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Final Project

**GeoBuz**

Geo location services adapted to your  
business

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# Resumen

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Con el desarrollo de las tecnologías móviles, la geo localización se ha vuelto una herramienta fundamental para el desarrollo de algunos negocios que necesitan que sus clientes no solo conozcan sus productos sino que además sepan dónde encontrarlos. Para ello es necesario ofrecerles las herramientas necesarias para llegar hasta ellos, independientemente del lugar donde se encuentren.

Este proyecto parte de esa idea para desarrollar un producto totalmente adaptado a las necesidades de cada negocio. Propone la creación de un producto único que una vez descritas las necesidades del negocio pueda personalizarse con las necesidades de éste.

El ejemplo empleado es una empresa de neumáticos que contaba con una red de renting de vehículos en la que determinados talleres ofrecen sus productos a los clientes de esta red. Es fundamental darse cuenta de que no era suficiente con tener una gran cantidad de clientes dentro de esa red, si no que había que dar a esos clientes el mejor servicio de atención posible. Para ello es necesario poner al alcance tanto de los trabajadores encargados de dar atención a estos clientes como de los propios clientes una serie de herramientas que hagan esta tarea mucho más sencilla y que permitan además dar una mejor solución a cada cliente dependiendo de su situación.

La herramienta desarrollada, tras ejecutar la metodología de diseño que se detalla en el documento, consiste en una aplicación web formada por un formulario y un mapa. En la parte superior aparecería el logotipo de la empresa y al realizar una búsqueda, en el mapa se situarán unos marcadores que variarán dependiendo de las necesidades del cliente. Para acompañar a la web se han diseñado también dos aplicaciones, una para Android y otra para iOS que están enfocadas al cliente itinerante que se encuentra en la carretera y necesita llegar a un establecimiento con la ayuda del GPS de un dispositivo móvil. En el caso del ejemplo empleado, la gran mayoría de las personas que solicitan información se encuentran en un vehículo ya en movimiento.

Para demostrar la eficacia de este sistema, se han realizado encuestas a los usuarios y a las personas que trabajan dando atención a éstos, cuyos resultados y conclusiones obtenidas se presentan en este documento.

Palabras clave: Localización, mapas, GPS, negocio, mobile app, servicio web, android, ios, HTML5

# Abstract

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As the mobile technologies keep improving, geo location has become a elemental tool for business development which need their clients not only to know their products but also where to find them. In order to do this, it is important to provide these clients with the right tools to reach them, regardless of where they are located.

This project is based on the idea to develop a product, which suits the needs of each business. It suggests the creation of a unique product, which once the needs have been described, can be customized in order to satisfy them.

The sample business used in this project is a huge tire company that has a car renting network in which several establishments (car dealers, workshops, etc.) provide their products to the clients of the network. It is essential to realize it isn't enough to have a large number of clients in the network, but it is also essential to give the clients the best possible service. In order to achieve this, it is necessary to make available a series of tools that make this job much easier for the customer service, and that provide the client with a much better solution.

After applying the design methodology described in the document, the developed tool consists of a web page formed of a form and a map. In the upper part, the logo of company would appear and when the user made a search, several markers would appear depending on the needs of the client. To complement this, there are two mobile apps, one for Android and one for iOS, which are oriented to customers who travel and need to find an establishment with the help of the GPS of their mobile devices. In the sample business used in this project, most of the people who need information are located in a moving vehicle.

As to verify the effectiveness of this system, the users of the system have been surveyed and also the people who work at the Call Center. The results and conclusions obtained are presented in this document.

Key words: Locations, maps, GPS, business, mobile app, web service, android, iOS, HTML5

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# 1. Introduction

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# 1. Introduction

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## *1.1 Motivation for this Project*

One of the most important things for a big company is not only to have all the information they need but also to use it in an efficient way.

This is the main idea of this project is to improve the user's experience on retrieving geo localized information without using more resources than necessary. By achieving this, the communication system will improve and time will be worth double. This would be possible by accomplishing our objectives in half the time we used to spend and making it possible for another information transmission to take place in that same space of time.

In this project, we'll be trying to solve a problem, which has been going on for several years. The company chosen as a sample is a huge tire company which has its main income in getting orders on the phone from the customers or the sales force. The department in charge of this is the Customer Service. They also have to help some of the customers who own renting cars when they have to take their car to the garage. These customers don't know what garages or dealers are part of their network, and to solve this problem they call the Customer Service in order to know where to take their car and how to get there. Around four out of ten people who work there answer this phone calls and after spending several days with them we've noticed that two out of ten order calls get unattended while these people are helping renting customers get to the nearest establishment.

In order to solve this problem and to make the best with the working time of the Customer service employees, we've decided to look for an alternative to the methodology used before. We've relied on one of the most popular technologies used nowadays, geo localization so as to set in a map all the possible destinations delimited by some variables set by the user, and to complement this idea we've designed an app for Android and an app for iOS so users won't need to call the Customer Service and can look the places for themselves anywhere.

The combination of these three apps (web, android and iOS) is the solution to this problem, therefore the solution we decided to develop within this final grade project. After taking into consideration several ideas, we've chosen the one that could save more time to the employees and more importantly give a better user experience to the customers.

After developing the project, the mail results lead t the conclusion that the chosen solution and applications developed are able to be offered to any kind of company that has the need to locate its establishments. In the following sections we will use the sample tire company in order to describe the methodology and the decisions taken to develop this final project.

## 1.2 Objectives of the project

The main objectives of this project are both improving the answer the customer gets when he asks for information on a garage or dealer, and gathering this information in the shortest time as possible.

The solution has to meet the following requirements:

It has to be **globally accessible**. The main users of this tool are people who travel a lot. They need the tool to be accessible not only from different places but also from different devices. An example of this group of people are truck drivers, they practically live in their trucks so they access the information by their cell phones, tablets or laptops. Not all the users accessing this tool are going to be on the road, but we want everyone to have the same information displayed in the same way so it doesn't make a difference whether you access from your cellphone on the road or a computer you have at home.

It has to be **user friendly**. This is one of the most important requirements because the target users are very different ones from each others. This means their knowledge on how to use the applications may vary, but as we won't everyone to be able to use it, we'll go for an easy website which doesn't need indications on how to be used. It also will need big icons and big letters as the age range is also very wide. An important fact is to give just the right amount of information to the user. We may have more information on our database but we need the user to get the information he is looking for by just giving a quick look.

It has to be **load fast**. One of the main requirements on the side of the client is quickness. Whether the customer is accessing the tool at home or from some mobile device, the information they are looking for must be given in the shortest time possible.

It has to be an **online solution**. Our users are located all over the country, and although this tool we'll be mainly used by people at the office, we want to make it possible for everyone to access it as this will save time to our workers and will increase the orders they are able to save. The main reason for using the cloud is that there will only be one database to be consulted, which means that every change someone makes in the information will get to everyone in the same way.

It has to be **easily upgradable**. One of the problems of this kind of tools is that information has to be handled by the administrators who have limited knowledge on the area; therefore the system developed has to be simple to work with.

It has to be implemented with **open source tools**. Nowadays, one of the main objectives of every company is to reduce their expenses. Normally, it is better to use tools that have been proven to work as this resumes as time saving.

### 1.3 Resources

In order to develop this project, we've used several resources, which include both software and hardware.

Hardware used:

- Apple Mac Mini
- LG L3
- Apple iPhone 4s
- Asus Display

Software used:

- Eclipse
- XCode
- Sublime Text
- SQLite
- Numbers
- Apple OS X 10.9
- Xampp
- Tom's Planner

### 1.4 Structure of the document

In order to help the reader understand this project, here is a summary of its content divided by each of its chapters.

Chapter 1 – **Introduction:** This chapter includes the main reasons for this project to be done. It also includes a summary of the objectives of the project including a description of each one of them. To conclude, there is a description of the available resources that have been used in order to achieve the target.

Chapter 2 – **State of Art:** This chapter includes an analysis on technology, all the different possibilities we have to carry on with this project. We also describe similar solutions for problems like ours. Then, there is an explanation on the ones chosen and the reasons we have to do this.

Chapter 3 – **Customer requirements and description of the tools and configurations to be used:** In this chapter we explain the requirements the user has regarding the tool. The three tools are described step by step.

Chapter 4 – **Project Development:** In this chapter the development of the project is described in deep from the beginning to the end.

Chapter 5 – **Results:** In this chapter it is described how everything is working. There is an analysis about the changes made and what do the customers think.

Chapter 6 – **Project Management:** In this chapter you can find the planning of the project including the dates and the time every step has taken. On the second part, there is a detailed description of the budget of the project.

Chapter 7 – **Conclusions and future lines:** In this chapter we analyze the conclusions obtained after this project and the future lines in which we can continue improving.

## 2. State of Art

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## 2. State of Art

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After a few meetings with some of the potential users and the employees in charge of these customers, we realized that the solution needed had to be a website which could be accessible from different types of devices and maybe some extra apps.

### 2.1 Standards and technologies

#### 2.1.1 Databases

<<A Database is a structured set of data held in a computer, esp. one that is accessible in various ways.>> – Thesaurus Dictionary

Due to the large amount of information included in this system there is a need of keeping it organized. Therefore, a database is the best way to keep all the information together for several reasons:

- If the information keeps growing, it will become unmanageable in any other way.
- If you need an online solution.
- If you need to perform complex queries.

##### 2.1.1.1 SQL

SQL (Structured Query Language) is a special-purpose programming language designed for managing data held in a Relational Database Management System (RDBMS). SQL is a language that most databases understand. SQL has three major components: the Data Manipulation Language (DML), the Data Definition Language (DDL), and the Data Control Language (DCL). The Data Manipulation Language (DML) contains the subset of SQL commands used most frequently – those that simply manipulate the contents of a database in some form. The Data Definition Language (DDL) contains commands that are less frequently used. DDL commands modify the actual structure of a database, rather than the database's contents. [3]

Originally based upon relational algebra and tuple relational calculus, the scope of SQL includes data insert, query, update and delete, schema creation and modification, and data access control. In addition, commands in SQL resemble simple English statements, making it easier to learn and understand.

The main advantage of SQL is its high speed in retrieving the queries. Also, it uses long established standard, which has been used for a long time now; this gives solidity to the system making it very reliable. Another advantage of this system is that it runs in different systems making it possible to move from one to another.



### 2.1.1.2 SQLite

At the very beginning, the scope of the project was a tool just for the office, a local tool. So the first implementation was made on a computer using SQLite as a database.

SQLite is an open source, embedded relational database. Released in 2000, it is designed to provide a convenient way for applications to manage data without the overhead that often comes with dedicated relational database management systems. SQLite has a well-deserved reputation for being highly portable, easy to use, compact, efficient, and reliable. [6]

SQLite offers a surprisingly comprehensive range of features and capabilities despite its small size. It supports a large subset of the ANSI SQL92 standard for SQL features along with many other features found in relational databases (triggers, indexes, etc.). It also has many rare or unique features, such as in-memory databases, dynamic typing, and conflict resolution—otherwise referred to as merge or upsert in other RDBMSs.

Its main advantages are its small size and portability. But there are other things everyone should take into account:

- **Zero Configuration:** From its initial conception, SQLite has been designed so that it can be incorporated and used without the need of a DBA. Configuring and administering SQLite is as simple as it gets. SQLite contains just enough features to fit in a single programmer's brain, and like its library, it requires as small a footprint in the gray matter as it does in RAM.
- **Simplicity:** As a programming library, SQLite's API is one of the simplest and easiest to use. The API is both well documented and intuitive. It is designed to help you customize SQLite in many ways, such as implementing your own custom SQL functions in C. The open source community also has created a vast number of language and library interfaces with which to use SQLite. There are extensions for Perl, Python, Ruby, Java, PHP, Visual Basic, and others. This design makes it easier to add new features to the database engine, is faster to debug, and results in better overall reliability.
- **Flexibility:** As an embedded database, it offers the best of both worlds: the power and flexibility of a relational database front end, with the simplicity and compactness of a B-tree back end. With it, there are no large database servers to configure, no networking or connectivity problems to worry about, no platform limitations, and no license fees or royalties to pay.
- **Liberal Licensing:** All of SQLite's code is in the public domain. There is no license. No claim of copyright is made on any part of the core source code. All contributors to this code are required to sign affidavits specifically disavowing any copyright interest in contributed code. Thus, there are no legal restrictions on how you may use the source code in any form. You can modify, incorporate, distribute, sell, and use the code for any purpose—commercial or otherwise—without any royalty fees or restrictions.

The main disadvantage of SQLite is that is accessible only if you have the database. For mobile apps, you need to update the app every time you update the information.

### 2.1.1.3 MySQL

After the first development, we realized that the tool had to be accessible by everyone who needed help and normally called the Call Center. After speaking with the client, we decided to take everything one step further, so we went from local to global. MySQL was the best option. The cheapest hosting plans found usually provide one or two MySQL databases in most of their basic plans.

MySQL is (as of July 2013) the world's second most widely used open-source relational database management system (RDBMS). [5]

The MySQL development project has made its source code available under the terms of the GNU General Public License, as well as under a variety of proprietary agreements. MySQL was owned and sponsored by a single for-profit firm, the Swedish company MySQL AB, now owned by Oracle Corporation.

