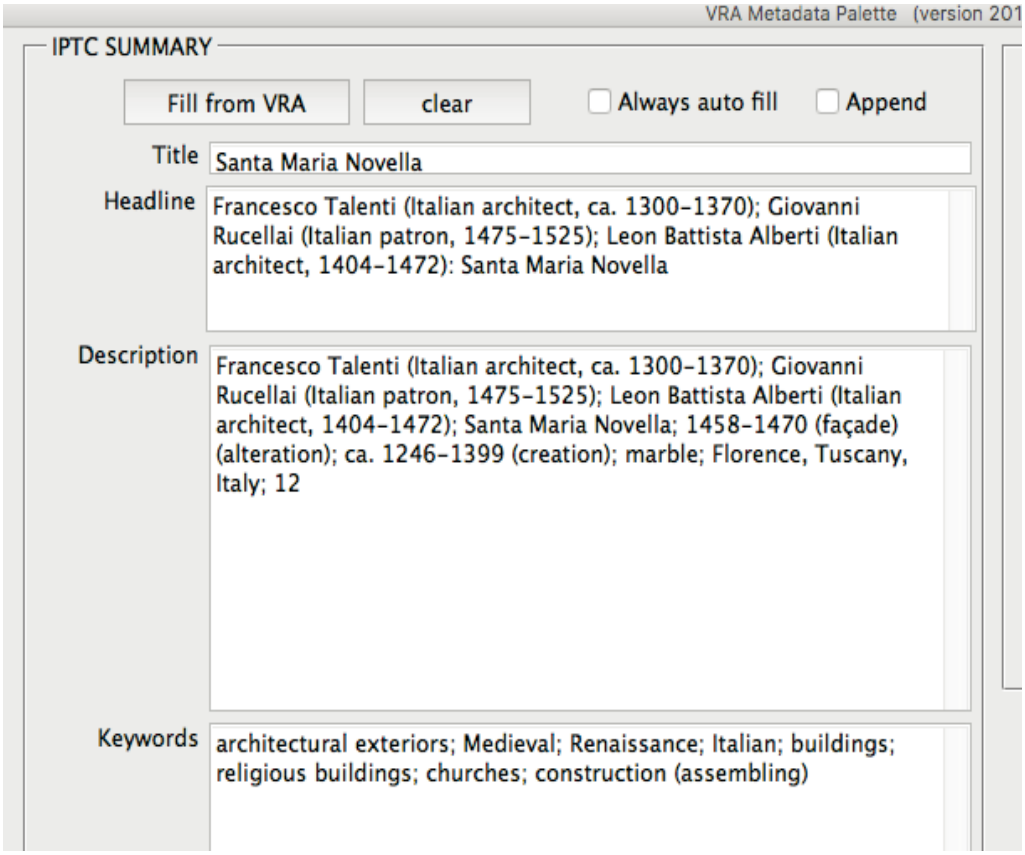

Figure 4. Screenshot of populating IPTC from VRA Core

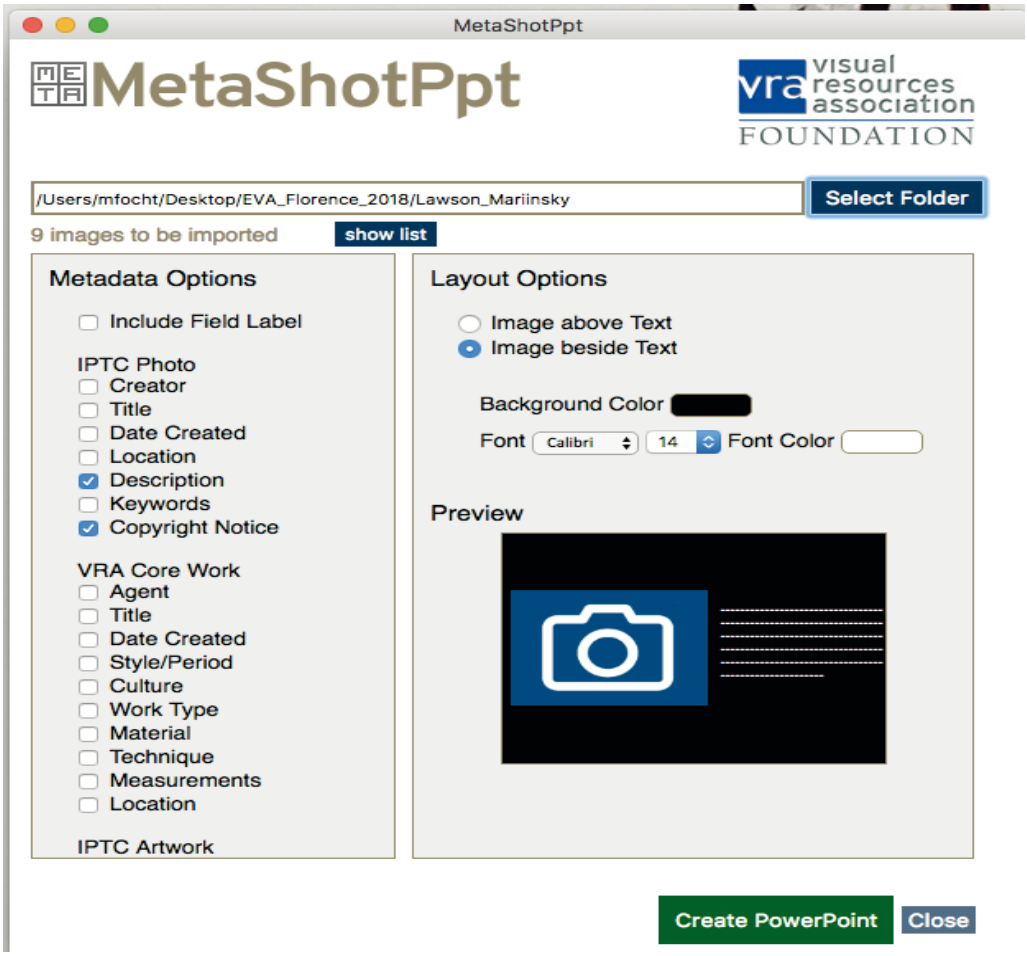

Figure 5. Screenshot of MetaShotPpt Tool

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[14] The VRA tools are free to download and can be downloaded from "Metadata Deluxe / FrontPage," accessed March 7, 2018, http://metadatadeluxe.pbworks.com/w/page/20792238/FrontPage

IL PICCOLO MASACCIO E LE TERRE NUOVE. CREATIVITY AND COMPUTER-GRAPHICS FOR MUSEUM EDUTAINMENT

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San Giovanni Valdarno

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Abstract – Since its opening, the Museum of the New Towns, housed in the Palazzo di Arnolfo in San Giovanni Valdarno, has dedicated a particular attention to the relationship with its audiences. In this context, the video "Il piccolo Masaccio e le Terre Nuove" has the purpose of bringing children and young people, in particular, closer to the museum main themes. The video presents a series of very different techniques, such as live shots, taken also by drone, Computer Graphics, 2D drawings executed with a tablet, drawings sketched with traditional techniques, such as India ink and watercolours, and digital videos taken from Google Earth.

INTRODUCTION

The Museum of the New Towns, housed in the Palazzo di Arnolfo in San Giovanni Valdarno (Museo delle Terre Nuove - http://www.museoterrenuove.it/), traces the genesis and development of the phenomenon of the New Towns, new settlements founded between the Thirteenth and Fourteenth century in strategic areas of the territory and under the control of a central authority. This phenomenon, widespread in several European areas, is well visible also in the Florentine territory with, for example, the towns of Firenzuola, Castelfranco, Scarperia, Terranuova Bracciolini and San Giovanni Valdarno. The visiting path through the rooms of the museum allows visitors to understand the reasons lying behind the birth of the New Towns, investigating the urban and architectural features (which revolutionized the spontaneous medieval stratification) and the aspects of daily life. The dwellers were migrants from villages, relocated with the promise of tax exemptions, the ownership of a building lot and cultivated lands. The museum dedicates specific attention to Castel San Giovanni (the early name of San Giovanni Valdarno), whose foundation dates back to January 26, 1299, with the aim of ensuring the Florentine power in the area by consolidating the road axis along the Arno river and weakening local lordships. San Giovanni, which as Castelfranco should have constituted an economic, military and demographic center of the upper Valdarno, will succeed in the fourteenth and fifteenth centuries in consolidating and establishing itself in the territory as an important urban reality and as a commercial hub along the route from Arezzo to Pisa.

