Electronic Imaging & the Visual Arts

EVA 2012 Florence

PROCEEDINGS
Editor: **Vito Cappellini**

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9 – 11 May 2012

edited by
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PROGRAM

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.

Main Topics

- Synergy with European & International Programmes
- Mediterranean Initiatives in Technology for Cultural Heritage
- New Technologies in Conservation & Education to Global Access
- Digital Image Acquisition and Restoration
- 3D Developments and Applications in the Cultural Heritage Area
- Integrated Digital Archives for Cultural Heritage and Contemporary Art
- Management of Museums by using ICT Technology: Access, Guides, Documentation & Other Services
- The Impact of New Mobile Communications on Cultural Heritage and Modern Arts Area
- Semantic Webs
- Human - Computer Interaction for Cultural Heritage Applications
- Copyright Protection (Watermarking & Electronic Commerce)
- Case Studies of Leading Edge Applications: Galleries, Libraries, Education, Archaeological Sites, Museums & Historical Tours
- Culture and *e-government*
- Activities and Programmes for *e-learning*
- Virtual Galleries
- Cultural Tourism & Travel Applications
- 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, 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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PROGRAM

1 - CONFERENCE

Thursday, 10 May: 14,30 – 18,25
Friday, 11 May: 9,00 – 18,30

2 - WORKSHOPS

Thursday, 10 May: 9,15 – 13,30
Friday, 11 May : 9,15 – 13,30

3 - SPECIAL EVENTS

Thursday, 10 May: 18,30 – 20,30

4 - TECHNICAL EXHIBITION

Thursday, 10 May: 10,00 – 18,00

1 - CONFERENCE

Thursday, 10 May

ROOM A

Chairmen: *Vito Cappellini, Florence University*
James Hemsley, EVA Conferences International

14,15 *Welcome:* *Representatives of Sponsors and Supporters*

Opening: *Cristina Acidini,*
Soprintendente per il Patrimonio Storico, Artistico ed Etnoantropologico e per il Polo Museale della città di Firenze, Firenze, Italy

15,15 Coffee Break

15,30 **SESSION 1 – STRATEGIC ISSUES**
Chairman: *Paolo Blasi, Università di Firenze, Italy*

"Excellence Digital Archive Project for Polo Museale Fiorentino: Exploitation Activities"

Cristina Acidini[1], Vito Cappellini[2], Takayuki Morioka[3], Marco Cappellini[4]
[1]Polo Museale Fiorentino, Italy
[2]MICC - Università di Firenze, Italy
[3]DIS Project, Hitachi Ltd., Yokohama, Japan
[4]Centrica, Srl, Firenze, Italy

"Stories and History - Digital Archives of the Staatliche Museen zu Berlin (National Museums in Berlin)"

Andreas Bienert
Staatliche Museen zu Berlin - Stiftung Preußischer Kulturbesitz
Dept. ICT, Berlin, Germany

"Open Low Cost HA Cluster Cloud for 'Biblioteca Nazionale Centrale di Firenze'"

Cristiano Corsani[1], Giovanni Toraldo[2]
[1]Servizi Informatici – BNCF, Firenze, Italy
[2]Liberosoft, Firenze, Italy

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ROOM A

16,45 **SESSION 2 – EC PROJECTS AND RELATED NETWORKS & INITIATIVES**
Chairman: Franco Niccolucci, PIN, Prato, Italy

"A Metadata Schema for Cultural Heritage Documentation"	Paola Ronzino[1], Franco Niccolucci[2], Sorin Hermon[1] [1]STARC, The Cyprus Institute, Nicosia, Cyprus [2]PIN, Prato, Italy
"The ENArC Project Visions and Activities"	Benedetto Benedetti[1], Stella Montanari[1], Thomas Aigner[2], [1]Scuola Normale Superiore di Pisa, Pisa, Italy [2]International Center for Archival Research, Vienna, Austria
"Documenting Abu Simbel: The 3D-COFORM Approach"	Franco Niccolucci[1], Denis Pitzalis[2], Mike Spearman[3] [1]PIN, Prato, Italy [2]Universitè Pierre et Marie Curie, Paris, France [3]CMC Associates, Edinburgh, UK
"3D-ICONS: European Project Providing 3D Models and Related Digital Content to Europeana"	A. D'Andrea[1], F. Niccolucci[2], K. Fernie[3] [1]Università degli Studi di Napoli L'Orientale, Napoli, Italy [2]PIN, Prato, Italy [3]MDR Partners, London, U.K.
"Personalized Access in the Cultural Heritage Sector"	Andrea De Polo, Francesca Tavanti, Dept. of R&D Projects, Alinari 24 Ore Spa, Firenze, Italy

Friday, 11 May

ROOM A

9,00 **INTERNATIONAL FORUM ON "CULTURE & TECHNOLOGY"**
Chairman: Vito Cappellini, Università di Firenze, Italy

The structure of the FORUM is presented.
Actual developments and perspectives are outlined:

- Cooperation Groups
- Proposed Projects
- Funding Opportunities.

Speakers Include:

- Antonia Ida Fontana, Centro UNESCO di Firenze
- Takayuki Morioka, DIS Laboratory – HITACHI Ltd., Yokohama, Japan
- Roberto Ruffino, Fondazione Intercultura Onlus, Colle Val d'Elsa, Siena, Italy
- Marco Aluigi, Fondazione Meeting per l'amicizia fra i popoli, Rimini, Italy

- Johan Møhlenfeldt Jensen, Picture Archive, Museum of Copenhagen, Copenhagen, Denmark

11,00 Coffee Break

11.15 **SESSION 3 – 2D - 3D TECHNOLOGIES & APPLICATIONS**

Chairman: Masayuki Tanimoto, Graduate School of Engineering, Nagoya University, Nagoya, Japan

"Collection-Specific and Target - Free Procedure for Color Optimization: Case Study on Monochrome Historical Prints"	U. Dercks[1], D. Keultjes[1], T. Resta[2], G. Trumpy[3], G. Vaccaro[4] [1] Kunsthistorisches Institut in Florenz, Max-Planck-Institut, Firenze, Italy [2] Centrica Srl, Firenze, Italy [3] Imaging & Media Lab, University of Basel, Switzerland [4] Università degli Studi di Firenze, Italy
"Materials on the History of Old Russian Art are in Learning and Research at the University"	T. Laska, E. Gaevskaya Faculty of Arts, Saint Petersburg State University, Saint Petersburg, Russia
"From Restoration to Management - A Sustainable Methodology for Castles, Towers and Medieval Churches"	Renata Salvarani Università Europea di Roma, Roma, Italy
"Non-desctructive Examination of Panel Painting Structures by Terahertz Waves"	K. Fukunaga[1], M. Picollo[2] [1]Electromagnetic Research Centre, National Institute of Information and Communications Technology, Tokyo, Japan [2]Istituto di Fisica Applicata "Nello Carrara", Consiglio Nazionale delle Ricerche, Firenze, Italy.
"2D Art Painting to Stereocopic 3D Conversion Using Semi-Automatic Depth Map Generation"	Raymond Phan, Richard Rzeszutek, Dimitrios Androutsos Department of Electrical and Computer Engineering, Ryerson University, Toronto, Ontario, Canada
"3D Spatial Reproduction by FTV"	Masayuki Tanimoto Graduate School of Engineering, Nagoya, University, Nagoya, Japan

13,15 Lunch Break

ROOM A

14,30 **SESSION 4 – VIRTUAL GALLERIES – MUSEUMS AND RELATED INITIATIVES**

Chairman: Andreas Bienert, Staatliche Museen zu Berlin, Berlin, Germany

"National Systems on Digital Cultural Heritage in the Frame of European Initiatives"	Rossella Caffo Istituto Centrale per il Catalogo Unico delle Biblioteche Italiane – Ministero per i Beni e le Attività Culturali, Rome, Italy
"The Interactive User. Modern User Generated Vernacular Photo and the Picture Archive.	Johan Møhlenfeldt Jensen Picture Archive, Museum of Copenhagen, Copenhagen, Denmark
"Between Reuse and Enhancing: The Archeological Museum of Santa Scolastica, Bari""	Isabella Lapi Ballerini Apulian Regional Direction of Cultural Heritage and Landscape, Bari, Italy
"Education or Edutainment?"	Elena Gaevskaya Faculty of Arts, Saint Petersburg State University, Saint Petersburg, Russia,
"Networked Museum: Our Vision and Experience"	Shinji Shimojo[1] Masaki Chikama[2], Kaori Fukunaga[2], Rieko Kadobayashi[3] [1]Cybermedia Center, Osaka University Ibaraki, Japan [2]National Institute for Information and Communications Technology Keihanna/Koganei, Japan [3]Osaka Electro-Communication University, Shijonawate, Japan
"Musint Project: Towards a Digital Interactive Archaeological Museum"	A.M. Jasink[1], L. Bombardieri[1], G. Dionisio[1], G. Tucci[2], D. Cini[2], W. Nunziati[3], [1]Department of Antiquity, Middle Ages and Renaissance Sciences and Linguistics, University of Florence, Italy [2]GeCo, Geomatics for Conservation & Communication of Cultural Heritage Laboratory, DiCR, University of Florence, Italy [3]Magenta Software Lab., Florence, Italy,

16,30 Coffee Break

ROOM B

16,45 SESSION 5 – ACCESS TO THE CULTURE INFORMATION

Chairmen: James Hemsley, EVA Conferences International, UK and

"The Intelligent Museum Fuition of Works of Art by All"	Pier Luigi Emiliani Institute of Applied Physics "Nello Carrara", National Research Council, Firenze, Italy
"Search Services for Cultural Institutions Using Google Technologies. A Collaboration between Itaca-M and Museo Galileo"	Marco Berni, Fabrizio Butini, Elena Fani Museo Galileo - Institute and Museum of the History of Science, Firenze, Italy
"SMARTCITY: Customized and Dynamic Multimedia Content Production for Tourism Applications"	F. Spadoni[1], A. Tatarelli[1], L. Loparco[1], R. Rossi[1], F. Tariffi[2], E. Sassolini[3], P. Ongaro[4], [1] Rigel Engineering Srl, Livorno, Italy [2] Space SpA, Prato, Italy [3] ILC – C.N.R., Pisa, Italy [4]Meta Srl, Lucca, Italy
"Cultural Tourism & Travel Applications"	Giovanni Gasbarrone Top Clients and Public Sector Marketing - Offerta Turismo, Telecom Italia, Roma, Italy
"The Senarum Vinea Project Wine Tourism and Mobile Multimedia Devices"	G. Benelli, A. Pozzebon Dipartimento di Ingegneria dell'Informazione, Facoltà di Ingegneria, Università di Siena, Siena, Italy
"Preliminary Results on Priming Based Tools to Enhance Learning in Museums of Fine Arts"	Annalisa Banzi[1], Raffaella Folgieri[2] [1]Istituto di Comunicazione, Comportamento e Consumi "Giampaolo Fabris", Università IULM, Milano, Italy [2]Dipartimento di Scienze Economiche, Aziendali e Statistiche, Università degli Studi di Milano, Milano, Italy

2 - WORKSHOPS

Thursday, 10 May

ROOM A

WORKSHOP 1 **INNOVATION AND ENTERPRISE – INNOVAZIONE E IMPRESA**
(Italian Language)
9,00 – 13,00
Chairman: *Francesco Chirichigno,Consigliere dell'Organo di Vigilanza per la Parità di Accesso alla Rete TELECOM TALIA*

Opening:	*Marco Bellandi,*	*Pro-Rettore al Trasferimento Tecnologico, Università degli Studi di Firenze*
Invited Speakers:	*Enrico Bocci,*	*Responsabile Commissione Regionale Servizi Innovativi e Tecnologici, Confindustria Toscana*
	Laura Castellani,	*Regione Toscana*

Technological requirements in the Cultural Heritage field are outlined and opportunities for Italian 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, Optoelectronics, Environment and Infomobility are presented.

Funding by European Commission is considered, with particular reference to multimedia and telematics for Cultural Heritage, Environment and Education (*e-learning*). Initiatives regarding the "know-how" transfer from Research Organizations to the Industrial Sector are described. Organizations and Companies present their activities and experiences.

Speakers include:
- *Claudio Tasselli, Sezione Servizi Innovativi e Tecnologici, Confindustria, Firenze*
- *Antonella Castaldi, Gruppo SESA, Empoli*
- *Riccardo Bruschi, T.T. Tecnosistemi, Prato*
- *Andrea Calistri, SAPAF Srl, Firenze*
- *Alberto Pecci, Pecci & C. Spa, Firenze*
- *Stefano Fasana, DOMINA Srl, Biella*
- *Franco Guidi, NEUMUS, Firenze*
- *Fosco Ferri, FIT TOSCANA*
- *Claudia Del Re, Studio Legale Del Re-Sandrucci, Firenze*
- *Roberto Borri, CSP Innovazione nelle ICT, Torino*

ROOM B

WORKSHOP 2 **INTERNATIONAL COOPERATION**
9,00 – 13,00 *Chairman: Ugo Di Tullio, CEO ITALY FILM INVESTMENTS, Rome, Italy*

The general aspects of international cooperation in Cultural Heritage are presented. The impact of new technologies in the field is considered, outlining the more suitable ones for cooperative plans.

The importance of Virtual Heritage for better cooperation among the Nations in the World is considered.

Projects currently developed in different parts of the World are presented.

The importance of coordination and promotion by International Organization (as by UNESCO) is outlined.

European Commission programmes and initiatives are presented. Collaborative activities in Mediterranean Area are in particular described.

Speakers include:
- *Maria Luisa Stringa, Centro UNESCO di Firenze, Italy*
- *Paolo Del Bianco, Fondazione Romualdo Del Bianco - Life Beyond Tourism, Firenze, Italy*
- *Aurelia Moser, Pratt Institute, Brooklyn, NY, USA*
- *Romana Krizova, Accord International s.r.o., Praha, Czech Republic*
- *Hiroku Kudo, Faculty of Law, Chuo University, Tokyo, University*
- *Sanja Halling, Swedish National Coordinator of Digitization, Swedish National Archives, Sweden*
- *Salvatore Siano, Istituto Fisica Applicata "Nello Carrara", Firenze, Italy*

Friday, 11 May

ROOM B

WORKSHOP 3 EUROPEANA AWARENESS: INITIATIVES AND PROJECTS OF THE CENTRAL INSTITUTE FOR THE UNION CATALOGUE OF THE ITALIAN LIBRARIES

10,30-13,00 *Chairman: Rossella Caffo, Director ICCU*

Workshop organised by the Central Institute for the Union Catalogue of the Italian libraries (ICCU).

The workshop aims at raising awareness on Europeana, the European culture portal, and the related strategies on digital heritage of the European Commission.

The workshop will introduce at first the results of the **Europeana Awareness event** held on May, 9th in Brussels where the culture ministers of the European Union illustrated their participation in Europeana and discussed upon online cultural heritage as a driver of creativity and digital innovation.

The "Europeana Workshop" held on the occasion of EVA Florence will illustrate the role that ICCU plays for the promotion and increase of Europeana. In fact ICCU is involved since many years, both as coordinator and partner, in some of the projects of the Europeana Group: currently they are Europeana Awareness, LINKED HERITAGE, Europeana 14-18, Partage Plus, EuropeanaPhotography, and ARROW+.

Europeana Awareness is a network of best practices coordinated by the Europeana Foundation, which involves 48 partners including the ICCU. The project objectives are to promote Europeana to users, policy makers, politicians and cultural organizations in each Member State; encourage institutions to supply the portal with content and promote cultural awareness of the economic potential of cultural heritage.

Linked Heritage was launched in April 2011 under the coordination of MiBAC to supply Europeana with over 3 million data, explore the use of Linked Data within the European portal, improve the semantic search through the use of multilingual terminologies, and involve the private sector into Europeana. It follows the steps of the previous successful project ATHENA.

Europeana 14-18 is a digitisation project aiming at feeding Europeana with documents relating to the First World War provided by a network of cultural institutions, including ICCU, coordinated by the Staatsbibliothek zu Berlin (Germany).

Partage Plus is a project leaded by Collection Trusts (United Kingdom) for the coordination of the digitisation activities of 25 partners, including ICCU, on the theme of Art Nouveau.

Europeana Photography is a project coordinated by Alinari 24 ORE (Italy) Spa for the provision to Europeana of digital cultural objects relating to ancient photography. ICCU participates as leader of the dissemination activities and in representation of the historical photography fund of the archive of the Italian Geographical Society.

ARROW+ is the follow up of ARROW, the network of European national libraries, publishers and collective management organisations which worked to help make digital content in Europe more accessible, usable and exploitable. ARROW, under the coordination of AIE (Italy) developed a distributed infrastructure for the management of copyright that allows libraries and institutions involved in digitization projects, to determine if a work is protected by copyright, or is in the public domain, locate the rights holders, and identify orphan works.

3 - SPECIAL EVENTS

Thursday, 10 May 18,30

RECEPTION at "Palagio di Parte Guelfa"
in cooperation with COMUNE DI FIRENZE (MUNICIPALITY OF FLORENCE)
Palazzo di Parte Guelfa, 1 - Firenze

Concert by Gabriele Spina and Beatrice Bartoli

4 - TECHNICAL EXHIBITION

Thursday, 10 May: 10,00 – 18,00

at Palazzo di Parte Guelfa
Piazza di Parte Guelfa, 1 – Firenze

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PROCEEDINGS

STRATEGIC ISSUES

EXCELLENCE DIGITAL ARHIVE PROJECT FOR POLO MUSEALE FIORENTINO: EXPLOITATION ACTIVITIES

Cristina Acidini, Superintendent Polo Museale Fiorentino, Florence, Italy
Vito Cappellini, President MICC, University of Florence, Italy
Takayuki Morioka, Director DIS Project, Hitachi, Ltd., Yokohama, Japan
Marco Cappellini, CEO Centrica Srl, Florence, Italy

1. INTRODUCTION

The Project on "Excellence Digital Archive for Polo Museale Fiorentino", developed by MICC – University of Florence, Hitachi Ltd. and Centrica Srl, with supervision by Superintendent Cristina Acidini, has completed the first phase of activities. Many important art-works of Polo Museale Fiorentino have been digitized at very high resolution:

1. Leonardo da Vinci, Annunciazione, Uffizi
2) Leonardo da Vinci, Adorazione dei Magi, Uffizi
3. Leonardo da Vinci, Battesimo di Cristo, Uffizi
4. Michelangelo, Tondo Doni, Uffizi
5. Tiziano, Venere d'Urbino, Uffizi
6. Caravaggio, Bacco, Uffizi
7. Caravaggio, Medusa, Uffizi
8. Piero della Francesca, Dittico di Urbino, Uffizi
9. Bronzino, Ritratto di Eleonora di Toledo, Uffizi
10. Botticelli, Madonna del Magnificat, Uffizi
11. Botticelli, Primavera, Uffizi
12. Botticelli, Nascita di Venere, Uffizi
13. Giotto, Madonna di Ognissanti, Uffizi
14. Raffaello, Madonna del Cardellino, Uffizi
15. Raffaello, Madonna della seggiola, Palatina
16. Lega, Il Canto dello Stornello, Museo d'Arte Moderna
17. Fattori, Libecciata, Pitti
18. Correggio, Adorazione del Bambino, Uffizi

Technological improvements have been added since we reported this Project and our technology of acquisition at EVA 2009 and EVA 2010.
Some developed activities are described in the following.

- **Exhibition and Demonstrations at Shanghai EXPO, China, June – October 2010.**
- **Presentation - Conference at Rimini Meeting, Italy, August 2011.**
- **Exhibition "Uffizi Virtual Museum" in Tokyo, Japan, November – December 2011.**

2. EXHIBITION AND DEMOSTRATION AT SHANGAI EXPO 2010

2.1. "Uffizi Virtuale" Exhibition Format

"Uffizi virtuale" exhibition proposes a new way of visiting the collection of Uffizi Gallery, in a virtual and "interactive" way. Centrica moves the innovative processes of digital imaging and visual interactive

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communication to the Cultural Heritage sector, giving a new "form" to the art works of the Uffizi collection, set in high resolution digital images. The visitor-user is no longer a mere spectator, but takes part in the exhibition and becomes an active part in the "story". The story is a virtual journey through extraordinary high resolution images, through a succession of installation points with which the visitor can interact in a natural way and touch the images. A journey through more than 1150 works of the Uffizi collection and Florence's history, its landscapes, culture and traditions.

According to the words of Cristina Acidini, Superintendent of Museum Network in Florence: "*this exhibit makes it possible to get extremely close to, almost entering into these precious and unmovable masterpieces. The viewer can navigate each one, enlarging detail after detail, always perfectly in focus, until one arrives at the most minute details: the impalpable transparency of a veil, fog in a distant landscape, delicate gold leaf applied to the boarders or rays. Details that are difficult to discern even by looking at the original can be enjoyed in these high resolution images which are capable of surprising and enchanting viewers while they discover these beautiful masterpieces".*

2.2. The Exhibition. Uffizi virtuale. A new Experience with Art (Shanghai Art Museum, 27th June – 21th July 2010)

During Expo 2010 "Uffizi Virtuale" hab been helded as the principal Exhibition at Shangai Art Museum.

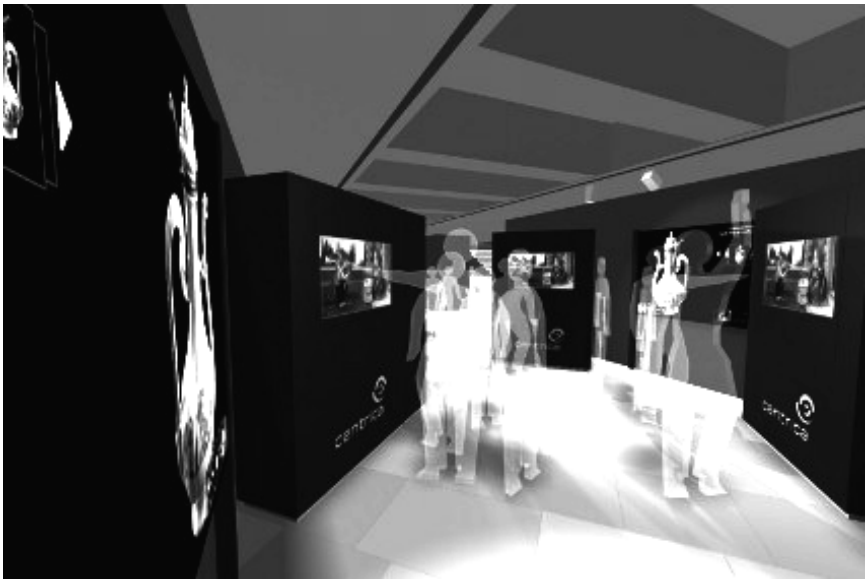

Fig. 1 - Exhibition side view

Nine multimedia installations, each with large format 42" touch screen interfaces present one masterpiece after another (1, 4, 5, 6, 8, 9, 10, 12, 14 as indicated in the Introduction). By touching the screen, visitors are able to examine every particular and zoom in to see the most hidden detail up to the point of perceiving the artist's brush strokes. Digital images were obtained with advanced technology recovery and mosaic and have a resolution between 200 Megapixel and 6 Gigapixel. The installation devoted to Leonardo's "Annunciazione" contains also an innovative audio visual interactive tour, highligting details of the 400 MegaPixel images synchronized with an audio narration. The system is based on XLimage® software produced by Centrica.

Fig, 2 - Chinese girls interacting with “Madonna del Magnificat” - Sandro Botticelli

The visit is thus transformed into a unique visual and interactive experience. The digital images used in presenting the works of art are the result of a long digital acquisition process (see Introduction). The tenth installation, Uffizi Touch®, Centrica product, gathers the whole collection of Florence’s Uffizi Gallery.

Fig. 3 - A visitor “plays” with Uffizi Touch® installation

Uffizi Touch® is the world's first product to encapsulate the entire Uffizi Gallery in a digital interactive “painting” acquired with extremely high resolution images. One touch of a finger and you’re in the world’s most famous Gallery, inside the actual artwork.

Uffizi Touch® contains 1.150 works from the Uffizi Gallery and Vasari Corridor as well as 100 works from the deposits, represented by digital image resolution from 40 to 150 Megapixels. You can browse the works of art collection by artist's name, by title, by location in the museum, and by historical period (more info regarding Uffizi Touch® can be found at http://www.uffizitouch.com).

2.3. Organizers and supporters

Organizers: Centrica, Agenzia “Toscana Promozione” of Tuscany Region, Soprintendenza Speciale per il Patrimonio Storico, Artistico ed Etnoantropologico e per il Polo Museale della città di Firenze, Shanghai Art Museum.

Supporters: Ministero per i Beni e le Attività Culturali, Istituto Italiano di Cultura a Shanghai, Consolato Generale d'Italia a Shanghai, Shanghai International Culture Association, Commissariato Generale del Governo per l'Esposizione Universale di Shanghai 2010.

2.4. The results

"Uffizi Virtuale" exhibition, during the 25 opening days, registered over 35.000 paying visitors. Chinese public was enthusiastic about the subject and the exhibit design approach. Uffizi Gallery and the fascination generated in the public are elements of strong attractiveness for all kind of people. The multi-sensory experience offered by the exhibition, the chance to see the works without glass and to touch them, was an irresistible opportunity. Centrica conducted a survey looking on 100 visitors during the opening of the exhibition, which revealed the following strengths of the exhibit:

- The layout has been able to give a spatial orientation to visitors, lighting has allowed public involvement and focus on the images, easy use by the public of all ages;
- The interaction between public and images showed the intuitive and easy use of the application;
- The average time spent at each station was approximately 3-5 minutes, while the Uffizi Touch® installation has exercised a high attractiveness to the public: in some cases people have interacted with the Uffizi Touch® application for a time of 15-30 minutes;
- Visitors, while using the applications, taught to new visitors the working way of the system, and the browsing way trough the images;
- Visitors at the end of the show have expressed a high level of satisfaction: 3% of people visited the exhibition for the second time.

3. PRESENTATION AT RIMINI MEETING

Any year in Rimini in the month of August a very great Meeting is held, managed by "Fondazione Meeting per l'amicizia fra i popoli".

In the framework of this Meeting, a Conference was organized in cooperation with Polo Museale Fiorentino on "Nuovo Rinascimento: Scienza e Arte nel terzo Millennio" (New Renaissance: Science and Art in the Third Millennium) on 23 August 2011.

Three Speakers presented the activities regarding the "Excellence Digital Archive Project for Polo Museale Fiorentino":

- The Superintendent Cristina Acidini, outlining the overall coordination of innovative "Excellence Digital Archive Project" and the contribution of digital acquisition for knowledge, preservation and access by users.
- The President of MICC, Vito Cappellini, presented scientific data, confirming the high quality of the developed work (in particular regarding high resolution and colour fidelity).
- The CEO of Centrica, Marco Cappellini, showing the implementation aspect and the technology advances in digital acquisition and intelligent access to the digital content.

The digitization activities in Uffizi Gallery carried out on the years 2000-2005 were presented with the new stand – alone system "Uffizi-Touch".

More recent digitizations, with very high quality, performed by MICC, Hitachi Ltd. and Centrica, were also shown (see INTRODUCTION).

The overall Presentation, covering the artistic – historical aspects, the scientific background and the technical implementation tools had a great success, with long fruitful discussion with the many high interested Participants.

4. EXHIBITION "UFFIZI VIRTUAL MUSEUM" IN TOKYO

4.1. Contents of Exhibition

To take advantage of the outcome from "Excellence Digital Archive for Polo Museale Fiorentino" Project, the "Uffizi Virtual Museum" was opened to the public from 22 November to 19 December 2011 at Italian Institute of Culture in Tokyo as one of main events for "Italy in Japan Autumn 2011". It was promoted by Italian Embassy in Japan, Italian Institute of Culture, Italian Ministry of Cultural Heritage and Activities, Board of National Museum in Florence, Media Integration and Communication Centre of University of Florence and Italy-Japan Foundation, supported by the Asahi Shimbun - Japanese leading newspaper, with the technical support by Hitachi, Ltd. and Centrica s.r.l.
Under the supervision of Board of National Museum in Florence, the following exhibits were prepared:

- Preshow

Near the entrance of exhibition, an introductory video letter from Dr. Cristina Acidini was projected to convey the concepts of "Uffizi Virtual Museum."

- Life-Size Replica

Ten "Life-Size Replica" were exhibited (1,4,5,6,8,9,10,11,12,14 as indicated in the Introduction). Ten 42-inch displays, paired with above replicas, were exhibited to highlight the official interpretation on each masterpiece with the image and text information.

Figure 4.1: Life-Size Replica and Large-Size Display with Description

- Digital Theater

In the specially built "Digital Theater", the video programs were synchronized on five separate screens: one 200-inch projector with 1920 x 1200-pixel resolution and four 100-inch short-focal projectors with 1280 x 800-pixel resolution.

Figure 4.2: Digital Theater

- Masterpiece Navigation

The “Masterpiece Navigation” allows the visitor to navigate and magnify ten masterpieces on 47-inch touch display interactively.

- Feel Uffizi

The “Feel Uffizi” allows the visitor to project the desired image in life-size from the collection of ninety two masterpieces especially selected for this exhibition.

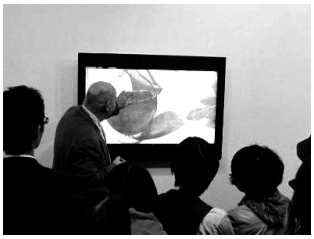

Figure 4.3: Masterpiece Navigation

Figure 4.4: Feel Uffizi

4.2. The Results

Approximately 8,000 visitors came to the exhibition in the period of 27 days. The first attempt in Japan to present the life-size replicas with extremely high-definition digital data received favorable reviews. Among them were more than 20 newspapers and other media, who reported this exhibition to the public. Approximately 2,000 questionnaires were collected during the exhibition. The excerpts of the questions and answers are as follow.

<< Top 3 answers to each question >>

- The most favorite works of art:

  #1. “Primavera” (19%); #2. “The Birth of Venus” (19%); #3. “Annunciation” (17%)

- The most favorite exhibit:

  #1. Digital Theater (29%); #2. Life-Size Replica (22%); #3. Masterpiece Navigation (21%)

- Justifying entrance fee:

  #1. 500 yen, approx. 5 euro (44%); #2. 1000 yen, approx. 9 euro (32%); #3. free (13%)

- Additional Comments:

  76% favored the concept of this exhibition.

The “Uffizi Virtual Museum” was an attempt to disseminate the extremely high-definition data to the event that can be enjoyed by the public. This event proved that such exhibition is an effective way to benefit from high quality digital data of cultural heritages. The questionnaire survey also proved that the need for such exhibition is high among not only art enthusiasts but also casual visitors.

5. CONCLUSIONS

As above outlined, very significant activities have been carried out to develop the “Excellence Digital Archive Project for Polo Museale Fiorentino”. The supervision of Superintendent Cristina Acidini was indeed a key reason for the obtained results and success, coordinating the Team of MICC – University of Florence, Hitachi Ltd. and Centrica Srl. The very high quality developed technologies can be used to prosecute the Project, extending to others Museums of Polo Museale Fiorentino, but also to other Museums in the world.

"STORIES AND HISTORY" - DIGITAL ARCHIVES OF THE STAATLICHE MUSEEN ZU BERLIN (NATIONAL MUSEUMS IN BERLIN)

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THE MUSEUM'S CONTRIBUTION TOWARDS A CULTURE OF KNOWLEDGE

The National Museums in Berlin [www.smb.museum] represent an entire and unique universe of art, architecture and culture. The fifteen well renowned museums, among them the 'Pergamon' and The National Gallery, three research institutes like the Rathgen Research Laboratory for conservation science, and a stupendous replica workshop cover a wide range of cultural heritage related issues. The collections, featuring altogether about six million objects of European and non-European art, archaeology and ethnology, spread out more than 6.000 years of history of mankind from the Nefertiti-Bust to Contemporary Art, from Babylonian sculptures to Renaissance paintings, from etchings to photography and video. By far more than 4.5 million visitors have been welcomed per year.

With it's origins in the Royal Museum, founded by Frederic William III. in Prussia in 1830, the National Museums are located, today, in almost historical buildings in different parts of the city. Museum Island, declared UNESCO World Heritage in 1999, is the very nucleus in the historic centre. It is supplemented by likewise iconic architectural settings at the Kulturforum close to Potsdamer Platz and - in the near future - in the reconstructed Royal City-Palace, the forthcoming "Humboldt-Forum".
Supported collectively by the German government and the federal states, the National Museums in Berlin regard themselves as a national institution of cultural federalism in Germany. They belong, among the State Library, the State Archive, the Ibero-American Institute and the State Institute for Music Research to the Prussian Cultural Heritage Foundation.

Collecting, preserving and exhibiting have always been recognised as primary functions of almost every museum. But it would be rather incomplete to restrict the historic mandate to this purely materialistic evidence. Furthermore, the valuable and various materials in the collections also represent a reliable and often even unique source of memory and knowledge. As "archives of memory" [Hermann Parzinger] Museums provide not only access to substantial treasures of the past but also opportunities for appreciation and understanding. Scholarly research and academic studies are under these auspices part of the same public mission as purely maintaining the objects in their trust. This has been clearly defined by the Icom Code of Ethics, and it is especially true for the Staatliche Museen zu Berlin.

Created in early nineteenth century "as educational institutions that were devoted to the same rules of academic study and scholarship as, for instance, universities and libraries" [Bernhard Schulz] the National Museums claimed a twin fold scientific and aesthetic purpose from the beginning.

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"Delight first, then teach," the motto of Wilhelm von Humboldt, the great Prussian reformer of education and learning, included both options – aesthetic delight and cognitive effort! King Frederick William IV, in 1841, even went a step further when he declared Museum Island in the river Spree a "sanctuary for art and scholarship", that is, an area explicitly devoted to the arts a n d scholarly research.

