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Facultad de Informática   Informatika Fakultatea

DEGREE:

Technical Engineering in Systems Computer Science

Reuse of software components orientated to *iOS* mobile devices

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End of Career Project, 23rd May 2013

Acknowledgments

Thank you Álex for telling me about my faults and for giving me ideas while I was writing the report. Thank you as well for giving me the chance to make the project in IK4-Ikerlan and for being such a good tutor. Thank you Juanpe for helping me integrate in the company and for introducing me all the people that afterwards have helped me to develop this application. I would like to give special thanks to Blanca, Aitor, Igor and Jone for giving me such a good technical support every time I needed despite they were usually busy. Thank you as well all the guys in the software technologies department of IK4-Ikerlan for letting me share their coffee-time with them and for being so kind with me, I felt really comfortable working with them. Thank you all the people in the company that I have met, especially during the lunch time, for making this time more entertaining.

Finally, thank you all the people that helped me during the development of this project and I am sorry if I forgot to mention someone.

THANK YOU SO MUCH!

RESUMEN

El objetivo de ésta memoria es describir lo más detalladamente posible el proyecto realizado éstos últimos meses para la empresa IK4-Ikerlan. Se trata del desarrollo de una aplicación basada en *sockets* para dispositivos móviles de la familia *Apple*, cuyo sistema operativo se denomina *iOS* y que es junto con *Android* el sistema operativo más utilizado del mundo en lo que a dispositivos móviles se refiere.

Ésta aplicación está disponible en la *App Store* y existe una versión para *iPhone*, y otra para *iPad*. Decidimos descartar la aplicación para *Apple TV,* ya que no contábamos con ningún dispositivo o simulador para probarla.

Cabe destacar que el objetivo del proyecto no es el de crear una aplicación desde cero, sino que la idea es la de coger la lógica de una aplicación para *Android* y trasladarla a *iOS*. Para ello, ha sido necesario convertir código *Java* en *Objective-C*, lenguaje con el que se programan todo tipo de aplicaciones para dispositivos de *Apple*, ya sean portátiles o de sobremesa. Gracias a una herramienta todavía en fase de desarrollo y creada por *Google*, llamada *j2ObjC,* ésta tarea ha resultado más fácil de lo que hubiera supuesto traducir estos códigos a mano.

ABSTRACT

Within the next few pages, I will try to give a wide description of the project that I have been doing for IK4-Ikerlan. For the last six months, I have been working in developing a socket-based application for *Apple* devices. These devices work under the *iOS* operative system, which is programmed in *Objective-C*, a language similar to *C*.

Although I did not have the chance to develop this application for *Apple TV*, I was able to create an application for *iPhone* and another one for *iPad*. The only difference between both applications was the screen resolution, but we decided to make them separately, as it would be really hard to combine both resolutions, and wallpapers, everything in the same workspace.

Finally, it is necessary to add that the main goal was not to create a new application for *iOS*, but to translate an *Android* application into *iOS*. To achieve this, it is required to translate *Java* code into *Objective-C*, which is the language used to develop applications for all kinds of *Apple* devices. Fortunately, there is a tool created by *Google*, which helped us with this exercise. This tool is called *j2ObjC*, and it is still being developed.

LABURPENA

Memoria honetan azken hilabeteetan garatutako aplikazioaren ezaugarri guztiak azaltzen saiatuko naiz. Proiektu hau IK4-Ikerlan enpresan garatu dut. Azalduko dudan proiektuaren helburua dispositibo mugikorretarako aplikazio bat garatzea izan da. Aplikazio hau *iOS* sistema eragilerako pentsatuta dago, hau da, *Apple* familiako dispositibo mugikorrentzat eta *socket* bidezko konexioetan oinarrituta dago.

iPhone eta *iPad*-erako aplikazio bana egitea pentsatu genuen lantaldean, bakoitzak erabiltzen zituen irudien resoluzioak desberdinak zirelako, eta, beraz, zaila gertatuko zelako biak kode berean integratzea. *Apple Tv*-rako aplikazio bat garatzea ere pentsatu genuen, baina dispositiborik edota simulatzailerik ez genuenez, ideia bertan behera uztea erabaki genuen.

Esan beharra dago, proiektuaren helburua ez dela *iOS*-erako aplikazio bat nahierara garatzea izan, baizik eta aurretik garatutako *Android*-eko aplikazio bat eredutzat hartuz, logika guztia *iOS*-era itzultzea. Horretarako, *Java*-n idatzitako kodea *Objective-C* ra pasatzea beharrezkoa izan da, pauso hau proiektuaren muina delarik. Ataza hau errazteko, *j2ObjC* izeneko tresna bat erabili dut. Tresna hau *Google*-ek sortu zuen eta oraindik garatze-prozesuan dago.

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1 INTRODUCTION

The result of this project has been a socket-based *iOS* application. This application can be run in the latest versions of *iOS*. The name of the *app* is *mSecurity* (a version of this application was developed for *Android* before starting with this project and it was called *mSecurity*). With this application, user will be able to take control of some devices in his/her house and change their status anywhere he/she is. The user will also receive a notification of every alarm that is forced in the house while the user is not at home. Some other functionalities are described in depth later on.

The first aim was to reuse as much software components (from the *Android*'s application code) as we could, but we soon realized that some important parts of the code were not reusable, for example, the User Interface. For this reason, the User Interface was started from scratch, but always trying to keep a similar appearance in the *iOS app* and in the *Android* one. Other parts, such as the socket client have been ported directly from *Java* to *Objective-C*.

To implement all these things, I used an *iMac* with *Mac OS X* operative system. At the same time, I used *Xcode* IDE for writing the code. The language used to develop *apps* for any *Apple* device is called *Objective-C*. I had never worked with this language before this project, so I had to learn the tricks of it. In order to do it, I looked for information on the Internet. However, newest versions of *Xcode* make things much easier for the developer.

For translating the code from *Java* (*Android*) to *Objective-C* (*iOS*), I used a tool called *j2ObjC*. This tool was created by *Google*, but it's still being developed, so it has been necessary for me to translate some parts of the code manually. To achieve this, I had a look at some *Java* manuals and tutorials about *j2ObjC* like the one shown in the *Google Inc.* (2013) repository.

The first idea was to create a universal app that could be used in both devices, but it resulted messy and difficult to manage with different resolutions in the same code, so we decided to create two different *apps*, one for each device. Applications are created for *iOS 6*, but it is possible to run them in earlier operative systems, as long as they are *iOS* operative systems. However, the *mSecurity* application is not available on the *App Store*, as we could not upload it due to the *Apple*'s restrictions.

1.1 Project objectives

The developed application is a socket-based application that will be used to protect the users home even when the user is away. For that, user will be able to choose between four scenes (home, away, night and holiday). In each scene, the sensors in the house will have a different status. A table with the list of items' status can be seen by touching the scene icon. For example, if the user is away, the movement detector will be on and will send an alarm if someone tries to get into the house. If the user is at home, the detector will be off, and alarms will not be sent.

User will also be able to change the status of a device in any of the four scenes. These orders will be sent to the server and the server will change the status of the devices.

When the order is executed, the server should return a notification to the mobile device notifying if the action has been finished successfully or not. Notifications will be divided in three groups. Alarms, system alerts and notifications. When an alarm comes to the device, a pop-up window will be raised, even if the app is in background mode. In this case, a universal pop-up will be raised first and then, if the "OK" button is pressed the app will be "launched" with the pop-up view controller. If not, the first notification will stay in the device's notification pane. If several notifications come and the user does not open any of them, the first one that will appear will be the oldest notification.

User will be able to see all the messages received, divided in 5 groups (alarms, system alerts, notifications, pictures, and all the messages). The last group will store all the messages, but user will not be able to see each message's details from here. On the other hand, the rest of the groups will have a detail view controller to see each message's details by clicking on a cell. If a message is still not read, that message's cell will be darker. Once the detail's view controller is opened, that selected cell in the table will be brightened.

As it was said before, when an alarm comes to the device, a pop-up window will appear. This window will show the user some details of the new alarm, such as the description, the time, or the date. When user skips these view controllers, he/she will have the chance to send an e-mail, make a phone call, or ask for some pictures. After the user makes the acknowledgement by clicking on a couple of buttons, the app will go back to the messages screen and the new alarm will appear in the alarms table view.

The app will always be active, obviously, except the first time that it is launched. For the app's first launch the app will load all the data from the web service, including scenes, devices status or users' information. User will need to authenticate by writing a four-digit pin number in the login view controller. The valid pin number will come from the web server. The web server will return a different number depending on the MAC number of the mobile device, which will be registered in a database. If the MAC number of the device is not registered, the pin will not be transmitted and login will not be possible. Once the user has entered the valid pin number, the system will open the socket connection and if authentication goes well and there is not a problem with the connection, the scenes view controller will be shown. If a problem occurs, the app will keep loading until the socket connection is opened. If the application is executing and internet connection is lost, app will keep trying to connect until the connection returns. At this point, authentication process will be repeated.

