

# CLICK TEATRO Project: Augmented Reality and Promotion of Theater Events

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**Abstract.** This work describes the activity related to the field of Augmented Reality (AR) developed in the “Integrated Multimedia Assets to promote TheaTrical” (CLICK TEATRO) living lab project.

The “Integrated Multimedia Assets to promote TheaTrical” project realizes a system addressed to the citizens in order to create a link between theater activities and commercial operators. Through the use of an App for Smartphone, the user will receive content related to the show (additional content, interviews, etc.) and service associated (restaurants, car parks, hotels, bar, etc.). This information will be generated and managed by means of Augmented Reality tools.

Finally, the involved activities will enter in a virtuous circle, in fact the user will gain discount bonus to be used for purchasing other tickets.. The app has been developed for iOS systems.

**Keywords:** Augmented reality · Image matching · AR code · AR marker · AR markerless · Living lab

## 1 Introduction

The Living Lab (LL) project modality has been introduced by Mitchell [1] [2], it represents a user-centric approach for conceiving, prototyping, validating and refining complex solutions in real life contexts. In the European Union the LL strategy has a specific network called ENoLL [3] which was founded in November 2006. The EU intends the LL as a “real-life test and experimentation environment where users and producers co-create innovations”. Many LL Project have been funded [4] [5] to cover the areas of interest such as smart cities.

In Italy there are many different activities of LL [13]: a relevant role is played by the Apulia Region which, through its in house consultancy company, InnovaPuglia, has launched different calls for proposal known as “Apulian ICT Living Labs” [6]. The calls are constituted by two steps: in the first one enterprises, research centers, academies and public organizations are invited to submit needs that can be met with a LL project, successively (second steps) project proposals are presented to satisfy the previous needs.

Based on Apulian ICT Living Labs paradigm, CLICK TEATRO initiative responds to a “user need” expressed by the Teatro Pubblico Pugliese (TPP) [7], which

promotes the dissemination and promotion of the performing arts also working as a promoter of the fund. This activity is important to contact all stakeholders, from the spectator theater to the actor, the manager of business activities related to the tourist on the region. The aim is to investigate and test new tools of advertising.

This paper is organized as follows: Section 2 presents an overview on the Augmented Reality. CLICK TEATRO Project and its application are, respectively, in Section 3 and 4. Section 5 reports an evaluation of system's usability and Section 6 the conclusion.

## 2 Augmented Reality: An Overview

Technologies based on Augmented Reality (AR) enhance our perception and help us to see, hear, and feel our environments in new and enriched ways. AR supports us in fields such as education, maintenance, design and reconnaissance, to name but a few.

On the reality-virtuality continuum by Milgram and Kishino [8] [9], AR is a part of the general area of mixed reality.

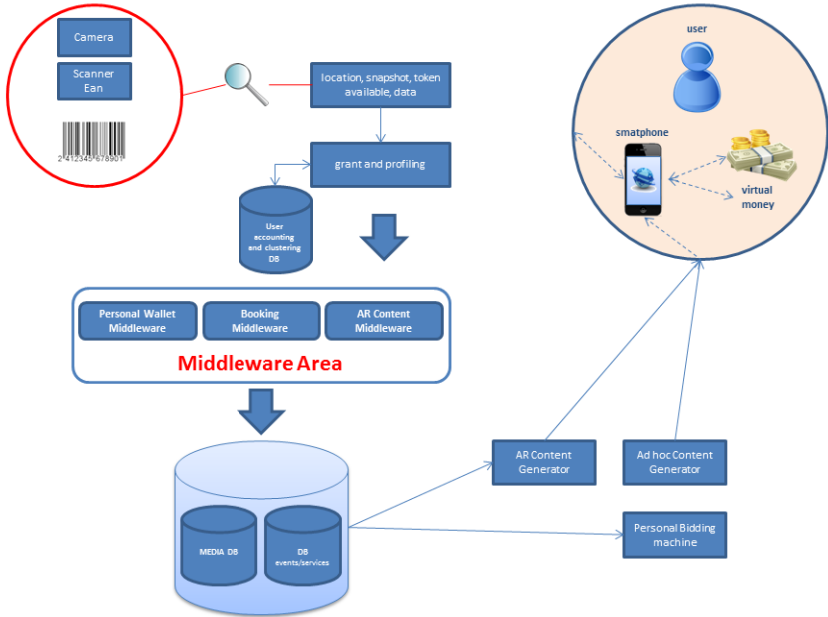
The difference between augmented reality and virtual environment is that augmented reality adds virtual objects in real time to a real environment. This tool has a great emotional impact finding application in various areas also very different from each other.

