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Web System Proposal for Control and Monitoring Fleets

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Abstract

Systems for managing and monitoring fleets are of great use nowadays due to their ability of controlling and visualizing in maps the routes assigned to their fleets with GPS (Global Positioning Systems) devices. These systems provide lot of usability to their environments because they improve the way that the workers utilize vehicles in fleets. They have helped the enterprises to detect delayed deliveries, routes detours, urgent maintenance reports and oil saving. In Cuba the system used by majority of enterprises was one that does not make route monitoring during vehicles trip making almost impossible to control if there was any inconvenience during the trajectory of the vehicle, causing the loss of several minutes and even hours to help the broken vehicle to get back in service again. In this paper a proposal to fix this is made by using coordinates taken from a GPS device and stored in KML or GPRMC format files. The system besides will allow supervisors the creation of routes and areas assigned to vehicles in fleets, in which the behavior of the vehicle will be reflected lunching alarms when the vehicle incurs in detouring problem and even in an over - speed problem. Also all the irregularities detected during a movement of vehicle will be registered in a database for supervisor revising purpouses.

Index Terms: GPS, Fleet Control, Positioning, Monitoring.

1. Introduction

The many advances in the last decade in the field of computing and telecommunications has led to the creation of various Geographic Information Systems (GIS) technology combined with GPS (Global Position System) have facilitated the development of IT applications capable of monitoring any type of sailing either land or sea. These programs are known as Fleet Management Systems, which are used to display a map in vehicles equipped with GPS devices. Fleet management can include a variety of purposes and functions such as

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maintenance, monitoring and control, remote detention of vehicles, mechanical diagnostics, driver management, fuel management, security management and overall, everything related to the analysis of data and information available and decision making related to the fleet. [1]

Every time there is an increased tendency to install fleet control systems as they provide a huge tangible benefits in the short and medium term in terms of profits and capital savings [2]. Companies commonly use this type of systems are related to the transport of goods by road, sales teams, ambulances, firefighters, transportation of passengers or any market that has the need to maintain tight control of their fleet.

A need for Cuban companies is to manage efficiently the resources they have, so are forced to develop strategies to help improve the administration of the means at his disposal, bringing a substantial improvement in both the public service delivery and the business sector.

The administration of the means of transport within the Cuban enterprises is one of the hardest hit areas due to the large number of indiscipline being committed by some workers in this sector. Usually it happens that many entities have economic losses due to inefficiencies in the services provided by transportation. The main faults are deliveries outside of time, inefficient routes, diversions tours with no corresponding interest with the company, thus increasing mileage, customer dissatisfaction, fuel consumption and decreased the useful life of the equipment.

In Cuba there is a control system that makes it possible to obtain different fleet vehicle data once the route is finished. This system cannot be aware of everything that happens during transit fleet to their destination. For example, the occurrence of a technical disruption of the pathway would be lost valuable minutes or hours between the occurrence of the event and the response to it.

After the situation described by the cross today Cuban companies with various means of transport, there is the following problem to solve: How to control the movements of the vehicles belonging to Cuban companies during their routes?

Taking into consideration the defined elements are presented a set of questions that constitute the main motivation of this research:

- Is it possible to visualize the routes of vehicles during their daily functions?
- The supervision of the route of vehicles will improve the control of the cuban enterprises over them?
- To accomplish the general objective, specific objectives are pursued:
- Create a mechanism for obtaining and decoding of frames with information either KML (Keyhole Markup Language), GPS, GPRMC (Recommended Minimum) formats.
- Create a system capable of interacting with supervisors fleet vehicles through visualization, insertion and modification of data in it.

2. State of Art

To know the characteristics of some the worldwide utilized computer applications dealing with management and control of fleets took into account the results of Internet searches on different search engines such as Google, Bing and Yahoo. Following the results obtained as solutions.

