

# Tecnologie per visite di siti e musei archeologici: opportunità e prospettive

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# IVU Lab







Interaction, Visualization, Usability and **U**ser eXperience

- HCI research group involved in research on

- Interaction Design
- Pervasive systems
- End-User Development
- Information Visualization
- Usability Engineering
- User Experience
- Serious games
- Internet of Things



- Multidisciplinary team, with different background (computer science, computer engineering, math, ...)

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# Explore!

## ■ Excursion-game

- Similar to a treasure hunt, played by groups of students
- Each group plays the role of Gaius, a Roman citizen who just arrived in Egnazia with his family and has to carry out some missions
  - Mission example: “You have to find a job for your son. Look for the Trajan Way where many coaches travel. Someone could need your son’s help to fix a coach wheel.”
- Each group receives two cell phones, a backpack with loudspeakers and the map of the park on paper

## ■ Easily adaptable to different sites



# Explore!: Virtual soundscape

## Contextual sounds at various locations

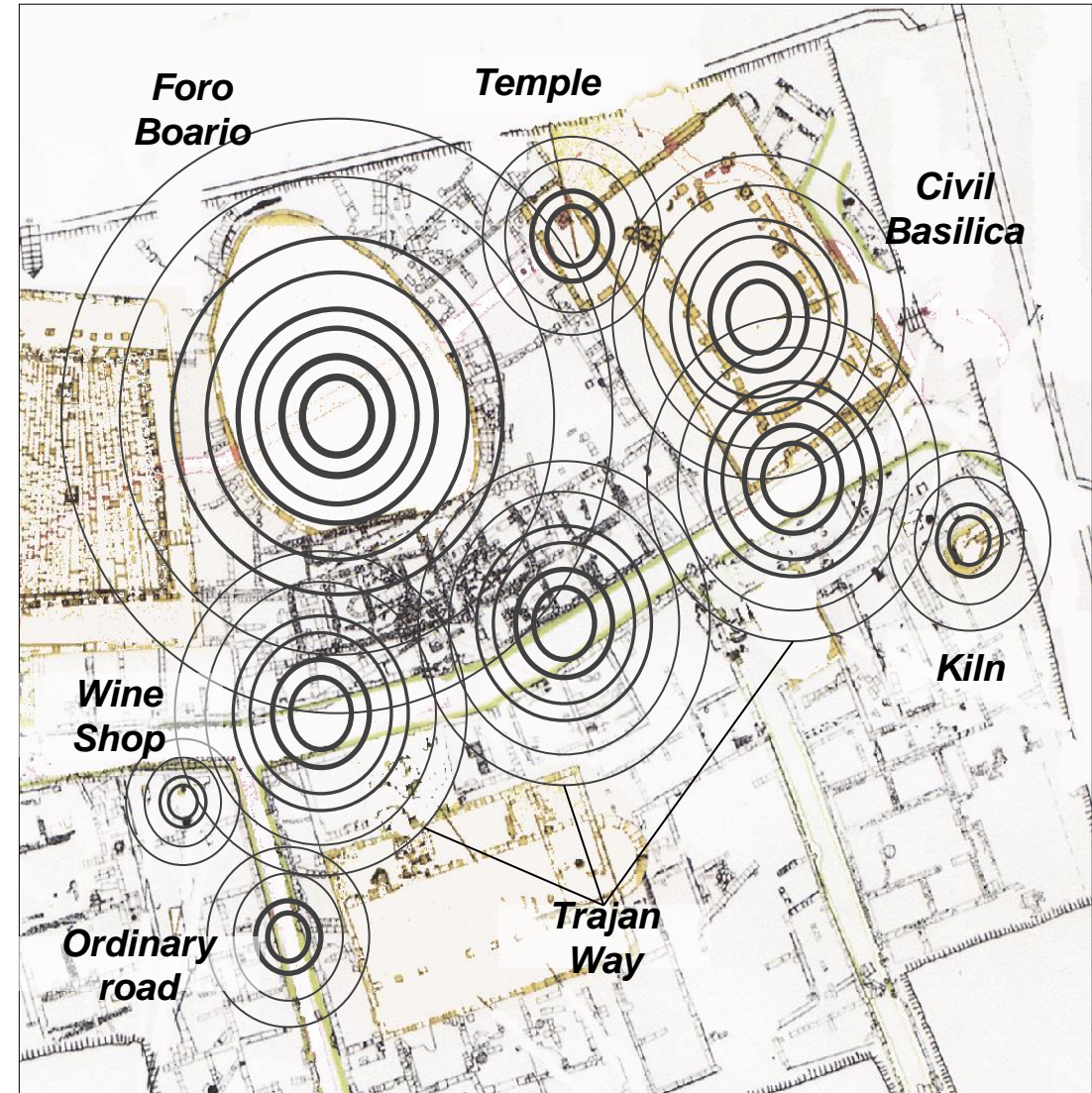
- cows lowing in the **Foro Boario** (the animal market)
- batons and discs played during ceremonies in the **Temple**
- noise of people in the **Civil Basilica**
- crackling fire near the **Kiln**
- carts running on the **Trajan Way**
- ...

