Design and Implementation of a system to estimate arrival times of public transport vehicles with Active RFID technology.

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ABSTRACT

Active RFID technology has positioned itself in recent years as a tool capable of performing solutions for logistics area in production lines, safety, health, etc. In this paper, the development and implementation of an application of active RFID for public transport vehicle arrival time estimation is presented. The system architecture and the implementation details are discussed. Results show that this technology is a viable solution for the control and monitoring of information systems robust, such as a transport system.

Categories and Subject Descriptors

H.3.4 [**Systems and Software**]: *Information networks*,

Performance evaluation (efficiency and effectiveness)

General Terms

Management, Measurement, Performance, Design.

Keywords

Keywords are your own designated keywords.

1. INTRODUCTION

Radio Frequency Identification technology (RFID) has become a commonly used tool for automatic identification and data acquisition. RFID is widely used in location applications, logistics, and security. RFID is based in on the process of reading a label that contains specific information via a radio frequency reader

RFID technology can be active or passive depending on the tags. Active-RFID tags have an internal power supply system involving the use of batteries; for this reason, ensure long read distances, low transmission power operation, and stability in the transmitted signals.

These features make the active RFID technology widely used in identification systems for people and vehicles. What it makes increasingly possible to expand its scope and applications to the point of obtaining the estimated time of arrival in the land transport operations. [1]

In this way, this paper includes the description of the development and implementation of an information system able to estimate arrival times at certain stops of a public transport vehicle, using RFID-active technology with which an information system capable of providing the user time to access the transport system is created.

2. ACTIVE RFID

Two types of RFID technology, which differ ac- cording to the power source that use: Active RFID and passive RFID.

A passive RFID-tag operates without battery; therefore it depends on the Radio Frequency (RF) energy transferred by the reader in the interrogation signal. A passive RFID system technology can be easily implemented in a supply chain and logistics ser- vices. However, systems with passive tags are unreliable for some applications since its functionality depends on different variables in the environment, such as the distance proximity to the RF reader, the integrity of the RFID tag and the operation frequency. Passive RFID tags are typically read at short distances, which limits the use of these labels for certain applications. [2]

On the other hand, an active RFID tags include a battery, allowing increasing the read range and ensuring integrity in the transmission and reception of data. The active RFID, ISO / IEC

18000-7 standard provides the communication structure for this technology, which is characterized by point-to-multipoint (P2MP) and defined that the control on the tags is in the reader. Currently, these systems are used to manage the supply chain logistics and business operations [2]. The main disadvantages of Active RFID technology compared to passive RFID technology are associated with larger costs and limited operational life. However, active technology offers higher reading distance, data transmission rate, and stability. [3]

3. ACTIVE RFID IN INTELLIGENT TRANSPORT SYSTEMS (ITS).

In the intelligent transport systems (ITS), the Active RFID technology has acquired an important role in the constitution thereof, due to the diversity in forms of integration and versatility of use. Some schemes based in active RFID applied for intelligent transport systems (ITS) have been proposed. Active RFID based positioning (ARP) for vehicles were proposed in [3]. This system consist of active RFID readers deployed in a road, allowing to determine the position in the road and the lane in wich a vehicle containing the active RFID tag is located[4]. There are also tracking systems based on active RFID technology as an alternative to traditional systems such as GPS geolocation. Experimental results show that this proposal for a tracking system can accurately recognize the locations of active RFID tags [5].

4. REQUIREMENTS AND ARCHITECTURE OF A SYSTEM ACTIVE RFID TECHNOLOGY FOR THIS.

The requirements of a system able to estimate arrival times at certain stops of public transport vehicles using Active RFID technology include:

• Minimal reading range of 40 m.

• Tag reading at a maximum speed of 100 k/h

• Data integrity avoiding collisions and interference

• Presentation of the estimated arrival times to the user in a clear and easily accessible way.

Figure 1 illustrates the system operational scheme.

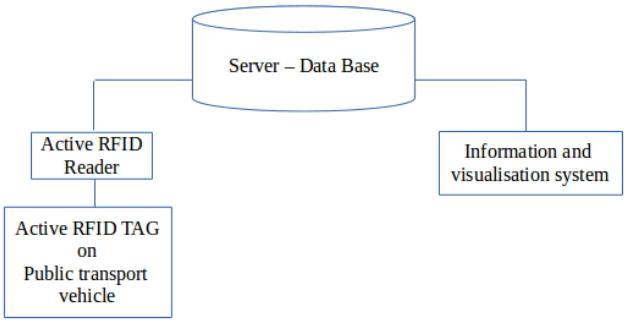

Figure 1. Scheme system operational.

Figure 2 illustrates the architecture the designed system able to estimate arrival times at certain stops of a public transport vehicle using Active RFID technology. Each active RFID tag, located aboard the vehicle, transmits an electromagnetic signal that contains the identification number associated with the tag. This signal is received by the reader and routes the data through the communication network to the server, where is processed, storage. Finally, it is presented to users.