MobileFleet: Is a company specializing in the management and control of fleets through a software solution called PSPFleet, which is able to control enterprise mobile assets wherever located and also allows access from any (vehicles, people, machinery, etc..) site thanks to new technologies. PSPFleet is a web application and is available online. IT has restricted access by username and password for each client to access the information you want to control from mobile assets, such as routes flown, reports, alerts, activity, etc. [3]

Another solution that was analyzed was developed by the company Micronav. This enterprise was created in 2004 in response to the growing demand from the transport companies. It has a standard technological solution that allows to efficiently manage and control the resources at their disposal. Among the main features that comprise this system are using GoogleMaps mapping, real-time tracking of fleets and the option to export reports. [4]

In Cuba there is a solution for vehicle tracking called MovilWeb, this is a web application for tracking moving on vector and raster mapping, designed to control fleets within a client - server architecture. This tool allows monitoring of mobile remotely over a communications network, making it possible to reconstruct the behavior of the vehicle in a given period of time, rebuilding his route, analyzing their speed and unauthorized stops. This application draws on the geospatial services available in the Spatial Data Infrastructure of the Republic of Cuba (IDERC) services as satellite images and vector mapping. [5]

After analyzing the solutions offered by MobileFleet and Micronav, a conclusion can be made. These companies have software capable of solving the problem, but require a fast connection to the Internet, since the applications are published in servers of the respective companies. They also use services like Google Maps and Google Earth so that the use of these systems in Cuba depends heavily on a technological infrastructure that must companies do not have today. There is a Cuban solution called MovilWeb for managing fleets and rebuiling its route, but does not perform monitoring during travel of the vehicle, making it impossible for the greatest amount of information to further active fleets have. So the creation of a new fleet management system that fits the needs and characteristics of Cuban enterprises is necessary.

3. Used Technologies

The technologies of information and communications had a great impulse in recent years which has led to the creation of many tools that ease the creation of websites. For the development of the present proposal it is necessary that the technologies that are used to help improve the results of it in terms of stability and security. Also due to license problems those technologies must be from the free software community. The following frameworks, technologies and tools were used.

3.1. Spring Framework

Spring is an open source framework, created by Rod Johnson to deal with the complexity of enterprise application development. It has several years on the market, which facilitated its constantly evolving and due this it currently provides well documented and easy to use solutions. It also provides the ability to integrate with other tools, as well as various frameworks such as: Hibernate and Spring Security. [6]

The main characteristics by which it was decided to use this framework are discussed below: [6]

- Configurable: sets and compose complex applications from simpler components. Application objects are composed declaratively, typically in XML (Extensible Markup Language English) or Annotations.
- Flexible: designed as a series of modules that can work independently of one another. It also maintains a minimum coupling between the application and the Framework itself so that it could be detached without too much difficulty.

3.2. OpenLayers Framework

Open Layers is an open source tool which runs on the client side. It is designed to work specifically with maps and is compatible with most web browsers. The mentioned framework works entirely client side, any specific configuration or server-side software to be executed is not necessary. OpenLayers has achieved a high level of maturity due to the large number of developers collaborating in its development, being an active part of the community of this framework. [7]

Open Layers is used as it is an open source tool for viewing maps on the client side and having compatibility with most web browsers.

3.3. Database Management System. PostgreSQL 8.4.0

PostgreSQL is a database management system for object-relational data, distributed under BSD license and its source code is freely available. It is considered the more powerful open code management system databases. [8]

Some of the main features of PostgreSQL are listed in Table 1:

Table 1. Main features about PostgreSQL 8.4.0

Limit	Value
Data base maximum size	Unlimited (Depends of the storage system)
Table maximum length	32 TB
Row maximum length	1.6 TB
Macimum field length	1 GB
Maximum rows per table	Unlimited
Maximum columns per table	250 - 1600 (depends of type)
Maximum number of indexes per table	Unlimited

3.4. GeoServer 2.1.3

GeoServer is an open source software server written in Java that allows users to share and edit geospatial data. Being a community-driven project, GeoServer is developed, tested and supported by a diverse groups of developers and organizations worldwide.

GeoServer is the reference implementation of the Open Geospatial Consortium (OGC), also has a high yield certificate of compliance Web Map Service (WMS).

3.5. Front-End AVL 1.0

The Front-End AVL (Automatic Vehicle Location) connects to AVL server through socket port and using communication commands obtains geographical information from each of the devices with GPS technology. In addition, a configuration must be made to get the format in which geographical information can be received, for example NMEA (National Marine Electronic Association) format. It also allows the creation of TIG tracks to share GPS information with GIS to consume this service [9]. More explanation about this process is illustrated on Fig. 1 where can be seen how the previous process is done.