## Attenuation depends on

- Distance from the virtual source
- Type of sound

## Cues for place identification

## Atmosphere of ancient times

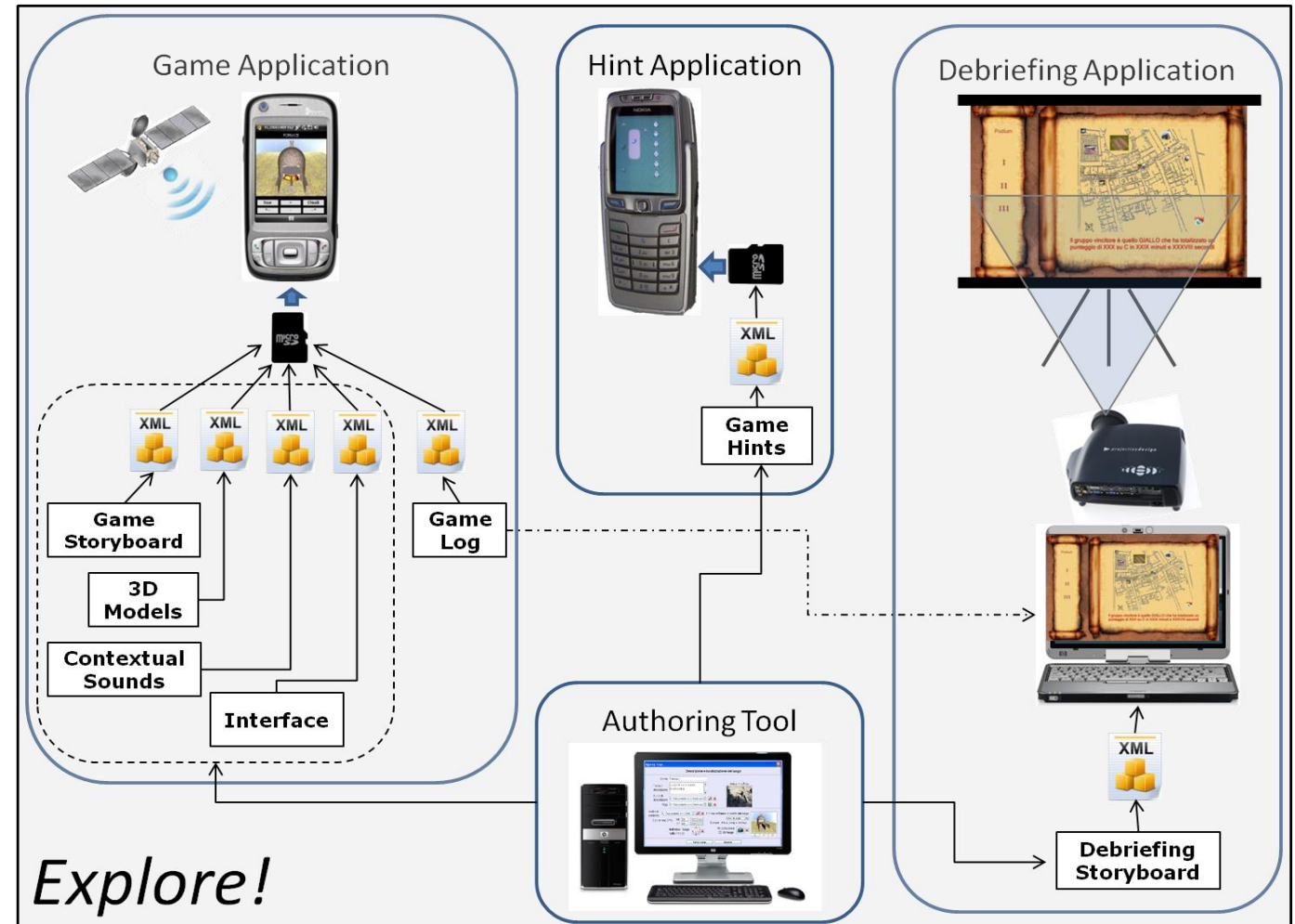


# Explore! architectural framework

Designed as a general framework to be adapted to different historical sites.

To be as device-independent and modular as possible, with a clear distinction between game content and game structure

Patent n. 1401512



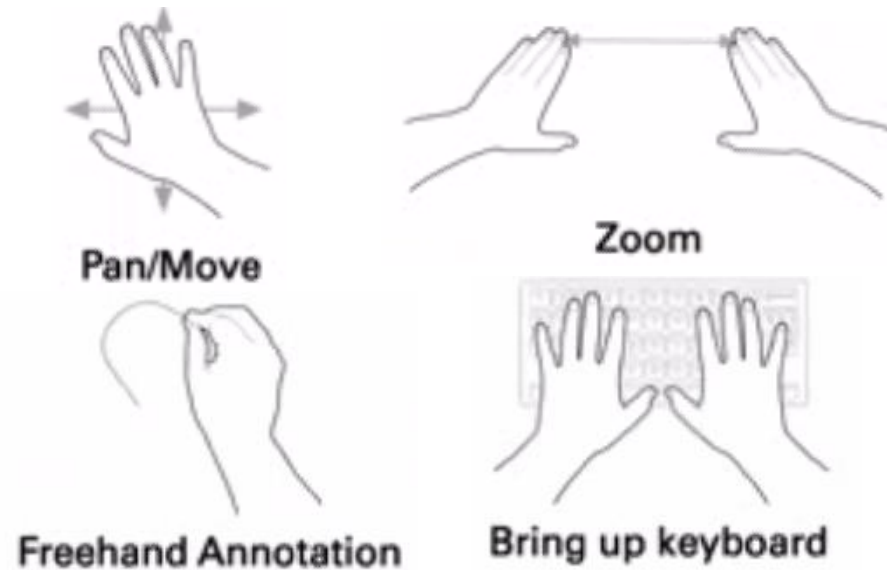


# Multitouch display



# Gesture-based interaction

- Gestures with fingers and hands are supported
- Many users can interact at the same time,
  - The maximum number is determined only by the display size