1.2 Tasks list

We consider two task types: tactical and operative. They are described in the following points:

- Tactical TASKS
  - File management
  - Meetings
  - Planning
- Operative tasks
  - To study the background required

- To build an application to test I/F building
- To build an application to test communications
- To port the application from Android to IOS
    - Analysis
    - Design
    - Implementation
    - Testing
- Documentation

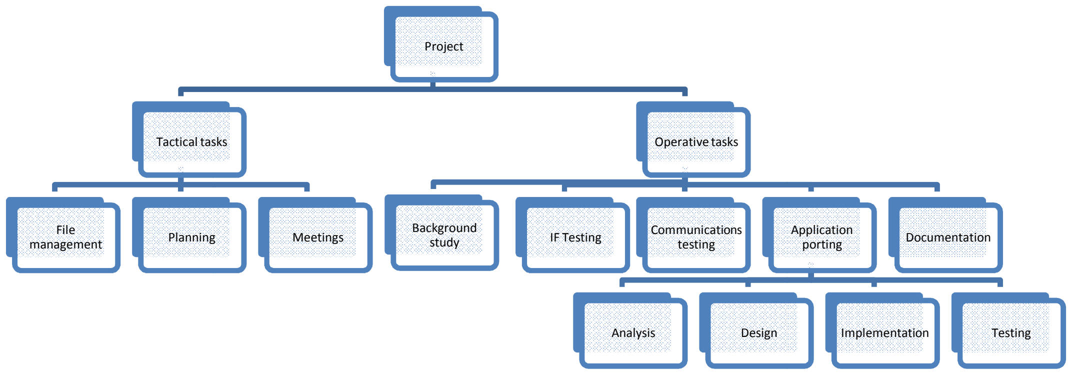


Figure 1 Tasks diagram

1.2.1 Deliverables list

- List of risks: The trouble that could come while developing the project. There are two types: generic risks and specific risks.
- Presentation transparencies: These are the sheets used to present the project.
- Class diagrams: Describes the structure of the system by showing system's classes, attributes and operations, and the relationship between them.
- GANTT diagram: Graphical definition of planned tasks and needed time to finish them. *Gantt format* (Gantt Project)
- Progress table: It is a table where estimated and used time for each task appears. Tasks are grouped and estimated and total time as well.
- Project report: It is the extended description of the project. It will be delivered in .doc and .pdf formats.
- Software code: The part of the executable code that will be available at the end of the project.

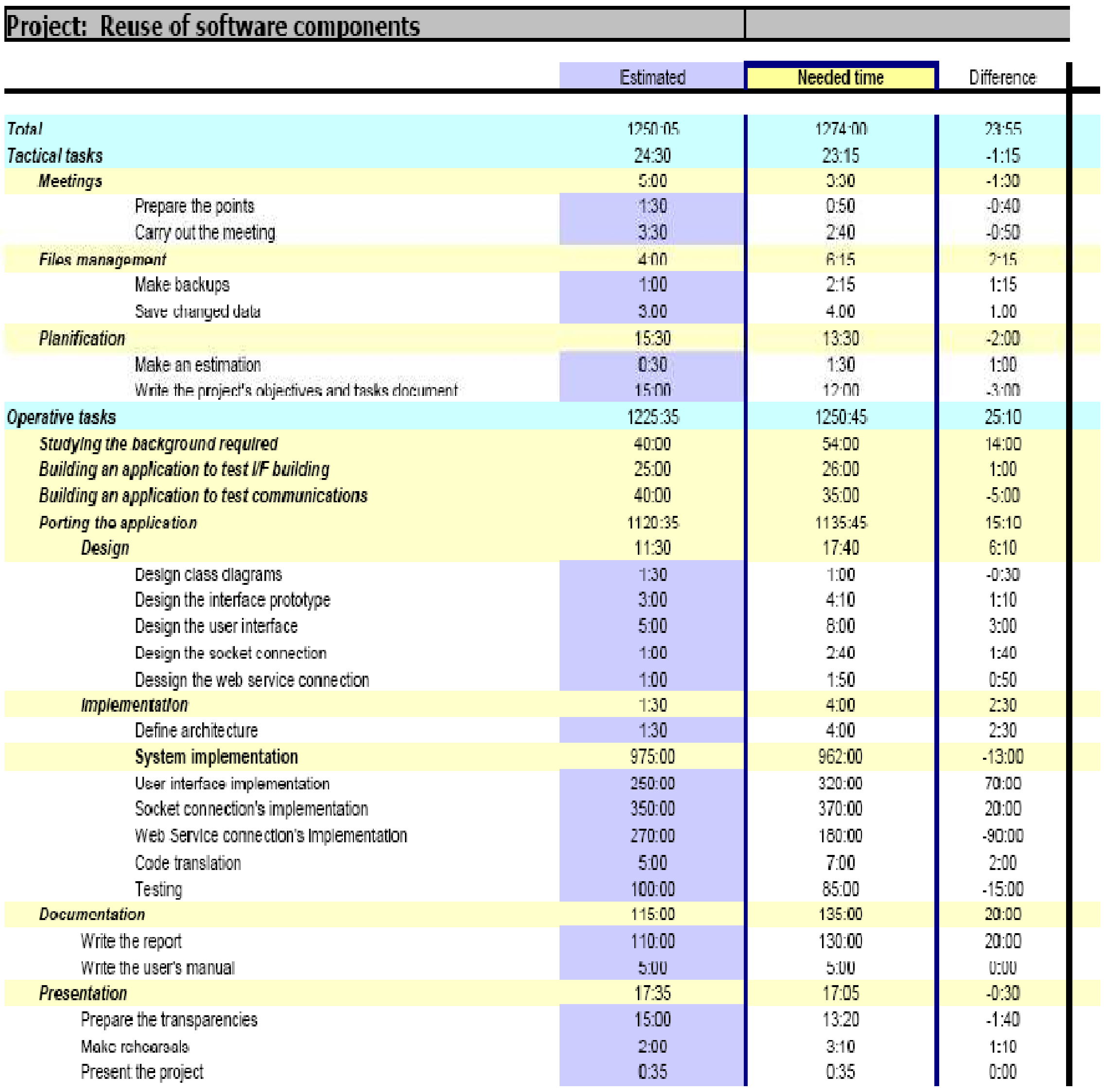
1.3 Risks

We have considered the following risks:

- Sick leave: It happens when one of the developers get sick and cannot go on with his/her planned tasks for those days. The level of importance is medium. The consequence will be a delay in the estimated periods and we could avoid these problems by trying to finish our tasks earlier than the date estimated first, although this becomes sometimes a difficult job.
- Wrong planning: It usually happens when the developer does not have much experience in big projects. The risk-level is high as given periods may not be respected and can cause delays in important deliverables. To prevent this case, it is advisable to take some time before making planning timetables.
- Loss of data: It can be a partial or a total loss of data. In the first case, lost work can be recovered by working more hours than the ones expected in the project. On the other hand, if we suffer the second one, we will need to take some time to try to recover all our data. To avoid this, it is necessary to make *backups* regularly.
- Lack of experience with used hardware/software: This is probably one of the most repeated problems for developers. If they need to make a project about a new subject, they will need to look for information in books, internet, etc. This causes loss of time. However, this risk is often expected before starting a new project, so its impact is weak.
- Lack of time due to external activities: This setback happens usually if the developer is also studying. It can become a dangerous fact, since estimated periods can be in risk if there is no physical time to make a task in a specific time. For this reason, the risk level is high and so is the impact.

1.4 Planning

1.4.1 Advance Table



Project: Reuse of software components

	Estimated	Needed time	Difference
Total	1250:05	1274:00	23:55
Tactical tasks	24:30	23:15	-1:15
Meetings	5:00	3:30	-1:30
Prepare the points	1:30	0:50	-0:40
Carry out the meeting	3:30	2:40	-0:50
Files management	4:00	6:15	2:15
Make backups	1:00	2:15	1:15
Save changed data	3:00	4:00	1:00
Planification	15:30	13:30	-2:00
Make an estimation	0:30	1:30	1:00
Write the project's objectives and tasks document	15:00	12:00	-3:00
Operative tasks	1225:35	1250:45	25:10
Studying the background required	40:00	54:00	14:00
Building an application to test I/F building	25:00	26:00	1:00
Building an application to test communications	40:00	35:00	-5:00
Porting the application	1120:35	1135:45	15:10
Design	11:30	17:40	6:10
Design class diagrams	1:30	1:00	-0:30
Design the interface prototype	3:00	4:10	1:10
Design the user interface	5:00	8:00	3:00
Design the socket connection	1:00	2:40	1:40
Dessign the web service connection	1:00	1:50	0:50
Implementation	1:30	4:00	2:30
Define architecture	1:30	4:00	2:30
System implementation	975:00	962:00	-13:00
User interface implementation	250:00	320:00	70:00
Socket connection's implementation	350:00	370:00	20:00
Web Service connection's Implementation	270:00	180:00	-90:00
Code translation	5:00	7:00	2:00
Testing	100:00	85:00	-15:00
Documentation	115:00	135:00	20:00
Write the report	110:00	130:00	20:00
Write the user's manual	5:00	5:00	0:00
Presentation	17:35	17:05	-0:30
Prepare the transparencies	15:00	13:20	-1:40
Make rehearsals	2:00	3:10	1:10
Present the project	0:35	0:35	0:00

Table 1 Advance table

1.4.2 GANTT table

Table 2 GANTT table for this project

shows the GANTT diagram for the project.