Still today this argument seems to be vital. Major demands of the digital information society are surprisingly close to the humanist programme. To provide the audience not only with reliable but also with attractive and almost contextualized information is regarded as a challenge on the Web. It is commonplace to remember: content is expected to be stories and not only information.

Thus, the contribution of the Museums to a globalized knowledge-society has rather been enforced than diminished. To allow for scholarship and comprehensibility, expert knowledge and participation is a warrantable objective in the use of networked, transient and accelerated electronic environments. 'Prodesse et delectare' is a purpose which has inspired the Staatliche Museen zu Berlin since their beginnings. In a modern sense it is still and even more in the very focus of the National Museums' policy towards the information society.

Encouraging young scientists by own scholarship programmes (since 2009), membership in the national research funding organisation (DFG), co-operation programmes with universities and leading research institutions as well as alliances and partnerships in international clusters of excellence reveal a continuously growing importance of research and expertise. Many of these projects are directly related to electronic media, web-based services and information systems. To meet the expectations of the generic audience and, simultaneously, support interdisciplinary scientific propositions - both approaches have to be regarded as a mission.

Let me refer in this sense to some of our actual digitization activities, touching different aspects of the implementation and use of electronic repositories and archives: publication and access issues, 2D-scanning, 3D-scanning and text-based editions. All of the mentioned projects have to be regarded as 'work in progress'.

Online access to the digitized collections: the web portal "SMB-Digital"

Providing online access to the rich, often highly fragile and endangered collections of the National Museums in Berlin is of primary importance. In close co-operation of all departments of the National Museums this challenge has been envisaged and put forward over the last years.
A unified central database management system has been implemented observing advanced standards of documentation and interoperability. The actual client/server application [MuseumPlus, by zetcom, Swizzerland] is going to merge already existing data from different sources and to accelerate the process of cataloguing richly heterogeneous collections. About 1.400.000 objects are already represented with at least a set of relevant and authentic core-data. Reproductions in 2D-, 3D-, text-, sound- and video formats are attached, of course, in minor numbers.

The forthcoming Online Portal of the National Museums 'SMB-Digital' opens ubiquitous access to this catalogue.

The beta-version, which I want to refer to here, has been realized as an eMuseumPlus web client. It allows for synchronizing processes with regard to the database management system. The database-interface, however, is technically based on the standardized Lightweight Information Describing Objects schema for metadata harvesting (LIDO). Thus, the catalogue will be accessible also by OAI-PMH featuring a true 'open data'-application using an XML-LIDO formatted document library. Relevant data will be transmitted and shared with information infrastructures on National and European levels.

Thus, the corporate portal of the Stiftung Preußischer Kulturbesitz – "SPK-Digital" [www.spk-digital.de] will allow for comprehensive access to all subject areas under the roof of the Prussian Cultural Heritage Foundation. Digital resources from museums, libraries and archives are merged comfortably and opened up in a unified Online Public Access Catalogue.

The forthcoming national portal German Digital Library "DDB" (Deutsche Digitale Bibliothek) reaches for a central catalogue of German Cultural Heritage [www.deutsche-digitale-bibliothek.de]. The "DDB" aggregates digital resources from German cultural and scientific institutions in a nationwide scale. The ambition is to make accessible the whole spectrum of National Cultural Heritage to the citizen's home computer.

The Europeana portal [www.europeana.eu], finally, represents a comprehensive access to digital resources of Europe's museums, libraries, archives and audio-visual collections.

Scanning in 2D: The collection of papyruses in Berlin.

The ongoing digitization of relevant parts or entire collections of the National Museums in Berlin is supported and co-financed in significant numbers by specific research and outreach projects in different collections. A very gainful example with respect to technical and scientific experiences is the digitization of ancient papyruses from the Egyptian Museum. The collection comprises several 10.000 papyruses, ostraca and written documents from different periods and in different materials like leather, wax or parchment. It is one of the largest collections of this kind worldwide. The Greek, Latin, Hebrew, Aramaic or Arab texts are in the very focus of an international research community, who systematically transcribes, reassigns and associates the highly fragmented texts with their historic contexts.
Given that many of these items are either in delicate conditions or difficult to handle the ambition of the ongoing scanning project is to make available facsimile-reproductions of the objects as well as metadata and occasionally already existing transcripts.
Particularly the technical aspects of the reproduction process have been challenging. The scanning of papyruses and 3dimensional ostraca is complicated by the textile, likely 3dimensional structure of the papyri. Narrow holes and damages in most of the pieces have been a problem. Most of the papyri are also fixed between glass plates of different size and format. As a result, ordinary scanners or cameras reproduced irritating light effects and dark artefacts which were indistinguishable from the dark ink or carbon of the writing.
Only a modified Cruse Synchron Table Scanner with a specially customized translucent glass-table and additional lighting from below the objects would solve the problem [www.crusedigital.com/cd_products_scanners.asp#table].
By now, several thousand fragments have been scanned with a minimum resolution of 600 ppi/24Bit. Although still in progress results are already published on the projects online website [http://smb.museum/berlpap]. The project is generously funded over a 3 years period by the German Research Foundation (DFG).

Scanning in 3D: Babylonian rolled seals in the Museum of Ancient Near East.

An example for the implementation of 3D reproduction methods within the collections of the National Museums is an innovative project of the Museum of Ancient Near. The Museum shares the excellence cluster TOPOI [www.topoi.org] and reproduced masterpieces of its famous collection of Mesopotamian and Babylonian rolled seals, i.e. about 1.300 very small and sensible cylindrical objects with only 1 to maximal 9 cm height and, nonetheless, very detailed narrative impressions on the surface.
While hitherto 3dimensional objects of this kind have only been photographed from different sides, the challenge was now to reach for geometric accuracy by scientific and preservative reasons. With support of the Fraunhofer Institut Jena, Abteilung Angewandte Optik und Feinmechanik (IOF) a high resolution scanning operation with structured light projection as bases for the triangulation has successfully been carried out. The movable scanning equipment, namely a 'colibri multi' scanner [www.vision.fraunhofer.de/de/texte/146.html], has been set up in the museum's laboratory and scan-jobs have been performed by museum's staff.
Actually, about 1.300 cylinders have been reproduced and virtually, that is without physical contact, 'rolled out' to JPEG images. Though colours have not been reproduced, the impressions on the seals can be analyzed with hitherto unknown precision also in synthetic colours.

Digital text Editions: the Virtual Erich Mendelsohn Archive "EMA"

Besides 2D and 3D scanning the digital edition of handwritten texts is of growing importance for the National Museums. The bequests and legacies of artists and patrons in it's archives are a rich resource of historical knowledge and autographical evidence. Publishing, therefore, is often requested by the public and of meaningful importance for the curatorial work.
On the occasion of an electronic edition of the correspondence of the architect Erich Mendelsohn and his wife Luise the technical and philological approach can be outlined.

The context of this publication-project, called "EMA", is the serendipitous fact of about 1.400 letters of the famous architect addressed to his wife Luise, kept mostly unpublished in the Art Library in Berlin, and corresponding letters of Luise, kept likewise completely at the Getty Research Institute in Los Angeles. The correspondence covers 43 years between 1910 and 1953. It is a surprisingly dense documentation of a nearly lifelong relation of the couple as well as a very personal commentary on the art, architecture and social history of the first half of the last century.
The online edition is generously funded by the 'Alfried Krupp von Bohlen und Halbach-Stiftung' [www.krupp-stiftung.de]and realized by the Art Library Berlin in close co-operation with the Getty Research Institute.

In a first step more than 6.000 handwritten pages of the letters of Erich Mendelsohn and another 4.000 pages of the letters of his wife have been scanned using a 300 ppi resolution. Cataloguing information and metadata have likewise been registered in the 'Kalliope' online database of autographs [http://kalliope.staatsbibliothek-berlin.de/].

Transcriptions and critical annotations of the letters are actually carried out using an advanced online transcription and publication tool for the editing of archival material, the 'Refine!-

Editor'. This smart co-operation platform has been developed by Christian Thomas und Gregor Middell and is supported by the Berlin web-company 3point-concept [http://3pc.de].

The Refine!Editor allows for online co-operation of various users and authors. It supports the administration of individual administrative rights and permissions, and a logging of a user's activities as well as document history. It features likewise the synchronization of image-formatted reproductions of physical pages in Museum's repository and text-formatted transcripts in the database. Indexing of the transcribed texts – by place, person, event, keyword, projects, chronology – is performed comfortably in the writing-mode. Each registered index phrase can be linked automatically with normative data and vocabularies like the GND, the linked data service of the German National Library [https://portal.dnb.de], Geonames [http://www.geonames.org] or LOC [http://catalog.loc.gov]. Additional links to relevant URLs can be added as well in the texts, themselves, as in the footnotes.
Last but not least, Refine!Editor allows for exporting the transcribed texts in the internationally standardized TEI xml format [http://www.tei-c.org]

The Website of the EMA – Edition is based on the Refine!Editor and will be launched in November 2012.

OPEN LOW COST HA CLUSTER CLOUD FOR BIBLIOTECA NAZIONALE CENTRALE DI FIRENZE

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In the last few years, one of the main problems of the cultural heritage institution is the progressive reduction of the investments. The hardware maintenance and licensing costs greatly affects IT budget. Virtualization addresses the need to streamline and consolidate infrastructure, even if the license costs remain high for commercial clouds. Open source solutions allow you to implement virtualization cloud which performance and functionality are suitable for the masses, without the constraints of hardware certifications and prohibitive licenses costs.

Our infrastructure allowed us to build a ha virtualized environment using commodity hardware, regardless of specific products or manufacturers. Based on the interaction between a common linux kernel module and a software-based storage pool, is managed by an intuitive web interface. The system provides adequate performances provisioning services like web pages, OPAC, digital resources showcase, cataloging tools, library management, mail, etc.

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EC PROJECTS AND RELATED NETWORKS & INITIATIVES

A METADATA SCHEMA FOR CULTURAL HERITAGE DOCUMENTATION

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Abstract – The paper will present the metadata schema used at the Science and Technology in Archaeology Research Centre (STARC) for the documentation of archaeological assets (objects, ancient buildings and archaeological sites). It presents some unique features of the STARC schema discussing the rationale behind them.

INTRODUCTION

A large part of the European Cultural Heritage is already part of digital collections (virtual museums, digital libraries, scientific repositories) requiring a huge effort for management, preservation and archival of the digital assets. To be able to retrieve information from repositories, data have to be well structured, preferably adhering to common classification standards.
Long term preservation and access to 3D digital objects are major concern and the development of standardize metadata and ontology can partially ensure this.
There are several metadata standards adopted by many cultural institutions, among them Dublin Core [1] and POLIS [2], or developed within European projects for the aggregation of data for Europeana, such as LIDO [3] and CARARE [4].
So far only the CARARE metadata schema has paid particular attention to the type of digital media files, such as 3D objects.
STARC started to develop an own schema when it was involved in two different e-content projects (EuropeanaLocal and Athena), and eventually in a third one (CARARE).
Each of these projects had developed its own schema according to the features of the digital objects that were its focus. Each schema was eventually mapped to the Europeana one (ESE, at the time) to enable aggregation and ingestion. For this reason STARC, a newly born centre, could not adopt directly any of the above as its native schema, as they were specifically designed for the project goals but did not match exactly the Centre's ones.
The paper will discuss the features of the STARC schema, among others the elements that enable to record the provenance of the digital objects.

THE STARC METADATA SCHEMA

The metadata schema developed by the STARC team has the goal to enable data interoperability and access to the digital resources stored in the local repository. Its structure allows retrieving models, activities, decision and answers the research question on how data

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can be used for data interpretation and re-used to perform further analysis and post-processing of raw data.
The datasets stored in STARC repository refer to 2D and 3D archaeological data including archaeological sites, museum objects and architectonic elements.
The schema was created after an assessment [5] of the most common metadata schemas which highlighted what was missing from the standards used by most cultural heritage institutions.
The schema is mostly based on LIDO and CARARE ones and is CIDOC-CRM compliant. The novelty of this metadata schema is the subset of metadata that has been designed to allow recording the information about the provenance of the digital objects, a particularly important aspect when the objects are 3D digital replicas of cultural objects as is the case for the majority of STARC assets.
The schema has a global wrapper named *PROJECT* and is divided into four main wrappers:

1. *Project Information*
2. *Cultural Heritage Asset*
3. *Digital Resource Provenance*
4. *Activities*

Project information

This wrapper contains information about the projects carried out at STARC and contains three sub-level wrappers:
- *Administrative Data*
- *Descriptive Data*
- *References*

The first set of metadata contains administrative data related to the project carried out by the STARC team including a unique identifier for the project, the *name* and the *principal investigator*, *collaborators* and *external partners*, *start* and *end dates* of the project and information about *financing*, in order to retrieve content created under specific projects. Further information is about the record: *metadata editor*, *editing date*, *language*, *rights* and *server location*.
The second set of metadata describes the *aim* and *type* of the research developed under the documented project.
The *References* set is about information regarding any publication, internal or external, which refers to the project and content or activities produced under the project.
It contains three sub-level wrappers: *Record Information* (from CARARE) with information about the records stored in the local repositories (*ID*, *source*, *creator*, *creation date*, *country*, *language*, *rights*), *Bibliographical Notes* (*title*, *subject*, *medium*, *type* and *authors*) and *Relations* (from CARARE), which includes *source*, *type* and *target* of relations.

Cultural Heritage Asset

This wrapper describes the physical asset of reference, which can include archaeological sites, historic building, museum objects and so on.
It is structured in two sub-level wrappers

- *General information*
- *CH subset*

The *General Information* sub-level wrapper is divided into three sub-sub-level wrappers, which give *Geographical Information* about the asset, *Descriptive* and *Administrative data*.
The *Geographical Information* set contains information about the location of the asset by recording the *toponym*, *historical toponym* and the *geopolitical area*.

Moreover *spatial reference information* is given by *reference system*, *coordinates*, *altitude MaSL* and by *cadastral reference*.
The *Descriptive* metadata set includes *type* of the asset, *details*, *cultural affiliation*, a set of *chronological* information and a *measurement set* (*perimeter*, *area*, *volume*, *height*, *width*, and *length*).
The *Administrative* metadata contains two subsets including *External object reference* (*name*, *historical name*, *external source catalogue* and information about *ownership* and *rights*) and *Internal Record Information* (*ID*, *metadata provenance*, *metadata editor*, *editing date language* and *rights*).
The Cultural Heritage sub-set wrapper is organized into three sub-sub-level wrappers including *Descriptive Data*, *Record Information* (CARARE) and *References* (CARARE) and is referred to the components of the general CH asset (i.e. architectonic component).
The *Descriptive* dataset includes *name*, *description* and *provenance* within the CH asset (i.e which part of the general asset is referred to and its relations), plus a set of *chronological information* and a *measurement set*. *Record Information* (CARARE) and *References* (CARARE) contain the same set of metadata as for the general asset.

Digital resource provenance

This wrapper represents the novelty in the metadata schemas for the documentation of CH assets. A pioneer study has been carried out within the 3D COFORM project [6] with the introduction of the problem of modelling provenance for both physical and digital objects by introducing an extension of the CIDOC CRM ontology, known as CRM_{dig} [7,8] able to capture the modelling and query requirements regarding the provenance of digital objects.
Since the creation of 3D content starts from capturing data from real objects with different methodologies (digital images, photogrammetry, laser scanning) or based on models created from scratch using Computer Aided Design (CAD) tools, and different software can be used to obtain the final result, it is important to register all these information.
The metadata schema adopted by STARC is based on the principle of recording every important detail of the digital provenance.
Within the STARC metadata schema, the *Digital Resource Provenance* wrapper is divided into three sub-level wrappers:

- *Acquisition*
- *Processing*
- *Publication*

The acquisition wrapper is divided into four sub-sub-level wrappers which contain *Record Information* (information about metadata editing), *Operative Info* (*operator*, *collaborators*, *paradata* and *date* of acquisition), *Technology* adopted for the digital data acquisition and *Relations*.
Within the *Technology* wrapper all the technologies adopted for the digital acquisition of the datasets are included: photogrammetry, 3D scanning, photography, GPS data acquisition, document scanning.
Every *Technology* sub-level wrapper contains information about: *Type* (e.g. aerial photogrammetry or close-range photogrammetry), *Device Specification* (e.g. for photogrammetry: camera details, lens, focal length, exposure time, operating distance etc.) and *Files Specification,* by providing information about the *file format*, info about the 3D model as *number of points*, *data input*, *data output*, *data decimation*, *file size* and *compression* (for 3D scanning acquisition).
Another concept that is important to mention is the paradata. The London Charter [9] defines "paradata" as information about human processes of understanding and interpretation of data objects.
Paradata include, for example, a note recording the methodology used in a laboratory, descriptions stored within a structured dataset of how evidence was used to interpret an

artefact, or a comment on methodological premises within a research publication. It is also important to record weather and light condition during the data acquisition process, because these factors can influence the final result quality (e.g. processing data acquired with image matching software) [10].
The *Processing* wrapper is divided into four sub-level wrappers: *Record Information*, *Operative Info*, *Technical Info* and *Relations.*
Within the *Operative Info, operator*, *collaborators*, *paradata* and *date* of post-processing of data acquired are described, while the *Technical Info* wrapper contains information about the software that was used to create the model; this is important because incompatibilities between different version of an application are very common [11]. File specification are also recorded (i.e. *number of vertices*, *number of faces*, *decimation*, *filters* applied, *file size* and *data compression* for 3D scanning).
The *Publication* wrapper is the one that describes the final result of the post-processing (i.e. the 3D model). It is divided into five sub-level wrappers: *Record Information*, *Descriptive Data*, *Operative Info, Technical Info* and *Relations.*
The *Descriptive Data* include *name*, *subject*, *type*, *description*, *link* (the url of the digital object in the best available resolution or quality in the local repository) and *is_shown_at* (the link to the web page that contain the digital object and the contextual information).
The *Technical Info* describes in two sub-level wrappers the *Software Specifications* and *File Specifications* which contain six sub-sub-level wrappers describing the digital objects types that are stored in the STARC repository: *Orthophoto*, *3D models*, *3D PDF*, *Text*, *Image*, *Video*.
Each of these digital objects is described by a set of information that is specific for each type of objects (see table below).

Orthophoto	File format, file size, horizontal resolution, vertical resolution, width, height, data compression.
3D model	File format, file size, number of vertices, number of faces, rendering time, texture, geometry type
3D PDF	File size, horizontal resolution, vertical resolution, width, height
Scanned documents	File format, file size, horizontal resolution, vertical resolution, width, height
Image	File format, file size, resolution, width, height
Video	File format, file size, duration, resolution, frame rate

Table 1. Sample of metadata about digital object

Activities

The *Activities* wrapper describes all the activities related to the digital objects (e.g. scanning acquisition, photographic campaign, aero-photogrammetric survey, virtual reconstruction, imaginary digital object creation).
It contains *Record Information*, *Operative Info*, *Descriptive Data* and *Relations* sub-level wrappers.
In the *Descriptive Data* the information about the event are described: *type* of the event, *location*, *event method* and *material and techniques used* during the activity.
The full schema and the mappings are available on-line with explanations and comments [12].

CONCLUSIONS

The digital provenance, which registers the process used to create the model from the original data, tools and parameters employed, has a fundamental role to ensure the long-term usability of the digital artefact, providing information to new formats in the future.

The combination of structured content and optimized metadata will increase the accessibility and the availability of 3D content, which will help the researchers in retrieving information and interpreting data, making it possible to re-use raw data.
The final model is, indeed, the result of various choices made about the data acquisition process, e.g. decisions about the most suitable methodology to adopt, the parameters to set, the scenario during the acquisition process and so on, or about the software used for the post-processing.
All these information are important because recording them allows the operator to retrace the various phases of the 3D model production and enhance them according to the desired outcome.
It is also important that metadata for 3D objects embed all information related to the creation process to limit the possibility of losing information about the asset, indeed changing one of the parameters adopted will produce a different final result.
To conclude, it is important to include in 3D objects metadata documentation:

- the different phases of the 3D model production, from data acquisition to post-processing in order to guarantee data transparency,
- all the software involved (open source or proprietary)
- the devices used for data acquisition
- the methodologies adopted
- the pipeline followed to achieve the final result
- the paradata.

Extension with virtual museums and procedural modelling are currently under development.

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THE ENArC PROJECT VISIONS AND ACTIVITIES

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European archival institutions are to be considered guardians of historical memory. All information kept in archives documents the birth and growth of Europe and constitutes the basis of the continent's identity and that of its various countries, people and culture. However, the use of these unique records has been generally a restricted business. At the same time, the interest of a wider public to access archival sources, in order to know more about the history of their families, communities or towns, has more and more increased in the last years. Some interesting examples of a more diffused use of archives that meet the interest of a wider, not specialized public are, on the web, the interactive video Europeana Remix[1] as well as permanent or temporary exhibitions as the museum Deutsches Auswandererer Haus in Bremerhaven[2], or the exhibition in the Vatican Archive "Lux in arcana" now running in Rome[3], which attract a huge amount of visitors proposing in an accessible form the complex history of the European cultural heritage through interesting samples from different archives proposed to "normal visitors" probably for the first time in the attractive framework of the Archivio Segreto Vaticano.
The purpose of the project **ENArC** is to offer to a wide range of European citizens a comprehensive and easy access to their historical memory via Internet. The project has a duration of 4.5 years (1 November, 2010 – 30 April, 2015) and will be implemented by the collaboration of 13 project partners (co-organizers) under the lead of the project coordinator Diözesanarchiv St. Pölten - Austria. Its first aim is to establish and expand the already existing network of ICARUS – International Centre for Archival Research, based in Vienna and to strengthen the international cooperation.
ICARUS is an all-open network aiming at overcoming borders, and deals with all the aspects of historical, civil and religious life as they are recorded through the documents of the single archives. Within this "easy to access" approach archives are are in touch with today's digital means and tools, including digitization, technical standards. The project supports also all new ways of communication,

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enhancing through of research tools also the development of professional competences of young operators and specialists.
ICARUS coordinates the inter- and transnational cooperation between commemorative and historical institutions such as archives, libraries and museums. In doing so, the Association creates a common platform for mutual support in expert issues and project management. Within this operative framework ICARUS has already promoted and established sustainable digital libraries, e.g. www.monasterium.net, www.matricula-online.eu/ , the portal of Austrian Archives, www.archivnet.at/ and now is going on supporting the creation of www.archinet.hr. Moreover ICARUS aligns its activities with all relevant national and international archival institutions while closely cooperating with government agencies, EU authorities as well as the national archival societies and the ICA (International Council on Archives).

The ENArC partners

- Diözesanarchiv St. Pölten and ICARUS – International Centre for Archival Research – Austria
- Narodni Archiv of Praha –Czech Republic
- Generaldirektion der Staatlichen Archivein Bavaria and Universität zu Köln – Germany
- Ministerio de Cultura, Subdirección General de los Archivos Estatales – Spain
- Scuola Normale Superiore di Pisa and Università degli Studi di Napoli Federico II- Italy
- Hrvatski Državi Arhivin – Croatia
- Magyar Országos Levéltár and Főváros Levéltára – Hungary
- Arhiv Republike Slovenije – Slovenia
- Ministerstvo vnútra Slovenskej republiky - Slovensk•• Národní Archív – Slovenia
- Balkanološki Institut SANU – Serbia.

The partners regularly hold bi-annual meetings and professional events and share some common goals, according to the guide-lines of EU-Culture program:
The project increases the **cross-border mobility of people** by

- Project meetings
- National workshops
- Expert Exchange program
- Linking the neighbourhood program
- Training program

as well as it stimulates **circulation of cultural output** thanks to

- digitization and indexing activities to provide materials and metadata for open access portals
- integration of digital content in existing national and international online portals as Apenet and Europeana through the Monasterium platform
- development of collaborative Internet tools
- scientific sub-projects based on the material and tools available online

as well as it promotes **intercultural dialogue** by

- strengthening the International cooperation
- improving the communication
- developing strategies and coordinating individual initiatives
- linking the neighborhood program
- organizing ICARUS as a permanent independent institution and expanding the already existing network

Linking the Neighborhood Program

In order to promote and facilitate archives from neighboring countries to join the network, some partners are entitled to special funding which include:

- Establishing new contacts
- Organization of a national workshop in the neighboring country together with a local host

In order to announce and disseminate the project results among experts within the individual countries and attract new partners for the network, one partner of each country will host a national workshop. The workshop should last one day and consist of two blocks:

- Appraisal of national activities in the area of digital processing of archival records
- A discussion in context of the project and international developments workshops in
- countries of participating partners

Workshops will take place in neighboring countries such as Bosnia, Bulgaria, Herzegovina, Poland, Romania and Spain, The program already succeeded to gain new members also from Canada, France, Finland, Malta, Netherlands and Switzerland.

Expert Exchange Program

The program aims allowing a staff exchange between partner institutions in other countries for a certain period of time (3-4 weeks) with the following objectives:

- Establish personal networks and contacts at expert level
- Familiarize with different working methods and technologies
- Intensively exchange knowledge and experience
- Strengthen the intercultural dialogue

The program will be coordinated by ICARUS as a project partner, carried out in cooperation with as a project partner, carried out in cooperation with the Moravian Regional Archive (associated partner).

ENArC lectures

- A program of 9 already planned lectures, each taking place in different countries will allow to
- Discussions with experts and historically interested laypersons
- Focus on a topic related to archives and the challenges of IT.
- Invite speaker from another country to increase the exchange of different experiences

All ENArC lectures will be transmitted online via the communication platform (web and podcast) and are coordinated by ICARUS.

Didactic work group

The group, coordinated by Antonella Ambrosio – Università Federico II in Naples, aims at promoting and organising learning activities for university students and young recent graduates. Such activities concern Diplomatics, Paleography and, generally, the use of historical sources. They are always supported by digital technologies, particularly by the website www.monasterium.net and the EditMOM tool. The learning activities aim at encouraging physical mobility of teachers and students throughout Europe and communication between distant research sites, in order to set up a worthwhile interchange of competence and experience**.**

Training programs

The activities coordinated by Scuola Normale Superiore in Pisa aim at develop training programmes on information technology for archival management and research, together with the other project partners. Post graduate students and professionals in the field of archival management will get the chance to come in touch with ongoing or recently carried out projects as well as with the achievements of the ENArC community. This will guarantee the exchange of best practices and allow consortium competences and project results to passed on directly, becoming part of the daily work of the individual archival and cultural institutions. The first of this courses already took place in September 2011 in Volterra (Pisa) while the second one will take place in May 2012 in Pisa. All training activities are regularly announced on the website of SNS and on the website of Icarus www.icar-us.eu.

[1] http://remix.europeana.eu
[2] www.dah-bremerhaven.de
[3] http://www.luxinarcana.org

DOCUMENTING ABU SIMBEL: THE 3D-COFORM APPROACH

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Abstract – In 1964-1968, the Abu Simbel temple in Egypt was disassembled and reconstructed in a higher position to save it from the flooding caused by the construction of the Aswan Dam. Before the monuments removal to safety, a campaign was carried out by the French IGN, making stereo pairs of photos as photogrammetric documentation of the temples in their original position both as a matter of record and as an aid to planning the removal of the temples. The 3D-COFORM project recovered these original analogue images and used them for creating image-based digital 3D models of the temples and their interiors. The results will then be compared with modern photographic and geometric records of the reassembled temples as an aid to the management and interpretation of the monuments.

INTRODUCTION

It is part of our story that the construction of the High Aswan Dam in the Fifties of the XX century, and the resulting creation of Lake Nasser endangered a number of Egyptian monuments in a very large scale. Saving these monuments from destruction was the subject of an international campaign led by UNESCO, and the Abu Simbel temples are perhaps the most famous example. In a massive engineering project, the temples, which were originally built into a hillside, were cut into parts, and moved (along with much of the hill) to a higher position and reassembled inside an artificial concrete dome built for the purpose [1]. All the salvage campaign is described in detail in a paper published by ICOMOS [2].
Between 1955 and 1964 the French *Institute National de l'Information Géographique et Forestière* (IGN) carried out a series of photographic campaigns to create a photogrammetric documentation of the monument, making hundreds of stereo photos of the temple and its interior in its original location [3]. The analogue technology they used was state-of-the-art for its time allowing the monument to be rapidly surveyed and recorded. The originals of these photos are stored in the IGN archives in Paris and were digitized for the 3D-COFORM project by the IGN. The conservation state of these pictures will be discussed in the paper.

3D-COFORM

3D-COFORM is a EU FP7 integrating project, aiming at enabling the use of 3D technology for Cultural Heritage documentation through the creation of a number of tools covering all the stages of the 3D pipeline, from data acquisition to presentation. The project started in 2008 and will end in November 2012.

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The 3D-COFORM work plan includes a number of demonstrators, i.e. pilot projects in which the 3D-COFORM tools are applied in practical case studies to demonstrate their potential for Cultural Heritage applications. One of these demonstrators concerns Abu Simbel. The temples were chosen not only for its fame and high visibility, but also because it is a perfect case for different tasks:

1. Recover the legacy documentation
2. Using image-based modelling, create 3D models from the existing data, i.e. the IGN photos.
3. Compare these models with recent photographic campaigns and plan for the modern survey of Abu Simbel temple using a 3D laser scanner and HD photography.
4. Save the original photographic material from oblivion documenting all the provenance to assure digital long term preservation.
5. Analyse the differences, evaluate the accuracy of the reconstruction and repeat periodically the acquisition and comparison to monitor the conservation state of the monument. This analysis concerns also wall paintings and sculptures, so both 2D and 3D documentation are involved.

The planning of this activity began in early 2009, establishing preliminary contacts at IGN and designing the acquisition campaign with the 3D-COFORM Egyptian partner CULTNAT. A site survey was carried out in 2010 and arrangements were made to start the acquisition campaign and continue it in 2011. Unfortunately, the situation created in Egypt by the so-called Arab Spring and the resulting political instability caused a number of postponements that have so far delayed completing the acquisition of a laser scanner 3D model of the current Abu Simbel temple.

RECOVERY OF LEGACY DOCUMENTATION

Fortunately investigations within the IGN and UNESCO photographic archives have produced results beyond our expectations.

Figure 1: Aerial view of Abu Simbel temple - © IGN 1964

Thanks to the collaboration provided by IGN and in particular by a retired IGN engineer who had worked in the Abu Simbel campaign and volunteered to search the institution's archives, a large number of photos, often in stereo pairs, were recovered, and IGN kindly converted them into digital format.
Unfortunately the metadata, especially the technical ones concerning cameras, vantage points and focal length/lenses, were sometimes incomplete. However, this was not an obstacle for using image-based modelling software, and it has been possible to 'reverse-engineer' the photographic configurations of the original recoding teams. From the newly digitized analogue photography it was possible to produce 3D models of almost all the rock-cut rooms in the temples and much of the exteriors sculptures. In general it has been possible to reorganize and make accessible this excellent photographic documentation of the original state of the temples, including details of wall paintings, before the 1964 operations concerning the "transferral" of the monument.

IMAGE-BASED MODELLING

High Definition Panoramas

Figure 2: Reconstruction of one of the wall of the main temple using photo stitching technique - Original photos © IGN

In normal circumstances panoramas can be easily obtained using algorithms that are nowadays well know in literature [4, 5]. Mainly the stitching process is composed of 3 steps: image registration, calibration and blending.

Image registration consist in finding matching features in the set of images we want to align that globally minimize the sum of absolute distance between overlapping pixels. When using direct alignment methods one might first calibrate one's images to get better results. Unfortunately, due to the particular condition of our images we had to align the images manually to help the feature matching stage, so that only neighbouring images are searched for matching features. This made execution of the comparison algorithm faster.

Image calibration is intended to match the characteristics of the camera-lens combination that was used, generating a matrix able to interpolate the optical defects such as distortions, exposure differences, vignetting and chromatic aberrations. Luckily the same camera with the same lenses has been used during all the 3 campaigns easing the approximation of such matrix.

Image blending is the application of the adjustments figured out in the previous step, plus some extra step such as the remapping of the images to an output projection (stitching) (i.e. rectilinear, cylindrical, equirectangular and so on). Colours can be adjusted between images to compensate for exposure differences seam line adjustment is done to minimize the visibility of seams between images.

3D Modelling from old photogrammetry

In an original document sent in 1955 to the Egyptian Ministry of Education one can read:
" … As M. Robichon [a French Architect] mentions in this appendix, this apparatus can be applied to all ancient monuments; it is called Photogrammetrie, and can make a model of any monument without touching it."
Starting from those images and using techniques developed during 3D-COFORM such as ARC3D and PhotoCLOUD we have been able to obtain partial 3D models such as the one in Figure 3.
Luckily the images have been scanned at real high definition, allowing us to apply algorithms of matching in a particularly precise way.

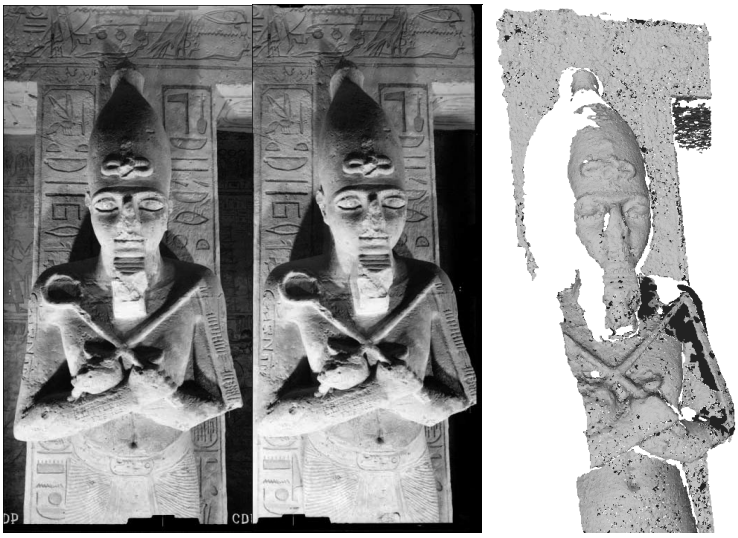

Figure 3: 3D reconstruction from photogrammetry

CONCLUSION AND FUTURE WORKS

The results of this activity will be on display during the 3D-COFORM exhibition that will take place in Brighton in July and August, and afterwards will move to other locations including some in Italy. We also continue to work with our partner in 3D-COFORM, CULTNAT, to transfer archive information to the Egyptian government and to plan for future re-recording of the temples.