# TimeVoyager

- A game to test knowledge acquired by visitors of archaeological/historical museums at the end of their tours







Era del Ferro

Museo

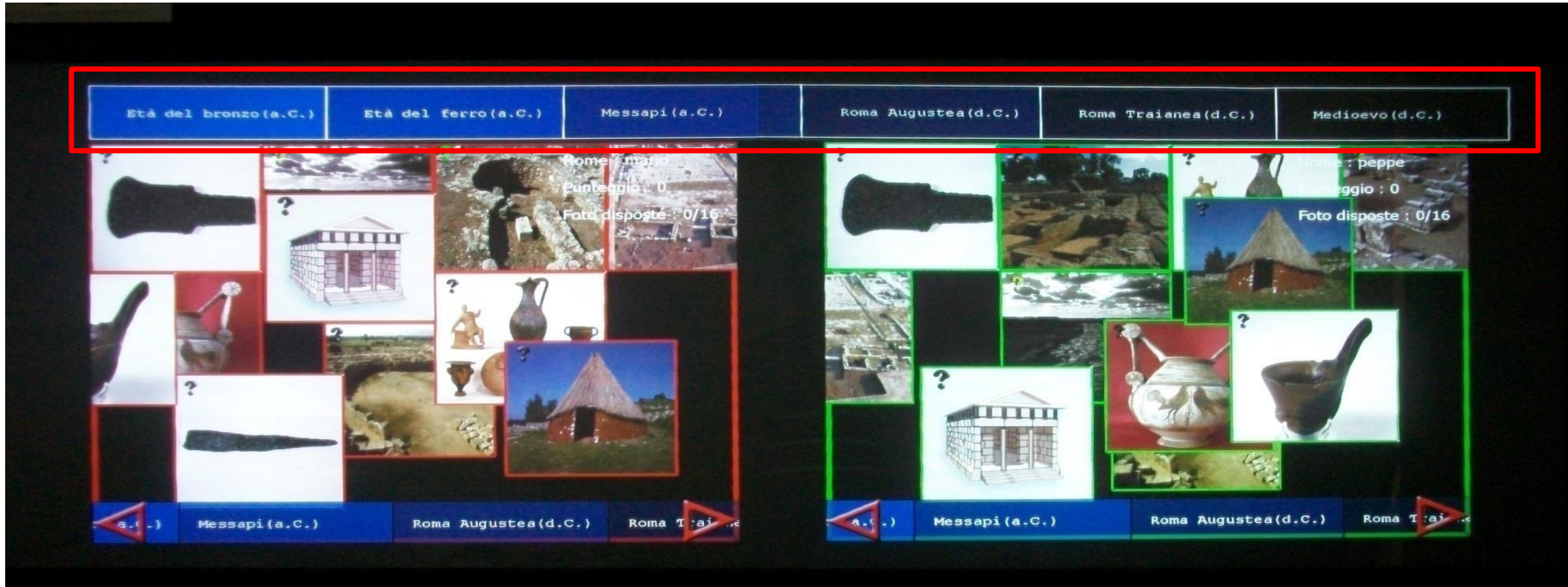


Il Museo di Storia

Il Museo di Storia

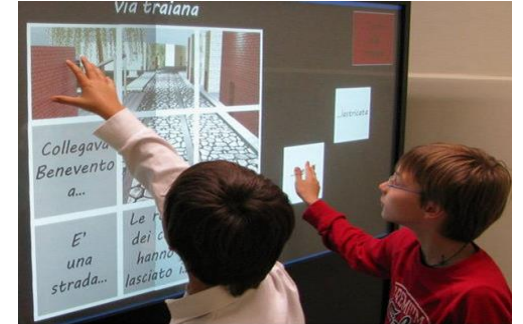
# Multiplayer

- Up to 10 players can interact with the 16-meters display



# History-Puzzle

■ It requires players to complete a set of puzzles related to the park they visited



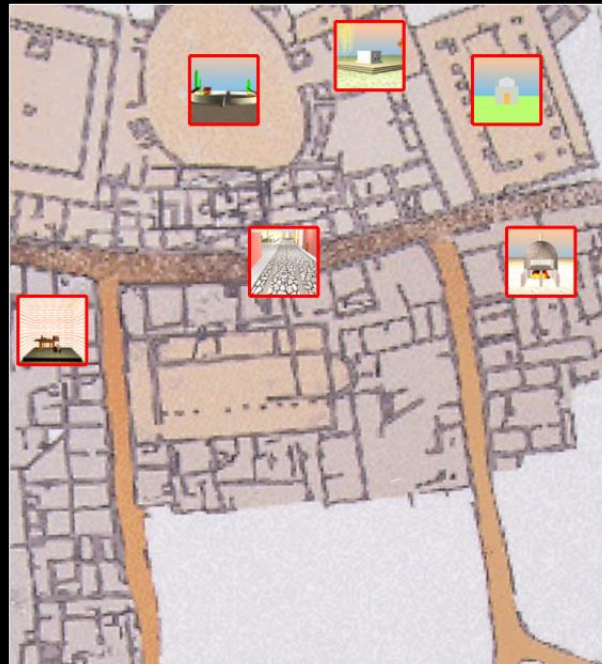
## Benvenuti

History-Puzzle è un divertente gioco per approfondire ciò che si è appreso durante la visita al parco di Egnazia ripercorrendo i principali punti del percorso.



