

# UNIVERSIDAD TÉCNICA DEL NORTE



## FACULTAD DE INGENIERÍA EN CIENCIAS APLICADAS

### CARRERA DE INGENIERÍA EN SISTEMAS COMPUTACIONALES

#### INFORME TÉCNICO

**TEMA:** Diseño e implementación de un sistema web geo-referenciado para la localización y análisis de información en tiempo real de vehículos, utilizando software libre y cartografía editable.

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# DESIGN AND IMPLEMENTATION OF A GEOREFERENCED WEB SYSTEM FOR LOCATING AND ANALYZING REAL-TIME INFORMATION OF VEHICLES, USING FREE SOFTWARE AND MAPPING EDITABLE

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**ABSTRACT:** We seek a mechanism to decrease the vehicle theft and "express kidnappings" in Ecuador, as well as the improvement in the profitability of the business for the transport of persons and / or valuables, so that in the future people keep doing further research in treatment technologies appropriate spatial data. The geo-referenced web application is made entirely on the basis of free and open source software, based on Java, PostgreSQL, Apache Tomcat, JPA, AJAX, JavaScript and OpenLayers, tools that have been used in the best way, thanks to agile development methodology and best practices, such as a MVC design pattern, and programming standards as well as the optimization of technological resources, using multithreading, and data persistence using UDP as the most optimal transmission protocol Data for sending frames from the vehicle locator to server. Was achieved optimal interaction with the locator device imported from China, also gave a good service to respect the Virtual Private Server (VPS) based in Madrid, Spain. Therefore, it is necessary to develop these types of technology for effective economic and technological development that the country needs.

**KEYWORDS:** Geo-referenced, Locating, Vehicle, Space, OpenLayers, UDP, Locator, VPS, MVC.

## 1. INTRODUCTION

As information technology and communication developed rapidly in recent decades, the technological needs of the human being increased geometrically, such as the trivial need of fast and efficient processing of alphabetic and numeric data, and lately to locate a person or thing through a geographic computer system.

Moreover, the criminal situation in Ecuador is dramatic, for decades there has been a high rate of vehicle theft, as well as the so-called "express kidnappings" have sunk into despair Ecuadorian

society, and efforts of the government to control and prevent are not effective enough.

## 2. OBJECTIVES

### 2.1. General

Design, develop and implement a georeferenced Web system for locating and analyzing real-time information of vehicles, using free software and mapping editable, to resolve some of the security issues affecting the country and improve business profitability transport of valuables and / or people, in a time limit of six months.

### 2.2. Specific

- To design the system according to a robust technology architecture, and proven stable, focusing on solving the problem, used in the most efficient hardware infrastructure with which it interacts.
- To develop the system using free software in full based on the best development practices and standards established in the planning of it, so that the system is easily extensible and maintainable over time.
- To implement the system based on the results of the functional tests conducted.

## 3. SCOPE

Regarding the devices used for GPS tracking, the system will be developed for the compatibility with the VT-310 AVLS from China for its low cost and high demand in the country, because of its versatile features and latest technology. When it comes to web mapping server will use the third-party maps: Open Street Map, to be editable and free software.

The application contains the following modules:

- Communication module.
- Security module.
- AVL's Management module.
- Maps and mapping viewer module.
- Report module.

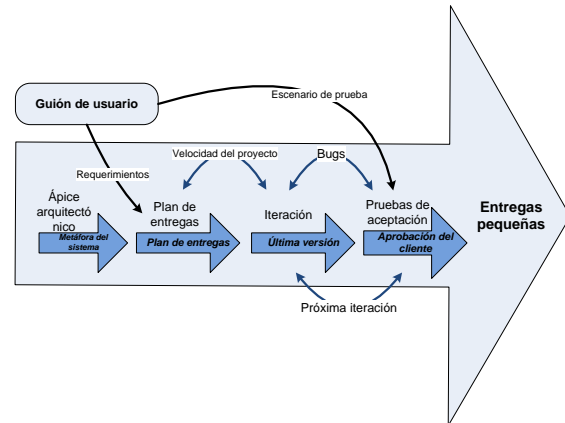
#### 4. JUSTIFICATION

It is necessary to develop a geo-referenced web system for locating and analyzing real-time information of vehicles is a national, independent, because the existing systems of this type in the country are purchased abroad or turn developed the country but with the same technological dependence, as is the case with the use of *Google Maps*® mapping for development, or worse tools developed proprietary software such as *Microsoft Corporation*®, which leads to the construction of software with closed standards, preventing, *handling*. This application seeks to wean Ecuadorian society of foreign technology, isolating support from abroad, as well as the purchase of software licensing of foreign corporations.

#### 5. METHODOLOGY

We used the agile methodology of software development "Extreme Programming", better known as "XP" (Extreme Programming). We used it for being an agile methodology, based on a series of good values and pursuing best practices in order to increase productivity.