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3D-ICONS: EUROPEAN PROJECT PROVIDING 3D MODELS AND RELATED DIGITAL CONTENT TO EUROPEANA

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Abstract – 3D-ICONS is a European project aimed to enhance the content base available to Europeana users through targeted 3D digitisation of European architectural and archaeological monuments which will be selected through their listing by UNESCO on its World Heritage (WH). The project aims to complement the collections which are being made accessible to Europeana via CARARE, Europeana Local, Athena and other projects which have developed the content base for the cultural heritage. 3D-ICONS is targeted to complement the 3D content brought to Europeana via the CARARE project and to increase the critical mass of this engaging content.

1. INTRODUCTION

The public is becoming increasingly familiar with 3D content through films, TV and games. But the provision of high quality 3D cultural heritage content goes above the current technological trends. It provides a highly attractive format for engaging with the cultural heritage which is increasingly popular with users as it allows better understanding and appreciation of our cultural treasures. However relatively little 3D content has yet made its way to Europeana and the digitisation of Europe's rich cultural heritage in 3D has, as yet, made less progress than the importance of these iconic monuments would suggest. There have been both technological and communication challenges to be addressed when digitising very large and complex objects: technical challenges, to acquire, manage and represent faithfully the complexity of surfaces and volumes; documentation challenges, to capture relations between the components of each monument and to cultural facts; cultural challenges in conveying the significance of the masterpiece; and communication challenges in publishing the results in a way which is understandable, interesting, entertaining and accessible to general Internet users. Previously funded EU research projects ([1], [2], [3], [4]) have solved most of the individual issues quoted above, but still mass digitisation of complex monuments is lacking.

3D-ICONS is a European project, funded by European Commission (CIP 297194), aimed to exploit existing tools and methods and to integrate them in a complete supply chain of 3D digitisation to contribute a significant mass of 3D content to Europeana. This project proposes to digitise a series of architectural and archaeological masterpieces of world and

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European cultural significance and provide 3D models and related digital content to Europeana, with the aim of contributing to the critical mass of highly engaging content available to users. 3D-ICONS started on the 1st of February 2012 and will run for three years. More details about the project and its partnership are available on the project web site [5].

2. PROJECT OBIECTIVES

The project focuses on UNESCO World Heritage monuments and other monuments of outstanding value at European level, to illustrate a particular strand of Europe's history. The digital content includes overall 3D models and reconstructions, enlarged models of important details, images, texts, videos. It will also include and re-contextualize in 3D, objects belonging to a monument but presently located elsewhere, for example in museums. The project's activities will include both new digitisation as well as the conversion of some existing 3D data into formats which are accessible for Europeana users. The project's anticipated impact is making accessible through Europeana an unprecedented quantity of high-quality, 3D, well-organized and attractive information about the masterpieces of European architecture and archaeology.

3D-ICONS will enhance the content base available to Europeana users through targeted 3D digitisation of European architectural and archaeological monuments. The project aims to complement the collections which are being made accessible to Europeana via CARARE, Europeana Local, Athena and other projects which have developed the content base for the architectural and archaeological heritage. Most notably, the results of 3D-ICONS will complement the 3D content brought to Europeana via the CARARE project and to increase the critical mass of this engaging content. It is also an important objective of the project to build on the results of previous EU projects most notably on CARARE for the aggregation services and guidelines on the publication of 3D for Europeana, and on 3D- COFORM for the 3D creation, management and visualization tools.

The target users of the 3D-ICONS include:

- members of the general public, tourists and students who wish to be able to explore and enjoy architectural and archaeological masterpieces which are often inaccessible to visitors either as a result of their remote locations or because conservation management restricts access to parts of the monuments.
- Europeana users who wish to access, explore and enjoy 3D models together with the related high-quality information.
- The cultural institutions who are in charge of internationally and nationally important monuments and buildings and who need tried and tested mechanisms to produce high quality 3D documentation and publish the results for Europeana as well as on their own websites.
- UNESCO and cultural institutions wishing to find new ways of delivering their missions to promote understanding and increase the sustainability of world and European heritage.
- Content providers and creative industry SMEs wishing to identify sustainable business models to make

3. CONTENT

The content which will be created by the project includes many of the most famous monuments and buildings in Europe, such as The Royal Site at the Hill of Tara in Ireland; Etruscan necropolises with their painted tombs; the Coliseum with the Roman Fora and other monuments in Rome and throughout Europe; Pompeii; Greek temples from Greece and Italy; the Italian medieval city of S. Gimignano; the Leaning Tower and the Cathedral of Pisa; the

Renaissance Centre of Florence; Versailles; to end with such icons of modernity as the Arc de Triomphe and the Centre Pompidou in Paris. A the end of the project some 60 such iconic monuments and sites will be available on Europeana, incorporating more than 1000 3D models of buildings, more than 4000 3D models of architectural details and related objects and more than 10.000 high- resolution images.

The project will consider a long-term sustainability perspective by developing a business model for monument digitisation, including a detailed cost and potential profit analysis. In general, this envisages balancing the costs of digitisation (as reduced by the rationalization induced by the solutions created by this pilot project) with the exploitation of 3D models for commercial use, in collaboration with the content owners. Since rich 3D models have started to have a market, in the medium term break-even should be reached, although in the beginning some seed money may be required.

The digitisation of archaeological and architectural monuments requires arrangements with the authorities in charge of the monument. For content directly digitized by the project, agreements have been made for provision, re-use, improvement and aggregation with already available content. For future use by others, the project will describe an IPR management model that is acceptable for most European public authorities, according to the very diverse legislations existing in Europe. It envisages free access for personal and "fair" use, such as access through Europeana, but allows IPR protection for commercial use. The tools used in the project will be mainly based on open source technologies and the „production pipeline' that the project plans to establish will be made publicly available for use by cultural institutions and others. The skills developed by the partners may enable them, individually or collectively, to offer consultancy and expertise services. This may include updating the technology.

4. TECHNICAL SOLUTIONS

The technologies likely to be used by the project include:

Scanning equipment

Many different technologies exist and have reached a sufficient level of stability and effectiveness to be used in standard digitisation campaigns

- short-range scanning based on triangulation,
- long-range scanning based on time-of-flight,
- images-to-3D reconstruction based on different incarnations of stereo-matching and photogrammetry,
- modalities for gathering enhanced 2D media, such as Polynomial Texture Maps (PTM) or very large panoramic image).

3D Data acquisition

The 3D data acquisition process involves technologies for both surveying and modelling (topographic surveying, 3D laser scanning, image-based modelling, etc.). A range of technology solutions are available for the processes and are well known and tested, and the equipment used will be selected case by case according to the features of individual objects.

3D model construction

The technology available for 3D model construction is mature and includes these examples of open source software created within previous EU projects:

- MeshLab, a well-known open-source software also developed within the 3D-COFORM project. MeshLab [6] supports a complete set of instruments for the easy and complete post-processing of raw data (range maps and point clouds), generating derivative models and so on. It is a very stable and consolidated system, with a wide user community (thousands of users worldwide).
- Blender [7] is a tool for further post-processing of the 3D models.

Creation of 3D models

The project will use procedural modelling for the creation of 3D models, for example in the reconstruction of models of destroyed or transformed structures or for the generation of large-scale 3D models (i.e. in the case of a city). A tool which supports this process is CityEngine, also developed in 3D-COFORM, which is commercially available (a light version is offered at low cost). The free version of SketchUp (the commercial version sells for less than 400 €) provides a tool for rapidly generating good quality content.

Metadata and harvesting

Building on work by the CARARE project, 3D-ICONS will implement tried and tested infrastructure to support interoperability and data exchange with Europeana (DEA) including:

- OAI-PMH compliant repositories. Research on repositories for complex 3D models and their metadata has been carried out within 3D-COFORM and other research projects, producing prototypes that may be useful for 3D-ICONS deployment.
- Metadata Mapping and Ingestion Tool (MINT) developed by the National Technical University of Athens and implemented by CARARE and a number of CIP-ICT-PSP funded Europeana Aggregation Services (including Athena, EU Screen amongst others).
- CARARE repository (MORE), based on the MOPSEUS system developed by the Digital Curation Unit of the Athena Research Centre which is in turn based on the widely used Fedora platform.

Publication

Building on the recommendations made in the CARARE for the publication of 3D models online in formats suitable for access by Europeana users, 3D-ICONS plans to convert complex 3D models to 3D PDF, a format supported by Adobe and which is widely used and fully mature.

3D-ICONS will monitor new open source technologies like WebGL as alternative technical solutions for bringing complex 3D content to popular Web browsers. However these technologies are not yet fully matured and are currently supported by a limited number of web browsers and are not suitable (not capable of) rendering complex 3D models.

Data will also be made accessible to external users in the Portal section of the web site, via dedicated high- quality browsers and visualization tools such as the open source Nexus multi-resolution representation proposed and endorsed by 3D-COFORM [2], availing of the experience of partners on using web-based technology for sharing 3D models over internet (as for example, the SpiderGL library [8] and the existing demos).

5. INNOVATIVE ASPECTS AND COMPARISON WITH EXISTING SOLUTIONS

3D-ICONS will build on the achievements of the CARARE project, which is already providing digital assets about European archaeology and architecture. It uses the CARARE aggregation service and extend CARARE's coverage by digitisation in 3D of monuments and buildings and creating a large number of related digital items such as 3D models, images, texts, and possibly more. Each digital replica will be considered an aggregation in the ORE OAI sense - that is a conceptual combination of many digital objects pertaining to the same monument in order to capture the cultural complexity of such masterpieces. Content will be published according to the Linked Open Data paradigm, by identifying things with standardized references (URI). This will align with the developments in Europeana (EDM, Danube release), building on the services already provided by CARARE and incorporating results from other Europeana-related projects such as EuropeanaConnect and Linked Heritage, 3D-COFORM, an FP7 Integrated Project on 3D collection formation and others, for example CASPAR (long-term preservation of digital data) [9].

The combination of these existing tools and services, so far tested only on a sample of sites (3D-COFORM), will result into an innovative service scheme addressing all the steps of the production pipeline from data creation/acquisition to publication.

The characteristics of the proposed pipeline are the following:

1. Flexibility in data creation. The project is adopting state-of-the-art, open source software with guaranteed performance and quality results but will use different systems for 3D data acquisition and modelling on different monuments enabling comparison of their relative advantages. An important outcome of the project will be clear guidance for future users in choosing one technology over another.

2. Advanced semantics. Rich metadata will be added to digital content produced by the project in order to comply with Europeana specifications for flawless ingestion. The project will adopt the CARARE schema which is being implemented by projects on the tangible heritage, preparing an extension for 3D capture if needed. Terminology will be based on existing standard thesauri, building among others on those adopted for historical buildings and archaeology by ICCD (IT), English Heritage (UK), Ministère de la Culture (FR), and using widely accepted standard lists such e.g. as VIAF, ULAN, *geonames* for other related information. Standardization will facilitate implementing a Linked Open Data approach. By adopting the aggregation approach proposed by ORE-OAI and creating conceptual objects from the aggregation of others, the complexity and multi-facetted nature of architectural masterpieces will be maintained.

3. Quality outcomes. The project will adopt relevant charters and best practices for the creation of 3D cultural heritage models and their use – mainly the London Charter[3] – and thus the methodology proposed by the project will guarantee high-quality results from a cultural perspective. Technological quality (e.g. high resolution) will be incorporated in the models, with provisions for publishing versions to optimize the balance between required bandwidth and high definition.

4. Business considerations for future implementation. The project will develop a business model including:

- Cost analysis of the different solutions for data creation
- IPR management models enabling free access through Europeana and exploitation for commercial use.
- Organizational models proposed to content owners, usually public cultural institutions, and service providers, usually SMEs.

5. Attractiveness and wide interest. The public will appreciate the possibility of accessing so famous European monuments and the related information. Altogether, the sites digitised attract millions of visitors every year, a measure of the interest for the digitised masterpieces. Content owners will have a safe IPR management model and content producers will rely on a tested business model.

6. CONCLUSIONS

The broad context of the 3D-ICONS is the 2020 strategy for Europe and the Digital Agenda for a flourishing digital economy and the standards and increased interoperability needed to support Europeana as a multilingual common access point to millions of objects for all European citizens. By January 2011, Europeana provided access to more than 14 million books, maps, recordings, photographs, archival documents, paintings and films from 1,500 cultural institutions across Europe exceeding the content targets which were set for it by the European Commission. This content begins to illustrate the potential for Europeana to be used in schools and in other services. Yet there is great potential to continue extending and enhancing the content base – this was highlighted in the Comité des Sages' (the EC reflection group) *New Renaissance* Report on Europeana in January 2011. Europeana has itself set out in its Strategic Plan objectives in terms of both extending the

content base and in seeking to cultivate new ways for its users to participate in their cultural heritage and to enhance their experience.

3D-ICONS supports these policy objectives by enabling increased access to important cultural heritage sites through an effective use of digital technology. Through 3D models the general public can visit sites which may be in remote locations, fragile and in some cases difficult to understand.

3D-ICONS will both contribute to the expansion of Europeana's content base and also offer enhanced experiences for its users by bringing exciting and engaging content for archaeological monuments and historic buildings. The content will comprise of a range of formats including 3D models, movies, texts and 2D images. More than 1000 3D models of buildings, more than 4000 3D models of architectural details and related objects and more than 10.000 high-resolution images will be brought to Europeana by 3D-ICONS.

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PERSONALIZED ACCESS IN THE CULTURAL HERITAGE SECTOR

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Abstract – Museum, cultural heritage institutions and galleries are looking for ways to recreate in the digital information space the opportunities that visitors to libraries, museums and archives have of sharing books, photographs, objects and ideas with each other. They would like to be able to personalize the experience for their digital library users, for example by suggesting content that is more likely to be of interest based on their profile. But cultural heritage portals lack the massive volumes of users and interactions that are required to enable analysis of user behaviors, usage patterns and visitor interests.

Museum curators and content providers are interested to access and share content in a more efficient way, involving for example semantic-aware adaptation strategies and semantic based reasoning user model elicitation which allow the effective personalization of the content navigation and presentation on various devices (e.g. cloud, Web application, iPads, etc.). In this, we integrate artifacts and background information that span over several collections and sources. Adaptive clustering mechanisms show the relations between art objects and links to background information, based on their metadata. In this paper we are bringing the experience of Alinari in the PATHS, DECIPHER GLOCAL and CONVERGENCE EU projects. The idea is to share the early results from those 4 research projects and post a questionnaire, during the conference, to the participants, in order to share afterword the results and success of the project with the audience.

INTRODUCTION

The new communications technologies popularized in the last decade—from the Internet to cell phones to iPods— are transforming our world. They are fundamentally altering the way we access information and how we interact with one another. Today, thanks to new applications of these technologies and to pervasive low-cost broadband access in the home, we are able to easily find information about almost any topic from almost anywhere in the world. And blogs, wikis, podcasts and other social networking technologies are enhancing interaction among individuals— enabling people from wildly diverse backgrounds to share their opinions and their expertise with thousands of others.

New technologies are not merely transforming where and when we are able to access information, but also the types of information we receive. Increasingly, sites like MyYahoo, Microsoft MSN, and the Wall Street Journal offer users the opportunity to control the content that appears on their homepage, tailoring it to the interests they have specified.

According to the website Trendwatching.com, the "addiction to instant access to any kind of useful and relevant information" is moving out of the virtual world and into the real world as well. Codes attached to physical objects can be used to gain more information about the object while standing in front of it—through text messaging, cell phones with barcode and other code readers, and voice recognition services. Now, when walking by a "For Rent" sign, you can send a text message to receive additional information about the apartment or house. Curious about a bottle of wine? Take a photo with your phone and e-mail it to get more

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details. As the boundary between the real and online worlds is blurring, every location and object can be "digitally augmented" and learned about at the moment of need.
One of the primary ways that museums are providing instant information access is through multimedia handheld devices—typically personal digital assistants (PDAs) or custom-designed devices—that visitors carry with them as they go through the museum. These devices typically provide enhanced content through text and images, audio, and video. But these devices can do much more than provide additional content. Other features include serving as way finding devices that can direct visitors to specific sites or exhibits at the museum, providing e-mail updates of special events as they are taking place, offering visitors opportunities to send messages to one another, and collecting feedback from visitors through surveys. Many of these devices include a bookmarking feature where visitors can identify objects or exhibits they are particularly interested in and have information about those objects e-mailed to them or stored on a personal web page that they can access at a later date.
The designer of an information dissemination system based on user preferences stated as user models is currently faced with three basic design decisions: whether to use categories, keywords - or both - to enable the user to specify his preferences, whether to use a static long-term model or a dynamic short-term model to register those preferences, and what method to use to provide summaries of the available documents without losing information that may be significant to a particular user even if it would not be considered as such in general terms. .
Cultural heritage institutions hold an enormous variety of digital content covering a broad range of subjects natural history, ethnography, archaeology, historic monuments, fine and applied arts which often cross national and linguistic boundaries. There is strong motivation to bring together content from different cultural institutions into European portals, which have typically offered access services based on traditional catalogues used in libraries, museums and archives. Search services have been geared towards subject specialists and experienced users. Yet the environment in which *users* and *digital library services* are operating has changed. People come to digital libraries with experience of using the web and with new expectations.

Cultural institutions wish to be able to offer users of their portals with an experience that is continuous with the way people experience the web. They are seeking to enable richer user experiences that support connectivity between people, content and applications, to support writers as well and readers, and to enable collaborations with and between users. A new generation of cultural portals is encouraging user participation by offering people with opportunities to interact with content (for example encouraging them to tag resources) and to make recommendations to other users.

Europeana (Connecting Cultural Heritage, http://www.europeana.eu/) is the prototype website of the European digital library which is being established and developed with project funding from the European Commission's eContentPlus and CIP ICT programmes. Europeana is incorporating millions of digitized items from Europe's archives, museums, libraries and audio visual collections and providing access through a single portal. The need for personalized user services has been recognized from the early stages of Europeana's development.

As a consequence, personalized access to cultural content, web site, blogs, RSS feeders, own portals become more and more popular those days. PATHS, DECIPHER, GLOCAL and CONVERGENCE EU projects will briefly provide some concrete answer and solutions to personalized access based on the early prototypes and usage feedback.

Convergence approach:

Compared to traditional solutions, CONVERGENCE provides important new search features for users seeking to locate specific photos

1. The possibility of searching for photos meeting well-specified search criteria (location, period, quality, technical characteristics etc.)

2. The possibility of using domain-specific ontologies to refine search criteria
3. Support for the definition of optimal search criteria from the CONVERGENCE CDS
4. The possibility receiving notifications every time a photographer publishes a photograph meeting specific search criteria
5. The possibility of searching multiple archives in a single operation (*distributed search)*

These possibilities benefit photographers, who will find it easier to sell their photos; professional users of photos, who will find it easier to find the photos they need; and Alinari, which will cut its process costs and be more attractive to its customers.

Annotation. Since the year 2000, Alinari has annotated photos using standardized in-house procedures in which every image is entered in a local database and checked by specially trained photo librarians and picture experts, who define and enhance the metadata for the photo. To an increasing extent, Alinari staff use standardized keywords (authority files, etc.), to guarantee that photos will be easily and correctly retrieved. This is standard procedure in many stock photography agencies and is well accepted by professional customers. However, it is expensive both for the agency and its customers. Services based on the CONVERGENCE CDS could make annotation far easier, allowing photographers to annotate their own creations, saving costs both for themselves and for agencies.

Referencing the content creator. In 2007, a survey of 400 photographer members of the Stock Artists Alliance showed that photographers who license their images for assignment or stock photography usually embed their copyright and contact information in the photographs. However many of these same photographers claim that their customers systematically remove this information. They are thus forced to purchase costly software to watermark their photographs. CONVERGENCE mitigates this problem by embedding ownership and licensing information in the VDI for the photo, by preventing unauthorized downloads and by providing owners with a report every time a photo is downloaded.

Long-term archiving and interoperability. Many experts used to believe that digital images and text files were for all practical purposes eternal. In reality, however, this is not the case. Changes in technology force archive owners to continuously migrate their content between different media, and different file formats – often losing data in the process. This problem is exacerbated by the problem of search. It is difficult to ensure that a user can find a press-photo that is more than 50 years old among 10 million other photos, without being forced to view ten thousand wrong hits. In most cases, additional metadata are added to make the photo searchable (and findable) for all the different kinds of customers. CONVERGENCE would help to alleviate this process by:

1. Allowing photographers to store photographs on the network, without using physical media
2. Providing automatic conversion between formats
3. Making it much easier for photographers to annotate their images.

DECIPHER approach:

DECIPHER proposes new solutions to the whole range of narrative construction, knowledge visualization and display problems, with a high degree of future proofing. It will produce a step change in the process by combining much richer, event-based metadata with causal reasoning models. This will result in a reasoning engine, virtual environment and interfaces that can present digital heritage objects as part of a coherent narrative, directly related to individual searches and user contexts. This will allow the user to interactively assemble, visualize and explore, not just collections of objects, but the knowledge structures that connect and give them meaning.

Storyspace makes a distinction between two types of stories – heritage object stories and curatorial stories.

A *heritage object story* is a story that can be told around a heritage object. The story could relate to how the heritage object was made and by whom, what the heritage object represents or what has happened to the heritage object since it was made. A heritage object may have many different stories for many different audiences. A heritage object and its associated label in an exhibition can be thought of as telling a heritage object story.

A *curatorial story* is a story that can be told across a number of heritage objects and associated stories. A curatorial story may be told that spans a number of heritage objects associated with the same artistic school. A curatorial story may describe how the work of a single artist changed over time. An exhibition of heritage objects and associated description drawing them together can be thought of as telling a curatorial story.

GLOCAL approach:

We describe the world by using words. Yet, words usually bring to mind different mental views of the world in different individuals, because of their personal experience and context. This is the reason why the "semantic gap" between our conceptualizations of the world, expressed using language, and our experience of the world, whose most direct representations are media, is far beyond the reach of current systems; and it is also why, so far, a universal solution of the problem of contextualizing search, navigation, and media management in general to the user needs and the operating environment has not been found.
The key idea underlying GLOCAL is to use events as the primary means to organize and index media, e.g., photos, videos, journal articles. Instead of starting from media and seeing, a posteriori, how we can meaningfully understand their contents (e.g., by tagging them), we organize a priori our data and knowledge in terms of events and use media to populate them, thus providing their experiential dimension. Events provide the common framework inside which the local experience-driven contextual information can be not only coded, but also shared and reduced to a common denominator.

Events have both a local and a global dimension. The local dimension enables the mapping of tags (conceptualizations) to media (personal experiences), while the global dimension enables the sharing of event descriptions (thus enabling social sharing and networking of events, media, and tags) but also of event structures across similar events, thus providing a common way to index media (social sharing and networking of event structures). In turn, the networking of events and event structures enables the creation of networked communities inside which common (global) descriptions of the world can be built and continuously enriched by the continuous flow of individual (local) descriptions.
The consortium has selected for the project a certain quantity of multimedia event based content, so far (in constant enlargement also thanks to the new Alinari photographic campaigns) that includes, whenever possible, gps information.
The selection of the corpora collection has been agreed and decided in coordination with all the partners involved in the project and by sharing and agreed in the selection of genre and kind of main events to be included into the corpora collection. The sharing of the agreed corpora content is done through specific API and web services that are provided by the content providers to the GLOCAL consortium.

PATHS approach:

The amount of cultural heritage material that is now accessible through digital library portals can be hidden from users who are typically offered a simple keyword-based search boxes which can seem like a closed door. Such search services are designed to respond to specific *questions* rather than respond to *users* who may not have ready questions in mind or different questions than those which collection catalogues are designed to support. The *users* of

cultural heritage portals, such as Europeana, have diverse information needs and individual information seeking behaviors which require support. Recent trends in information access services have recognized the need to provide support for more exploratory and serendipitous search behaviors, and to offer personalized services.
PATHS will address these issues by offering users ways of visualizing the information space and the contents in a digital library. Using the map as a metaphor through which users are able to explore the collection's landmark items and follow or create pathways, PATHS will act as a personal tour guide through the virtual collection offering suggestions about items or information to look at. It will enable users to create, edit and annotate pathways and to share their discoveries with other users.
PATHS will take a user-centred approach bringing users into the research cycle from the beginning of the project, gathering their input at all stages in the development on how it can help to meet their needs and feedback on the functionality as prototypes are field tested. Different users will have differing needs from pathways and an important aspect of the research will be to build up knowledge and understanding of user profiles, their needs, interests and preferences and feed this into the system development.

Conclusions:

PATHS, DECIPHER GLOCAL and CONVERGENCE EU projects try to answer in each way the complexity of content management, intelligent search, retrieval and personalized information. The importance to provide personalized access in the cultural heritage sector become today more and more important and this paper, we hope, has been able to raise even further the interest from the participants to the conference about this very important topic in the museum field.

An anonymous questionnaire will be distribute during the conference and participants will be able to perform a test drive of the projects once they will enter into the final stage. Please stay tuned!

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2D - 3D TECHNOLOGIES AND APPLICATIONS

COLLECTION-SPECIFIC AND TARGET-FREE PROCEDURE FOR COLOR OPTIMIZATION: CASE STUDY ON MONOCHROME HISTORICAL PRINTS

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Abstract - The unfalsified reproduction of the delicately nuanced monochrome sepia or grey of historical photographic prints between 1850 and 1930 is not ensured by the traditional tools of color management (profiling through targets); but is crucial for work with digitalized images. The prototype of a color optimization specially developed for these prints was produced during the pilot project and will now be tested on a sample of 800 large format photographs. The project will make a significant contribution to the quality assurance of digitalized historical photographic prints.

"CIMELIA PHOTOGRAPHICA" OF THE PHOTO LIBRARY

The Kunsthistorisches Institut in Florenz, Max-Planck-Institut is a German research institution dedicated to the history of Italian art in its European and global context. Founded in 1897, the KHI has belonged to the Max-Planck-Gesellschaft since 2001. With a focus on Central and Northern Italy, the photo library documents Italian art and architecture from Late Antiquity to the present day, and holds some 600,000 photographs. A part of the Florentine collection dates back to the early days of photography in the 1850s [1].

These especially valuable historical holdings include prints from such pioneering photographers as Alphonse Bernoud, Adolphe Braun, Fratelli Alinari, Carlo Naya, Paolo Lombardi or Pompeo Pozzi [2]. The techniques used in them comprise albumen and silver gelatin processes and carbon prints. A part of these prints consists of large format photographs with measurements up to ca. 70 x 50 cm, which are separately conserved under specially controlled conditions in the Florentine photo library. These holdings provide ideal materials for the study of historical photographic techniques. The photo library offers an opportunity for the research of photography both as a tool of art history and as an object of artistic, cultural and academic interest in its own right.

One of the photo library's projects is the "Cimelia Photographica" project which has transformed the systematic processing of a significant historical inventory into a focal point of the work of the photo library [3]. This includes high-resolution digitalization of the whole photographic board and its publication online.

The particular focus of this case study is that of large format historical paper prints of works of art of architecture, sculpture and painting, whose color spectrum is distinguished by delicately nuanced sepia, grey or blue tones. The necessity to discriminate particular tonalities and color nuances of each of these historical photographs far exceed, however, the contribution given by the color palette of a normal target, since these must cover the whole color spectrum and not all the subtle gradations in nuance can be taken into account. "It is important, however, for the analysis of picture content that clarity should reign over the reproduction techniques used" [4]. That is why the unfalsified reproduction of photographs in their original color spectrum and material composition is of such crucial significance.

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The digitalization of an historical photograph that is as faithful as possible to its original color spectrum can provide clues not only about its particular technique, but also about possible retouches and corrections made to the original.

Figure 1: Cimelia photographica: Adolphe Braun & Cie.: Leonardo da Vinci, "Saint Anne with the Virgin Mary and the Christ Child" (Detail), Louvre Museum, Paris, carbon print, before 1904. Board: 70 x 53.8 cm (Photo library of the Kunsthistorisches Institut in Florenz, Max-Planck-Institut, inventory no. 5124)

COLOR MANAGEMENT

The correct management of digital color information plays an essential role in the process of migrating from analogue to digital archives. The adoption of correct procedures is fundamental to ensure a faithful interpretation of the colors in the digital reproduction of photographs [5].

The characterization of the acquisition system is a fundamental step to be performed in the color management workflow. This process aims to generate an ICC profile that allows the correspondence to be established between the device-dependent values (RGB values) read from the acquisition system and the corresponding values in a device-independent reference system (e.g. the colorimetric space CIELAB) [6].

The standard method of profiling makes use of the color targets commercially available (IT8, ColorChecker®, etc.). These targets are characterized by colored surfaces (patches) whose colorimetric coordinates are known and tabulated. The colors of these patches are distributed in the whole color space: this way, the target can be used for any chromatic content to be digitally reproduced.

STANDARD PROFILING: THE UNCERTAINTY DUE TO INTERPOLATION

The wide colorimetric distribution of the patches of the standard targets represents an element of strength for the majority of cases; on the other hand, for the reproduction of objects characterized by a small gamut, this wide distribution becomes a point of weakness. In fact, to achieve greater accuracy, it is convenient that the colorimetric distance between the reference color-points and the colors of the collection to be reproduced is short.

If the chromatic variability of the collection is rather limited, it may happen that no color to be reproduced has a chromatically similar patch on the standard target. In such cases approximations can be considerable for the whole collection [7,8].

COLLECTION-SPECIFIC AND TARGET-FREE APPROACH

The present work reports the results of the application of an alternative procedure for color optimization that has been applied in the framework of the digitization of the collection "Cimelia Photographica". This method [9] does not make use of a color target; it is based, instead, on the identification of a set of representative color-points directly selected on the material to be reproduced (the collection) and measured with a spectrophotometer to obtain accurate colorimetric values.

With respect to the general colorimetric characterization that uses standard color targets, such a methodology has two main advantages:

1. The colorimetry of the training set reflects the colorimetric characteristics of the object to be reproduced.
2. The match between the type of materials that constitute the training set and the type of materials that constitute the object to be reproduced is perfect.

Those two facts make the color optimization perform better [8,10,11,12].

A fundamental key-point of the procedure is the selection of the representative color-points.

The collection "Cimelia Photographica" has been visually inspected to identify the key characteristics for the various printing techniques. A group of 19 representative photographic prints has been selected so that the printing techniques present in the collection are appropriately represented (namely: albumen, silver gelatin and carbon prints). For each technique, the prints selected cover at best the hue variability within the single technique. After having identified the most suitable representative prints, a set of representative color-points was found for each of them so that all the levels of exposure were included. A total of about 200 color-points were selected on 19 different prints; those points have been then measured with a spectrophotometer Konica-Minolta CM-2600d.[1]

Those points have been selected in homogeneous parts of the prints so slight displacements of the point of measure did not entail significant variations in the colorimetric data. In order to determine precisely the points measured, transparent masks have been created for each print, and measurements have been carried out placing the photometer on the mask; those masks have a univocal position on the print and circular holes in correspondence of the selected points have been created. The diameter of these holes is 1 cm: this diameter allows the colorimetric measurement to be properly performed (as a matter of fact, the aperture of the integrating sphere is 8 mm).

[1] This device is equipped with an integrating sphere (8 mm opening diameter) and works in the d/8 configuration; it obtains the colorimetric values from the reflectance spectrum of the point measured in the range 360 nm - 740 nm with 10 nm wavelength pitches.

The group of 19 prints were then captured with the RGB digital back Sinar 54H with a resolution of 22 million pixel, using a standardized photographical studio condition, and illuminating the object plane with two flashlights of Elinchrom Style RX 1200 (guide number 4,5). The acquisition device saved the images as a DNG 16 bit; the software Adobe Camera Raw then converted them in TIFF 16 bit.Every image has been obtained with identical parameters (lighting sources, lighting geometry, exposure, processing, etc.).

The pixels corresponding to the area involved in the spectral measurement have been identified with the help of the masks. The average RGB data of a circular selection corresponding to an area of 8 mm diameter (matching the aperture of the integrating sphere of the spectrophotometer) have been read.

Thus, as a result, for the 200 color-points measured, we had the RGB-CIELAB correspondence. For the implementation of the target-free method a training-set with 154 color-points were finally used. The training-set allows the definition of the transformation that maps the RGB space defined by the acquisition system in the CIELAB space. Hence, this transformation is applied to the RGB images of the group of representative prints.

Figure 2: Measured color-points on a photographic print

QUALITATIVE ANALYSIS

The results of the color optimization with the “target-free” procedure have been assessed visually with an EIZO ColorEdge® monitor opportunely calibrated and profiled. Several persons participated together at the visual assessment of the results of the color optimization; the observers compared the original photographic prints and the digital reproductions displayed on the monitor, while exchanging verbal description of visual appearances and impressions. The results have been evaluated both for the images obtained with the standard procedure that uses the commercial color targets and for the images obtained with the “target-free” procedure.

The comparison of these results made the observers agree in recognizing a sensible improvement of color matching for the images obtained with the “target-free” procedure.