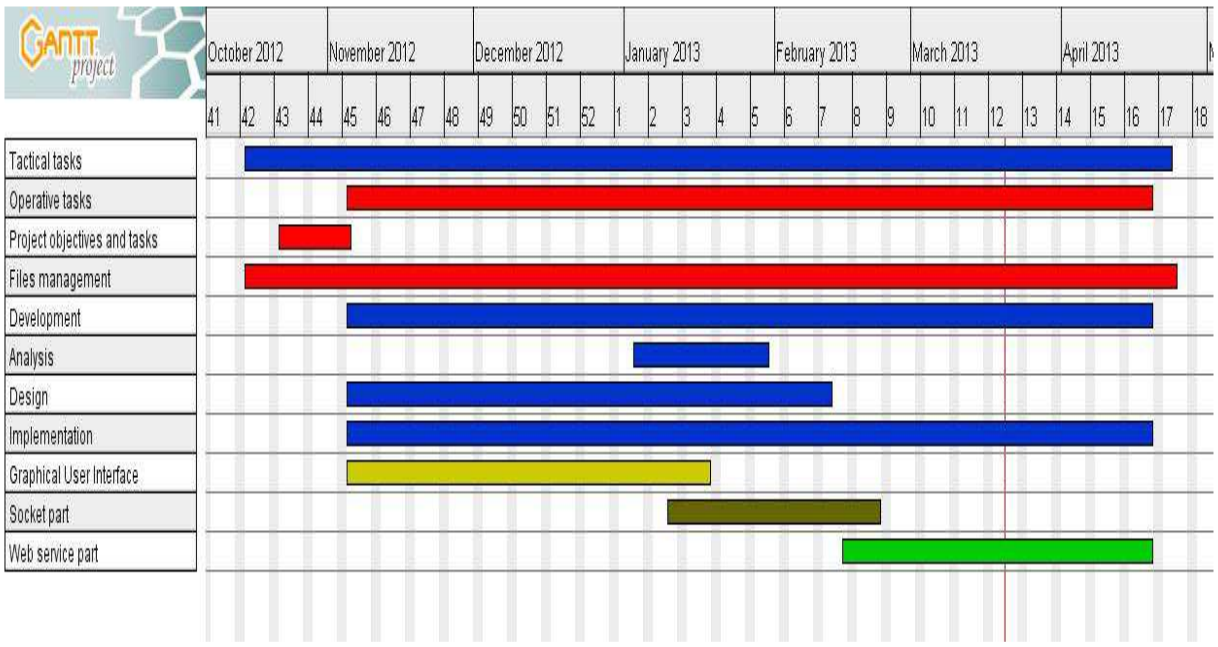


Table 2 GANTT table for this project

1.5 Document's structure

This project's report starts with the "Project's objectives and tasks document". There, we can see the motivations that made us develop this project, apart from a brief description of the *app* and its functionalities. This document describes our aims, made tasks, the different phases of the project or the risk's list.

The second point describes the background of this project. In this chapter, the most popular mobile operating system is described deeply (*Android*) talking about its expansion and the comparison between this operative system and *iOS*. Some of the experiences we had before starting with the current application are also explained. These experiences consisted on testing some graphic interface functionalities and some socket-based simple connections.

The next two chapters give us a description of two sample applications we designed before starting with the final application. These applications were developed in order to take some practise with the *Objective-C* environment, the *Xcode IDE*, and the socket connections.

The fifth point talks about the developed application and is divided in another six subchapters. All these chapters explain different parts of the application developing, such as a global description, the design of the Graphical User Interface, the network connections, or the system’s architecture.

The next point talks about my personal opinion about the project and the things that can be made in the future to improve this application.

In the dictionary chapter, some of the words that appear in this report and can sound strange to the user are explained.

In the last point, the bibliography is revealed defining the author, the year and a brief description of each reference or source.

Finally, some appendixes are added to the document where some tutorials, user manuals or installation guides are available for the reader.

1.6 Work methodology

Before starting the project, I needed to search some things, mostly, on the internet. The most important terms were *"Objective-C"* and *"j2Objc"*, as these are project's main focuses. When the GUI part was almost finished I got focused in the *socket* connection. When I had any problem with a connection, I looked for information on the internet, in forums, and I asked for advice to some colleagues. To sum up, I have used the next methodology to look for information in most cases: general concept, tutorials, and discussing forums (when getting an error in the code).

In order to start developing the *mSecurity* application properly, we focused on the background of the project. We put special attention in the *Android* developing tools and we created a sample *Android* application. We also studied the differences between *Android* and *iOS* and had our first experience with *Objective-C*. For this purpose, we designed two beta applications using *Xcode*. After this, we were ready to start working in the final application.

Once we started working in the *mSecurity* application we planned a strategy for *backups*. Every day, after eight hours working in the project we used to create a security copy to prevent the loss of data. This *backup* usually contained the two projects’ (*iPhone app* and *iPad app*) folders, the list of the new sites visited for getting information and all the documentation written during the day. The list of information sources and the documentation were saved in a folder and the new data was added to the previous one. However, the project’s files were replaced by the new ones every day.

2 BACKGROUND

Although reuse of software components has been used for a long time, it hasn't been until the last decade that reuse of software got popular among software developers. This popularization comes according to a request of producing less software with the aim of reducing maintenance costs, producing software quicker or increasing software quality.

Reuse is possible in some kinds of fields, for example, in application systems, components or objects and functions. Naturally, this technique has advantages and disadvantages, both of them will be discussed in depth further on.

Reuse of software can be done both for small functions or bigger ones; it depends mostly on our interest. It is really important to keep the next factors in mind:

- Software develop schedule
- Software's expected lifetime
- Developer team's knowledge, skill and experience
- Application's domain
- Application executing platform

It is said that corporate reuse of software was born in Japan in the year 1984, when some engineers developed the software named *Cusamoto.* Afterwards, the American company *Hewlett Packard* tried the same experience with *Gris* and *Proto.* This means that reuse of software is used frequently in huge companies in order to reduce costs and earn more benefits, as well as to save time implementing and planning. This method has also some risks, but the mentioned companies prefer to face these risks than unknown risks, as in the case of original development.

Reusable components are not specially developed, but are based on existing components previously implemented and used application systems. First of all, we need to ask ourselves if it will be worthwhile to reuse a component, instead of creating a new one. The main costs of the reuse are based on the component's documentation, validation and the costs to make this component more generic. Some of the steps to make a component more reusable are the next ones:

- Delete specific methods of the application
- Change names to make them more universal
- Add methods to cover functionality
- Deal with exceptions so that they are consistent
- Add needed components to decrease dependency

To sum up, reuse of software components give us the chance to increase productivity as reused components use to be more reliable, and apart from this, we can save lots of time during the development process.

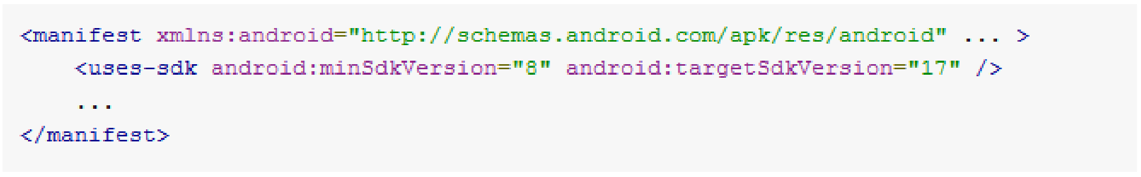
On the other hand, making a component to be reusable is not as easy as it seems, due to the fact that we need to create generic interfaces for these components. At this point, we should think about looking for a harmony between reuse and create.

The next subchapters describe the two operative systems related to this project (*iOS* and *Android*). In the first subchapter, the design of a sample application in *Android* is explained. This application was developed using *Eclipse* and the *Android SDK*. The next chapter makes a comparison between *Android* and *iOS* and its respective sales and market. Afterwards, a brief description of how to develop an *iOS* graphical interface is presented. The advantages and disadvantages of using Android's developing tools are also defined. Apart from the user interface, a general description of sockets is also detailed. Finally, some differences between *iOS* and *Android* are explained, focusing on the *IDE*s (*Eclipse, Xcode)* and the programming languages (*Java, Objective-C*) used to develop applications for both operative systems.

2.1 Android

Android applications are developed in *Java*. In the beginning of the project, we started developing some trial applications in *Android* to see what we could do with the user interface. To develop this trial application we used the *Eclipse IDE*, after installing the ADT plugin for *Eclipse*. Apart from this, it is also needed to install the Android SDK, and then, download the latest SDK tools and platforms using the SDK manager. There is some interesting information about this in the *Pro Android Apps Performing Optimization* book (Hervé Guihot, 2012).

Now we are ready to create an *Android app* with *Eclipse* by clicking on "New Android Application". A manifest file will then be created describing the fundamental characteristics of the *app* and defining each of its components. Figure 2 shows the appearance of a manifest file (*XML* format)



```
<manifest xmlns:android="http://schemas.android.com/apk/res/android" ... >
    <uses-sdk android:minSdkVersion="8" android:targetSdkVersion="17" />
    ...
</manifest>
```

Figure 2 *AndroidManifest.xml* file

The <uses-sdk> element declares the *app* compatibility with different *Android* versions.

When running the project an empty window will appear in the simulator's or device's screen. From now on, the different activities (screens) will be declared in this file and each activity will have a class where the developer can declare all the elements that will appear in that screen.

There are two ways to run the *app*. The first one is using an *Android* simulator in the *PC*. The *SDK* includes an *Android Virtual Device Manager* which gives the developer the chance to create a virtual machine in a few steps. Once the virtual machine is configured, the application is launched by clicking on the "run" button and selecting "Android application".

