IoT to Monitor the BRT Bus

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Abstract: - Technological evolutions at Intelligent Transport Systems (ITS) is allowing that ubiquitous society use the ITS facilities to conducting their activities. At this scenario the paper presents a study case in order to use ITS technologies applied to conduct his activities, mainly for bus tracking. The study case presented in this paper uses the concept of IoT (Internet of Things) to make the inspection of trucks; all study case considers the use of existing ITS infrastructure, as well as the deployment of new infrastructure. In order to implement the IoT, the study case use the RFID (Radio Frequency Identification) technologies associated with sensors installed at vehicle in order to identify the vehicle when it pass through a portal and the associated information, if available, as: temperature, average velocity, doors and others relevant information. The advantage of IoT is the ability to identify the vehicles and other information without disrupting the normal flow.

Key-Words: - IoT, BRT, RFID, BRT, Mobility, Transportation

1 Introduction

Technological developments in recent years, reflected intensely in all aspects of social life creating new ways of thinking, feeling and acting in society, may be called "Technological Society" [1]. The use of technological resources at day by day of society is changing behavior, and especially, introducing new values and establishing new forms of relationship and interaction. Considering accessible cost, the technology can be applied to monitor the vehicle, enabling increased effectiveness and significantly changing the behavior of society.

This paper presents an effective solution for the surveillance of bus through the use of IoT (Internet of Things) technologies and integration with ITS, allowing in real-time to identify each vehicles and it is position.

The Internet has revolutionized the world as any other invention was able to make. The integration of computers through telecommunications networks permit to create a mechanism of information dissemination worldwide and a means to collaboration and interaction between the peoples and their computers, regardless of their geographic localization.

The technological evolution that began with the first research on packet switching and ARPANET (Advanced Research Projects Agency Network) and its technologies permitted to expand the infrastructure horizons in various dimensions as scale, performance, functionality, operational and management aspects of global and complex computer network infrastructure.

Actually the Internet is a large infrastructure of information that involves many aspects: technological, organizational and community. And its influence reaches not only to technical fields of computers and telecommunications but whole society that are using the facilities supplied by Internet to accomplish electronic commerce, exchange information and community operations.

On October 24, 1995 the Federal Networking Council defining the term Internet as the global

information system that is logically linked together by a globally unique address space based on IP (Internet Protocol) to support communications using the TCP/IP (Transmission Control Protocol / Internet Protocol) suite and provides, uses or make accessible, either publicly or privately, high level services layered on the communications and related infrastructure described. [2]

The e-mail was one of first application of Internet and continues to be invaluable, because allows communication between two or more people in an extremely easy way, also the multimedia environment of Internet is another great application, this characteristic changed the way to do the marketing, to attend the customers, to do business, to educate, to learn. Online attendance with video, high quality video, content translation into other languages, electronic medical records of patients with decentralized access the Internet, an emphasis on distance education at the level of training posts or tutorials for classes, interactive polling and elections are example of services on Internet. In Brazil have several success cases as the delivery of income tax over the Internet and emission of invoice through the internet, both in terms of convenience for the population and in terms of reduced costs for in case the government.

There are several researchers groups developing the concepts of Future Internet in order to provide an overview, directions and trends. These groups are studying and defining the future internet architecture, including capacity, ubiquity, scalability and virtualization. Also these groups are discussing the focus of Future Internet like: service-centrism, neutrality, openness, diversity, extendibility, flexibility, usability, simplicity and sustainability. [3]

\According FIRE (Future Internet Research and experimentation), the internet has become the anchor of world economies, form financial markets and health, energy and transport services, and it is likely to become more important in the future, because it creates a new large business and is transforming existing segments. For example, future healthcare systems can be expected to use the internet to increase affordability, quality and efficiency, through medical information systems, be electronic patient record systems, remote patient monitoring and healthcare delivery, with improved diagnostics and imaging technologies. [4]

The future internet is governed by four areas, as shown on figure 1: Social, Psychological & human interaction, Technical and Economic and it is necessary to develop Policy, Governance, Operations & management and Regulation & legislation issues. At future the internet will have a great influence at people's life, it is expected that in 10 years the internet will have 40% of influence in everyone's day and in 20 years will be 60%, as shown on figure 2, so the Internet will present constantly in day-by-day activities.

