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DESIGN AND IMPLEMENTATION OF A PROTOTYPE TO TRACK THE BUS ROUTE OF THE ANTONIO NARIÑO UNIVERSITY-CAMPUS VILLAVICENCIO

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ABSTRACT

This project focuses on the design and implementation of a prototype to track the bus route of the Antonio Nariño University - campus Villavicencio. The prototype was developed from a Web application for tracking and locating the geo-referenced position of system actors (drivers and members of the educational community); and a mobile application, which allows users to know vehicle location data and an estimate of the actual travel time. Applying and evaluating the developed prototype, it was possible to establish that it is functional. The service provided to the users is efficient and generates a great benefit to the entire university community. In addition, it encourages the use of the transportation system because it is easier to access the service, without having to wait a long time in the indicated points and avoiding inconveniences such as the loss of travel and additional costs to go to the University.

Keywords: geo-referenced location, mobile application, route tracking, web application.

1. INTRODUCTION

The Antonio Nariño University (ANU) - campus Villavicencio is located in the village La Cecilia at a distance of approximately 2 km from the road from Villavicencio - Puerto López in the department of Meta (Colombia). Unfortunately the different public transport routes do not enter La Cecilia, affecting the activities of the university community.

In order to benefit the students mainly and in general to all the members of the university community, the ANU has put to the service a bus that realizes several daily routes from the denominated park of the students, located in the center of the city, to the campus of the ANU. This provides a significant benefit to the entire community.

Although the university community has the schedules of these routes, which are duly published, the transportation in Villavicencio city presents drawbacks and congestions. This creates situations such as increased waiting time by passengers, loss of route, low levels of use and lack of knowledge of the location and route of the vehicle that is currently carrying out the route.

Due to this, this work proposes a system of monitoring and information in real time, on the schedules of the routes, location and displacement of the vehicle, which offers information to the users via a web application on their mobile devices. "Seeing real-time position of selected vehicles" will bring a great benefit to the entire university community and will encourage its use (Caballero, 2011). In addition, it will stimulate an increase in students who choose to enroll in the academic programs offered by the ANU - campus Villavicencio.

Every day technology is advancing in its development and launching of new applications that aims to locate specific places or categories by mapping, allowing searches and generating routes (Pastor, 2013). This is based on the improvement of the quality of life of society, hence the importance of this prototype that has web applications, fundamental in the monitoring system. It is an application available on a server, which is waiting to receive requests from a client to generate a response and send it. The client accesses the server application in various ways, being the most common through a web browser (Granados, 2014). This allows the user to perform various tasks. This application is easy to use since the interaction with the user is established based on elements to which he is accustomed (Cuesta, 2000). In addition, web applications can run in multiplatform environments (Londoño, 2014), which means that it does not have the need to create new applications for its operation.

Another important application for the prototype system is the Mobile Application which is a software application designed to run on Smartphones, tablets and other mobile devices. They are available through application distribution platforms, which are typically operated by the mobile operating system user. In addition, they have been designed according to the needs of users and the requirements of different web platforms that seek to carry out different functions for defined purposes (Arias, *et al*., 2014). Under the integration of these applications a prototype for the monitoring of the buses in a specific route was designed.

2. MATERIALS AND METHODS

The prototype was developed from a Web application for tracking and locating the geo-referenced position of system actors (drivers, members of the educational community), and a mobile application, which allows users to know the location of vehicles. The figure shows the schematic diagram of the system components. It can be appreciated that there is a web server with the databases and all information that is required so that the user can consult the location of the bus from the mobile device.

Figure-1. System components.

2.1 Web application for tracking and locating buses in routes

This application aims to locate on a map specific place or by categories, allowing searching and generating routes. In addition, it has zoom options to generate a better view. Through the web browser the user can make different types of queries, such as: view the map with zoom, different types of map (normal, hybrid, satellite), choose a route to view, start and end of the route, etc. (Caballero, 2011) the technologies used in this application are described below.

2.1.1. CSS

Language used to organize the presentation and appearance of a web page. This language is mainly used by internet web browsers and computer programmers to choose from a multitude of presentation options such as colors, font types and sizes. (Sierra, 2009).

