How the AR can help to appreciate the hidden value of pictorial masterpiece

Venice's Gallerie dell'Accademia Case History

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Abstract: This paper will describe the mobile App designed and developed by ETT S.p.A. ICT Company for the new wing of the Gallerie dell'Accademia Museum in Venice (Italy), recently opened to the public. The Mobile App is a real video guide, which integrates the BLE (the Bluetooth Low Energy) technology with Augmented Reality solutions to retrieve geolocation information from transmitters Beacons, and automatically shows the gallery of the works in the room in which the visitor is located. Designed for different types of users (Children, Teenagers, Adults), it helps to investigate aspects and details of the works that cannot be perceived naturally, in order to make the visit to the Gallery more interesting also to children and young people who can learn the history of the structure and the works while having fun. The app contains features, such as thematic routes and augmented reality contents, through which visitors can see what emerged during restoration work, or view the artworks in three-dimensional mode, in addition to enjoy videos with in-depth information, available for some of the artworks, and gaming features. Augmented reality features were developed using image recognition techniques that allow the visitor to recognize the works by using the camera of the mobile device. A precise tracking of all the works in the structure was made, in order to allow the application to draw information from a local dictionary, no need for internet connection. Thanks to the AR solutions integrated with the Beacons, the visitor is able to access the information more quickly and better understand the value of the masterpieces exposed in the Gallery.

Keywords: Augmented reality, mobile app, Bluetooth Low Energy, Beacons

Introduction

The application of technology and innovative devices for the enhancement of cultural heritage and artworks is a topic of great interest in the world of culture and research. Thanks to the use of technological solutions to share and spread the knowledge of artworks and territories, cultural enjoyment becomes a new kind of experience, both involving and immersive.

The development of technology offers a new way of looking at architectural spaces and museum collections, adding a "virtual dimension" that goes beyond the limits of reality.

According to *The Virtual Museum of The Learning Museum Network Project* [1,2], (prof. Massimo Negri) some of the main functions that a virtual museum can specifically fulfil, deal with:

- Active role of users in building their own collections
- Visual archives of past temporary exhibitions
- RSS: following history in the making

- The possibility to compare digital objects of the most divers physical natures
- Enrichment of the user experience: closer access to masterpieces…but at a distance (Google Art), augmented reality, 3D modelling….

In recent decades, the influence of the last point, in particular, has led from the idea of a collection-oriented museum to that of a visitor-oriented one, in which the relationship between the exhibition and the individuals goes beyond the time of the visit.

Today, many institutions, museums and libraries, feel the need to innovate, making works of art usually reserved for a niche audience more interesting and captivating. Although these places are particularly suitable for processes of learning and acquiring new knowledge, the concept of "museum" is even today often associated with something boring and old. Nevertheless, new Technologies can help change this way of thinking and can be used to build new types of educational activities aiming at regaining a wider audience; no longer passive but active and participatory.

This concept promotes "knowledge through action" and "recognition by touching", to create synergy with gallery artwork and environments, in order to allow each age and social group to relate to the immersive visitor experience in a dynamic and personalized way.

The quality of content is equally important; it must be adapted to satisfy every type of user. The choice, guided by the museum curators, has been made to allow diversified levels of reading, from the general to the particular. The visitor can find information about museum exhibition design as well as on single artworks, described with many degrees of in-depth (description / datasheet / artist's biography/ bibliography) useful for both tourists and academics.

New technology solutions and endless possibilities to satisfy curiosity with high quality contents leads to positive visitor feedback and to an increase in the number of visitors.

As a private company specialised in multimedia exhibits, ETT has the opportunity and the good fortune to manage projects involving the use of advanced virtual technologies.

ETT's approach to Museum exhibition design

As mentioned above, the introduction of new technologies in the cultural sphere has led to a continuous evolution of the concept of Museum and of fruition of the artistic and cultural heritage, which have become interactive and increasingly digital.

In addition, the very role of the visitor has changed and, from passive observer, has become "visit-actor", able to choose the museum path in a personalized way. The enhancement of the visitor experience is, therefore, the central point on which ETT has focused its development activities.

