

# Advanced ICT projects for Cultural Heritage

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UNIMORE  
UNIVERSITÀ DEGLI STUDI DI  
MODENA E REGGIO EMILIA



softech-ict



COSTRUIAMO INSIEME IL FUTURO



**Softech-ICT**

**ICT for Enterprise**

**Centro Interdipartimentale  
di Ricerca Industriale di UNIMORE**

Dipartimento di Ingegneria «Enzo Ferrari»

Dipartimento di Economia Aziendale  
Facoltà di Economia «Marco Biagi»

**softtech-ict**

**Laboratorio del  
Tecnopolo di Modena  
Rete ad Alta Tecnologia  
Regione Emilia Romagna**



UNIONE EUROPEA  
Fondo europeo di sviluppo regionale



**POR FESR 2007-2013  
OBIETTIVO COMPETITIVITÀ  
E OCCUPAZIONE**

**Regione Emilia-Romagna**



**COSTRUIAMO INSIEME IL FUTURO**

# RICERCA IN ICT



## Research Units

1. **Software systems**: software services, apps, mobile and cloud
2. **Multimedia systems**: vision, machine learning and heterogeneous content
3. **Information systems**: knowledge management, db, bd and business analytics
4. **Digital systems**: electronics and telecom
5. **Economic systems**: business model and marketing

# MULTIMEDIA SYSTEMS :IMAGELAB

[www.imagelab.unimore.it](http://www.imagelab.unimore.it)

IMAGELAB

DIEF UNIMORE Lab

5 staff people

15 phd students and post doc

1 spin-off

>300 scientific publications

# UNIMORE

UNIVERSITÀ DEGLI STUDI DI  
MODENA E REGGIO EMILIA



IMAGELAB

University of Modena and Reggio Emilia

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## Attivazione master di II livello - MUMET: Master in "Visual Computing and Multimedia technologies"



Al via il nuovo Master MUMET. Il master vuole creare nuove figure professionali (MULTIMEDIA DATA SCIENTIST), con competenze avanzate sulle tecnologie informatiche multimediali e sul visualcomputing, competenze attualmente molto rare ed assai richieste per i sistemi, servizi ed applicazioni nelle smartcities and communities.

Presentazione del Master

Sito web del Master in "Visual Computing and Multimedia technologies"

## International Workshop on Wearable and Ego-vision Systems for Augmented Experience (WEsAX)



emerging in this field.

ImageLab is organising the first International Workshop on Wearable and Ego-vision Systems for Augmented Experience (WEsAX) that will be held on the July 3, 2015, in conjunction with the IEEE International Conference on Multimedia and Expo (ICME), Turin, Italy. The goal of the first International Workshop on Wearable and Ego-vision Systems for Augmented Experience (WEsAX) is to give an overview of the recent technologies and system solutions, create a forum to exchange ideas and address challenges

## Seminario Nvidia

Lunedì 17 Novembre 2014 dalle 14.00 alle 16.15 presso l'Aula P0.4 (ex FA-OC) - dipartimento DIEF - si terrà un seminario sulle architetture parallele



ImageLab is a research laboratory at the Dipartimento di Ingegneria "Enzo Ferrari", University of Modena and Reggio Emilia, Italy. ImageLab is also part of the Centro di Ricerca Interdipartimentale in ICT Softech-ICT of the Modena Technopole.

Research at ImageLab covers topics of Computer Vision, Pattern Recognition & Machine Learning, and Multimedia, applied to optical images and videos as well as data from different sensors.

In addition, ImageLab is currently involved in research activities on vision-based human-computer interaction.

In particular, the main research activities concern:

video surveillance, machine vision and robot vision, medical imaging, human-centered multimedia, content-based retrieval, people detection and tracking, human behaviour understanding, Egocentric vision and embedded sensors.



## Computer Vision

the scientific discipline studying **how to perceive and understand the world through visual data by computers.**

## Pattern Recognition

the scientific discipline studying **how to classify or recognize patterns** and observed data **using a priori knowledge or statistical information**

## Machine Learning

the scientific discipline studying **how to constructs algorithm that can learn from and make predictions on data.**

## Multimedia

the scientific discipline studying **how to deal with big heterogeneous data( video, audio, text, sensors) for human-based interactive applications**

Then... Machine Vision, Medical Imaging, Video surveillance, Perception for

Autonomous systems, Biometry, ~~Multimedia big data analysis~~, Cultural heritage, HCI .....

