

UNIVERSIDAD DE SAN CARLOS DE GUATEMALA



FACULTAD DE INGENIERÍA

GEOGRAPHIC INFORMATION SYSTEMS ON THE WEB

TRABAJO DE GRADUACIÓN

**PRESENTADO A LA JUNTA DIRECTIVA DE LA
FACULTAD DE INGENIERÍA**

POR

HÉCTOR ALBERTO HEBER MENDÍA ARRIOLA

**AL CONFERÍRSELE EL TÍTULO DE
MAESTRO EN TECNOLOGÍAS DE LA INFORMACION Y LA
COMUNICACIÓN**

**GUATEMALA, OCTUBRE DE 2009
UNIVERSIDAD DE SAN CARLOS DE GUATEMALA**

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YO HECTOR ALBERTO HEBER MENDIA ARRIOLA RECONOZCO QUE LOS CONOCIMIENTOS ADQUIRIDOS EN LA MAESTRIA DE TECNOLOGIAS DE LA INFORMACION Y LA COMUNICACION FUERON FUNDAMENTALES PARA EL PROYECTO DE GRADUACIÓN DENOMINADO GEOGRAPHIC INFORMATION SYSTEMS ON THE WEB POR LO CUAL LA UNIVERSIDAD DE SAN CARLOS PODRA UTILIZAR DICHO PROYECTO PARA USO INTERNO O PARA DAR SERVICIOS ACADÉMICOS A TERCEROS SIN FINES DE LUCRO.

EL CODIGO FUENTE DE PROGRAMACION GENERADO DURANTE EL PROYECTO SERA PROPIEDAD DEL SUSCRITO.

TODAS LAS MARCAS REFERENCIADAS AQUÍ SON PROPIEDAD DE SUS RESPECTIVOS PROPIETARIOS.

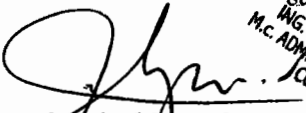
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El Director de la Escuela de Estudios de Postgrado de la Facultad de Ingeniería de la Universidad de San Carlos de Guatemala, luego de conocer el dictamen y dar el visto bueno del revisor y la aprobación del área de Lingüística del trabajo de tesis de graduación titulado **GEOGRAPHIC INFORMATION SYSTEMS ON THE WEB** presentado por el Ingeniero en Sistemas **Héctor Alberto Heber Mendía Arriola**, apruebo el presente y recomiendo la autorización del mismo.

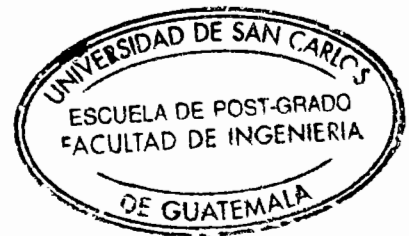
"ID Y ENSEÑAD A TODOS"

A handwritten signature in black ink, appearing to be 'Carlos Humberto Pérez Rodríguez'.

Msc. Carlos Humberto Pérez Rodríguez
Director
Escuela de Estudios de Postgrado

Guatemala, Octubre de 2009.

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El Decano de la Facultad de Ingeniería de la Universidad de San Carlos de Guatemala, luego de conocer la aprobación por parte del Director de la Escuela de Postgrado, al trabajo de graduación de la Maestría en Tecnologías de la Información y la Comunicación titulado: **GEOGRAPHIC INFORMATION SYSTEMS ON THE WEB**, presentado por el Ingeniero en Sistemas **Héctor Alberto Heber Mendía Arriola** procede a la autorización para la impresión del mismo.

IMPRÍMASE.

Ing. Murphy Olympo Paiz Recinos
DECANO

Guatemala, octubre de 2009

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ABSTRACT

This document describes relevant design, construction and implementation features of the graduation project called "Latitud14", currently hosted in the site www.Latitud14.com; the site presents various GIS (Geographic Information System) resources for the use of the general public and specific customers.

Interactive maps provide the primary interface for most GIS applications. Each GIS application has a set of interfacing tools that allows work with its contents.

OBJECTIVES

General

Provide a better service of maps, improving the time of response of the maps, mashups with other maps services

Specifics

Improve the service of the maps for a better display and content.

Improve the time of response by optimizing the code and the GIS services.

Increase the number of visit of the site and the time spend of the visit.

INTRODUCTION

Today we experience in the world major global problems such as population growth, global warming, environmental pollution, social conflicts, resource reduction and loss of biodiversity. Their complexity and severity is increasing, posing a great challenge to the present and future of society.

We need more comprehensive and sensitive approaches on how we design and manage our activities, approaches that consider the impacts of our actions and guide us to a more sustainable future.