BUON DIVERTIMENTO

## HISTORY-PUZZLE



## Come si gioca

Per iniziare a giocare tocca un punto sulla mappa e nella nuova schermata completa le frasi trascinando le parti finali su quelle iniziali.

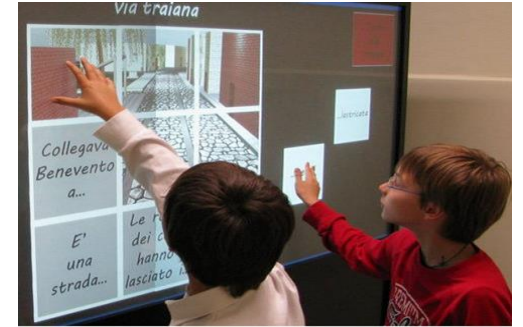
Se l'associazione è corretta verrà visualizzata una porzione del puzzle e guadagnerai 5 punti.

Se l'associazione non è corretta ti verranno sottratti 2 punti.


Quando avrai completato il puzzle vedrai una ricostruzione del luogo con cui hai giocato.

# History-Puzzle

■ It requires players to complete a set of puzzles related to the park they visited

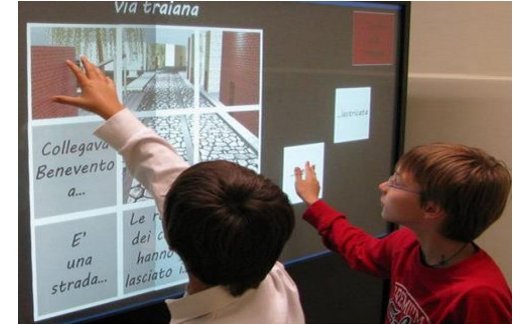


*fornace*

<i>...tomba antica</i>	<i>...combustione</i>	<i>E' costituita da una camera di...</i>	<i>Fu costruita su una...</i>	<i>La camera di combustione è preceduta da un...</i>	<i>...tre</i>
<i>...sacerdotessa</i>	<i>...corridoio</i>	<i>La parola messapica 'tabapa' significa...</i>	<i>E' un locale a pianta...</i>	<i>Ha un diametro di metri...</i>	<i>...terracotta</i>
	<i>...circolare</i>	<i>Serviva per la cottura di vasi di...</i>	<i>Le fornaci ad Egnazia erano...</i>	<i>E' vicino la via...</i>	<i>...principale</i>

# History-Puzzle

■ It requires players to complete a set of puzzles related to the park they visited



*fornace*

...combustione

E' costituita da una camera di...



Ha un diametro di metri...

E' vicino la via...