Rita Cucchiara 2015



# ICT AND CULTURAL HERITAGE

# WHY (ADVANCED) RESEARCH ICT PROJECTS FOR CH?

..and not only CH projects with ICT..



J De Barbari 1500? Ritratto di Luca Pacioli

Digitalization  
and Preservation

Knowledge  
Management

Experience  
Evaluation

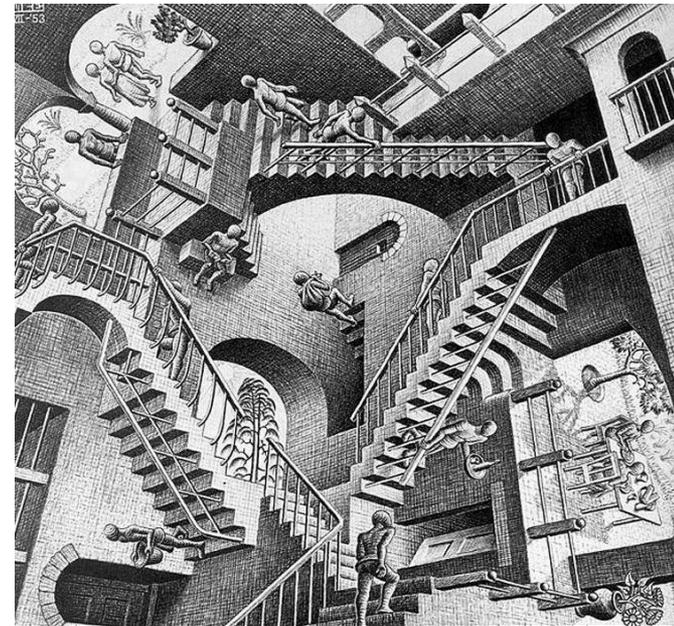
Experience  
Augmentation

# Digitalization and Preservation

# Knowledge Management

Experience  
Evaluation

Annotation  
Similarity Standards  
Text Metadata  
Rendering  
Reconstruction 3D Formats  
Search  
Animation  
Retrieval  
Restoration  
Experience  
Imaging  
Augmentation  
Multispectrality