The Geographic Information Systems (GIS) use the geographic, geodesic and information technologies as their foundation. The GIS technology provides standards and workflows for organizations that want to improve their decision making as they pursue a diversity of projects and goals.

Nowadays GIS applications are being implemented around the world in many fields. The growing number of applications suggests that GIS technology is a major instrument for the comprehension, treatment and transformation of the geographic environment. Examples of GIS application are the location of nearby businesses and potential customers, access through the streets, customers concentration, environmental resources such as rivers, lakes, etc. and a host of other elements that are susceptible to have a geographic representation.

1. PROBLEM DEFINITION AND JUSTIFICATION

1.1. Introduction

The Latitud14 project has two main objectives; the first one is to provide a service of Web mapping over the Internet, open to all people without any fee; and second, to provide exclusive services to any client who may require them.

GIS generated and manage maps provide a powerful mechanism to define and standardize how people use and interact with their geography. Interactive maps provide the primary interface for most GIS applications. Users can point to locations and discover attributes and relationships not previously seen, perform editing and analysis, and effectively communicate results using geographic views such as maps and geodesic globes.

These interactive maps can be accessed and used on a computer or a mobile device. Each application is aimed to help users get their work done, using GIS. Each GIS map has a set of tools built into its interface that allows them to work contents in an effective and easy.

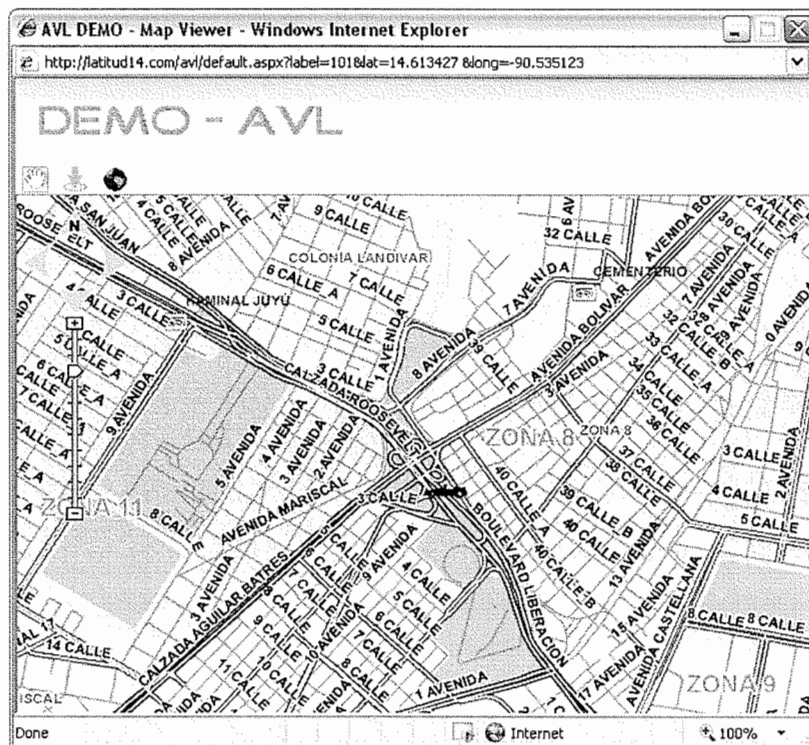
The www.latitud14.com portal is currently aimed to anyone that is searching for maps of the Central American region. The next step will be implement services such as navigation, geocoding, point-to-point routing and finding.

1.2. Identification of needs

Many users would want to view their information using a map. Those needs are present in various types of industry like:

In AVL (Automatic Vehicle Location) this means that one can visualize a vehicle in any time in any place using geographic coordinates. At this moment this is an important market because it's growing; an online demo for can be found in <http://www.latitud14.com/avl/default.aspx> this site provides more details about AVL. It's possible to send parameters of required coordinates to this application like in the following way: <http://www.latitud14.com/avl/default.aspx?label=uno&lat=14.9&long=-90.7>

