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The use of ICT technology for reliable transport control, Cape Verde case study

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ABSTRACT

In order to create a high quality of transport system, accessible, and safe is necessary to develop strategies for the implementation of telematics solution. For this a detailed study of the existing infrastructure, technologies into practice, and real needs, are necessary. This work will propose a new approach to the management and delivery of public transport services in cape Verde, Praia city, in order to create more efficient transport network. The main idea is to develop strategies that can reduce journey time variability, and further expansion of the real time information system capable to provide travelers more information. The focus will be on delivering a safe and integrated transport system. There is an emphasis on improving public transport as reduction of the number of empty vehicles on the road, and improving safety and security for all transport users. This paper propose a methodology, using the concept of smart cyber society. This concept will be focusing in the transport mobility. Providing users with dynamic and multi-modal information for traffic and transport efficiency, as well as for assuring sustainable, reliable and safe public transportation.

KEYWORDS: Transport, Reliability, Information and communication technology

1. Introduction

This paper aim to study the implementation of smart city for an reliable transport control, the case study is Praia City in Santiago island, Cape Verde. In this paper is presented the proposal for the implementation of the smart technologies taken in the consideration the smart city characteristic taken from the literature review.

The lack or insufficient organization of transport is one of the biggest problem faced by developing countries, especially small Islands developing states as Cape Verde [1]. This is due to rapid growth of the population, increasing the need for movement of people and goods. The use of the Information and Communication Technology (ICT) for transport control is becoming very popular due to its positive results [2].

The world is experiencing an evolution of Smart Cities. The innovations in ICT technologies has led the creation of new economic and social opportunities [3]. Smart appliances are being used in many cities. Homes, cars, public venues and other social systems are now on their path to the full connectivity known as the Internet of Things. Smart city initiatives vary widely, they all aim to be smarter and greener in order to improve citizens quality of life and economic opportunities.

Most leading cities in Europe, U.S and in Asia have adopted ICT and green technologies as way to revitalize economic opportunities and to strengthen their goal opportunities. These initiatives range from small-scale applications of individuals clean technologies to ambitious projects to transform entire urban areas through planning and infrastructure development [4].

According to the literature review, as of 2012, there are approximately 143 ongoing or completed, self-designated smart city projects [5]. Some of those cities are currently leading efforts to implement smart tech-nologies to address and resolve such urban problems such as energy shortages, traffic congestion, inadequate urban infrastructure, and some issue in health and education. The European Union (EU) is investing in smart city strategies for metropolitan city regions such as Barcelona, Amsterdam, berlin, Manchester, Edinburgh and Bath. Asian countries are active with more than 40 different projects, including Singapore, Hong Kong, Seoul, Busan and Songdo. Smart cities initiatives extend as well to others regions around the world, including South America, the middle east and Africa [5].

This paper proposes the concept of smart cyber society, based in the concept of the Web of things and cyber physical system to be implemented in Praia city. It is also taken in the consideration, the existing infrastructure in the country, the local population mentality and knowledge, and surrounding environment to ensure a good use and understanding for the success of this technology in the country and an reliable transport control.

2. Research problem and research methodology

Cape Verde is an archipelago in the Atlantic Ocean, near to the west coast Africa. It consists of ten islands. Just nine of the islands are inhabited, Cape Verde is not just small but without any natural resources. Most of the population of Cape Verde, is concentrated on the island of Santiago (238 335 inhabitants), corresponding to 54.4 [%] of the population of Cape Verde. Praia's city, whose capital city, is located in Santiago island. In the last forty years, the city of Praia has been experiencing an extremely rapid growth [6]. This has led to increasing needs to travel from one point to another, mainly from municipalities to the city and within the city, for work and to provide and receive various supporting services and supplies. These necessities generate an increase in movement of means of transport.

Santiago island has a National Road with an extension of 389,705.00 (m) [6]. The first fast road in the country, called circular of the Praia (Circular da Praia), has a length of 17 kilometers, built in November 2007 [DGTR].

Fig. 1. Circular of the Praia [own study]

The network of the city's transport system consists of nine lines connecting the center with surroundings areas essentially in radially [DGTR]. The country has good coverage of land routes, although many localities in rough terrain areas remain isolated.