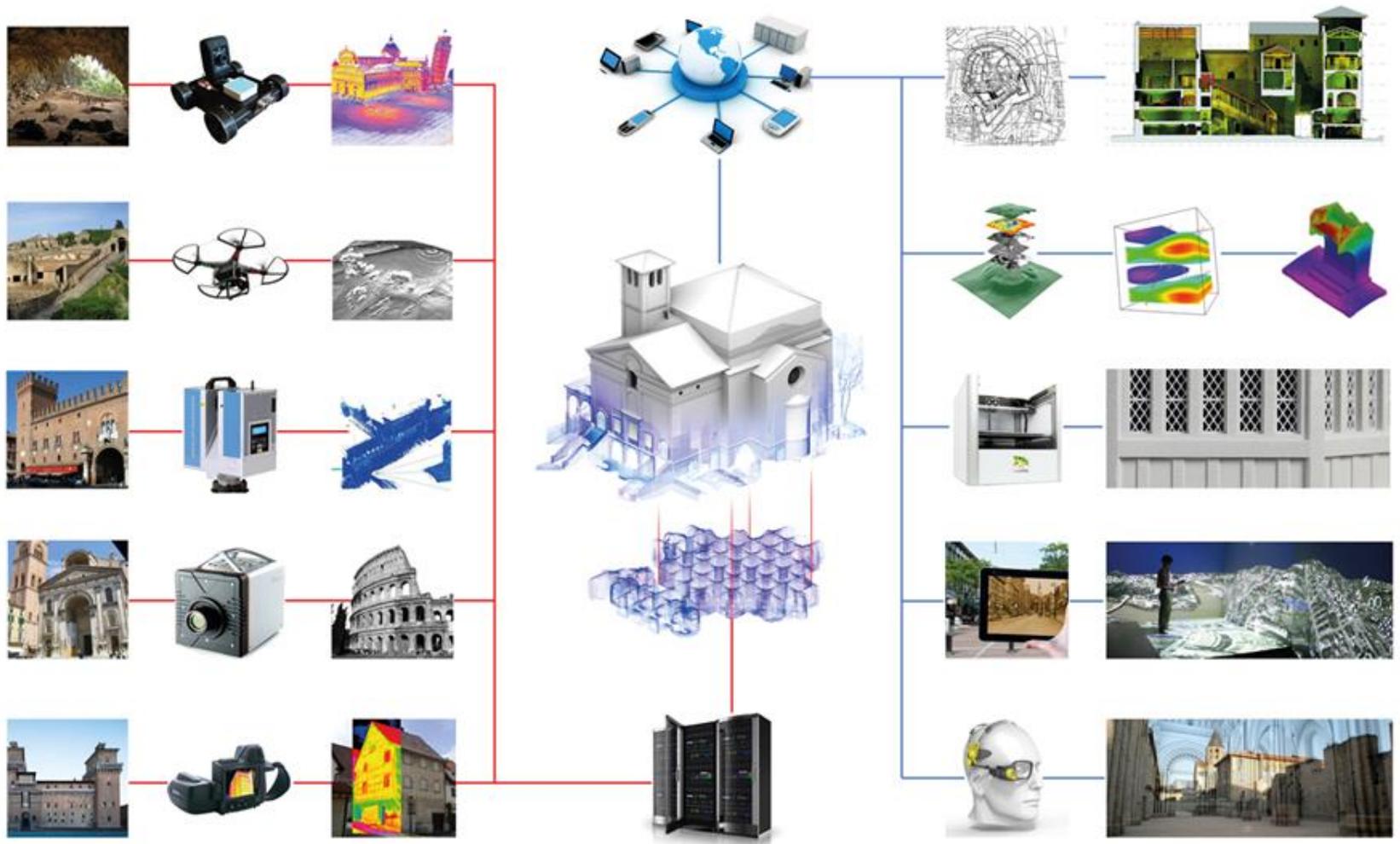


Maurits Cornelium Eshcher Relatività 1955

# INCEPTION

Inclusive Cultural Heritage in Europe through 3D semantic model

EU 2014 REFLECTIVE 7 thanks to M.Balzani Teknehub Ferrara



Digitalization  
and Preservation

Knowledge  
Management

Experience  
Evaluation

CrowdFlowAnalysis  
PeopleTracking

AttentionAnalysis

User Counting

Eye-tracking

VideoAnalytics

Profiling

Experience  
Augmentation



## from Evaluating the Practical Applications of Eye Tracking in Museums

By E.Bachta, R.Stein, S.Filippini-Fantoni, T. Leason, Indianapolis Museum of Art, USA