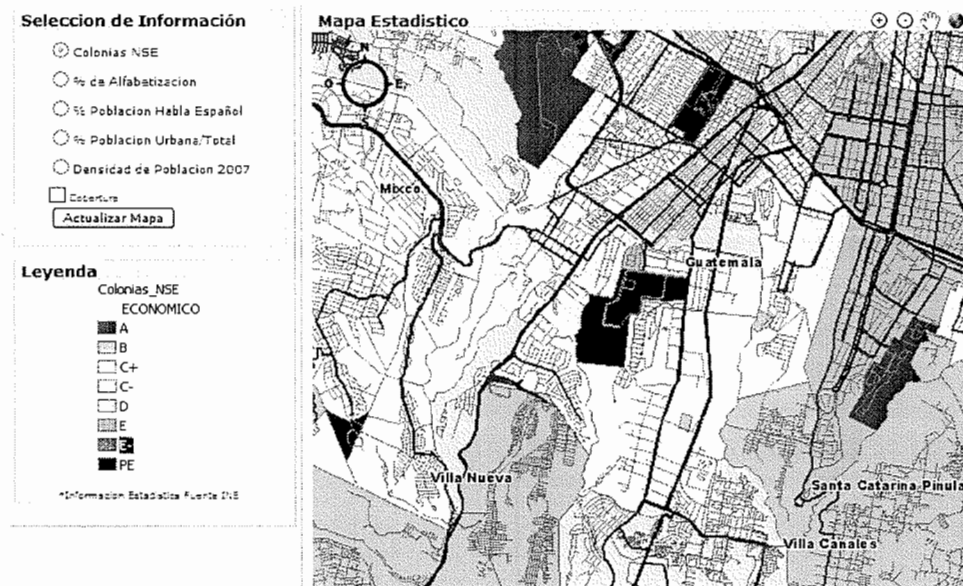
Figure 1. Example of AVL application



Real state, visualization of the value of land, commerce, use and any other relation between elements.

Thematic maps, locations of territories, customers or business, it is possible visualize in a map the location of customers and do analysis from this information such as: density, interpolation, incidents, etc.; segregation of people, "red" (danger) areas, etc.

Figure 2. Example of thematic maps



In Points of interest, layers with information of different kind result relevant for many markets such as: banks, ATM, hospitals, fire stations, schools, gas stations, etc.

These are examples of how to visualize, discover and interpret the information in a better way; one can graphically visualize a huge quantity of information in an easy way and not only as tables or reports. The GIS improves the communication and improves analysis.

1.3. Target market

Internet map services are the primarily objective, offering a set of tools aimed at satisfying the needs of the clients.

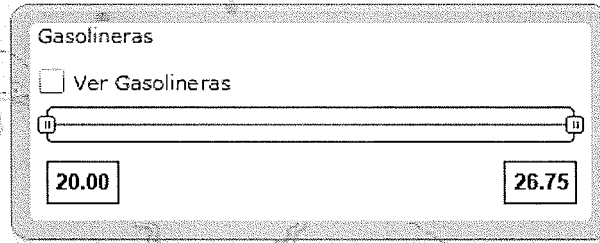
Right now there are two branches, one offering free maps with rich information in maps (streets, neighborhoods, suburbs, etc) and information about points of interest, starting with information about gas stations. This site is accessible through the site <http://www.Latitud14.com>

Figure 3. Example of the point of interest (gas stations)



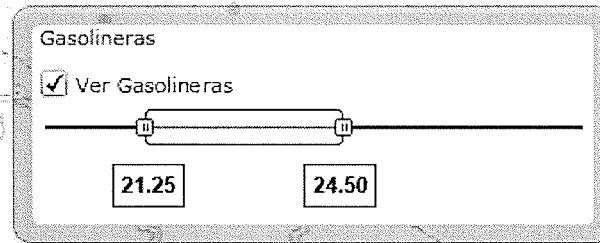
There will be an option for filters the data. Through this tool anyone can specified only certain items for own convenience.

Figure 4. Visualization of tool



The points of interest will be hided automatically and the user can get instant feedback of their actions on the map, according of their actions. Because the tool is not so common, this will have a simple design and very intuitive interface.

Figure 5. Filtering gas station by price



Another function is the capability of use WAP (Wireless Application Protocol) services that can be consumed for mobile devices. Anyone can submit an address and get the map of the address that was entered.

Figure 6. Example of map in mobile device



The second branch is for clients that pay a fee to get some specific functionality, support, and continued improvement of the service adding more features to the site that they use.

2. NEED TO COVERING: REGIONAL

2.1. Introduction

The base maps provide information at regional level, covering Guatemala, Honduras and El Salvador. The possibility to add information about other countries will depend on demand from the clients. Current customers are using information about these countries, as for now the site covers all requirements.

3. METHODOLOGY TO USE

3.1. Introduction

The server is composed by four parts in a general context: the maps, the publication of those maps, the applications that are used for clients and the architecture that support the communications

3.2. The production or creation of maps

For this project we used maps created by Geosistec S.A.; they have the rights of these maps, and have captured all the data using GPS, ortophotos, cartography sheets, etc. almost all data was taken from the field.

3.3. The publication of the maps

For the publication of these maps over the Internet we are using a software called ArcGis Server 9.3 (<http://www.esri.com/software/arcgis/arcgisserver/index.html>) created by ESRI company. This software allows the publication of the maps over the internet, and some analysis and other functions.