This programming model is based on the compilation and synthesis of traditional methodologies, in which priority is given to work with direct results, significantly decreasing the protocol documentation. Less documentation and more operating software.



### 6. THEORETICAL FRAMEWORK

#### 6.1. ¿What is a geo-referenced web system?

A geo-referenced web system is a Geographic Information System (GIS) that operates on the Internet. The term GIS or GIS currently applies to computer systems for storing and analyzing data using specialized equipment and software in managing geographically referenced spatial data. There are several definitions to characterize a GIS. "A GIS is a 'computational tool' composed of hardware, software, geo-referenced data and requiring users organize, analyze, automate processes and produce information" (Solivelles, 2012).

#### 6.2. Web Server and servlet container Apache Tomcat

A web server and servlet container is the software that allows the system to operate geo-referenced on the web, is one who is responsible for making the deployment of the web application developed in Java and under a Java Enterprise Edition (J2EE) multilayer. . The servlet container is responsible for interpreting "servlets" (implemeta Java class that interfaces to receive data from the client and sending data to it, among other benefits).

#### 6.3. Data Base Management System PostgreSQL + PostGIS

As relational database management system (RDBMS) PostgreSQL was chosen, because today is the most widely used RDBMS software development because

it has great performance in transaction and a myriad of features that make even more potent.

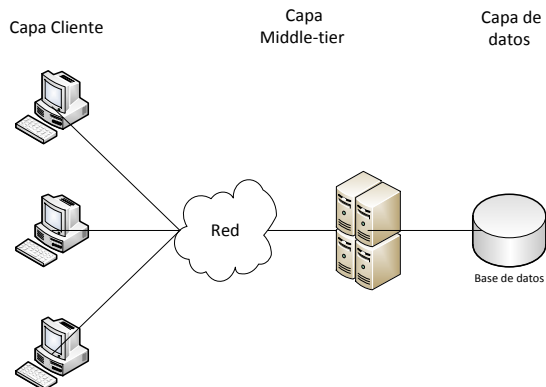
If it is understood that a GIS or GIS (Geographic Information System) is an organized integration of hardware, software, and geographic data designed to capture, store, manipulate, analyze and display all forms of geographically referenced information to solve complex problems of planning and management, it is easy to understand that PostGIS is one of the tools to perform the above, calculating the relationship between the geographic objects that are very difficult to model unused space objects.

#### 6.4. Programming platform Java Enterprise Edition

There are several features that has Java Enterprise Edition, one of which is that: "Using the libraries included in this platform, it is possible to build robust applications that can be hosted on a wide range of servers and they are able to be executed from different types of customers "(Martin Sierra, 2011). Then, considering the future needs to be submitted for these web applications, is planned to develop a system with these features and services that can scale future.

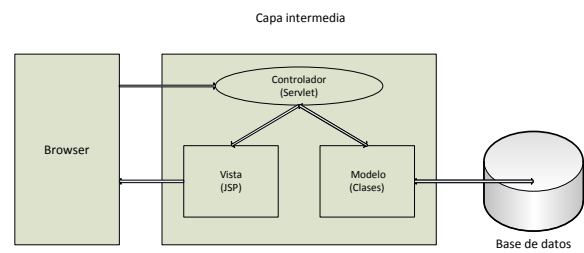
##### 6.4.1. Three-layer architecture

A web application is a computer program that can serve multiple users simultaneously run it through the Internet. These types of applications are based on what is known as a three-tier architecture, where the different actors involved in the same elements are divided into three blocks or layers (Martin Sierra, 2011), so that given the current needs regarding Internet solutions, we planned to build a web application with the aforementioned architecture.



##### 6.4.2. Model View Controller Architecture

The intermediate layer is developed based on an architecture Model View Controller (MVC), since it is necessary to structure a model for this layer in a series of blocks or components, so that each of these functions are defined within the application and can be developed independently. In addition, MVC architecture conforms to the development of an application with the Java Enterprise Edition platform, architecture that provides a clear separation between the different responsibilities of the application components.

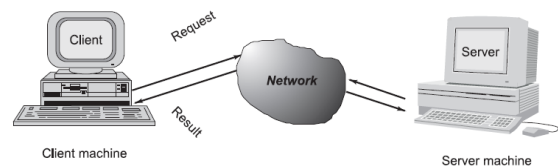


#### 6.5. Programming platform Java Standard Edition

It is a platform that provides all the functionality needed to develop an application that allows for proper interaction with the AVL server.

##### 6.5.1. Sockets Programming

To make it possible to interact with the AVL server and thus tracking the vehicle in question, it is necessary to make a socket programming on the server itself. Thus the AVL will have the ability to communicate with the server where it is hosted web application of this work, so it is necessary to implement a platform for client / server communication.



#### 6.6. JavaScript

JavaScript rather than a programming language has become an essential tool in the development of the user interface of a web application, because it can handle all the functional components of a web browser and manipulate the user experience

according to same needs and capabilities of the software developer (Zakas, 2006).