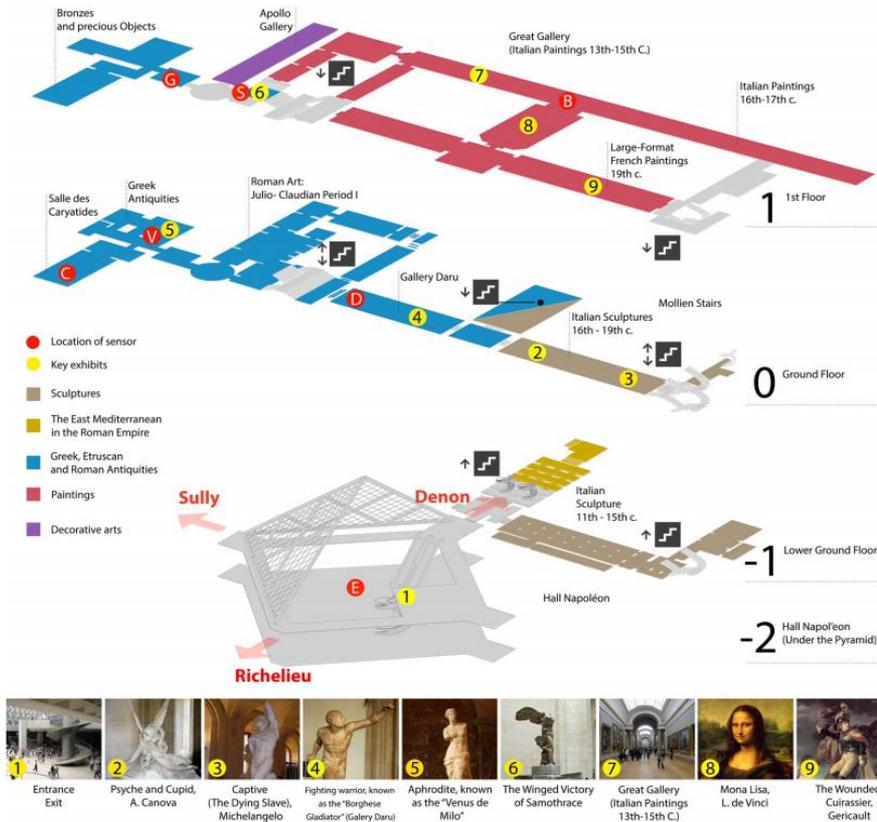
In “Museums and the Web” Conf. 2012



Profiling user attention  
in art enjoyment



# from An analysis of visitors' behavior in The Louvre Museum: a study using Bluetooth data, By Y.Yshimura, S Sobolevsky, C Ratti, MIT USA ,F Girardin, J Carrascal, J Blat, R Sinatra in Environment and Planning B: Planning and Design 41(6) 2014



**Table 6.** Three types of visitor transition rates from node E to the subsequent node expressed as a percentage.

Subsequent node from node E	All visitors	Short-stay visitors	Long-stay visitors
D	43.32	42.41	40.34
V	11.25	12.80	11.38
C	9.59	10.02	11.32
B	6.80	9.20	7.51
S	21.53	21.02	20.82
G	7.51	4.54	8.63

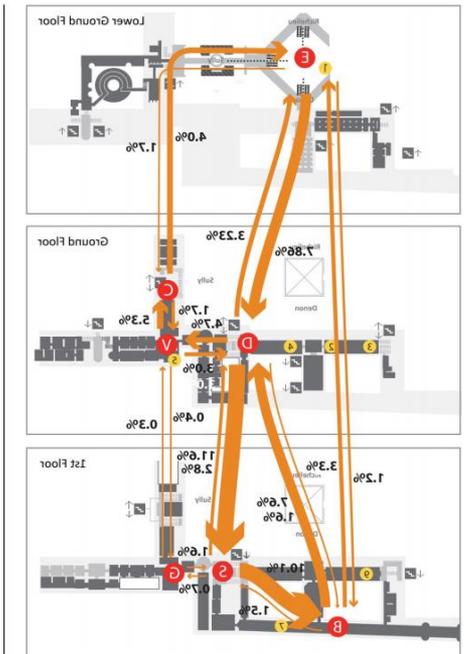


Figure 1. The Louvre Museum visitor paths (H) from visitor paths

Profiling user path  
in museum enjoyment

Digitalization  
and Preservation

Knowledge  
Management

*Computer  
Vision* + *Machine  
Learning* + *IoT*  
Experience  
Evaluation

Experience  
Augmentation



D.Velasquez 1656 Las Meninas

# Research projects for Augmenting Cultural Experiences

- 1) Enjoyment Experience: Playing with data
- 2) Interaction Experience: Playing with the body
- 3) Collective Experience: Playing with the others

*Computer  
Vision* + *Machine  
Learning* + *IoT*

- 1) Enjoyment Experience: Playing with data
- 2) Interaction Experience: Playing with the body
- 3) Collective Experience: Playing with the others



D. Hirst L-Tyrosince-15N, 2001' in a gallery in London

# New metaphors for discovery masterpieces in artistic books in the RERUM NOVARUM project UNIMORE- F. C. Panini

From Miniature illustrations retrieval and innovative interaction for digital illuminated manuscripts. By Daniele Borghesani, Costantino Grana, Rita Cucchiara in ACM Multimedia Systems. 20(1): 65-79 (2014)



- 1) Enjoyment Experiences: Playing with data
  - 2) Interaction Experiences: Playing with the body
  - 3) Collective Experience: Playing with the others
- Gesture recognition
  - Expression/mood recognition
  - Body recognition
  - Brain Activity recognition



Yves Klein's "Anthropometrie" 1960

## Ego-centric vision in interaction: project “Città Educante” cluster: Smart Cities and Communities

From Gesture Recognition using Wearable Vision Sensors to Enhance Visitors' Museum Experiences“ L. Baraldi, F. Paci, G. Serra, L. Benini, R. Cucchiara in IEEE Sensors Journal, vol. 15, n. 5, pp. 2705-2714, 2015