3.4. The applications for end users

Obviously the information that is presented to end customers comes from an application. The applications that are used right now are based in JavaScript and two RIAs (Rich Internet Applications) like Adobe Flex/Flash and Microsoft

Silverlight. Each one has some advantage over the others, the decision of one or another is determined based on application richness, interactivity with the client.

On the client side, the only need is a computer with access to Internet, and in some cases a plug-in for running the RIA applications.

3.5. The Architecture

The design over which the site is implemented allows an adequate response to a large number of clients without losing performance; most GIS services use REST and pre-generated images so clients can get maps in a very efficient way.

The project is using one server in the initial configuration, containing all necessary architecture for the service.

3.5.1. Web Server

The first tier is the Web Server, all webs applications are hosted by the server running in an IIS Server over Windows. Most applications are using the .NET Framework

Many of the services that can be accessed are REST and the answer can be obtained in the formats JSON and XML. The benefits RESTful architecture is scalability of component interactions, generality of interfaces, independent deployment of components, and intermediary components to reduce latency and enforce security.

Another great benefit of using REST is that is Stateless, this means that each request from any client contains all the information necessary to service the request, and any state is held in the client. This not only makes the server more visible for monitoring, but also makes them more reliable in the face of network failures, and enhances their scalability.

The REST services are really fast in a RIA, this type of feature is very valuable for any client.

3.5.2. GIS Server

In this tier is installed the software that process all requests for maps, when a client request to see a specific area in a specific scale of the map this software takes the request, and generate the answer. Also processes the entire geoprocessing request: search for address, influence area, and any other thing that involves a map.

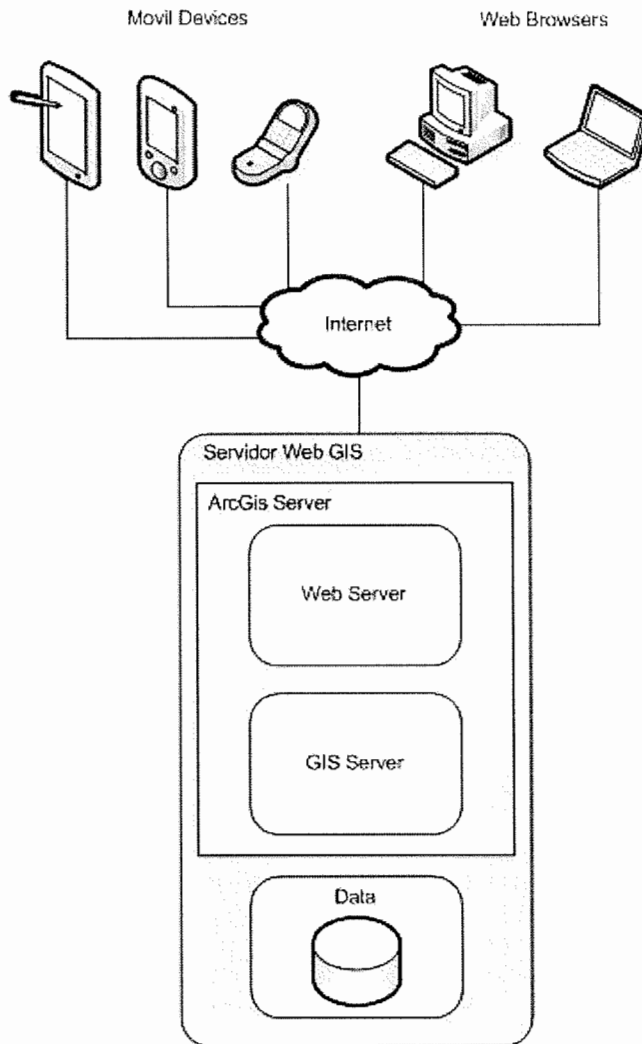
In this level there are many services running at OS level, at least there are one service for a map; each of these services have the responsibility to resolve the entire request that someone is making to a map.

3.5.3. Data Server

This last tier has all the data, maps and tables; some maps are file-based and others reside on a data base.

The data base also keeps a record of certain statistics that are generated by consuming some sites, for example the XY coordinates of a map, scale, date, time.

Figure 7. Latitud14 GIS Architecture



CONCLUSIONS

1. In last two years the service of maps and applications was been improved, in richness of content, displayed maps, accessibility.
2. The time of response of the maps is very less that the initial maps service created in the initial implementation of the site.
3. The number of customers and visitors has been growing in lasts months, and the time spent in the site is more.

RECOMMENDATIONS

1. Guatemala even needs improve the offer of services technological for the creation of services like this.
2. Is necessary to make new technologies more accessible to student, to get advantages of them.
3. Put more attention in the user interface, because provide a better experience for any user and this will result in visit longer from the users.

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