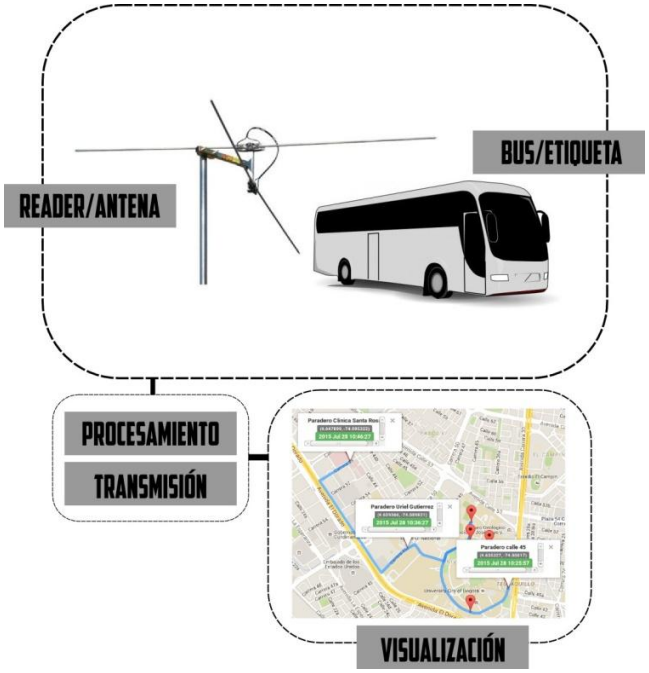

Fig. 2: Architecture of a system to estimate arrival times of public transport vehicles with Active RFID technology.

The proposed implementation of Active RFID technology in a public transport vehicle is aligned with the parameters of intelligent transport systems and technologies that integrate vehicle identification, communication tools and transaction data. This toolkit is intended to offer an efficient and intelligent service that facilitates user mobility.

5. SYSTEM IMPLEMENTATION FOR ITS ACTIVE RFID TECHNOLOGY.

The proposed system was implemented and assessed in the National University of Colombia, Bogotá to estimate arrival times of the public transport service offered to the community in the campus.

This service is used by transport users, students from the National University of Colombia, Bogotá, from the main campus to the "Clinica Santa Rosa" campus for approximately 7 kilometers apart.

The routes of the public transport service offered by the National University of Colombia in Bogota are illustrated in Figures 3 and 4.

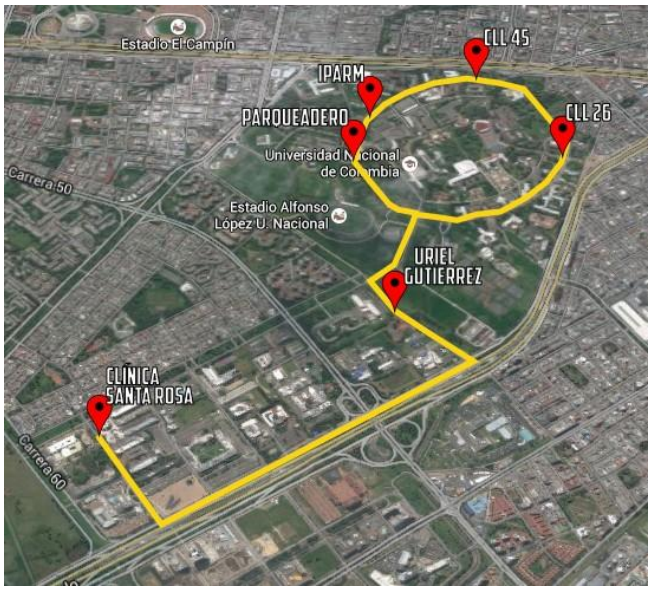

Figure 3. Internal drive public transport service National University campus

Figure 3 shows the path 1 that performs the public transport of the National University of Colombia, Bogotá. This route includes the inner ring road to the main campus ring and then goes to the facilities of the "Santa Rosa Clinic" campus. Figure 4 shows the path 2 that comprises the path between the "Clinica Santa Rosa" buildings to the main campus parking lot that will is the final point of this route.