(a) Like gesture in the museum setting



(b) Dislike gesture



(c) Ok gesture in the museum setting, in low light



(d) Point gesture



(e) Slide right to left gesture in the museum setting, while another visitor walks in



(f) Slide left to right gesture in the demo room setting performed by user 3



(g) Take a picture gesture in the demo room setting

An open CALL: G.Serra, R.Cucchiara, J.Civera, K.Kitani IEEE Transactions on Human-Machine Systems Special Issue on “Wearable and Ego-vision Systems for Augmented Experience” 2016

Body interaction by sensing floors : the FLORIMAGE project

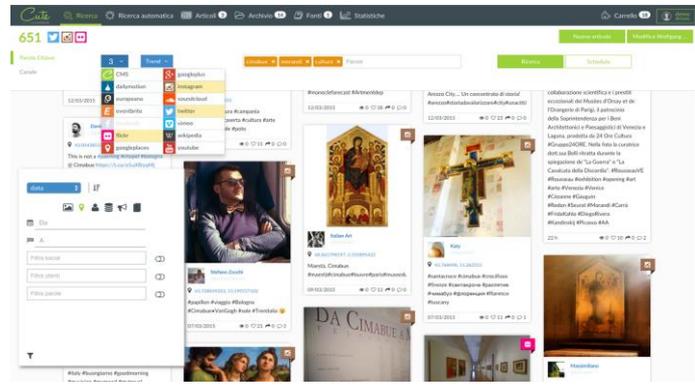
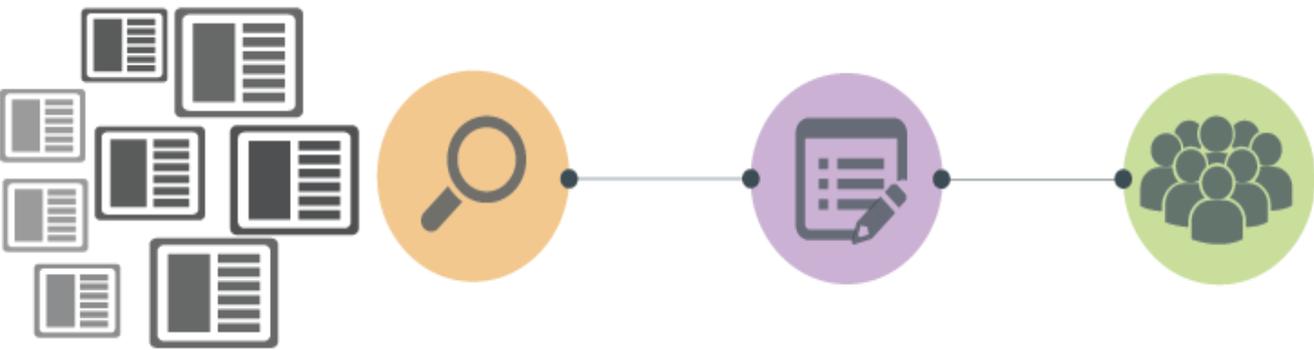
**“A General-Purpose Sensing Floor Architecture for Human-Environment Interaction”**. R. Vezzani, M. Lombardi, A. Pieracci, P. Santinelli, and R. Cucchiara. *ACM Transactions on Interactive Intelligent Syst.* 5, 2, 10 2015



- 1) Enjoyment Experiences: Playing with data
- 2) Interaction Experiences: Playing with the body
- 3) Collective Experience: Playing with the others



DICET - INMOTU PON Project Lecce  
 storyboarding with AR, thanks to L.Bevilacqua Engineering