Since its opening, the museum has dedicated a particular attention to the relationship with its audiences in the belief that only an effective dialogue with visitors can improve the life of museums. Therefore, multiple work-flows have been activated in relation to the different targets - from residents to tourists, from schools to families. In this context the video "Masaccio e le Terre Nuove" has the purpose of bringing children and young people, in particular, closer to the museum main themes thanks to an innovative approach, capable of combining scientific reliability and digital language.

"IL PICCOLO MASACCIO E LE TERRE NUOVE"

"Il piccolo Masaccio e le Terre Nuove" is a short animated educational video explaining the origins and the history of San Giovanni Valdarno, a city of foundation [1].
The protagonist is one of its illustrious citizens: Masaccio, the painter (Castel San Giovanni, 1401 – Rome, 1428) (Figure 1). He is presented as a kid of the early '400, attentive listener to inspiring explanations about the city provided by the Vicar of his time, Giovanni di Forese Salviati. The Vicar is used as a storyteller, capable of inspiring in the young Masaccio the interest for the rational rules that underlie the design of the city of San Giovanni, as well as other urban agglomerations born out of a precise planning. The choice to resort to the figure of Masaccio (the real name was Tommaso) as a kid is dictated both by his bond with the city and by the possibility of being a vehicle of identification for a young audience, to whom the video is mainly addressed.

Fig. 1 – A shot from "Il piccolo Masaccio e le Terre Nuove": Tommaso and his younger brother Giovanni. A study on lighting.

The story, after a brief contextualization in the present time, takes place in 1409, and ends with a return to the present, reconnecting San Giovanni Valdarno to other still existing cities born from a rational and planned project.

MIXED MEDIA FOR AN EDUCATIONAL SHORT FILM

The video presents a series of very different techniques. It makes use of live shots, taken also by drone, Computer Graphics, 2D drawings executed with a tablet, drawings sketched with traditional techniques, such as India ink and watercolours, and digital videos taken from Google Earth.

Fig. 2 - A reconstruction of San Giovanni Valdarno and its surroundings as it could have been at the start of the XVth century.

The live shots present San Giovanni as it is now. These shots were filmed by hand-held camera in the city streets, to highlight some of their most characteristic historical elements, and have been integrated with drone shots. The aerial view is the best way to understand the geometry of the city and it leads the viewer towards the San Giovanni of the past, which appears immediately afterwards, as a virtual reconstruction.
The digital model reconstructs the city and the landscape surrounding it (Figure 2). For the procedural reconstruction of San Giovanni (with CityEngine - http://www.esri.com/software/cityengine) the precise measures and proportions coming from well documented studies on the city were used and some details were realized with photogrammetric techniques (PhotoScan - http://www.agisoft.com/). Apart from these two commercial softwares, most of the work has been completed in Blender (https://www.blender.org/) and in an Open Source pipeline.

In order to highlight a connection with the artistic nature of the character of Masaccio, the video also makes use of the contribution of traditional techniques such as drawing and watercolour painting, which visually and creatively embellish the film.
The ending, with the sequence created in Google Earth, brings the audience back to the present day by recalling a technological tool of common use. Through this solution, it is possible to offer a suggestive and direct evidence of the persistence over time of urban structures organized around precise geometries and shapes.

Mixed media were very effective in order to optimise the production pipeline. The reconstruction of the city started from a .DWG file delivered by the administration and reproducing the current version of San Giovanni Valdarno. The procedural modelling rules were devised using the information given by Puma [4], Bertocci [2] and Bianchini [3] on the road axis coming from the .DWG file. The programming rules of procedural modeling fitted particularly well the rational spirit underlying the original creation of the city, conceived as a set of regular modules distributed in urban space according to a precise logic.
For the chromatic choices, for the buildings and for street furniture, the inspiration was found in the frescoes painted inside the Brancacci chapel, in Santa Maria del Carmine, in Florence [5]. In particular the fresco *Guarigione dello storpio e resurrezione di Tabita* delivered quite a few hints about the colour of the facades of the buildings, the typology of windows and doors and other details, deeply inspired by the curtain of buildings lying on the background of the opera and strongly resembling Masaccio's hometown.

The central part of the video is focused on a communicative effort for explaining the historical origins of San Giovanni and the architectural rules underlying its urban design. In order to improve the effectiveness for an audience of youngsters, we chose a narration relying on different techniques according to what we considered as the best way for presenting the different concepts.
For highlighting the so called "matrix of Arnolfo", that is the geometrical developmental patterns coming from Arnolfo di Cambio urban design, a mix of 2D and 3D is used. As a matter of fact, all the urban elements in San Giovanni, from the design of the defensive walls to the articulation of the four different building lots up to their hierarchy, follow the "ad quadratum" proportioning methodology based on a rectangle whose sides are in relation to each other, equal to the root of two. This system allows to reconstruct in a simple and direct way, starting from a single element in which these laws are codified, the whole design of the city [2].
The rules of proportionality are shown with animations over a simplified version of the procedural 3D model of the city.

A different choice, but always in line with the logic of mixed media, was made for the sequence in which the Vicar illustrates to Tommaso the historical events that characterized the city. The Florentine political and socio-economic strategies that had led to the creation of Castel San Giovanni are presented using 2D graphics realised, in this case, with watercolor and ink drawings (Figure 3). The 2D elements were animated and integrated in Blender with a 3D background, simulating a parchment [6].

Fig. 3 - The use of 2D graphics for summarising some of the historical elements of San Giovanni Valdarno.

Given that San Giovanni is a city of foundation, another central theme in the short video is that of the ideal cities; a subject crossing over the whole history of urbanisation, from ancient times to the present day, passing through the renaissance, regarding cities whose urban scheme reflects principles of rationality both scientific or philosophical.

Fig. 4 - Tommaso imagines some stylization of ideal cities.

To better represent this complexity, the topic has been introduced by the sequential use of different techniques including: 2D digital stylizations, realistic 3D representations and satellite visualizations, such as those coming from Google Earth. The scene down the staircase, in particular, when Tommaso elaborates the information received by the Vicar and "dreams" sketches of ideal cities, combines the animated 3D model of the character and stylized geometries of ideal cities. The latter have been realized stylizing photographs, paintings and images of architectural references in order to highlight the geometries that originated cities such as Grammichele, Avola or Palmanova, in a way that can hopefully impress the mind of a young audience (Figure 4).

After Masaccio's reverie, a brief come back to his time closes the video before displaying satellite images from Google Earth of some of the cities already presented as geometric skeletons. The aim is to underline the importance and persistence over time of urban settlements designed as rational systems. The Google Earth sequence shows how many cities around the world have retained their original structure and how it is visible even today.
The choice to use this technique for the final part and to keep it even during end credits makes the message more lively. Google Earth is a tool familiar to young people and with an effective visualisation style, very useful for highlighting how ideally designed urban landscapes actually affect the whole world, from Italy, to France and Germany, but also Brazil or India.

CONCLUSIONS

The variety of contents presented in "Il piccolo Masaccio e le Terre Nuove" is a starting point for further educational applications, which can be developed for different media.
For example, the rationale laying behind the educational part of the video can be considered as a lesson in itself about ideal cities: the case study of San Giovanni Valdarno can be a sort of paradigm that, integrated with further explanations about other cities that underwent the same kind of development, can clarify this historical process.

ACKNOWLEDGEMENTS

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CANALS, CITIES, MUSEUMS, LIBRARIES & PHOTOGRAPHY: A RECONNAISSANCE STUDY OF REGENT'S CANAL, LONDON

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Abstract - City waterways are a valuable part of our cultural heritage. Over the years the usage has changed from business to pleasure. Regent's Canal, cutting across north central London since 1820, has a rich social and industrial history. Much of this history has been and is being captured via photographs. Many of these are being lost due to limited museum resources and disparate collections. This paper reports on phase one of a fifteen-month exploratory research project. The research aims to explore ways of aiding image capture, selection, storage and retrieval. We hope to link with researchers elsewhere, especially in Italy.

REGENT'S CANAL & CAMDEN BOROUGH CONTEXT

Canals came relatively late to central London. Canals, for irrigation and water supply, first emerged some 6,000 years ago in present day Iraq (Mesopotamia). Subsequently, canals were built by many others, notably by the Romans. China was also a relatively early mover, including the Grand Canal of China and early development of a lock system in AD 983. Venice is justly famous for its iconic canal-centered build (and there is even a 'Little Venice' at the western end of Regent's Canal). Milan developed its system in the 12th century with Leonardo da Vinci revolutionizing lock technology two centuries later [1] which is widely used today– still more than 400 years before Regent's Canal would be built. The Canal du Midi, built from 1666 to 1681 under Colbert, minister to Louis XIV, connects Toulouse with the Mediterranean and stretches 240 km with almost a hundred locks; this is now a World Heritage site. Today, the country of canals, the Netherlands is especially suited to their use due to being small and flat and having a substantial population, industry and commerce.