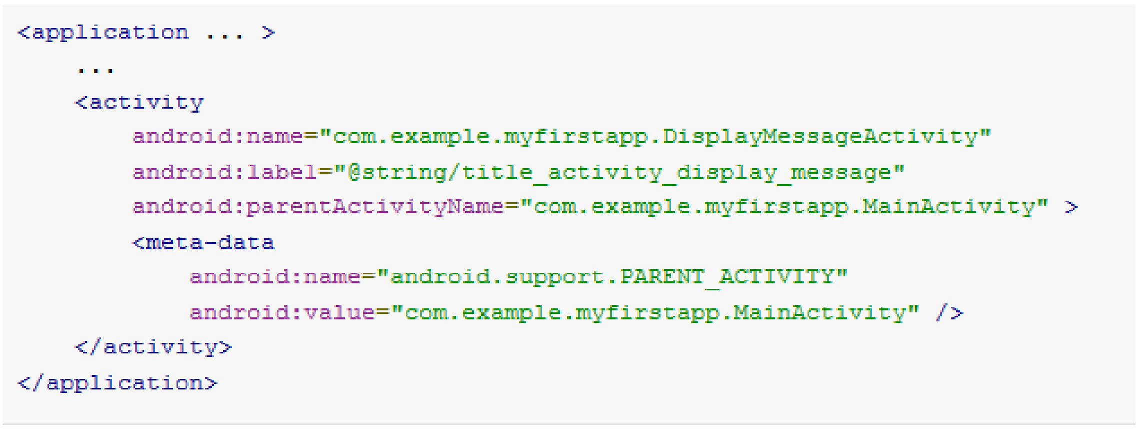
The second one is using a real *Android* device. For this, it is just necessary to plug in the device to the development machine and install the appropriate drivers to enable the *USB* debugging. The running process is the same as with the simulator.

The main aim of our trial application was to see how we could create a link between two screens. We started creating a screen with a "Hello World" message and a button that would send the user to the second screen. To make this, a hierarchy with *ViewGroup* objects is defined. *View* objects are usually widgets including labels or buttons. When a new application is created and a BlankActivity template is chosen, the system creates automatically a *RelativeLayout* root view and a *TextView* child view.

In the root view, we add a label with the text "Hello World" and a button with the text "send". This button will have a call to a method using the "onClick" method of the element. This method will be defined as a *Java* method in the *MainActivity* class. After this, we can start implementing the method that will be used as a linker between both activities. First, we need to create an "intent" class. "Intent" is an object that provides runtime binding between separate components (such as two activities). To make the call to the second activity, we will make it this way: "startActivity(intent)".

The next step is to create a *Java* class which extends an "activity". There is a predefined method where it is possible to customize the appearance of the new screen such us "onCreate" method.

Finally, in the *AndroidManifest.xml* file the new activity is declared as the Figure 3 shows.



```
<application ... >
    ...
    <activity
        android:name="com.example.myfirstapp.DisplayMessageActivity"
        android:label="@string/title_activity_display_message"
        android:parentActivityName="com.example.myfirstapp.MainActivity" >
        <meta-data
            android:name="android.support.PARENT_ACTIVITY"
            android:value="com.example.myfirstapp.MainActivity" />
    </activity>
</application>
```

Figure 3 Adding a new activity

Every activity is invoked by a previously created "intent". This class will have a list of attributes that could be strings, numbers, etc. When the new view is loaded, the view can read these attributes using the method "getIntent()". In other words, this is the way to pass attributes from one view to another one.

As a result, we managed to create a “Hello World” sample application formed by two views linked by a button. We have also passed the text appearing in the root view’s label to the second view and write it in another label.

2.2 IOS: first steps

iOS was created by *Apple* in 2007 for the *iPhone* and *iPod Touch*. It can't be used under non-*Apple* hardware, so development must be made with *Apple* hardware. As of September of 2012, *Apple*'s *App Store* contained more than 700.000 applications (from now on, *apps)*, which have been downloaded more than 30 billion times. It is said that it is the second most used operative system for mobile devices, just behind *Google Android* with a 14,9% share. Its interface is based on tactile interaction, using slices, switches or buttons. *iOS* derives from *Mac OS X*, which derives at the same time from *Darwin BSD,* based at the same time on *Unix*. Actual version (*iOS 6.0*) needs approximately 770 megabytes of free memory in the device for running.

iOS was released officially on June 29, 2007. *iPhone* was created first of all, and some months later *iPod Touch* was released. On January 27, 2010 iPad was released and by April 2010, more than 185.000 *apps* were available for *iOS* in the *App Store*. *iOS 6*, (the *app* developed in this project is running on this operative system) was presented on 12 September 2012, and it is the newest operative system in the family as of today.

One of the biggest improvements of *iOS* has been multitasking support. It is available on *iOS 4.0* and newer versions. This is a really important fact when working with sockets, as connections must be opened at any time, even when the *app* is running in background. Unfortunately, *Apple* accepts only the next *API*'s: audio in the background, VoIP, location in the background, push notifications, local notifications, task completion, and quick change of applications. If no features related to any of these *API*’s are included in the application, *Apple* will not let our *app* to keep our tasks alive in background mode. In other words, our *app* will go to a suspension state.

iOS does not support *Adobe Flash* nor *Java*, as they are no secure and use too much battery in Steve Jobs' opinion. On the other hand, *iOS* uses *HTML5*. The operative system gives the user the chance to install a *Jailbreak*, which is used for installing software non-supported by *Apple*. This software is not available in the *App Store*. Installing this "patch" is completely legal, but invalidates the warranty of the device.

The programming language used for software developing is called *Objective-C*, which is similar to *C*, but more orientated to objects. The operative system also has a development kit, which can be used in *Xcode*, an *IDE* integrated in *MAC OS X*. *iOS* has four abstraction layers: the *Core OS* layer, the *Core Services* layer, the Media layer, and the *Cocoa Touch* layer, which will be explained later on.

Android and *iOS* are the most popular operative systems for mobile devices in the world. *iOS* has a share of 14,9%, while *Android* has the 75%. *iOS* is developed by *Apple*, and the company is responsible of manufacturing their products. However, *Google (Android*'s developer), doesn't produce its devices, *Samsung*, *LG*, and other companies do it for them. This means that *Apple* gets more money for each device they sell, approximately a 30:1 rate (10$ for *Google*, 300$ for *Apple*). Apart from that, only

33% of *apps* in the *Apple's App Store* are free, whereas the percentage in *Android* is of 64%. In summary, *Android* sells more devices due to their low prices, while *Apple* gets more benefits for each device they sell.

In this context, *Google* decided to create *j2ObjC*. This is a tool used to translate code from *Android apps* (*Java* code) to *Objective-C*, with the aim of reusing components. It is complex to understand why *Google* would like to implement this kind of tool, but there may be some reasons. One of them could be to try to get developers to write *apps* for *Android* first. Many people think that it is easier to write *Java* code as it is more popular, than to write in *Objective-C* which is a newer language. This way, *Google* gives *iOS* developers the chance to write in *Java* first, and make them easier to start developing their *app*, as many of them are not familiar to *Objective-C*. At the same time, it will be a good opportunity for them to develop an *Android app*.

2.3 IOS: User I/F

At the beginning of the project we thought that the best way to satisfy the *app's* user would be to develop a universal *app*. This means that the same application could be used in both an *iPhone* and an *iPad*. We started working on that idea the first days, but we realised that it would be confusing to work that way, especially due to the difference between *iPhone*'s icons and *iPad's* icons resolutions. Apart from that, we did not have all the icons available at first, as they were designed in other department, so we decided to focus on *iPhone*'s *GUI* first.

Although, we did not have a sample *app* in *Android* for a *Smartphone* (we just had a sample *app* for a tablet), we had some *PDF*s explaining the application's main utilities. These documents were enough for us to help us understand the appearance and the main functionality of the *app*. Some of these documents showed us the different views of the *app* and their relationship. Others mentioned the different functionalities of each button, text field, table view, etc. The objective of the app we needed to develop was to make the user understand easily the functionalities of the application and try to simplify as much as we could the user's experience.

The *app* needed to support different interface orientations, so that when the user spins the device, the display spins in the same direction. We decided to support three orientations (portrait, landscape left and landscape right). At first, we thought this will be an easy task, but, then, we saw that it would not be so easy, as we needed to customize programmatically all the orientation changes.

The status bar would be always shown during application launch. This way, user can check internet connectivity and battery status every moment, a fact that will be very important in our *app*.

The first screen would be an authentication screen, where user would need to enter a "pin" number. After this, the system would check for the users' list in the web service and depending on the user who is trying to authenticate, the system will check if the pin written by the user is the correct one. Afterwards, system would display a welcome message and main screen would be displayed.

The main screen would contain a tab bar. The tab bar would have three tab bar items (“scenes”, “manual control”, and “messages”). Each of them would have different options. The first one would give the user the chance to change their location (home, away, night or travel). The user would also be able to check the status of the appliances for each location. The second one would be used to switch on or switch off different devices and appliances at home. Finally, the third tab would contain the different messages received from the server. Messages will be divided in five groups (“alarms”, “alerts”, “notifications”, “pictures”, and “all the messages”). This display lets the user see the different messages in detail just by clicking on the element of the list he/she wants to check, apart from sharing the notification with other devices.

When a notification comes from the server, a pop-up would be displayed, even if the application is in the background mode. This notification would stay on display until the user clicks on it. The user would need to slide a bar to unlock the display and see the notification details. Pressing the “OK” button will dismiss the pop-up and the new notification would be added to the proper group in messages tab as a new message. While the pop-up is being shown, the user would be able to choose if he/she wants to send a message, or call someone. He/she would also have the chance to ask the server for pictures taken by different cameras located in the house, and share them if needed.