An AR system [10] [11] [12] combines real and virtual objects in a real environment, registers (aligns) real and virtual objects with each other and runs interactively, in three dimensions, and in real time.

Displays, trackers, graphics computers and software remain essential in many AR experiences. In particular, the augmented reality can be used through a workstation (PC or MAC) with webcam, through the use of mobile devices equipped with camera (smartphone or tablet) or through the use of particular viewers (smart glasses). Thanks to these devices is taken up the surrounding environment, the engine "AR Engine" reworks the flow in real time by adding multimedia content to the real context. In this work smartphone-based AR tools have been applied to the aims of the projects.

## 3 CLICK TEATRO System

CLICK TEATRO system has been planned in order to create a link between theater activities and commercial operators. Figure 1 shows an overview of the system. Through the use of a Mobile App the user receives content related to the shows and services associated. The Augmented reality tool represents a modern way to perform a kind of "visual search". Each user can also access his/her personal wallet and be reached by targeted communication related to his/her personal interest generated by the system (TPP and/or other organizations) or self-generated by artificial intelligence algorithms.



**Fig. 1.** Interaction macro process in CLICK TEATRO framework

The system includes several modules described (briefly) in Table 1.

## 4 Augmented Reality and CLICK TEATRO

Two applications of AR have been considered and developed:

- AR for poster of theatrical events;
- AR for a localized event.

In the first case (Fig. 2-a) the user will shoot, using the smartphone camera, a billboard or a poster of a theatrical event. Above the actual picture will be superimposed objects with additional content related to the show. A specific marker is reported on the poster so the related code can be recognized by the Mobile App and transmitted to the AR Content Middleware in order to get back (by the AR Content Generator) the related info. Typically these additional info also include the possibility to directly buy tickets. The communication between the App and the remote server are performed by means of web-services.

The second application (Fig. 2-b) gives the possibility, to the user, to frame the landscape: the AR engine shows events and POI (Point of Interest) in the neighbors within a certain range. In this case a markerless AR solution is adopted: the system uses the GPS capabilities of the smartphone/tablet to identify and interact with resources. The AR Content module activates the following functions:

**Table 1.** Description of system modules

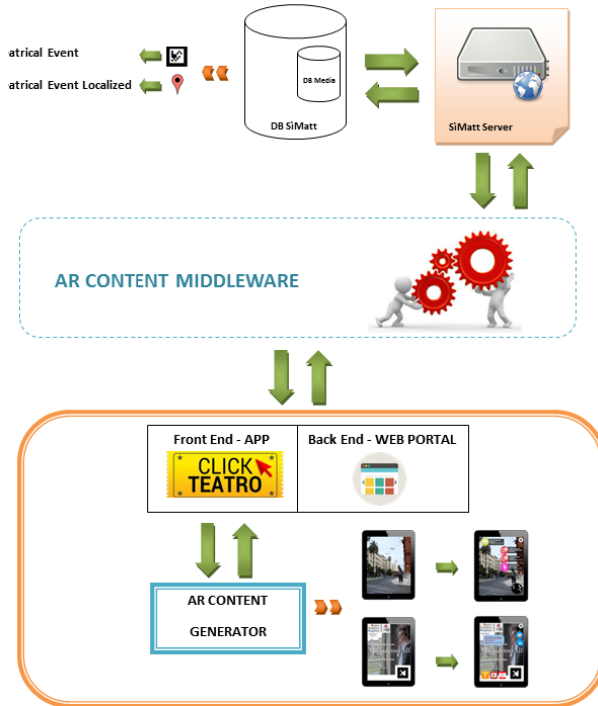
Module	Sub-Module	Description
<i>Middleware Area</i>	<i>Booking Middleware</i>	This module manages the on-line ticketing system, theater events, additional information and services associated with a theatrical event. These services are close to the structure hosting the event.
	<i>Personal Wallet (PW)</i>	This module manages the user portfolio. In particular, it allows the displays of accrued credit and the insertion of a new credit by scanning the EAN code reported on a receipt or manually typing the code (released by a merchant of the net).
	<i>AR Content</i>	This module allows the use of content available in augmented reality mode.
<i>DB</i>	<i>User accounting</i>	Used for the storage and retrieval of user’s profiles during the login phase.
	<i>Media BD</i>	This DB stores all media files associated to services and events.
	<i>Event DB</i>	All events are here stored.
<i>Back Office</i>	<i>Bidding Machine (BM)</i>	Those modules represents a system for the:
	<i>Ad hoc content generator</i>	<ul style="list-style-type: none"> <li>• User’s profiling;</li> <li>• Identification of events of interest based on artificial intelligence techniques;</li> <li>• Delivery of recommended events to the target user.</li> </ul>
	<i>AR Content Generator</i>	It allows the management of AR System.
<i>Front Office</i>	<i>Mobile App</i>	It ensures the access to all services.