In Cape Verde, exist 58,340 vehicles, where 57.5 [%] of these vehicles are in Santiago Island, and most operate into the city of Praia. Taking into the consideration that the city is very small, if there are more vehicles than the capacity of the road, will create a disorder in the city, thus creating a need for traffic control [7].

The city of Praia has an urban transport system of passengers, regulated by the legal framework Decree Law No 30/2014 of 24 July 2014. Which regulates the transportation in vehicles, the conditions of access and activities of public transport. The public urban transport service of passenger is made through the concession of the Municipal chamber.

The small dimension of Praia City in Cape Verde, combined with the rapid growth and increased urbanization, lead to the traffic congestion and pollution, raising a variety of technical, social, economic and organizational problems, tend to compromise the economic and environmental sustainability of the city. There is an urgent need for the organization and management of means of transport.

This paper propose a methodology, using the concept of smart cyber society. This concept will be focusing in the transport mobility. Providing users with dynamic and multi-modal information for traffic and transport efficiency, as well as for assuring sustainable, reliable and safe public transportation [8].

Fig. 2. Smart City Example [9]

An smart city should be able to optimize the use and exploitation of both tangible (e.g. transport infrastruc-tures) and intangible assets (e.g. human capital, intellectual capital of companies, and organizational capital in public administration bodies).

This work propose a methodology divided in two parts: virtual communication platform and architecture for smart cyber society. The asset Layer as shown below, composes the virtual communications platform. The layer is composed of the real world entities that are subject to monitoring or controlling with the help of sensors or some other means. Assets provide a role of a bridge between the digital world and the physical world.

A smart cyber society is a virtual environment composed of networked to various societies and transportation system located in a large geographic area. These societies are powered by web application server, which is used for integration of various capillary devices (wearable devices, electric appliances, social networking,

and so on). Architecturally, the proposal for the smart cyber society is composed of two domains, such as cyber society domain, and cyber mobile domain as shown below in the Figure 3. The greater the number of devices can access smart city services, greater is the effects of these services. Smart services are accessible over multiple device platforms including IOS & Android apps, mobile webs and other specific devices [10].

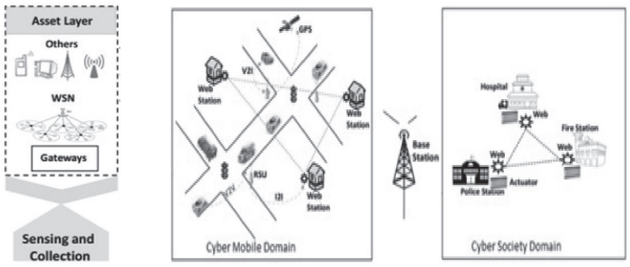

Fig. 3. Architecture for smart cyber society [own study]

Cyber mobile is, under an infrastructure (including vehicles, ambulance, GPS, roadside units and the web station), with the effective integration of information technology, control technology, sensor technology, and GPS system technology. Moreover, it can applied to roads infrastructure to achieve the real-time monitoring system accurately, and with the highly effective transportation system. The cyber mobile domain is based on the cyber transport network (CTS), in which all the vehicles are connected to the roadside units. The roadside units are connected to the GPS system and web station. Such technique helps the vehicle to broadcast its physical location. Hence, cyber society domain can easily get various information about the vehicle, such as arrival time, current location, accident, and other. If there is an accident on the road, the desired information is passed on to cyber society domain where the police station, fire brigade and ambulance react accordingly.

The CTS has the following characteristics. Application Advancements (AA): the resource facility technique of web computing leads the application service, to facilitate the integration of various services of the mobility resource. Inter operation (IO): it supports the interoperation of the cyber mobile domain with the cyber society domain. Dynamic Resource Distribution (DRD): through resource distribution, calculating the speed of the vehicle, current location with the help of GPS, updating record of vehicle in the web station, sharing the information with the domains. Fast Response (FR): various services, such as web, roadside unit and vehicle to vehicle communication (V2V), vehicle to infrastructure communication (V2I), and infrastructure to infrastructure communication (I2I) are integrated to facilitate the flexible and quickly respond to the event [11].

The core attribute of the smart cyber society is the cyber society domain, which is composed of various societies, such as hospital (for healthcare system), police and fire brigade station (for security and fire). This domain is capable of receiving service calls from mobile domain by being connected to the gateway (i.e., web server), and reports them to proper authorities, through a reliable communication channel. All the societies in this domain are connected to their actuator and web servers and this able to provide value-added services for a variety of society applications.

