Chapter 9

Leveraging IoT Framework to Enhance Smart Mobility: The U-Bike IPBeja Project

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ABSTRACT

The planning, designing, deploying, and measuring the smart mobility concept is very important since it can impact several aspects of city life such as how and where people live and fulfil their needs and desires. Given the complexity of the problem, this chapter proposes a general IoT framework for smart mobility that could guide the development of a smart mobility system to manage communications, devices, and services, as well as applications to achieve smart mobility goals. This chapter describes the U-Bike system within the IoT framework and smart mobility paradigms, i.e., in terms of IoT framework structure and operationalization, as well as quality attributes (i.e. non-functional requirements). Recently, the U-Bike system began to be used, making it possible to estimate if it fulfils the objectives of the project. This assessment was performed using focus group method and interviews.

DOI: 10.4018/978-1-7998-2112-0.ch009
INTRODUCTION

Smart city is probably one of the most analysed concept among people (government, companies/industries, researchers, and citizens) all over the world. The idea is to optimise modern, useful technologies to create a sustainable and self-aware city. This multidimensional concept is mainly based on Information and Communications Technology (ICT) structured around smart mobility, smart environment, and smart living.

According to (Tomaszewska & Florea, 2018), smart mobility consists in the use of ICT, networks, databases, software and devices, to produce more effective and efficient transport and logistics services. At the same time, it optimises resource utilization and reduces the negative impact of mobility, mainly pollution. Therefore, smart mobility is one dimension of the smart city concept and is interrelated with other concepts, such as smart environment or smart living. As for mobility management in a smart city, transporting city inhabitants by meeting their daily mobility needs is one of the ultimate goal. Nevertheless, promoting and enabling smart mobility in cities plays an important role in making cities financially and environmentally sustainable. Over the years, cities must be able to deal with the effects of globalisation trends in a sustainable way and the energy overconsumption in the mobility context has been one of the culprits in accelerating air pollution in the cities. A sustainable smart mobility example is to promote and encourage more people to ride bikes, for example through bike sharing projects (OOMap, 2019), in order to reduce the individual carbon footprint (smart environmental strategies).

The Internet of things (IoT) is one of the most important technological developments of the last decade. Society is driven by digital technologies and the Internet. This has changed, and keeps changing, the way businesses operate, i.e., the companies are rethinking their business models, hence identifying new opportunities for creating new value. According to (Iansiti & Lakhani, 2014), the Internet of Things is transforming business models because digital technologies have properties to increase operations at near-zero marginal costs as well as to generate innovation and new opportunities. Nevertheless, no transformation comes without risks, which need to be well managed via awareness, transparency and the pursuit of sustainability (e.g. economic, environmental, social). Advancing IoT solutions for smart cities helps promoting economic, environmental and social issues. It has the potential to support smart city goals and affect the quality of life of its citizens. However, its success relies greatly on a well-defined architecture that consists of a list of sensors, services, communication protocols, users, and interface layers integrated in a scalable and secure basis for its deployment. Several concepts are identified in an IoT system, and because a commonly agreed conceptualization is not found, several different approaches are usually considered (Abdmeziem, Tandjaoui, & Romdhani, 2016): a three-layer architecture composed by Application, Network and Perception layers; a five-layer architecture including also Business and Process layers; cloud and fog systems; and social IoT paradigms. IoT infrastructures are still at their early stage of development and relevant progress is expected to be made in the next years to cover issues such as interoperability (i.e. devices from different sellers will have to cooperate in order to achieve common goals), security (i.e. integrity, availability and confidentiality) and scalability (systems will have to handle a growing amount of work by adding resources). Given the complexity of the problem, the objective of this chapter is to propose a general IoT framework for smart mobility that should guide the development of a smart mobility system in order to manage communications, devices and services, as well as applications to achieve smart mobility goals.

The “U-BIKE Portugal” project is a national project, which aims to promote the adoption of more sustainable mobility behaviour through the provision of electrical and conventional bikes in academic...