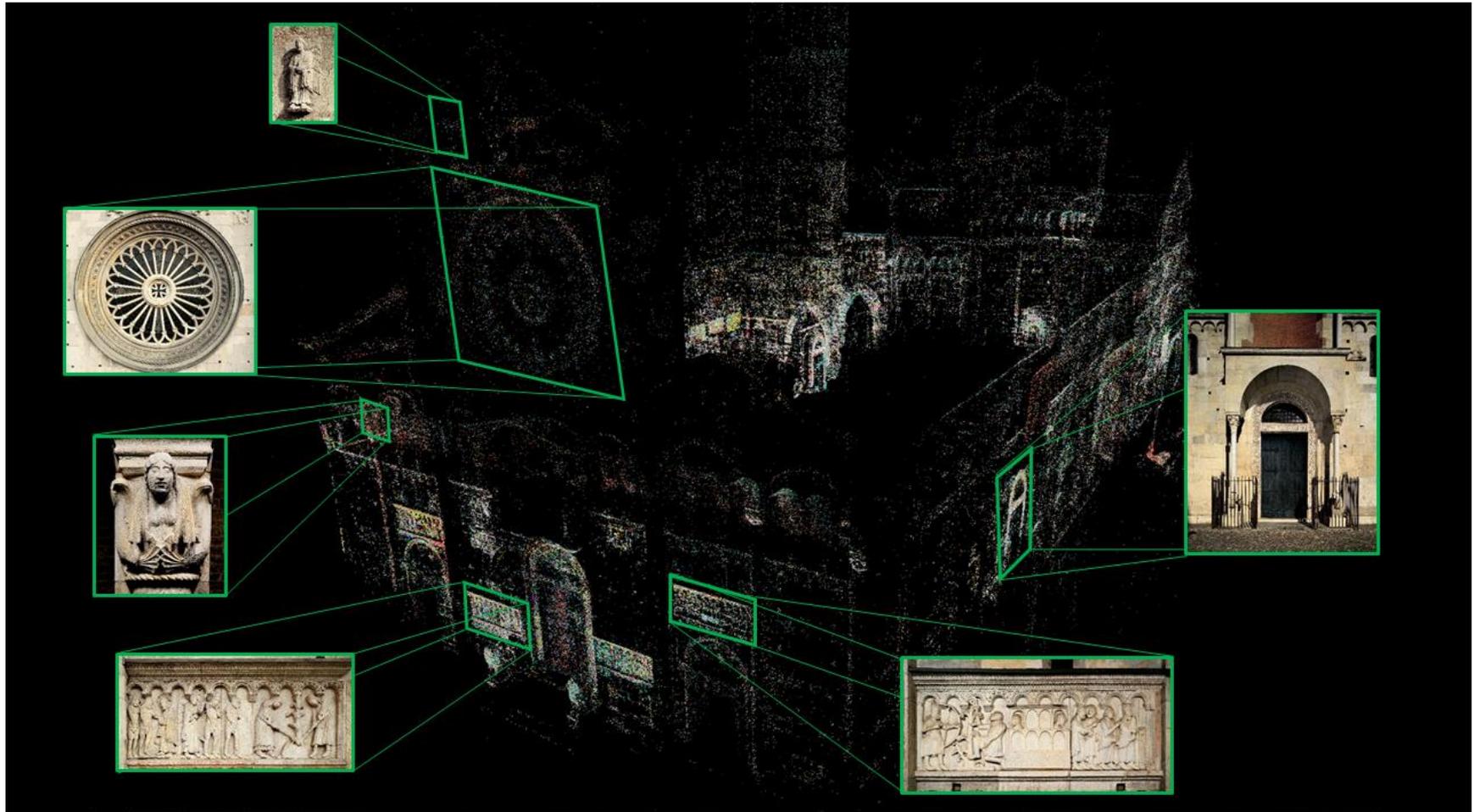


UNIVERSITÀ  
 DEL SALENTO



ENGINEERING

"Wearable Vision for Retrieving Architectural Details in Augmented Tourist Experiences" A. Alletto, D. Abati, G. Serra, R. Cucchiara Proceedings of the International Conference on Intelligent Technologies for Interactive Entertainment (INTETAIN), 2015



Form mobile or wearable user generated content  
To dynamic 3D reconstruction



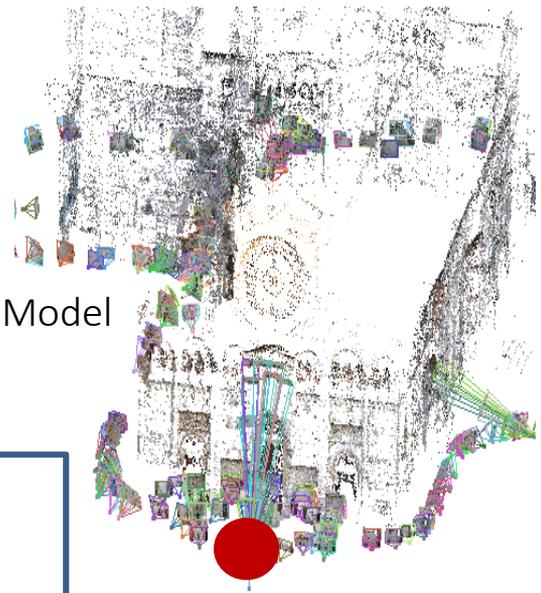
Image Retrieval  
based on BOW  
descriptors



