Chapter 23
A Location–Aware Architecture for an IoT–Based Smart Museum

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ABSTRACT

The Internet of Things, whose main goal is to automatically predict users' desires, can find very interesting opportunities in the art and culture field, as the tourism is one of the main driving engines of the modern society. Currently, the innovation process in this field is growing at a slower pace, so the cultural heritage is a prerogative of a restricted category of users. To address this issue, a significant technological improvement is necessary in the culture-dedicated locations, which do not usually allow the installation of hardware infrastructures. In this paper, we design and validate a no-invasive indoor location-aware architecture able to enhance the user experience in a museum. The system relies on the user's smartphone and a wearable device (with image recognition and localization capabilities) to automatically deliver personalized cultural contents related to the observed artworks. The proposal was validated in the MUST museum in Lecce (Italy).

1. INTRODUCTION

The Internet of Things (IoT) (Atzori, Iera, & Morabito, 2010; Mainetti, Patrono, & Vilei, 2011) is leading to the development of a plethora of smart objects that are intended to sense environmental parameters and human beings' behavior, in order to provide advanced services to the users. This trend aims at realizing smart environments able to capture, in a pervasive way, all useful information from the real world, and to automatically anticipate users' needs (Mainetti, Mighali, Patrono, Rametta & Oliva, 2013; Mainetti, Mighali, Patrono, & Rametta, 2014). The continuous attention towards this new vision puts an extraordinary stress on the so-called smart cities. They aim at increasing the effectiveness and efficiency of tourism, energy and water supply, healthcare, home and building automation, by integrating various systems through Information and Communication Technology (ICT) (Naphade, Banavar, Harrison, Paraszczak, & Morris, 2011). Unfortunately, the industrial world is still reluctant to invest directly on smart cities and most enterprises seek to secure their entrance with standardization and business models. To encourage the standardization of hardware and software solutions dedicated to smart cities, a smart city architecture should have a well-defined structure. This issue is well treated in (Anthopoulos, 2015), where the author uses literature findings and combines them with data from well-known smart cities to suggest a proper structure for a smart city architecture. The result is a five-layered architecture that could represent the baseline for smart city standardization. Referring to this structure, the IoT has well-defined position and contribution in the smart city architecture, since it belongs to the "ICT-based Hard Infrastructure Layer", which concerns all smart hardware able to provide sustainable smart city (SSC) services.

Among all the possible areas of applicability of ICT technologies, art and culture (identified by "Education & Tourism" in the aforementioned architecture) are becoming more and more interesting since they play an important role in human beings lives. Over the centuries, hundreds of museums and art galleries have preserved our diverse cultural heritage and served as important sources of education and learning. However, visiting a museum could often be quite boring because museum curators are not able to catch the tourists' attention properly. In particular, it is difficult to define in advance a tour for all the visitors, because interests may vary from person to person (e.g., from children to adults, students group from single visitor, casual visitor to fond-visitor). Given these issues, an important research question has to be answered: *can a smart tourism application effectively enhance customer experience within a museum?* To address such question, interactive and personalized museum tours need to be developed. In this perspective, a significant contribution can be given by the IoT, which aims to create a better world for people, where smart objects around us act accordingly like suggestions' generation that are relative to our insights.

Together with the IoT vision, also the role of mobile and wearable devices is increasing. Mobile devices, such as smartphones and tablets, are almost ubiquitous in our society, since they are not only communication means, but also technological tools for controlling other devices and communicating information about users (Alam, Saini, & El Saddik, 2015). For this reason, the trend to use them for interacting with smart environment is increasingly widespread. Finally, another key element of the current digital world is the Cloud, which is becoming the main mean for sharing data, information, and events between services and users.

Taking into account these considerations, it could be possible to design and develop a smart system able to improve the user experience in a museum. The fundamental concept of the system should be the location-awareness, that is, all the provided services have to act according to the users' position

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