QUANTITATIVE ANALYSIS

	Spectral measurement			Target-free procedure					Standard procedure				
color-point	***L****	***a****	***b****	L*	a*	b*	**ΔE**	**ΔE_a*-b***	L*	a*	b*	**ΔE**	**ΔE_a*-b***
A	*33.7*	*10.7*	*14.4*	33	10	15	1.2	0.9	30	10	16	4.1	1.8
B	*64.2*	*8.9*	*21.7*	65	8	21	1.3	1.1	62	9	19	3.5	2.7
C	*53.0*	*10.3*	*21.7*	50	10	22	3.0	0.4	49	11	22	4.1	0.8
D	*71.0*	*5.4*	*19.8*	72	6	17	3.0	2.9	70	7	17	3.3	3.2
E	*41.2*	*6.9*	*16.0*	40	7	16	1.2	0.1	37	8	17	4.5	1.5
F	*66.4*	*3.1*	*12.5*	61	5	12	5.8	1.9	58	5	11	8.7	2.4
G	*84.2*	*0.0*	*7.7*	83	1	4	4.0	3.8	83	2	3	5.2	5.1
H	*30.8*	*12.1*	*13.8*	30	10	14	2.3	2.1	26	12	15	5.0	1.2
I	*82.6*	*4.1*	*18.3*	81	5	16	3.0	2.5	79	5	16	4.4	2.5
J	*82.0*	*1.3*	*8.9*	82	2	5	4.0	4.0	80	2	5	4.5	4.0
K	*58.9*	*1.8*	*6.7*	59	2	5	1.8	1.8	57	2	4	3.4	2.7
L	*68.6*	*10.3*	*25.5*	70	10	26	1.5	0.6	67	11	25	1.8	0.8
M	*26.6*	*8.5*	*5.9*	26	8	7	1.4	1.2	22	9	8	5.1	2.2
N	*43.3*	*10.7*	*19.4*	43	11	19	0.6	0.5	40	12	20	3.6	1.4
O	*68.4*	*9.6*	*26.9*	69	9	25	2.1	2.0	65	10	24	4.5	3.0
P	*39.0*	*0.6*	*4.0*	38	1	3	1.5	1.1	36	1	3	3.2	1.1
Q	*72.7*	*0.9*	*8.7*	72	1	6	2.7	2.7	70	2	6	4.0	2.9
R	*31.4*	*0.5*	*2.0*	30	1	1	1.8	1.1	28	1	1	3.6	1.1
S	*58.8*	*0.9*	*8.8*	59	1	8	0.9	0.8	57	1	7	2.6	1.8
T	*50.9*	*1.0*	*5.8*	50	1	5	1.2	0.8	48	1	4	3.4	1.8

Tab. 1 Numerical evaluation of the results of the color optimization: colorimetric comparison between the standard and the target-free procedures

As already affirmed before, the collection-specific and target-free method for color optimization here implemented is theoretically more effective than the standard procedure that uses color targets because the reference color-points belong to the object of the digitization [10,11,12].

This theoretical assumption is confirmed by the colorimetric data reported in the Table 1. Since, it is advisable to perform image quality analysis on different spots than the reference colors that have been used to produce the color-optimized content [8], the numerical evaluation of the results has been conducted on a set of color-points that have been spectrally measured but were not part of the 154 points that were used for the color optimization (training-set).

The numerical assessment of the performances of the "target-free" procedure has been carried out through a comparison with the standard profiling procedure. The colorimetric distance ΔE between the CIELAB values read on the digital image and the values measured with the spectrophotometer, has been chosen as indicator of the performances of color optimization; for the 32 points reported the improvement of the results for the "target-free" procedure with respect to standard procedure is evident.

CONCLUSION

Compared to the standard technique, the method presented here requires a higher number of hours in the initial phase; moreover, a certain competence of the operators in selecting the reference color-points is necessary. Anyway, the time spent in the initial phase will be recovered in post-production because the improved color accuracy makes the visual correction of individual images unnecessary.

With regard to the authenticity of the color reproduction, the process promises a far-reaching automation of color profiling and therefore an effective improvement in the digitalization process.

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MATERIALS ON THE HISTORY OF OLD RUSSIAN ART ARE IN LEARNING AND RESEARCH AT THE UNIVERSITY

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Abstract
The article is focused on the Project "Theoretical aspects and methodological framework for creating virtual computer reconstructions of monuments of historical and cultural treasure" and includes two components: a description of reconstruction and restoration of the Church in terms of art history and the research of pedagogical approaches to the use of web-based resources in the learning process. The Church of Our Saviour Transfiguration on Nereditsa is an outstanding monument of ancient Russian architecture.

DEVELOPMENT OF RECONSTRUCTIONS OF MONUMENTS OF ARTS AND CULTURE. The Church of Our Saviour Transfiguration on Nereditsa River.

Project "Nereditsa. The Link of Times" has been developing at St. Petersburg State University. The project is dedicated to the unique monument of ancient Russian art and architecture, the Church of Our Saviour Transfiguration on Nereditsa. By decision of UNESCO in 1992 the Church of Our Saviour Transfiguration on Nereditsa was included in the World Heritage List, among with several other monuments of Novgorod and the surrounding area[1].

The Church of Our Saviour Transfiguration on Nereditsa is undoubtedly one of the brightest monuments of Russian culture and art. During World War II, the temple was on the front lines. As a result of constant attacks from 1941 to 1943, the church was virtually destroyed. Fifteen percent of the surviving murals, numerous fragments of plaster with remains of paintings, black and white photographs, sketches and copies are all that remains of this remarkable ensemble of ancient architecture and monumental art. 325,313 found fragments cover the area of approximately 224.3 m2, and 105.17 m2 are safe on the walls of the monument. These materials enable scientists to carry out restoration works and recover at least some compositions on the walls of the church. To carry out a complete reconstruction is possible only with the help of modern computer technology: it is about creating a virtual reconstruction of the temple and its murals.

In 2010 work began on creating a computer reconstruction of the monumental painting of the Church of the Transfiguration on the basis of the preserved specimens from the collection of frescoes of Novgorod State Museum.

On the example of mural of Nereditsa consisting of 325,000 pieces, it becomes apparent that the process of restoring the frescoes may take many years and will require enormous effort. Moreover, we realize that much of the material had been lost forever at the moment of the temple destruction, and also because of the further movement and displacement of the fragments. We understand that there will be impossible to restore the murals in full for objective reasons.

Appeal to the reconstruction is dictated by the practical needs of science and education. Reconstruction becomes a means of studying monuments and providing researchers with accurate information on monuments. The main aspects of development are the issues of theoretical reconstruction - the analog reconstruction methods.

On the basis of modern methods of architectural monuments reconstruction we

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decided to start testing methods through the example of the composition "Last Judgment" (Western Wall) and "Baptism" (Southern wall) of the Church of Our Saviour Transfiguration on Nereditsa.

METHODS OF THE CHURCH OF OUR SAVIOUR TRANSFIGURATION ON NEREDITSA RECONSTRUCTION

Reconstruction activities can be divided into the following stages:

1. Measurements and photo survey of the existing condition of the interior.

Implementation of architectural drawings based on their measurement are necessary for reconstruction and restoration of monuments. Photographies give only an idea of the form (modern photography represents the color as well), but sketches and drawings show layouts, sections and orthogonal facades and interiors of buildings.

- photographic survey of interior and elements of frescoes on the walls of the temple (1,3);

2. Photographic survey and scanning of mural elements stored in museum funds:

• photographies are taken frontally and in a single scale,
• fragments scanning using a color scale.

As a result of this phase of work it is necessary to get the most detailed color-corrected images of mural fragments of the exact size and scale. Shortcomings inherent in traditional photographic images can be avoided during the scanning process. Scanning should be done using the color scale, which helps to avoid color distortion in the process and makes color correction easier for further processing. The materials obtained allow to consider the fragments in the larger, more detailed study of the technical and technological features of painting materials, identify the features of the surface texture and color, and study the stroke direction and style, to analyze the morphological characteristics of the fragments. High resolution of modern monitors, multiple zooming, as well as computer processing using graphics programs allow you to detect even invisible to the eye elements.

Moreover, as a result it is possible to build a digital database of the collected fragments, which is the simplest and most effective way to save them. We understand that the found priceless fragments are subject to adverse destructive impact, despite the efforts of the restorers. Digitization of the fragments will help to keep them at least in the present state in electronic form.

3. Creation of a single toning image on the basis of archival photos:

• Correction of angle distortions in photographs with reference to fragments of plaster remaining on the wall;
• creation of a single image;
• creation of the scheme of author's painting.

Archival photographs are used on two stages:

• localization of the mural fragments kept in museum collections;
• filling of the tonal graphic image in lost fragments.

In practice, it turned out that the main photos taken before the war were not taken frontally, which greatly complicated the work. Distortion was caused by the projection of the variable wall curvature on the image plane and additional angle distortion when shooting. To eliminate the geometric distortion of photos is only possible when combining them with the architectural measurement drawings. The effectiveness of archival photographs scaling depends on the number of fragments remaining on the wall (the so-called reference points).

Archival photographs scaling and fragments localization are related processes. At this stage it is expedient to be guided by historical accuracy, and assemble the fragments having sufficiently accurate pictorial and graphic reference to the fragments on the wall. Localization of mural fragments will later help to scale b/w photos in the lost fragments more accurately, as well as to perform tonal correction of photos. Thus, the fragments of the murals remaining on the wall become surrounded by fragments attached to them graphically.

The result is an architectural elevation of the wall with the painting. On the basis of the image a very detailed scheme of the author's painting was made at a 1:1 scale indicating

drawing lines width, wrinkles, bleached fragments borders, lost fragments borders.

4. Creating wall elevations applying photos of the existing mural elements:

• the exact location of the composition fragments on the drawings is determined in accordance with the supposed author's painting.

Location of the fragments is based on the following:

• large fragments having distinct morphological characteristics;

• coloristics of the compositions

• the apparent matching of the outer contours of the fragments.

We understand if we mistakenly assemble a fragment of a wall in the temple, its removal or displacement will lead to additional exposure and risk of fragment damage. And working with a computer model is painless for the fragments preservation: if there is a need to relocate parts installed incorrectly it will not cause any technical difficulties. Creating such a framework ensures the continuous development and further work on determining additional materials.

After combining black and white (archive photo) and color (existing fragments) images we got a documentary graphic subbase to restore color and drawing in the lost fragments, including the recovery of lost graphics. Since then, the continuation of the work can be called an analog reconstruction.

5. Creating a technological coloristic map of murals

First, we would like to note that the color restoration is one of the most interesting and, at the same time, the most difficult tasks. Spirituality and variety of images, unique color and tonal proportions, simplicity, and at the same time, inexplicable spiritual complexity and power of monumental painting of Nereditsa can not be represented by any copy or any photo.

The study of color system and creation of paints will allow accurate work with color during computer and graphic reconstruction.

6. Creating colored sketches of the murals (at 1:1 scale) (2, 4)

7. Combining the sketches and three-dimensional models.

PEDAGOGICAL ASPECTS OF THE USE OF WEB RESOURCES ON THE HISTORY OF OLD RUSSIAN ART

The use of electronic resources is becoming increasingly popular in the practice of higher education. In this regard, there are a number of issues. There are at least two approaches to the organization of training activities on the basis of electronic resources. The first is based on the active role of developers, who not only form the content of the resource, but also design a structure of the resource which allow using it in training activities. The key idea of the second approach is that the students are designers of their learning environments. The role of the teacher is to provide them with the opportunity to design their virtual learning spaces and recommend necessary materials on how to assess the validity of such materials.

The first approach is based on the concept of pedagogical design, and the second one is associated with ideas of connectivism and largely reflects the current trends of the Internet development. Both approaches are used in the design of educational resources. Therefore, to study the outstanding monument of ancient art - the Church of Our Saviour Transfiguration on Nereditsa - two types of resources were created - an educational portal "Nereditsa – the Link of Times" and the site of the All-Russian Conference "Problems of Restoration and Reconstruction of Monuments of Historical and Cultural Significance".

There is a wide range of views on the creation of models of educational resources developed by Russian and foreign authors. We took a look at the concepts of M.F. Paulsen, and George Siemens. M.F. Paulsen has revealed the basic features of most theories of pedagogical design and proposed universal model of educational resource developing process - Model ADDIE. George Siemens, one of the founders of pedagogy of connectivism, argues that 'special education resources' have lost their relevance in the era of Web 2.0. It is wiser to instruct the students themselves to look for such resources in the Internet and allow them to

create 'their own virtual classrooms'.

Our experience shows that students do not always cope with the task of finding reliable material on a given topic. From our point of view, solution to this problem is training of future professionals to find accurate information on the Web. This requires solving at least two tasks: (1) to provide students with a system of criteria for the selection of trustworthy information and (2) to create a model of depository of resources from which this information can be extracted.

The method of forming "personalized classroom" includes the following steps: (1) the study of criteria for evaluating the reliability of the information, (2) selection of information from the depositary based on the criteria presented by the teacher, (3) selection of information from the resources on the Internet based on the criteria.

As a tool to carry out testing of this technique, we use the resources developed under the project "Theoretical aspects and methodological framework for creating virtual computer reconstructions of monuments of historical and cultural treasure" - an educational portal "Nereditsa – the Link of Times".

Since we are working on a project for many years, the portal can be viewed as an educational resource for "two generations". Learning management system of the portal is SAKAI, which allows you to organize the wide range of educational services, including the publication of educational materials in various formats, to test and evaluate students' knowledge, and organize the exchange of information between the actors of the educational process.

The content of the resource includes video, audio and multimedia, educational texts and references. The available material is structured in the following sections: Classes, Resources, Learning Tasks, Tests, Bibliography.

In the context of learning in a common virtual classroom Classes section is the main part of the portal. It includes 46 training modules based on abstracts of the lectures by an outstanding specialist in ancient art, V.A. Bulkin. After reviewing the abstracts a student gets the task(s), to fulfill which it is necessary to use materials of Resources and Bibliography sections.

As part of connectivism approaches Resources section becomes the heading element which is being developed by us as depositary and contains materials on the history, reconstruction and restoration of the Church of Our Saviour Transfiguration on Nereditsa (Novgorod). In this case method of teaching is case study, the research is associated with the need to find credible scientific data. For the material selection students use criteria to evaluate sites, Resources section content, the sites of museums, and conferences.

Pedagogically speaking, a prospect for the project is the comparative analysis of the effectiveness of these techniques. We hope in future to acquaint colleagues with our findings.

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Appendix is a list of images

Img.1. The Church of Our Saviour Transfiguration on Nereditsa River. Western Wall, the last judgment. Real state
Img.2. The Church of Our Saviour Transfiguration on Nereditsa River. Western Wall, the last judgment. Virtual reconstruction
Img. 3 The Church of Our Saviour Transfiguration on Nereditsa River. Mural “Baptism”. Real state
Img. 4 The Church of Our Saviour Transfiguration on Nereditsa River. Mural “Baptism”. Virtual reconstruction

Img. 01

Img. 02

Img. 03

Img. 04

FROM RESTORATION TO MANAGEMENT A SUSTAINABLE METHODOLOGY FOR CASTLES, TOWERS AND MEDIEVAL CHURCHES

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The project "From Restoration to Management. A sustainable methodology for castles, towers and medieval churches (2010-2012)" is promoted by the Faculty of History of the European University of Rome and co-funded by Fondazione Cariplo. It focuses on a historical and documentary research, materials and land analysis. Surveys have been carried out with advanced integrated technologies and computerized data encryption systems. The project has been developed to demonstrate the applicability and effectiveness of the experimental method and the launch of its replicability.

The main aim of the project is putting together voluntaries and professional figures to get an high standard conservative performance and, at the same time, to sensitize new generations about cultural heritage, proposing new professional figures and job chances. This social and cultural action is doubtless supported by the use of new technologies that provide a real context to work on.

The research project includes a 3D reconstruction which goes hand by hand with planning works and interventions. Thanks to this digital technology you could have preventive perception of what the intervention will be, and also its impact on the complex and its value.

The three-dimensional elaboration provides a general vision of the work, managing planning and interventions in an homogeneous and organic way. The modern graphic technologies in three-dimensional field perfectly fit in with extreme detail reconstruction's hypothesis when the asset taken in exam is disappeared, in ruin or crumbling. More, they provide to the public a realistic vision of past time and they give to scholars an idea of planning hypothesis.

The project "From the Restoration to Management", often recurring to digital reconstructions, attempts to improve a methodology for the upkeeping of cultural heritage, which seems to be of primary importance, considering the costs that a restoration involves. A

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failed upkeep defeats the works of recover, the economic investments and all the practical work. The realistic 3D images offer a preventive tangibility of intervention operations that are going to take place. Rendering devices succeed in faithfully reproducing natural illumination, refraction and reflexion of light and confer to the models coherent chromatic proportions that simulate in the correct way the outcome of the intervention.

In three-dimensional scenes it is possible to set a camera and arrange a virtual walk through the project, moreover it is possible to establish different kinds of camera movements with many distinct perspectives.

In the 3D reconstruction a great importance has been given to visual and emotional aspects, because the project foresees an active participation of the community and of associative and voluntary realities present in the territory, involving them in the upkeep of cultural heritage, for instance cleaning the surrounding areas.

The main purpose of 3D reconstruction in the project "From Restoration to Management" is the planning of a recovery which doesn't involve the use of chemical substances and polluting materials, in accordance with environmental sustainability and compatibility. This kind of interventions, made with traditional construction systems, doesn't involve the use of invasive technologies and needs specific professional and manual skills.

Particularly Cavriana's castle has been the object of a complete 3D reconstruction, supported by an accurate historical an iconographical research. 3D reconstruction starts with deep analysis and archive study, demonstrating that documents rich of memory and techniques could be an opportunity for new interventions, creating strong connections between the academic world and the operative one. The research about digital reconstruction mainly consists in gather and study project tables, architectural relieves either historical or current, iconographic representations, written descriptions from reports and letters, previous studies or written stories, stylistic hypothesis of integration suggested by contemporary and geographically compatible construction typologies and suggestions of experts. The deep collocation of the elements emerged from the historical and archaeological study has been necessary to reach a level of detail and realism as high as possible.

The project is based on low cost technological instruments for preliminary survey that allowed, in experimental way, to get a general preview of the interventions. Indeed through the use of aerial photos taken by a plane and radio-controlled platform is possible to get images not available in other ways.

Reconstructions and 3D modelling don't have only a function of spread and communication of knowledge acquired about documentation and techniques, but they also have an epistemological function, related with the comprehension of building processes and

with the landscape's study, seen in its historical ever-changing nature, that arrives until nowadays.

The project demonstrates how historical researches and operative good practices can work together to obtain high level results.

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NON-DESTRUCTIVE EXAMINATION OF PANEL PAINTING STRUCTURES BY TERAHERTZ WAVES

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Abstract – Terahertz (THz) spectroscopy and imaging techniques have made progress in these 10 years, and some transportable systems have been applied to conduct non-destructive tests on various materials and objects. Since THz waves (or rays) can penetrate opaque materials and provide both material and structural information without contact, THZ techniques are expected to be useful in the investigation of cultural heritage objects. In this paper, we report examples of THZ application on the investigation of the preparations layers of some panel tempera paintings.

INTRODUCTION

Electromagnetic waves are commonly used in the research field of cultural heritage science, and to examine panel paintings in particular [1]. Imaging techniques from X-ray to infrared regions are used to non-destructively examine artworks. X-ray can easily detect metallic objects, such as the presence of nails in panel paintings; ultraviolet rays show the condition of the superficial layers of the paintings, such as the varnish layers and some pigments. Infrared imaging shows under-drawing and *pentimenti*. Near- and Mid-infrared spectroscopy has also been used in laboratories to identify substances. Meanwhile, microwave and millimetre wave radar has been applied for detecting objects buried in the soil by archaeologists. The frequency region between mid-infrared radiation and radio waves is generally reported as far-infrared and sub-millimetre waves; only recently as THz waves. Since stable sources in this frequency range (THz) have not been available up to around 20 years ago, there was a "gap" in frequency band, as shown in Fig. 1.

THz IMAGING

Terahertz (THz) waves (frequency: 0.1-10 THz; wavenumbers: 3-300 cm^{-1}; wavelength: 0.033-3.3 mm) exist in the range between radio waves (electronics) and lights waves (optics). THz spectroscopy and THz imaging techniques are expected to have great potential for analysing artworks. THz waves can penetrate beneath the surface of artworks, reaching the preparation layers non-invasively, and spectroscopic imaging can be obtained without the THz system coming in contact with the artwork. The various activities conducted around the world have been summarized in a recent review paper by Jackson *et al*. [2]. In general, the spectroscopic approach is used to identify unknown materials by using reference spectral library. In THz region, however, there is only one specific spectral library on artists' materials available (http:thzdb.org/), so further contributions are required for the application of THz spectroscopy to identify materials used in artworks. The reflection spectra of pigments in THz region do not always show particular peaks to identify the specific compounds; the reflection

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level can be used at least for distinguishing materials in imaging. Fig. 2 shows reflection spectra of two white pigments and the imaging results by a commercial THz imaging system. The highest level of the reflection in power integration is shown as 100% white in the grey scale images, and these two white pigments, lead white ($2PbCO_3 \cdot Pb(OH)_2$) and calcite ($CaCO_3$), can be clearly distinguished in the THz region.

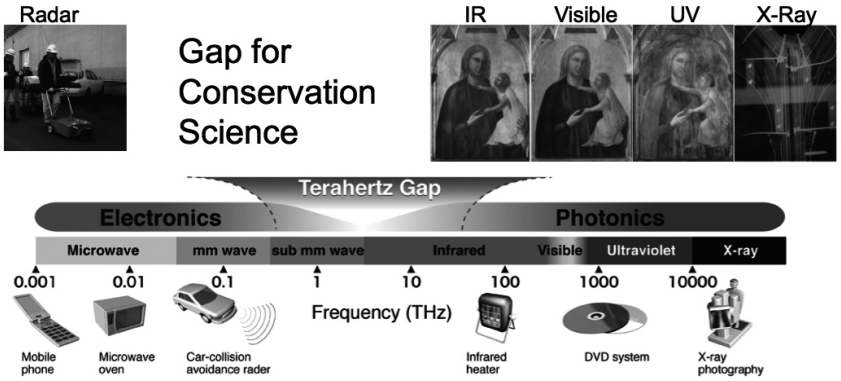

Fig. 1 Terahertz gap in electromagnetic waves used in the art conservation field.

THz time domain imaging using THz pulse has advantages in the investigation of preparation layers of panel paintings when compared to other techniques [3]. When a THz pulse is applied to a multi-layer object, made of materials A and B (Fig. 3(a)), the reflection pulses from each interface, air/A, A/B, B/air appear as a sequence of pulses, and the amplitude and the phase are determined by the refractive index of materials at each interface. It also means that the material information at the internal interface could be estimated from the output signal.

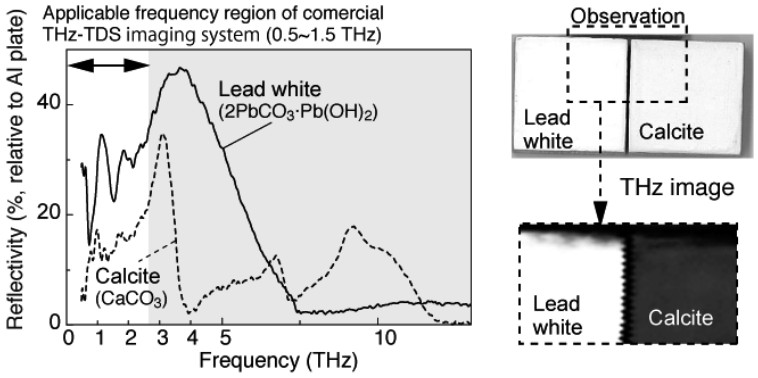

Fig. 2 THz reflection spectra (left) and THz image (right) of two white pigments.

Fig. 3(b) shows the output signal from the back side of an old Japanese panel screen, which had to be removed for conservation. The four peaks in the graph indicate the number of paper layers, which was four, in the back side, and this datum was confirmed by removing the papers from the back surface. The THz-TDS system can be synchronized with a scanning stage, resulting in three dimensional imaging by reconstructing data sets. Spectroscopic information can be extracted by applying the Fourier transform algorithm.

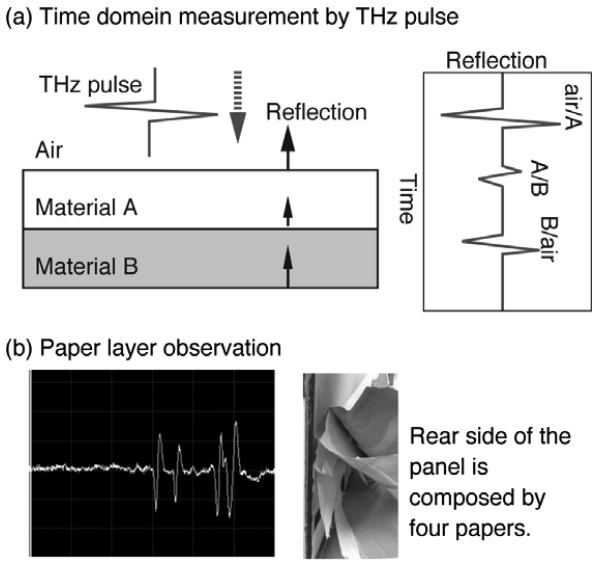

Fig. 3 Internal structure examination by using THz pulse time domain imaging.

CASE STUDIES: PREPARATION LAYER OBSERVATIONS

We had the opportunity to study a masterpiece of Giotto di Bondone, *Polittico di Badia* (1300), which is part of the permanent collection of the Uffizi Gallery in Florence, Italy.

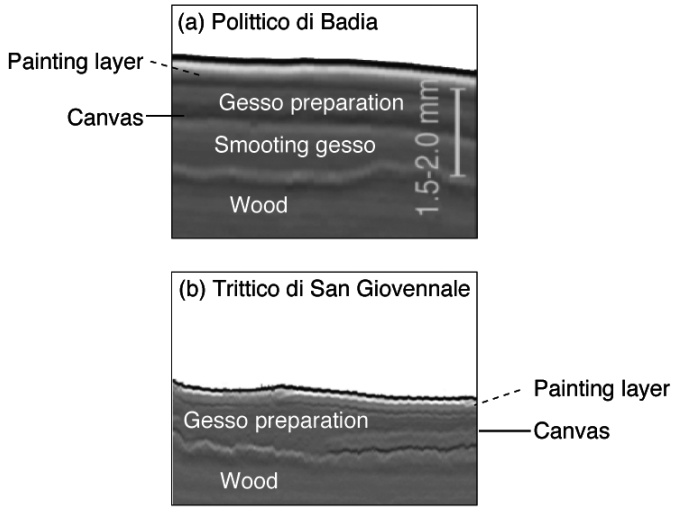

Fig. 4 Non-destructive cross-section images of panel painting masterpieces.
(a) *Polittico di Badia*, Giotto, (b) *Trittico di San Giovenale*, Masaccio.

The artwork was under restoration in 2008-2009, and we applied the THz technology to investigate the internal structure. The instrument used for this work was a transportable THz

time domain imaging system (Picometrix, T-Ray 4000). The non-invasive cross section image of the Polittico (Fig. 4 (a)) clearly showed that there were two gesso layers and a linen canvas in between; a gesso layer was directly applied on the wooden support to flatten the carved wood, and another gesso layer was present on a canvas support as a preparation layer for painting [4]. We also conducted micro-invasive visible observation by sampling, and confirmed that there are two gesso layers with the canvas sheet in between. It proves that Giotto followed a technique commonly used in the medieval time. We had conducted other scientific analysis, including photographic examinations (IR, UV, X-ray), FTIR analysis of varnish on samples, cross-section observation by SEM-EPMA, UV-Vis-NIR Fibre Optics Reflectance Spectroscopy (FORS), and so on. These results are reported in a book dedicated to the conservation of the Polittico di Badia [5].

We have observed another masterpiece, *Trittico di San Giovennale* (1422), by Masaccio while the painting was under conservation in 2010. Unlike Polittico di Badia, it has one gesso layer, similar to early Renaissance panel tempera paintings as shown in Fig. 4 (b). There is a small area which had no canvas. The difference in the preparation layer is clearly recognised when comparing the *Polittico di Badia* to the *Trittico di San Giovenale*. It suggested that at the time of Masaccio, the first gesso layer was not required to have a smoothly wooden surface to make the preparation layer for the paint layers. Some irregular internal structural patterns were recognised in this masterpiece, which need to be further investigated.

These experiments prove that THz time domain imaging can give useful information in the field of art history as well as be helpful in the practical conservation procedures of artworks.

ACKNOWLEDGMENTS

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2D ART PAINTING TO STEREOSCOPIC 3D CONVERSION USING SEMI-AUTOMATIC DEPTH MAP GENERATION

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Abstract – We present a method for the further appreciation of fine art pieces by introducing a sense of depth – given that their digitized versions are available. Our objective is to create left and right stereoscopic image pairs of the art piece for appreciation on compatible 3D viewing technology. We achieve this in a semi-automatic fashion, allowing the user to sparsely mark the relative depths in the image. With this, the algorithm determines a depth map to be used in this conversion process. We present depth maps of various art paintings, and their stereoscopic image pairs for better appreciation of these pieces.

Stereoscopic imaging and the depth perception of 2D content has sparked interest in the last several decades. Specifically, the focus has been on rendering two distinct views presented to the left and right eyes, resulting in a more realistic experience. Research in stereoscopic imaging has produced many different technologies for the depth perception of 2D content. Though there are many technologies, there are a limited amount of *methods* to produce stereoscopic content. In addition, very little work has been performed in the arts and culture perspective, and stereoscopic research – specifically, in art paintings – would benefit the user by enhancing their depth perception of the viewed work, leading us to our purpose. The area we speak of is commonly known as *2D to 3D conversion*, and its goal is to recover a *depth map*. This is a monochromatic, or grayscale image, where a low intensity indicates a far distance from the camera, and a high intensity indicates a close distance. Within this realm of 2D to 3D conversion, there are two categories of methods to perform this task. The first are *automatic methods*, observing and calculating features in an image to automatically infer the depths for all the pixels. Some examples of this are the following: Tam *et al.* [1] use YCbCr color space of the image, and use the Cr channel, with some simple post-processing techniques to generate a depth map. Cheng *et al.* [2] use edge information, where the object edges are a good indication of what is close and far from the camera. A similar approach was taken by Jung *et al.* [3], where the gradient, as well as linear perspective cues were used. Saxena *et al.* [4] use steerable filters to estimate the texture and gradient energies over different sized image patches. The output of each filter serves as a particular feature in a concatenated feature vector associated with each patch. These feature vectors are used to form a probabilistic model to determine the depth between the patches, and with the feature vectors in the model. Though very little intervention by the user is seen in these methods, automatic methods are subject to a variety of problems, including extensive pre- and/or post-processing, or have no provision for correcting errors, where objects may appear at the wrong depths. The second method is *semi-automatic* methods, which are less known, but are starting to become more popular. This is preferred for converting art paintings to stereoscopic 3D, as the user can control how much depth perception the painting can have, and can be tuned to their liking. Many institutions and companies are researching this, and the prominent two performing this research are Guttmann *et al.* [5] at Tel Aviv University, and Wang *et al.* at Disney Research Zurich [6]. As [5,6] give a very good model on how to perform semi-automatic 2D to 3D conversion, our work is based on [5]. We chose not to base our work on [6], as we have found exploits in [5] that lead to a simpler method, and can still achieve very

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convincing results. However, [6] has better provisions in handling errors that arise after the conversion in their post-processing pipeline, but these only result when converting videos. As we deal only with images, we have found that our framework, though it is loosely based on [5], can generate very good results without the error resilience in [6]. We will now go through the details of our 2D to 3D conversion scheme, and illustrate examples on how this can be applied to art paintings, with depth maps and stereoscopic left and right image pairs to accompany the depth maps.

METHOD

Our main motivation is that this is a special case of image segmentation. Considering depth map generation as an image segmentation problem is very intuitive. In multi-label semi-automatic image segmentation, for each object we wish to extract, we mark those pixels characteristic of each object, and assign those pixels a unique ID – one per object, with the rest of the pixels marked as unknown. Using this user-provided information, the output of a multi-label segmentation determines which ID, and ultimately which object each pixel belongs to. For the case of semi-automatic depth map generation, each object is considered a separate *depth*. The user merely marks each area, or each object with their relative depths and for the rest of the unmarked pixels, the algorithm determines these depths using the user-provided information. One issue that may surface is whether or not the user is *accurately* marking what the actual perceived depth is in the image. In [5], they showed that the exact depths are not required to be known, and as long as the user is perceptually consistent in marking the depths in the image, the perceived stereo effect can still be appreciated well.

As mentioned previously, our work is based on [5]. They achieve good results, but results in a complicated system, requiring many processing steps to obtain the final depth map. With the marked depths, four equations are used and solved in a least-squares framework to generate the best depth maps that are subject to the least amount of error. These equations describe piecewise continuity of the depth values, in both a spatial and temporal fashion. This produces an intermediate result, and is fed into a Support Vector Machine (SVM) classifier for training purposes. Classification using SVM is used for the final depth values. Our work demonstrates that the same quality is possible, with a simpler method. Interestingly, the least-squares framework is a derivative of Random Walks segmentation by Grady [7], and we exploit this. Our method is a two stage process, using the smoothing properties inherent to the Random Walks framework, with the hard segmentation by the Graph Cuts segmentation framework [8]. In Random Walks, the labels belong to a continuous set $D \in [0,1]$. Thus, it is possible for Random Walks to assign pixel labels not assigned by the user to begin with. With Graph Cuts, the resulting segmentation only produces labels that are within the user-provided set, and are thus *hard*. Graph Cuts is another semi-automatic image segmentation framework that minimizes an energy functional. The labeling best minimizing the energy functional is the segmentation result used. Graph Cuts converts this to a graph theory problem, and the best graph partition is the best segmentation. Random Walks has problems preserving strong edges, due to its nature in providing a continuous set of labels, and similarly, Graph Cuts preserves strong edges due to its hard property, but does not respect smooth gradients or fine detail well. By combining the two, we can retain strong object boundaries, while allowing smooth gradients. Specifically, we use Graph Cuts to generate an initial depth map, or a rough initial depth estimate, using the user-defined depth strokes. We call this a *depth prior*. After, the depth prior and the same depth strokes are integrated into the Random Walks as an additional feature for determining the edge weights. The merits of Random Walks are combined with Graph Cuts, producing a good quality depth map.