MySQL is a popular choice of database for use in web applications. Free-software-open source projects that require a full-featured database management system often use MySQL.

The main advantages of MySQL are:

- Speed: MySQL is fast, and getting faster
- Ease of use: MySQL is a high-performance but relatively simple database system and is much less complex to set up and administer than larger systems.
- Query language support: MySQL understands SQL , the standard language of choice for all modern database systems.
- Capability: The MySQL server is multi-threaded; many clients can connect to it at the same time. You can access MySQL interactively using several interfaces that let you enter queries and view the results: command-line clients, Web browsers, or GUI clients. In addition, programming interfaces are available for many languages, such as C, Perl, Java, PHP, Python, and Ruby. You can also access MySQL using applications that support ODBC and .NET (protocols developed by Microsoft). This gives you the choice of using prepackaged client software or writing your own for custom applications.
- Connectivity and security: MySQL is fully networked, and databases can be accessed from anywhere on the Internet, so you can share your data with anyone, anywhere. To provide additional security, MySQL supports encrypted connections using the Secure Sockets Layer (SSL) protocol.
- Portability: MySQL runs on many varieties of Unix and Linux, as well as on other systems such as Windows. MySQL runs on hardware from small devices such as routers and personal computers up to high-end servers with many CPUs and huge amounts of memory.

- Availability and cost: MySQL is an Open Source project available under multiple licensing terms. First, it is available under the terms of the GNU General Public License (GPL). This means that MySQL is available without cost for most in-house uses. Second, for organizations that prefer or require formal arrangements or that do not want to be bound by the conditions of the GPL, commercial licenses are available.
- Open distribution and source code: MySQL is easy to obtain; its source code is accessible for everyone to take a look. Users can report bugs; this feature makes it more secure and reliable.

#### **2.1.1.4 SQL Server**

Microsoft SQL Server is a relational database management system developed by Microsoft. As a database, it is a software product whose primary function is to store and retrieve data as requested by other software applications, be it those on the same computer or those running on another computer across a network (including the Internet). There are at least a dozen different editions of Microsoft SQL Server aimed at different audiences and for different workloads (ranging from small applications that store and retrieve data on the same computer, to millions of users and computers that access huge amounts of data from the Internet at the same time). Its primary query languages are T-SQL and ANSI SQL. Its main advantage is security. [8]

#### **2.1.1.5 MS Access**

Microsoft Access, often abbreviated "MS Access," is a popular database application for Windows. Access allows users to create custom databases that store information in an organized structure. The program also provides a visual interface for creating custom forms, tables, and SQL queries. Data can be entered into an Access database using either visual forms or a basic spreadsheet interface. The information stored within an Access database can be browsed, searched, and accessed from other programs, including Web services. [9]

While Access is a proprietary database management system (DBMS), it is compatible with other database programs since it supports Open Database Connectivity (ODBC). This allows data to be sent to and from other database programs, such as MS SQL and Oracle databases. This compatibility also enables Access to serve as the back end for a database-driven website.

Advantages:

- Cost  
Microsoft Access 2003 costs between \$100 and \$200, as opposed to larger systems that may cost thousands of dollars.
- Ease of Use  
Access contains Wizards that walk you through each step of the way. You do not need to have database experience in order to use it.

Disadvantages:

- **Multi-User Functionality**  
Microsoft Access is not meant to have multiple users at any given time.
- **Single-File Save**  
All the information from your database is saved into one file - this can limit what you can do with it and make everything very slow.
- **Data**  
Each database can't store more than 2 GB of data.
- **Speed:** Since Microsoft Access cannot handle large data requests, if you are using close to the maximum amount of data, it will run slowly.

#### **2.1.1.6 Oracle**

Oracle Database is an RDBMS. An RDBMS that implements object-oriented features such as user-defined types, inheritance, and polymorphism is called an object-relational database management system (ORDBMS). Oracle Database has extended the relational model to an object-relational model, making it possible to store complex business models in a relational database.

Advantages:

- **Customized Applications:** One of the potential advantages of using Oracle Database is that it can help you create customized database applications. Instead of getting a standardized database program, you get a program that can be customized to fit your needs. It uses open source industry standards to help you have features made specifically for your business.
- **Data Mining:** This database application makes it possible to find relationships in data that would otherwise be difficult to find on your own.

Disadvantages:

- **Costs:** One of the potential disadvantages is the cost. When you invest in this type of database management software, you will have to pay a fee for the use of the program. If you plan on using the program on multiple computers, you will need to buy licenses for each computer that you utilize it on. If you plan on making the software available on many computers, these costs can really add up.
- **Learning Curve:** Another potential drawback is that there is a learning curve involved. If you are unfamiliar with it to begin with you may need to hire a professional to help you get the program set up and customized to your liking.

#### **2.1.1.7 Comparison**

Here is a comparison of the 5 different systems:

	Oracle	MySQL	SQL Server	SQLite	Ms Access
<b>License</b>	Commercial	Open source	Commercial	Public Domain	Commercial
<b>Server OS</b>	AIX HP-UX Linux OS X Solaris Windows z/OS	FreeBSD Linux OS X Solaris Windows	Windows	Serverless	Windows
<b>Supported programming languages</b>	C C# C++ Clojure Cobol Eiffel Erlang Fortran Groovy Haskell Java JavaScript Lisp Objective C OCaml Perl PHP Python Tcl Ruby Scala Tcl Visual Basic	Ada C C# C++ D Eiffel Erlang Haskell Java Objective-C C OCaml Perl PHP Python Ruby Scheme Tcl	.Net Java PHP Python Ruby Visual Basic	Actionscript Ada Basic C, C#, C++ D Delphi Forth Fortran Haskell Java JavaScript Lisp Lua MatLab Objective-C OCaml Perl PHP PL/SQL Python R Ruby Scala Scheme Smalltalk Tcl	C C# C++ Java (JDBC-ODBC) VBA Visual Basic.NET
<b>Database Model</b>	Relational DBMS	Relational DBMS	Relational DBMS	Relational DBMS	Relational DBMS
<b>Max database size</b>	Unlimited	Unlimited	524,258TB	32TB	2GB
<b>Price</b>	\$180	\$0	-	\$0	\$349

Figure 1 - Database comparison

After all the research done, we decided MySQL was the best option as it matches the open source requirement, it is free and most importantly it is very simple.

## 2.1.2 Programming languages

After deciding what type of tool was going to be developed, the most important decision was the language in which it was going to be programmed.

### 2.1.2.1 HTML 5

HyperText Markup Language (HTML) is the main markup language for creating web pages and other information that can be displayed in a web browser.

It is written in the form of HTML elements, which consist of tags enclosed in angle brackets (like <html>), within the web page content. These tags may come in pairs (opening tag and closing tag), but there are also individual tags. In between, they can have text, more tags or other types of content. [13]

Web browsers are in charge of reading these documents and turning them into what we know as web pages. They interpret the language through the tags. HTML elements form the building blocks of all websites. HTML allows images and objects to be embedded and it provides a means to create structured documents (headings, paragraphs, etc.). It can embed scripts written in languages such as JavaScript.

Web browsers can also refer to Cascading Style Sheets (CSS) to define the appearance and layout of text and other material. The W3C encourages the use of CSS over explicit declarations in HTML.

Its last revision is HTML5; its core aims have been to improve the language with support for the latest multimedia while keeping it easily readable by people and consistently understood by computers and devices (web browsers, parsers, etc.). HTML5 is intended to subsume not only HTML 4, but also XHTML 1 and DOM Level 2 HTML.

Following its immediate predecessors HTML 4.01 and XHTML 1.1, HTML5 is a response to the fact that the HTML and XHTML in common use on the World Wide Web are a mixture of features. It is also an attempt to define a single markup language that can be written in either HTML or XHTML syntax. It introduces markup and application programming interfaces (APIs) for complex web applications. For the same reasons, HTML5 is also a potential candidate for cross-platform mobile applications. Many features of HTML5 have been built with the consideration of being able to run on low-powered devices such as smartphones and tablets. In December 2011, research firm Strategy Analytics forecast sales of HTML5 compatible phones will top 1 billion in 2013.

HTML5 new features include large signature features of HTML such as video playback and subtitles, form controls and form submission, and a 2D graphics API known as the HTML canvas, as well as the integration of scalable vector graphics (SVG) content which replace the use of generic <object> tags and MathML for mathematical formulas. These make it easier to include and handle multimedia and graphical content on the web

without having to resort to proprietary plugins and APIs. New attributes have been introduced, while some elements and attributes have been removed. Some elements (<a>, <cite> and <menu>) have been changed, redefined or standardized. The main parts of HTML5 are the APIs and DOM (Document Object Model).

### 2.1.2.2 PHP

PHP is an acronym for "PHP Hypertext Preprocessor". It is a widely-used, open source scripting language with its scripts being executed on the server. Its files can contain text, HTML, CSS, JavaScript, and PHP code.

It's interpreted by a web server with a PHP processor module, which generates the resulting web page. The PHP commands can be embedded into an HTML source deleting the need to call an external file to process data. It has also evolved to include a command-line interface capability and can be used in standalone graphical applications. [15]

Advantages of PHP:

- PHP is Open Source. This means it is readily available and absolutely free! If you are planning to hire PHP developers and they have a good background in C and Java, they will do excellently in PHP. If the truth is spoken, PHP is actually much simpler than the rest and so you can stay assured of fabulous results.
- PHP is cross-platform and therefore enables operation across various operating systems. It works excellently on LINUX, UNIX and Windows platforms. What's more, it interfaces effortlessly with Apache/MySQL.
- PHP, being very fast to develop ensures that there is a quick turnaround time. When you hire PHP developers, their efficiency brings you an online solution that you were probably looking for since a long time.

Disadvantages:

- PHP's speed is not its best quality.
- There are some security flaws as there are unknown vulnerabilities.

### 2.1.2.3 JavaScript

JavaScript (JS) is an interpreted computer programming language. As part of web browsers, implementations allow client-side scripts to interact with the user, control the browser, communicate asynchronously, and alter the document content that is displayed. It has also become common in server-side programming, game development and the creation of desktop applications.

JavaScript is a prototype-based scripting language with dynamic typing and has first-class functions. Its syntax was influenced by C. JavaScript copies many names and naming conventions from Java, but the two languages are otherwise unrelated and

have very different semantics. The key design principles within JavaScript are taken from the Self and Scheme programming languages.[6] It is a multi-paradigm language, supporting object-oriented, imperative, and functional[1][8] programming styles.

The application of JavaScript to uses outside of web pages—for example, in PDF documents, site-specific browsers, and desktop widgets—is also significant. Newer and faster JavaScript VMs and frameworks built upon them (notably Node.js) have also increased the popularity of JavaScript for server-side web applications.

JavaScript was formalized in the ECMAScript language standard and is primarily used as part of a web browser (client-side JavaScript). This enables programmatic access to computational objects within a host environment. [14]

### 2.1.2.4 XML

Extensible Markup Language (XML) is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. It is defined in the XML 1.0 Specification produced by the W3C, and several other related specifications, all free open standards.

The design goals of XML emphasize simplicity, generality, and usability over the Internet. It is a textual data format with strong support via Unicode for the languages of the world. Although the design of XML focuses on documents, it is widely used for the representation of arbitrary data structures, for example in web services.

Many application programming interfaces (APIs) have been developed to aid software developers with processing XML data, and several schema systems exist to aid in the definition of XML-based languages.

As of 2009, hundreds of document formats using XML syntax have been developed, including RSS, Atom, SOAP, and XHTML. XML-based formats have become the default for many office-productivity tools, including Microsoft Office (Office Open XML), OpenOffice.org and LibreOffice (OpenDocument), and Apple's iWork. XML has also been employed as the base language for communication protocols, such as XMPP. [17]

Advantages:

- XML uses a human language, which is very easy to read.
- It supports Unicode.
- Namespaces allow you to divide the XML

Disadvantages:

- XML needs an application processing system.
- Each field name has to be written double.
- It is slower than newer schemas.



### 2.1.2.5 JSON

JSON, or JavaScript Object Notation, is an open standard format that uses human-readable text to transmit data objects consisting of attribute–value pairs. It is used primarily to transmit data between a server and web application, as an alternative to XML.

Although originally derived from the JavaScript scripting language, JSON is a language-independent data format, and code for parsing and generating JSON data is readily available in a large variety of programming languages.

The JSON format was originally specified by Douglas Crockford, and is described in RFC 4627 and ECMA-404. The official Internet media type for JSON is application/json. The JSON filename extension is .json. [20]

Advantages:

- JSON is very fast. The packet size is small; therefore the data transmission is faster.
- JSON has a small data structure. This makes it use less memory.
- JSON is very easy to parse.
- JSON support is provided in other languages.
- JSON can be sent as plain text.

Disadvantages:

- JSON is very precise, so you have to be careful with misplacing commas.
- It is not as readable as other standards.

### 2.1.2.6 XML vs. JSON

In order to connect the database and the web there were a few options, but the final choice was XML. The main reasons were that the amount of data isn't that big and I was more familiar with XML than with JSON.

Although JSON has more advantages than XML, this doesn't mean it has to be used in every project. If you have a very big database and you need to process a lot of information in a very short time you will need JSON, but XML is also a very suitable option for other kinds of projects.

### 2.1.3 Maps

The main element of the tool is the map. It was needed to display the establishments, but also to transform the users input into coordinates. After several modifications the directions part was finally added to the tools.