The new trend in museum design is based on the use of the most recent and sophisticated technologies that are able to improve visitor experience by creating immersive and interactive experiences.

The application of new technologies and devices to this new concept of museum exhibitions aims at:

- Enhancing visitor interaction and engagement
- Letting visitors become "visit-actors", with an active role to play throughout the exhibition path
- Absorbing the visitor into the museum storyline by creating and "immersive" environment

Thanks to its design capacity and to the innovative and managerial approach, ETT has been able to create Museums and exhibits, in which the virtuous combination of the most modern set design guidelines, latest technologies and the emerging trends of museum storytelling, allows the creation of involving and multi-sensory experiences to learn about different themes.
Both ETT's technological expertise and its knowledge integration capacity allow proposing effective solutions to organize the right messages within exhibition areas, using a mixed and multidisciplinary approach consisting of top-down storytelling and bottom-up technology selection and design.
For the achievement of these goals, ETT can rely on a team of professionals with multidisciplinary expertise and different types of knowledge that combine creativity, museology and research and development.

New technical solutions for the art enjoyment of a wider audience

The enjoyment of art can become more accessible and understandable thanks to the use of new applications and technical solutions that allow a wider audience of different ages and social backgrounds to get involved in the museum path according to their personal interests. The Gallerie dell'Accademia Museum represents an example of this new approach to art and culture.

Fig. 1 – A room in the new *Gallerie dell'Accademia* wing

The Gallerie dell'Accademia Museum

Located in a building dating back to 1343, the Gallerie dell'Accademia is a museum gallery featuring a collection of masterpieces of Venetian painting of the seventeenth and eighteenth centuries in the heart of Venice.

Thanks to the contribution of Samsung in collaboration with Venetian Heritage Foundation, five new rooms re-opened to the public, enriched with various electronic devices and a smart classroom for an innovative teaching approach.
ETT developed all the software applications installed on the devices, which consist of several exhibit touch screens located in the new wing of the museum and a mobile application integrated with each other to create a real multimedia journey through Venetian art.

Entrance

At the entrance, six touch monitors 32" welcome visitors and allow them to access information on the five new rooms.
A message of the director James Ivory starts by touching the monitor and welcomes visitors and introduces them to the exhibit. The visitor can view the works on display in the new five rooms and get in-depth information about them. Besides, it is possible to see the thematic routes defined within the museum and to view the previous locations of the works in the city of Venice. The favorite routes can also be downloaded on visitors' mobile devices. Visitors, moreover, have the opportunity to express their preference about each work by sharing it on social networks (for privacy reasons only from personal devices).

Fig. 2 – The Touch screens at the Entrance

The Grandi Gallerie

In the three exhibition halls of the **Great Galleries two touch monitors** help visitors understand the theme of the room and the individual works in it.
The first monitor is a **static device** that describes what is in the room, using an unobtrusive graphic that does not distract the visitor from the works on display.

The second is an **interactive device** that allows users to view some of the artworks and to access to further information. The image of the single painting is resizable to see it in detail.
The contents of both monitors are proposed by default in Italian with the possibility to change the language.