**Fig. 2.** Application of AR for a poster of a theatrical event (a) and on POI (b).

- display of theatrical events in the nearby;
- display of associate services (restaurants, parking, hotels, bar, etc.).

Figure 3 shows data flows and modules interactions.



**Fig. 3.** AR Data Flow

Additional files and media are stored into a database. These contents are useful to enrich and complete the information in the events of the Public Theatre Pugliese in order to obtain an Augmented Reality.

The system has been prototyped for iOS smartphone and the following applications have been used:

1. METAIO for Augmented Reality software. More specifically, it has been used for EAN code recognition, POI identification and marker recognition;
2. APIs, provided by third party companies for the realization of the web services related to the modules: *Booking Middleware*, *AR content Middleware*, *Personal Wallet Middleware* and *Personal Bidding Machine*.

## 5 Evaluation of System's Usability

Tests have been performed according the Living Lab approach. At the moment tests are going on, however some results are already available. More specifically 20 users have been interviewed by means of a questionnaire consisted of 20 questions grouped in 9 distinct tasks:

- Task1: Find a theatrical event by Category;
- Task2: Buy a theatrical event;
- Task3: Visit the offer available on local services;
- Task4: Test of augmented reality through the use of a poster;
- Task5: Test of augmented reality through theater events located;
- Task6: Virtual wallet usage to view credit accrued and to accumulate new credits;
- Task7: Search a theatrical event among those Suggested by the system;
- Task8: Search and navigate a theatrical event;
- Task9: Usability Evaluation.

Results have been evaluated in terms of “Success Rate” evaluated for each task used to evaluate the usability of the system. Table 2 shows some of the results obtained: for each question the user answered with a value between 1 (strongly disagree) and 6 (totally agree). A failure (F) of the task is represented with the values 1-2, a partial success (P) of the task with the values 3-4 and a success (S) of the task with the values 5-6.

**Table 2.** Usability testing results

	<b>Task1</b>	<b>Task2</b>	<b>Task3</b>	<b>Task4</b>	<b>Task5</b>	<b>Task6</b>	<b>Task7</b>	<b>Task8</b>	<b>Task9</b>
User1	S	F	F	S	S	S	S	P	P
User2	S	F	F	S	S	P	S	S	P
...									
User20	S	S	F	S	S	S	S	S	P

The usability has been evaluated by considering the Success Rate. This parameter has been calculated as:

$$\text{Success Rate} = \frac{S + P \cdot 0,5}{S + P + F} \tag{1}$$

So, experimental results carried out are: S=125, P=33 and F=22 . The overall success rate obtained (79%) demonstrates the ability to complete more than half of the assigned tasks.

More specifically, the students had greater difficulty in task 2 (S=4, P=5 and F=11) related to the buying a theatrical event and task 3 (S=8, P=4 and F=8) related to buying and displaying deals on local services, while greater success has been obtained

in task 4 (S=20) and task 5 (S=20), respectively, related to the tests of Augmented Reality through the use of a poster and theater events located.

## 6 Conclusion

This paper presents the system developed for the project CLICK TEATRO. It involves two applications of Augmented Reality on Mobile environments. The first is marker-based and it is used to add info on a poster of a theatrical event (additional content, interviews, etc.) and service associated with its use (restaurants, car parks, hotels, bar, etc.). The second solution is marker-less and based on the GPS position of the device: real landscape is enriched with POI (Point of Interest) in the near by. The system has been prototyped for iOS smartphone and some tests have been performed in order to evaluate it in real environments and use cases: a success rate of the 79% was observed. Problems were identified related to the buying a theatrical event or buying and displaying deals on local services.

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