Top ranked images with 3D localization info

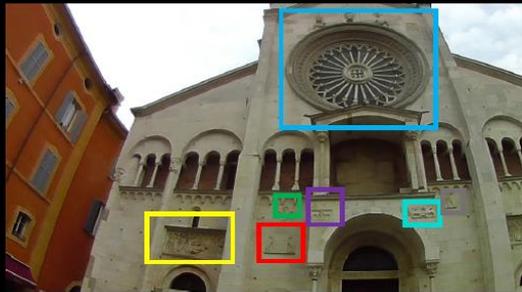
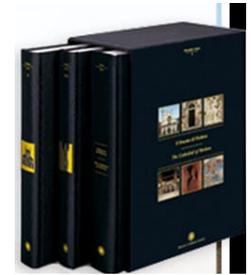


3D Model

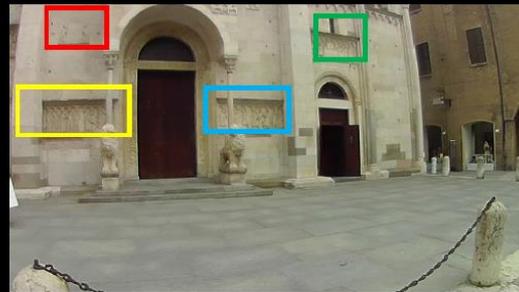


Person  
Localization

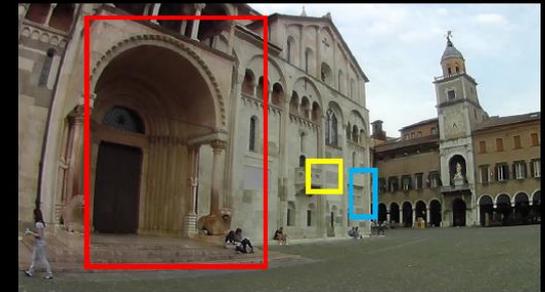
Form mobile or wearable user generated content  
To dynamic 3D identification



- First Panel with scenes from the Genesis. TAP to know more
- Enoch and Elias supporting the tablet with the inscription recording the foundation of the Cathedral. TAP to know more
- The Campionese rose window. TAP to know more
- Winged genii with torches. TAP to know more



- First Panel with scenes from the Genesis. TAP to know more
- Enoch and Elias supporting the tablet with the inscription recording the foundation of the Cathedral. TAP to know more
- Second Panel with scenes from the Genesis. TAP to know more
- Third Panel with scenes from the Genesis. TAP to know more



- South side. Giacomo da Ferrara and Paolo di Giacomo. Pulpit overlooking the Piazza. TAP to know more
- South side. The «Porta Regia». TAP to know more
- South side. Agostino di Antonio di Duccio. Four episodes from the life of St Geminianus. TAP to know more



Form mobile or wearable user generated content  
To suggest the Point of Interest by collaboration



SELECT YOUR SHOTS FROM YOUR VIDEO SEMANTIC MAP

Write your search here using name of labels of the three categories, connectors "and", "not", "or", and eventually names of points of interest

church and modena cathedral and attention or wandering or stop

SEARCH RESET

SHOTS ARE CLASSIFIED ACCORDING TO THE THREE MAIN CATEGORIES  
You can insert your video with drag and drop option selecting shots which better fit your preferences

Stop and Moves	Behavior Patterns	Points of Interest
Stop	Attention	Church Modena Cathedral [W]
Stop	Attention	Church Modena Cathedral [W]
Stop	Wandering	Church Modena Cathedral [W]
Stop		Church Modena Cathedral [W]
Stop		Church