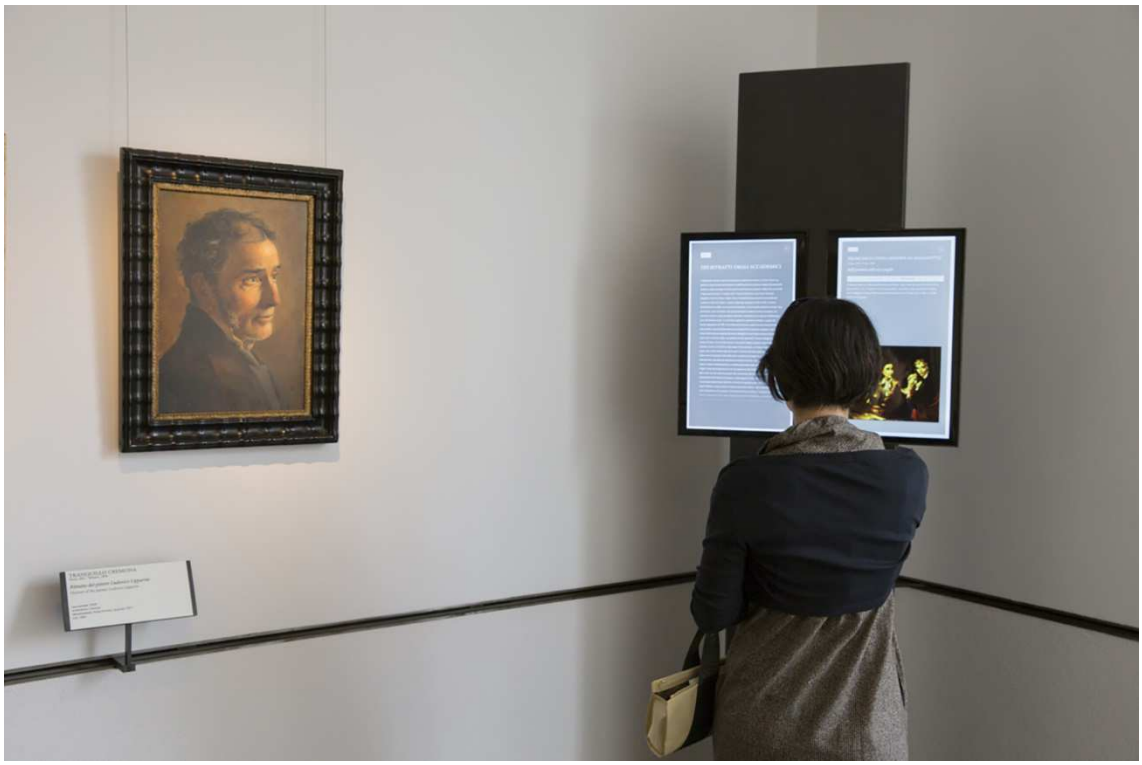

Fig. 3 – The Touch screen application in *The Grandi Gallerie*

Inside Room 4, a **video wall** consisting of 9 elements displays a **virtual tour** describing the evolution of the *Accademia* structures in different centuries.

Fig. 4 – The Video wall in Room 4

Mobile App

The Mobile App is a real video guide, developed for both iOS and Android platforms and can be either enjoyed on the museum rentable tablets or downloaded on the visitors' own devices.

It integrates the **BLE** (the Bluetooth Low Energy) technology with **Augmented Reality** solutions to retrieve geolocation information from transmitters Beacons, and automatically shows the gallery of the works in the room in which the visitor is located. In this way, the visitor is able to access the information more quickly, avoiding searches through the application menu.

In order to improve the speed of information retrieval and use of content, an interaction was developed between the mobile device and the touch positions in the Welcome area of the museum. In particular, after selecting a path in the touch application, visitors can instantly reach the same path using the QR Code made available from the mobile app, simply by pointing the camera at the QR code on the touch screen.

The App helps to investigate aspects and details of the works that cannot be perceived naturally and, being designed for different types of users (Children, Teenagers and Adults), is able to make the visit to the Gallery more interesting also to children and young people who can learn the different themes proposed while having fun.

Fig. 5 – The Mobile App for young visitors

In the sections dedicated to Children (5-10 years) and Teenagers (10-16 years) a series of games will accompany visitors on a guided tour in the three rooms.
The games among which visitors can choose are:

Memory: The classic memory game where users need to find pairs of the same work images in a 3x4 grid. With each new game, the cards are placed randomly.

Puzzle: A puzzle game where young users will have to reconstruct an image, chosen between 4 works available, by simply moving the pieces arranged randomly on the screen. Different difficulty levels are available.

Treasure Hunt: In this game, a clue is offered for each room and the visitor will have to choose the corresponding work between the three proposed on the device screen. For each new game, the location of the works changes randomly.