2.1.2. HTML

HTML is the language used for the development of web pages. It consists of a series of tags that the browser interprets and shapes on the screen. HTML has tags for images, hyperlinks, line breaks, lists, tables, etc., which are essential for web application presentation (González, 2009).

2.1.3. PHP

PHP is a programming language with syntax similar to C and Perl languages, which is interpreted by an Apache web server and generates dynamic HTML code. That is, it allows creating a program that can be run on the server from a web page viewer program (Muñoz, 2011).

2.1.4. Laravel

Laravel aims to be a framework that allows the use of elegant and expressive syntax to create code in a simple way and allowing a multitude of functionalities. This framework will be used for a better development of the project in a simpler and more elegant way (Altamirando, *et al*., 2015).

2.2Mobile applications

The mobile applications to use are the Natives (iPhone, Android, BlackBerry, Windows Mobile) and Web Apps for mobile (Web Apps). The technologies used in the mobile application are described below.

2.2.1. Phonegap

It is an application development framework for multiplatform mobile devices. It allows creating applications with native aspect that can be developed in different mobile platforms: iOS, Android, Blackberry, Windows Phone, Web Os, Symbiam and Bada (Aransay, 2013). These are vital for the functional development of the mobile application structure.

2.2.2. Materialize

Materialize is a front-end design framework based on the design of materials that can be used in the application just like Bootstrap. This is undoubtedly one of the most impressive materials design frames. Provides SCSS, CSS and JavaScript files, along with design icons and source materials (Materialize, 2016).

2.2.3. JavaScript

It is an object-oriented scripting language (scripting) and allows developers to write source code that will be analyzed by a computer. It is a client-side language, that is, the scripts are executed by the user's browser (client). This differs from the so-called server-side scripting languages that are executed by the web server; this is the case of languages such as PHP. A server-side script will be responsible for creating the web page that is sent to the browser (Menéndez, 2013).

2.2.4. Android

It is platform software for mobile phones, based on Linux. In addition, tablets, netbooks, music players and even computers also use this operating system (although not very usual). Android allows programming in a Java framework, applications on a Dalvik virtual machine (a variation of the Java machine with run-time compilation) (Báez, *et al*., 2011).

2.2.5. Google Maps

It is a map application server on the web and offers scrollable map images. It has a tool to search. For example, it traces the route to go from one origin site to another destination, showing the result on the map (González, 2014).

2.2.6. GPS

It is a US-owned service that provides users with positioning, navigation and timing information. This system consists of three segments: GPS space segment consists of a constellation of satellites; GPS control segment consists of a global network of ground installations; and the user segment consists of the GPS receiving equipment that receives satellite signals (National Coordination Office for Positioning, Navigation, and Satellite Timing, 2016).

3. RESULTS AND DISCUSSIONS

The schematic diagram of the system architecture is presented below. It can be seen that the information is loaded from the mobile device located in the vehicle,

which in turn sends it to the internet from which it can be queried by users from fixed or mobile devices.

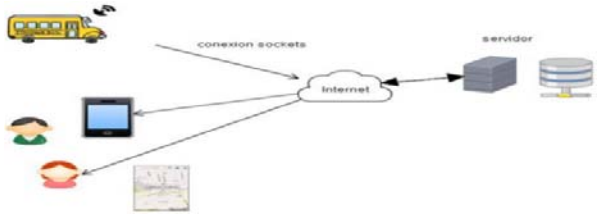

Figure-2. Schematic diagram of the system architecture.

Consequently, the first task to be executed is the development of the application to be installed in the vehicle, for the monitoring and transmission of its geo-referenced position and other variables that are necessary to provide the user with the required information. This application will be developed on the platform provided by the Android system.

The architecture of a Web site has three main components: a web server, a network connection, one or more clients (González, 2016).

The Web server distributes formatted information pages to the customers requesting them. The requirements are made through a network connection, and for this the HTTP protocol is used. Once the request is made through the HTTP protocol and the Web server receives it, it finds the Web page in its file system and sends it back to the browser that requested it (González, 2016).