Drag and Drop selected shots here

YOUR SELECTION ON THE MAP

YOUR PERSONALIZED VIDEO

MOVE YOUR VIDEO

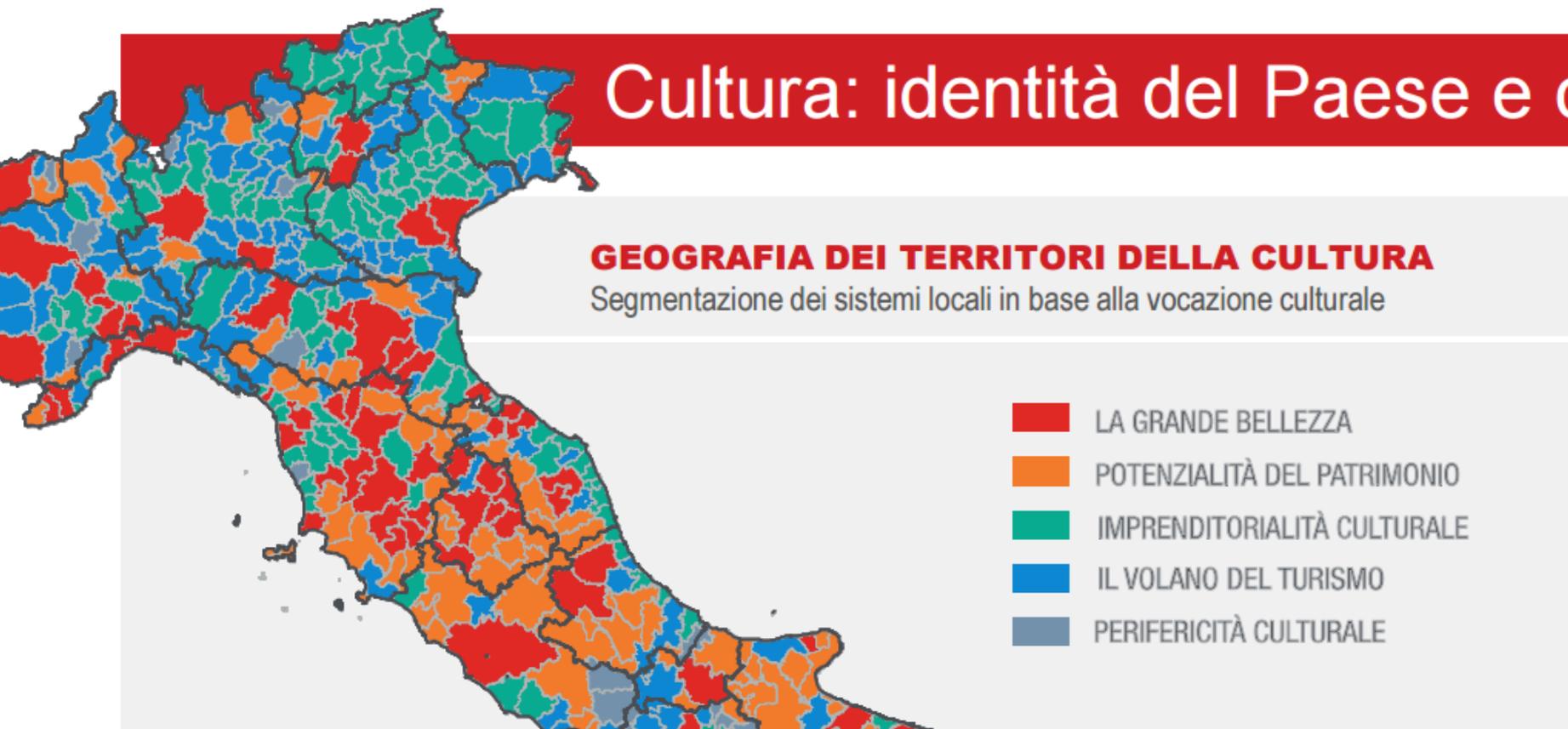


Form mobile or wearable user generated content  
To summarize single and collective experiences

# Ok good... and what should we do now?

- It is time to apply new IT results to CH
- It is time to change **the scale factor**
- It is time to **engineered solutions**

**RAPPORTO**  
**ANNUALE 2015**  
La situazione del Paese



Universities  
Research Centers  
Technopoles  
Labs..

The Cultural and  
Creative industries

*The next future..*

The public bodies  
The Cities  
The private CH sites

New human  
cultural  
experiences



Thanks.

Thanks to all Imagelab researchers.

Thanks to Pon DICET-INMOTU

Thanks to VAEX Fondazione Cassa di Risparmio di Modena

Thanks to project “Citta’ Educante” cluster Smart City and communities



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