### **2.1.3.1 Google Maps**

Google Maps is a web mapping service application and technology provided by Google, which powers many map-based services and maps embedded on third-party websites via the Google Maps API. It offers street maps and a route planner for traveling by foot, car, bike (beta), or with public transportation. It also includes a locator for urban businesses in numerous countries around the world. Google Maps satellite images are not updated in real time; however, Google adds data to their Primary Database on a regular basis and most of the images are no more than 3 years old. It is the most popular map system nowadays, used by more than 350,000 websites. [21]

Google Maps uses a close variant of the Mercator projection, so it cannot accurately show areas around the poles.

Google Maps is also available as a Mobile App for Android, iPhone, and other OS.

The most important advantage of Google Maps is that, as it's the most popular map system, people are already used to it and they know how it works without further information.

The biggest inconvenient is that, recently, they've limited the number of requests to 2500 per day. This number may be too small depending on the amount of times you use it.

### **2.1.3.2 Microsoft Bing Maps**

Bing Maps Platform (previously Microsoft Virtual Earth) is a geospatial mapping platform produced by Microsoft. It allows developers to create applications that layer location-relevant data on top of licensed map imagery. The imagery includes samples taken by satellite sensors, aerial cameras (including 45 degree oblique "bird's eye" aerial imagery licensed from Pictometry International), Streetside imagery, 3D city models and terrain.

Bing Maps Platform also provides a point-of-interest database including a search capability. Microsoft uses the Bing Maps Platform to power its Bing Maps product. [24]

Key features of the Bing Maps Platform include:

- Photo-based images with features such as Streetside and 45 degree oblique "bird's eye" views (nominally including 4 views at 90 degree viewpoint increments) that present data in context while simplifying orientation and navigation.
- The ability to overlay standard or custom data points and layers with different themes.
- Building-level geocoding for more than 70 million addresses in the United States.
- Developer support options available.
- Set of APIs available upon which developers can build applications.

One of the main advantages is that its SDK is very interactive, which makes it very easy for new users. Also, it includes 125000 requests to use in 12 months. But, on the other side, the free version does not include 'bird's eye' or 'streetside' maps.

### ***2.1.3.3 Here***

Here (stylised HERE), formerly Ovi Maps (2007–2011) and Nokia Maps (2011–2012),<sup>[3]</sup> is a Nokia business unit that brings together Nokia's mapping and location assets under one brand. The technology of Here is based on a cloud-computing model, in which location data and services are stored on remote servers so that users have access to it regardless of which device they use. [25]

### ***2.1.3.4 Apple Maps***

Apple Maps is a mapping service provided by Apple. It is developed to be used in iOS devices. Maps gives you turn-by-turn spoken directions, interactive 3D views, and the stunning Flyover feature. All in a beautiful vector-based interface that scales and zooms with ease. [26]

Nowadays, Apple Maps is winning users while Google Maps for iOS is loosing them.

### ***2.1.3.5 MapQuest***

MapQuest is an American free online web mapping service owned by AOL. The company was founded in 1967 as Cartographic Services, a division of R.R. Donnelley & Sons in Chicago, Illinois, United States. It moved to Lancaster, Pennsylvania in 1969. When it became an independent company in 1994, it was renamed GeoSystems Global Corporation. MapQuest was acquired in 2000 by America Online, Inc. Company headquarters are in Lancaster, Pennsylvania and Denver, Colorado. [27]

The main advantage of this map system is it doesn't have a limit for the number of requests, which makes it very useful for big companies. Another advantage is it's cheaper than other mapping service providers.

### ***2.1.3.6 OpenStreetMap***

OpenStreetMap (OSM) is a collaborative project to create a free editable map of the world. Two major driving forces behind the establishment and growth of OSM have been restrictions on use or availability of map information across much of the world and the advent of inexpensive portable satellite navigation devices.

Created by Steve Coast in the UK in 2004, it was inspired by the success of Wikipedia and preponderance of proprietary map data in the UK and elsewhere. Since then, it has

grown to over 1 million registered users, who can collect data using GPS devices, aerial photography, and other free sources. These crowd-sourced data are then made available under the Open Database License. The site is supported by the OpenStreetMap Foundation, a non-profit organization registered in England.

Rather than the map itself, the data generated by the OpenStreetMap project are considered its primary output. These data are then available for use in both traditional applications, like their usage by Craigslist, Geocaching, MapQuest Open, JMP statistical software, and Foursquare to replace Google Maps, and more unusual roles, like replacing default data included with GPS receivers. These data have been favorably compared with proprietary data sources, though data quality varies worldwide. [28]

### *2.1.3.7 Map comparison*

There were three choices to make.

The first one was the maps for the web. As explained before, at first we needed to set custom makers in the map and we need geocoding. After taking into account all the alternatives, Google Maps was the chosen one mainly because it is very user friendly and it had all the options we needed.

For the Android App, there was almost no choice to make. As Android is a Google OS, Google Maps was, by far, the best option and it is widely proven that it runs very smoothly.

For iOS, the choice was different. At first, Google Maps for iOS was the best option but after knowing it had been loosing user towards Apple Maps everything changed. In the end, I did two similar apps using Apple Maps and Google Maps and realized that Apple Maps had a few things that were worse than on Google Maps but the most important features were better. The final choice was Apple Maps.

	Google Maps	Microsoft Bing	Here	Apple Maps	MapQuest	OpenStreetMap
<b>License</b>	Proprietary	Proprietary	Proprietary	Proprietary	Proprietary	ODbL
<b>Countries with full functionality</b>	Australia, Canada, China, France, Germany, Israel, Italy, Netherlands, Spain, UK, United States	United States, Canada (with the exception of the rural northeastern provinces), United Kingdom, Germany, Italy, Australia, New Zealand, Japan(Yahoo Japan only), India	More than 180 navigable countries	Austria, Belgium, Canada, Denmark, France, Germany, Ireland, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, UK, USA	Spain, Uk, USA, and more.	All
<b>Countries with limited functionality</b>	Andorra, Austria, Belgium, Brazil, China, Croatia, Czech Republic, Denmark, Finland, Gibraltar, Greece, Hong Kong, Hungary, Ireland, Liechtenstein, Luxembourg, Monaco, New Zealand, Norway, Poland, Portugal, Russia (Moscow only), San Marino, Singapore, Slovakia, Slovenia, South Africa, Sweden, Switzerland, Turkey (Istanbul only)	Unknown	Voice guided navigation for both pedestrians and drivers for 74 countries in 46 different languages	Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Croatia, Czech Republic, Denmark, Egypt, Finland, France, Germany, Hungary, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Luxembourg, Macau, Malaysia, Mexico, Netherlands, New Zealand, Norway, Peru, Philippines, Poland, Portugal, Russia, Singapore,	Unknown	No limited functionality

					South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, UK, USA, Venezuela, Vietnam	
<b>Supported web browsers</b>	IE7+, Firefox 2.0.0.8+, Safari 3+, Mozilla 1.7+, Opera 8.02+, Google Chrome 1+	IE6+, Firefox 2+, Safari 3+	IE7+, Mozilla Firefox 3.5+, Google Chrome 4+, Safari 4+	None, application-dependent		
<b>3D Mode</b>	Yes	No	Yes	Yes	No	Yes
<b>Directions</b>	Yes	Yes	Yes	Yes	Yes	Yes
<b>Public transport</b>	Yes	Yes	Yes	No	Yes	Yes
<b>GPS integration</b>	Yes	Yes	Yes	Yes	Yes	Yes

Figure 2 - Map comparison

### 2.1.4 Mobile OS

As the web was developed in HTML5 it was accessible from any device with a web browser but the directions feature was not very friendly for drivers. In order to improve this we decided the best thing was to develop apps for mobile OS.

#### 2.1.4.1 Android OS

Android is an operating system based on the Linux kernel, and designed primarily for touchscreen mobile devices such as smartphones and tablet computers. Initially developed by Android, Inc., which Google backed financially and later bought in 2005, Android was unveiled in 2007 along with the founding of the Open Handset Alliance: a consortium of hardware, software, and telecommunication companies devoted to advancing open standards for mobile devices. The first Android-powered phone was sold in October 2008.

Android is open source and Google releases the code under the Apache License. This open-source code and permissive licensing allows the software to be freely modified and distributed by device manufacturers, wireless carriers and enthusiast developers. However, most Android devices ship with additional proprietary software. A developer survey conducted in April–May 2013 found that Android is the most popular platform for developers, used by 71% of the mobile developer population.

Its latest version is Android Kit Kat 4.4 at the moment of writing this document.

#### **2.1.4.2 iOS**

iOS (previously iPhone OS) is a mobile operating system developed and distributed by Apple Inc. Originally unveiled in 2007 for the iPhone, it has been extended to support other Apple devices such as the iPod Touch, iPad, iPad Mini and second-generation Apple TV. It had a 21% share of the smartphone mobile operating system units shipped in the fourth quarter of 2012, behind only Google's Android.[7] In June 2012, it accounted for 65% of mobile web data consumption (including use on both the iPod Touch and the iPad). At the half of 2012, there were 410 million devices activated.

iOS is derived from OS X, with which it shares the Darwin foundation and various application frameworks. iOS is Apple's mobile version of the OS X operating system used on Apple computers. [31]

Its latest version is iOS 7 at the moment of writing this document.

#### **2.1.4.3 Blackberry OS**

BlackBerry 10 is a proprietary mobile operating system developed by BlackBerry Limited (formerly Research In Motion) for its BlackBerry line of smartphone and tablet handheld devices. BlackBerry 10 is based on QNX which was acquired by BlackBerry in April 2010. BlackBerry 10 is the third major release of a QNX based operating system, following the release of BlackBerry Tablet OS with the BlackBerry PlayBook on April 19, 2011, and BlackBerry Tablet OS version 2.0 on February 21, 2012. BlackBerry 10 and BlackBerry Tablet OS have numerous technical similarities, with BlackBerry 10 providing substantial enhancements over the earlier releases. [32]

#### **2.1.4.4 Windows Phone**

Windows Phone (abbreviated as WP) is a series of proprietary smartphone operating systems developed by Microsoft. It is the successor to Windows Mobile, although it is incompatible with the earlier platform. Unlike its predecessor, it is primarily aimed at the consumer market rather than the enterprise market. It was first launched in October 2010, with a release in Asia following in early 2011.

The latest release is Windows Phone 8, which was launched on October 29, 2012. With Windows Phone, Microsoft created a new user interface, featuring a design language named "Modern" (which was formerly known as "Metro"). Additionally, the software is integrated with third-party and Microsoft services, and sets minimum requirements for the hardware on which it runs.

Microsoft is currently developing an updated version of Windows Phone, code named "Windows Phone Blue" (previously "Windows Phone Apollo Plus") which will be named either Windows Phone 8.1 or Windows Phone 8.5. [33]

#### 2.1.4.5 Other

There are other mobile OS such as Firefox OS, Symbian, etc. These OS' market share is so small that we are not taking them into consideration for now.

**Worldwide Smartphone Sales to End Users by Operating System in 2Q13 (Thousands of Units)**

Operating System	2Q13 Units	2Q13 Market Share (%)	2Q12 Units	2Q12 Market Share (%)
Android	177,898.2	79.0	98,664.0	64.2
iOS	31,899.7	14.2	28,935.0	18.8
Microsoft	7,407.6	3.3	4,039.1	2.6
BlackBerry	6,180.0	2.7	7,991.2	5.2
Bada	838.2	0.4	4,208.8	2.7
Symbian	630.8	0.3	9,071.5	5.9
Others	471.7	0.2	863.3	0.6
<b>Total</b>	<b>225,326.2</b>	<b>100.0</b>	<b>153,772.9</b>	<b>100.0</b>

Source: Gartner (August 2013)

Figure 3 - Cell Phone OS Comparison

#### 2.1.4.6 OS Comparison

In order to decide which OS was the one the customers used more we developed a survey and it was carried away through the call center. Every time a user called the person from the call center asked them a few questions.

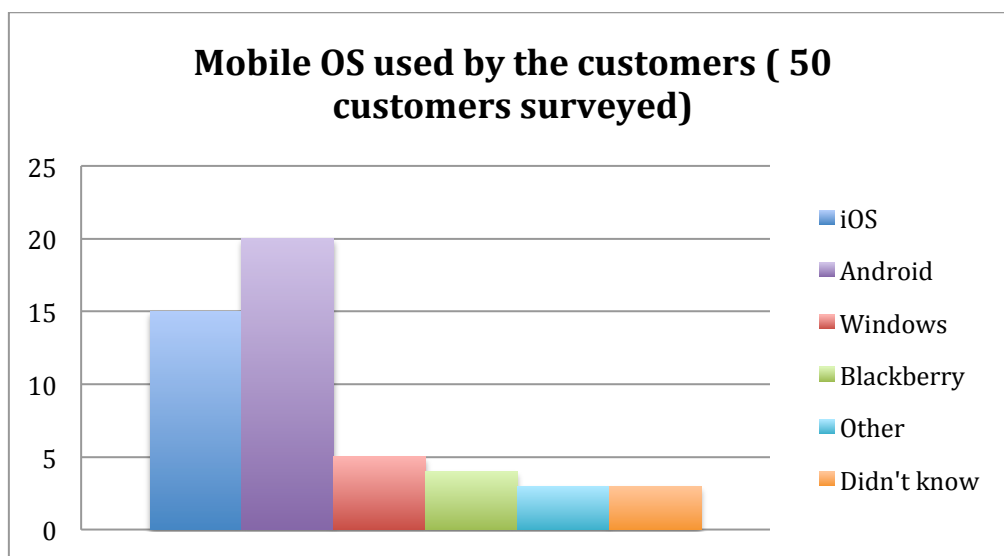


Figure 4 - Customer's survey



## 2.2 Tools to develop the system

In order to develop this project several tools, online and offline, have been essential.