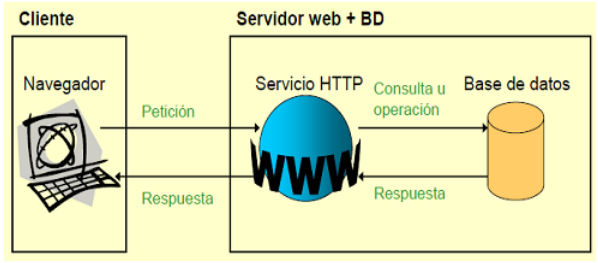

Figure-3. Architecture of a web application.

An Android Application works as a client. This contains the logic and interface of the application. Communication with the server is done using the library, a web services server provides the information of the points of interest (PI), this server is implemented using WCF (Windows Communication Framework), and this server can access the PI data. Communication between the Client and the server can be done through an Internet communications network (Najar, *et al*., 2012).

The cases of uses of the system are the following:

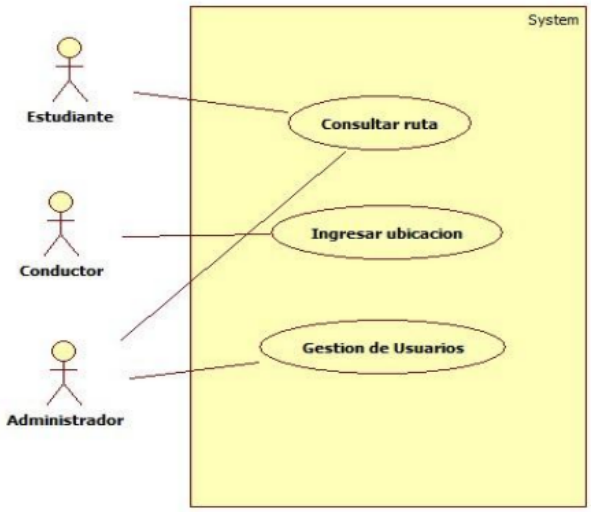

Figure-4. Uses of the system by the stakeholders.

Usage cases are made by the Stakeholders: students to consult route, the driver to enter location and the administrator who performs the management of users and maintenance of the system. The student by means of mobile application will have the current bus location. The driver through the mobile application, shares its location with other users. The system allows the users of administrator type to manage the access of the conducting users.

It has an architecture consisting of a web-type component and two applications for mobile devices, the first must be installed on a web server or local and applications on Android-type mobile devices.

The following is the operation of the system by each user:

- Log in where only authorized "driver" users will be able to access your account by means of credentials, such as their ID number and a password previously provided.
- Login for which only authorized users of type "administrator" will be able to access your account by means of credentials, such as their ID number and a password previously provided.

There is the option of editing profile, which allows users to update their data. Selecting the route of the route will load the stops, and begin to share your current location (driver).

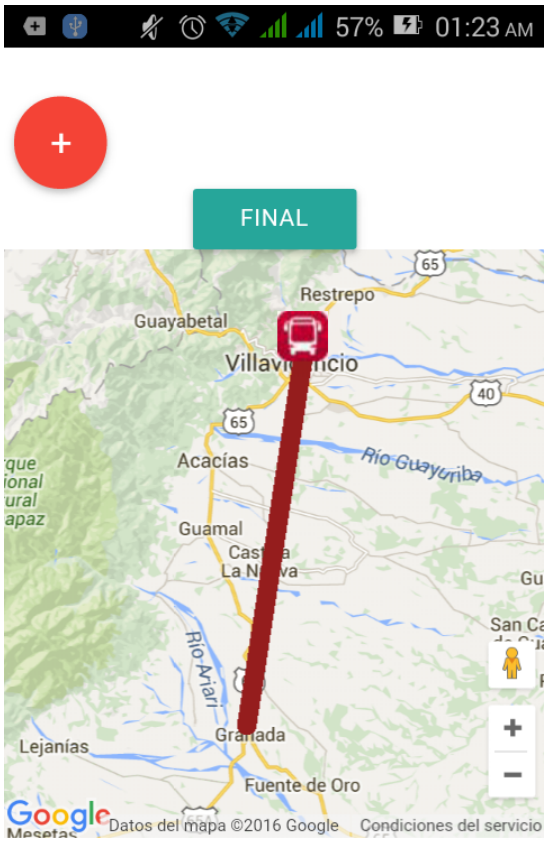

Figure-5. Route selection.

