

Chapter 14

Design and Prototyping of a Smart University Campus

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ABSTRACT

The authors propose a framework to support the “smart planning” of a university environment, intended as a “smart campus.” The main goal is to improve the management, storage, and mining of information coming from the university areas and main players. The platform allows for interaction with the main players of the system, generating and displaying useful data in real time for a better user experience. The proposed framework provides also a chat assistant able to respond to user requests in real time. This will not only improve the communication between university environment and students, but it allows one to investigate on their habits and needs. Moreover, information collected from the sensors may be used to automatically identify possible anomalies in the available spaces of the campus, facilitating this way the planning actions necessary to solve them.

INTRODUCTION

It is well known that the “city” represents a suitable context for the design and development of solutions based on Information and Communication Technology (ICT), which make accessible the challenges for a sustainable technological advancement toward a “smart” planning and organization of resources and data. On the other hand, we have witnessed the revolution of the digital age, which has radically changed the way of living by introducing not only new ways to collect information, but also new techniques for their analysis and processing. Nowadays anyone can access the internet from any point or location, at home or on the road, with the possibility of processing functions for any need, as defined in the “*ubiquitous computing*” paradigm. Ubiquitous computing can be defined as a new computing strategy such that computers are implicitly integrated into the daily actions of users, who are frequently in contact with electronic equipment such as personal computers, smartphones, bracelets, refrigerators and even

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glasses. At the base of the ubiquitous computing we find new network infrastructures, operating systems, sensors, microprocessors, all supporting the idea of surrounding ourselves with computers and software constantly active to provide assistance based on daily activities and according to our interests (Pradhan et al., 2014). This idea is further confirmed by the technological development of Internet, which is easily accessible thanks to special components from any object able to communicate with people and other machines, creating this way a network of objects called the “Internet of Things” (IoT). Data produced by users and their devices, in the IoT field, and by the digital urban infrastructures, in the smart city area, therefore require solid technologies that provide a great deal of information, in order to detect, aggregate and extract novel information useful to support decisions and to improve the experience of each user.

Ubiquitous computing is therefore a basic concept in order to understand the notion of *smart environment* which, according to (Weiser et al., 1999), is “a physical world that is richly and invisibly interwoven with sensors, actuators, displays, and computational elements, embedded seamlessly in the everyday objects of our lives, and connected through a continuous network.” While the smart city is a very complex and complete smart environment, smaller and simpler examples are those of hospitals, universities, shops, etc., which are part of a city in their turn.

In this chapter, the design and prototyping of a smart university campus is described. The proposed framework is based on the data supplied by the users and provides useful services for the integration and mining of these and other data retrieved from sensors. The main goal here is to support the “smart planning” of the university environment, improving the management, storage and mining of the involved information. To this aim, a platform is proposed which allows for interaction with the main players of the system, generating and displaying in real time useful data for a better user experience. The proposed framework provides also a chat assistant able to respond to user requests in real time. This will not only improve communication between the university environment and the students, but above all it will be useful to know their habits and needs. Information collected from the sensors also allow to automatically identify anomalies in the campus, making easier to perform actions for their solution.

BACKGROUND

Middleware and Technologies

In order to define a good infrastructure, IoT needs to be supported by a middleware that allows consumers and application developers to interact in a user-friendly way, despite the differences in each user’s perspective of IoT systems (Boman, Taylor & Ngu, 2014). The literature reveals a variety of strategies, models, and frameworks in order to define a Smart Campus environment. It is possible to distinguish two main factors for their design:

1. Communication protocols;
2. Storage and persistence technologies.

As for the first point, the main aim is to identify a protocol suitable for the transport and reliability of information within an area. Among the most common protocols on the Internet is *HTTP (HyperText Transfer Protocol)*, which is based on the request/response pattern. Within the Internet of Things, sev-

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