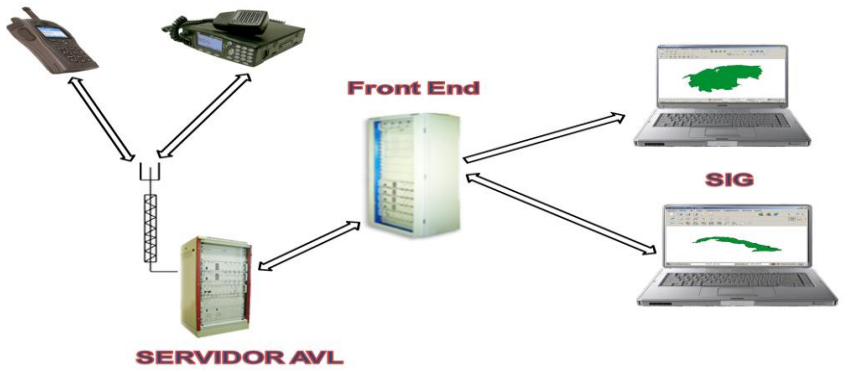

Fig.1. AVL Infrastructure

4. System Proposal

As described in the previous sections there is a need to automate the process of fleet control during their route, and to manage routes and areas, which could then be assigned to the fleet. Similarly it is necessary to maintain a record of information vehicles that have committed any offense during their stored.

This proposal intends to create a web system to monitor and analyze the behavior of vehicles during travel. The system will be deployed on a web server, Apache Tomcat v6.0.26 specifically, which may be accessed by supervisors from a client computer using a web browser. To visualize the position of vehicles, the system will use the external application Front-End 1.0 AVL, which will provide GPS fleet information in KML(Keyhole Markup Language) format or GPRMC(GPS Recommended Minimum Configuration). This information consists of the longitude, latitude, altitude and time and date for the position of the vehicle, to be displayed on a map, which will be obtained through a WMS service (Web Map Service) published by GeoServer version 2.1.3 map server. It will also allow supervisors to create areas and routes, which will allow to define the behavior of the fleets.

The system will be capable of detecting irregularities in the behavior of vehicles, such as speeding and deviations from assigned routes. These irregularities will be recorded in a database, storing the vehicle name, type of offense and the time that he committed the offense, for later reference.

The following image shows a visual description of the proposed system:

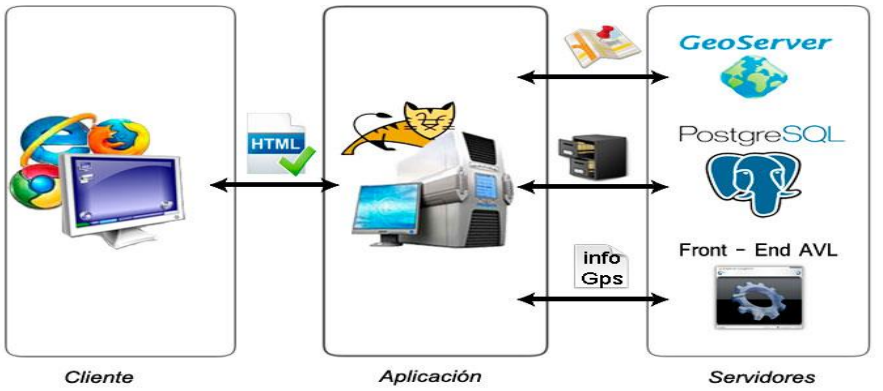

Fig.2. System proposal

For the creation of this proposal is considered appropriate the use of a domain model, since there is not a customer nor partner who can clearly explain the business processes, so these are not well identified. Also the team does not have experience working with fleet management systems. Domain Models make possible understanding the concepts with which users interact with the application when the processes of it are not clearly visible business processes. In Fig. 3 a domain model of the system proposal that could be used to understand better how the proposal is going to work once in a real environment:

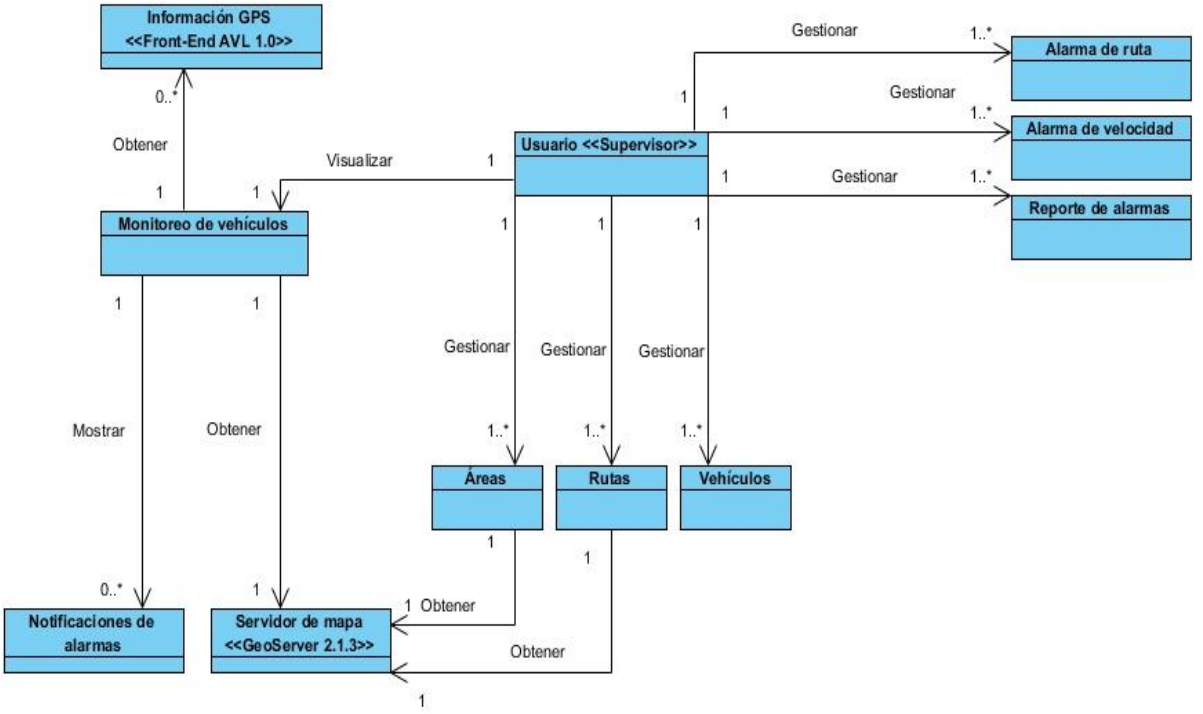

Fig.3. Domain model of system proposal

In figure 3 there are shown some concepts of the proposal that need to be explained in order to understand how system will work. Those concepts are listed following:

- Supervisor: The one who controls the vehicles and every information concerning their routes, speed, and other variables.
- Alarma de ruta: This concept represents relative data about the route assigned to vehicles.
- Alarma de velocidad: This concept represents relative data about the speed stablished to vehicles.
- Monitoreo de veh ículos: This concept represents relative information and position of active vehicles.
- Notificaciones de alarmas: This concept represents information that will be shown to supervisors in case of detection an irregular behavior of a vehicle.
- Historial: This represents the stored information about vehicles captured within a period of time.
- Servidor de mapa: This represents map server GeoServer 2.1.3, which provides maps to visualize location of a fleet.

Functionalities are conditions or capabilities that the system must accomplish. In Fig. 4 are shown de functionalities that will contain the system.