Regent's Canal was the final link between Midlands industry and London, then the world's largest port: an extension of the Grand Union Canal running from Paddington Basin to the Thames at Limehouse Basin. It was termed 'a road without ruts', since the corresponding road systems were lamentably poor; moreover, the existing water route via Oxford was much longer. When the Regent's Canal was constructed 90% of its route to the Thames was across agricultural land. Its hinterland now comprises five central London boroughs: Westminster; Camden; Islington; Hackney and Tower Hamlets with a joint population over one million. Building the canal began in 1812 at the tail-end of the Napoleonic Wars; arduous planning, negotiations and financial capital-raising extended into the construction period which lasted until 1820. A notable milestone was reached in 1816 when it was opened to Camden Lock. Important personalities and organizations were involved such as the leading architect, John Nash, responsible for Regent's Park; the Prince Regent [later King George IV]; the Houses of Parliament (Special Acts were necessary); local authorities and numerous other stake-holders. The work included the creation of all the necessary infrastructure such as bridges, tunnels, towpaths for the horses and donkeys, water- pumping stations; locks and even lock-keeper cottages. London's Canal Museum at King's Cross provides an historical picture *'-- about the lives of the workers, the cargoes, horses and how canals work.* Conveniently close to the canal for an informative and enjoyable detour, it is a '*former ice warehouse built in about 1862-3 for Carlo Gatti, the famous ice cream maker, and features the history of the ice trade and ice cream as well as the canal's.* [2]

The great Canal Era proved to be somewhat short-lived in London. The first commercial Steam Engines had already appeared in mines and other industrial applications well before the Regent's Canal construction work began. The canal system was quickly outperformed in speed, engineering and economics. At the beginning of Queen Victoria's long reign in 1837 the canals were already in relative decline although still increasing in tonnage carried. The Railway Era had arrived but canals still played a strong supporting role in London until well into the 20th Century.

The Borough of Camden is extremely heterogeneous; it stretches from Bloomsbury's graceful green squares and part of Covent Garden in the south to Hampstead Village high up in the northern end; from 'posh' Primrose Hill in the west to mixed but gentrifying parts such as Kentish Town in the east adjoining the neighbouring borough of Islington. In the centre lies not only lively Camden Town but also one of the most deprived parts of Europe: Somers Town bifurcated by Euston Station. Camden borough's diverse population of just over 300,000 is multiplied by the floods of commuters, tourists and visitors, the latter especially on weekends and holidays.

The Regent's Canal with its immediate hinterland curves like a ribbon through Camden Borough. From the London Zoo (shared with Westminster borough) in the west to King's Cross in the east is only about a mile, but it – and its immediate geographical context - contains the vibrant centre: Camden Market (Lock), the largest street market in London [3]. Camden Market is now the main pull factor, especially for tourists and visitors from abroad and the UK, but there are numerous other cultural and historical places to visit. The northern side includes the new University of the Arts (UAL) Central St Martin's campus, the Roundhouse Theatre, the new King's Place Concert & Arts Centre and the London Canal Museum, the latter just over the borough border in Islington. The southern part of the ribbon embraces the British Library, three mainline railway termini (Euston, King's Cross and St. Pancras) and the splendidly revitalised Victorian St Pancras Hotel. On both banks there are art murals and striking graffiti on the walls, greenery, stark industrial heritage buildings, modern apartment and office blocks with enormous towering cranes. In the next phase our research will extend its geographical context westwards to embrace the Borough of Westminster.

FORTY YEARS AGO: CANAL BOAT & PHOTOGRAPHY EXPERIENCES AND THE NEED FOR PRESERVATION

The personal recollections of Graham Diprose describe his early experiences as a photographer working on canal boats and succinctly provide a compelling case for the preservation of photos of the canals:

> *'My own interest in canals dates from over forty years ago, when as an unemployed college leaver with a qualification in photography, I became a volunteer assistant coal merchant on the Town Class Large Woolwich Narrow Boat 'Alton'. This was being restored by the Narrow Boat Trust* [4], *of which at some point or another, I ended up as chairman for a year or two. Almost inevitably, these two strands combined, particularly when I became an assistant photographer in a studio over Belsize Park Underground Station, just north of Camden Town and the Regents Canal. Apart from taking some pictures of my own, I also became involved in copying and restoring old Black and White photographs of London's Waterways and those of South East England for two books by Martyn Denney* [5], *a friend from childhood. Sometimes I was copying tiny prints, while on other occasions we were offered a series of glass negatives that had never been printed. As word went out among the canal community that we were looking for new and unpublished images, soggy shoe boxes would arrive, rescued from some dead relative's decaying garden shed. Many were beyond saving. Some were well fixed or sepia toned for*

longevity, while others would already be fading to a pale yellow, bronzed with a metallic silver surface, or green with mould.

When we visited local council and waterways orientated museums, curators would often tell similar stories of random boxes of prints arriving, sometimes left on the doorstep after hours. Some would become among the most iconic and well recognised and republished images of London's canals, while the fate of others often rested on whether unskilled volunteers could document and do any rudimentary preservation on these images to ensure their survival to the present day. What had survived, or been lost forever, was totally by chance and random in nature. Perhaps this particular example could be repeated in many thousands of different historical subjects and topics, but as waterways provided a particularly interesting and well covered subject for early Victorian photographers onwards, it provides a particularly thought-provoking case in study.

Probably millions of photos of the canals have been taken over the years. Many of the photos have been lost or are not available for public access, which is as true for old prints as it is for modern digital images. Although there is substantial interest in the canals, which is being documented, much is being lost. How is even a specialised museum curator to decide which photos is are more in need of "saving" when there are so many?

Images in the form of digital data are already proving to be far more fragile than either Victorian Black and White prints or the Colour Dye Images of the 1950's to 2000's. Canal and Waterways small museums/archives are particularly vulnerable, due to very limited funding and in many cases, poor IT skills. Voluntary assistant curators are often in their retirement years. "Born Digital" images are at greater danger of losses than digitised silver- based images; in the latter case, the original can still survive and be digitised again.

Waterways Museums tend to be poorly funded and staffed by unskilled voluntary labour, which means that any donation of historic canal pictures on film (transparency or negative) risks being hidden away in a box and later discarded to make more space. There is considerable pressure to apply for Lottery and similar Heritage Grants in order to digitise both Black and White prints and Colour images. This is most laudable from the point of view of sharing their collection online to a wider audience, although it can raise issues over lost revenue, where print sales would previously have produced a revenue stream. However, there remains among many curators and the public the belief that canal image digitisation 'preserves' the images for longer.

One can liken many of today's museum curators who store their digital collection on CD, Hard Drive or RAID (redundant array of independent disks) storage, to those Museums that carefully archived the wonderful early silent movies of the early part of the last Century in thousands of tin film cans; when opened the Acetate Film inside had either disintegrated to dust or was otherwise useless. When we consider archiving digital images over the next 50 years or longer far more consideration needs to be taken of "Bit Rot". This could be due to non-migratable file formats, data simply disappearing while being stored or even during repeated migration to file formats and hardware beyond our present comprehension.

The historic images presently in archive in our waterways museums are survivors. There have been massive random losses of the photographic records of not only industrial and transport systems but also of the people and communities that initially fired much of the Victorian Industrial Revolution. Digital images are an even more fragile form of image storage, much of which is unlikely to survive the next 50-100 years even in well-funded and highly skilled museum environments let alone in small archives and institutions. There is a need for a structure and guidelines in relation to preservation, including education on the "dangers" of digital preservation. Such guidance should be used by funding bodies as well as museums.

PRESERVING PHOTOS FOR MANY GENERATIONS

Diprose and Seaborne [6] propose archiving vital images and documents as hard copy inkjet prints, not in place of digital storage and migration, but rather as an insurance, using established conservation methods and acid free paper and pigments. This would, in effect, be a means of sending our most significant artworks, digital photographs and documents forward into the 23rd century. The images could then be recovered from the print-out with minimal loss using whatever capture or scanning technology may be available in the future. There have been some initial attempts at such an insurance policy; below we present three previous long-term photograph preservation case studies and one new one. Born digital photographic imaging does present an interesting opportunity. We already know from previous research [7] that certain combinations of pigment inks in a few digital printers, combined with particular acid free, non-baryte unwhitened rag papers can produce digital prints with an expected life of 350 years plus.