Depth Prior Generation

Graph Cuts is based on solving the Maximum-A-Posteriori Markov Random Field (MAP-MRF) labeling problem with hard constraints, or the user-defined labels. The solution to the MAP-MRF will provide the most likely labeling for any given pixel from the provided hard constraints. It is shown [8] that the solution is found by the following energy minimization:

$$E(P) = \sum_{p \in P} D_p(f_p) + \sum_{\{p,q\} \in \mathcal{N}} V_{p,q}(f_p, f_q) \quad .$$

Here, *E(P)* is the "energy" over the set of all image pixels *P*, with *p* being an image pixel belonging to this set. $D_p(f_p)$ is the data cost, or the cost when assigning a label f_p to *p*. $V_{p,q}(f_p, f_q)$ is the smoothness cost incurred when assigning two different labels to two pixels in some spatial neighborhood, $\mathcal{N}$ The solution that minimizes the entire energy of the image, *E(P)*, is the solution that finds the minimum cut or maximum flow of a graph [8]. When the maximum flow is calculated, the minimum cut represents the best partition between any two labels. A consequence is that Graph Cuts only produces *binary* segmentation results, and we require a multi-label segmentation framework for our work. Therefore, we assign a unique integer label, $k \in [1, N_D]$ to each user-defined depth value provided, where N_D is the total number of unique depths, with the unknown label assigned as 0. Graph Cuts segmentation is performed for each label separately, setting the rest of the pixels to label 0. The maximum flows for each label, or their corresponding smallest energies to minimize *E(P)*, are all recorded. If a pixel was only assigned to one label, then that is the label it is given. However, if a pixel was assigned multiple labels, the final label it is assigned is the one with the highest maximum flow, corresponding to the least amount of energy required to classify the pixel. In some cases, this may result in some pixels being unclassified, but region-filling methods can be used, and we will address this later. In our work, we use the following weighting function for the *n-links*, or for the smoothness cost:

$$N(i,j) = \gamma \left(\frac{2}{1 + \exp(\beta[d(\vec{c}_i, \vec{c}_j)]^\alpha)} \right),$$

where $d(\vec{c}_i, \vec{c}_j)$ is the Euclidean distance of the CIE L*a*b* co-ordinates between pixels *i* and *j*. The constants were chosen experimentally as $\gamma = 255, \alpha = 2, \beta = 1$. For the *t-links*, or the data costs, we used a modified Potts model, rather than the log-histogram probability in [8]. Table 1 shows the link weights for a user-defined label, *m*, with the Graph Cuts segmentation label, *k*. The value of *K* is defined in Section 2.5 of [7].

Type of Link	Weights		
	$m = k$	$m \in [1, N_D],\ m \neq k$	$m \notin [1, N_D]$
Source Link	K	0	K
Sink Link	0	K	K

Table 1: *t-link* weights used in the Graph Cuts segmentation for label *k*

Once the segmentation is performed, a depth prior is generated, and it will be used to augment the depth map generated in the Random Walks stage, which we discuss next.

Generating Depth Maps via Random Walks

With the same user-defined strokes from the previous stage, we use Random Walks in the same manner as [7], and it is easily adaptable to become a multi-label segmentation framework. To segment an image using Random Walks, we solve the following linear system: $\mathbf{L}\vec{x} = \vec{b}$. $\vec{b}$ is the boundary condition, $\vec{x}$ is the set of image probability values, where both vectors have a length amounting to the total number of pixels in the image. Finally, **L** = *deg*(**A**) – **A**, and is also known as the Laplacian of the adjacency matrix. Random Walks is a

binary segmentation problem, where a pixel is classified as an object if $x > 0.5$, and the background otherwise. To modify this for multi-label segmentation, each label is assigned a unique label within the set $D \in [0,1]$. The resulting probabilities for all pixels can be directly interpreted as a depth map. However, it is known that Random Walks is susceptible to noise, and to alleviate this, a modified version known as Scale-Space Random Walks (SSRW) is used [9]. This preserves global image structure, while mitigating the effect of noise in the depth maps. SSRW constructs an image pyramid by repeatedly subsampling the image in half. Each subsampled result is a *scale*, and each is Gaussian blurred before proceeding to subsample again to generate the next scale. Random Walks is performed on each scale, and the results are combined using the geometric mean. To incorporate the two paradigms together, we must modify the depth prior. Graph Cuts produces a hard segmentation, where each region was assigned an integer depth label. When this labeling is obtained, it is processed to obtain a lookup table, $T[k]$, that finds a one-to-one mapping from the integer labels to the set D. What is actually done is the user-defined labels are assigned from D first. After, the values are sorted from lowest to highest, and each unique label is assigned an integer label for the Graph Cuts segmentation. To incorporate the depth prior into the Random Walks paradigm, we append this information into the edge weights. In the original SSRW framework, the same previously mentioned equation used to calculate the *n-links* is used, with the same experimentally found parameters. To incorporate the depth prior into SSRW, the distance between two color pixels will need to change, and it is now:

$$d(\vec{c}_i, \vec{c}_j, d_i, d_j|\alpha) = \sqrt{d(\vec{c}_i, \vec{c}_j)^2 + (\alpha(d_i - d_j))^2}$$

This is a modified version of the Euclidean distance seen previously, but we introduce d_i and d_j, which are the depths at pixels i and j from the depth prior, and α is a positive scale factor, determining how much contribution the depth prior has in Random Walks. As the dynamic range of the generated depth values are in the range of 0 to 1, and those in the CIE L*a*b* color space are much higher, the color components in this modified equation will overpower those in the depth prior. Therefore, each component is normalized individually, with all components within [0,1]. These normalized components are used to calculate the modified Euclidean distance for the edge weights for SSRW, and thus produce our depth map.

RESULTS

We now illustrate some conversion examples when applied to digitized art pieces. Here, α was experimentally chosen to be 0.5. We have also posted full-resolution depth maps, with the color versions of the original images, the synthetically generated right views, and the anaglyphs merging the two images together at http://www.rnet.ryerson.ca/~rphan/eva2012. Here, lighter strokes denote locations that are closer perceptually, while darker strokes denote locations that are far. To generate the synthetic right view, we use the depth maps from our system; each pixel was shifted to the left by a scaled version of the final depth map. The resulting occlusions were filled using Random Walks to simulate anisotropic diffusion. For the occlusion regions, they are separated into their individual color channels, and their gray-level intensities are used as "user"-defined strokes. The results from all three channels are combined using each triplet of gray-level intensities at each location to convert them to their respective color values. Fig. 1 illustrates a result using Thomas Kinkade's Venice. Fig. 1(a) shows the original image, while Fig. 1(b) shows the user-defined depth strokes. Marking the strokes is quite intuitive, taking roughly 30 seconds to 1 minute. Should the user be unsatisfied with the results, they simply have to observe the errors are in the resulting depth map, touch up those strokes, and re-run the algorithm. Fig. 1(c) illustrates our calculated depth map, and Fig. 1(d) is the synthetically generated right view. The depths are captured adequately, with the right-side buildings increasing in depth as we move in further, just like the river, the gondolas, and the buildings in the middle. The computation time on this 330 x

499 pixel image, using an Intel Core 2 Quad 2.4 GHz Q6600 with 8 GB of RAM, took ~6 seconds. We show one more example in Fig. 2, using Bernardo Bellotto's Florence. The results are presented in the same style as Fig. 1. The computation time on this 799 x 542 pixel image took ~13 seconds, with approximately the same amount of time to label the image as in Fig. 1. The depths are also captured adequately, with the buildings on both sides increasing in depth as we move further, just like the boats and the bridge in the background.

CONCLUSIONS

We presented a semi-automatic system for obtaining depth maps for the purpose of transforming art pieces in digitized form into its stereoscopic 3D counterpart. Viewing art pieces in stereoscopic 3D allows for further appreciation of the work, and performing this in a semi-automatic fashion is preferred over an automatic one, as we can directly control the perceived depth for objects in the scene. Our work obtains similar results to [5], but is a much simpler method. We have incorporated two very well known segmentation algorithms in a novel way to produce stereoscopic image pairs.

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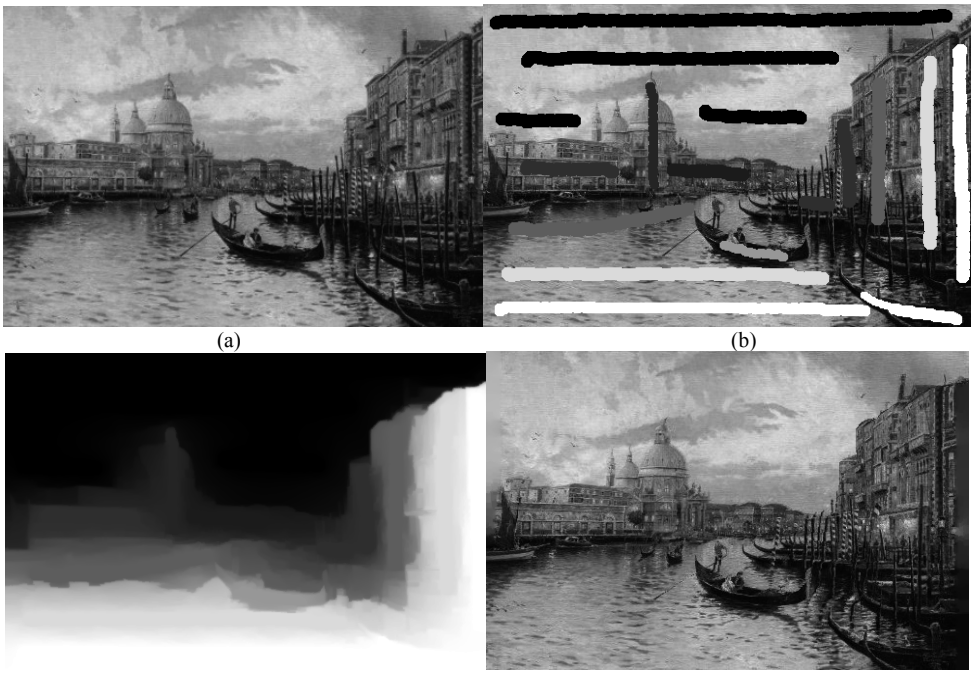
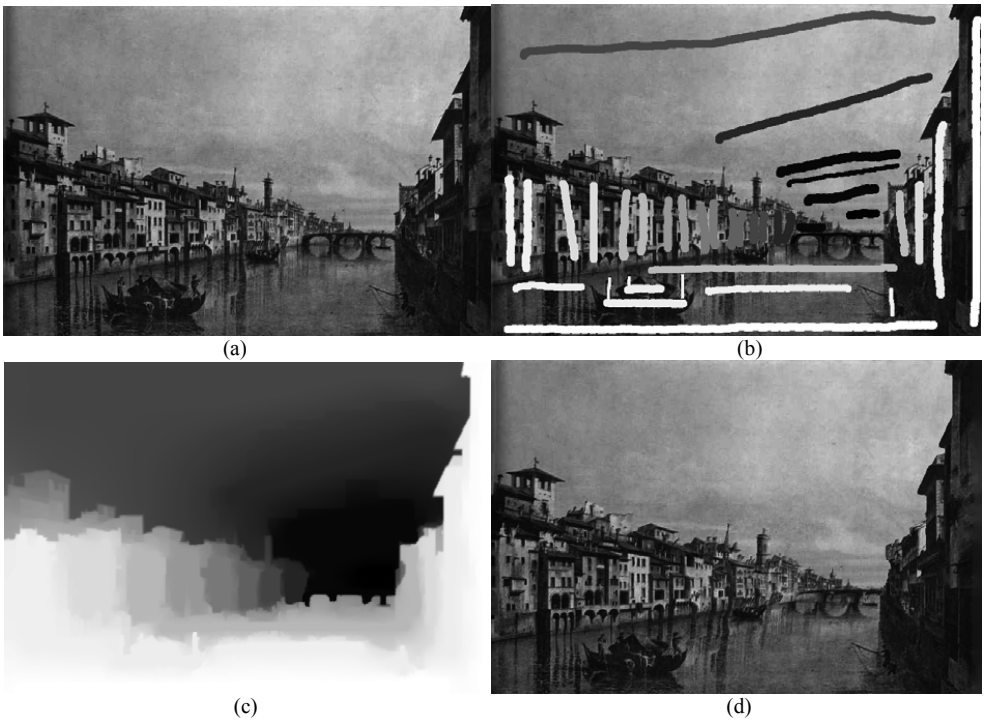


(a) (b)

(c) (d)

Fig. 1: Results using the Thomas Kinkade Painting – (a) Original Image, (b) Depth Labels Superimposed, (c) Resulting Depth Map, (d) Synthetically Generated Right View



(a) (b)

(c) (d)

Fig. 2: Results using the Bernardo Bellotto Painting – (a) Original Image, (b) Depth Labels Superimposed, (c) Resulting Depth Map, (d) Synthetically Generated Right View

3D Spatial Reproduction by FTV

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Abstract – FTV (Free-viewpoint Television) enables 3D spatial reproduction since it captures all rays in 3D space and reproduces the same rays at different place and time. We have developed various types of ray capture, processing and display technologies for FTV. FTV is available on a laptop PC or a mobile player. The international standardization of FTV has been conducted in MPEG. The first phase of FTV was MVC (Multi-view Video Coding) and the second phase is 3DV (3D Video).

INTRODUCTION

We are surrounded by audio-visual information in 3D space. It is the ultimate target of communication and broadcast to transmit and reproduce 3D space with all audio-visual information.

FTV (Free-viewpoint Television) [1]-[4] enables us to view a 3D scene by freely changing the viewpoints as if we were there. FTV is the ultimate 3DTV that transmits the infinite number of views and ranked as the top of media. It is also the best interface between human and environment, and an innovative tool to create new types of content and art.

We proposed the concept of FTV and verified its feasibility with the world's first real-time system including the complete chain of operation from image capture to display [5]. FTV with audio was realized by adding free listening-point function [6].

FTV is based on the ray-space method [7]-[9]. We developed ray capture, processing, and display technologies for FTV. All-around ray-reproducing FTV has been realized by using these technologies [10].

The international standardization of FTV has been conducted in MPEG. The first phase of FTV was MVC (Multi-view Video Coding). MVC was completed in May 2009 and has been adopted by Blu-ray 3D. The second phase of FTV is 3DV (3D Video). 3DV is a standard that targets serving a variety of 3D displays.

CORE TECHNOLOGIES OF FTV

Capture

A "100-camera system" [11] was developed to capture larger spaces. The camera setting is flexible as shown in Fig. 1. The system consists of one host-server PC and 100 client PCs (called 'nodes') that are equipped with JAI PULNiX TM-1400CL cameras. The interface between camera and PC is Camera-Link. The host PC generates a synchronization signal and distributes it to all of the nodes. This system is capable of capturing not only high-resolution video with 30 fps but also analog signals of up to 96 kHz.

Furthermore, we have developed an all-around dense ray capture system and an efficient ray capture method that can capture several rays per 1 pixel [12], [13].

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Fig. 1. 100-camera capturing system.

View Generation

The quality of the generated view images depends on the ray-space interpolation as shown in Fig.2. The ray-space interpolation is achieved by detecting depth information pixel by pixel from the multi-view video. We proposed several interpolation schemes of the ray-space [14]-[17].

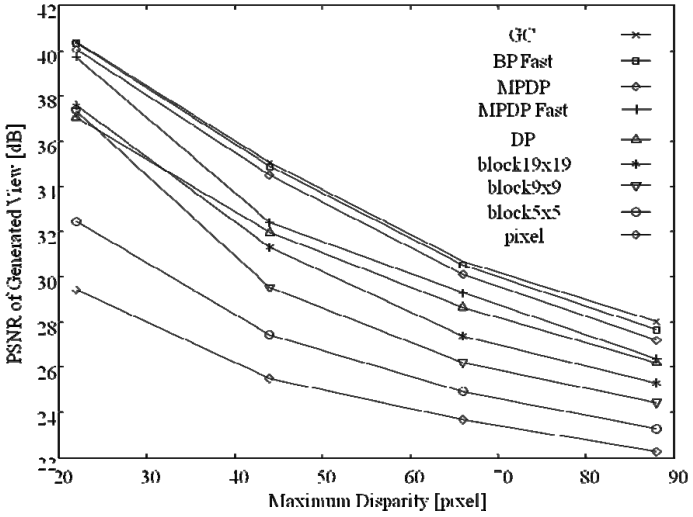

Fig. 2. Relation between maximum disparity and PSNR of generated image for various interpolation schemes.

Synthesized view contains artifacts if there is error in depth estimation. Considering the fact that synthesis artifacts can be measured at the location of the reference views, thus we can eliminate similar error in the synthesized location. Based on this idea, we have developed three methods which can be applied during free-viewpoint rendering to suppress errors [18]-[20]. Fig. 3 shows view synthesis by reliability-based optimization and improvement of free-viewpoint images.

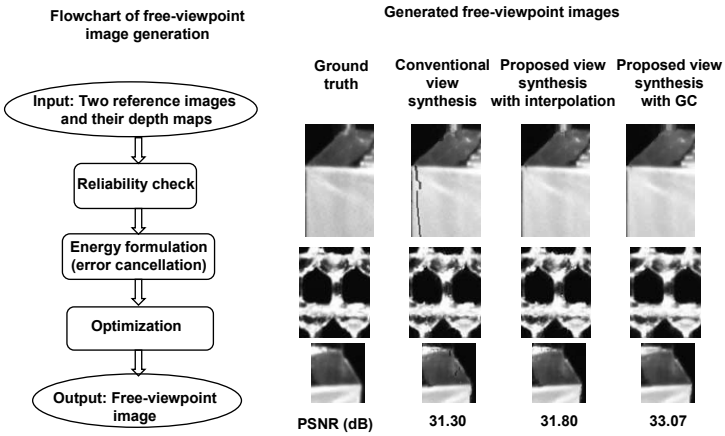

Fig. 3. View generation by reliability-based optimization and improvement of generated images.

User Interface

Various types of 2D/3D displays as shown in Fig. 4 were developed for FTV.

The upper right of Fig. 4 shows an all-around 3D display, the Seelinder [21]. It is a 360-degree, ray-reproducing display that allows multiple viewers to see 3D FTV images. It consists of a cylindrical parallax barrier and one-dimensional light-source arrays. LEDs are aligned vertically for the one-dimensional light-source arrays. The cylindrical parallax barrier rotates quickly, and the light-source arrays rotate slowly in the opposite direction. If the aperture width of the parallax barrier is sufficiently small, the light going through the aperture becomes a thin flux, and its direction is scanned by the movement of the parallax barrier and the light-source arrays. By synchronously changing the intensity of the light sources with the scanning, pixels whose luminance differs for each viewing direction can be displayed. We can see the 3D image naturally, and the images have the strong depth cues of natural binocular disparity. When we move around the display, our views change corresponding to our viewing position. Therefore, we perceive the objects just as if they were floating in the cylinder.

Fig.4. Various types of 2D/3D displays for FTV.

All-AROUND RAY-REPRODUCING FTV

We have developed a 3DTV system that captures and displays 3D images that covers 360-degree of viewing zone horizontally [10]. 3D images are captured and reproduced as gathering of dense rays. As shown in Fig. 5, the all-around 3DTV system consists of a ray capturing unit, a real-time image correction unit, data transferring system and a cylinder-shaped 3D display that allows viewers to see 3D images from 360-degree. The capturing unit acquires multiview images from all horizontal directions around an object with narrow view interval, which the display needs as ray data. The image correction unit performs real-time correction of rotation and distortion caused by optics of ray capturing unit.Free navigation of dynamic scenes needs ray capture by multi-camera. However, for static scenes, rays can be captured by moving a single camera.

Fig5. All-around ray-reproducing 3DTV.

INTERNATIONAL STANDARDIZATION

We proposed FTV to MPEG in 2001. First, many topics on 3D were discussed. The discussion was converged on FTV in January 2004 and the standardization of the coding part of FTV started as MVC (Multi-view Video Coding) [22]. MVC was the first phase of FTV and completed in March 2009. MVC is based on H.264/MPEG4-AVC and has been adopted by Blu-ray 3D. MVC is used as shown in Fig. 6.

FTV cannot be constructed by coding part alone. We proposed to standardize the entire FTV and MPEG started the standardization activity of FTV and MPEG-FTV was established in April 2007.

In January 2008, MPEG-FTV targeted the standardization of 3DV (3D Video) [23]. 3DV is a standard serving for a variety of 3D displays. 3DV is the second phase of FTV. “Call for Proposals on 3D Video Coding Technology” was issued in March 2011 [24]. 3DV is used as shown in Fig. 7.

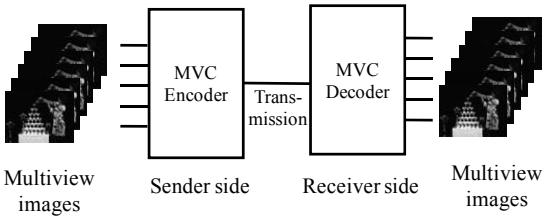

Fig. 6. Framework of MVC (Multi-view Video Coding)

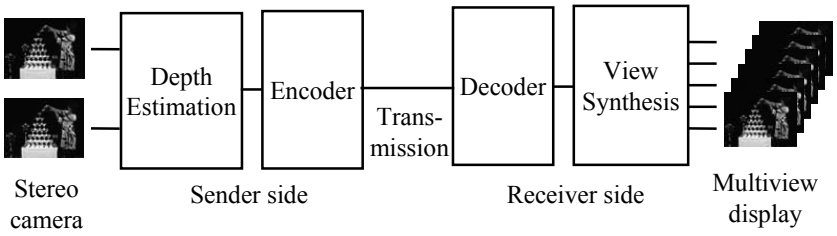

Fig. 7. Framework of 3DV (3D Video)

CONCLUSION

FTV is an innovative media that allows one to view a 3D world by freely changing the viewpoint and will bring an epochal change in the history of television.

The most essential element of visual systems is ray. FTV is not a conventional pixel-based system but a ray-based system. We have been developing ray capture, processing and display technologies for FTV.

FTV will find many applications in the fields of broadcast, communication, amusement, entertainment, advertising, exhibition, education, medicine, and so on since FTV is an ultimate 3DTV that captures and transmits all visual information of a 3D scene, the best interface between human and environment, and an innovative tool to create new types of content and art.

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VIRTUAL GALLERIES - MUSEUMS AND RELATED INITIATIVES

NATIONAL SYSTEMS ON DIGITAL CULTURAL HERITAGE IN THE FRAME OF EUROPEAN INITIATIVES

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ICCU promotes the aggregation of digital cultural content with the twofold aim of raising the visibility of the Italian cultural resources at the national and European levels.

ICCU manages two major initiatives: Internet Culturale, the portal of the digital content of the Italian libraries, and CulturaItalia, the Italian culture portal. The information of Internet Culturale is also published in CulturaItalia; by the other hand, CulturaItalia is the national aggregator for Europeana.
CulturaItalia (www.culturaitalia.it) proposes a guided access to the world of Italian culture. Thanks to innovative IT solutions, the portal gathers and organises millions of informational elements on the resources that make up the country's vast cultural universe, and place them at the disposal of web users at large.
InternetCulturale (www.internetculturale.it) guides the user through 6M of images from the databases of ICCU: Opac SBN, Edit16, Manus, Remi, Biblioteca digitale and 215 historical catalogues from the Italian libraries.

The role of an aggregator for Europeana is not limited to the transfer of metadata. The aggregator, in fact, plays an important role also in other sectors involved in the dissemination of the vision and objectives of Europeana with its network of institutions, contributes to the European debate on the issues of technical-scientific field (interoperability, multilingualism, terminologies, IPR, standards, linked data, user expectations, etc..) contributes to the implementation of international standards of literacy and cultural workers.

The Italian Ministry was represented by its minister at a major awareness event around Europeana that was held in Brussels on 9 May 2012. The main aim of the event was to raise awareness of Europeana's rich resources among citizens and to demonstrate that online cultural heritage is a driver of creativity and digital innovation. The flagship of Italy on that occasion was a masterpiece from the Uffizi in Florence, "Tondo Doni" of Michelangelo Buonarroti, visible in Europeana via CulturaItalia.

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THE INTERACTIVE USER.

Modern user generated vernacular photo and the picture archive.

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The interactive user-integrating installation "VÆGGEN" (THE WALL) has now been in action in two locations in Copenhagen for more than a year. More than 5500 pictures have been uploaded and a large amount of comments and user activity has been collected.

The Picture archive at the museum has traditionally concentrated on topographically relevant pictures, largely leaving the artistic aspects of the pictures - both paintings and photographs - aside.

In light of the character of the user generated pictures, which to a relatively high extent play up against current artistic trends, such as low-fi, evident manipulations, staged photo etc., it is a pertinent question how we should respond to these trends, all the more in light of the changes to our relation to our users the museum currently undertakes. We want to be more responsive to the current lived culture of the city, rather than just a recorder of days gone by.

This makes the traditional criteria for assessing the "value" of an individual photo less relevant, and sets the need for new ways of doing this.

The paper examines the museum's tentative steps in this direction in the light of recent research into vernacular digital photo.

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BEETWEEN REUSE AND ENHANCING: THE ARCHEOLOGICAL MUSEUM OF SANTA SCOLASTICA, BARI

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Abstract

The most important restoration project, in progress at the moment in Bari, refers to the future seat of the Museum of Archeology in Santa Scolastica, located inside a former monastery in the old city centre.

The peculiar location of the building has set, as a priority aim, the need of highlighting, besides the primary function of housing the famous art collections of the Province of Bari and of the State, its value as "link", between the natural "gate" to the city from the sea and the historical stratification of the "old village", actually a widespread museum. The project reconciles the respect of the complex historical stratigraphy of the place with the essentials functions, technological and multimedia innovations of a modern museum.

THE *PLACE*

The monastery of Santa Scolastica and the contiguous area of Saint Peter, in the old city centre of Bari, represent, according to the use established in June 2001 by Bari University, owner of the building and the Province of Bari, under a commodate contract, the chosen location to house the famous collection of the Provincial Museum of Archeology seated at Palazzo Ateneo. This museum was opened in 1895, closed to the public in 1994 due to the restoration works and definitively removed in 2001, by determining a strong lack in the already meagre number of museums in the Apulian capital.

After alternate events that continued up to 2010, by the subscription of the MoU dated 30.10.2010, the Province of Bari gave to the Regional Direction for the Cultural Heritage and Landscape of Puglia, the difficult task, because of the many expectations on the theme, coming from the scientific community as well as from the citizens, to plan and start the general recovering of the site, aiming at the creation of the Archeological Museum of Santa Scolastica, - dedicated in a wide sense to the archeology of the old Peucetia, through the historical State and Province collections – whose works in progress at the moment, represent a first stage.

The strategic location of the complex is marked by many factors:

- the environmental value of the place, overlooking the sea;
- the proximity to the touristic port on one side and to the old city center on the other side;
- the density of historical, architectural and archeological meanings and values;
- the direct and contextualized picture of the cultural stratification of the city.

All the values merge in the symbolic meaning of the sea and the port for the city of Bari from ancient times up to nowadays. The peculiar location of the monument has set, as a priority aim, the need of highlighting, besides its primary function of as museum, its function as "link", between the natural "gate" to the city from the sea and the historical stratification of the "old village", actually a widespread museum, for the density and variety of the architectural, historical, artistic and archeological values it expresses.

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THE GENERAL PROJECT

The general project for the realization of the Archeological Museum of Santa Scolastica insists on two areas different in planning: the former monastery and the archeological site of Saint Peter, yet both areas are complementary for the recovery and enhancement of the whole area.

For the reuse of the former monastery of Santa Scolastica as a museum, - it was once used as seat of the Architecture faculty between the 1980s and 2001- have been provided necessary interventions for the functional adjustment and development of its many-sided rooms, by doing a project that gives a new meaning to the exhibition of the precious and sometimes exceptional archeological finds, alternating itineraries inside the monument with traditional exhibition rooms, multimedia sections with "immersion" rooms, which can trigger the emotional and cultural involvement of the visitor.

For the rehabilitation of Saint Peter's site it will be conducted a propedeutic and widespread activity of stratigraphic excavation, that will give back to the town unedited pages of its history; it will plan a suitable itinerary to visit the area, linking those parts of the building which are intended to be seen by the visitors, with the provided exhibition hall and consequently with the museum complex of Santa Scolastica.

In short, if we consider the whole area of Santa Scolastica and its entire availability, the general project includes the following planning:

- an Art- Way on the ground floor, to identify the crossing of the site from the gate towards the sea to the gate towards the city;
- functional readjustments works of the rooms on the first and second floor, to be employed as exhibition rooms for the archeological collections and as offices;
- restoration of the existing archeological remains inside the complex and at the same time archeological investigation of the external area surrounding it;
- scenic itinerary to visit the Bastions, starting from the inside, passing by the terraces on them and going down to Saint Peter's area and up to the sea front. It is an itinerary full of historical evocation (a real diachronic visit to the city), which rejoins the "Muraglia route" to the sea front.
- functional readjustment works of the new southern glass wall, planned and constructed in 1980s to be used as place for temporary exhibitions;
- coffee shop on the basement floor near the archeological area of the southern courtyard with an entrance both from the museum and from the outside.

THE FIRST FUNCTIONAL LOT – THE ART-WAY

The main aim of this first lot of works – total amount of 1.900.000 euro, obtained thanks to the funds of A.P.Q. MiBAC and Puglia Region- is to carry out the restoration works, the functional readjustment, the museum and the multimedia setting of the places involved with the Art-way, in order to allow the immediate use of this part of the complex at the end of the works.

The works will provide the construction of a continuous way, by the creation of walkways, platforms, footboards, connecting structures and coverings in metal and glass, by eliminating the barriers along it, in a place with frequent differences in level. Particular attention has been given to the realization of a "smooth" way in order to guarantee different levels of accessibility, according to the " Guidelines for overcoming the architectural barriers in places of cultural interest" edited by MiBAC.

The installation of technological plants (electric, air conditioning, fire-fighting, voice-data net, alarm, cable radio) will be provided in consideration of the future expansion of the exhibition rooms.

For what concerning the archeological excavation inside the Saint Peter's area, a surface of 5,600 square metres will be interested and the above excavation will be lead starting from the ones interrupted in 2005, in order to define the horizontal and vertical stratigraphy of the site.

In parallel with this, a topographic and stratigraphic relief of the site will be provided to document layers, structures and finds. At the same time the finds will be classified, restored and exhibited.

THE ART WAY: THE CULTURAL PROJECT

The Art-way, spread between the new entrance to the rampart next to the port (which, though with a different collocation, ideally suggests the original link to the sea) and the current entrance in Via Venezia, will allow the visitors to get the global perception of the area, observing both the monumental values and the complex stratigraphy of the site, without damaging the original architectural elements, though by showing the signs of the restoration works made between 1972 and 1984, which transformed the place in a university seat.

Different from the exhibition rooms, the way will be crossed without paying a ticket, and it will be a way to get to the different places (museum, rooms for temporary exhibition, info point, ticket office, etc.). It has been conceived to prepare the visitor to the detailed visit of the complex and of the museum. It will help him to understand and identify the archeological aspects of the site, through the suggestions offered by the monument and the exhibition rooms and by a visual, virtual, interactive and immersive communication.

It is a kind of double *ouverture* or prologue from the sea side to the *opera* performed by the superior floors and by the museum on the ground floor; from the city side it is a prologue to the *opera* performed by the eccentric and picturesque monumentality of the old city centre.

THE ART WAY: THE MUSEOLOGICAL PROJECT

The art-way itinerary which will cross the rooms on the ground floor from the new entrance opposite the port and to the traditional entrance in the Old City centre, aims at favouring the historical comprehension and the archeological value of the place, offering the visitor information about historical and archeological themes of the town and progressively on the Terra di Bari and on the whole region. Furthermore a preview of the collections of the Museum of Archeology of Santa Scolastica will be offered, giving hints on the future arrangement of the superior floors, as well as on the new museum which will be made in the nearby area of Saint Peter.

The itinerary will be divided into the following sections:

a. The origins of Santa Scolastica: Bari during the Byzantine times.

Inside the bastion, where it is possible to see the remains of the Byzantine church of the Saints John and Paul, it will be proposed the projection on the walls of images referring to the architectural and artistic testimonies of Bari in the Byzantine times, with a particular attention to places of worship discovered during archeological excavations in the old city centre and already included in independent itineraries. In this section there will be the exhibition of the findings belonging to the different life stages of the monastery.

b. Before Santa Scolastica: the archeology in Terra di Bari.

In the long portico, to which a new space covered by a glass roof will be added, the archeological pre-existing structures located in the site of Santa Scolastica will be shown and by means of a progressive extension of the conceptual itinerary, the exemplary sites of the archeology in Terra di Bari will be presented. To the usual museum paneling multimedia, interactive and immersive products will be added, according to different communicative levels (chronological, thematic etc.)