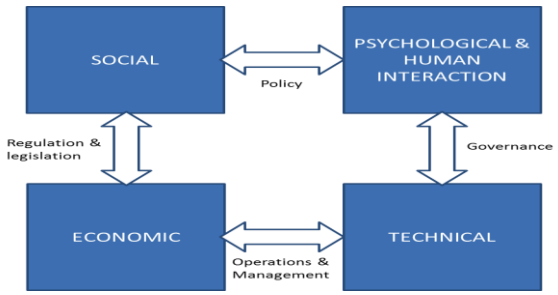
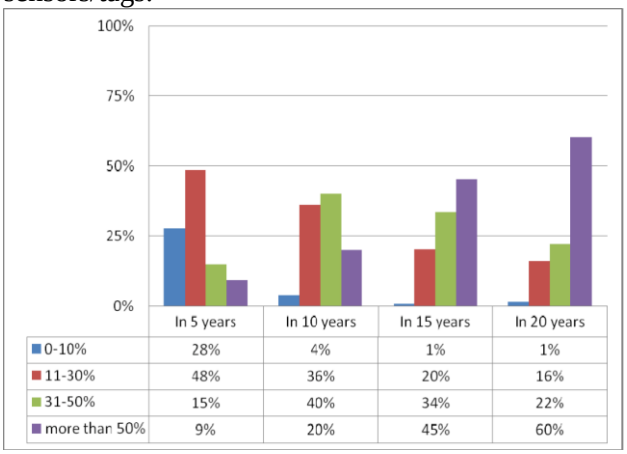


Fig.1: Key Issues for Future Internet

The people will use the internet far more at future, so its is essential to understand what needs the future internet will have to meet, in an interview now it is necessary a basic voice and data communication, social networking, primary source of news & information and. In 10 years the demand will be Entertainment, Day life maintenance and Interconnection of humans, machines and Interconnection of humans, machine and sensors/tags.



	In 5 years	In 10 years	In 15 years	In 20 years
0-10%	28%	4%	1%	1%
11-30%	48%	36%	20%	16%
31-50%	15%	40%	34%	22%
more than 50%	9%	20%	45%	60%

Fig.2: Percentage of day influenced by internet [4]

In order to delivery public services may turn to internet to access these services, it is necessary to increasingly deeper interaction between providers and end-users and greater trust and security.

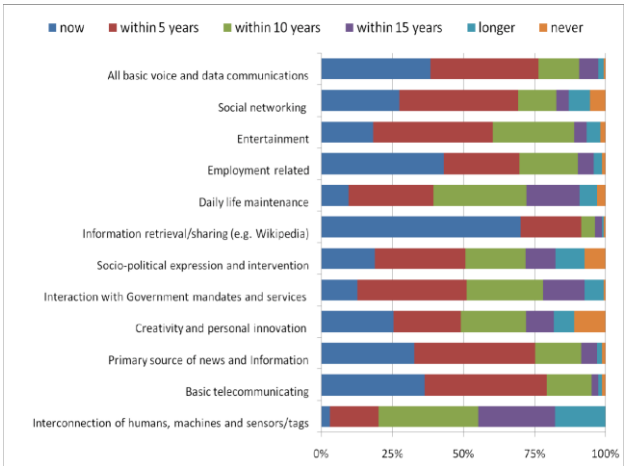


Fig.3: Forms of Interaction

In Future Internet context, there is a discussion to implement the IoT (Internet of Things) that refers to the interconnection network of everyday objects, so everyone can access any object through internet. The idea is to implement in everyday objects a device that will permit the interaction with it, so the people could receive information about status of object, temperature, status and so on. For example: an medicament will have a device that will collect temperature and pressure information from production to the retail, so the consumer could access this device and verify the temperature and pressure information of a specific period, then the consumer could check if the medicament was properly stored [14][15].

The device may be developed using several technologies. For example: Alcatel-Lucent developed Touchatag that is an RFID service for consumers, application developers and operators. The consumers can trigger what touchtag calls applications, which can include opening a webpage, sending a text message, shutting down the computer. [5]

2 Understand the Problem

The BRT is a transportation system that offers quality services at low cost, as well as a short-term deployment compared to other modes of transport. So many cities are choosing the BRT as an ideal solution for mass transportation, meeting the daily needs of people for displacement in urban centers. The BRT concept consists of key elements focusing on the planned operation, adequate infrastructure, technology, effective management and quality service to passengers.

The ITS system consists of a technology matrix intended for operation and management of urban mobility. It consists of sets of information systems, communication, control, monitoring, sensing, acting and among others. It aims to provide greater operational efficiency to transport and transit operations services as well as provide comfort and safety for users of BRT services.

One of several features of the IIS for BRT is to monitor the bus can be performed using various technologies. In this context, this paper evaluates the use of the RFID tag as a possible solution to make the BRT bus monitoring.

3 Solution Proposition

To solve the problem presented in the anterior topic is necessary to use an integrated solution, consisting of equipment, means of communication and integration with ITS. For this purpose, this paper proposes the solution presented in this topic.

Equipment

The solution consists on the development and implementation of a device that can collect information of product status or the bus and deliver it via the Internet.

The proposal is to use an active RFID tag with sensors interconnected with them. The models of sensors will depend on the need or demand for each product shipped, for example, optical sensors can be used to control the opening and closing doors, engine speed sensors to verify and monitor the use of the engine, among others [13].

To read the RFID tags should be installed on highways, airports, ports and major strategic points RFID portals to take reading and writing the tags, and especially to provide information through the Internet, figure 5.