### 2.2.1 Eclipse

Eclipse is a development environment written mostly in Java. Eclipse SDK is free and open source software (although it is incompatible with the GNU General Public License). By using plug-ins, Eclipse can be used to develop applications in several languages such as Java, PHP, Perl, JavaScript, HTML, CSS, etc.

By the Android Development Tools (ADT) plug-in, Eclipse is a great start to build Android Apps. ADT extends the capabilities of Eclipse to let you quickly set up new Android projects, create an application UI, add packages based on the Android Framework API, debug your applications using the Android SDK tools, and even export signed (or unsigned) .apk files in order to distribute your application.[35]

Eclipse Kepler will be used to develop the Android App included in the project.

### 2.2.2 Xampp

Xampp 1.8.3 was used as the server solution for the local solution of this system. After considering other options, Xampp was replaced for a more global option.

XAMPP is an easy to install Apache distribution containing MySQL, PHP and Perl. XAMPP is a compilation of free software (comparable to a Linux distribution), it's free of charge and it's free to copy under the terms of the GNU General Public License. [37]

### 2.2.3 Sublime Text

Sublime Text is a text editor for code, HTML, and prose. It features rich selection of editing commands, including indenting or un-indenting, paragraph reformatting, line joining , multiple selections, regular expression search and replace, incremental find as you type, and preserve case on replace. Create macros, snippets, auto complete, and repeat last action. It has build tool integration ability, automatic build on save, and WinSCP integration for editing remote files via SCP and FTP. [38]

Sublime 2.0.2 was used in this project to sketch the code for the website.

### 2.2.4 SQLite Database Browser

SQLite Database Browser 2.0b1 was used on the first version of the project as a SQLite database managing system.

SQLite Database Browser is a freeware, public domain, open source visual tool used to create, design and edit database files compatible with SQLite. It is meant to be used for users and developers that want to create databases, edit and search data using a familiar spreadsheet-like interface, without the need to learn complicated SQL commands. [40]

### 2.2.5 XCode

XCode was used to develop the iOS app.

Xcode is Apple's powerful integrated development environment for creating apps for Mac, iPhone, and iPad. Xcode includes the Instruments analysis tool, iOS Simulator, and the latest SDKs for iOS and OS X. [41]

### 2.2.6 Apple Numbers

Numbers was used to keep the information of the establishments. This file was after uploaded to SQLite and MySQL.

Numbers is a spreadsheet application developed by Apple Inc. as part of the iWork productivity suite alongside Keynote and Pages.[1] Numbers 1.0 was announced on August 7, 2007 and thus it is the newest application in the iWork suite. Numbers runs on Mac OS X v10.4 "Tiger" or newer. On January 27, 2010, Apple announced a new version of Numbers for iPad with an all new touch interface. The app was later updated to support iPhone and iPod Touch. On October 23, 2013, Apple released a redesigned Numbers 3.0, and made it 100% free for anyone with an iOS device. [42]

### 2.2.7 Apple OS X Mavericks

OS X is the operating system that powers every Mac. Built on a rock-solid UNIX foundation, it's engineered to take full advantage of what the hardware is capable of. And it's designed to deliver the most intuitive and integrated computer experience in the world. [43]

### 2.2.8 Tom's Planner

Tom's Planner was used to keep track of the development, helping to plan the project.

Tom's Planner is a web based project planning application that enables you to create & share Gantt Charts and project plans with drag & drop simplicity. [44]

## 2.3 *Similar developed tools*

There are some tools that perform similar actions as the one developed for this project.

### 2.3.1 Google Places API for Business

The Google Places API gives you access to detailed information about places across a wide range of categories. These 'places' include businesses and points of interest, updated frequently through owner-verified listings and user-moderated contributions. [45]

Google Places API allows developers to include maps with information on different businesses.

### 2.3.2 Foursquare

Foursquare is a location-based social networking website for mobile devices, such as smartphones. It helps you find locations around you such as night clubs, restaurants, etc.

### 2.3.3 Around me

AroundMe quickly identifies your position and allows you to choose the nearest Bank, Bar, Gas Station, Hospital, Hotel, Movie Theatre, Restaurant, Supermarket, Theatre and Taxi.

AroundMe shows you a complete list of all the businesses in the category you have tapped on along with the distance from where you are.

For every listing you can choose to see its location on a Map, view the route from where you are, add the information to your contact list or even email the information to a friend.

The Nearby listing allows you to find information using Wikipedia about what is around you.

## 3. Client Requirements and Tool Description

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<b>3.2 Tool Description .....</b>	<b>37</b>

## 3. Client Requirements and Tool Description

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### 3.1 Client Requirements

The main requirement set by the client was that the tool we implemented had to reduce each call by at least half of the time. They also needed a big differentiation between the different types of establishments, as they have a priority rank in order to send the customers to one or another establishment. Another requirement they had was that the place you send the customer to could not be more than 30 km away.

As a big company it has several offices all over the peninsula, therefore information is managed by people located in different places communicating by phone or email. This means the database has to be unique and manageable by every user independently of their location.

The main issue with the previous system was that the tool wasn't precise enough and the customer service workers could only give an approximate solution. As the info they had was stored in an Excel document, they could only select the locations by their zip code. This means that if the closest location to the customer was in another zip code the one given by the customer service would be further away but in the same zip code. In addition to this and as part of the Excel limitations, they had to filter several columns to get a more effective result. Normally, they know which location can offer the best service to the customers; this implies applying several filters manually to the columns of the database. In conclusion, they weren't giving the best solution to each query.

This was also a big concern, the user had to wait for an answer and this wasn't always the best one.

As explained before, there are other technical requirements such as:

- Global accessibility
- User friendliness
- Speediness
- Ease of upgrading
- Use of open source systems

### 3.2 Tool Description

The solution adopted consists of three tools. The first one and the most important one is the website. The second one is an Android app and the third one is an iPhone app.

### 3.2.1 The Website - <http://ameliatfg.comyr.com>

The website is the main tool, as the other two perform queries to the website in order to obtain the information.



Figure 5 - The Website

As you can see, it consists on a form and a map. We use the form to set the location of our user, in case we are part of the call center, or our own, if we are the user.

On the text area we can write the complete address (i.e. Calle Comercio 2 28007 Madrid), the zip code (i.e. 28010), or an interesting place of the city (i.e. Museo del Prado, Madrid).

The more accurate the address is the more precise our location will be.



Figure 6 - Possible searches

After setting your location the user can select the radius in which you want to search for establishments. In this particular case, it is established that the locations given by the call center cannot be more than 30km away from the client's location. Therefore the radius is limited to 30km. The user can also select what type of establishments he wants to see. For example, Franchise A establishments are owned by the company so

the company wants them to be the first option when the people from the call center answer a call.



Figure 7 - Radius select



Figure 8 - Type selection

After clicking Search or pressing enter, the results are displayed in the map.

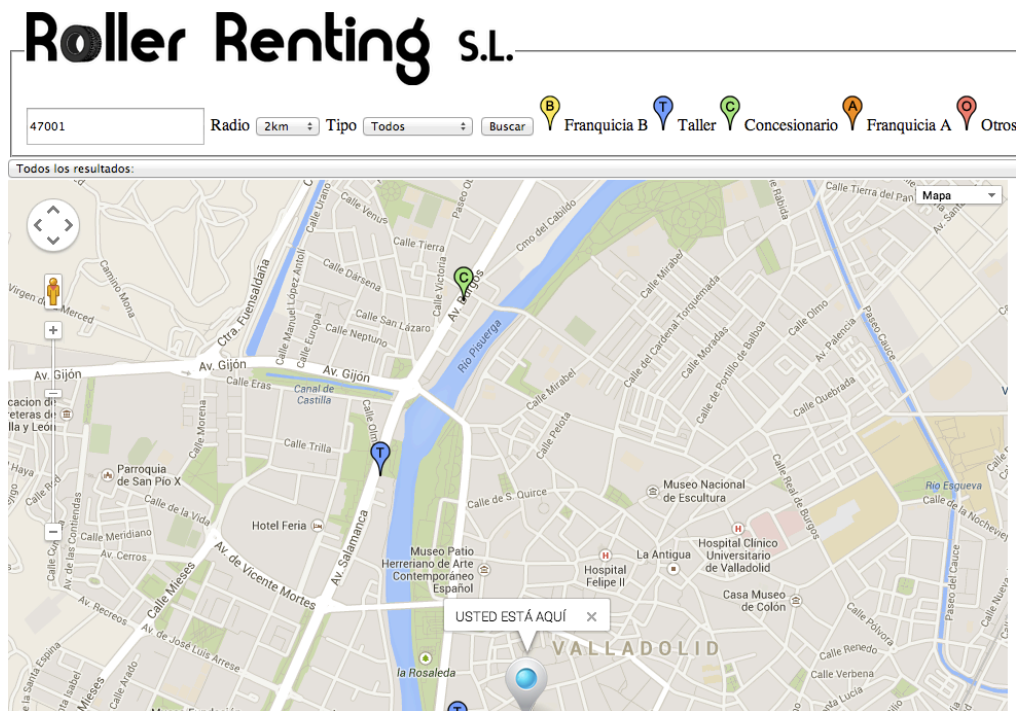


Figure 9 - Results

If there are no results for our search a pop-up shows telling the user that there are no results for that search. In this case, the user can set a higher radius or set the type to All.

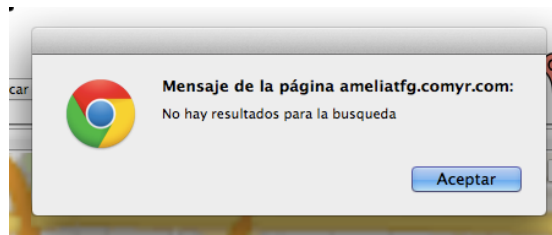


Figure 10 - No results

Once the search gives you results, you will get a marker with the users position and the markers were the establishments are located. Also, you will get a drop-down list with all the results including the user's distance to each of them. The results are arranged by distance.

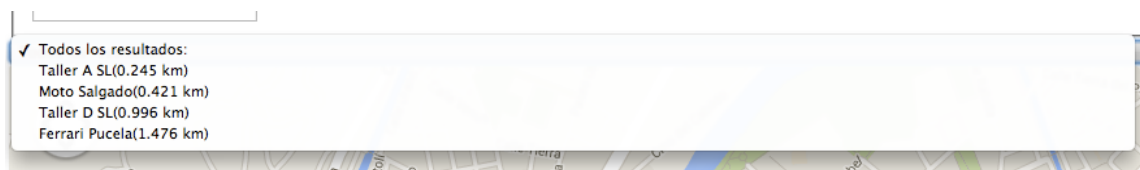


Figure 11 - Drop down list

If the user clicks on any of the markers, a window will show up with all the information regarding this place.

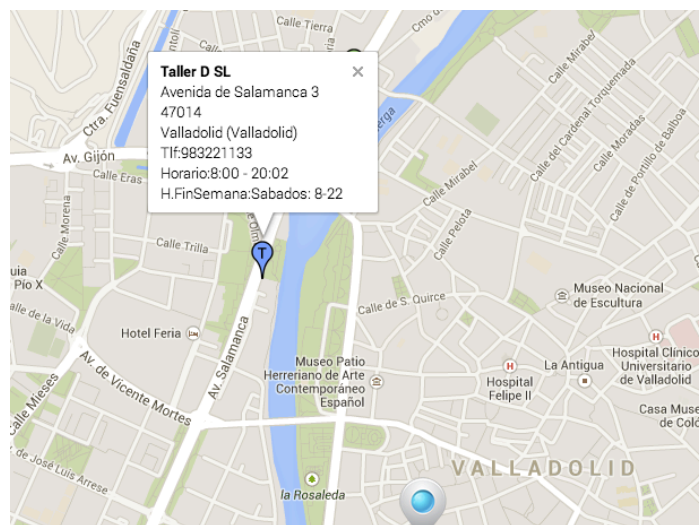


Figure 12 - Marker example

If the user does double click, directions from your location to that marker will show at the right of the window. These directions are to go by car.