Furthermore important and exemplar archeological contexts coming from provincial and state art collections will be shown:

- ceramics and bone and stone tools from huts dating back to the Bronze Age and coming from Saint Peter's site (XVIII cent. b.C.);

- funerary equipment dating back to the archaic age (VI cent. b.C.), coming from Saint Peter's site;
- equipments dating back to the classical age (V cent. b.C.), coming from Santa Scolastica's site;
- objects of common use dating back to the Roman age, coming from San Francesco alla Scarpa site end epigraphs belonging to the Roman age from various sites in Bari.

c. Archeology in Puglia

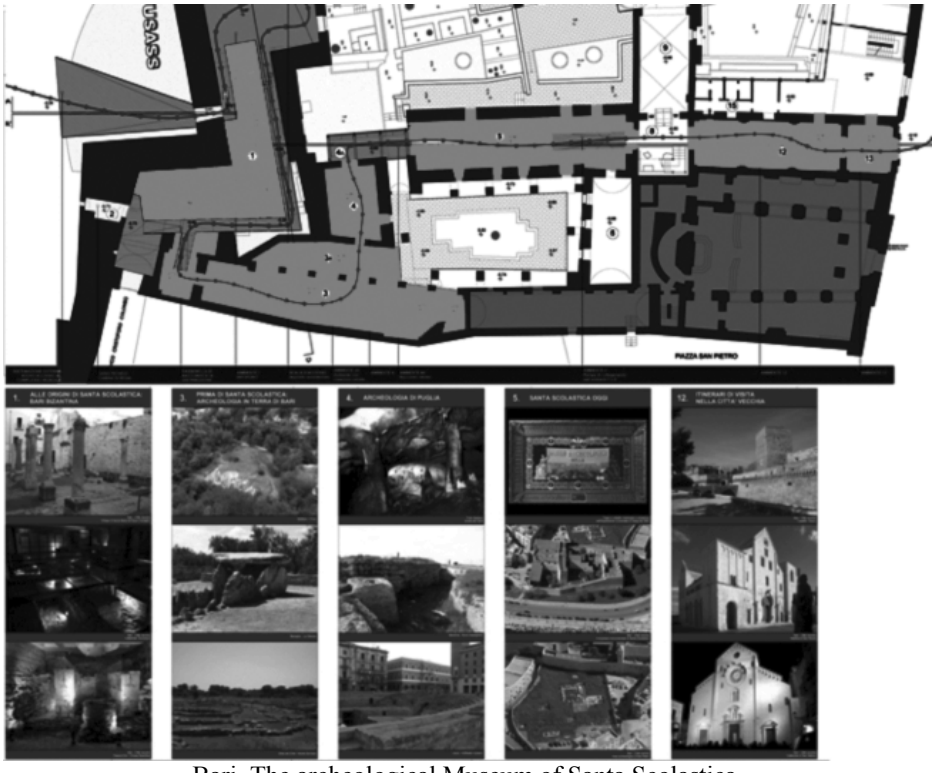
The next small room is a space dedicated to the archeology of all the Apulian territory. By the projection of small film clips (medley) of max. 5/6 minutes; the visitor is led into the extraordinary world of archeology and of the ancient civilizations of Puglia.

d. Santa Scolastica today: services for the visitors

It has been provided a place that in the future will be used as reception and, at the end of the first stage of the works for the Museum, it will house the work in progress of the museum as well as the exhibition of the findings of recent acquisition.

e. The itineraries in the old city centre.

By using systems of multimedia communication, possible itineraries in the Old City centre will be shown to the visitors to discover its history and the monumental stratification of its urban fabric. Each itinerary will have its own flyer.



Bari, The archeological Museum of Santa Scolastica.
The museological project.

Bari, The archeological Museum of Santa Scolastica.
Inside rendering, the new runway and architectural projections.

Bari, The archeological Museum of Santa Scolastica. Building site fencing.

Education or Edutainment?

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Abstract

The article focuses on aspects of cooperation of museums and universities in training and research. The author bases her conclusions on years of experience in the project "The Russian Museum: Virtual Branch".

INTRODUCTION

The Internet reflects real life giving space for a wide variety of social activities: business, entertainment, informal communication, etc. Educational segment of the modern Internet community is represented by a wide range of resources, from NASA website [1,2] to kindergarten websites. In the context of our research we are interested in museum sites [3-9] reflecting their educational activities.

Learning via the Internet has its own specificity. It is reflected in modern pedagogical theory where such areas as distance learning [10] and edutainment [11] develop rapidly. Edutainment theory, from our point of view, is connected with ideas of such scholars as M. McLuhan [12, 15] and Albert Bandura [13]. Museums are actively engaged in the learning process of Internet users, and today many of major museums have learning sections on their websites [3-9]. These websites provide an interesting material for the research of this modern educational trend.

PEDAGOGICAL ASPECTS OF COOPERATION BETWEEN MUSEUMS AND UNIVERSITIES

Educators and users ambiguously evaluate this phenomenon. On the one hand, publishing high-quality and reliable materials online allows users to explore history and objects of cultural heritage of mankind and must be considered a very valuable activity. Through the efforts of educators, art critics and computer scientists resources for people of different ages, educational levels and place of residence are developed allowing them to spend free time and motivating to visit the museums.

On the other hand, the vast majority of these programs are designed as entertainment. Proponents of "combining teaching with entertainment" maintain such educational practice. Critics argue that this approach leads to bad consequences. Content of education is becoming primitive, people are beginning to treat universities and museums as Disneyland, which is hardly correct for the institution whose mission is to preserve the historical and cultural heritage and provide people with opportunities to admire and learn cultural and historical treasure.

These issues reflect pedagogical aspects of the Internet development. We are contemporaries of the processes that were predicted in the 60s of last century: the development of the Internet has a serious impact on the cultural realities of the modern world, and education in particular [15, 170-193].

We assume that there are the following leading abilities in e-learning: (1) to navigate in a large number of information resources, (2) to express oneself in the virtual space and (3) to combine interaction with respondents on the Network and in reality.

In this regard, several questions arise, for example, how can online learning space be

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organized, what can be considered as an electronic textbook, what kind of teaching methods can be developed on the web? The author has some thoughts on these issues. They are based on years of experience in the project "The Russian Museum: Virtual Branch" [9].

ABOUT THE PROJECT "THE RUSSIAN MUSEUM: VIRTUAL BRANCH"

"The Russian Museum: Virtual Branch" is a large-scale international project that embodies the idea of access to the world's largest collection of Russian art. Among the participants of the project there are universities, cultural institutions and institutions of further education, Russian culture centers in cities of North-West and Central Russia, Siberia, the Urals and the Far East, as well as in Finland, Greece, Slovenia, China, India, Ukraine, Lithuania, Kazakhstan and other countries. The project is an international network of 91 organizations in 10 countries.

The project implements educational goals: involving a wider audience in sharing the values of Russian culture, the historical past of Russia, through free access to digital materials (computer programs on the history of Russian art, video, and electronic catalogs of major exhibitions), as well as formation of a single cultural and information space for the project participants.

Each center receives from the Russian Museum the Media Library, a unified database of multimedia software and video created in the Russian Museum. Computer technologies, such as three-dimensional modeling, panoramic photography, allow users to get acquainted with the collections of the Russian Museum, take a virtual tour of the museum halls, reconstruct the lost palace interiors, take a virtual journey through these interiors.

An important component of the project "The Russian Museum: Virtual Branch" is the portal [9] highlighting project work and linking partner organizations.

COOPERATION BETWEEN ST.PETERSBURG STATE UNIVERSITY AND THE STATE RUSSIAN MUSEUM

St. Petersburg State University is one of the partners in the project. “Russia's oldest university” founded in 1724, St. Petersburg State University has deserved the right to be called one of the best universities in Russia: a rich historical past, current broad research activity, active development and innovation put SPSU at the forefront of Russian science. [14]. It is obvious that the cooperation of such organizations as St. Petersburg State University and the State Russian Museum opens perspectives for the development of a web community project as a whole.

"The Russian Museum: Virtual Branch" is not only the public access to artistic and scientific potential of the world's largest museum of Russian art, but also the possibility of fruitful cooperation on the basis of joint educational and research projects. Two major areas are developed on the basis of the project in St. Petersburg State University: student learning and collaboration of experts in the arts and humanities.

Computer programs on the history of Russian art, videos and electronic catalogs of the largest exhibitions offered by the Russian Museum to virtual branches, can most fully and vividly present to students the artistic culture of Russia. In addition to the preservation of the Russian cultural and historical traditions, the project allows creating a multicultural environment involving partners from other countries and cultures. A good example is the seminar on "Information Technology at the Museum" within "Virtual Museums" course. Participants did not have to leave their classrooms in Finland and Russia, as it was organized through distance learning.

One of the main requirements of the modern university education is that the students

are involved in research work at the earliest stages of learning. Students have possibilities to meet experts of the Russian Museum, collaborate on degree projects.

It is impossible to imagine a modern university without active research work and international cooperation. Among the projects of this kind we would like to mention the conferences held in partnership with our organizations: International Workshop on Sustainable Development of Museums (2007), Development of Information Technology at the Museum (2008) and the All-Russian Conference "Restoration and Reconstruction of the Monuments of Old Russian Culture" (2011).

An important issue is the development of virtual resources that can be used in scientific and educational practice. These resources should be made by professionals and have the quality of reliability. Cooperation of museums and universities in this area is a matter of debate. Certainly the priority in the development of computer programs on the history of Russian art, videos and electronic catalogs of the largest exhibitions belongs to the museum. University specialists will focus on developing electronic tutorials, conference websites and resources created at the university distance learning portal.

CONCLUSION

In conclusion, the author answers the questions posed in the beginning of the article. We are sure that network organization of e-learning is promising. Nodes of the network, in our case, are the museums and universities. The links between nodes are research and training activities in all their diversity, as described above. Our experience shows that such activities are gradually forming eLearning methods, namely student's individual work with online resources, discussion in a variety of formats ranging from informal exchanges of views in a chat room to participation in video conferences, consultations with experts, implementation of joint projects, etc. At the same time the strong point of these methods is that the students and teachers can collaborate with leading experts in a particular field of knowledge.

The question of whether it is possible to extract information from the Internet for training, from an educational point of view can be interpreted as follows: how to teach the student to extract reliable information from the web? (16). This opens a larger stage for the development of methodologies for reliability assessment of the information posted on the Internet, as well as training of future professionals to develop credible publications. By the way, the museum community has proposed a system of criteria (17) which can be effectively used as a textbook for training.

We would like to emphasize that museum websites containing information about the artistic and scientific treasures that make up their fame serve as an enrichment resource for the content of education and modernization of university training methods. Methods should be developed on the basis of interactive participation in the scientific community and the educational process and aimed at generating reliable content.

Will education or edutainment be the development trend of learning in museums and on their websites? We think that entertaining has never harmed the university studies, and, vice versa, scientific content has never worsened the game. Therefore, the Internet will be a place for both courses. It is important that as a result of our work more and more highly skilled professionals and users become interested in both virtual and real museums.

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Networked Museum: Our Vision and Experience

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Abstract – In this paper, we propose a concept of Networked Museum (NM). On the contrast of the form of the current museum, Networked Museum consists of high definition local display, network and cloud and it could share its contents as well as software to handle contents. In this paper, we show our vision of Networked Museum and dicsuss what we learnt from our experiences.

INTRODUCTION

Digital technology is used in museum extensively in many occasions. Advance in digital technology in terms of network, storage, devices, sensors and display brings new opportunity to museum. Digital Archiving of materials in museum helps to preserve their precious contents as well as to give more opportunity for audience to see their contents. Most advanced example of this is Google Art Project [1]. National Palace Museum in Taiwan use digital archiving for a preservation purpose of their large number of preservation. Also they use Digital archive extensively to make a computer generated animations for attracting general audiences[2].

However, Introducing digital technology cause many issues such as security, operational cost and infrastructure. Therefore, museum should find a way to build cost effective infrastructure for introducing digital technology. To tackle there issues, in this paper, we propose a concept of Network Museum and define common platform for networked museum. We show our experiences using our proposed platform.

CONCEPT OF NETWORKED MUSEUM

Issue of Digital Archiving has been discussed for long time. It has benefits such as preserving precious contents for a long time and easily accessing contents for more diverse audiences, and it also has disadvantages such as easy duplication of contents and higher operational costs for infrastructure. However, by the introduction of the cloud computing, the meaning of Digital Archiving has greatly changed.

The potential users of digital archives of artworks behind the Networked Museum are not only visitors but also people who works for museum, such as historians, curators, conservators, and heritage scientists. The huge amount of knowledge and analytical information of artworks can be stored in the cloud, and shared by all. It gives direct benefits to researchers who needs to access the archives, and it should raise direct collaboration among them. When it comes to visitors, digital museums currently proposed give visible images with some text information. This is already beneficial to people who cannot visit and see real artworks. In addition, however, invisible values of artworks, such as history and conservation,

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should stimulate visitors' curiosity. Vice versa, public interests may raise new research topics. Of course attractive visualized contents are required to get the public attention.

The Cloud computing is the delivery of computing service rather than a hardware [3]. A user can get desired application service on demand and in any scale. Through the use of cloud computing, a user can get benefit of reduction of hardware and operational cost. The user can get many benefit through the use of cloud. One is sharing the contents. By using cloud, you may have an infinite amount of storage which is suitable for high fidelity contents for museums. Also operational cost can be minimum. Especially there is no need for setting up hardware for storage.

The other benefit is sharing software and tools for displaying and managing contents for museum. In cloud, if someone develops software for a museum to display shared contents, it will run on the cloud and every other user can just use it.If someone upgrade that software and puts it on the cloud, every other user can get benefit of it. This mash up and crowd source effect of improving software is one of the big benefit of cloud computing.

To get best benefit from cloud computing environment, one should adapt common platform consists of cloud for contents sharing, network connecting museums and the cloud, local computer environment to display rich contents from cloud. We think this is the concept of networked museum.

PLATFORM OF NETWORKED MUSEUM

For a common platform for local display environment, we adopt Tiled Display Wall (TDW) and its related software. Tiled Display Wall consists of multiple of consumer displays and clusters of computers who manage multiple displays effectively. Software platform such as CGLX[4] and SAGE[5] running on these cluster of computers make multiple displays a single large high definition display. The TDW connected to the cloud through high speed network. It retrieves high definition contents in 2D, 3D format, movie and live streaming and show them effectively. Leigh proposed an idea to use TDW to make a virtual class room or Cyber-commons[6].

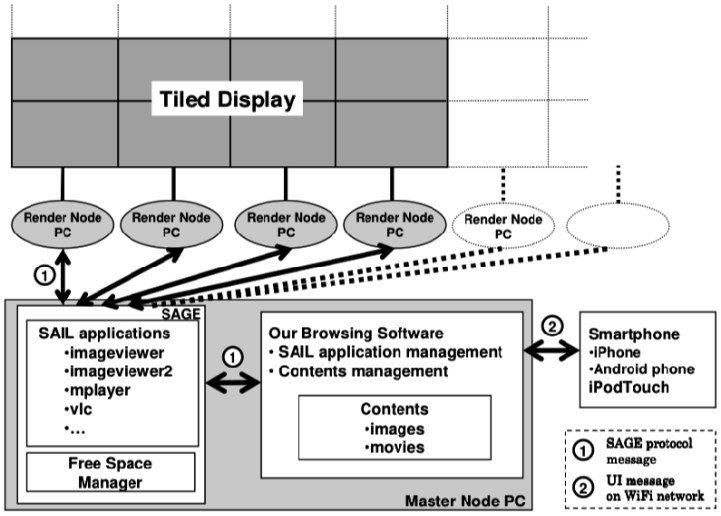

Fig. 1 I-TDW architecture

We developed an interactive TDW (I-TDW) system that allows users to explore digital heritage content with intuitive interface realized by using a smartphone. We can sense motion and orientation of a smartphone from equipped motion sensor. We translated these movements into user's actions, transferred them from the smartphone to our browsing software and controlled contents such as image and movie. This enables a user to explore the contents displayed on the TDW intuitively. The user can explore the contents by a touchpad on smartphone as well. For example, the user can move cursor by tilting the smartphone and switch between images by swing the smartphone up or down.

We developed a browsing software for I-TDW using SAGE, a middleware for visualization in distributed computing environment. The browsing software runs on a master node PC. It receives user's actions from a smartphone through WiFi network, and sends control messages to SAGE using SAGE protocol. Based on the messages, SAGE displays appropriate images and movies on TDW. Figure 1 shows the architecture of I-TDW.

The SAGE consists of three components. A *Free Space Manager* manages a virtual desktop of TDW. *Render node PCs* are responsible for displaying each part of the desktop. In our 24-display configuration, each render node PC has 4 displays. Finally, a *SAIL application* draws pixels on the desktop. Examples of the SAIL application are *imageviwer* that displays images, *mplayer* that plays movies and *vlc* that shows streaming video. We developed a new SAIL application that can change images with display effect like dissolve.

Hardware configuration of I-TDW is divided into three categories: TDW, network, user interface. TDW is composed of one master node PC and one or more render node PCs with each PC connected to one or more displays. The master node PC and the render node PC(s) are connected via a gigabit network. A smartphone equipped with a motion sensor is used as an user interface.

SAGE can configure a number of render node PC and a number of display on render node PC. This feature enables us to construct any size of virtual desktop on SAGE. We can

Fig. 2 Interactive presentation of "Polittico di Badia" (Collaboration with Uffizi Gallery)

demonstrate I-TDW on different TDWs because our browsing software runs on the virtual desktop as full-screen application. If an essential part of contents is hidden behind a bezel of display, we would adjust a offset of image or exchange the display with thinner or no bezel under the circumstances. All the contents of images and videos are currently on master node PC.

EXAMPLE USE OF NETWORKED MUSEUM PLATFORM

We use proposed networked museum platform extensively in various occasions. We pick some of the examples below.

Giotto's “Polittico di Badia”

NICT have applied THz imaging to the analysis of a Giotto (1267-1337)'s masterpiece, "Polittico di Badia" (c.a. 1300) at the Uffizi Gallery. This is the first ever internal observation of a tempera masterpiece with maps of the layer of interest. Terahertz imaging is a new non-invasive technique which can penetrate in opaque materials as radio wave, and can analyze materials as infrared. By using time domain spectroscopy, internal structure of non-metal materials, such as wood, gypsum, cloth, paints can be observed. The non-destructive cross section image clearly shows the layer structure and proves that Giotto followed the early Renaissance polyptychs manner for the preparation. I-TDW allows a user to explore the content interactively with a mobile phone equipped with a motion sensor and a touch panel as shown in Fig. 2. We build TDW with five displays and show interactive exhibit of this painting at Trial showcase event for north Umeda project, “Knowledge Capital” [7]. The user can move the cursor by tilting the mobile phone, choose an item by tapping the touch screen, and zoom in/out by scratching the screen. The layered images switched to another by swinging the mobile phone.

Takamatsuzuka Tumulus

The Takamatsuzuka Tumulus, located in Nara, Japan, is a tow-tier domed tomb and dates from the late seventh century to the early eighth century. The diameter of the lower dome is 23m and that of the upper dome is 18m, and the total height is 5m. It became famous as there were colored paintings of male and females figures, and sacred animals on the surface of the stone burial chamber when it was discovered in 1972. The wall paintings were designated to national treasures, and the tumulus was designated to a national historical site. However, the wall paintings have been deteriorated seriously after the excavation. Finally, the Cultural Affairs Agency has decided to dismantle the stone chamber to restore the paintings in a dedicated room where temperature and humidity are fully controlled. Visitors can only enjoy the copies of the wall paintings and the replica of the chamber in the Takamatsuzuka Mural Hall.

Fig. 3 3D reconstruction of Takamatsuzuka Tomb (Collaboration with Nara National Institute for Cultural Properties)

As one of the contents of the I-TDW system, the wall paintings of the Takamatsuzuka Tumuls have been revived. There are a lot of collections of photographs shot in various ways such as close-up and infrared. Using these photographs, we have created an interactive content which users can switch the 5 paintings including the ceiling, zoom in/out the images with an intuitive user interface i.e., a smartphone. When exhibited in events in Nara and Osaka, the content appealed to many people in Fig. 3.

HD streaming over Internet

At Trial 2010, we try HD video conference over internet. At this time, Digital Archive of Uffizi Gallery captured by Hitachi Inc. is shown on the TDW and at the same time, Live video stream from IFAC is sent to the TDW at Osaka over internet using Panasonic video conference system (Fig. 4). This shows extensibility of Networked Museum platform.

Conclusion

In this paper, we propose a concept of Networked Museum (NM). We propose Networked Museum consists of Tiled Display wall, high speed network and the cloud. Since it could share its contents as well as software to handle contents, it extends museum outreach and reduce operational costs. We show some of the examples using Networked Museum Platform.

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Fig. 4 HD transmission between Italy (IFAC) and Japan collaboration with Panasonic Inc.

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MUSINT PROJECT: TOWARDS A DIGITAL INTERACTIVE ARCHAEOLOGICAL MUSEUM

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Abstract – This paper illustrates all different technical aspects involved in the realization of MUSINT's virtual museum on the Web and its first exhibition which focuses on the unknown Aegean and Cypriot antiquities collections held by Tuscan museums. The various itineraries and engagement modalities offered to the visitor provide a multimedial and interactive experience of the contents, assuring a close look – also in 3D – to valuable archaeological finds, virtually reconnected to other pieces now physically separated and to the geographical sites they come from, through an historical approach to contexts and archaeological art and craft ware typologies.

INTRODUCTION

MUSINT is the result of a collaboration among public and private cultural and scientific institutions active in Tuscany. It represents an interactive museological network dedicated to archaeological collections spread in the regional area. The just concluded research project achieved the implementation of a complete and innovative exhibition gathering digital information on various collections of Aegean and Cypriot antiquities, making in this way available to Web users finds distributed in different museums and frequently hardly accessible. The idea has been to create a novel "museum of museums", which stands as a highly flexible display medium from different points of view. On one side MUSINT offers the opportunity of alternative itineraries for scientific and educational purposes and, on the other, it makes it easy to realize specific exhibitions on topics and objects not attainable through traditional museology. Thanks to the advantages of an interactive environment, MUSINT will exhibit all contents held in its archives regardless of the availability of physical spaces, maximizing the enjoyment of the cultural heritage.
Within these aims MUSINT can have the important role for the Heritage Institutions dislocated in the territory to reinforce their offerings, to improve their visibility and to attract an enlarged "audience".
The impact of this project can be referred to multiple targets and will be directly beneficial for the Tuscany Region, in view of Internet global features, which may contribute to attract visitors in the regional area with possible positive social and economic advantages.

THE ARCHAEOLOGICAL COLLECTIONS

The analysis of the Aegean and Cypriot antiquities held by public archaeological museums in Tuscany has brought to light very interesting documents mainly pertaining to the history of the collecting processes within a wide arch ranging from the end of the XVIII to the XX Centuries.
In fact, besides the most conspicuous and representative collection of the National Archaeological Museum in Florence [1: 7-22, 2], smaller groups of Aegean and Cypriot antiquities are also currently displayed in permanent collections of local district museums all over the region.

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Aegean and Cypriot materials reached our region coming from different contexts of provenance; besides the objects coming directly from the Italian Archaeological Mission in Crete, materials have been acquired mainly from the antiquity market, or directly as public acquisition (or donation) of private collections, over the last two centuries.
An overall survey of the public archaeological museums in Tuscany revealed that such peculiar materials are currently held by five different collections on the territory.
As stated above, the main collection is at the National Museum in Florence and has been mostly (but not only) formed as a representative collection of "Mediterranean Counterparts", with didactic purposes by the ancient director of the Museum, Luigi Adriano Milani, at the turn of the XX century. The collection of selected objects coming from Neolithic and Bronze Age Mainland Greece and Cyclades have been enriched by an ongoing acquisition of Cypriot antiquities (in particular thanks to the intermediation of the Italian diplomat Cavalier Colucci), by the arrival of Cretan objects coming from the first Italian excavations in Phaistos and Haghia Triada, and afterwards by the acquisition of offering goods collections from funerary contexts excavated by Italian archaeologists in Rhodes, under the Italian mandate.
Two collections are kept in Pisa, one at the Museo Nazionale di San Matteo - the small Mackenzie collection of Early Cycladic Idols - and one at the Antiquarium of the Dipartimento di Scienze Archeologiche of the University, displaying a ceramic collection representative of typical Mycenaean productions of South Italy provenance (Scoglio del Tonno) as well as Cypriot and Cretan assemblages of the Bronze and Iron Ages.
Two collections are held by the Museo dell'Accademia Etrusca in Cortona, where a small group of Cypriot antiquities from the Middle and Late Bronze Ages to the Hellenistic and Roman periods has been formed through the donation of private collectors: Monsignor Guido Corbelli, Apostolic diplomat in Egypt under the pope Leo XIII, and Luigi Pancrazi, member of the Accademia in the 30's.
The latest collection of Aegean and Cypriot artifacts to be acquired is currently located in Montelupo Fiorentino: the small group of ceramics and little limestone statuary of standard Mycenaean and Cypriot productions is part of a bigger archaeological collection donated by the heirs of Paolo Azzati and is currently displayed at the Museo Archeologico Comunale of the small town nearby Florence.
The analysis of the mentioned Aegean and Cypriot Collections by the research team of the University of Florence already produced a inter-related series of studies dedicated to specific productions, single objects of art as well as to the history of the collecting processes [1: 23-41].
Thus, the ongoing development of an interactive museum is actually marking a significant upgrade within the project frame. Such a new research tool is offering a positive contribution in strengthening the team work with the aim to enhance the precious heritage of the Tuscany antiquities collections, overcoming the standard difficulties of a traditional musealization.

THE DIGITAL CONTAINER

In order to reach out for a wide audience, the MUSINT digital container has been designed around a dynamic web platform. The site is conceptually organized in the following three main dimensions (or *navigation keys*):

1. Geography. This is the primary navigation key for the user. The five different regions (corresponding to the main provenance locations of the items: Greece, Crete, Cycladic islands, Rhodes and Cyprus) can be selected from an interactive map of the Aegean Sea, to enter the section of the collection related to that particular region;
2. History. Once the region of interest has been selected, the user interface displays around the region an interactive "time-wheel", where the historical periods of the region are highlighted and can be selected to obtain further information on sites and finds (Fig. 1);

3. Production. For each region and period, the items are further organized into seven predefined classes of manufactured production, each of which can be accessed via an iconic representation of the class itself.

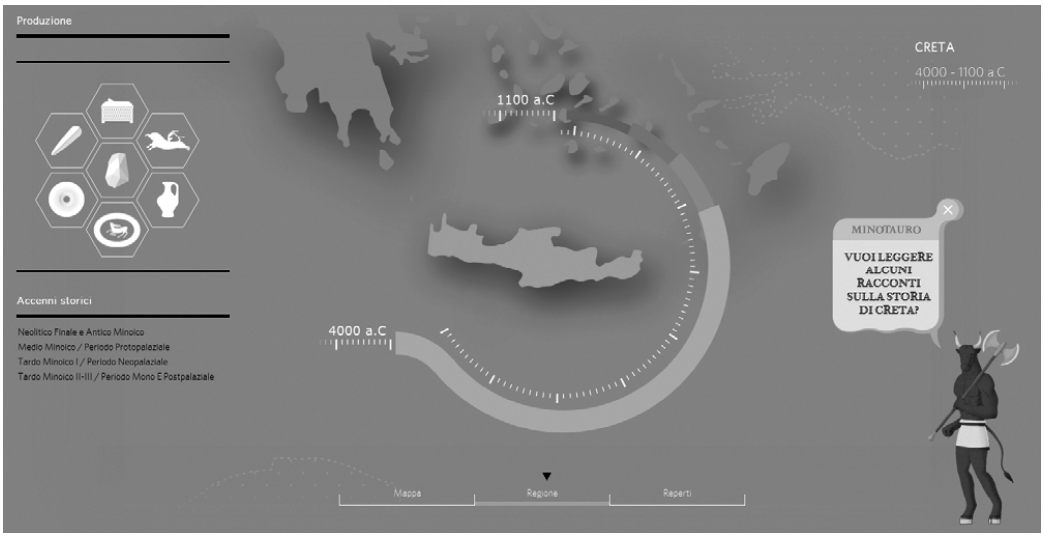

Fig. 1 – An example of the user's interface, once the region of interest has been selected.

The three navigation keys can be accessed through dedicated tools that have been completely designed using the Javascript programming language, to realize an interface that is at the same time intuitive, usable, and visually appealing.
Besides the above described interaction, a reduced set of the content is also available in the form of a number of simplified narrations proposed by the cartoons of mythological characters of ancient Greece and Crete: these should attract children as well as a casual user interested in a lighter reading with respect to the main focus of the site (for a description of the educational path, see the following section).
The most fundamental source of information that can be accessed through the tools of the user interface is the catalogue that forms the collection. Similar to a traditional collection book, each artifact is shown in a dedicated page where both textual and visual information are presented. A distinctive and innovative aspect of the site is the use of interactive 3D content for part of the displayed items, to provide the user with a fully satisfying exploration experience (Fig. 2). The 3D models acquired for the project (as described in the section ahead), have been first converted and sub-sampled to make their size manageable for a standard Internet connection, and then published in the web pages by using the recently introduced WebGL standard. WebGL (Web-based Graphics Library) is a software library that extends the capability of the JavaScript programming language to allow it to generate interactive 3D graphics within any compatible web browser (at the time of writing, the standard is supported by recent versions of the Mozilla Firefox and Google Chrome browsers). Based on OpenGL ES 2.0, WebGL allows a programmer to specify the objects and operations involved in producing high-quality graphical images, specifically color images of 3D objects. WebGL code executes on a computer display card's Graphics Processing Unit (GPU), which must support shader rendering. WebGL is a context of the canvas HTML5 element that provides a 3D computer graphics API without the use of plug-ins. For the MUSINT web site, the Three.js software library has been used to load and render models via WebGL.
The main reason for the choice of WebGL for the MUSINT project is the possibility to create pages with 3D content without relying on external, proprietary plugins (such as Adobe Flash or Unity 3D, both popular solutions for games staged in 3D environments) [1: 115-124].

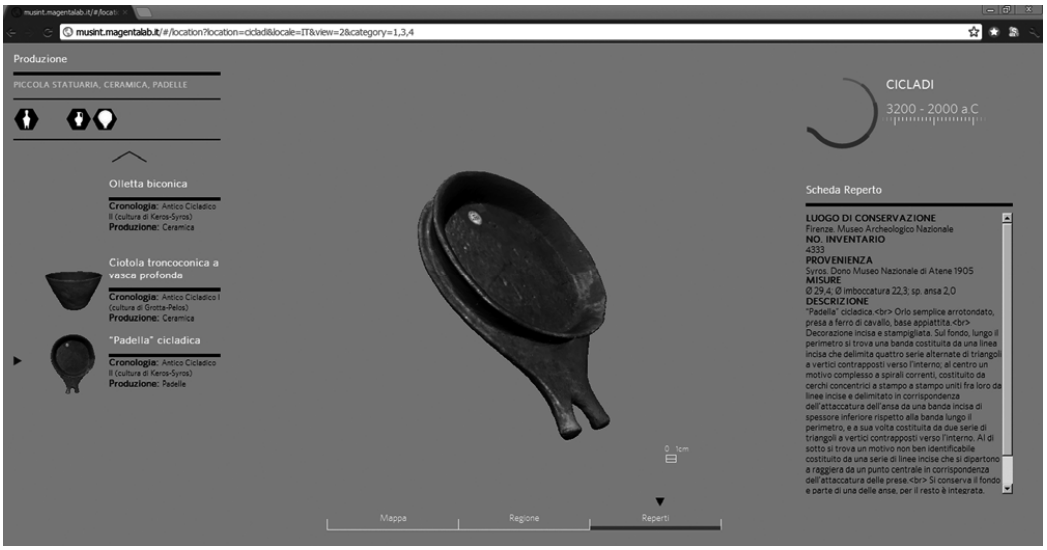

Fig. 2 – Page of the exhibition's catalogue, with textual and visual (here, 3D model) information.

AN EDUCATIONAL APPROACH

The educational trail of the MUSINT project has been conceived on the basis of a series of interviews to primary school children to understand their expectations about interactive museum resources dedicated to them and to enlighten the aspects of the preserved objects that could increase their attention (for a close examination of the authors appraoch and decisions related to the educational contents in MUSINT, see [1: 43-52]). We felt that asking for suggestions and proposals was the best way to create an educational tool capable to approach concretely the children's learning mode.

The special itinerary for young visitors through the contents repository is accessible selecting two of the five macro regions included in this first MUSINT exhibition, committed to the Aegean and Cypriot antiquities held by Tuscan institutions: Crete and Mainland Greece. Entering one of these two sections, appears an animated figure, respectively the Minotaur (Fig. 1) and Agamemnon, which invites the user to join him in a simplified virtual tour.

A short introductory text is provided for each geographic area in story-telling form, containing essential information on the civilization, its organization and development, and consequently linking to a series of images. Each section includes an epic story or a legend because fables attract children a lot more.

From this page, children can also access the informative records of five selected artifacts for each macro region that are part of the project collections. Each object is visualized in three-dimensions and can be digitally rotated and flipped over. Furthermore, a series of images to highlight the morphology and decoration of these objects have been made available. Each record also offers a brief description that includes essential information on the find's function, origin and characteristics.

From this starting point we aim to enlarge and deepen our scope extending the educational trail to the other three geographical areas (Cyprus, Cyclades islands and Rhodes) and developing new interesting topics.

3D DIGITAL CONTENT PRODUCTION

One third of the archaeological finds currently available in MUSINT's digital interactive repository has been digitized in three dimensions for real-time visualization of the present condition

and a closer look at their spatial form and features and decorative patterns. The resulting 3D models allow to explore the objects they represent very faithfully from other viewpoints than the ones permitted by normal and direct non-contact inspection, not to mention the very limited ones offered by photos. And the reviewing at close range allowed by the system's zooming options on the virtual replica may be at a scale larger than real.
Most of the selected artifacts have been surveyed on-site, in their respective museums, with a triangulation-based laser scanner [3]; a few have been digitized with photogrammetric techniques [4], which are based on the use of a calibrated digital reflex camera, a slide bar and a proprietary algorithm for multifocal image analysis and generation of high-resolution point-clouds where every point is identified by 6 values, the x y z space coordinates and the RGB color ones (for the description of the photogrammetric techniques employed for MUSINT see [1: 101-104]).
Either way, sets of hundreds of thousands or even more than a million points have been accurately measured on the external surfaces of each object and on the visible parts of the internal ones. Based on these starting data-sets, for every selected artifact we have made available a 3D digital copy for the on-line virtual exhibition and one for off-line scientific examination (on request), entailing therefore different usage requirements and modalities. In both cases, though, the final models preserve high fidelity to the real finds.