...principale

...sei



# History-Puzzle

*fornace*

*...combustione*

*E' costituita da una camera di...*



*Ha un diametro di metri...*

*E' vicino la via...*

*...principale*

*...sei*



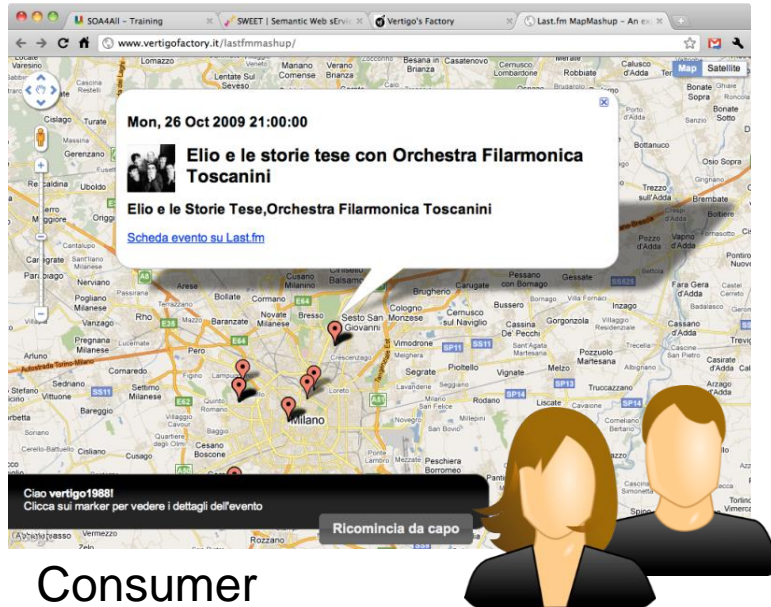




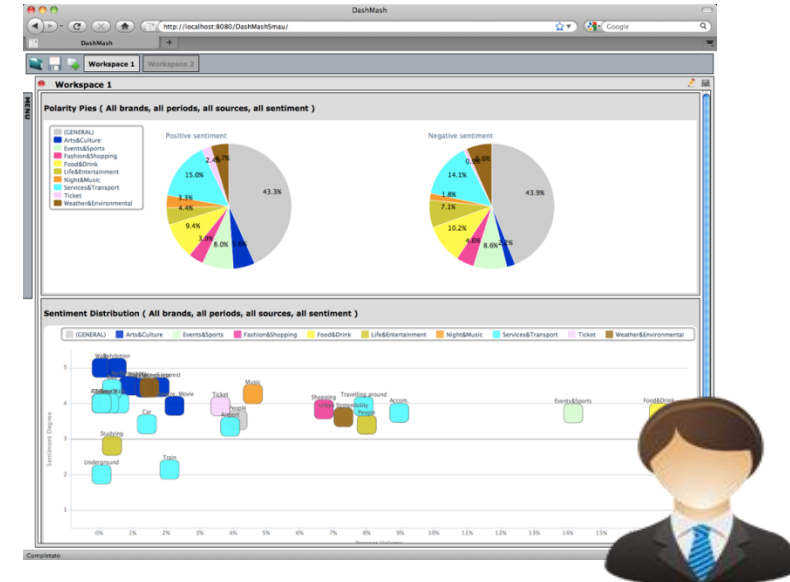


# Web mashups

*Online applications that use and combine data, presentation or functionality from two or more sources to create new services*



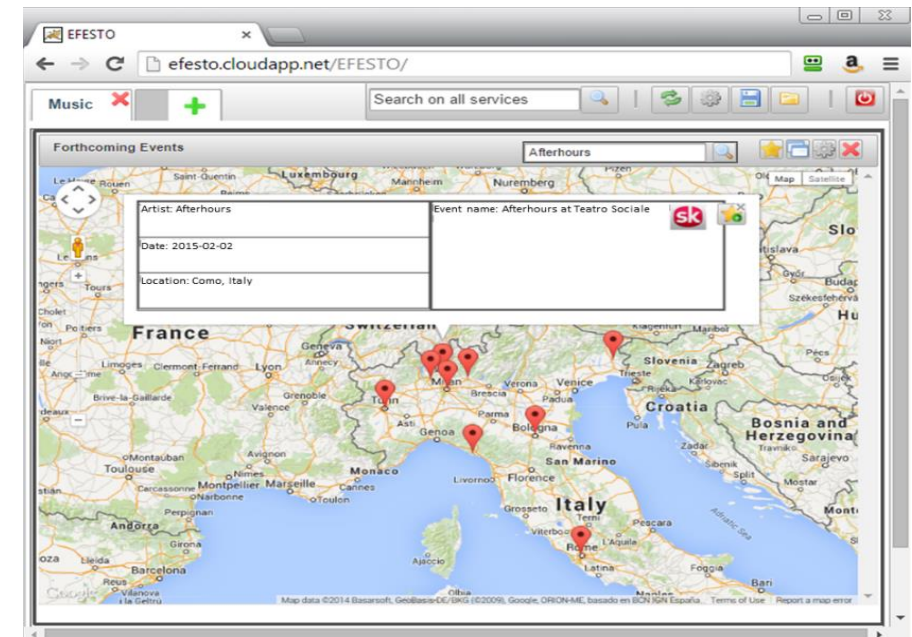
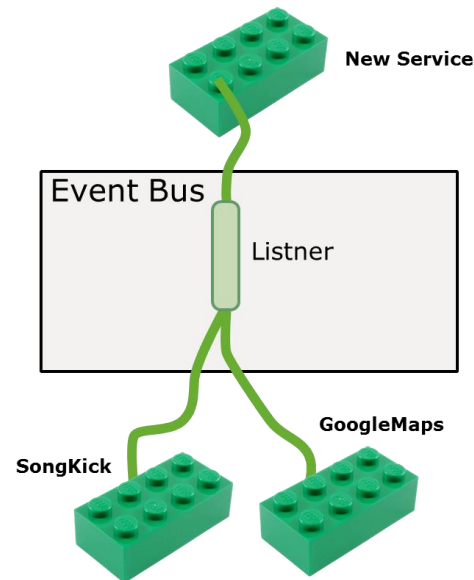
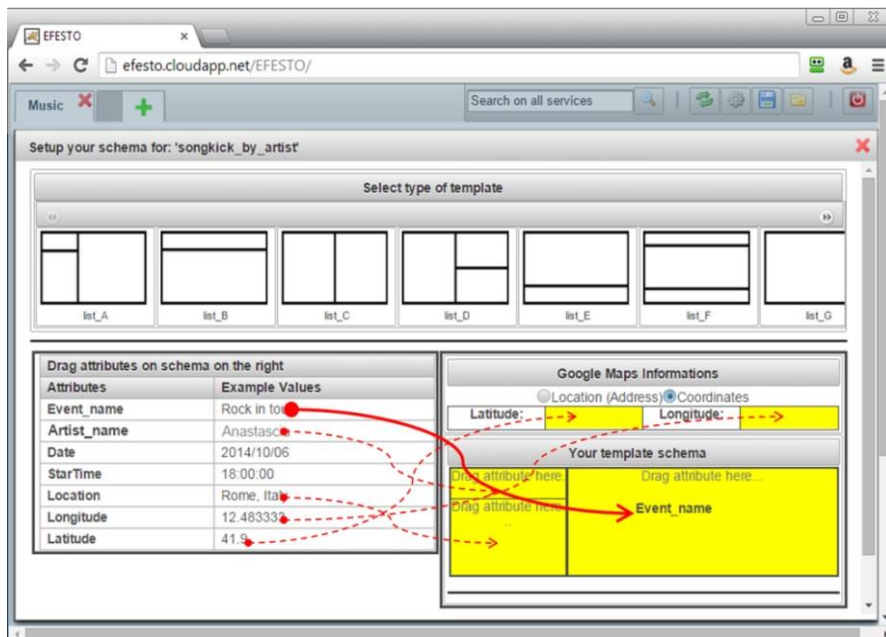
Consumer Mashups