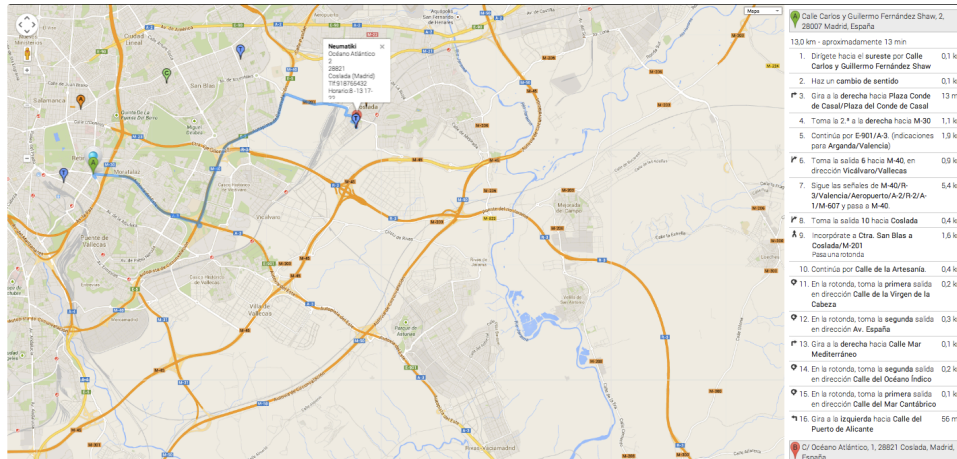


Figure 13 - Directions

If the user wants to check the directions to any other marker, the user just has to double click on the new marker to obtain them.

The website is accessible from any web browser, as well as cell phones, tablets, etc.

### 3.2.2 The Android App

On the Android App, the main and only screen is a map. The map is centered on the user's location.

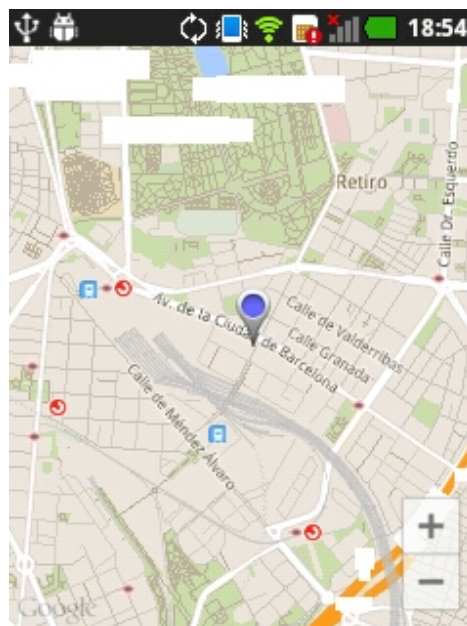


Figure 14 - Android app

In this case, there is no filter so all the establishments are shown. As the map is zoomed in you will see only the closest places to your location.

The establishments' markers have the same color as on the web in order to differentiate their type. If you press a marker a information window will pop-up showing the information on the establishment.

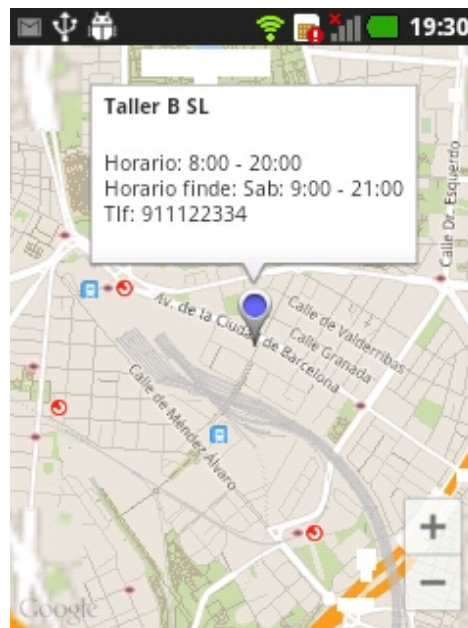


Figure 15 - Marker example

Once you select a marker the app saves its info, this is used for the GPS function. If the user wants to use the GPS of the phone to get directions to an establishment, they just have to select the marker, press the menu button and select the GPS option. This will open the GPS app on the phone setting the destination as the selected establishment.

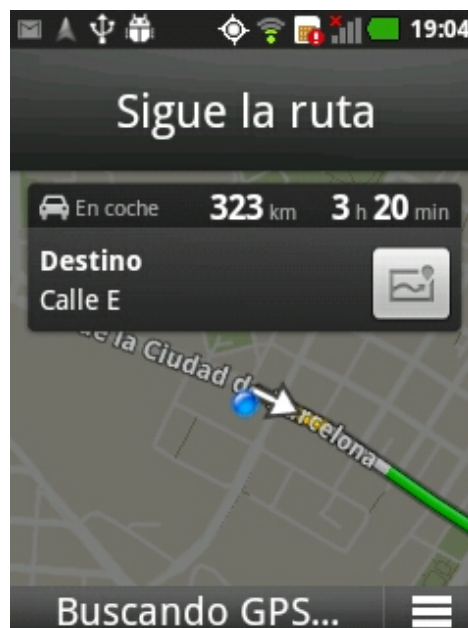


Figure 16 - GPS

Through the menu button the user also can check the legend of the markers, reposition its location or change the map's view.

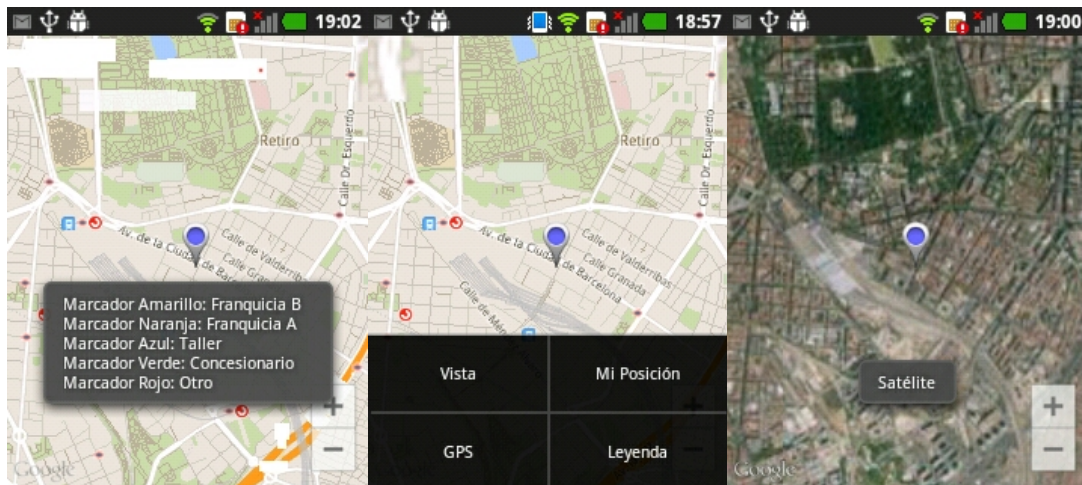


Figure 17 - Menu options

### 3.2.3 The iOS App

The iOS App is very similar to the Android app. Once the user enters the app the first view is the map centered on their location.

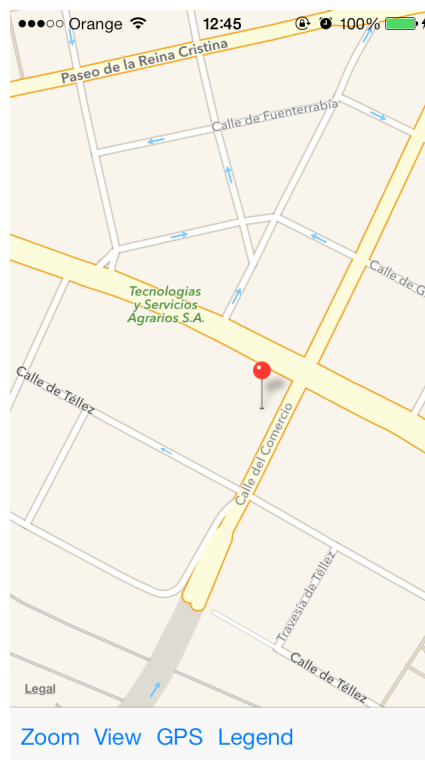


Figure 18 - iOS app

If the user selects a maker, a window with information regarding the establishment will pop up.

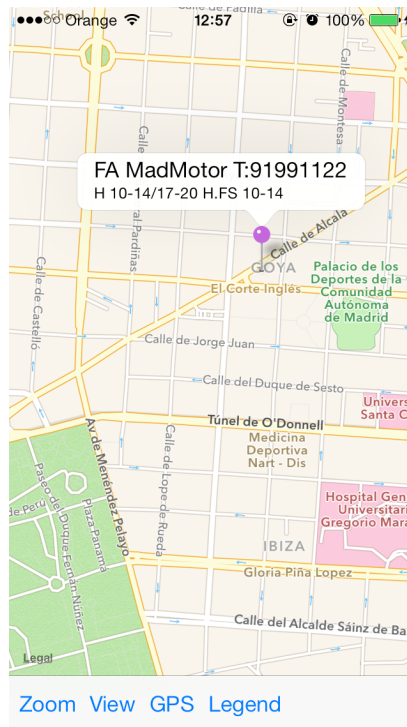


Figure 19 - Marker example

In this case, the differentiation between the markers is only done with two colors. The purple markers represent the Franchise A establishments which, as explained before, are owned by the company. The red markers represent the rest of the establishments.

There are several buttons at the bottom of the screen:



Figure 20 - Menu

- Zoom: The app will zoom to the users location
- View: The app will change the type of map (Satellite, Standard or Hybrid)
- GPS: Apple Maps will open with the destination set on the last marker the user had tapped. The origin will be the users location.
- Legend: A message will pop telling the users the information on the colors of the markers

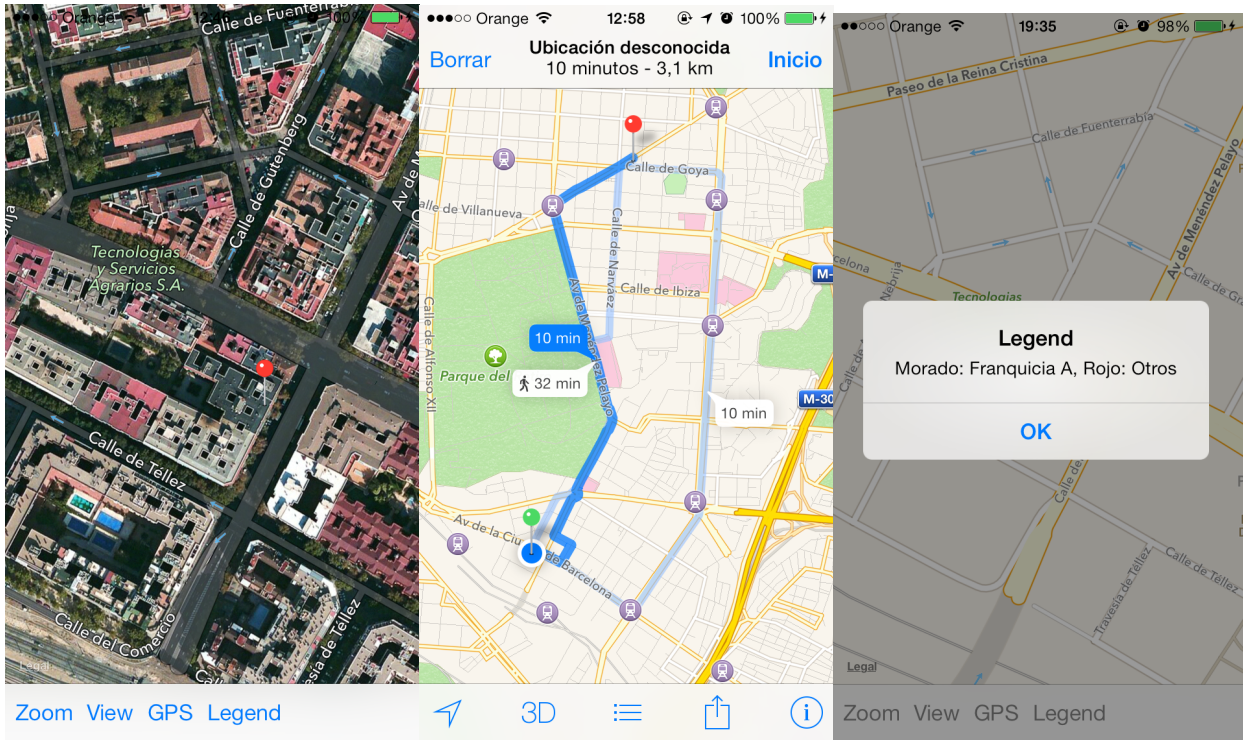


Figure 21 - Menu options

If the user does not select a marker and taps on GPS an alert message will pop up.

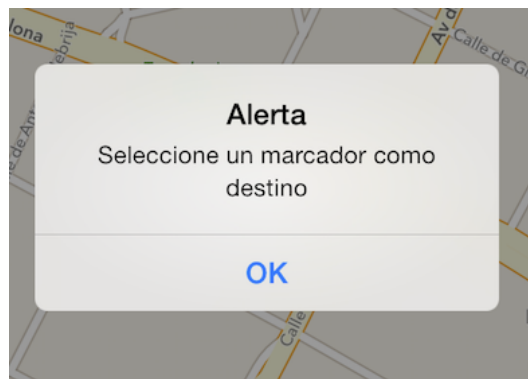


Figure 22 - GPS alert

# 4. Project Development

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# 4. Project Development

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## 4.1 Software development methodology

There are several methodologies for software development. So, in this project, the two most important ones have been compared in order to see which one was more suitable for our project.