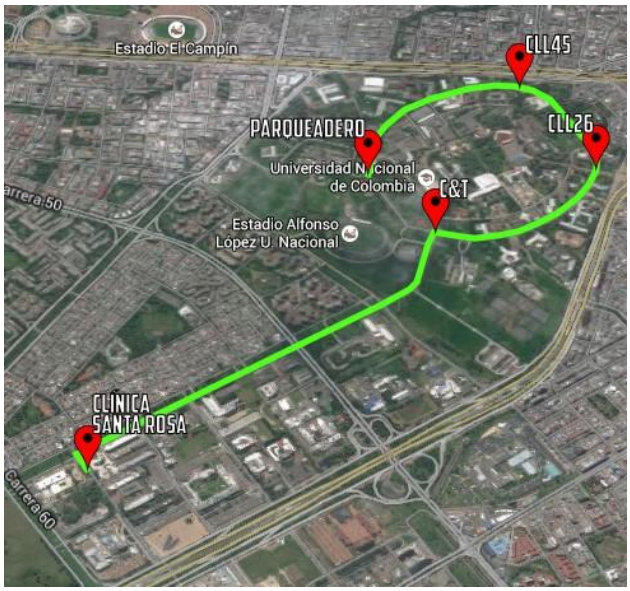

Figure. 4 Internal drive public transport service National University campus.

A total of 10 tag Active RFID were installed in vehicles of the universitary public transport service. The Platform for Intelligent Traffic Control (PCIV) was used in this case for storaging, processing, and presenting the information to the users. This platform is a web service used to estimate arrival times of public transport vehicles at certain stops from the data provided by installed readers. PCIV supports data provided by the active RFID reader through a process of validation and authentication previously established

It allows information to be displayed on an interface easy to read and accessible to users. The processing and display platform PCIV is shown in Figure 5.

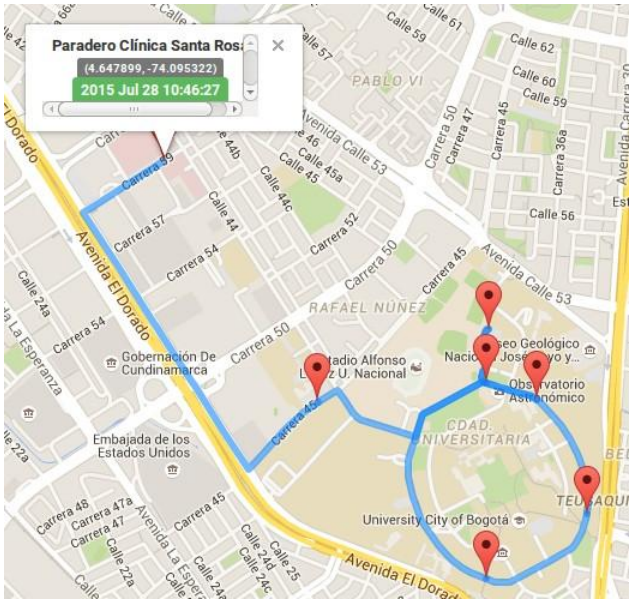

Figure. 5 Visualization platform. Blue will travel trans- port vehicle and red staging points established indicated.

Users can access the view provided by the PCIV platform through a web browser and typing the URL where the service is hosted**. http://www.rutas-un.appspot.com/**

6. RESULTS

The results of the implementation of an information system able to estimate arrival times at certain stops of a public transport vehicle using Active RFID technology are presented in this section. It is evident in obtaining these times by implementing Active RFID technology according to the scheme presented in Figure 1, and executed from the proposed architecture shown in Figure 2 in public transport offered by the National University of Colombia in Bogotá.

The table in the figure 6 shows the estimated arrival times for the implemented service, each time is related to a stop on the public transport system of the National University of Colombia, Bogotá is observed. Additionally each stop is associated with a geospatial coordinate in terms of latitude and longitude, to highlight the location of it.

In that sense this information is recorded, processed and displayed in real time by the PCIV platform, and is available to users.

Nombre	Latitud	Longitud	tiempos
Parqueadero	4.641925	-74.083691	---###-----
Paradero calle 26	4.632998	-74.083783	02:00:00
Paradero calle 45	4.635327	-74.080170	03:30:00
Paradero Iparm	4.640024	-74.083772	04:30:00
Paradero Uriel Gutierrez	4.639366	-74.089821	06:00:00
Paradero Clínica Santa Rosa	4.647899	-74.095325	10:00:00
Punto de control	4.639423	-74.081972	00:00:00

Figure. 6 Times obtained for the application

The times obtained for each stop public transport system, are the result of the arithmetic average held during reading time for 5 repetitions of the routes shown in Figures 3 and 4.

Figure. 7 arrival times system shutdowns in a public transport vehicle using Active RFID technology working.

The system running the user interface is shown in Figure 7, where its accessibility and implementation slight evidence.

We can say that the system has an approximate error margin at the estimated time of ±1: 30 min, which was determined during the commissioning of the system, facing a real situation with the information provided by the platform.

6. CONCLUSIONS

Into a complete system consolidation applicable to intelligent transport systems. The integration of Active RFID technology for mobility and transport dynamics favor the optimization of resources and time involved, generating a positive impact on the perception of users regarding the quality of service.

7. ACKNOWLEDGMENTS

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8. REFERENCES

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