Enterprise Mashups

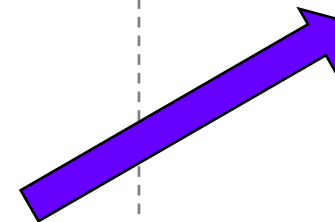
# EFESTO mashup platform

- A mashup platform characterized by
  - Abstraction from technical details
    - A platform speaking a language close to the users (functionality and terminology), possibly through **visual mechanisms**
  - Live programming
    - **Immediate visual feedback** → immediate mashup execution (no distinction between design-time and execution-time)

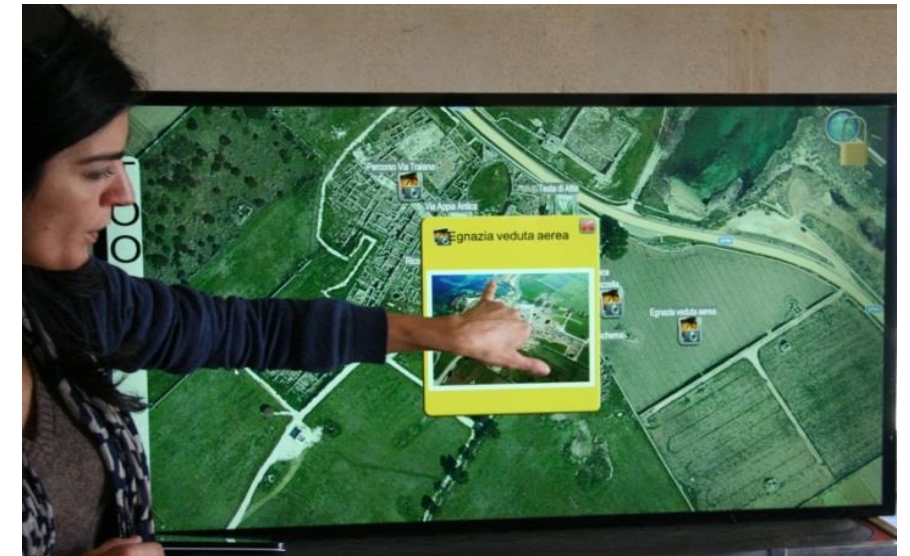
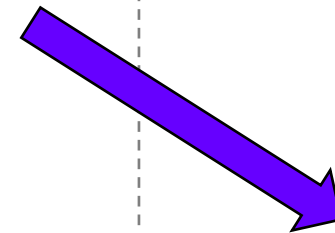


# Authoring tool to create multimedia content for interactive visits

Authoring tool to create interactive workspaces



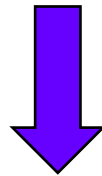
Workspace deployment



# Designing Smart Visit Experiences with IoT

# Motivation

- *Smart objects* can foster important changes in our lives as they are increasingly pervading the environments we live in
- Obstacles
  - Programming the behavior of smart objects is currently a prerogative reserved for professional developers
  - Smart objects expose very specific functionalities
    - it is not relevant to provide end users with very specific applications governing the behavior of single objects



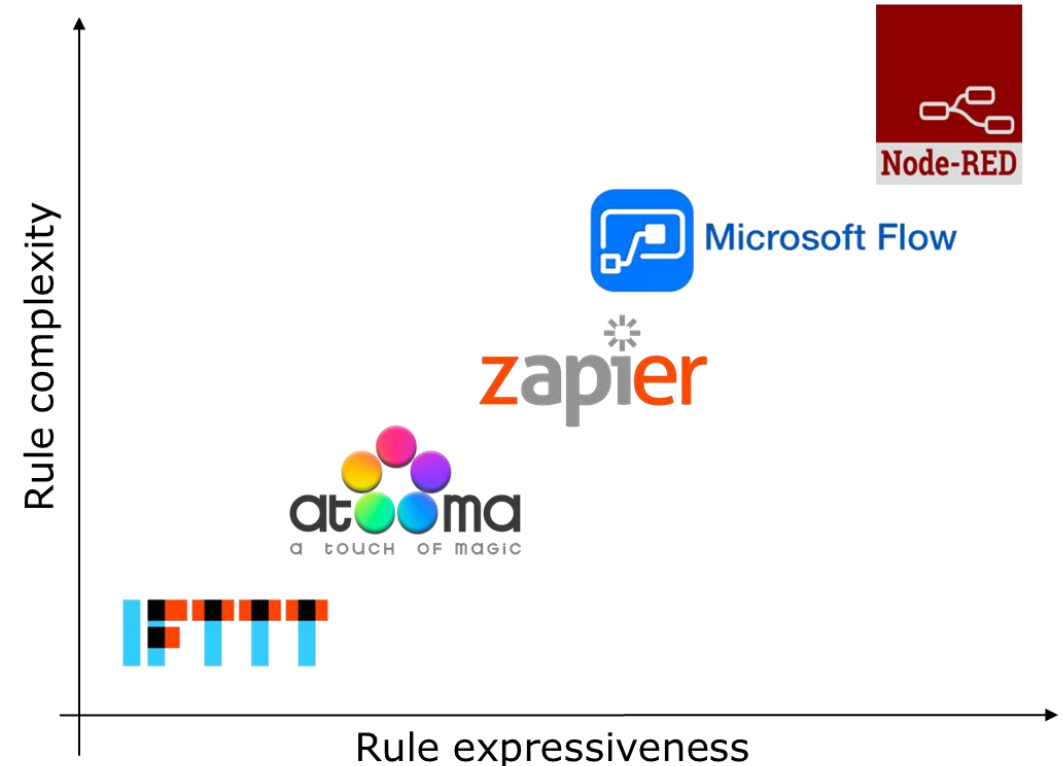
- Interaction paradigms to allow non-technical users to take advantage of *ecosystems of interoperable smart objects and services* by *flexibly* configuring their behavior