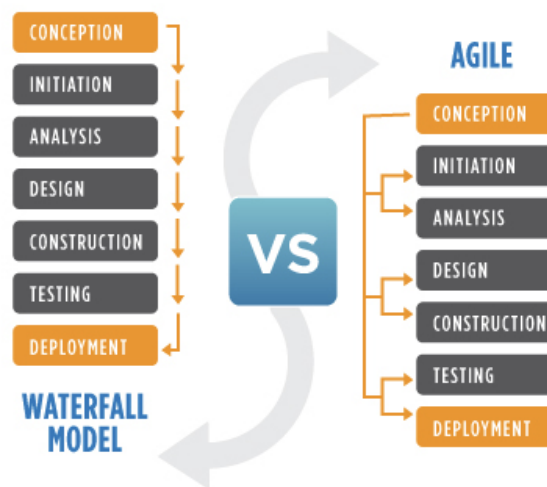


ILLUSTRATION BY SEGUE TECHNOLOGIES

Figure 23 - Methodologies

- Waterfall Model, also known as Traditional

Advantages:

- \* Developers and customers agree on what will be delivered early in the development lifecycle. This makes planning and designing more straightforward.
- \* Progress is more easily measured, as the full scope of the work is known in advance.
- \* Throughout the development effort, it's possible for various members of the team to be involved or to continue with other work, depending on the active phase of the project. For example, business analysts can learn about and document what needs to be done, while the developers are working on other projects. Testers can prepare test scripts from requirements documentation while coding is underway.
- \* Except for reviews, approvals, status meetings, etc., a customer presence is not strictly required after the requirements phase.

- \* Because design is completed early in the development lifecycle, this approach lends itself to projects where multiple software components must be designed (sometimes in parallel) for integration with external systems.
- \* Finally, the software can be designed completely and more carefully, based upon a more complete understanding of all software deliverables. This provides a better software design with less likelihood of the “piecemeal effect,” a development phenomenon that can occur as pieces of code are defined and subsequently added to an application where they may or may not fit well.

Disadvantages:

- \* One area which almost always falls short is the effectiveness of requirements. Gathering and documenting requirements in a way that is meaningful to a customer is the most difficult part of software development, in my opinion. Customers are sometimes intimidated by details, and specific details, provided early in the project, are required with this approach. In addition, customers are not always able to visualize an application from a requirements document. Wireframes and mockups can help, but there’s no question that most end users have some difficulty putting these elements together with written requirements to arrive at a good picture of what they will be getting.
- \* Another potential drawback of pure Waterfall development is the possibility that the customer will be dissatisfied with their delivered software product. As all deliverables are based upon documented requirements, a customer may not see what will be delivered until it’s almost finished. By that time, changes can be difficult (and costly) to implement.

- Agile Methodology

Advantages:

- \* The customer has frequent and early opportunities to see the work being delivered, and to make decisions and changes throughout the development project.
- \* The customer gains a strong sense of ownership by working extensively and directly with the project team throughout the project.
- \* If time to market for a specific application is a concern, Agile can more quickly produce a basic version of working software.
- \* Development is often more user-focused, likely a result of more and frequent direction from the customer.



## Disadvantages:

- \* The very high degree of customer involvement, while great for the project, may present problems for some customers who simply may not have the time or interest for this type of participation.
- \* Agile works best when members of the development team are completely dedicated to the project.
- \* Because Agile focuses on time-boxed delivery and frequent reprioritization, it's possible that some items set for delivery will not be completed within the allotted timeframe. Additional sprints (beyond those initially planned) may be needed, adding to the project cost. In addition, customer involvement often leads to additional features requested throughout the project. Again, this can add to the overall time and cost of the implementation.
- \* The close working relationships in an Agile project are easiest to manage when the team members are located in the same physical space, which is not always possible. However, there are a variety of ways to handle this issue, such as webcams, collaboration tools, etc.
- \* The iterative nature of Agile development may lead to a reduction in overall system quality, as there is less emphasis on understanding the finished system as a whole early in the project. This becomes more pronounced in larger-scale implementations, or with systems that include a high level of integration. [46]

After taking into consideration all these reasons, the Agile methodology was decided to be more suitable for our project. This methodology is based on iterative and incremental development, where solutions require collaboration between the people involved in order to achieve a better result. The work done is continuously evaluated by the customer who will be giving feedback on it.

Finally we decided SCRUM was the best framework to implement the Agile methodology. This framework consists on the lack of description on the development of the solution; this is left for the team as they will know best how to solve the problem they are presented with. Scrum suggests the project should progress through a series of sprints and it has its main strengths on the continuous feedback and the synchronized work of the whole team. [47]

## 4.2 Project Development

This project has been developed with the collaboration of two more departments. The department in charge of the management of fleets provided the information from the locations they wanted to be available for the clients. They had an Excel file, which included all the information from the location, the financial situation, and the most important field was if the location was active or not. This last field differentiated which locations were available for the clients and which weren't.

The other department in charge was the one aimed to give a service to the customer. They had the same database as the first department but they only needed some of the information. They were using this database to get the most appropriate location close enough to the clients position, not only based on the proximity but also on other factors such as the type of place and the service they gave to the client. Each call lasted around 10min, as they had to get the location of the client, filter the province, then the city if existed, the type of location, etc. Even after all this the answer was never as precise as it could be as filtering in the Excel is not the most accurate way to find locations.

The main issue was getting the correct information on the establishments. As explained before, the establishments are classified by types depending on their business model. They can be a franchise type A, which depends on the company, a franchise type B, a workshop, a car dealer, an independent business or just part of the rest. Most of the locations were missing more than half of the information used by the call center. This included info about the services they provided (replacement car, car pickup, etc.), their timetable and what is more important, its coordinates.

Taller D SL	Avenida de Salamanca 3	47014	Valladolid	Valladolid	983221133						Taller	SI
Ferrari Puzella	Avenida de burgos 30	47009	Valladolid	Valladolid	983001122						Concesionario	SI
Neumatici	Océano Atlántico 2	28821	Coslada	Madrid	918765432						Taller	SI
Carcasas Sole	Paseo de la Rosa 30	45006	Toledo	Toledo	925873456						Otro	SI
FA Ruedines SL	Francisco Guerra 5	06011	Badajoz	Badajoz	924785463						Franchisista	SI
Bebienes SA	Miguel Cano 5	29601	Málaga	Málaga	952123456	9-13 17-22	9-15				Franchisista	SI
Seat Madrid	MADRIDES PLAZA DE MAYO N4	28017	MADRID	MADRID	913674011	DE 09:00 A 18:00 Y D	SABADOS DE 09:00 A 13:00	40.4328293	-3.6417126		Concesionario	SI

Figure 24 - Database

Around 10 people form these two departments, 3 are from the one managing the fleets and 7 are from the call center. Each of them had a different file, with different information, as they didn't share it when they changed something. All this caused a small chaos, as they couldn't agree on what information was the good one.

After deciding which info was correct the next step was gathering the information missing. It was the task of the managers of the franchise to send the information on the timetables and services provided. This took around 3 weeks and ended up with only half of the information. The information on the weekend timetables was missing and also information on the replacement car service. Meanwhile, the two departments were focused on getting the coordinates of every location. This took around 3 weeks as they didn't agree on the format and they had to redo around half.

Once we had the Excel file with all the information and after an exhaustive research, I decided Google Maps was the best option. The customer needed very precise information about a location in the shortest possible time. With the other available options the information would have been not as precise and it would take the people from the call center at least double the time. This option would give a very visible and precise option in a very short time. The number of daily requests allowed was enough for the scope of our project. At first thought of using Microsoft Access as the database system, the information must remain in a server only accessible from the office and this system has a good performance but it's main issue is that it only works in Windows and the server destined for this job was running on Linux. Another big issue was the

cost, so I decided to use SQLite in stead. Android also accepted SQLite so people could have the information without needing to connect to the office network. HTML 5 was mandatory as the website has to be accessible not only from computers but also from cell phones and tablets. I chose PHP to make the get the information from the database because I'm familiar to it and it's very efficient.

At first, and following a Google example, the website included a map and a form. The form included a search bar and an option drop down list where the user can select the radius in which he wants to search for locations. When a search was made, the markers where differentiated only in two types: Franchise A and the rest. This was the first prototype.

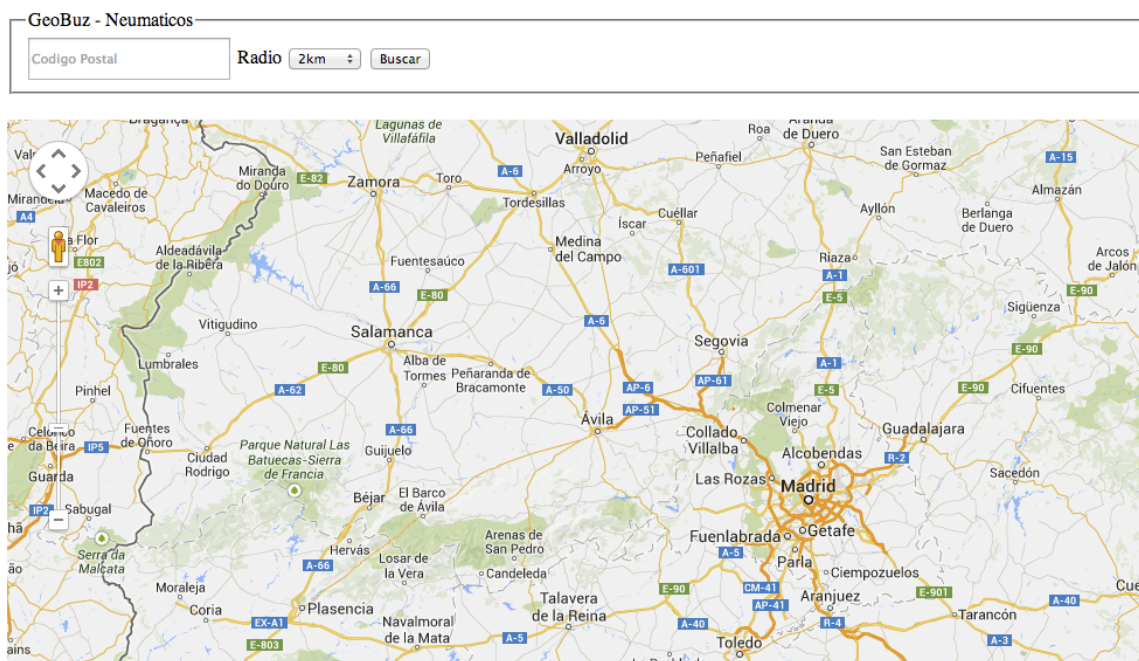


Figure 25 - First prototype



Figure 26 - Differentiation

The web was hosted in the computer used to program it using XAMPP and the database was managed with SQLite Database Browser.

	Nombre	Direccion	CP	LOCALIDAD	PROVINCIA	TELEFONO	HORARIO	HORARIOFS	LATITUD	LONGITUD	TIPO	ACTIVO
1	Taller A SL	Doctrinos 20	47001	Valladolid	Valladolid	983123456	8:00 - 20:00	Sab: 8:00 - 20:00	41.6495194	-4.7319425	Taller	SI
2	Taller B SL	Comercio 2	28007	Madrid	Madrid	911122334	8:00 - 20:00	Sab: 9:00 - 21:00	40.4039542	-3.6813543	Taller	SI
3	Taller Murcia SA	Calle Murcia	30007	Murcia	Murcia	986523215	9 - 10	10 - 12	37.992331	45.750000034	FranquiciaB	SI
4	FA Mestalla	Calle Valencia	46006	Valencia	Valencia	963736430	9:00 - 16:00	SAB: 10:00 - 12:00	39.4699075	881000000107	FranquiciaA	SI
5	Wagen Sanchez	Camino Los Alj	35572	Tías	Las Palmas	612345678	9 - 13 / 17 - 2	Cerrado	077498942503	097124670467	Concesionario	SI
6	Moto Labarga	Calle Mayor 64	26250	Santo Domingo	La Rioja	999112233	9-12/14-19	Cerrado	009728704415	771198517177	FranquiciaB	SI
7	FA MadMotor	Calle Alcalá 100	28009	Madrid	Madrid	91991122	10-14/17-20	10-14	40.4250869	711000000002	FranquiciaA	SI
8	Renault Arguell	Calle Gaztambier	28015	Madrid	Madrid	611223344	9-21	9-15/Dom Cer	40.4332441	493000000206	Concesionario	SI
9	Legasport	Avda de la Univ	28911	Leganés	Madrid	611223345	9-21	9-15/Dom Cer	40.3312359	71999999743	Taller	SI
10	FA Ruedas &am	Avenida de Gra	28916	Leganés	Madrid	912233445	9-12/14-19	9-15/Dom Cer	40.340602	11499999674	FranquiciaA	SI
11	Moto Salgado	Divina Pastora	28004	Valladolid	Valladolid	983456789	9-12/14-19	10-14	41.6483029	474800000053	Concesionario	SI
12	Taller C SL	Avenida de Vall	47100	Tordesillas	Valladolid	983223344	9 - 13 / 17 - 2	Cerrado	41.5028392	228999999985	Taller	SI
13	FA Rueda &am	Alonso Pesquer	47340	Sardon de Duer	Valladolid	983778866	9-12/14-19	Cerrado	41.6084583	664799999974	FranquiciaA	SI
14	Taller D SL	Avenida de Sala	47014	Valladolid	Valladolid	983221133	8:00 - 20:02	Sabados: 8-22	41.6576028	169799999994	Taller	SI
15	Ferrari Pucela	Avenida de bur	47009	Valladolid	Valladolid	983001122	9:00-21:00	Cerrado	41.6630287	166219999996	Concesionario	SI
16	Neumatiki	Océano Atlántic	28821	Coslada	Madrid	918765432	8 -13 17-22	9-15	40.4195795	73999999754	Taller	SI
17	Carcasas Sole	Paseo de la Ros	45006	Toledo	Toledo	925873456	9-13 17-22	9-15	39.862029	032000000105	Otro	SI
18	FA Ruedines SL	Francisco Guern	06011	Badajoz	Badajoz	924785463	10 -13 17-22	9-17	38.8709541	470300000036	FranquiciaA	SI
19	Balbuena SA	Miguel Cano 5	29601	Marbella	Malaga	952123456	9 -13 17-22	9-15	36.5080873	994899999991	FranquiciaB	SI

Figure 27 - SQLite Database

When sharing this with the people from the call center we discovered several mistakes. The first one was that the search radiuses were too big (10km, 20km, 30km, 50km), as they could only inform the client of locations in a maximum radius of 30km. The second thing was that the marker differentiation we made wasn't enough. We needed to get Franchise B differentiated as well. In order to do this, I developed an Excel formula where I took several fields into account and another field was set depending on some of these values.