Case 1: Thames - London's Changing Riverscape. In 1997, Mike Seaborne, Charles Craig and Graham Diprose made a continuous photographic panorama of both banks of the Thames from London Bridge five miles downstream to Greenwich: a remake of a panorama first photographed in black and white in 1937 for the Port of London Authority (PLA). Concerned that the newly created digital TIFF files would not outlast the 1937 Silver Gelatine original, even entrusted to the Museum of London's considerable expertise, they convinced the PLA that the safest way to ensure that the new digital panorama would survive for their bi-centenary in 2109 was to make an ink jet printout to match that from 1937 with the same lengths of sections and locations. This allows any river location to be viewed simultaneously with the 1937 and 2008 versions placed side-by- side.

Case 2: River Thames Revisited. In a further project by Diprose and Robins: '…in the footsteps of Henry Taunt' sponsored by English Heritage, the photographers digitally revisited the hundred or so 'tripod spots' of the first Victorian photographer to document the entire length of the River Thames. Their new digital images went into the Archive in Swindon, alongside Taunt's Silver Gelatine Prints from 1860-1920, but again, to avoid the possibility of photographs from 130 years ago outliving their new digital images, the whole project English Heritage National Monuments Record (NMR) was archived as A3 digital ink jet prints as well as Tiff files.

Case 3: John Cass East End Archive. This historic and contemporary photography and arts archive was originally planned as a digital only collection. Diprose and Seaborne used the opportunity to explore further aspects of 'sending collections into the future' such as ease of access using multi-image pages on A2 sheets and the risks of losing colour management information during repeated future migrations.

The corresponding EVA 2014 Florence paper [6] provides the three case details; it attracted lively discussion.

Case 4: A New Case Study at Oxford: The archives of University College, Oxford University hold precious documents and images going back to the Renaissance and before. This case will be presented at EVA London 2018 [8] by Graham Diprose, Michael George and university archivist Robin Darwell-Smith.

These four case studies indicate that the very long-term preservation problem is attracting increasing attention. We hope for much more debate on the concept, scope and details but emphasize that this approach is 'an insurance policy' for solely digital methods, i.e. in addition to whatever new innovations will appear, not as a substitute. Moreover, it is proposed for just a small selected sub-set of the images of a museum or collection; this brings up the 'selection dilemma'.

This paper reports the first steps of a potential fifth case study, or at least a 'thought experiment', which opens the possibility of extending the scope of such techniques to the tributaries of museum archives: that is to the personal collections of current and future photographers which – if they are of potential historic or artistic importance – may sooner or later feed into museum holdings as 'trusted repositories' for access. What we hope to produce, inter alia, by mid-2019, from this case study of Regent's Canal is a policy for documenting, recording and then preserving a small number of selected images and their contexts for access and use hundreds of years into the future. There are numerous approaches to short and medium-term preservation of photos and other artworks. We shall explore some of these later in the project.

FIRST STEPS

Creating a Thesaurus

The Camden section of Regents Canal has a long and proud history, its use changing over its two centuries from business to pleasure. It has provided a home for waterfowl, fish and humans. Along the towpaths, and in the water, there are many plants. Every day many people walk or cycle along the canal or spend their breaks on one of the many benches. There are many possible professional users of Regent's Canal photos, e.g. journalists, marketing agents, museum curators and librarians, as well as the general public.

How can all this diversity be captured and made available for retrieval? How can a record of the life on and surrounding a canal be created? One method used by museums to deal with the complexity involved is to create a thesaurus. The Collections Trust, a UK internationally-oriented organisation which aids museums to create documentation standards employing specialised thesauri as appropriate, defines the term as follows [9]:

> *'A thesaurus is a structured wordlist that is used to standardise terminology. It provides the user with a single preferred term from a hierarchy that is cross-referenced to other groups of terms which may be relevant to the subject. Using standardised terminology like a thesaurus to catalogue objects in your museum collections enables you to keep consistent records which give reliable answers when searched.'*

The main purpose of a thesaurus is to aid indexing, structuring and retrieval of specific objects in a collection (or information about these). In order to achieve this the structure of the 'wordlist' is key. In creating a thesaurus to eventually serve as a guide for creation, selection, sorting and retrieval of Regents Canal images, key measurements of success are Ease of Use and Usefulness of Results. If it is not easy to use or (as intuitive as possible a Mac designer might say), or if the search results are not useful then it will not be adopted. A search result is not useful if it either delivers too many results or too few. A too restrictive hierarchy for example would mean that not enough suitable results are delivered, for example an image researcher wanting to find all photos of Kings Cross Basin but only seeing those from the year 2015 - correct classification and filtering would have avoided this error. Creating a suitable structure needs to be tailored to the subject matter at hand, for example, a structure for photos of the life on a canal needs to be different than a structure for photos capturing the life of an indigenous tribe. It is likely that a search for photos of a specific subject will be limited by dates, area or desired perspective. Ideally all this information will be saved with the image for example in the form of keywords, so that retrieval is as easy as possible.

For the hierarchical structure of a thesaurus in this case a categorization via Content is assumed to be the most suitable. For example what do we consider to be the content of life on the Camden section of Regents Canal? Is it the wildlife, such as the ducks, fish and swans? Or the humans making use of these water lanes? Or

the ‘infrastructure,’ such as locks, tow paths and bridges, which also determine what use can be gained from the water? And what other factors play a role? A tentative first selection of categories can be made as follows (see Figures 1-7 for examples)

- **Nature - e.g.** Flora and Fauna, Weather, Water
- **Canal Infrastructure** - e.g. Locks, Moorings
- **Humanity & closely related objects and activities**, e.g. Narrow boats, Canoes, Graffiti, Walkers

Some examples of key search related questions still to be tackled are "How to choose a category if a photo includes elements of various categories (e.g. Ducks swimming in front of a narrow boat just approaching a lock)? How can relevant preservation information best be included? Envisaged next steps include comparing the initial thesaurus with museum thesauri on similar subjects as well as the types of structures used by historical photo libraries and commercial stock agencies (briefly discussed below). After the first iterations, which will probably include more substantial changes, the thesaurus will be enriched with suitable definitions of the terms used and the desired scope of the categories.

Current Photo-library and Microstock Agency Practice.

We made an initial trial search of one photo library and one microstock agency. Founded in 1964, the Mary Evans Picture Library [10], a specialist historical photo library (partnered with Alinari), currently have ‘only’ half a million images online, adding about 100 daily, with categories and tagging. The term ‘Regent’s Canal’ had 44 hits, all but one being black & white as to be expected from an historical archive. In contrast, Alamy, a large agency based in Oxfordshire with a reported 127 million ‘images, vectors and films’, the majority in colour, increasing by 100,000 per diem, was founded in 1999 [11]**.** They also use a category and tagging system for classification and retrieval. The search term ‘Regent’s Canal’ returned the high figure of 7,529 stock photos and images. Drilling down from top-level categories is required and we shall consider leading current practice for photo libraries in the next phase of our research. However, this first comparison shows the much greater current image resources available from microstock agencies, but they do not have (yet) the historical resonances of, for example, a photo of a narrowboat from a century ago.

We close by referring to an aim regarding evolving from ‘multi-disciplinarity’ to ‘interdisciplinarity’. For our work we define Interdisciplinary Research as: ‘Bringing together different perspectives, experiences and backgrounds to enable a more holistic approach’. ‘Multi-disciplinary’ may be regarded just as a set of different disciplines. The evolution from one to the other will be observed as the project advances further. We will also consider other perspectives: walkers, boat dwellers and office workers, such as this office-based journalist admirer of the Canal:

> *‘For the past two summers, from windows in the Guardian office in London adjoining Regent’s Canal, I have watched a pair of swans raise two flotillas of cygnets. She broods, he patrols, and the young ones go from fluffy cuties to scruffy teenagers who stay in line far less during family outings on the dark water between the moored barges. It’s a rather peace-inducing flash of nature in the relentless, hard-edged crush of this great city.’* [12]

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Figures 1-7. Examples of Nature, Infrastructure and Humanity on the Regent's Canal

Figure 1. A Hungry Visitor

Figure 3. Winter Arrives

Figure 5. Lock and Building in Progress

Figure 7. Fun on the Canal

Figure 2. Gulls, Ice and Industrial Architecture

Figure 4. The Ice Retreats

Figure 6. Camera Happy Tourists

Photographs by Christina Hemsley
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3D VISUALIZATION: REVEALING IMAGERY SPACE BY TECHNOLOGICAL PARAMETER

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Abstract: **The paper examines several examples of visualization common to the contemporary Russian scene, which 1) follow the long tradition of elaborating texts; 2) are developed on the border between the science of geography and visual art; 3) belong to the sphere of amateur production that by trial and error method propose a special 3D filming as a proper way to present an archive. Among other projects concerned with questions of memory work and its visual presentation, it is the latter one that orients itself towards the possibilities of the future.**

The technological development knows no boundaries, and in Russia, as well as in other areas, it makes the work of translation of cultural heritage in digital format possible. As usual, local context sets the direction of how visualization technologies would be applied, what parameters would be chosen to structure the process of visualization itself. The following is based on the hypothesis, that Russia's context is in many ways determined by the length of extended territory and «the feeling of space». Accordingly, visualizations often seem to be guided by imagination categories and have map as their principle model. These characteristics form the frame in which IT programmers embed their encoding and build visual presentations of their products.