Finally, user would make all these requests asynchronously. This means that user would be able to make different things such as change scene, change device status, or look at received messages, while system is dealing with a previous request. When the request is finished (does not matter correctly or if an error occurred), a pop-up would be showed whatever the user is doing.

2.4 IOS: sockets

Many *iOS apps* use HTTP protocols to communicate to a web server, as it is easy to implement the connection and it is, at the same time, well-supported. However, in some cases it is necessary to go a bit lower in the TCP/IP architecture, and communicate using TCP sockets to a specific server. These are some of the advantages of using sockets on *iOS:*

- It is possible to send just the data needed
- Server can always send data to connected clients
- Socket servers can be written in any language and without a dependency with a web server

A socket is a tool that allows to transfer data in a bidirectional way. It is used to exchange data between two different machines (it can also be used to exchange data in the same machine) which are identified by an IP address and a port number. Figure 4 gives a graphical description of a socket communication.

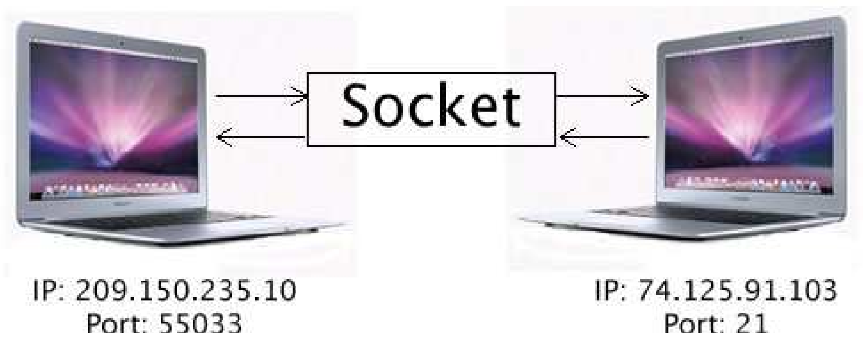


Figure 4 Graphical description of a socket connection

Both machines must also define a transport protocol (TCP, UDP, etc). Sockets are usually server-client based connections. When a server is listening and a client wants to pass or receive data to/from it, a connection is opened. This connection is called socket and it has a unique integer number, which will be the socket identifier. The same process repeats with any other number of clients. The connection is only closed when the client decides to close it, or when the server gets stopped.

There are different types of sockets:

- Datagram sockets (they use *User Datagram Protocol*)
- Stream sockets (they use *Transmission Control Protocol* or *Stream Control Transmission Protocol*)
- Raw sockets (the transport layer is bypassed, and the packet headers are accessible to the application)

The type used in our application will be the TCP-based client. Implementation will be explained in another chapter. Many libraries are available in iOS, so all the different types of sockets can be implemented.

There are many websites that explain how to create and use socket connections, but one of the most comprehensive is the Ray Wenderlich site (Razeware LLC. 2012).

2.5 IOS: learned experiences for developers

Accessibility is one of the weakest points in *iOS*. It is necessary to have a *Mac* (*iMac, MacBook,* etc.) for programming *iOS* applications. In addition, the developer will need to keep his/her computer always updated with the latest version of *Mac OS X*. Otherwise, he/she will need to pay to have the latest version of *Xcode* and then, the chance to develop for the latest *SDK*s. On the other hand, *Android* developers will use *IDE*s like *Eclipse* or *NetBeans* to create an *app.* These *IDE*s (and *Android*'s *SDK)* can be installed in *Mac, Linux* or *Windows*.

The main difference between both operative systems is the programming language used for developing *apps*. While *Objective-C* is used to develop an *iOS* app, *Java* is used in *Android*. It is known that *Java* is a more popular language than *Objective-C*. For this reason, *Java* community is bigger and there is much more documentation for *Java*. However, both of them are based on *C*, so they have some similarities like primitive types. So we could say that *Objective-C* has its advantages, but, *Java* has more cultural and practical advantages.

After *iOS 5.0*, *Apple* created the *Automatic Reference Counting*. This tool makes the compiler use the memory administration system during the compilation of the *app*. This means that developers will need to write less code with the same performance. Besides, developers will always have the choice to manage memory leaks manually if any errors occur.

Interface design and development is easier with *Xcode* than with *Eclipse*. The main advantage of *Eclipse* is that it can be used in almost any operative system (*Linux, MAC OS X* or *Windows*), and it gives us the chance to program in many different languages, such as *Java*, *Ada, C, C++* or *Perl*. Nevertheless, it is necessary to install different plugins to be able to program in each language as long as you are not developing in *C* or *Java*. This fact makes *Eclipse* perform slower than *Xcode*. View controllers are also more intuitive and faster in *Xcode* (particularly, after storyboards were available). There are many different samples of view controllers in *Xcode* (standard view controller, table view controller, navigation controller, tab bar controller, etc) while *Eclipse* just has a standard one, so the most part of the view design must be done programmatically.

Both *Android* and *iOS* have their simulators. From my point of view, *iOS* simulator is faster than *Android* one. However, *Android* simulator allows changing the hardware details, such as the amount of RAM memory of the device, while *iOS* simulator uses the resources of the PC. It is interesting to simulate an *Android* device with its natural resources, but sometimes its performance can be annoying, so we must be careful with the specifications we set in the simulator when running an *app*.

2.6 Review of related documents

This chapter shows the different information sources used during the project and a brief description of each source.

Books

Guihot, Hervé.* "Pro Android Apps Performance Optimization" –*Apress

This book shows us how to optimize the performance of *Android* applications. For this purpose, different algorithms are compared. The book is not only focused on algorithms, but also on different user interfaces and socket connections. It is an interesting book for an advanced *Android* developer, as it is necessary to have some *Java* skills to understand some of the techniques explained.

***Mac Programadores.* "El lenguaje Objective-c para programadores C++ y Java"**

It is a quite interesting book to create different user interfaces. The book puts special attention in the programming language (*Objective-C*) to design stylish applications. It starts explaining some basic code pieces in *Objective-C*, and then, explains how to implement user interfaces programmatically. The book also talks briefly about internet connections.

***Watters, Blake.*"Introduction to RestKit"**

It is a book that helps us understand the *RestKit* framework. This framework is not easy to implement for beginners, so it is a very useful tutorial.

<u>Websites</u>

Apple Inc. (2012)

iOS Developer Library

http://developer.apple.com/library/ios/navigation/

It is the official help website for application developers. There are many different articles here, such as tutorials for uploading an *app* to the *App Store*, characteristics of *iOS 6.0*, or *Objective-C* tutorials. There are up to 1690 articles in this website to this day.

Arizona Board of Regent (2003-2010)

The University of Arizona
http://math.arizona.edu/support/account/remoteshell/putty.html

This website explains the steps to use *Putty*, a tool used to make connections via SSH.

Awesome Inc. template (2013)

Deusty

http://www.deusty.blogspot.com.es/2010/05/introducing-cocoa-lumberjack.html

This blog explains how to use the Cocoa Lumberjack *framework* in *Xcode*. It does not explain how the framework works, but the steps to follow to make it run.

Cortex IT Ltd (2013)

Convert String

http://www.convertstring.com/Hash/SHA256

This web tool returns the SHA256 code from an input text. It returns 64 hexadecimal characters in the text field above.

Google Inc. (2013)

Google Projects

http://code.google.com/p/wsdl2objc/wiki/UsageInstructions

It gives some explanations about how to use the *wsdl2ObjC* tool. This tool created by *Google*, offers this blog to resolve doubts, show tutorials, or help users installing the tool.

Google Inc. (2013)

Google Projects

http://www.code.google.com/p/j2objc/

It is the official website for the *j2ObjC* tool, created by *Google*. From here, the tool can be downloaded and some tutorials can be checked. There are also installation guides, forums, etc.

IBM (2013)

http://www.ibm.com/developerworks/webservices/tutorials/ws-eclipse-javase1/chapter5.html

This is a tutorial to create a *standalone* web service based application. This web service is executed with *Eclipse*, and it helps us to test the server and to export the *WSDL* file.

iPhone4Spain (2011)

iPhone4Spain

http://www.iphone4spain.com/tag/curso-programacion-ios-aplicaciones-iphone-ipad/

It is an ideal tutorial for beginners in *iOS*. It shows how to use *Xcode*, how to create views and make links between them, how to design tables, etc. It also offers some exercises to practise.

iPhone Dev Sdk (2013)

http://www.iphonedevsdk.com/forum/

In this forum, how to port an application from *iPhone* to *iPad* is discussed. It is very useful as it helps us to do the porting in a few steps.

iPhone SDK Articles (2011)

http://www.iphonesdkarticles.com/

There are some useful tricks related to *Objective-C* in this website. There are also some advices about graphical interfaces design and it shows how to create from scratch views and tables. There are some screenshots to help the reader in an intuitive way and also lots of code lines, so that the user learns quickly the tricks of graphical interfaces in *iOS*.

Lamarche, Jeff (2013)

iPhone Development

http://www.iphonedevelopment.blogspot.com.es

Jeff Lamarche shows some tricks for graphical interfaces in his blog. He puts special attention in the dialogs, as it is not easy to customize them.

Razeware LLC (2012)

Ray Wenderlich: Tutorials for iPhone/iOS Developers and Gamers *http://www.raywenderlich.com*

This website offers all kinds of tutorials. Graphical interfaces, *socket* connections, simple applications, games, etc.

Refsnes Data (1999-2013)

W3 Schools

http://www.w3schools.com/webservices/default.asp

It gives general information about web services; how to implement them, how to call them. Apart from this, there are some examples of web services to test some of them with our browser.