The Figure 4 bellow, show the Flowchart of the Smart Cyber Society communication [11].

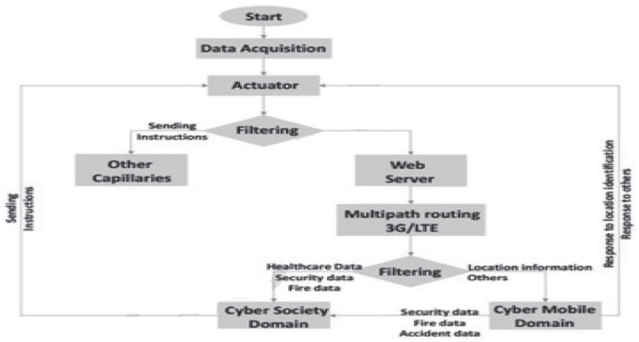

Fig. 4. Flowchart of the smart cyber society communication [12]

A smart city ultimate goal is to create sustainable value for citizens, employees, shareholders and other stake-holders.

In Santiago island the public bodies, work independently from each other. For developing the smart cyber cities, for an reliable transport control, it is very important to study and analyze some important dimensions as partnership formation, that includes the examination of the city various types of private-public partnership for service development. The ICT infrastructure for supporting smart city initiatives and creating higher network effects with complementary multiple devices.

Nowadays, in Cape Verde is easy to access the internet, and is very popular the use of smart phones and web of things, this show that the city started to invest in the use of technology's, what facilitate the conditions to start to develop the concept of the smart cyber city. According to the 2015 report of the International Telecommunication Union (ITU), Cape Verde occupies the 4th position in the field of Information and Communication Technologies in Africa with 4.62 points, behind only the Mauritius Islands (5:41), Seychelles (4.96) and South Africa (4.90) [12].

Besides ambulance, police vehicles and fire brigade vehicle, in Praia city, operate two private companies of urban transport of passenger (Bus, Sol Atlántico and Moura Company), the public transport system with driver (Taxi, there is no taxi company), and Hilux/ Hiace (individual owner) make the transportation between cities and municipalities, however, some of these operates within the city as illegal. through the study of selected problems in the control of urban transport in Praia city [8] it was possible conclude that the transport system does not have a good organization and management, the transport system control is far from been reliable.

The first step towards implementation of Cyber City would be the management of these means of transport by creation of central public transport management, responsible for the monitoring, and controlling the public transportation with the help of the sensors, GPS and others means. This central will be also the responsible for providing a bridge between digital world and physical word. This central will be the asset layer. The asset layer must be connected to the various societies, such as hospital, police, fire brigade station and automobile maintenance workshop, to support and guaranty the safety of the transport and the population. As an example in

case of accident this base have the possibility to know where the vehicle is and send support for them in time, the support can be an ambulance, fire truck or maintenance services. The proposed management system lead to the creation of a smart cyber society.

The solution proposed in this work is already in use in some developed countries, this work aims to conduct a technological transfer, what means that the study of the actual situation, the populations need and the existing infrastructure is very important.

3. Conclusion

Smart initiatives do not only entail technology changes, but also investments in human capital and changes in urban living practices and conditions, for this is important the study in order to understand the local population mentality and impact of the implementation of the proposed solution. According to the study made by Lopes Maria Fatima on the quality of services of urban transport in Praia city [4], was possible to reach some conclusions, one of them is, passengers consider the three dimensions, reliability, safety and availability, are one of the most important factors in assessing the quality of service provided by the companies. For this is very important the development of a smart concept that can manage this variables ensuring an efficient transport solution. The facility to access to internet, the use of smart phone and web of things show that the city started to invest in the use of technology's, what facilitate the conditions to start to develop the concept of the smart cyber city.

The analyze of important dimensions as partnership and ICT infrastructure for supporting smart service development is also an important factor for an reliable transport control, and to develop strategies for imple-mentation.

For the future, it is required the study to the mapping for the installation of the proposed technology given the existence infrastructure, after establishing agreements and develop the necessary tools. In the study for building a cyber city is very important to consider the cyber security. For this is proposed the cyber security risk assessment for the future.

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