After the euphoria of the 1990s, the state was to pay attention to cultural heritage. New technologies are being used to register the conditions of various objects that need to be preserved, to predict the future without any premises, as in the case with Zariadievo park pavilion, but often they also reveal for the first time something that was produced dozens of years ago, survived the revolution, underwent the first decades of Soviet era and was nearly forgotten after the war. This is the case with 1) film restoration and 2) stereoscopic cinema. Both are part of long tradition that has an origin in avant-garde movements common to Russia and European counters, and present a normal activity within the visual field today. Digital mixing of color-separated negatives, time-lapse image restoration of color animated films shot according to Soviet tricolor system, such as «Santa Claus and the grey wolf» (Lenfilm studio, 1937), «Winter's tale» (Soyuzmultfilm studio, 1945), «Carnival of flowers» (Soyuzdetfilm studio, two-tone system, 1935) and others, are a part of the transfer work that uses new technologies to open to the public the archive of visual heritage [1]. These films are being presented to public already in the new elaborated form, and it is questionable whether anyone except specialists would be able to watch them in «old», almost unrecognizable form, since current technologies seem to change the habits of viewing and watching dramatically. But this is the question to be asked again on behalf of the last example here.

Another way to use new technologies of visualization is also rooted in the development of film production, this time related to the stereoscopic cinema. An outstanding film director S. Eisenstein was a known connoisseur of stereoscopic cinema, he considered it the technology of tomorrow: «.. this is much dynamic drama! - the interaction of the foreground and depth, from which it actively emerges, breaking the foreground» (1947). He had obviously an experience of watching films of that type, since the first stereo cinema was opened in Saint-Petersburg in 1911; the world's first

glasses-free stereo cinema was opened in Moscow in 1941.
The development of a glasses-free system started at Scientific Cinema-Photo Institute with the use of a raster screen, proposed by the inventor S. Ivanov, in 1937. The raster stereo screen provided the formation of the so-called zones of selective vision of the left and right images of the stereo pair, these zones diverged from the center in a horizontal plane at the level of the eyes of the audience. First films based on Ivanov-system were done with the placement of a stereo pair in the area of one frame of 35mm film. The first film in this system was "The Concert" (director A. N. Andrievsky, cameraman D. V. Rusenski), shot in 1940 and shown on a wire raster screen at the Moscow stereo cinema in 1941, that is, right before the war.
Although now the adherents of stereoscopic cinema exist, seem to have their niche and promote their art of making cinema, touristic products, exhibition design etc., I traced these examples rather to indicate that after avant-garde period they were replaced by visualizations of another type, namely those connected with «written word» in general and literature in particular.

Expanding the text images

The proportion of the visual in the cultural production, perception, and habits needs to be pointed out. On several reasons it's so occurred in Russia by 19th century that generally the word had more cultural weight than the image. One could even speculate that historically the visual context was changed so violently for so many times, that it finally affected the way of visual perception itself in such a way, that it can be given only a subordinate role. Apparently, it is necessary to speak about it in the present time, because in some examples it is obvious that it remains so, since the most frequent translations into digital format are the translations of written documents and ”great Russian literature".

Therefore, these visualizations are inscribed in what is now called «computational philology». They are being made by institutionalized specialists in philology (though it is claimed that linguists, philologists, historians, culturologists, computer science specialists and media designers work in these laboratories side by side, de facto they unite mainly linguists and philologists). Accordingly, their main interest is still work with texts, and these are texts that they «visualize»: no work of Russian avant-garde artists, video art or Japan manga, but solely manuscripts. The corresponding concept of visualization is quite showing.

I'd like to demonstrate it on the example of Digital Humanities Center, a small branch of the faculty of humanities of Higher School of Economics, Moscow. Organized in 2016, the center declared to work at the intersection of computer methods and knowledge of humanities; with intention to pay special attention to the practice of digital publication, methods of network analysis and computer analysis of literary text, the creation of genre structures and electronic tools for research in humanities.

Their projects include : world map of scripts (the user clicks on certain region on the world map, a side window opens and shows details of the language, alphabet and scripts to be loaded if needed); Persian poetic corps; a parallel presentation of the different translations of the "Poetics" of Aristotle (clicking each section of the text coded in figures opens a file with original version, then 3-4 translations into Russian made in different periods of time, then English and other versions, including Persian; one following the other, loaded in one file, no visualization techniques added) , network analysis of drama and similar others. Their another project is the Easy Linavis Web service that allows to quickly turn text or other data into a graph and explore it using network analysis methods; programming skills are not required.

This laboratory took part in another massive project, "Tolstoy in one click", in collaboration with Samsung Company that developed special apps, and the State Museum of Tolstoy, guided by one of the great-granddaughters of the writer. The level of interaction with the audience was valued as extraordinary (in two weeks people of different professions and age : engineers, IT professionals, doctors, teachers, geologists, linguists, students and other participants from 49 countries read all 90

volumes, or 46,000 pages of the works of L. Tolstoy. At the first stage, the participants had to download ABBYY Fine Reader and check all the texts to eliminate possible errors that occurred during digitization. The second phase of the project involved a more thorough proofreading of the texts. After the third, final proofreading the results were converted to PDF with a text layer, and also in e-book formats .fb2 and ePub), while visual side was, again, very simply organized. Obviously it was not the main task, to make Tolstoy's texts visual, but only to make them readable because downloadable. The main objective of the semantic marking of Tolstoy's electronic publication was to reproduce, at a new technological level, metatext information, critical apparatus, comments and pointers accompanying Tolstoy's complete works edition. What the authors call «interactive graphs of the relationships of the characters of the novels» and «visual analysis» is at best a kind of a static map, or better a diagram where lines are drawn between schematic «portraits» of characters.

Before going further let's fix this connection between visualization and a static map that presents itself in all above mentioned examples: you see the connections between extracted elements when you imagine the novel as a whole, a vast world of all existing languages, or a long treatise. In a way, one does not need this type of visualization if she or he reads attentively and knows what the text is about. The weight of visualization is set by the fact that its object can be seen on the screen of PC, though in its still textual form. It seems to remain a part of a written archive, an archive of utterances, rather than a mediated visualized from that new technologies allow producing.

Nevertheless, there is one more type of examples which on the one hand uses data obtained in different ways (not written text only or pictures exclusively, but necessary archive work) and, on the other, combines it with map-like presentation. This is the case of Dynamic Gulag Map, being done in collaboration with Oxford University, Great Britain. A geographic information site of several regional maps showing how the Gulag shaped the landscape in the Soviet Union's peripheries and of the countless number of people who came through them. The geography of the Gulag was complex and penal institutions were not fixed in time and space, some local places have long since disappeared from site, overgrown by forest; some continue to perform the same role in the present day. «The distinctive geography of prisons demonstrated on this site goes some way to explain why certain elements of past practices still plague the penal system, such as the *etap*, or prisoner transports, that can run into weeks taking up new rights to visit prisoners» [2]. This example is boundary also in the sense, that visualization here is neither an entertainment nor heuristics or epistemic tool: it literary or better formulated, in conventional visual form of several simple maps (and some of them can be applied one onto the other by the viewer) opens the distant land for the viewer's imagination.

Though here, too, a kind of discrepancy between the formulated tasks and final (though changing upon new information being collected) visual form is obvious. As philologists intend to «visually analyze Tolstoy's roman» and do not show how it could be done in their de facto absent visualizations, the organizers of Gulag maps, doing their uneasy project write of «optimal way to represent the data» and «coming to new analytical indicators with the help of spatial analysis methods», and again, restrict themselves a lot with presentation techniques and visualization capacities.

Between artistic production and scientific research

A group of complex visualizations appear at the junction of art and science, namely the science of geography, the emergence of the latter is not surprising if one bears in mind the mapping tendency in visualizations that was already pointed above : S. Gavrilova needs visualization to take the distant peninsula Chukotka from the imagery zone and present it as a "Not-mainland" (the flight Moscow - Anadyr is the longest in the world over the territory of one country); going in the opposite direction a cultural geographer M.Kaluzkov seeks to explain the artistic work by means of the peace of the land where a work of art was created.