Rose India (2013)

http://www.roseindia.net/tutorial/iphone/examples/index.html

There are some steps to write the code in a simple way in order to take less time to develop and application in this site. There are some code samples to directly copy and paste. This code can be related to dialogs, buttons with text, sample applications, validating text fields. There is a section for each of them, and there is a deep explanation of how to use each code piece.

Schwartz, Alex (2012)

GT Productions

http://gtproductions.net/blog/ways-to-get-rejected-by-apple-app-store-tips/

This blog explains the steps to follow in our application to prevent it from being rejected in the *App Store*. There is some advice that can result really useful as it needs some time from uploading the application until an answer from *Apple* is received.

Youtube, LLC (2013)

Youtube

https://www.youtube.com

This popular site has been used to look for interesting *iOS* tutorials. Most of the tutorials are in English.

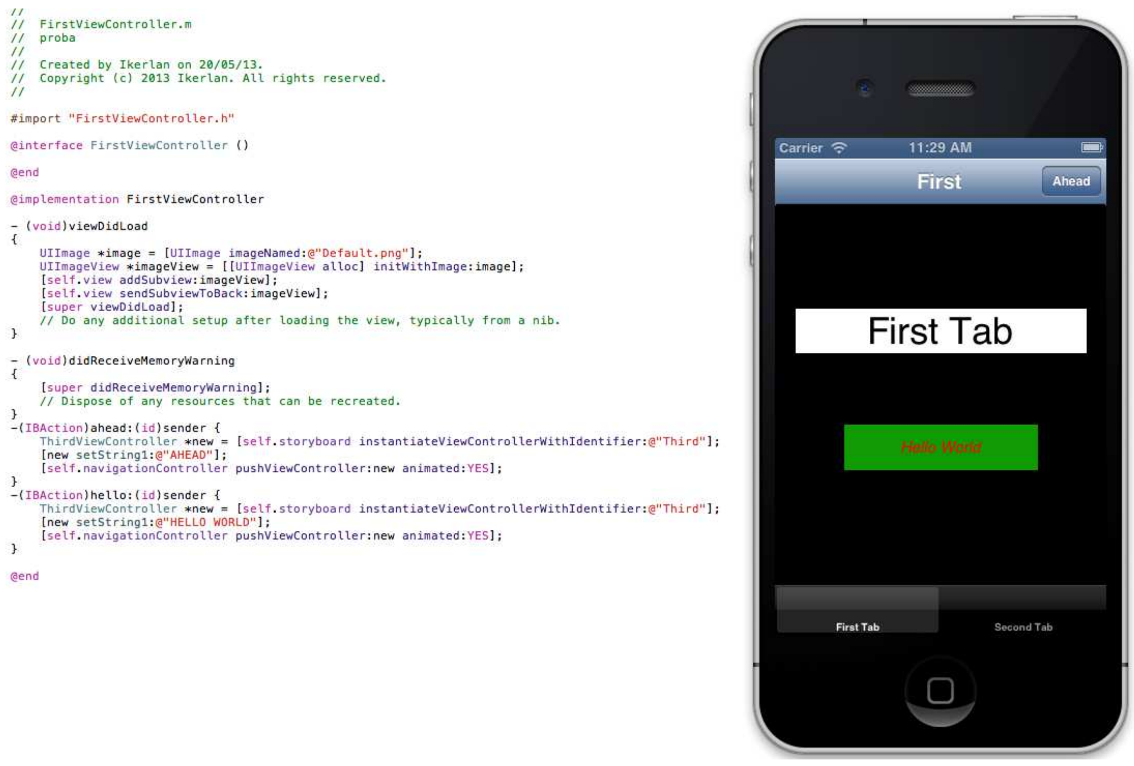
3 PROTOTYPE: *IOS* USER I/F

Before starting with the development of the *mSecurity* application we started creating simple applications to start dealing with graphical interfaces. One of those applications is described in this chapter. A general view of how to manage a project in *Xcode* is described in Appendix I (basic *Objective-C* experiences).

3.1 Sample application

This application is a "tab bar" based application. It has two tab bar items. The first tab bar has two views in its hierarchy and the second tab bar has three views. The concepts in which we put special attention were the management of a tab bar, the transition between different views, the use of sliders, the use of a variable in different screens, and the use of table views. This application does not have a useful functionality for the user.

The first screen of the application shows a view with a navigation controller in the top of the screen and a button. Figure 5 shows us the appearance of the first screen in the *iPhone* simulator and the implementation file of the view controller.



```
//
//  FirstViewController.m
//  proba
//
//  Created by Ikerlan on 20/05/13.
//  Copyright (c) 2013 Ikerlan. All rights reserved.
//

#import "FirstViewController.h"

@interface FirstViewController ()

@end

@implementation FirstViewController

- (void)viewDidLoad
{
    UIImage *image = [UIImage imageNamed:@"Default.png"];
    UIImageView *imageView = [[UIImageView alloc] initWithImage:image];
    [self.view addSubview:imageView];
    [self.view sendSubviewToBack:imageView];
    [super viewDidLoad];
    // Do any additional setup after loading the view, typically from a nib.
}

- (void)didReceiveMemoryWarning
{
    [super didReceiveMemoryWarning];
    // Dispose of any resources that can be recreated.
}
-(IBAction)ahead:(id)sender {
    ThirdViewController *new = [self.storyboard instantiateViewControllerWithIdentifier:@"Third"];
    [new setString1:@"AHEAD"];
    [self.navigationController pushViewController:new animated:YES];
}
-(IBAction)hello:(id)sender {
    ThirdViewController *new = [self.storyboard instantiateViewControllerWithIdentifier:@"Third"];
    [new setString1:@"HELLO WORLD"];
    [self.navigationController pushViewController:new animated:YES];
}

@end
```

Figure 5 First view controller (implementation file and simulator screenshot)

This screen gives the user a couple of options. If the user presses the "ahead" button a new screen will be opened with the "Ahead" message. However, if the user presses the "Hello World" button, the new screen will show a "Hello World" message. This is achieved by using the "setString" method which is called when any of the buttons are pressed. The input parameter is saved in the local variable of the new screen and the new value is used as the text in the new screen's label. The transition is made by using the method "pushViewController" as shown in figure 5. Figure 6 shows the second screen after clicking on the "ahead" button of the navigation bar.

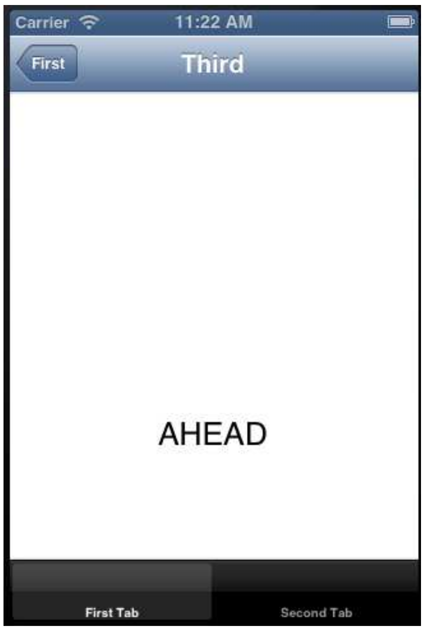
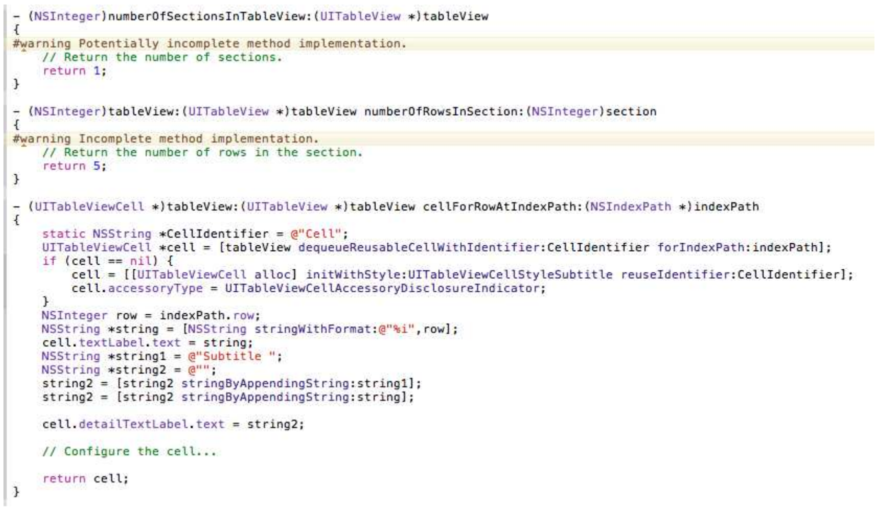