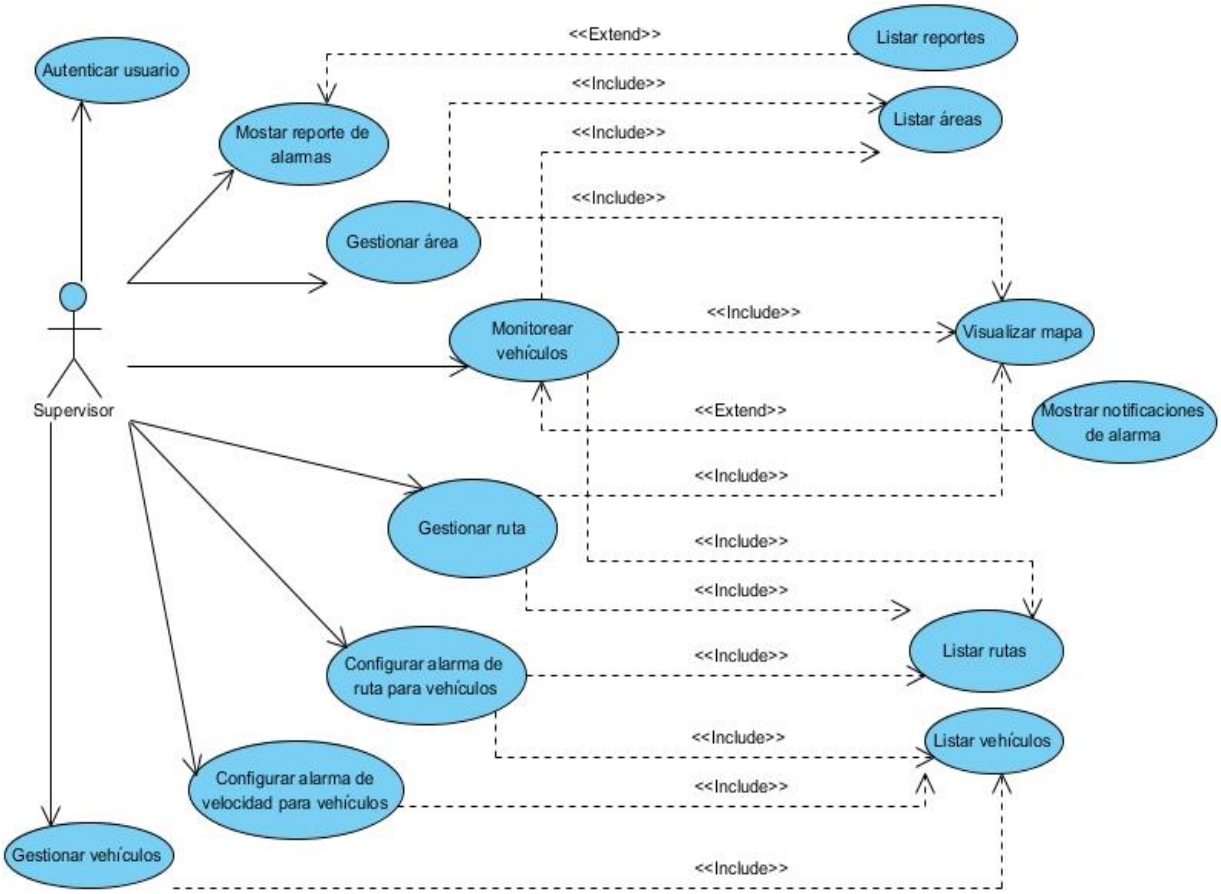

Fig.4. Functionalities proposed

4.1. System Arquitecture and Patterns

Architecture is the hierarchical structure of program components (modules), how the components interact and the structure of data to use the components. Can be generalized to represent the main elements of the system and their interactions. [10]

The MVC pattern refers to the threefold division of an application, which are [11]:

- Model: Contains information that is transferred between the controller and the view. It also stores the data of the business model, such as operations, transformations and rules for data manipulation.
- View: The views are used to display system information via user interfaces.
- Controller: It is responsible for processing requests, perform operations with the model classes and restore sight to be shown to the user.

Each part of the MVC architecture is defined only for a purpose, for example the logic is responsible for manipulating the data that is contained only in the model, the logic to display the data is only handled by the view, and the code that is responsible for managing the user requests and return the specific views is contained in the controller. This division between components of the application allows the programmer to organize all

items, facilitating the maintenance and extension of functionality at any time of the software lifecycle. [11]

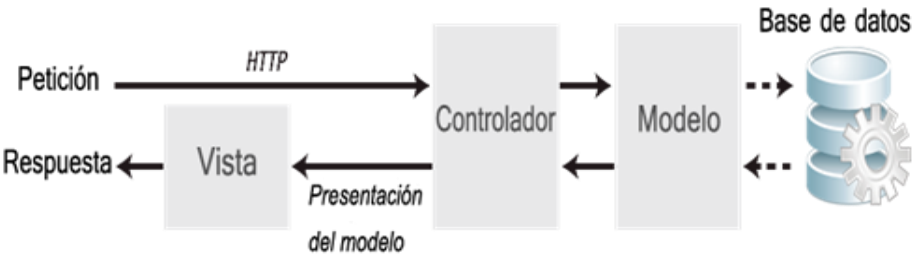

Fig.5. MVC Arquitecture

5. Results

After some months of investigation, design, implementation and test this proposal reveals as a final product that could be use in Cuban enterprises. The system is able to successfully manage all the information about fleets, vehicles, routes, areas and alarms. The following image shows the functionality Routes and Areas Management.