On the second prototype, the radiuses had been reduced to 1km, 2km, 5km, 15km, and 30km. Also, the markers differentiation had been extended to three types: Franchise A, Franchise B and the rest. They wanted this because they have some location to which they don't want to send the client as the first option. For a couple of weeks we used this system in a parallel way with the other one. The people who were using it had a list of requirements missing and advantages and disadvantages of this new system. Their main requirement was more differentiation between the locations as it still wasn't enough. This could have been avoided if all the differentiations had been mentioned after the first review. They complained about the lack of information on the distance between the client and the location. In order to improve this, I added a list that showed the distance between the location provided by the client and the location of the workshop or car dealer. This was arranged from the closest one to the one further away. On their feedback they mentioned that some of the locations they know by heart weren't located in this new system. The good part was that the time spent in each call was reduced by half when the locations were found on the map.

After a couple of weeks trying to fix the coordinates of almost 30% of the locations, the final website was delivered. We had a few meetings with the people from the call center to set the final differentiation, which ended up having 5 categories: Franchise A, franchise B, workshop, Car Dealer and the rest. In order to make the search a little bit

friendlier I added a drop-down list to filter the search by the type of location and a “You are here” marker to make the search more visible.



Figure 28 - Search options

Once this was working, the only work left to do was to use it with every call. The people from the call center still had the Excel file as a backup but they could use it only in case of emergency. During this period of time, there were around 4 or 5 locations, which were located in another place.

After a couple of weeks we had a meeting to see how the system was working. Everyone was very happy about its performance; our objective of reducing the time spent on each call by half was being achieved. The locations wrongly located had been reduced to approximately one a week and the clients seemed much happier about the precision on the solutions given. There were a couple of things bothering them, the first one was that some clients were asking for directions as they didn't know the area or had a GPS system with them. After doing some research I realized Google Maps API had some functions, which could make this possible. So now when they made double click on any marker the driving route between both spots would be shown on the right side including every step to follow. The second issue had to do with where the website was being hosted. They wanted the clients to be able to do all this by themselves, and for now this was not possible. The idea was to move the website to a public server in order for everyone to access. As of the possible places to host it, the company had already an agreement with one of them so the only things to discuss were if the hosting had to be Linux or Windows. Finally, we chose Linux because it was cheaper and our needs were fulfilled.

In its final stage the website was implemented in a Linux hosting and using MySQL as a database. As of today, there are still some misplaced locations, around 2%, and the people from both departments are fully in charge of maintaining the database updated.

«T»	NOMBRE	DIRECCION	CP	LOCALIDAD	PROVINCIA	TELEFONO	HORARIO	HORARIOFINSEMANA	LATITUD	LONGITUD	TIPO	ACT
<input type="checkbox"/>	Taller A SL	Doctrinos 20	47001	Valladolid	Valladolid	983123456	8:00 - 20:00	Sab: 8:00 - 20:00 Dom: Cerrado	41.6495194	-4.7319425	Taller	SI
<input type="checkbox"/>	Taller B SL	Comercio 2	28007	Madrid	Madrid	911122334	8:00 - 20:00	Sab: 9:00 - 21:00	40.4039542	-3.6813543	Taller	SI
<input type="checkbox"/>	Taller Murcia SA	Calle Murcia	30007	Murcia	Murcia	986523215	9 - 10	10 -12	37.992331	-1.130457500000034	FranquiciaB	SI
<input type="checkbox"/>	FA Mestalla	Calle Valencia 1	46006	Valencia	Valencia	963736430	9:00 - 16:00	SAB: 10:00 - 12:00	39.4699075	-0.3762881000000107	FranquiciaA	SI
<input type="checkbox"/>	Wagen Sanchez	Camino Los Aljibes 1	35572	Tías	Las Palmas	612345678	9 - 13 / 17 - 20	Cerrado	28.948077498942503	-13.653097124670467	Concesionario	SI
<input type="checkbox"/>	Moto Labarga	Calle Mayor 64	26250	Santo Domingo de la	La Rioja	999112233	9-12/14-19	Cerrado	42.441009728704415	-2.9540771198517177	FranquiciaB	SI
<input type="checkbox"/>	FA MadMotor	Calle Alcalá 100	28009	Madrid	Madrid	91991122	10-14/17-20	10-14	40.4250869	-3.674711000000002	FranquiciaA	SI
<input type="checkbox"/>	Renault Arguelles	Calle Gaztambide 20	28015	Madrid	Madrid	611223344	9-21	9-15/Dom Cerrado	40.4332441	-3.7155493000000206	Concesionario	SI
<input type="checkbox"/>	Legasport	Avda de la Universidad 33	28911	Leganés	Madrid	611223345	9-21	9-15/Dom Cerrado	40.3312359	-3.7684719999999743	Taller	SI

Figure 29 - MySQL database

After fully developing the website, we asked the people from the call center to ask the customers what OS their cell phones had. Almost 70% had Android, where 15% had iOS, around 5% had Blackberry and the rest didn't have a smartphone. Therefore we decided the first app we developed had to be for Android. Our first move was to use the same SQLite database we had for the website, we had to adjust it a little bit but it didn't take us that much time. During this time we had to make several changes on the database, it was then when we realized every time the data had to be updated a new version of the app had to be released. This didn't make much sense so we decided it had to load from the website, but we couldn't do anything until the website was set public. Once the website was done, we decided to call it for an XML response were the data was stored. This would keep the app as updated as the website. The GPS functionality is a plus as only a small percentage of the people calling ask for directions to the final destination. The next step was the iOS app.

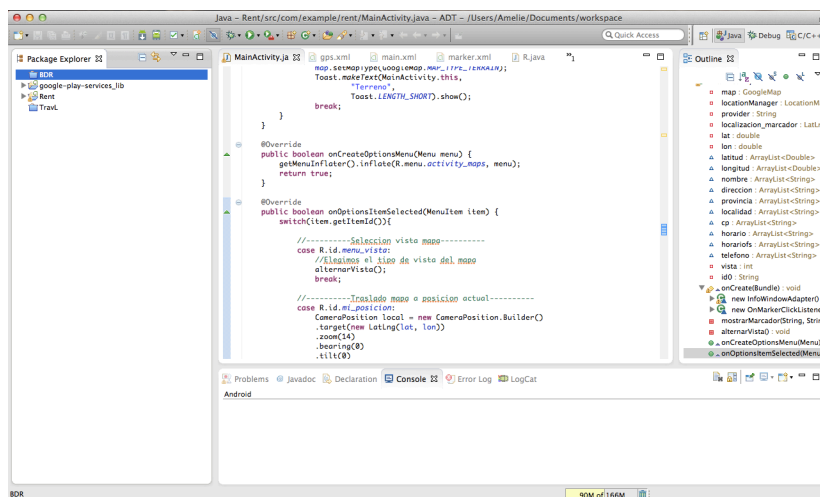


Figure 30 - Android App development

In order to do this, the first thing was thinking on the design of the app. It had to have the same functionalities as the Android app. As this was the first time programming for iOS, it took quite a while to develop it.

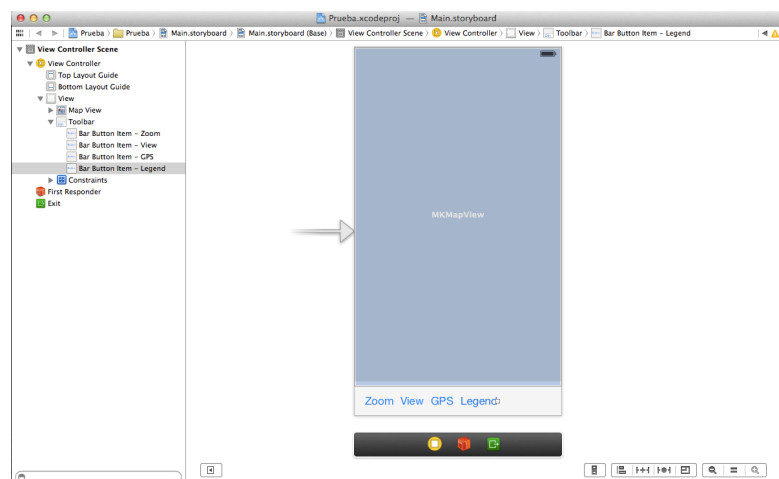


Figure 31 - iOS App development

When the app was finished we had a member of a fleet of trucks trying it in order to know if the app was working properly.

Also, during these months, I had several meetings with the designer to agree on the logo and the icons we were going to use on the web and apps.

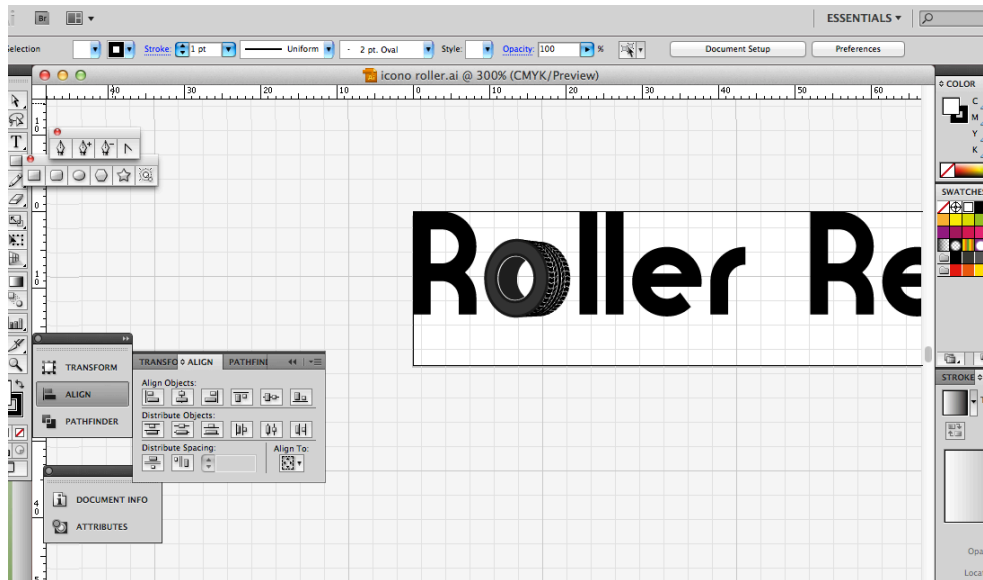


Figure 32 - Client's logo design

Also we had to design the our company's logo.

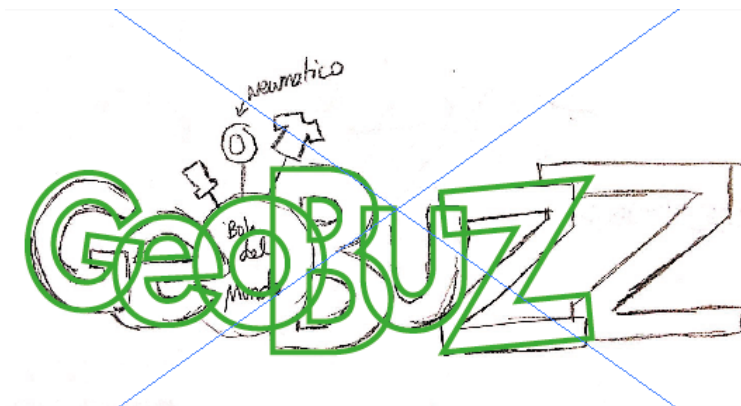


Figure 33 - Sketch



Figure 34 - Creation



Figure 35 - Final company logo



## 5. Results

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The results of this project have been much better than expected at first. There are two main groups of people who have appreciated these improvements; the people who work at the call center form the main group.