Figure 6 "Ahead" message

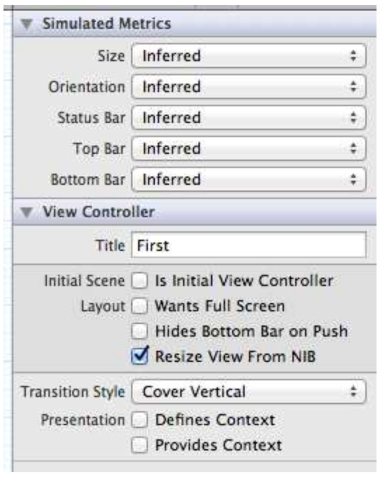
The first screen in the second tab has a similar appearance as the first screen in the first tab. If the user presses the "ahead" button, now a slider will appear in the new screen. If the slider's thumb is moved completely to the right, the application will go to the next screen. This screen will be a table view. The data in this table view will be loaded programmatically. Figure 7 shows the code needed to add data to a table using the Table View Controller template.



```
- (NSInteger)numberOfSectionsInTableView:(UITableView *)tableView
{
#warning Potentially incomplete method implementation.
    // Return the number of sections.
    return 1;
}

- (NSInteger)tableView:(UITableView *)tableView numberOfRowsInSection:(NSInteger)section
{
#warning Incomplete method implementation.
    // Return the number of rows in the section.
    return 5;
}

- (UITableViewCell *)tableView:(UITableView *)tableView cellForRowAtIndexPath:(NSIndexPath *)indexPath
{
    static NSString *CellIdentifier = @"Cell";
    UITableViewCell *cell = [tableView dequeueReusableCellWithIdentifier:CellIdentifier forIndexPath:indexPath];
    if (cell == nil) {
        cell = [[UITableViewCell alloc] initWithStyle:UITableViewCellStyleSubtitle reuseIdentifier:CellIdentifier];
        cell.accessoryType = UITableViewCellAccessoryDisclosureIndicator;
    }
    NSInteger row = indexPath.row;
    NSString *string = [NSString stringWithFormat:@"%i",row];
    cell.textLabel.text = string;
    NSString *string1 = @"Subtitle ";
    NSString *string2 = @"";
    string2 = [string2 stringByAppendingString:string1];
    string2 = [string2 stringByAppendingString:string];

    cell.detailTextLabel.text = string2;

    // Configure the cell...

    return cell;
}
```

Figure 7 Table View Implementation

In this case, each cell of the table will have a title and a subtitle. The title of the row will be the number of the row using the *row* attribute of the *indexPath*. The subtitle will also contain the number of the row but it will be preceded by a text (“Subtitle:”). In the methods above the number of sections and the number of rows for each section are defined, in this case, five rows for one section. The table will have a navigation bar inherited from the previous screen which is defined in the right-side of the project screen in *Xcode* as seen in Figure 8. The navigation bar is listed as “Top Bar”. In this case, all the attributes are inherited (inferred) from the previous screen.



▼ Simulated Metrics

Size: Inferred
Orientation: Inferred
Status Bar: Inferred
Top Bar: Inferred
Bottom Bar: Inferred

▼ View Controller

Title: First

Initial Scene: ☐ Is Initial View Controller
Layout: ☐ Wants Full Screen
☐ Hides Bottom Bar on Push
☑ Resize View From NIB

Transition Style: Cover Vertical
Presentation: ☐ Defines Context
☐ Provides Context

Figure 8 View Controller’s attributes

Finally, Figure 9 shows the main storyboard for this project. For a proper transition between screens we used a navigation controller for each tab bar (this technique is also used in the *mSecurity* application). There are not arrows linking the different views as all the transitions have been made programmatically using the “pushViewController” that was mentioned above in this chapter.

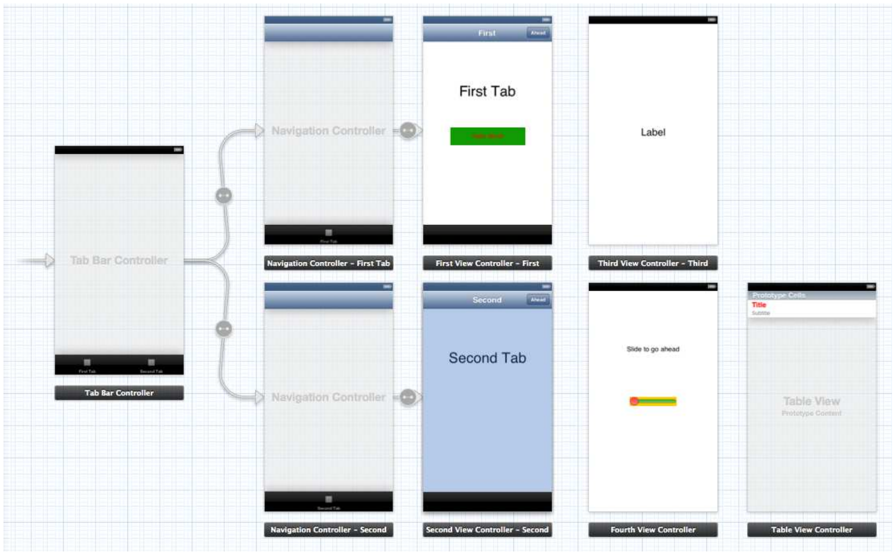


Figure 9 Application’s main storyboard

4 PROTOTYPE: *IOS* COMMUNICATIONS

This chapter describes the application we designed as a beta application to test a server-client communication using the SOAP protocol. The first two sub points give some information about two popular protocols for exchanging information (SOAP and REST). The third one deals with the application.

4.1 REST Protocol

Representational State Transfer is a style of software architecture for distributed systems such as the World Wide Web. There are six constraints in its architecture which are the next ones: client-server, stateless, cacheable, layered system, code on demand and uniform interface.

REST generally runs over HTTP so it uses HTTP operations (GET, POST, PUT, and DELETE) and involves reading a web page that contains an *XML* file. REST is often used in mobile applications, social networking Web sites, mash up tools and automated business processes.

REST is an “architectural style” that takes advantage of the existing technology and protocols in the web, including HTTP and XML. REST is easier to use than SOAP (Simple Object Access Protocol), which requires writing or using a provided server program (to serve data) and a client program (to request data).

Some interesting facts about REST protocol are discussed in the Introduction to Reskit book by (Watters, 2011).

4.2 SOAP Protocol

SOAP is a protocol specification for exchanging structured information in the implementation of web services. It relies on *XML Information Set* for its message format and in other layers such as HTTP or SMTP (Simple Mail Transfer Protocol) for message negotiation and transmission.

The SOAP processing model describes a distributed processing model. This model contains the following nodes:

SOAP sender: A SOAP node that transmits a SOAP message.

SOAP receiver: A SOAP node that accepts a SOAP message.

SOAP message path: The set of SOAP nodes through which a single SOAP message passes.

Initial SOAP sender (Originator): The SOAP sender that originates a SOAP message at the starting point of a SOAP message path.

SOAP intermediary: A SOAP intermediary is both a SOAP receiver and a SOAP sender and is targetable from within a SOAP message. It processes the SOAP header blocks targeted at it and acts to forward a SOAP message towards an ultimate SOAP receiver.

Ultimate SOAP receiver: The SOAP receiver that is a final destination of a SOAP message. It is responsible for processing the contents of the SOAP body and any SOAP header blocks targeted at it. In some circumstances, a SOAP message might not reach an ultimate SOAP receiver, for example because of a problem at a SOAP intermediary. An ultimate SOAP receiver cannot also be a SOAP intermediary for the same SOAP message.

This is an example of a SOAP message for the “getMensajes” method:

```
<?xml version="1.0"?>
<soap:Envelope xmlns:soap="http://www.w3.org/2003/05/soap-envelope">
  <soap:Header>
  </soap:Header>
  <soap:Body>
    <m:GetMensajes 
xmlns:m="217.126.198.179:8080/SrvSecurityRemotoHogar/servicioAccesoRem
otoHogarService?wsdl">
      <m:alarma>id=M_1201</m:alarma>
    </m:GetMensajes>
  </soap:Body>
</soap:Envelope>
```

Interesting information about SOAP services is available in the *iPhone Dev Sdk* (2013) and *iPhone SDK Articles* (2011) websites.

4.3 Sample application (calculator)

We decided that it was more interesting to implement a SOAP based server-client architecture for our application. To make a trial with it we created a simple calculator that would send some data to a server and this server would have some methods (sum and subtract) that would give an answer depending on the input numbers.

The first thing was to create a user interface for the calculator. There are two labels and an operator button. There is another button to change the operator sign. When the user writes the two numbers and presses the operator’s button, the application sends a request (SOAP message) to the web service, and when the web service answers with another SOAP message, then, all the data is parsed and the number is showed in a third label.

The web service contains a WSDL file with all the operators defined on it.
The next points explain the process to parse data from the *WSDL* file, in other words, the process to translate an *XML* document into a string.