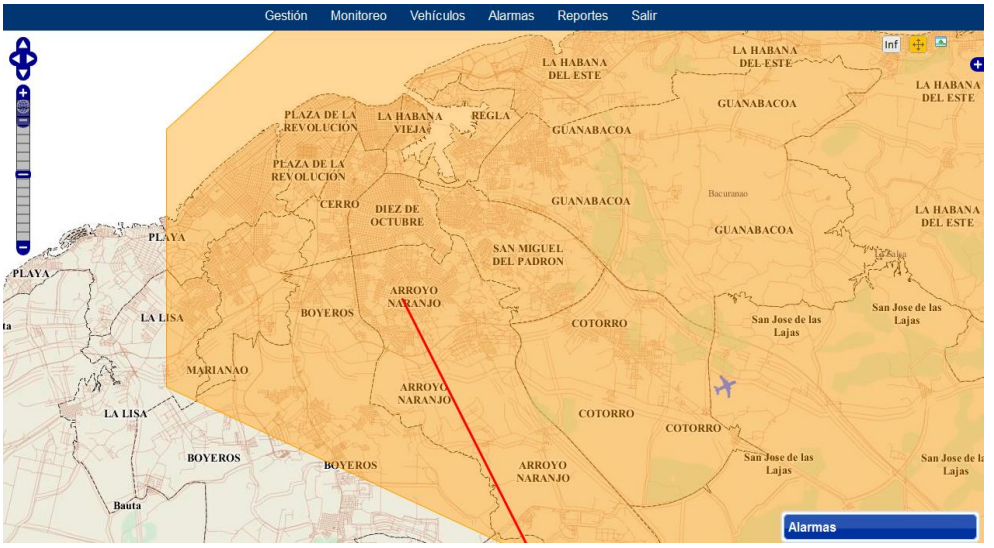

Fig.6. Routes and Areas Management

There is also some useful functionalities that the system supervisor can use to get real information about vehicles (Fig. 7) moving in their respective routes and areas, that can allow him to have a real notion about what a driver is doing in his way to a destiny but even if he is following the trajectory of another vehicle, the system will rise alarms when any of the registered vehicles in the system increase their mandatory speed, change its route or stops for a several time (Fig. 8).