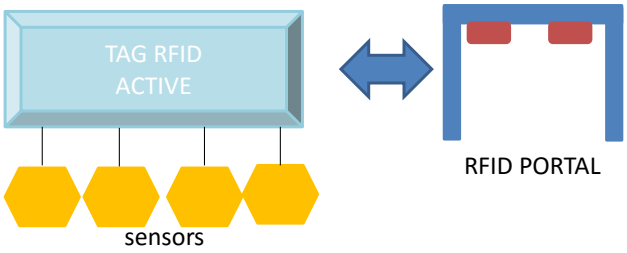


Fig.5: Equipment

RFID

The RFID technology allows the identification and location of a given object using radio frequency at short range (typically 0.5 to 5m) and can be used both for identification of vehicles (as in the Brazil DENATRAN SINIAV project), and identification of cargo through containers, pallets, cases, individual products or bulk [10][11]. Through reading equipment (readers and antennas) installed at strategic locations, can become a key tool in an

integrated solute ion for tracking, see figure 6. [12][14]

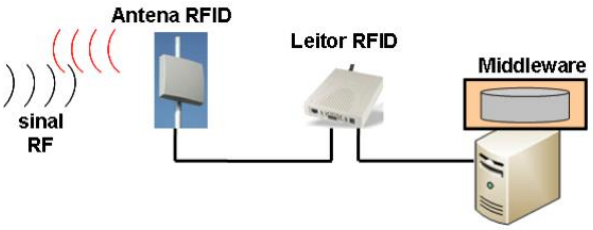


Fig.6: RFID Arqchitecture

The main strengths of RFID for identification are:

- The vehicle identification accuracy is typically higher than the automatic reading of plates by OCR. RFID systems have accuracy rates of at least 95%, with typical results above 99%;
- There are Brazilian government projects with the participation of research centers dedicated to the subject, such as the design of SINIAV DENATRAN for identifying vehicles nationwide, and the project BRASILID for the standardization of RFID tags and infrastructure to identify any kinds of products in circulation in the national supply chain and logistics.

Moreover the technology has points of attention that must be taken into consideration in the projects:

- The technology is intrusive, it requires an tag RFID are installed across the fleet of vehicles;
- Identification by RFID typically references a family of radio technologies and standards for short distances that include both active devices (self-powered) or passive (powered by the electromagnetic field radiated by the reader antenna), and may require a different communication protocols, requirements information security, storage and processing capabilities. This wide range of options means that there are solutions for all cases. It is necessary a project of readers, antennas, tags, software and operating model for each desired state supervision of vehicles.

The proposal is to install an RFID tag on each bus, so to spend on each portal the bus can be identified on both the aspect of the position regarding the date and time. Considering the following two portals and the date and time of data you can calculate the average time of each bus and to anticipate the arrival of the same at the next bus stop. Depending on the average speed values it can be concluded that there are problems on the road, such as obstructions and thus an alert can be generated for someone to check what is happening. As shown in Figure 6.

Another possibility is the bus itself store data in the RFID tag, thus to pass over the portal. Tt sends this data that can be processed on the server. Among the data, it can be informed vehicle speed, number of passengers on the bus, and other information. In this case, the bus is equipped with sensors that collect data and store the RFID tag.

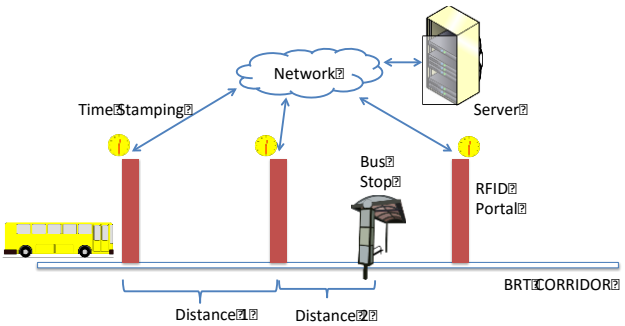


Fig. 6: Bus Monitoring

If the RFID tag is damaged it will not be possible to identify the bus, which can interfere with the BRT operation. Solutions that do not use semaphore system of real time, when the bus passes through a portal, it can send a signal to the traffic signal controller in the field to trigger the green, this solution is functional, however the number of bus has to go through the traffic is high, there is great possiblity to halt the cross not allowing any vehicle pass.

4 Conclusion

The IOT will allow a major breakthrough for the intelligent transport systems, because information relating to any object (vehicles, parts, lights, signs, goods, among others) will be available via the Internet also may contain information about the environment which this object is inserted. With that ITS can provide more accurate information to the actors that compose the system, thus allowing decisions to occur easily.

The use of RFID tag is feasible for monitoring the bus and to permit that the ITS system can perform taking appropriate decision in each situation. The implementation of the solution is simple, with the greatest difficulty lies in definition the location of each portal.

Another interesting point is that there are government programs that consider the use of RFID tag for vehicle monitoring, cars, buses and trucks.

Thus the implementation of the RFID tag is a trend.

5 Acknowledge

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