### **6.7. AJAX**

The AJAX term refers to a mechanism for combining technologies and customer standards, consisting of asynchronous request to the server from a web page and using them to update a portion of it, without forcing the browser to make a reloading of the whole page (Martin Sierra, 2011).

### **6.8. Map Viewer**

To make the map display and the construction of related dynamic characteristics of the vehicle position in the geo-web system was used refernciado free use JavaScript library: OpenLayers, which has allowed us to develop the characteristics that make this system an application intended use web for geography.

### **6.9. OpenStreetMap**

OpenStreetMap, also known as OSM map server is created as a collaborative project to create free maps and editable. OpenStreetMap uses a topological data structure. The data is stored in the WGS84 datum lat / lon (EPSG: 4326) Mercator projection.

The main servers are housed in the University College London. The server infrastructure associated with the OSM project is composed of a database server for high performance, an application server for the website, three application servers for the API and a server application for map rendering.

The database server management system used as database PostgreSQL PostGIS spatial extent more storage space geometry of objects in vector format, also used as renderer Mapnik © these spatial data are stored in the same . The website and the API are largely programmed in Ruby on Rails.

## **7. DESARROLLO DEL SISTEMA**

### **7.1. ÁPICE ARQUITECTÓNICO**

This section aims to explain in detail the whole process done in the planning phase of system development geo-referenced web. Is divided into:

- Customer interaction
- Study of the tools, technologies and development practices.
- Construction of the prototype structure and design.

### **7.2. Release Plan**

The delivery schedule is comprised of:

- The prioritization of user stories.
- Development of scheduling.

### **7.3. Construction**

#### **7.3.1. Iterations**

This section details each of the iterations, describing the tasks performed, as well as acceptance tests and incidents. The iterations were:

- First iteration
- Second iteration
- Third iteration
- Fourth iteration
- Fifth iteration
- Sixth iteration

### **7.4. Release**

#### **7.4.1. Implementation of the final release**

This section details the process undertaken to implement the application on the VPS (Virtual Private Server), which was leased to the service provider by adding a pre-installed operating system CentOS 5.8. The implementation consists of the following parts:

- Compiling PostgreSQL
- Compiling PostGIS
- Installing Apache Tomcat
- Creation of the database.

#### **7.4.2. Manuals**

This section describes the manuals that explain how users use the system correctly. The system handles two types of users are:

- **ADMINISTRATOR:** It is in charge of the administration of the system, is responsible for

creating the system's AVLS, as well as end users to create, not Administrator type users.

- **END USER:** It is the one that gets all the functional benefits of the system, the system was created for this person.

## 8. CONCLUSIONS

- With respect to the implementation of the VPS with the core software as the operating system required, the lease and the implementation of it, was very easy to get, what concerns the installation of additional software as the basis of geo-spatial also did not demand a thorough investigation.
- It was necessary to acquire AVL vehicle tracking with delay in shipping from China but without inconvenience. They had to choose another cellular operator because Sure, it was proposed to use in the preliminary driving higher costs relative to Movistar, which finally decided to use. Moreover, AVL configuration to operate with Movistar had no major drawback because concise and detailed documentation containing this.
- The Java application development for communication, storage and decrypted frames of AVLS successfully achieved through the implementation of Sockets programming explained in Chapter II, was the most exciting development since it was believed that going to be the hardest work.
- Modification of the Open Street Map mapping is an essential advantage for what is developing such solutions, since it is possible to correct mapping errors and add missing information in it, and thus collaborate with the community

OSM international so that everyone is in the ability to use this mapping.

- Adding and customizing Open Source tools such as the display of maps, mapping, frameworks (libraries JavaScript) client-side and server-side has been a very rewarding field because it has been able to exploit these tools to the fullest capacity through extensive documentation exists and is also able to manipulate the source code in some of them, and therefore is considered to Open Source tools as a rich source of knowledge and science.
- In general, the development of this work has had an impact on the author as this has been his first work of this magnitude in the field of knowledge of computer science and communications, so this work will be the apex of a great investigative work when it comes to these sciences and propellant big dreams.

## 9. RECOMMENDATIONS

- An ideal would close foreign technological independence when it comes to the production of equipment using GPS locators, in Ecuador is making inroads in this field but still not enough because the lack of industrialization in our country is lagging. Similarly with regard to acquisition of Ecuadorians servers that offer their services, you should put more emphasis on these issues.
- The Open Street Map mapping is released for public use so that everyone should correct or enhance information on this platform for the common benefit.

- Also, it is recommended to emphasize the use of free and open source software because with them because you can extend the range research in the area of computer science and computer systems which would lead to technological development and thus economic development of the country.
- Finally, we recommend continuing research new technologies related to geographic software because it is a new field that is taking the baton from traditional software like financial and accounting software as the area of artificial intelligence; therefore is made use of this work for those purposes.

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