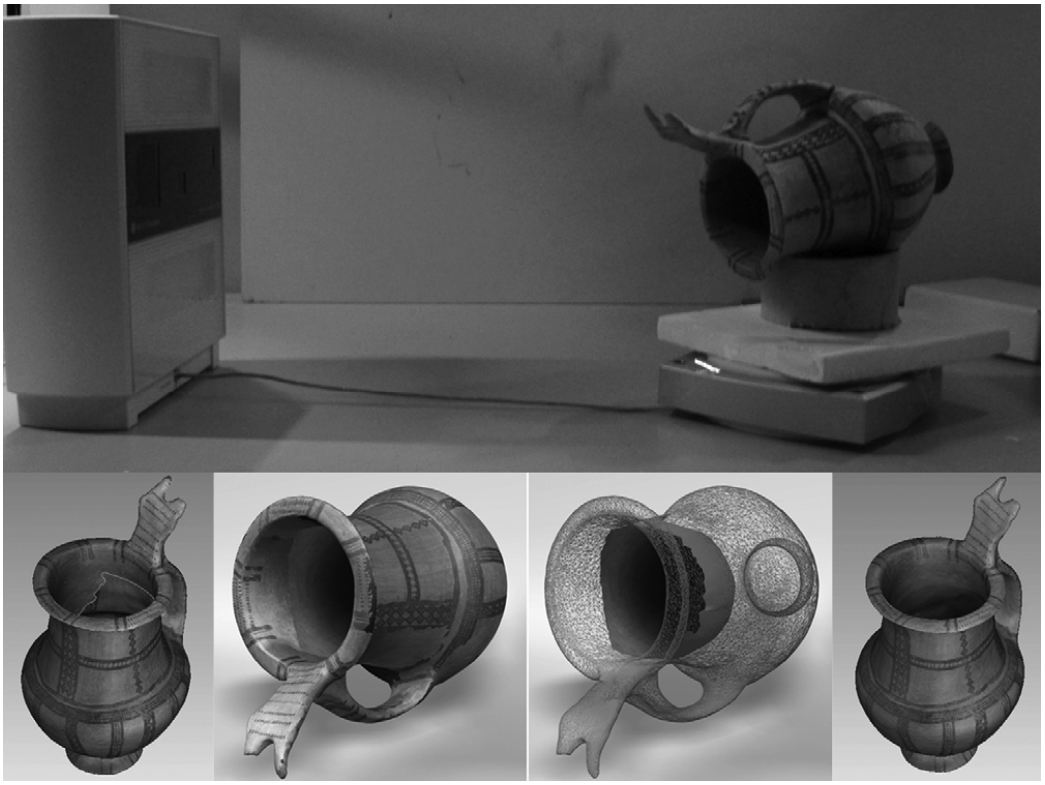

Fig. 3 – Laser scanning a tankard from Cyprus; 3D models during and after the elaboration process.

The desktop laser scanner we used acquires shape data of the scanned object, sweeping its 4 laser stripes across the encountered surfaces and recording the position of every visible shined point in its own space coordinate system, and captures also correlated photos through its built-in camera, for color textural information of the same parts. The acquisition process is quite short and basically automatic once the setting of parameters (e.g., range distance and resolution) and the choice of the

right supports and arrangement of the artifact - for every needed view - are done. The object may be resting or standing on a rotating base which turns on predefined steps, connected to the scanner (Fig. 3, picture above).
The challenge is to cover all surfaces, regarding safety conditions for the valuable artifact and the ideal distance between object and scanner at every different angle, in order to have good quality in the resulting data; but at the same time the goal is to achieve all this with the minimum number of scans, which in a second moment will have to be filtered and combined. At the end of this first phase, several point-clouds of very dense geometric samples on the visible surfaces of the object are created and can be visualized with their related texture.
The collected information is then processed to obtain the digital three-dimensional model: separate scans are registered in the same coordinate system, and then all sequences tied together in a global one; after cutting out low quality and redundant data, all patches are fused in one polygonal (actually, triangle) mesh. At this point a few small areas may be still missing in undercut and narrow hollowed regions, where coincidental visibility for the scanner's laser emitter and receiver couldn't be pursued (Fig. 3, lower left). This is the final stage for the digital copy intended for scientific documentation and knowledge sharing. After merging the selected grid surfaces, in fact, we have obtained a highly detailed and precise virtual replica of what of the object the device could capture: this 3D model may be measured, guaranteeing sub-millimetric accuracy, and also be used to extract sections, in order to show e.g. the ceramic vessel's morphological irregularities, which derive from the way it was manufactured and from its conservation history, and thickness where the internal parts have been acquired by the instrument.
For the virtual display version, instead, we have pushed the elaboration process far beyond mesh fusion, completing a truthful and accurate photo-realistic watertight reconstruction of the whole object (Fig. 3, lower right), conveniently simplified in order to be easily viewed on the Web application, and edited in its textural appearance with photo-retouching tools to mitigate color and tone variations derived from the source photos and remove reflections given by shiny surfaces, which, of course, couldn't be pre-treated with talc powder during the survey planning phase, in respect of the object's historical values.
As a consequence of our testing different procedures on a great variety of shapes and materials and a high number of objects, we optimized a methodology for data acquisition and processing [5], and prepared a clear exposition of technical guidelines [1: 65-100] to be followed easily also by non-specialized digital information providers and in other similar Cultural Heritage applications, giving at the same time transparency on how we obtained the resulting models and the possibility to trace back steps and choices to whoever is going to deal with this data in the future.

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ACCESS TO THE CULTURE INFORMATION

THE INTELLIGENT MUSEUM
FUITION OF WORKS OF ART BY ALL

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Abstract – Ambient intelligence is considered a likely embodiment of the Information Society. This emerging environment will change the way many activities are carried out. For example, it will also have an important impact on how museums will be organised and people will access education and enjoy works of art. Some preliminary considerations are presented in the paper, with reference also to problems that people may have in finding and accessing museums and in enjoying works of art due to limitations (e.g. sensorial) in some of the necessary functions (e.g. seeing).

INTRODUCTION

It is commonly accepted that, due to the developments of Information and Communication Technology (ICT), contemporary society is undergoing a fundamental transition from the present industrial society towards an information society. Among the possible embodiments of the emerging information society, an interesting and widely discussed potential instantiation is the Ambient Intelligence (AmI) paradigm. This will have an impact in many activities necessary to get information about museums and their contents, to navigate to the museums and through them, and to enjoy the works of art.

ICT AND AMBIENT INTELLIGENCE

In most of the available literature, the information society is not seen as being characterised by an increased diffusion and use of present-day computers and telecommunication terminals, but as the emergence of an environment in which "people are surrounded by intelligent intuitive interfaces that are embedded in all kinds of objects and an environment that is capable of recognising and responding to the presence of different individuals in a seamless, unobtrusive and often invisible way" [1]. People are surrounded by intelligent objects offering functionalities necessary for access to information, interpersonal communication and environmental control.

This will entail the emergence of a new environment where intelligence is a distributed function, that is, computers will behave as intelligent agents able to cooperate with other intelligent agents on distributed data. Wearable computers, disappearing computers, mobile systems, ambient intelligence, and a variety of technical platforms are some of the expressions emerging from technical discussions. The information society is expected to evolve in the direction of the proliferation of computational systems that integrate a range of networked interactive devices embedded into a physical context (in either indoor or outdoor spaces). These systems will provide hosting for a broad range of computer-mediated human activities and access to a multitude of services and applications. Such systems are based on the distribution of computers and networks in physical environments, and are expected to exhibit increasingly intelligent and context-sensitive behaviour. On the user side, it is starting to become clear that the variety of users of ICT users will increase to the point of including practically all people [2].

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This concept provides a vision of the information society in which emphasis is put on greater user-friendliness, more efficient support of services, user-empowerment, and support for human interaction. Interaction is intended as taking place through "natural" interfaces in the context of an environment which meets the requirements of being unobtrusive (that is, it impinges on people's consciousness only when needed), personalisable, adaptive to different user needs, and anticipatory (that is, it tries to anticipate user needs). People are surrounded by intelligent intuitive interfaces that are embedded in all kinds of objects and an environment that is capable of recognizing and responding to the presence of different individuals in a seamless, unobtrusive, and often invisible way. Audio interfaces (e.g. speech synthesis and recognition), video interfaces (e.g. gesture recognition) and tactile interfaces (able to present tactile information or to react to touch) are supposed to be freely available in the environment.

The AmI environment will be populated by a multitude of hand-held and wearable "micro-devices" and computational power and interaction peripherals (e.g., embedded screens and speakers, ambient displays) will be distributed in the environment. Devices will range from "personal" (e.g., wrist-watches, bracelets, personal mobile displays and notification systems, health monitors embedded in clothing), carrying individual and possibly private information, to "public" in the surrounding environment (e.g., wall-mounted displays) [3].

To have an idea of the type of technology, interactions, and services available in the information society, let us now summarize their main characteristics [4]. First of all the hardware is supposed to be very unobtrusive. Miniaturization is assumed to produce the necessary developments in micro and optical electronics, smart materials, and nanotechnologies, leading to self-generating power and micropower usage; breakthroughs in input/output systems, including new displays, smart surfaces, paints, and films that have smart properties; and sensors and actuators integrated with interface systems to respond to user senses, posture, and environment. Many technologies are conceived as handheld or wearable, taking advantage of the fact that intelligence can be embedded in the environment to support the individual personal system. This means being lightweight, but also readily available. It is taken for granted that people can have with them everything necessary for performing even complex tasks. For example the only communication item (sufficient, e.g., for carrying out navigation, environmental control, and communicating with other people) foreseen in the available development scenarios [1] is a personal communicator (P-Com). Its characteristics are not precisely defined. It does not have a specifically defined interface, but is a disembodied functionality supported by the AmI with different interfaces. It is adaptive and learns from user's interactions with the environment. It offers communication, processing, and decision-making functions. Finally, it must not necessarily be a highly sophisticated piece of equipment, whose performances are limited by size, weight, and power. The intelligence necessary to support the transduction of information necessary to address the different modalities and to support the user can be in the environment and in the network. In principle, the only limiting factor can be bandwidth.

Then a seamless mobile/fixed web-based communications infrastructure is supposed to be available. Complex heterogeneous networks are supposed to function and to communicate in a seamless and interoperable way. This implies a complete integration of mobile and fixed networks, including ultrafast optical processing. These networks will have to be seamless and dynamically reconfigurable. Dynamic and massively distributed device networks will be in place. The AmI landscape is a world in which there are almost uncountable interoperating devices. Some will be wired, some wireless, many will be mobile, many more will be fixed. The requirement will be that the networks should be configurable on an ad hoc basis according to a specific, perhaps short-lived, task, with variable actors and components. Human interfaces will have to become natural. A central challenge of AmI is to create systems that are intuitive in use. This will need artificial intelligence techniques, especially

dialogue based and goal-orientated negotiation systems, as the basis for intelligent agents and intuitive human to machine interaction, which are supposed to be multimodal (multiuser, multilingual, multichannel, and multipurpose). The environment is also supposed to be adaptive to user requirements providing context-sensitive interfaces and information filtering.

Finally, the AmI world must be safe, dependable, and secure, considering all physical and psychological threats that the technologies might imply and giving important emphasis on the requirement for robust and dependable software systems components.

Despite the current incomplete knowledge on how AmI will materialise, it is commonly recognised that it is likely to bring about new opportunities for all citizens in the Information Society, including people with activity limitations and older people, but, at the same time, new challenges for access to computer-based products and services. Some of these possible limitations and advantages will be pointed out in the following.

THE INTELLIGENT MUSEUM INFRASTRUCTURE

In this environment, the museum must be seen as a node in a complex interconnected environment, where information technology and telecommunications are instrumental in favouring (or impeding?) all activities that make possible the fruition of the works of art, including the identification of sites (museums, private collections, expositions) where they are located, the navigation to the sites and through them, access to information about them and the works of art, possibly irrespective of the lack of some abilities of people [5, 6].

Finding the museum

The locution "finding the museum" addresses two orders of questions. The first is related to the problem of finding information about where a specific work of art is located or where a significant collection of a specific artist is available. In the AmI environment, specific intelligent agents will be able to explore information about museums and/or private collections to find this information worldwide. Moreover, knowing the interests of people, as explicitly expressed by them or acquired in previous searches, the agents can be proactive, suggesting museums or expositions that could be of interest.

Then, it is necessary to identify how it is possible to navigate to the museum, suggesting e.g. a route to the museum in the city where the person is living or planning an intercontinental travel. In the second case, agents are supposed to help in planning and in negotiations with air companies, car rentals, hotels and so on. They can completely take care of the organisation or cooperate with the user helping her to make her choices. Obviously in the case of complete delegation, lack of abilities in the person is not significant. If cooperation is necessary, the agent will take care of using accessible media (e.g., voice for a person who is not able to see).

Navigation to the museum

In case of long range travel, Ami is supposed to be able to take care of all aspects of travelling. For example, the traveller (let's call her Mary) will be able to pass through the arrivals hall of an airport without any delay. If a professional, she can travel much lighter than less than a decade ago, when she had to carry a collection of different so-called personal computing devices (laptop PC, mobile phone, electronic organisers etc). Her computing system for this trip is reduced to her 'P–Com' that she wears on her wrist. Her visa for the trip was arranged by the agent and she is able to stroll through immigration without stopping because her P-Com is dealing with the ID checks as she walks.

A rented car has been reserved for her and is waiting in an earmarked bay. The car opens as she approaches. She does not need a key. She still has to drive the car but she is supported in her journey downtown to the hotel by the traffic guidance system. Downtown traffic has been a legendary nightmare in this city for many years. But Maria has priority access rights into the city centre because she has a reservation in the car park of the hotel. All arrangements have been negotiated between her personal agent and the transaction agents of the car-rental and hotel chains. Obviously, if she is blind, a different transportation is arranged.

If moving in the home city, Mary can ask the AmI, by means of a voice command, to find a vehicle to share with somebody on her route. The AmI starts searching the trip database and, after checking for willingness of drivers, finds someone that will pass by in thirty minutes. The in vehicle biosensor has recognised that this driver is a non-smoker – one of her requirements for trip sharing. From that moment on, Mary and her driver are in permanent contact if wanted (e.g. to allow the driver to alert her if he will be late). Both wear their P-Coms allowing seamless and intuitive contacts. Thirty minutes later she goes downstairs onto the street, as her driver arrives. When Mary gets into the car, the VAN system (Vehicle Area Network) registers her and by doing that she sanctions the payment systems to start counting. A micro-payment system will automatically transfer the amount into the e-purse of the driver when she gets out of the car. In the car, the dynamic route guidance system warns the driver of long traffic jams up ahead due to an accident. The system dynamically calculates alternatives together with trip times. One suggestion is to leave the car at a nearby 'park and ride' metro stop. Mary and her driver park the car and continue the journey by metro. On leaving the car, Mary's payment is deducted according to duration and distance. AmI is able to support navigation of any person, including e.g. blind people and people moving on a wheelchair, with information about suitable routes and guidance through them.

Navigation in the museum

Mary passes through the hall of the museum. She does not need to stop at the cloakroom. She has only a small bag and her P-COM. Tickets have been arranged by the intelligent agent and entrance is granted through conversation between her agent and the entrance control agent of the place. If she likes, the agent will make available to the AmI a description of her physical and sensory characteristics. In this case a special support can be offered. In most cases she can cope with the normal facilities of the place.

The museum catalogue is made available on the P-Com. Maria's agent will take care of asking her whether she wants to buy it. In this case it will not be cancelled from the P-Com at the end of the visit. A special fare will be charged if she also wants to print it when at home or to have it mailed home in printed form. AmI is tracking the position of all the people and the P-Com takes care of guiding them through the exposition according to the known or explicitly expressed preferences of the persons.

FRUITION BY ALL

The virtual museum

Mary is an art student. She is working on a bas-relief. After class, she is at home and the enhanced 3-D interactive image processing and projection facilities help in trying different approximations of the figure in the landscape and in playing with different colour combinations. She is not happy with the human figure, which appears "without life".

What about to have a chat with Jane? She is confident of her appreciation of the problem both from the technical and the esthetical perspective. She call Jane with the video-telephone. One of walls of the living room becomes a video display. Jane asks Mary about her morning work and the improvements in comparison with the day before. They reproduce the outcome of the work in the morning on their home 3-D representation systems. Jane agrees that there are improvements, but probably this is not enough. They agree that it is a good idea to go to the museum to look at real artefacts and to discuss with friends.

However, does Mary know that an exposition has opened today in Japan, dealing with the same technique Mary is using for her work? Would not it be interesting to visit it together? After negotiations of their intelligent agents with the museum agent in Japan, Mary and Jane can stroll virtually through the museum. They can look at the exposed items and they can also touch them, because the tactile displays in their room reproduce the real tactile sensations. They could also speak with people there, if they would be able to speak Japanese. Obviously, they could also use an automatic translation service, but these services are still very expensive

Through a real museum

Mary starts her visit of the museum. She does not have time to see the entire exposition. The P-Com knows what she wants to see and, in cooperation with the tracking system of the museum, is able to guide her to the sites of interest. While she is walking through the rooms, the AmI gives her some information about what is around. The quantity of information is a function of the movement speed. When she stops in front of an artefact, the AmI gives her a description of what she is looking at - an eye pointing system is also able to spot the zone of the artefact she is looking at for some time. The AmI knows that Maria is an art student and it is able to match her known or perceived needs. For example, on the basis of the time available and the number of artefacts to be considered, it can estimate the amount of information that can be made available. This estimation can be reiterated after each item. If AmI is allowed to have personal information about Maria, offered by her or constructed through data collected during multiple visits, AmI can also personalise the presentations and suggest possible changes to the planned visit.

The AmI environment, when allowed, is able to track the positions of all persons in the museum. In particular, Maria's P-Com knows all her friends and can ask the AmI if some of them are in the museum at the moment. If this is the case, it can ask if they are interested in visiting the exposition with Maria. As a matter of fact, according to recent research, it is clear that visiting museums is considered a social activity and people like to share the experience. As soon as a group is formed, AmI reprograms itself in order to take into account the needs of all the participants in the group and not to be too invasive, offering information only if explicitly asked. Obviously, AmI can adapt the form and media of presentation to the needs, requirements and preferences of individual visitors of the museum.

Blindness and pictorial information

An open problem is to give access to the fruition of works of art to people who cannot see. In many museums blind people are allowed to touch statues and other physical artefacts, thus getting the possibility of reconstructing mentally their form. With pictorial information, the approach is normally to transform it in a tactile representation. 2D and 3D representations have been proposed. In the first case contours are extracted and represented as raised lines, while colours are represented as different textures. In the second case a bas-relief representation is produced, with colours represented as textures.

As an example, the "Tactile Museum of Ancient and Modern Painting – Anteros" (Istituto dei Ciechi "Francesco Cavazza" – Bologna - http://www.cavazza.it/museoanteros) makes available several 3D reproductions of works of art (for example the "Gioconda"). As a matter of fact, a complete approach (based on the investigation of cognitive processes) to the problem of presentation of works of art has been developed by the museum, including education and training (for example to the appreciation of the perspective from tactile representations).

With reference to these activities, two different perspectives can be considered. The first is cultural, including the transfer of information about what is represented in the paintings. From this perspective a tactile representation of works of art that people can explore may probably be more efficient than a verbal description, giving blind people the possibility of accessing a spatial representation of what is available. But, from the perspective of enjoying the work of art the approach is more problematic. Experiments with blind people show that these representations are able to elicit emotions. But, is there a connection with emotions elicited looking at the painting? The same question occurs with visual representations of music for deaf people, where the score is reproduced with forms of different colours evolving in time according to the rhythm of the music. These representations elicit emotions but what about the connection with emotions of people listening to the music?

CONCLUSIONS

Apparently, the Ambient Intelligence environment and some of the technologies developed for its implementation (e.g. voice synthesis and recognition, gesture recognition, tactile displays) will be useful to give access to information about works of art and to help people in physical access to it, irrespective of the sensorial abilities of people.

Virtual reality systems will also be able to allow a partial fruition to people who cannot move. Giving access to works of art (sculptures and particularly paintings) to blind people, as well as giving access to music to deaf people is an open problem that needs further attention at the physiological and psychological levels.

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SEARCH SERVICES FOR CULTURAL INSTITUTIONS USING GOOGLE TECHNOLOGIES. A COLLABORATION BETWEEN ITACA-M AND MUSEO GALILEO

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Abstract – In October 2011 a collaboration between Museo Galileo and ITACA-M was established to develop a search engine with Google Search Appliance technology that integrates the various resources within the Museo Galileo. Infrastructure architecture foresees the storage of all resources in a Triple Store using RDF/OWL as common data model and subsequently maps them on corresponding Europeana concepts in ESE and EDM, extending the model when necessary. The metadata entered in the system are aimed at structured search, allowing to obtain the capabilities of semantic search systems while maintaining the ease of use typical of Google. The system could be used by similar cultural institutions also to build a federated search system.

INTRODUCTION

A collaboration between Museo Galileo and ITACA-M joint laboratory was established on October 2011. Museo Galileo is one of the foremost international institutions in the History of Science, combining a noted museum of scientific instruments and an institute dedicated to the research, documentation and dissemination of the history of science. The Information Technology and Computer Aided Mapping knowledge centre (ITACA-M) is a Competence Center founded by Università degli Studi di Firenze and Google Inc. aiming to create innovative digital applications for the public sector.

The collaboration involves the development of a search engine with Google technology that integrates the various resources within the Museo Galileo (web pages, databases, text, etc.) and facilitates access to Internet users. This will make it possible to maximize user satisfaction both in terms of retrieval of searched resources, and in terms of usability of the search engine.

NEED FOR A SEARCH SYSTEM

A research institution, such as Museo Galileo, hosts items of various kinds, including physical objects like instruments, pictures, books, archival documents, and digital resources, such as the Digital Library and the Multimedia Catalogue. All these collections are often already catalogued in electronic format by experts in specific fields, using different methods and standards for each type. This causes within each institution the presence of different search systems that are not homogeneous among themselves. Over the years several integrated solutions have been sought, both in the form of cataloguing standards (e.g. Dublin Core) [1] and specialized search engines (e.g. Europeana) [2]. In the meantime, however, users have become accustomed to the use of generic but friendly and highly sophisticated systems such as Google.

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What we feel is the need to combine the two methods, i.e. propose a search system that is perceived as familiar by users, but that provides information in a rigorous way. This can be accomplished in two ways: by providing every proprietary system with a "Google like" interface or by integrating existing data formats into the Google search engine. The first hypothesis is hardly feasible, as it often requires the modification of proprietary software, with obvious problems of cost and time. We have chosen to go the second route because we believe that it has a better cost/benefit ratio.

EXPECTED FEATURES

For cultural institutions is crucial to implement a simple and efficient search system that is able to search all their databases, and at the same time is able to make specific searches refining the results based on specialized characteristics of each archive.

The generic search is generally performed very well by Google, both in terms of quality and speed. However the inability to use the specific features of individual databases is the weak spot of the generic Google engine because there is no semantic search that takes into account structured fields. On the contrary the technology of Google Search Appliance (GSA) [3] can be used to combine the power of Google's search algorithms with customized features of one or more specific databases.

For us it is important to perform searches based on metadata and structured fields, add metadata to automatically crawled pages, refine and filter search results. All these operations are not possible with the public Google engine, but can be activated through the GSA, and this motivates our choice.

DATA ARCHITECTURE

Strategic choices

Our approach is to use a dedicated repository in which data coming from various databases are stored with a common syntax and semantics.

We chose RDF/OWL [4,5] as common data model since it has become a de facto standard for representing semantically connoted data, therefore allowing their use through advanced tools (SPARQL [6], Semantic portals [7]) and well-known interchange formats (RDF/XML, N-Triples [8], Turtle [9]).

As storage architecture we chose Triple Store technologies because they were created to allow the persistence of RDF/OWL using efficient design methodology. As Triple Store engine we selected Jena/RDF [10] because at the moment it seems to be the best solution for several reasons: it is completely open source (unlike other more efficient but higher cost products e.g. AllegroGraph [11]), it allows various models of persistence (native and based on RDBMS) and provides a reasoner that uses both RDFS/OWL semantic and custom rule sets. We are aware that Jena/RDF is not the most efficient solution, because the persistent based inference is still an open challenge, but is sufficient for our needs.

The main databases of the Museo Galileo use very different standards and systems. The Library catalogue is in MARC 21 format [12], uses the proprietary system Amicus and has two proprietary search systems: Librivision and AquaBrowser. The Digital Library uses a system developed ad-hoc, relying in part on the data contained in the Library. The museum web site [13] utilizes MODX for the general part and an internally developed system (ARAM) -based on a relational database- for the management of the Multimedia Catalogue, the Scientific Itineraries in Tuscany and temporary exhibitions. There are also other web applications such as the Galileotheka (on Galileo) and similar ones still under development

that are not yet integrated into the search system, but could be easily added when the system will be fully operational.

In order to map all data with shared metadata an analysis was performed on all the archives to find common concepts and properties. In a second phase, corresponding Europeana concepts both in ESE and EDM [14, 15] formats were identified. If such correspondences were not found, metadata have been integrated to allow a complete mapping and possible future additions of more databases by creating ad hoc classes and properties that extend Europeana model. These processes are considered as iterative processes whose lifecycle involves successive refinements.

Information Architecture

From each database (Fig. 1) a specific application (Importer) creates and stores the triples in a triple store Jena/RDF. The triple store can be integrated with manual additions (in particular, links between different databases and/or external resources) and with the enrichment of a reasoner to define new concepts/relationships inferred from the existing knowledge base.

The data stored in the triple store is accessible through a SPARQL engine (Fig. 2) and can be exported in various formats and for various purposes, present and future. At the moment the targets are feeds for the GSA and the EDM format for Europeana. In the future we also plan to use the system to create sitemaps for Google and other search engines, for projects such as Linked Open Data (LoD) and other specialized portals such as Internet Culturale.

In the case of GSA, feeds -divided into sections for convenience- can be easily imported into the system and make it possible to activate a number of advanced features that we discuss in the next paragraphs. When only static web pages are involved feeds comprise just metadata. For library resources, where crawlers cannot follow links due to the presence of Javascript, feeds provide both metadata and content. This guarantees to index only the desired information, making the search experience even more effective.

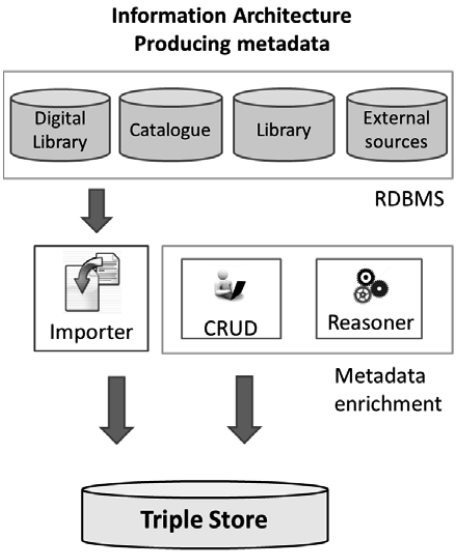

Fig. 1 Extraction and enrichment of metatadata for Triple Store import.

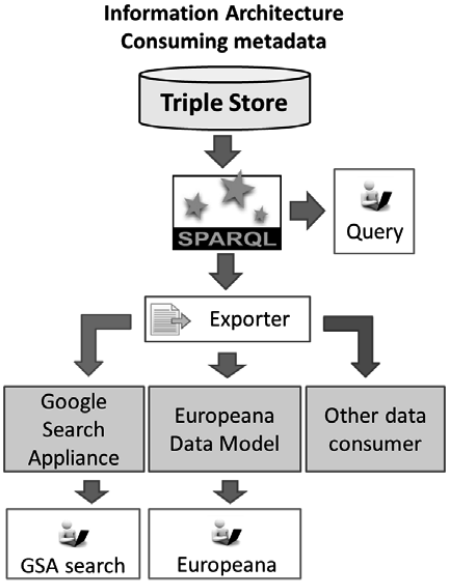

Fig. 2 From Triple Store to the end user.

Metadata

The metadata entered in the system are aimed at structured search (Fig. 3). To enable separate searches in different parts of the site, each record has been provided with a metadata that express the section it belongs to, allowing for example to filter the search inside the Library or in the Multimedia Catalogue. The metadata "europeana_type", instead, has been used to distinguish the type of content you want to find (text, image, video and audio), exactly as in the Europeana portal.

Person names associated with resources are stored in special tags and allow semantic search, thus preserving one of the key features of OPACs that are not normally provided by general search engines.

Specific metadata for individual sections, such as those that permit to identify publisher, collections, typologies, subjects, etc. are also generated. These metadata will grant specific filters for each section.

One of the most important metadata is the date, that the GSA application can handle as a range. Once the dates are generated correctly GSA ensures a very sophisticated search by exact date and time interval. The system limitation is the quality of the data in the original archives that, in some limited cases, have not been designed for automatic processing. In this case it is still possible, with a small manual intervention to provide a complete compatibility with both the GSA and the EDM, obtaining with little effort a significant increment of quality of service.

Places are a more complex case because even within the same institution, cataloguing standards are very heterogeneous. At present these are treated as a traditional metadata, deferring to a later stage the possibility of using interactive maps.

Finally, both here and in Europeana, the thumbnails of the content are used in the presentation of the results list. This is a typical example where the efforts for research systems and presentation are reused in several areas.

```
<record url='http://catalogo.museogalileo.it/oggetto/AstrolabioPiano_n02.html' action='add'
<metadata>
<meta name='dcterms_isPartOf' content='Catalogo'/>
<meta name='europeana_type' content='Testo'/>
<meta name='dc_title' content='Astrolabio piano'/>
<meta name='dc_description' content='
    Questo astrolabio contiene cinque timpani, quattro dei quali per le latitudini 0° e 18
<meta name='dcterms_temporal' content='1301 - 1400'/>
<meta name='marc21_LDR_06' content='Oggetto'/>
<meta name='dc_type' content='Astrolabio'/>
<meta name='dc_language' content='ITA'/>
<meta name='dc_subject' content='astronomia'/>
<meta name='dcterms_medium' content='ottone dorato'/>
<meta name='imss_inventory' content='1109'/>
<meta name='europeana_object' content='http://catalogo.museogalileo.it/images/cat/oggett
</metadata>
</record>
```

Fig. 3 Metadata example

INTERFACES

The system interface (Fig. 4), in the tradition of Google, is extremely simplified but offers many features. Given its structure is also possible to further enrich it. Through the use of metadata a set of very useful additional information is made available. For each search result it is possible to configure the snippet adding metadata. More significantly, on the right of each result you can see, where available, the thumbnail of the content. On the left hand column a list of filterable metadata relevant to the search query is automatically generated. This feature regains the capabilities of semantic search systems while maintaining the ease of use typical of Google.

Among the various filters implemented in the system is worth mentioning the one related to dates, since it allows to work with time intervals that can be customized to suit your needs.

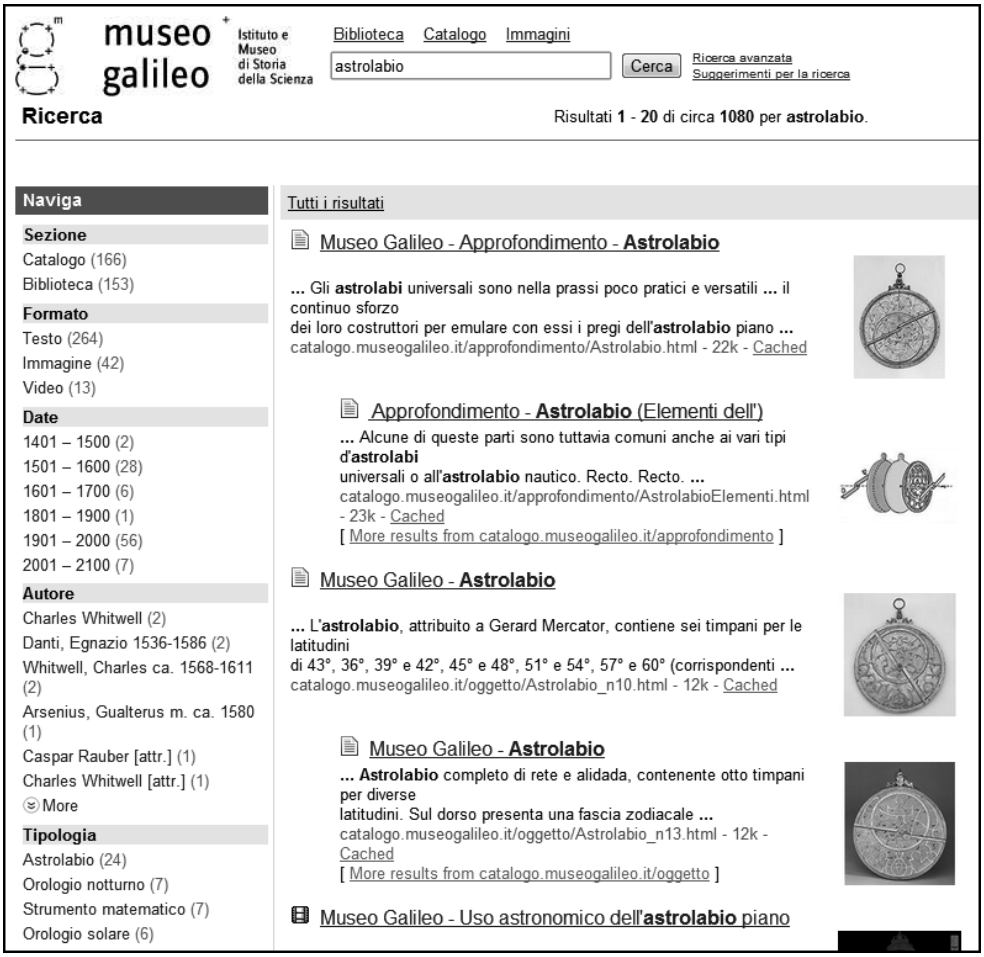

Fig. 4 Example of simple search. Results are identified by an icon showing the typology and the thumbnail of the content. On the left an automatically generated list of filterable metadata related to the search query. Special metadata allows to filter by time range

CONCLUSIONS AND FUTURE DEVELOPMENTS

At present (March 2012) the project is still under development. Specialized interfaces will shortly be created for each database and an extensive series of tests will be conducted to refine the functionalities. We expect to present the product in the summer of 2012.