They had been working with an offline system for more than two years and every call took them between 5 and 10 minutes. The solution they gave to the customer was the result of a couple of searches done in an Excel file based in the city, the province, the type of location and only sometimes the zip code. As an example, if the customer was in the limit between two zip codes the solution given was the one from the zip code in which they were located when sometimes the one from the other zip code was closer to their actual location. The lack of a visual help made this very difficult, even though they knew some of these particular cases by heart and they gave really good solutions to the customers. Although it is only around 5% of the people who call the ones that need the route to the final location, every single call takes around 15minutes as to provide this information to the customer. This method was giving a non-updated solution, which may cause problems to the customer while already on route. Another issue is that the information had to be entered by hand so if the route wasn't as good as expected the information had to be set all over again.

With this new method the search was way more visual so they could tell which dealer, workshop, franchise, etc. was the closest one and which the color differentiation they could send the customer to the one with the best service. This entire search took around 20 seconds as it was done all together. It is important to mention that there is no need to update Google Maps as it is done by others. With the previous method, the maps from program used by the people to give the route weren't updated, as they had no license. This made them less accurate and even wrong sometimes.

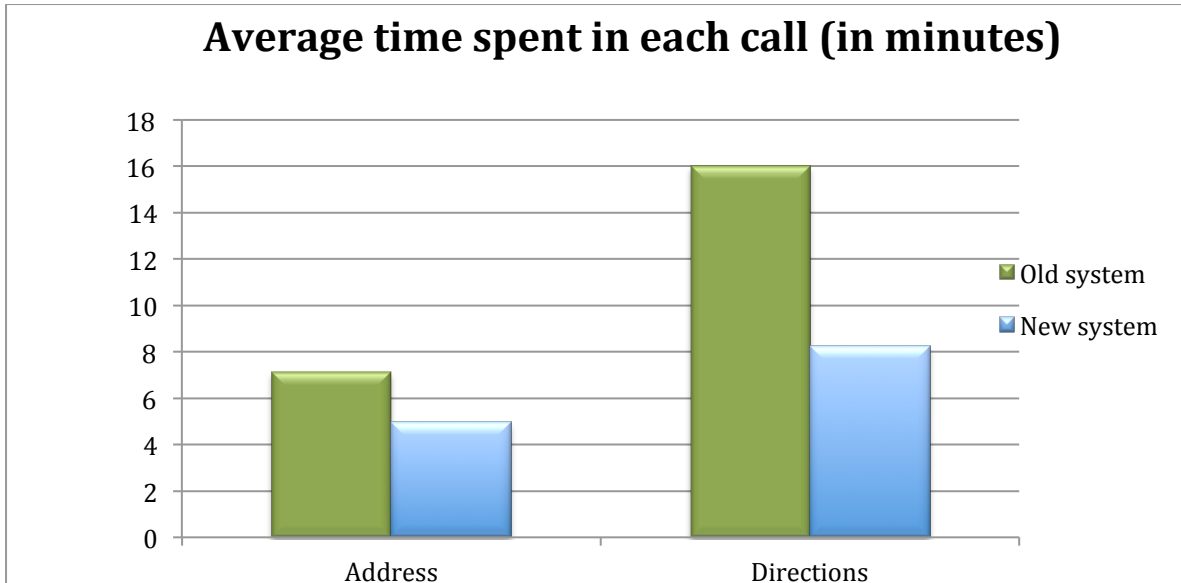


Figure 36 - Average time per call

As for the apps, only a few customers are using them as part of the beta program. These people, normally truck drivers that are part of a float, have reduced their calls by almost 50%. Some of them still make a call in order to get more precise information on the services this locations offer. In a survey some of them answered, the satisfaction level of this group of people showed that these changes had improved the system. Also, this new system gave more freedom to the clients as they could check the places independently of their own location and the time of the day they wanted to do the search.

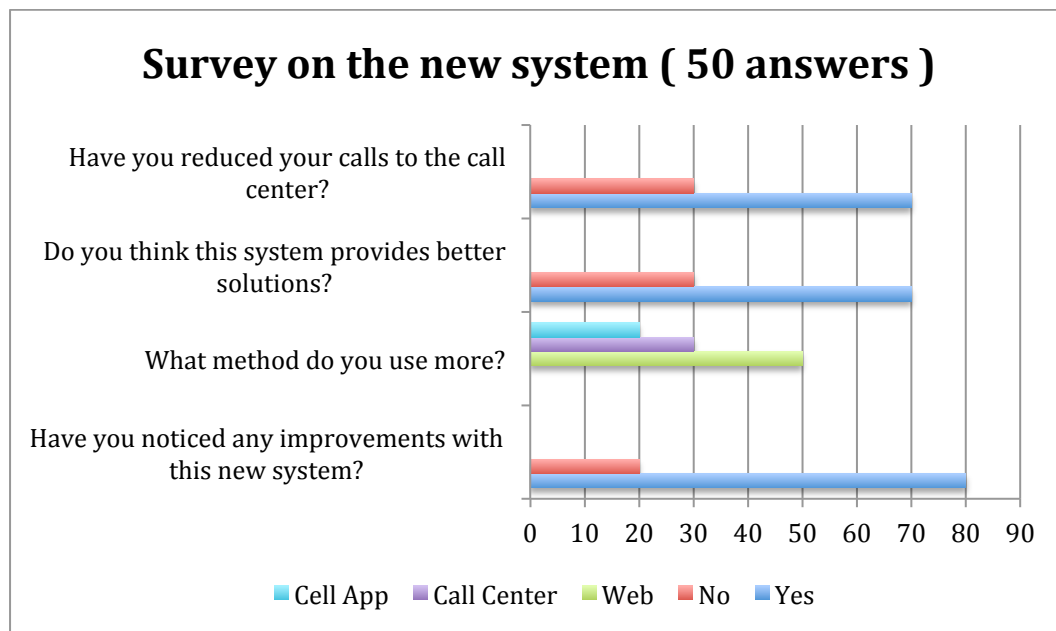


Figure 37 - Survey

# 6. Project Management

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# 6. Project Management

## 6.1 Project Planning

The project has been developed in several stages.

- Planning:
  - \* Requirement analysis
  - \* Scope document
  - \* Task distribution
- Database Organizing
- Implementation, testing and documenting:
  - \* Code programming
  - \* Software testing
  - \* Documentation writing
- Deployment and maintenance:
  - \* Changes and last minute adjustments
  - \* Evaluation
  - \* Software maintaining

The software maintaining has to go on as long as the system is still working.

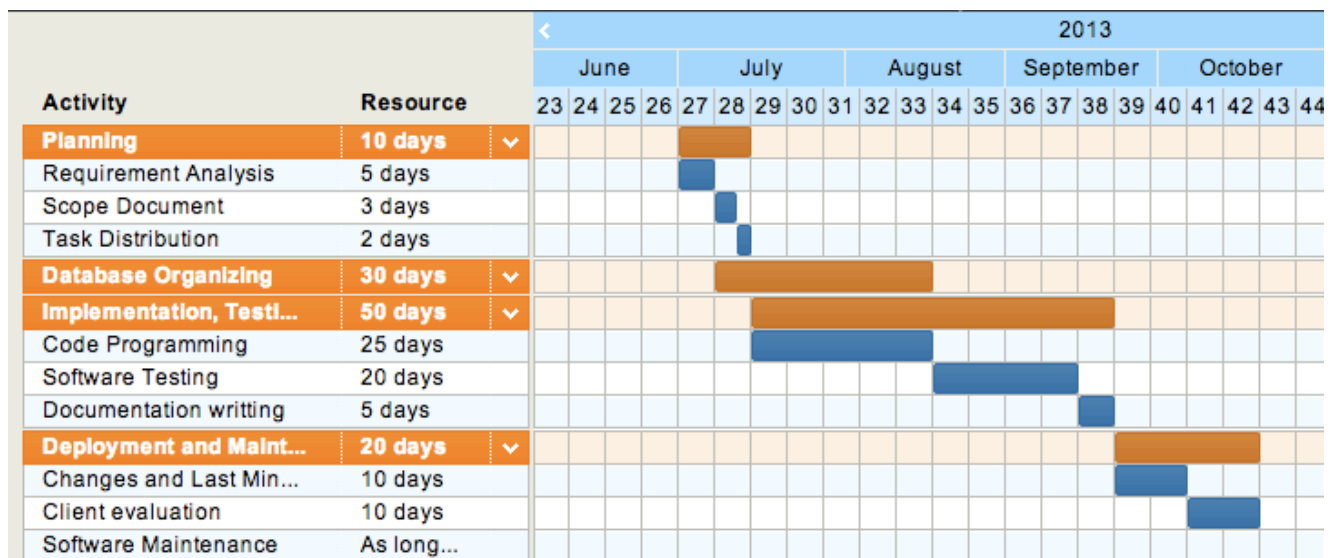


Figure 38 - Gantt diagram

## 6.2 Project Budget

In order to develop this project there are several costs we need to take into account. These can be classified as personal costs, hardware costs, software costs and indirect costs.

### 6.2.1 Personal expenses

These costs include salaries for team members on the project.

Staff	Category	Men/hour cost	Dedication	Cost
Salgado	Junior	20€	500	10000€
Riaño, Amelia	Engineer			

Figure 39 – Principal personal expenses

### 6.2.2 Hardware costs

These costs include all the equipment used in this project with the corresponding amortization based on its lifespan.

Equipment	Cost	Approx. Lifespan (months)	Usage time	Cost for the project <sup>a)</sup>
Mac Mini	649€	50	3 months	38,94€
Keyboard & Mouse	8,89€	24	3 months	1,12€
Asus Display	77,99€	50	3 months	4,68€
Apple iPhone 4s	399€	36	3months	33,25€
LG L3	81€	36	3months	6,75€
			<b>Total:</b>	<b>85,74€</b>

Figure 40 - Hardware costs

This equipment will be needed to maintain the system so this total cost is referring only to the initial development.

### 6.2.3 Software costs

Service	Cost	Cost for the project
1&1 Domain and Hosting	14,52€	14,52€

Figure 41 - Software costs

These costs are only for the first year, and then if the client wants the service to keep running there will be extra costs.

#### 6.2.4 Indirect costs

These costs include those which can't be computed exactly, such as electricity, Internet, etc. This is around 10% of the direct costs of the project.

Costs	Percentage	Costs for the project
Direct costs		10100,26€
Indirect costs	10%	1010,26€

Figure 42 - Indirect costs

#### 6.2.5 Total costs

This is the summary of the total cost of the project:

Type	Budget
Personal costs	10000€
Hardware costs	85,74€
Software costs	14,52€
Indirect costs	1010,26€
<b>Total</b>	<b>11110,29€</b>

Figure 43 - Total costs

The approximate total cost of the project is **11110,29€**.

a) The formula to calculate the amortization

$$\frac{A}{B} \times C \times D$$

- A: months the equipment is used
- B: depreciation period
- C: equipment's cost
- D: % of usage dedicated to this project

# Conclusions and future lines

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# 7. Conclusions and future lines

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After finishing this project, several conclusions were extracted and some future lines were defined.

## 7.1 Conclusions

After a hard work of planning and designing, the project was a big success. The main objectives of this project were to reduce the time spent on each call and to give the customer a better solution. As shown on this document, these two objectives have been reached.

There are several things in the whole process that should have been planned differently. First, the lack of implication on the client's side would have been a huge handicap. The information on the establishments is the root of the system and it would have taken too long for it to be delivered in a correct way. Even after the information had been delivered, a lot of misplaced establishments would have kept popping up. It is essential to have the information set correctly in order to achieve the final objective. Second, on the clients side there must be a person in charge of the project in order to make decisions and set the goals. With this client, it wouldn't have been clear who was the person in charge. This would have made decision taking a lot worse as no one would have taken responsibility for anything. Third, when you are going to start a project it is important to establish the scope of it from the beginning. If the scope had been established from the beginning we wouldn't have loosen time with smaller solutions.

At the end, this is very helpful for the next business we want to work with. We already have all the systems; it is only necessary to adapt them. Every business will have it's own requirements which will mean changes and adjustments. The things learnt from this client will make the next projects take less time to be developed and also, we'll be able to offer the client an already working solution.

The choices made on the technical side have been proven to be the correct ones. Some of the requirements were that it had to be a fast loading solution; with an average Internet connection this is achieved. The web and the apps offer an answer to the customer in a couple of seconds. Also, it had to be easily upgradable. After everything was developed, the people in charge of the information were taught on how to maintain a MySQL database and now they are able to do the changes on their own. There is a monthly monitoring to make sure everything is working fine.

This final project has been developed and deployed in the same way as if it were designed for a real world company with tight deadlines and sprints, which had to be met; there were real customers, which needed real help, etc. The other fact was that the people who were asked for feedback didn't actually know anything about



programming or about the current technology used in this cases, so all the choices were made left for the developer.

A very important amount of the knowledge acquired through the whole degree had to be put into practice. Not only the part about programming, but also the part of how to carry a project with its planning, its schedule, programming and configuring the software and technologies needed, etc.

## *7.2 Future lines*

As this is a project designed to use under any kind of circumstances, the main line would be to develop the web and the apps for other kinds of business. The client would have to tell you the differentiation that had to be made and also, they should deliver a standard database.

In this particular case, the future lines are making the apps accessible for all the users. There are some mobile OS for which the apps should be available as well. For now, the users are able to access the website but this does not provide a GPS access.

Also, there are some things that need to be improved such as the iOS app. The customization has to be better, as for now the only personalized item is the app icon. Depending on the differentiation the client needs the markers should be personalized.

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