S.Gavrilova, a professional geographer and then an artist, a nominee of Kandinsky Art price (2012), spent some years studying various zones of the country: the current state of the territory of the Leningrad blockade ring, empty spaces of the main building of Moscow State University, visually reopened the territory of New Moscow turned into a big construction site. Her video installation "Pits" shows landscapes, built on the scheme of geological samples. Meditative contemplation of landscapes, similar to the content of the "tubes", allows focusing on the very horizon, which is often hidden in the urban areas, but serves a necessary part of our worldview. Landscape panoramas, applied to the mirror surface, offer images to be completed by the viewer, relying only on its visible parts. This work literally explores the emotional sensations that arise because of a forced change of environment, when the viewer tries to complete the picture by only the fragment of it, sweeping away what surrounds her or him at the moment of exhibition.

All together allows understanding the connections between these landscapes and the viewer of the exhibition, and what they are in. According to the artist, thus formalized experience is specific. You cannot see «live» those kinds of landscapes that are presented for viewing, because many of these areas are rebuilt, some wasteland overgrown, some filled with something else. Time passes, and the landscapes change, and those at the exhibition are moments of their existence, which the artist visited, whether she was in Karelia, the Urals or the Far East.

This specific balancing between imagined territories and viewing them «in real time» which necessarily adds to these visualizations a tone of simulative construction, seems to be more appropriate strategy in the land where population long had to invest more in imagination then in memory. On the one hand, people of this land still tend to evade solving the extreme problematic questions of politics : revolution 1917, concentration camps, dissolution of Soviet Union etc., on the other, they do not seem to expose demur against visual activity linked to these events, such as not numerous film representations, posters etc. Probably the answer is that they seem to be more trained to be more or less critical when the text is concerned, and are able to tolerate a lot in the visual sphere, in the sense that visual is not exactly «seen», it is not a part of everyday experience. One of the reasons is that a new proletarian state demanded a «new look» of city streets, new people (no bourgeoisie), new visual system. It was necessary to introduce this system as the best in the world. For example, the famous Moscow subway was not built simply as transportation system, but as an outstanding work of art, a "glee space." Processes of making visually all new world could be described by the formula, taken from the International, a hymn based on a poem by French poet Eugene Pettier (1871) : «The whole world of violence we destroy to the ground, and then we have ours, we construct a new world ...». This aspect of "destroying to the ground" is to be stressed, as this seems to be a guide to understand how the visual sphere is worked through: this is not just a rejection of old monuments, this is their destruction; physical, material, cleaning "to the ground," no poetic treatment of ruins, or at least practical use for them; it desired no layers and did not intend to keep any.

Strangely enough the erasure-construction process did not stop, although formally, "Soviet logic" should have ceased to exist after 1991. It renews itself in the desire to erect something new while sweeping away the old, in the belief that the new is better, more modern, and more functional (these three arguments guided the construction of Moscow-City). There seems to be a problem that constant erasures do not allow the gaze to turn back in order to see what it slips upon. These processes made normal the situation in which it is not monuments that trigger the work of memory, but other things – and very often they are private things – which cannot be united into something big and standing on the square, like toys played by two or three generations of family members, or some crockery pieces, or family photo albums. There seems to be no level of commonly accepted visuality.

Thus the elaboration work seems to be done primarily within the sphere of the visual, whatever imagery, and utopian, blind it can be as an objective of cultural heritage preservation. Though Great Russian literature covers a big amount of the cultural worldview, thought it cannot do without

visual technologies today. Though land is important, it cannot produce its own images, since at some places it is still wild and almost undeveloped, at the others it has mixed layers of different often destroyed cultures that need to be reinstated in a manner which would be probably a supplement to "the self-framing of earth" [3,4] and forensic constructions [5]. Therefore a tiny and accurate, preferably indirect work seems to be a proper tactics of visualization. That is why examples similar to Gavrilova's seem to be showing the slow graduate elaboration of events and their places that not only make look back and remember, but help to watch ahead, and see how they can be unwrapped in the visual sphere today.

«To keep or to throw away»: stereo pairs in a 3D-film

The last example of visualization would be an amateur one that seems to be more striking then professional videos of Gavrilova. Perhaps to some extent unconsciously, it combines characteristics that were outlined above: the restoration of stereo images produced almost a century ago that pose questions of how we are able to percept a technique which is not commonly used today; the relation to the past (not necessarily in the form of memory, but imagery, too), the place of literature, text and «pure visuality», an archive, the simulative construction, and the map. Last but not least this is an example of a vigorous activity directed by images that finally led to a 3D visualization, an active work with the sphere of the visual that is so necessary today.
In the subtitle are put the exact words of the inheritor of the photo archive of Russian photographer S.Chelnokov uttered to explain the main task in a personal talk. The archive consists of more than one and a half thousand glass slides and negatives (mainly stereo pairs) and a series of colored slides in the technique of autochrome, all made between 1880 and 1917; it also includes Taxiphot apparatus for viewing stereo pairs of small format. The collection of autochrome (50 color diapositives) is more than the entire collection of Polytech Museum in Moscow, and this fact is very showing for the intermediate status of this archive : it is somewhere between private and public, between visionary phantasies and documented reality, between garbage and work of art, between two countries, between past and future.

The undecidable status of these images was a riddle for the successor and the inheritor of this archive. He was not working with the visual professionally, not at any level. He never photographed himself or worked for any institution dealing with images, museum or gallery. Furthermore, he had no specific training to be able to watch stereo pair that he inherited. Of course, he has eyes inhabited with modern technologies of making/watching images (iPhone apps etc.). He explained he just couldn't see them because he couldn't figure out what he was seeing — and that's very characteristic. He could not decide what to do with them because it was unclear to him whether they were interesting or should they be thrown away. That is why, out of inquietude, he began to look for ways to watch them collectively.

This is how the story of presenting the Chelnokov archive to the public began, at present moment it includes: an album of printed photographs where each page contains one photograph converted from a stereo pair[6], the international conference dedicated to photography in general and Chelnokov archive in particular; an exhibition (September 2017-February 2018, Manage Gallery, Moscow) that consisted of demonstration of several stereo pairs, a (necessary) map of Russia with incorporated stereo pairs indicating places which Chelnokov visited with his camera, and finally a 3D film produced from stereo pairs.

The latter is the most successful way to open Chelnokov's photographs to the wide audience, because on the technical level it creates the space between two photographs of an each chosen stereo pair, and at the same time manages to keep the movement of an eye tracing possible links between figures inside the frame. Certainly this combination was not possible at the beginning of the 20th century. However, it does not come close to the contemporary model of 3D film either, since it does not seem to create a feeling of three-dimensionality in the viewer by kinetics of visual images, though it still has music underneath and background voice pronouncing a kind of literature

narrative loosely connected to the images seen on the screen. It is also a step aside from the cinematic tradition to present a sequence of still photos without travelling («La jetée» (1962) is the most famous in this series). Thus the inheritor of Chelnokov's archive and his colleagues proposed a technology of visualization that uses new media differently: on the one hand, apart from contemporary usage of technology, on the other hand, creating a supplementary view of old photos. This is a way by which a technology allows viewing these photos "for the first time", notwithstanding the fact that they've materially existed during almost a hundred of years.

Of course it is rather a construction, not merely reconstruction; it contains clear signs of «today» manifesting the specific media shift, but exactly this opens new perspectives in what was considered familiar, what was considered "heritage". This constructive converting of Chelnokov's photo archive into specific 3D film makes these stereo pairs a part of contemporary visual field since it is being brought out of oblivion, but in addition this visualization demonstrates how the future can be open as a variable, how the work with the visual by visual technologies can be done.

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A TECHNO SOCIAL COLLABORATIVE PLATFORM TO MANAGE OPTIMIZE AND CROWDFUND CULTURAL HERITAGE INITIATIVES

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Abstract – This paper presents the first results of HERIBITS, a research project co-funded by the Tuscany Region Government, under the Operative Regional Program FESR POR 2014-2020. The project proposes an innovative methodology as well as advanced technology platform enabling a new paradigm for bottom-up and top-down management of cultural heritage initiatives. The techno-social platform integrates collaborative tools for CrowdSourcing, as well as analysis tools for rating project ideas and evaluate socio-economic impact, to propose best practices and to detect similar initiatives in order to avoid project duplications. The platform provides also social network capabilities and integrates an ad-hoc CrowdFunding shop.

INTRODUCTION

Cultural initiatives such as the protection and enhancement of cultural heritage, the promotion of local identities and the impulse to cultural tourism often suffer of a chronic inability to effectively engage and spend substantial community and national resources for underdeveloped areas.

In fact, there is virtually a lack of structured methodologies that provide the correct time to market of planned initiatives, as well as the alignment of projects to industry best practices and a coordination of cost centers, avoiding duplication and lack of critical mass.