Find the differences: for each room, visitors are proposed two images of works seemingly identical, and will have to discover five hidden differences.

Adults will find features, such as, thematic routes and augmented reality contents through which they will be able to see what emerged during restoration work, or view the artworks in a three-dimensional mode.
For some of the works also videos with in-depth information will be available.
Moreover, adult visitors will be able to play the Memory, Treasure Hunt and Find the differences games in a more complex and dynamic way.

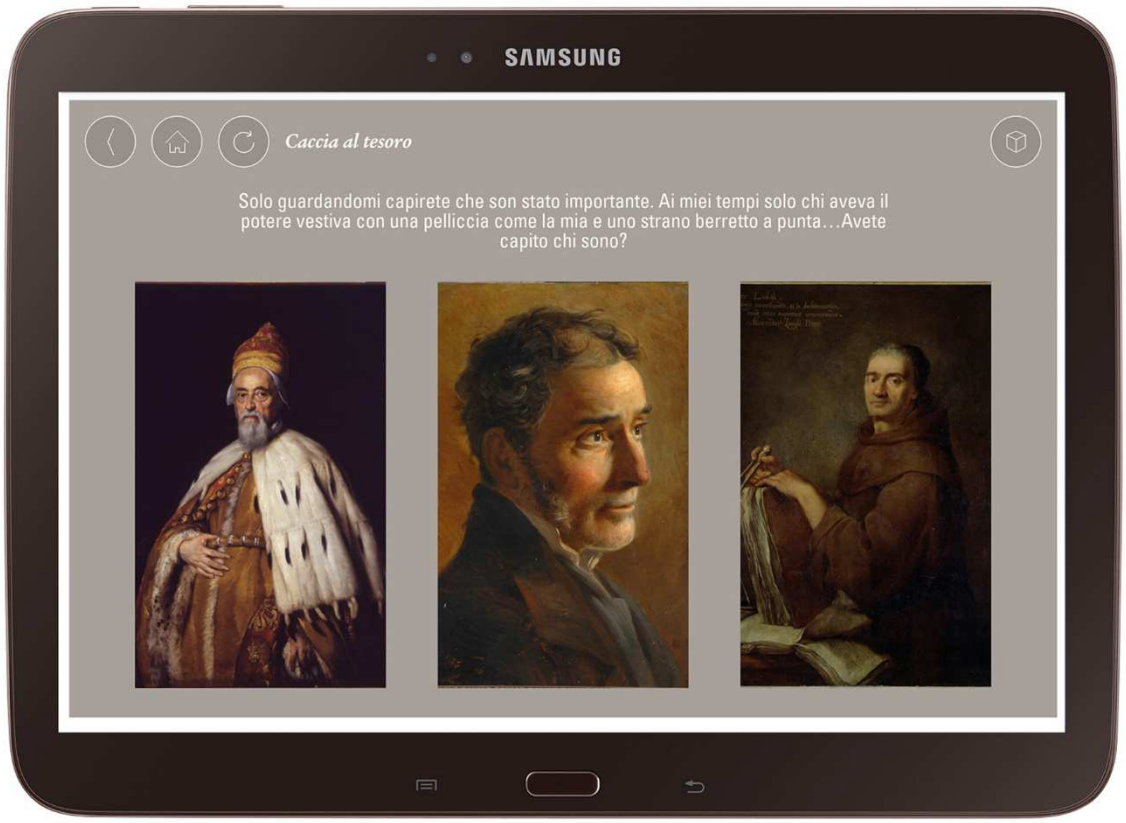

Fig. 6 – Example of mobile app gaming feature: Treasure Hunt

In the *Treasure Hunt* game, indeed, only the clue to the work of the selected room will be proposed on the screen of the device: to complete the research, the visitor will receive immediate feedback by framing the picture with the camera. In *Find the differences*, instead, the device will show only the non-original work image, thus asking the visitor to compare it with the real painting to find out the differences. In order to stimulate the educational aspects of the *Memory* game, in the end, the visitor will be asked to find associations between the work and its author.