The current driver location is shared as long as it has an internet connection. In case of losing the route the mobile will indicate it.

It is also possible to search the users by their name or ID. In this case basic data such as last name, name, ID, age, date, state, etc. are displayed.

It allows the editing of basic data like name, surname, ID, gender, address, telephone, date of birth, state. It can mainly change the password of any user in case of loss. Enables or disables users to prevent them from accessing the system.It also allows the creation of new users by filling out a form similar to the user editing form.

For the web administrator installation process, the following steps were performed:

- On Linux install Apache 2: Open a terminal, Install apache 2, using the commands: sudo apt-get update and sudo apt-get install apache2.
- Open a web browser at the address: http://localhost/
- Install mysql and php>= 5.5.9
- Create a file named miphp.php with the following information: phpinfo (); This file is stored in the address: /var /www /html
- From the browser opens http://localhost/miphp.php
- Install phpmyadmin using the command: sudo apt-get install phpmyadmin
- Type in theweb browser: http://localhost/phpmyadmin
- Create the database, after that, enter the database: import the file "base.sql"
- Copy the source folder to: /var /www /html

EL Database model, consisting of: Stop: saves the information of the stops, Route: saves the information of the route; Current_path: indicates which route you are working in the cities, Coordinates: saves the geo-referenced data of the bus, taken by the driver's device; User_type: User classification, Users: basic user data and Report: notifications made by the driver in order to inform in more detail the current status of bus.

Evaluation of the operation of the prototype and the necessary adjustments for its optimization were made. It was possible to establish that the system of monitoring and information in real time, on the schedules of the routes, location and displacement of the vehicle, provides sufficient information to the users to obtain access to the bus transport system of the ANU, without mishaps and under a constant monitoring that allows to be in the indicated stop, for the trip to the campus.

The prototype that was developed to follow the route of ANU - campus Villavicencio, was designed from the integration of a web application that allows the geo-referenced location of vehicle or bus and the route to the campus defined for the benefit from service; And a mobile application, which allows users to enter the platform to know the real location data of the vehicle and an estimate of the time of travel, which can reach the respective stop for transfer to the University on the outskirts of the city.

The system will be on an environment which has internet access, allowing access to the user through this connection and will indicate with messages in case of error or necessary information.

The system will be over an environment which has internet access, allowing access to the user through this connection and will indicate with messages in case of error or information necessary for the user to understand what happens. Mobile applications are supported on the Android system and access to the system is only allowed by means of credentials such as the user ID and password provided for each user requiring the application.

The system has functional advantages that are easy to use, due to the user's interaction with the mobile phone and the web pages, which allow him to know the functionality of the system with little effort. It is easily accessible, from any point in the network, as long as the user is authorized. Portability of the system because web browsers have been developed for all types of equipment with defined basic characteristics. In addition it will be easy to develop the prototype because it has availability of components and updating them for continuous improvements.

Through the construction of the prototype you can follow the route of the bus. However, a stable connection must be ensured by the driver, because during the tests information was lost. The connection must also guarantee a data redundancy, in order to avoid the loss of vital information for the operation of the system.

It was determined that, because it is a centralized system, a server crash would cause a malfunction, since all users work with the centralized data on the server. In order to avoid this, using a VPS from Digital Ocean services was considered. When evaluating the developed system, it was established that it is functional. The service provided to the users is efficient and generates a great benefit to the entire university community. In addition, it encourages the use of the transportation system, as a way to access the campus and fulfill the assigned functions.

The system allows users to know the real-time location of the vehicles that make the route of the route defined by the ANU. With this, the service is more easily accessed, without having to wait a long time in the indicated points, avoiding inconveniences such as loss of travel and additional costs to get to the University.

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