# Task Automation tools

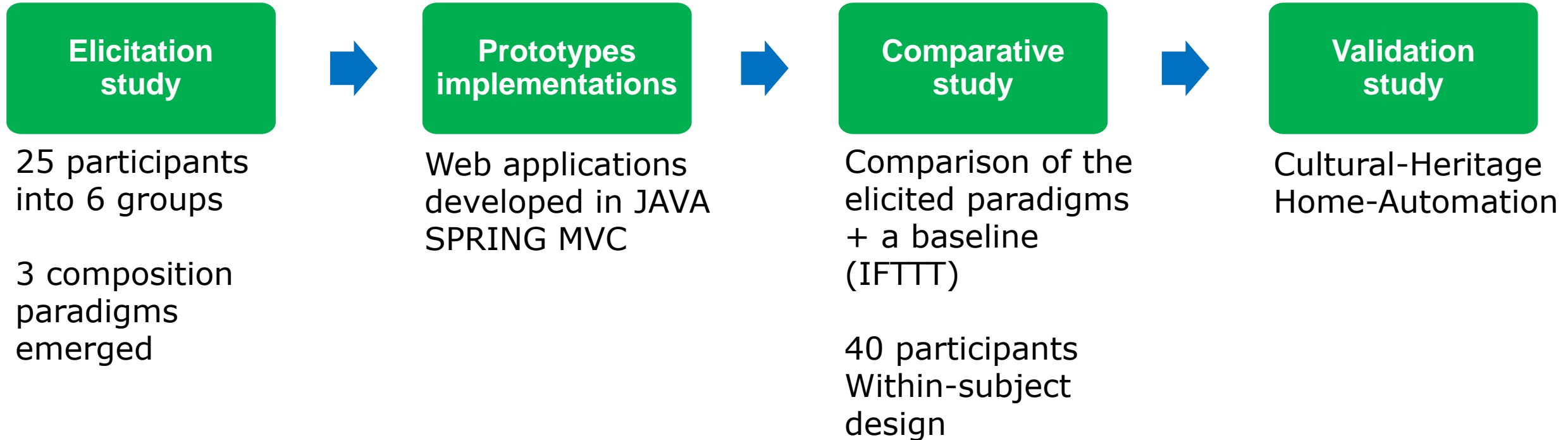
- *Task Automation* (TA) tools allow to combine social services, data sources and sensors
- Limitations of most of the tools
  - the expressive power of the Event-Condition-Action (ECA) rules is limited to very simple synchronized behaviors
  - graph-based notations are suitable for programmers
- Scarce adoption of the available tools especially by non-technical users



- *Usable paradigms* offering a trade-off between rule power and tool usability



# A Human-Centered design process



Detailed description of EFESTO 5W prototype, studies, results and design implications in:

Desolda G., Ardito C. and Matera M. (2017). Empowering end users to customize their smart environments: model, composition paradigms and domain-specific tools. *ACM Transactions on Computer-Human Interaction (TOCHI)* 24(2).





# From Smart Objects to Smart Experiences

- Different stakeholders would benefit from managing ecosystems of interoperable smart objects to create enhanced visit experiences
- For example, in CH sites smart objects may enhance access to CH collections, to ensure a more engaging visit experience and to increase the appropriation of CH content by visitors
- We propose an approach that, by means of a visual composition paradigm, allows non-programmers to define *smart environment (Smart Interactive Experiences)*

# An example scenario in the CH domain

- Andrea is a professional guide at a museum hosting an exhibition on the archaeological investigation process and used tools
- The exhibited documents and tools are equipped with NFC tags that visitors can scan to obtain additional information
- Andrea wants to create a game for pupils who visit the museum: pupils would be asked to identify the archaeologists' tools that respond to a specific characteristic, for example, those related to the excavation phase
- To play the game, each small group of pupils is provided with a smart lantern that is able to read by proximity the properties of a tool, for example, its usage phase. Pupils receive quests by the guide, e.g.: *Find tools whose "Usage phase = excavation"*
- Walking in the museum room, players bring the lantern close to the tools they think correspond to the guide's quest. When they approach the right tool, an audio file is played on the smart lantern describing the main characteristics of the tool. The player gets points as a reward



# Limits of TAS in creating Smart Interactive Experiences

- In the Andrea museums many smart objects might be installed



Lamp1



Lamp2



Lamp3



Lamp4



Lamp5



Lamp6



Lamp7



Lamp8 ... LampN



Pick1

Pick2

Pick3



Book1

Book2

Book3



Trowel1

Trowel2

Trowel3



Shovel1 .... tool1

Shovel2 .... tool2

Shovel3 .... tool3

# Limits of TAS in creating Smart Interactive Experiences

- In the Andrea museums many smart objects might be installed
- For each combination between smart objects would be created

“IF the *lantern\_012* is put close to the NFC=6554 AND the quest is *Usage\_phase = excavation* THEN the *lantern\_012* plays the soundtrack <audio01.mp3>”.