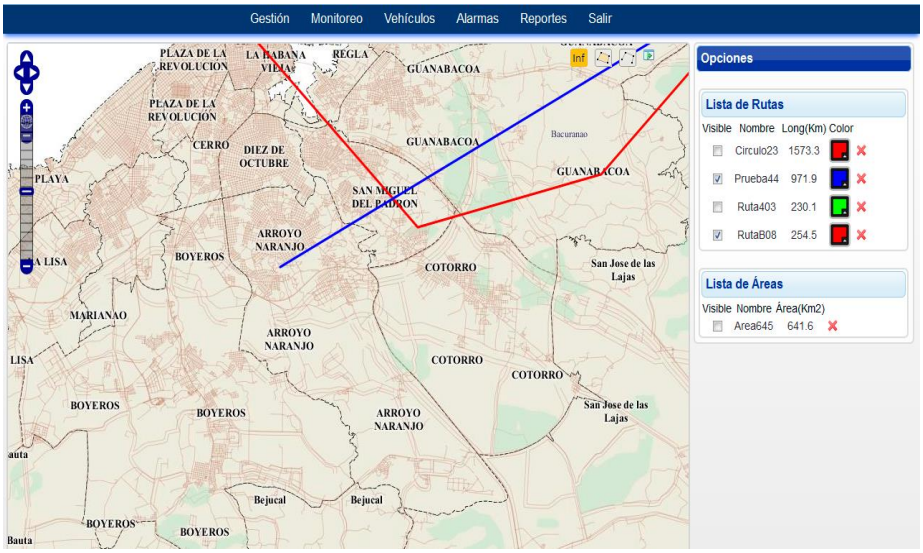

Fig.7. Monitoring Vehicles Functionality

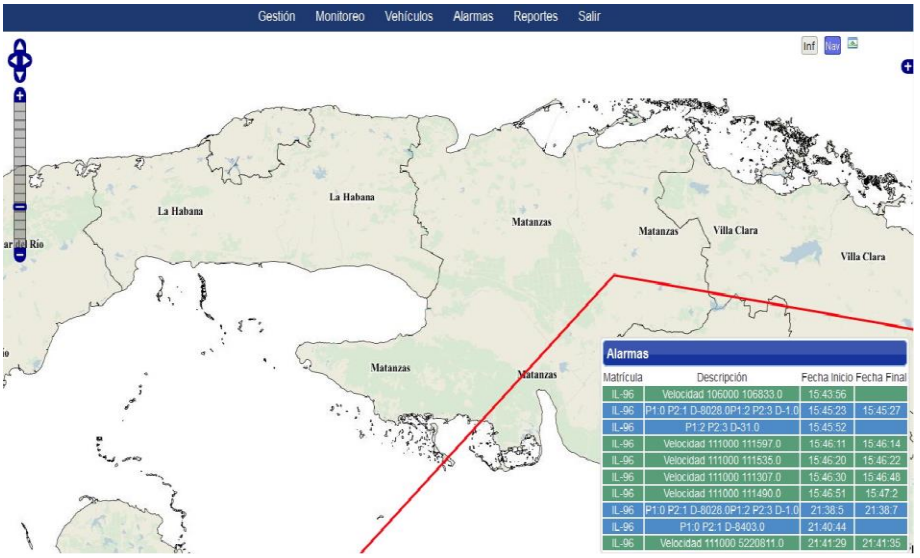

Fig.8. Alarms rised by vechicles incorrect behaivor .

6. Conclusions

This paper has presented a proposal of a web system for control and monitoring fleets in the Cuban enterprise environments.

The design diagrams, the selection of appropriate architecture and design patterns and the used frameworks and technologies has lead this investigation to the creation of a system that can be used in any enterprise concerning transport fleets. This system can obtain the real positioning coordinates while vehicle is moving allowing system supervisor to control their status in any point of their real trajectory. Also the system is able to

manage information of those fleets, routes, areas and alarms by the insertion, modification and visualization of the stored data.

One of the advantages is the fact that this system was developed using only free technologies so it is patent – free meaning that Cuban enterprises do not have to pay for extra licenses to make an effective control of their vehicles. It also has been developed in terms of scalability so with further development the system can grow strong with some security features like the use of digital certificates.

References

[1] Gestión de Flotas e Inteligencia de Negocios. Gestión de Flotas e Inteligencia de Negocios. [En línea] 2008. [Citado el: 21 de Septiembre de 2012.] http://www.ful-mar.com.ar/es/gestion-de-flotas.php. 1.
[2] Introducción respecto a los sistemas para control de flotas de vehículos. [En línea] 11 de Octubre de 2011. [Citado el: 24 de Septiembre de 2012.] http://es.scribd.com/doc/70647884/Control-de-Flotas.
[3] MovilFleet. MovilFleet. [En línea] 2012. [Citado el: 12 de Octubre de 2012.] http://www.mobilefleet.es/que-es-mobilefleet.php.
[4] Micronav. Micronav. [En línea] 2012. [Citado el: 14 de Octubre de 2012.] http://www.micronav.net/.
[5] MovilWeb: Aplicación para el control de flotas basada en PostgreSQL. Suárez, Guillermo González. 1, s.l. : Revista Cubana de Ciencias Informáticas (RCCI), 2011, Vol. 5.
[6] Craig Walls, Ryan Breidenbach. Spring in Action 2. 2008.
[7] Hazzard, Erik. OpenLayers 2.10. Beginner's Guide. 2011.
[8] PostgreSQL. PostgreSQL. [En línea] 2011. [Citado el: 4 de Diciembre de 2012.] http://www.postgresql.org.es/sobre_postgresql.
[9] Escalona, Yosel Hernandez. Propuesta de Front End para gestión de posicionamiento vehicular sobre redes TETRA NEBULA. Habana : s.n., 2011.
[10] Pressman, Roger S. Ingeniería del software, Un enfoque práctico quinta edición. 2002.
[11] Freeman, Adam y Sanderson, Steven. Pro asp.net mvc 3 Framework. s.l. : apress, 2011.

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