This paper introduces the results of the research project HERIBITS, co-funded by the industrial research program “Bando Unico della Ricerca” issued by the Tuscany Region. The project proposes an innovative methodology as well as advanced technologies enabling a new paradigm of collective awareness in the planning, sourcing and execution of Cultural Heritage initiatives.

The objective of the project is to prototype a software platform able to support the process of selection, design and implementation of a large scale of initiatives of cultural innovation, ensuring: (i) timing; (ii) sharing from the bottom; (iii) the quality of project management by comparison with certified success cases; (iii) the socio-economic effectiveness by effective and objective methods of rating; (iv) sustainable integration in the social fabric, through a direct participation of the stakeholders involved; (v) sharing between regions, adopting proper communication and sharing initiatives.

To this end, the project will develop techniques to use linear funds to manage the exponential complexity of the aggregated cultural initiatives: (i) crowdsourcing and sentiment analysis, (ii) project analysis

and matchmaking, (iii) rating of socio-economic impact and social crowdfunding of project ideas, (iv) adapting and refining the existing methodologies, and (v) integrating them in an original way for the aims of the project.

To demonstrate the method, the HERIBITS project is developing an innovative web platform that will integrate several application modules to crowdsource a project ideas, to optimize them both technically and structurally, to asses their impact, for crowdfunding and stakeholders participation) in a user interface oriented to usability and characterized by a sharp style of organizational communication. This platform can be viewed as a *project factory* based on sharing models of proven effectiveness, integrating crowdsourcing tools as well as assessment techniques to evaluate the socio-economic impact of the initiatives to be implemented.

By implementing *matchmaking* techniques for candidate initiatives to find relevant success cases, the project factory strongly focuses on clustering and re-use of certified existing solutions in contrast to the current state of obsolescence, mediocrity and duplication of projects, amplified by the multiplicity of centers of public spending. In addition this platform provides a mechanism of project management based on *social revenue crowdfunding* solutions involving circles of "social investors" clearly identified as indirect beneficiaries of the innovation projects, in a context of *accountability* and effective communication of the initiatives implemented.

The most relevant areas of innovation are the deployment and integration of a set of *artificial intelligence* technologies (machine learning, neural networks, text analytics, ontologies) to analyse unstructured data and find meaningful relationships (i.e. matchmaking of projects ideas and solutions, identifying new significant evaluation metrics).

The HERIBITS project is also developing solutions of socio-economic analysis of the cultural projects dropping at the project factory, in order to determine their priorities according to their expected returns and to their contribution to higher level development policies. In addition, financing management solutions are adopted based on a crowdfunding engine able to connect the investment projects to stakeholders who will benefit directly or in terms of visibility.

METHODOLOGY

HERIBITS developed a techno-social web platform, able to support shared programming by accepting bottom-up requests, and involving the community in the processes supporting the long-term management of the works carried out. In the current panorama of consultancy services carried out in isolated (and to some extent intentionally esoteric) environment of the regional programming technostructures, HERIBITS proposes a decidedly innovative approach, in opening the process, through appropriate tools, to a Collective Awareness methodology. It is a real revolution, which can, even if with some implicit risk in the methodological novelty, open new markets and effectively change the current rules of the game.

HERIBITS intends to support this transition not only with the "bottom-up" balancing of the traditional top-down logic of programming, but also through the introduction and integration of technical modules able to direct the change towards new objectives, guaranteeing greater socio-economic efficiency. of the shipyards initiatives, their correspondence to criteria of structural solidity and non-duplication, and the rooting of the results achieved over time, according to new shared management models.

We started by reengineering the entire process of conception, formulation and implementation of cultural innovation projects for territorial development, through a critical examination of concrete cases,

and with the support of domain experts. To this aim, we defined a set of key succeed factors as well as critical aspects in need of optimization. Such optimization is realized by leveraging the technical modules of the HERIBITS platform, capable of giving an effective response to the critical issues that have emerged.

Subsequently, we translated the set of requirements and functional needs emerging from the reengineering process into a complete system architecture, defining from a technical point of view the different application modules that the system needs, their operational integration and the general characteristics of the collaborative techno-social platform provided by HERIBITS. (web system with cooperative nodes, inspired by platforms of collective awareness).

Then we realized the technical modules composing the HERIBITS platform, namely: a collaborative tools for CrowdSourcing, analysis tools for rating project ideas and evaluate socio-economic impact, propose best practices and advice on possible project duplications, as well as an ad hoc CrowdFunding shop.

We implemented the modules composing HERIBITS techno-social platform according to an iterative software development process, as foreseen by the incremental and evolutionary software development paradigm known as Unified Process (UP). UP is the process for the development of systems based on UML (Unified Modeling Language) and object-oriented analysis and design (OOA & D), which follows an iterative and incremental approach, guided by use cases and focused on the system architecture.

HERIBITS TECHNO SOCIAL PLATFORM

The HERIBITS platform is composed of the following technical modules: **collaborative tools** for **CrowdSourcing**, **analysis tools for project rating** dedicated to the **a-priori evaluation of potential project outcomes,** to evaluate **socio-economic impact**, propose **best practices** and **de-duplications**, that is advising on **existing similar projects,** The platform, enabled with native as well as third party **social networks** capabilities, integrate also an ad-hoc **CrowdFunding** shop. The key innovative aspects of such modules are detailed in the following paragraphs.

The module for e**xplicit and implicit crowdsourcing methodologies of cultural innovation** is dedicated to designing, modeling and technically specifying the reporting software module from the bottom of design ideas, and of presenting successful cases with storytelling techniques.

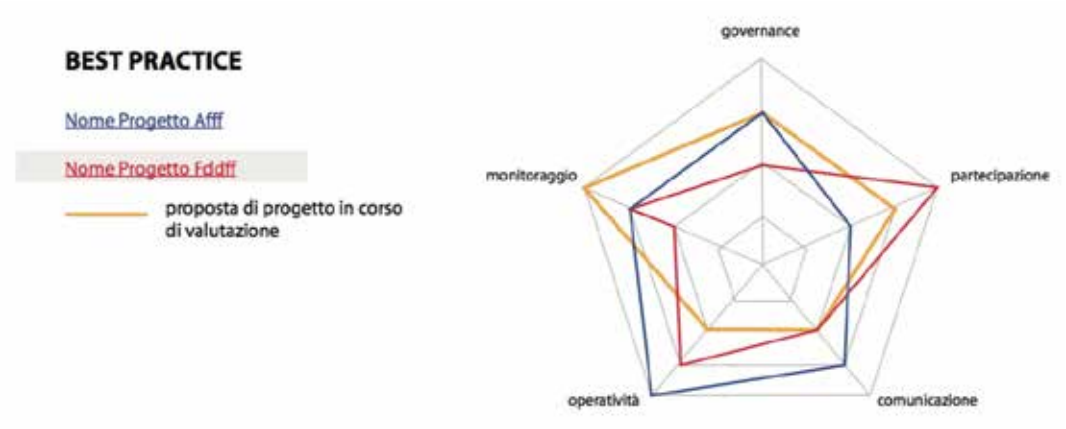
The module for for crowdfunding cultural innovation initiatives is dedicated to implementing the most suitable crowdfunding models and methodologies to maximize the involvement of local stakeholders in the launching and running of new structures and services of cultural and tourist interest.

The module for the **deduplication and best practicing of project initiatives** is a design optimization software module which performs functions of deduplication (analysis of similarities and reconditioning of polygenetic instances to unit models implemented in a shared way) and best-practicing functions, ie analysis the weaknesses of each project compared to the best practices certified, with suggestions for the actions needed to optimize the organizational structure and operational parameters.

To this aim, we defined deduplication and best-practicing analysis models for design optimization, and seamlessly integrated into HERIBITS platform the third party analysis tool ***Asset*** from K4D (Knowledge for Development, a socio-economic analysis consultancy dedicated to public administrations).

The study of a methodology aimed at defining the criteria of deduplication and best practicing was based on the analysis of questionnaires submitted to project designers and/or project partners of 25 tourism and cultural heritage projects. Such projects have been selected in different Italian regions (geographical criterion) and for different types of actions implemented (variety criterion). This allowed gathering information on a broad, though not exhaustive, sample of projects in the sector of interest.

The questionnaire was developed to detect the relevant aspects of the projects following the Logical



Framework Analysis (LFA) scheme.