- This rule would be replicated for each tool and for each lantern
- In case of N lanterns, M tools, a total of NxM rules are needed

# Custom Attributes

- For each smart object, the CH expert defines properties (attributes of the object) that can express the semantics and the role of an object according to the visit dynamics
  - If the exhibition is about the tools used by archaeologists, possible attributes can be
    - “Usage Phase” (with values: *source collection*, *excavation*, and *stratigraphic reconstruction*)
    - “Usage Place” (with values: *digging place*, *library*, etc.) to indicate the place where the tool is used
    - “Audio” (with values indicating *names of audio files*) to specify the audio to be played
    - ...

Usage Phase: *excavation*  
Usage Place: *digging place*  
Audio: *pick description*  
Points: 3



Usage Phase: *source collection*  
Usage Place: *library*  
Audio: *book description*  
Points: 1



**Custom Attributes**, since are defined depending on the SIE designer’s goal, without any constraint (syntactic or semantics) on the type of properties to be specified

# Custom Attribute Advantages

- Having defined custom attributes, Andrea specifies the ECA rules controlling the behaviors of the smart objects

- ECA rules are defined through a visual interface (avoiding technical languages)
- More formally, a rule is:

*Rule<sub>i</sub>*: “IF a *lantern* is close to a *tool* WHERE *tool.Usage\_Phase* = *quest.Usage\_Phase*  
THEN *lantern* plays the *tool.audio\_file*”

- ↑ The variables used in the rules are exactly the custom attributes previously defined by Andrea

- ↑ Custom attributes introduce abstractions that favor generalization

- Without custom attributes, several rules would be defined for each device, such as

“IF the *lantern\_012* is put close to the *NFC=6554* AND the *quest* is *Usage\_phase = excavation* THEN the *lantern\_012* plays the soundtrack <audio01.mp3>”.

- This rule would be replicated for each tool and for each lantern

- ↑ The single *Rule<sub>i</sub>* addresses an entire class of devices with the same behavior

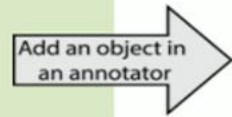
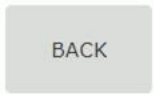
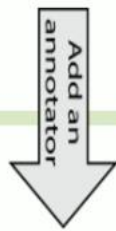


**Rfid Reader**

- Amphora 1
- Amphora 2
- Coin 1
- Coin 2
- Musical tool 1
- Musical tool 2
- Vase 1
- Vase 2

RFID  
Rfid Reader

Add new Rfid Reader object



Ardito C., Buono P., Desolda G., Matera M., (2018). From smart objects to smart experiences: An end-user development approach. *International Journal of Human-Computer Studies*, 114, 51-68

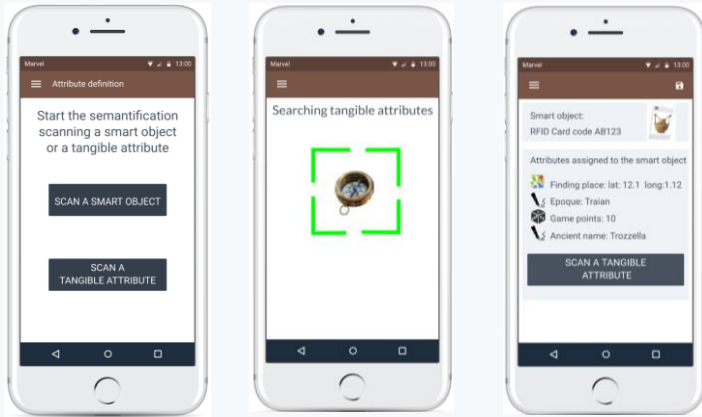
# Fostering creativity in the design process

- Both these activities, attributes creation and rule definition, represent the design process of smart environments
- One of the most important ingredient of the design is the *creativity*
- The previous tools support the design of Smart Environments but they do not take into account creativity
- Can we support the *creative design*?
- We decided to revise the creation of custom attributes, which represent the most important one in the entire process



# Natural Interaction Paradigms to Design Smart Environments

## Tangible



- Real objects are sources for different types of attributes
- With a mobile device, users scan the objects and then select the object attributes that are useful for the smart visit design
- Each time a physical attribute is scanned, a pop-up appears on the mobile device to define the attribute details by writing its name and value

## Pervasive



- The surrounding environment is conceived as a set of passive objects with their attributes
- Users exploit a smartphone to explore the surrounding environment in an augmented reality fashion to collect useful attributes
- Users can scan a smart object to paste the collected attributes

## Tactile



- A tabletop surface is used to facilitate the association between attributes and smart objects
- The attributes are represented as tangible objects
- When a smart object is placed on the surface, a proximity area appears around it
- Physical attributes can be assigned to the smart object by placing the relative tangible object in the proximity area