Fig. 7 – The Augmented reality mobile app

The development of the Augmented Reality features was based on the use of image recognition techniques that allow the visitor to recognize the works by using the camera of the mobile device. All the 48 works were precisely tracked, in order to allow the application to draw information from a local dictionary, no need for internet connection during use. The 3D reconstructions displayed in some of the cards have been inserted using Unity3D scenes, properly integrated to the native code of the application.
Visitors, moreover, have the opportunity to view the status of conservation of some works before restoration, thanks to the use of image recognition features. Focusing the work with the camera of the device, they will be able to "scratch" with their fingers on the screen to erase the effect of the restoration and display the work in its original state.

Technical characteristic
Both the Application versions are made using native language, Objective-C for the Apple platform and Java for Android.
The sources were supplemented with Unity3D scenes for easy manipulation of 3D objects and a library for image recognition based on the mapping of 2D images and a dot matrix suitably coded and stored in the device memory.
In order to ensure optimum performance, the management of the camera is performed using native framework of both platforms. The code was compiled 64bit to take full advantage of the hardware features of the latest generation of mobile devices while maintaining backward compatibility with 32-bit hardware.
For updating content, the app connects to a remote CMS submitting data through the exchange of files of type JSON and HTTP calls. All contents are downloaded in a SQLite database inside the app, to allow the use

offline. This type of communication allows you to manage content for all applications (iOS, Android, touch applications) without having to create a dedicated software module to each of the platforms.

Results

The new wing of the museum and all exhibits were opened to the public on May 9TH 2015
Thirty Samsung Tablets (Galaxy Note 10.1) with the Museum pre-installed application were available for renting for the first three months: every day all of them were used by visitors.
The number of the Mobile App downloads, as far as the first half of January was, 196 for Android and 171 for iOS.
Over the years, technical support and content update are guaranteed for pre-installed and Mobile applications.
From the first days of use, different targets of visitors of all ages have been involved in the visit and have greatly appreciated the chances offered by new ICT tools and the opportunity to deepen the content and to learn through gaming.
A better evaluation of the effectiveness of the solutions implemented will be carried out during the coming months.

Lessons to be learnt by the project

The *Gallerie dell'Accademia* project gives a new opportunity to experiment the effectiveness of New Technologies in conveying cultural messages and in appreciating pictorial masterpieces.
With the integration of different technologies (touch screens, mobile app, video wall, BLE) ETT managed to offer personalized pathways of visit, adapted to different age groups and interests.
The proposal developed by ETT in the *Gallerie dell'Accademia* in Venice is different from many of the common solutions applied in museums for the multiplicity input offering. Not everyone has the same kind of intelligence nor the same kind of interests, so it is important to decline contents in differentiated ways (audio, video, text, graphics ...).
Compared to solutions based on a single input, such as audio or video guides, today in many great museums (ex. Uffizi, Vatican Museum, the Prado Museum, the Louvre, the British Museum etc.), mobile applications are emerging for their ductility and ease of use.
The comparison with some museum applications recently presented in the Italian context showed the originality of ETT solution in many respects:
- Intuitive logical structure that enables visitors to orient themselves in the collections and choose their personal tour route (rooms/ artistic tendency/ chronology/ place of provenance of artworks/ main artworks); while many solutions include unique paths with only the main artworks.
- Rich content with different levels of in-depth unlike many applications that have simplified texts, not able to satisfy the curiosity of different target audiences
- The Gallerie dell'Accedemia application differs from the new applications produced in Italy using beacons technology (ex. The Museo dell'Opera del Duomo in Florence, Palazzo Farnese in Piacenza) with regard to the number of mediums used in the museum (touch screens, Mobile app, video wall, BLE), which offers everyone the opportunity to deepen content.

-The app contains augmented reality contents, through which visitors can see what emerged during restoration work, or view the artworks in three-dimensional mode.
- Gaming sections dedicated to Children (5-10 years) and Teenagers (10-16 years).
Education through Entertainment (Edutainment) is one of the best ways to learn and it can be greatly helped by the use of innovative devices and technologies.

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