As a main objective we plan to adopt the application as the search system for the Museo Galileo website. At the end of the first phase of the project we foresee to make it available for other institutions that may be interested in its adoption.

If the feedback will be positive the system could be used by similar cultural institutions to build a federated search system, by mean of the integration of resources from multiple agencies, easily accessible by a single entry point.

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SMARTCITY: CUSTOMIZED AND DYNAMIC MULTIMEDIA CONTENT PRODUCTION FOR TOURISM APPLICATIONS

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Abstract - This paper presents the SMARTCITY project experience: customized and dynamic multimedia content production for professional tourism applications.

INTRODUCTION

This paper presents the final results of the SMARTCITY project, co-funded by the Tuscany Region under the POR CREO 1.d program. The project proposes an innovative methodology as well as advanced technologies enabling professional services for cultural tourism applications in urban areas as well larger archaeological sites.

As of today, many scientific and technological efforts in the specific sector focused on the introduction of technology and all the advantages it brings in cultural and tourism scenarios, rather than content. In addition, the lack of thorough analysis of the needs and behavioural pattern of the new "experience tourists" when performing real or virtual tourist routes, strongly limits the impact that new technologies have on the development of innovative products and services capable of completely fulfil user expectations.

The SMARTCITY project defines new ways of technological and content oriented "cognitive mediation" of the cultural and tourist experience, by implementing in a simplified but pragmatic and effective way, the paradigm of the so-called ambient intelligence. The project developed methodologies and solutions to meet the emerging demand of fruition of the cultural space and cognitive mediation directly or implicitly expressed by tourists. To this end, the project tries to replace old manual techniques and "handmade" manufacturing solutions, characterized by high intellectual labour intensity and very low flexibility in reuse and adaptation of the content, with industrial oriented methodologies suitable for large scale production, aimed at different fruition target, flexible in reuse and content cross-referencing. Such innovative methodologies allow to realistically enforce the business assumption of systematic, efficient and flexible market coverage of the national landscape of cities and places of culture, starting from the Tuscany regional scenario.

The first part of the research was dedicated to accurately and concretely modeling of user needs and behavior during fruition of cultural tourism events, and to the analysis and development of an innovative methodology for information retrieval and indexing of a large unstructured knowledge base.

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The second part of the project was focused to finalize a loosely-coupled system architecture integrating the different system components (knowledge extraction, indexing, authoring editor for guides) and to design and implement the authoring tool for preparing multimedia tourist guides. Finally, the authoring tool has been evaluated with real professional tourist guide authors.

To validate the proposed methodology, the project developed a collaborative platform where non technical users can easily design and develop dynamic multimedia content for the proactive and personalized fruition of tourist routes and cultural paths both in physical (e.g. in the context of art cities) and in virtual locations.

In the next Section, we will give an overview of the general methodology developed in SMARTCITY for the dynamic production of tourist guides based on a selected corpus of texts. Then, we will provide some details about the descriptive, topological and semantic thorough indexing methods used to extract meaning from for unstructured content resources. In the main Section, we will present in detail how the general methodology developed in SMARTCITY has been implemented in an authoring system dedicated to non-expert tourist guide editors, for the creation by an iterative process of search - refinement - composition - enrichment. Finally we will propose some conclusions and further work indications.

GENERAL APPROACH

The project started by analysing the behavioural patterns as well as the use of information "experience tourism". Then, the project focused on information retrieval and aimed to develop the methodological and technical foundations for a new approach to content management systems for supplying tour guides and focused on two aspects: (i) descriptive, topological and semantic thorough indexing methods for content resources, and (ii) interactions between audio and physical space, and between audio and Virtual Reality Spaces.

The main idea of the SMARTCITY approach involves the development of new technologies to improve both creation and access to tourism content. Today's tourism content engineering is characterized by a *handcraft* approach: every content is built from scratch for each specific field of application. That means that if the same content has to be published both to a paper book and a Web site, the two publications will require formatting, styling and revisioning twice. It also means that a publisher will always choose only the traditional publication formats, which can be reached by the most tourists and do not require extra work, time and money.

An *industrial* approach instead would optimize the content production process, through the management of digital content repositories. This kind of approach provides structured tourism information to each publisher. The user will not create new guides from scratch but he will be driven through a step-to-step publication, selecting the required information potentially among thousands of different sources. The available data will be automatically parsed, categorized, indexed and easily reached through categorization and intelligent suggestion of contents. Each piece of work by the publisher will not generate a single content, as in the *handcraft* approach. It instead produces a digital repository including all the required tourism information, which can now be published in several formats, without any effort from the publisher itself. The same guide can be published both to paper book and Web content, it can be available for Internet navigation, as a mobile devices application, virtual 3D tour or combination of some of them. The dynamic content generated can also be used by the next-generation of audio guides as well as for off-line and on-line interactive visit supports.

All these functionalities will be provided from the SMARTCITY environment. Moreover, an old guide can be used as a starting point to create new contents, both saving time and providing better quality to the end user.

On the other side, the industrial approach meets the requirements of the undergoing radical transformation of cultural consumption. Due to recent changes to the touristic behaviour, the tourism experience has become personal, unstructured and focused to individual interests both in terms of location and cognitive orientation. The *industrial* approach allows the publisher to provide custom content, dynamic guides, interactive experiences that can be enforced just reorganizing the original guide and choosing different publication formats. For example visiting a museum, a tourist that is interested in some specific pictures will be pleased to choose his own itinerary through the museum, and listen the description of each picture while walking through the rooms. The same guide will also be available to conventional tour guides, not requiring custom itinerary and audio description.

Another aspect involves the variety of the available information. As a very big part of the touristic targets include minor destinations, it becomes difficult to arrange together information about many less known touristic targets. Consequently it is also difficult to find similar attractions or interesting places near to a single location. The SMARTCITY approach allows finding that kind of information with automatic suggestion of similar contents and restriction of the geographic search area. As the entire database is available to the publisher, he will require no direct knowledge of the place to write about neither hours of research for documentation and cross-referencing. The arranged material can always be published in many formats and reused for future work, spending even less time.

Within the framework of the project, we created a specific domain reference (text) corpus that contains a network of knowledge, automatically extracted, concerning the city of *Empoli* and its neighbourhoods, which offers authors semantic syntheses useful for our specific search needs.

SEMANTINC ANNOTATION AND INDEXING TECNIQUES

The project devised a methodology for the creation of semantic metadata specific to the text materials, i.e. the creation and production of analytical, descriptive and semantic metadata, not only for the entire text unit (text, the volume digitalized, etc.), but also for the *atomic* textual units (at level of single page, paper, or section). The approach developed is based on a *generalized* text enrichment, which is able to identify all forms of knowledge in the text, through the integration of available technologies for statistical and linguistic analysis, without the use of hypotheses, or predefined structures and ontologies. All information extracted, are associated with the text in a *paratextual* formalism made with XML tags. The resulting well-annotated corpus is then appropriately indexed to improve search performance.

To characterize the various parts of our Corpus of text, which do not necessarily correspond to the original units, we provide the system developer the ability to identify specific parts of the Corpus, at user's request. For example, in the characterization of Points of Interest (POI), it is important to define the particular subdomain. Generally, the descriptions of POIs can be traced to known categories such as: works of art (painting, sculpture), and museum objects or archaeological excavations. By analyzing a text, there is no automatic way to distinguish public from religious monuments on the basis of the original document or by type of content. There is not enough information for the categorization of documents, particularly in text materials downloaded from the web. For this reason we are able to identify macro-areas only, on which we are able to ensure a correct attribution. The concept of *artwork* is too broad and contains within it, objects of different nature. The terminology typical of each subdomain should be sufficient to identify the relevant parts of the text, but everything is still conditioned by the size of the subdomain.

Based on past experience we have developed procedures for the generation of semantic filters (or fields of interest) to assign a score to each textual unit, representing its significance with respect to each domain of interest for each unit of text and for each volume, and a statistical summary of the semantic information extracted, such as terminology, multi-words as named entities, verbs.

The development and integration of results led to categorization of some paragraphs and / or volumes. The subdomains tested are *"Archaeology (Archeologia)"* and *"Production of glass art (Produzione del vetro artistico)"*.

For areas where automatic semantic filters have not produced accurate results, because they were not sufficiently characterized by terminology, such as: "*Biographies of famous people (Biografie di personaggi celebri)"* and "*History* (*Storia*)", we have experimented a different strategy that takes into account the extracted terminology and the type of the texts. For example, there are texts relating to biographies of famous people in the Empoli area, such as Alessandro Marchetti, Ferruccio Busoni, Jacopo Chimenti, etc. that have allowed certain attribution directly from the structure into chapters.

AUTHORING SYSTEM

The previous chapter explained how the information is parsed and how the indexing process works. The usage of the indexed material is allowed by the graphical user interface and by the functionalities provided by the authoring system, that presents a step to step procedure that helps the publisher to choose the information, arrange it and choose the preferred publication features.

Figure 1 - Simple text search

The authoring system has a very important role, as it directly offers functionalities to the end user. If it is well structured it increases productivity. Moreover the publication process all happens here: the raw information selected using the graphical interface are automatically formatted from the back-end, and published using the user preferences.

Figure 2 - Category and map area selection

As we can see in Figure 1 - Simple text search, new material can be easily found through a text query. For each result the system will automatically give an introduction, the matched categories and a short list of similar documents.

The initial search can be further restricted to more specific results by selecting one or more categories or by map area selection, as we can see in Figure 2. In a few steps the publisher can collect a great amount of information.

After the collection stage the user can organize the content in a tree structure, adding personal modifications and searching for multimedia to associate to each content as we see in Figure 3 – (multimedia may not be published depending on the chosen format: obviously video and audio would not be available to paper guides).

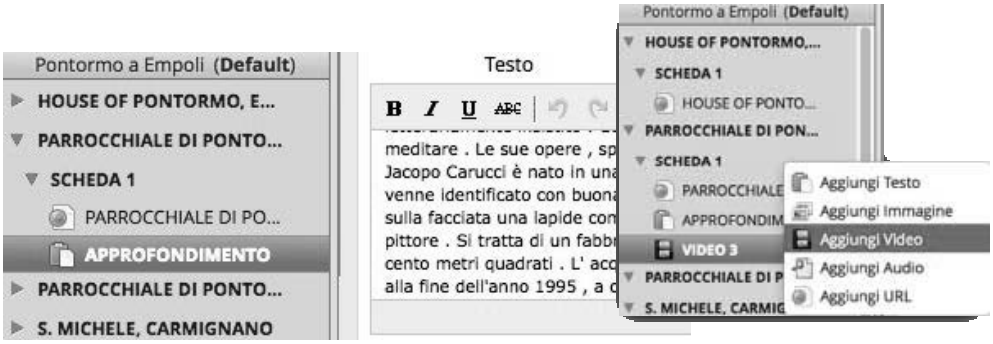

Figure 3 – Edit text and add multimedia

While organizing the guide structure, the publisher can use the map. Each point of interest is automatically located and his position is shown, in order to allow an easy tour planning. If needed, the user can also show path and directions of the itinerary (Figure 4 – Itinerary and directions).

Figure 4 – Itinerary and directions

When finished to edit guide contents, the publisher will choose generator and options to publish current guide. The chosen generator will automatically format contents, insert media and create the user interface of the current publication. An example of generation can be found in Figure 5.

Figure 5 – Publication options and examples

ACKNOWLEDGMENTS, CONCLUSIONS AND FURTHER WORK

This work is partially supported by the Tuscany Region under the POR CREO 1.d program. The authors want to thank all the participants to the project for their contributions.

The project SMARTCITY developed advanced tourist guide editing processes taking advantage of industrial practice, research progress and emerging web 2.0-style collaborative technologies. The involvement of real users, i.e. professional tourist guide editors, in the development of the methodology and tools, as well as in the subsequent validation effort is essential for its acceptance in the target markets.

The first part of the research was dedicated to accurately analyze and model needs and behaviors of users during the fruition of cultural tourism events, and to the development of an innovative methodology for annotating and indexing a large unstructured knowledge base. Then, the project implemented the authoring tool for preparing multimedia tourist guides, integrating the different components described in this papers (knowledge extraction, annotation and indexing, authoring editor for guides). The authoring tool interface was designed to accommodate the large amount of heterogeneous data (text, multimedia, maps) and to allow operators to efficiently manage the knowledge intensive process of search – selection – use – refinement and publication activities defined by the SMARTCITY methodology.

Further work is envisaged in the industrialization effort to bring the current prototypes to the market, including internationalization (the current semantic annotation is only for the Italian language) as well as for extending the methodology to different applications such as theatrical productions, theme parks or videogames.

CULTURAL TOURISM & TRAVEL APPLICATIONS

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Abstract – Telecom Italia's Nuvola Italiana "The only cloud with the network inside," is the great opportunity for the tourism industry, and provides benefits to public sector institutions and top clients, by developing and hosting eTourism applications and digital contents.

Nuvola Italiana is "The only cloud with the network inside," which states that the Telecom Italia solution is the only real Cloud computing system in Italy designed to guarantee the reliability and security required by tourism businesses, thanks to the combination of web and IDC infrastructures allowing the management of the service on an end to end basis, and with high quality levels.

Telecom Italia (TI) is currently developing and experiencing new services to support tourist in their travel experiences. By leveraging on innovative technologies, TI would like to build a new offer for the tourism sector in order to contribute and enhancing competitiveness.

Support for Public Administrations (PAs) and operators participating in the national tourism system (Regions, Provinces, cities of art, managers of archaeological, cultural and food & wine paths, consortia of municipalities and agencies, Parks, …) is one of TI's goals and for which it can provide technology and advanced business models.

Tourism represents for our country an inexhaustible source of revenues and visibility worldwide. "Italy" is a brand to enhance and develop with the support of institutions, individuals, and technology.

Tourism is a primary source of income for Italy, contributing to the national GDP (Gross Domestic Product) with 12 %.

The tourist sector in Italy is a quite "rich" market with its 152 Bn€ contribution to the national GDP in 2009, but, since 2001, it has been living a difficult period.

Recently, an important share of the tourist market is evolving in the dimension of personalization, where tourists are choosing their own unique itineraries and experiences among multiple offers and available options.

eTourism appears as a promising application domain with the goal of providing an improved and personalized experience to tourist by the application of the latest technologies (both in terms of hardware and software) and information coming from the Web 2.0.

In particular, local governments (PAs) and telco operators can make synergies to offer advanced services for tourists using their mobile phones.

The provision of cloud applications can deliver better services and travel experiences, if properly addressed in tourism ecosystem. The local territories, in fact, can generate great business opportunities for operators if they have the chance to rely on tourism platforms powered by new cloud technologies.

Telecom Italia's Nuvola Italiana "The only cloud with the network inside," provides infrastructure and enhanced hosting capabilities designed around the needs of the tourist.

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The cultural tourism market is moving towards a growing visitor satisfaction . The tourist shows an increasing need to play an active role, integrating the cultural content of the visit with a personal auto-generated content and sharing them with the "traveller community".

At the same time it's becoming possible to develop instruments that give an incentive to visit typical places for culture and great beauty but little known.

Nuvola Italiana platforms are very useful for the provision of services to support urban tourism mobility based on LBS services information .

The smart city services are now able to plan a real time travel, and participate in actively to the improvement of urban mobility, for example by providing information on traffic conditions.

Telecom Italia considers it important to contribute to the development of a tourism innovative project that help redesign the supply chain of tourism services usable by mobile devices in cities with information on routes and cultural and entertainment points of interest .

From a series of trials and public demonstrations, Telecom Italia has created its vision to guide the design of ICT services for tourism sector: the intention is to support the Public Administrations (which will be TI's direct customers) in the aggregation and development of an eTourism offer for the benefit of all the actors of the value chain, with a Business2Business2Consumer (B2B2C) business model.

THE SENARUM VINEA PROJECT: WINE TOURISM AND MOBILE MULTIMEDIA DEVICES

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The Senarum Vinea project is a research program carried out by the University of Siena to study and safeguard the historic vineyards still extant within the Medieval City Walls of the city of Siena and in the close neighbourhoods. As a result of this study, several century old vine plants have been discovered: what's more, many of them belong to unique grape varieties that cannot be found anywhere.
In order to safeguard this priceless botanical heritage, several operations have been carried out: the genetic code of these plants has been analysed, and a "germoplasm bank" where samples of these plants are being cultivated has been realized, while the final purpose of this operation will be the realization of some vineyards composed only by these unique varieties in order to produce a so called "medieval wine".
At the same time, work is going on to promote the knowledge of this heritage that is both natural and cultural because while on one side it represents a unique botanical legacy, on the other side it is a sort of time capsule of the medieval farming techniques. The first step in this direction has been the creation of a tourist itinerary, linking different sites inside the city walls of Siena strictly connected with the wine culture. These sites include natural settings where ancient vineyards can be found but also cultural sites where artistic statements related with the vine cultivation can be seen.

In order to allow single visitors to follow autonomously the itinerary, and to provide them additional information, a system based on the use of QR codes has been developed, allowing single users to browse on their Smart Phone multimedia information concerning the path to be followed and the point of interest they are visiting. The system has been designed to use the QR code not only as a key to retrieve the information but also as a localization instrument: in fact, the decoding of the QR code allows the user to find his position an a Google map and the retrieve data concerning the path to be followed to reach the previous and the following point of interest.
The itinerary has been subdivided in six stops, associated with the related points of interest. For each stop an ad-hoc signpost has been designed, including a short summary briefly describing the point of interest, an image and the QR code. The QR code can be read with a common scanner application to be installed on the Smart Phone of the user, for example Lynkee for IPhone or Barcode Scanner for Android. The QR code keeps a URL allowing the user to be directly connected with an Internet page displaying detailed information on the point of interest: in this page the user finds a text, a set of images showing details of the site he's visiting and an interactive menu allowing him to access additional multimedia information.
The menu gives access to six different interactive sub-sections. The *Map* section visualizes the current position of the user on Google map: the localization procedure doesn't use the GPS positioning system but it employs the identification feature of the QR code to retrieve the exact position of the user. The *Previous Stop* and *Following Stop* sections give to the user the information to reach the two adjoining sites: moreover, using the same localization process of the *Map* section, the paths to be followed are visualized on a Google map. The *Yesterday/Today* section provides an interesting multimedia content: through the processing of old and new images, an animation has been realized showing the transformation of the specific site from years to years. The *Senarum Vinea* Project section gives a short description of the project describing the research and the goals to

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be achieved. Finally, the *Links* section provides a directory of useful links to the institutions involved in the project.
A the end of the page the user finds the flags describing the languages in which the text is available and he can select them simply clicking on them. Below the flags two links are provided to share the page on the most common social networks (Facebook and Twitter).

The described system can be obviously widened in many directions. New stops can be added at the itinerary simply adding new signposts and updating the application, while new sub-sections can be added to the application to provide new multimedia contents. In particular, a new itinerary is being studied to extend the system to sites located outside the Siena city walls: this itinerary will involve mainly tourist provided with a car, allowing them to visit rural areas that present distinctive features that cannot obviously be found among the palaces of a city.

PRELIMINARY RESULTS ON PRIMING-BASED TOOLS TO ENHANCE LEARNING IN MUSEUMS OF FINE ARTS

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Abstract. **The goal of this paper is to assess whether a tool based on visual-perceptual repetition priming, a kind of implicit memory, may improve the methodology of looking at artworks. Watching is a learned skill that is neither innate nor spontaneous. Onlookers would benefit from a method that may enhance their visual skills. In this work we also present preliminary results obtained analysing subjects' brain signals collected by an EEG-based device during the verification test phase of the performed experiment. This new approach appears promising and we are planning to perform more experiments with a larger number of subjects.**

INTRODUCTION

Museums are seeking to offer visitors ways to participate and contribute in the making of the museum experience. While the focus in this paper is on technology as a communication medium, technology also represents the tools we use to solve problems and develop the products that we need (e.g., many museums in United States offer workshops and programs that engage children in using technology to design things, make tools, and express creativity). The multiple types of technologies offer museums the opportunity to track visitors and understand what they are doing both in the museum and on-line. Many museums have incorporated surveys or feedback mechanisms into their technology devices as well [29].

The structure of the forthcoming paper is divided into three main parts. The first part provides an introduction to visual skills in order to select the major features required. The second part investigates what is visual-perceptual priming and why priming-based tools may be useful in the museum environment. Finally, we discuss how visual-perceptual priming may enhance the museum experience. The purpose of this paper is to focus on visual-perceptual priming-based tool as a means to promote visual skills development.

DEVELOPING VISUAL SKILLS

Michael Baxandall in the introduction of *Patterns of intention: on the historical explanation of picture* [2] explains how we look at an artwork: "When scanning a picture we get a first general sense of a whole very quickly, but this is imprecise; and since vision is clearest and sharpest on the foveal axis of vision, we move the eye over the picture, scanning it with a succession of rapid fixation. The gait of the eye, in fact changes in the course of inspecting the object. At first, while we are getting our bearing, it moves not only more quickly, but more widely; presently it settles down to movements at a rate of something like four or five a second and shifts of something like three to five degrees – this offering the overlap of effective vision that enables coherence of registration.

A work of art is composed by visual clues employed to express its meaning. How can we achieve this meaning? How does the artist set the scene or sketch out his characters in order to "create" this meaning? Some strategies for helping people to develop visual skills in looking at subject matter (objects and incidents represented) and expressive content (combined effect of subject matter and visual form) of different forms of Visual Arts are here considered.

Taylor [25] investigates how to approach drawings, paintings, graphic arts, sculptures, and architecture. He begins the artwork analysis describing what is represented through different visual forms. He picks over composition as a dominant contributor to the expressive content of a painting.

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He discriminates lines, shapes, colours, symmetry, objects arrangement, proportion, and space. He stresses that the choice of material and technique is paired with the artwork character. In order to improve the understanding of an artwork, Taylor *compares* different artworks representing the same subject but using different expressive contents.

Museum educators often adopt the inquiry-method in order to explore an exhibit with the lay public. GRAM (*Grand Rapids Art Museum*) staff has provided a methodology based on a inquiry-based tour of the museum. They stress the importance of encouraging the development of viewers oral and written communication skills in relation to Visual Arts. GRAM docents are trained to exploit specific questioning techniques in the course of the tour. Such questionnaires aims at encouraging visitors response. After a period of time spent observing an exhibit, museum goers are asked to answer some questions, suggested by teachers, such as: *What is going on in this picture? Has your first impression changed now that you have spent time with it?* All these questions are followed by another one: *What do you see that makes you say that?* This question helps people beginning to look at an image separate from their own past life experiences and to find evidence for their response within the artwork itself. The inquiry-based method is used to analyse the formal elements (shape/composition, line, colour, pattern/texture, light, subject/function, and interpretation) as well. The interpretation level, for example, is examined through questions like: *Why do you think the artist created this work? What effect do you think the artist's time period had on his work?* Knowing about the artist's education, partnerships and ideas about art, GRAM staff uphold, may help the viewer to see a work from a new perspective and to catch novel meanings.

Shall we use other methodologies of looking in order to achieve the same goal? We would like to tackle this topic from a different point of view. The next section introduces the psychological phenomenon called visual-perceptual priming that can be used to foster visual skills.

VISUAL-PERCEPTUAL PRIMING

The exposure to a visual-perceptual, semantic, or conceptual stimulus influences response to a later stimulus. Consider this case. A person reads a list of words including the word *apple*. Subsequently the person is asked to complete a word starting with *ap*. The probability that he/she will answer *apple* is increased because the word was previously primed. Therefore, if a stimulus is primed, later experiences of this stimulus will be processed more quickly and precisely by the brain. Priming is a kind of implicit memory (a sort of tacit memory that is not consciously retrieved or observed). While performance of episodic memory based on explicit tasks initially improves with age and declines in advancing age, priming remains relatively stable from age 3 to 80.

Visual-perceptual priming is defined by enhanced processing of previously seen visual material, relative to novel visual material. Wiggs and Martin [27] review the literature as to the main visual-perceptual priming experiments. They stress that perceptual priming is sensitive to changes in physical appearance only in some instances. In general, stimulus attribute alterations – such as colour, pattern, luminance, contrast, location, left-right reflection, and size – do not influence priming. At the same time, perceptual priming can be attenuated when stimuli are changed so as to affect the ability to identify stimulus form. Specifically, it is not affected by relatively small changes in orientation (e.g., rotations in depth up to 67°) but is eliminated by large changes in orientation (e.g., rotations in depth > 80°). Furthermore, the phenomenon is diminished with changes in an object's exemplar (e.g., a different picture of the same-named object), and with changes in a word's typography from *study* to *test*. These results suggest that physical attributes essential to the representation of object form – such as line elements of drawings, or written word form (e.g., print typography of letters) – do influence perceptual priming.

Finally, «the degree of attention devoted to encoding typically does not affect the magnitude of priming. Thus, when attention is divided during encoding, priming is no different than when attention is focus» [27, 228].

HOW TO IMPROVE ONLOOKERS' SKILLS WITH VISUAL-PERCEPTUAL REPETITION PRIMING-BASED TOOLS

The purpose of the present research is to develop a priming-based tool that takes into account the most relevant experimental and physiological findings and applies them to the museum environment.

Students and lay public are often unskilled visual onlookers. They do not know that an image or an artistic object may be read just as a book. They lack a proper education. To help them an education well-founded in visual language and communication is needed [18]. The ability to analyze the artwork formal qualities, as we mentioned previously, is intrinsic to complete understanding of the art-making process. Therefore people need to develop or improve visual skills. Besides, museum visitors should learn a methodology, based on the knowledge of the main features contained in an artwork, to approach and comprehend an artistic object. In order to achieve these aims we have chosen to analyze and apply priming to museum environment. This phenomenon, as we described earlier, possesses some interesting characteristics: perceptual priming effects are long-lasting in normal adults and amnesic patients, priming remains relatively stable from age 3 to 80, the degree of attention devoted to encoding typically does not affect the magnitude of priming, and finally this phenomenon seems to be independent of cultural background.
Our aim is to improve visitors visual skills showing visual primed stimuli related to artworks (colours, lines, shapes, and so forth).

During the test performed at the end of the experiment, to verify the effects of priming stimuli, we also adopted an innovative approach successfully used to measure humans reaction to specific stimuli. We acquired subjects' EEG data while participants were asked to answer some questions about the experience. For its temporal resolution, EEG could give, in fact, important indications, confirming if and when, answering to the questions, participants present variation in EEG signals, due to stimuli recognition, frustration and/or change in attention levels.

Experimental Setup

The goal is to implement either technological devices and educational resources (wall and caption texts, booklet) based on priming process. Each artworks expressive content, described previously by art historians and museum practitioners, have been proposed as visual stimulus for a short period of time to the lay public, before the encounter with the real work of art.

The experimental setup takes advantage of visual-perceptual repetition priming. It is based on a museum tour (Pinacoteca Ambrosiana – Milan, Italy) where participants singularly watch prime stimuli on a screen under the supervision of researchers. On the whole, the experiment requires three statistically sampled groups of subjects: prime stimuli group, neutral stimuli group, and control group. As to the kind of stimuli, 5 prime stimuli are selected (colours: red, green, brown, white, and blue). In this experiment, the portions of colours have been selected from 5 artworks positioned in Pinacoteca Ambrosiana. In order to choose the colours we followed some criteria: the colour extent, the colour saturation and value, and the repetition of the hue in the Pinacoteca paintings. The neutral stimuli are unrelated to the artistic features of the works of art selected (e.g., picture in black and white of sunglasses).

Procedure. At the onset, participants read the instructions they will then paraphrase back to the experimenter. After a practice trial, participants are asked whether they have any doubts as to what they have to do. The prime group watches a session of 5 prime stimuli (colours: red, green, blue, brown, and white) related to 5 paintings features, alternated with neutral prime stimuli (objects in black and white not depicted in paintings: luggage, phone, baby's bottle, vacuum cleaner, and headband) for a short period of time (1 minute circa). The neutral stimuli group watches a trail composed by 10 stimuli unrelated to paintings (objects pictures in black and white such as sunglasses) for a short period of time (1 minute circa). A control group visits the museum without

any previous visual stimulus. At the end of their tour, participants are asked to answer some questions about the masterpieces chosen for the experiment in order to check if the *prime* stimuli (colour) helped them remembering the artworks main features such as characters, title and so forth (*target*).
During the final test, we also registered subjects' EEG signal [19], using a Brain Computer Interface (BCI) devices [1] to collect EEG signals, to avoid influence in anxiety of participants. BCI devices are a simplification of the medical EEG equipment and currently several kind of low-cost, non-invasive BCI could be chosen for our research objective. We choose to collected EEG data using a Neurosky *Mindwave*™ BCI device, used in several research applications and yet used by authors in previous works [5, 9]. Neurosky *Mindwave*™ BCI device consists of a headset with an arm equipped with a single dry sensor acquiring brain signals from the forehead of the user at a sample rate of 512 Hz, transmitted via bluetooth to a host computer. For its easiness in positioning on the users' scalp and for the use of dry sensors, we choose the Neurosky *Mindwave*™ BCI because it results more comfortable for users. Moreover brain functions interesting our work are related to the premotor frontal cortex area, on which the *Mindwave*™ sensor is positioned. In fact, the signals from the frontal lobes are linked to higher states of consciousness.

BCIs collect several cerebral frequency rhythms. In our work, we concentrate on alpha, beta, theta and gamma band. We recall that activity in the alpha band (7 Hz – 14 Hz) is related to relaxed awareness, meditation, contemplation, etc. Beta band (14 Hz – 30 Hz) is associated to active thinking, active attention, solving concrete problems. Theta band (4 Hz – 7 Hz) is usually related to emotional stress, such as frustration & disappointment, while activity in gamma band (30 Hz – 80 Hz) is generally related to cognitive processing of multi-sensorial signals.

Results

Developing and training visual tools using priming is the goal of the present research. As previously mentioned, priming has interesting features, such as long-lasting effects, stability despite age, imperviousness to attention degree, and independence of cultural background, that can be exploited in museum environment.

Data collected by EEG signals have been analysed using *MATLAB*™ functions, to detect the presence of differences in brain activity during the final questions session. To this aim, we calculated the average Power Spectral Distribution (PSD) [21] in alpha, beta, theta and gamma rhythms [19, 3] for all the groups of users. The value of PSD gives information about how the power of a signal is distributed with frequency, and therefore the average values in each band indicates the overall behaviour of the brain activity eventually induced by the visual stimuli. For PSD we used the Welch's method [26] with Hamming window function (overlap 50%, segment length 64) [20] and we computed for each user data the ratio between the average power in each band and the average power in the frequencies interval between 0 Hz and 80 Hz.17, to compensate the different data ranges for each user, due to personal variability. We finally computed an average of these ratios in each band. From the analysis of the obtained plot, it results that in subjects who received the visual stimuli we can see an increase in the attention level (Beta and Gamma bands, for active thinking and attention). At the same time, in subjects who received the visual stimuli, Theta brainwaves decrease, indicating that participants did not feel frustration or disappointment, if compared to individuals who did not received the same stimuli and to subjects who received a neutral one. In these cases, Beta and Gamma bands decrease, compared to the first group, while we registered an increasing of Theta band.

For subjects who received the visual stimuli, Gamma and Beta bands revealed an average band power significantly greater than participants who did not receive a stimulus and to whom received a neutral one. The average band power for Alpha and Theta rhythms decrease for the first group, compared to the other two.

The described new approach appears on one hand promising for this kind of application, to measure the effects of visual stimuli. On the other hand, the application of EEG signal analysis to this kind of experiment represents a challenge and we are aware that the presented experimental

setups are not based on a specific task. In fact, the activity in the analysed bands is often considered and studied in well-defined task-based experiments. We are currently considering other experimental setups, based also on ERPs, in order to investigate the actual information given by the beta/alpha ratio as an index of attention in EEG based experiments on visual prime.

CONCLUSIONS AND FUTURE WORKS

Developing and training visual skills using priming-based tools is the goal of the present research. As previously mentioned, priming has interesting features, such as long-lasting effects, stability despite age, imperviousness to attention degree, and independence of cultural background, that can be exploited in museum environment. In this paper we presented encouraging results obtained submitting individuals to a museum tour where participants singularly watch prime stimuli on a screen under a researcher's supervision.

During the final question session, we registered participants' EEG signals using a BCI device. The obtained preliminary results show that in participants who received the visual stimuli, we registered an increasing of the attention level corresponding to questions related to the visual stimuli, increasing the engagement of memory in the process. Also beta and gamma rhythms, indicating active thinking and attention, presented regular tracks on the same questions, while Theta brainwaves did not show frustration symptoms and, correspondently, alpha values confirmed the relaxed attention state of the subjects.

This new approach promises future improvement in exploring priming mechanisms, but, at the same time, we are just in a preliminary phase in experimenting the use of EEG for our research aims. We plan to individuate more specific measures and also to perform a larger number of experiments to validate this innovative approach, representing both a great opportunity and a challenge.

Future detailed experiments will better test how much such elementary psychological process may help museum practitioners to improve visitors' visual skills.

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