Figure 1: Best practices

The module for the **ex-ante multi-criteria evaluation of cultural innovation projects** is aimed at developing a model of socio-economic analysis of the projects and their potential short and medium-term effects, based on multicriteria analysis techniques implemented through analysis dashboards and dynamic simulation of simple and composite georeferenced indicators. The aim is to evaluate the projects ex-ante, assigning them specific priorities, in terms of expected socio-economic impact, in order to be able to better allocate the available resources (both public/government and crowdfunding). Also this module is implemented by properly integrating the Asset software tool into the evaluation workflow provided by te HERIBITS platform.

IMPLEMENTATION

The techno-social platform is implemented in the form of a web application, adopting a three-tier architecture. We used the widely adopted XAMP platform (OSX, Apache, MySQL and PHP) which is a valid development environment for web server applications, based on Apple's operating system, the open source Apache web server, with license also for commercial use, the very popular open source relational database MySQL and the server-side scripting language PHP, in PHP5 version with JSON

support, which will be used to implement the business logic. The Symfony web development tools will also be used to make business logic software more efficient.

All the **development frameworks** adopted are cross-platform and implement the Model View Controller (MVC) paradigm, a *design pattern* that ensures portability and interoperability. We also used front-end (ionic2, Angular2JS, ReactJS, vue.js) and back-end frameworks (react2, php + laravel 5, nodejs, sails.js).

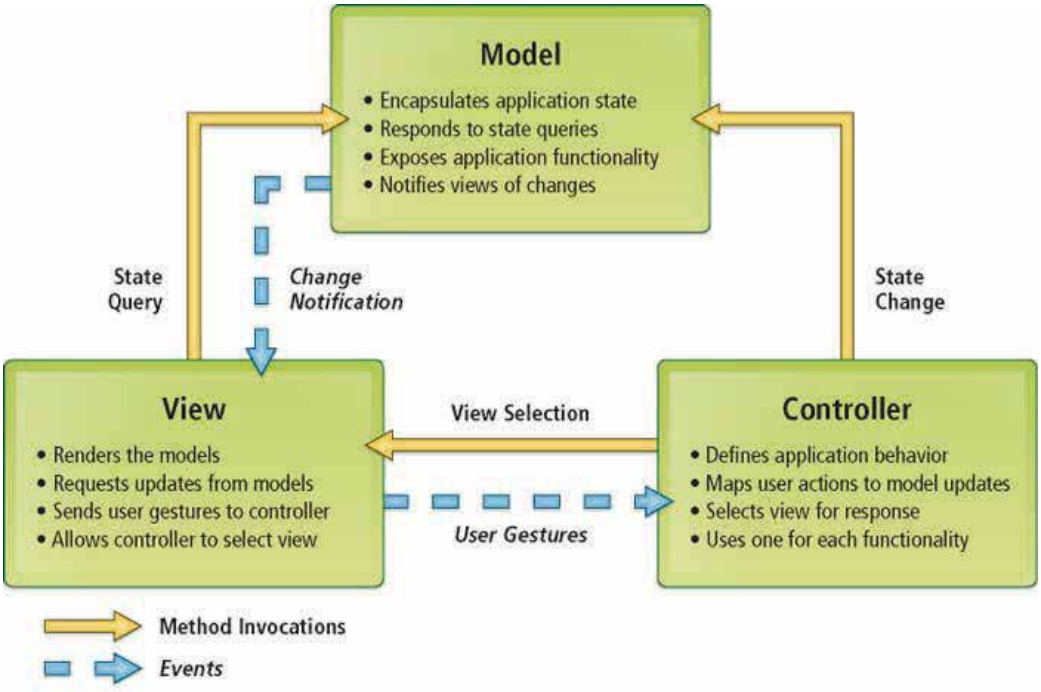


Figure 2: MVC design pattern

For the automatic analysis of non quantitative data from the HERIBITS project database, as well as to mine unstructured information scraped from external Social Network (SN), we used MongoDB as content repository, for its speed in data storage and support for JSON format, a Javascript-based open standard format[1] used to exchange data among distributed web applications and services, widely used by SN APIs and SN aggregators.

MongoDB is a document-oriented NoSQL-Database. MongoDB stores records not in tables as a relational database but in BSON documents, which is a binary version of JSON and very similar to the object structure. The usage of MongoDB makes his development easier and deployment faster.

[1] JSON (Java Script Object Notation) uses human-readable text to transmit data objects consisting of attribute–value pairs. It is used exchange to transmit data between a server and web application, as an alternative to XML

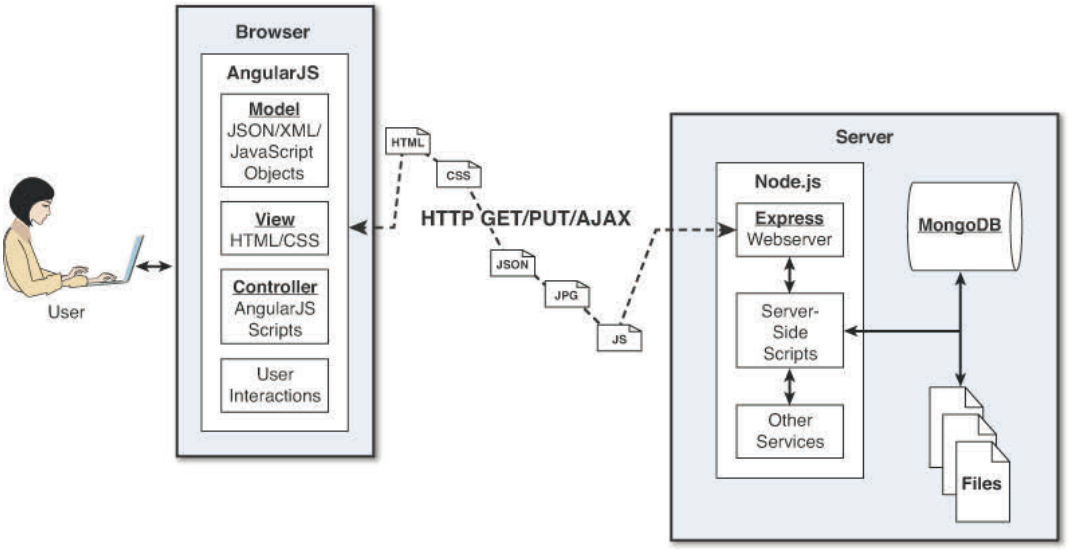


Figure 3: server and client frameworks with MVC

In addition, we used ElasticSearch to query MongoDB, since it is very efficient to query large and complex databases, again with JSON support.

Elasticsearch is used to process the vast amount of content in social media. Many recommendation engines use Apache Mahout[2], we preferred ElasticSearch for a more general support to query data, while Mahout is specialized on user profile data (e.g. Mahout is capable of recommending articles based on user's preference). In addition, ElasticSearch is dedicated and optimized for data query, and it is a perfect complement for MongoDB.

Elasticsearch is a Java-based search server based on Lucene. It provides a distributed, multitenant-capable full-text search engine with a RESTful web interface and schema-free JSON documents. It provides scalable search and near real-time search.

Elasticsearch supports data-intensive distributed applications and implements a computational paradigm named MapReduce (via the plugin Taste from Grouplens). The Taste plugin for ElasticSearch is Mahout Taste-based Collaborative Filtering implementation, providing the following features: (i) Data management for Users/Items/Preferences, (ii) Item-based Recommender, (iii) User-based Recommender, (iv) Similar Users/Contents and (v) Text Analysis.

[2] Apache Mahout is aimed to produce implementations of distributed machine learning algorithms focused primarily in the areas of collaborative filtering, clustering and classification. Many of the implementations use the Apache Hadoop platform

CONCLUSIONS AND FURTHER WORK

This paper presents the first results of the Heribits project, a research initiative to leverage collective awareness and openness in the planning, sourcing and execution of Cultural Heritage initiatives, focusing on the technological aspects of the research.

The project proposes an innovative methodology as well as an advanced technology platform enabling a new paradigm for bottom-up and top-down management of cultural heritage initiatives.

The techno-social platform integrates collaborative tools for CrowdSourcing, as well as analysis tools for rating project ideas and evaluate socio-economic impact, to propose best practices and to detect similar initiatives in order to avoid project duplications. The platform provides also social network capabilities and integrates an ad-hoc CrowdFunding shop.

The first part of the research was dedicated to re-engineering of the process of cultural project proposal and evaluation, through critical examination of real world cases, and with the support of domain experts.

Subsequently, we translated the set of requirements and functional needs emerging from the reengineering process into a complete system architecture, defining the technical modules implementing the different macro functions.

Finally we implemented the collaborative techno-social platform, in the form of a web application with cooperative nodes, inspired by platforms of collective awareness. The system is currently being tested with alfa and beta users, and will be subsequently validated with real users several locations in Italy.

ACKNOWLEDGMENTS

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