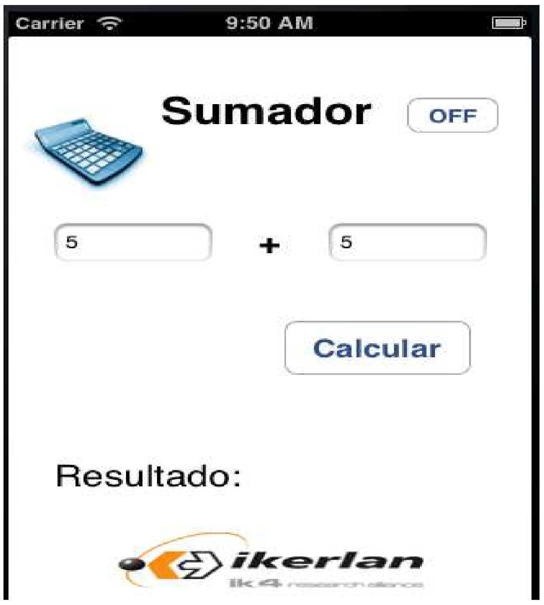
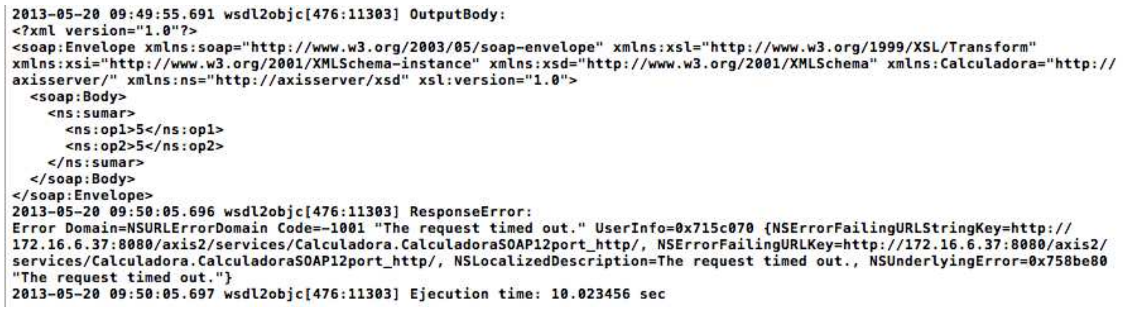


Figure 10 Screenshot of the sample application

Figure 10 shows us a screenshot of the developed calculator. The “off” button is used to change between the sum and the subtraction. When clicking on this button the sign between the two digits will change. The result will be visible in the text area next to “Resultado:”. When clicking on “Calcular”, the request will be sent to the web service within a SOAP message, and the web service will return an answer. Figure 11 shows the request SOAP message sent by the application to the web service and the web service’s response.



```
2013-05-20 09:49:55.691 wsdl2objc[476:11303] OutputBody:
<?xml version="1.0"?>
<soap:Envelope xmlns:soap="http://www.w3.org/2003/05/soap-envelope" xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:Calculadora="http://
axisserver/" xmlns:ns="http://axisserver/xsd" xsl:version="1.0">
  <soap:Body>
    <ns:sumar>
      <ns:op1>5</ns:op1>
      <ns:op2>5</ns:op2>
    </ns:sumar>
  </soap:Body>
</soap:Envelope>
2013-05-20 09:50:05.696 wsdl2objc[476:11303] ResponseError:
Error Domain=NSURLErrorDomain Code=-1001 "The request timed out." UserInfo=0x715c070 {NSErrorFailingURLStringKey=http://
172.16.6.37:8080/axis2/services/Calculadora.CalculadoraSOAP12port_http/, NSErrorFailingURLKey=http://172.16.6.37:8080/axis2/
services/Calculadora.CalculadoraSOAP12port_http/, NSLocalizedDescription=The request timed out., NSUnderlyingError=0x758be80
"The request timed out."}
2013-05-20 09:50:05.697 wsdl2objc[476:11303] Ejecution time: 10.023456 sec
```

Figure 11 SOAP request and response messages

In this case, the web service returns an error message because the server was off by the time the screenshot was taken.

4.3.1 Using wsdl2objc to export code from a wsdl

wsdl2ObjC is an open source tool created in 2008 by a group of American developers to translate in an easy way a *WSDL* into *Objective-C* code. Three versions have been released since it was created (0.4, 0.5 and 0.6). The one used for this project has been 0.6 which includes fixes for *iPhone* compatibility and a greatly improved *WSDL* compatibility.

Interesting information related to exporting data from a WSDL using the mentioned tool is available in the blog created by *Google Inc.* (2013) for this tool.

A *WSDL* is a document in *XML* format which is used to describe web services. A *WSDL* describes the public interface of a web service. A *WSDL* is often used in combination with *SOAP* and *XML Schema*. A client can see in the *WSDL* file of a web service the available functions of it, and can use *SOAP* to make a call to one of these functions. Special data types are included in a *XML Schema* format in the *WSDL* file.

The structure of a common *WSDL* is described by the following elements:

-**Data Type:** This chapter defines the data type used in the messages (*XML* format).

-**Messages:** The elements of each message are defined here. Each message can have many logic parts.

-**Port types:** In this chapter the allowed operations and the exchanged messages in the service are defined.

-**Bindings:** Used communication protocols are defined.

-**Services:** Group of ports and their respective addresses are defined. The previous chapters may be referenced here.

A *WSDL* example:

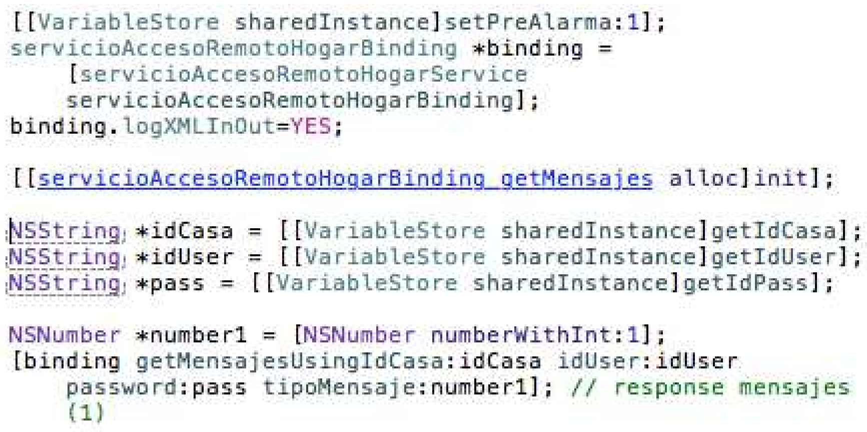
```
<definitions name="HelloService"
   targetNamespace="http://www.examples.com/wsdl/HelloService.wsdl"
   xmlns="http://schemas.xmlsoap.org/wsdl/"
   xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
   xmlns:tns="http://www.examples.com/wsdl/HelloService.wsdl"
   xmlns:xsd="http://www.w3.org/2001/XMLSchema">

   <message name="SayHelloRequest">
      <part name="firstName" type="xsd:string"/>
   </message>
   <message name="SayHelloResponse">
      <part name="greeting" type="xsd:string"/>
   </message>

   <portType name="Hello_PortType">
      <operation name="sayHello">
         <input message="tns:SayHelloRequest"/>
         <output message="tns:SayHelloResponse"/>
      </operation>
   </portType>

   <binding name="Hello_Binding" type="tns:Hello_PortType">
   <soap:binding style="rpc"
      transport="http://schemas.xmlsoap.org/soap/http"/>
   <operation name="sayHello">
      <soap:operation soapAction="sayHello"/>
      <input>
         <soap:body
            encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
            namespace="urn:examples:helloservice"
            use="encoded"/>
      </input>
      <output>
         <soap:body
            encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
            namespace="urn:examples:helloservice"
            use="encoded"/>
      </output>
   </operation>
   </binding>

   <service name="Hello_Service">
      <documentation>WSDL File for HelloService</documentation>
      <port binding="tns:Hello_Binding" name="Hello_Port">
         <soap:address
            location="http://www.examples.com/SayHello/">
      </port>
   </service>
</definitions>
```

Once we are familiarized with *WSDL*s, usage of *wsdl2ObjC* will be explained. First of all, we need to download the necessary files that can be found in the official website in the downloads section. After downloading the files, we launch the application and paste the *URL* of the *WSDL* that we want to translate in the upper text field. In the second text field, the destination folder will be defined. The created files will be added to this directory after clicking on “parse *WSDL*”. There will be one .m/.h file for each namespace in the source document.

The next step is to add the generated files to *Xcode*. Each project that uses the generated web service code will need to link against *libxml2* by performing the following for each target in the *Xcode* project:

1. Get info on the target and go to the build tab
2. Add "-lxml2" to the Other Linker Flags property
3. Add "-I/usr/include/libxml2" to the Other C Flags property

It is also necessary to add the *CFNetwork.framework* to build an *iPhone* project.



```
[[VariableStore sharedInstance]setPreAlarma:1];
servicioAccesoRemotoHogarBinding *binding =
    [servicioAccesoRemotoHogarService
    servicioAccesoRemotoHogarBinding];
binding.logXMLInOut=YES;

[[servicioAccesoRemotoHogarBinding_getMensajes alloc]init];

NSString *idCasa = [[VariableStore sharedInstance]getIdCasa];
NSString *idUser = [[VariableStore sharedInstance]getIdUser];
NSString *pass = [[VariableStore sharedInstance]getIdPass];

NSNumber *number1 = [NSNumber numberWithInt:1];
[binding getMensajesUsingIdCasa:idCasa idUser:idUser
    password:pass tipoMensaje:number1]; // response mensajes
    (1)
```

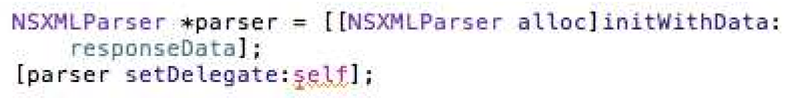
Figure 12 Using a web service

Figure 12 shows us how to use a generated method. It is necessary to import the main class from the ones generated with *wsdl2ObjC*. Then, an instance of the *binding* is created and space is allocated for the needed method. The next step is to define the input parameters of the method before using it. Once all the needed parameters are loaded the call to the method is made. The treatment of the received answer (including data parsing) will be explained later on.

4.3.2 Parsing the wsdl

wsdl2ObjC uses the *NSDATE+ISO8601Parsing* class to parse the received data from the *WSDL*. This class is a little bit ambiguous. In order to parse the data we decided to use the official *Apple*'s parser. This class is called *NSXMLParser*. Although it is not one of the fastest parsers available in the internet, it was good enough for our needs and being the *Apple*'s official one would be a big advantage as there is a lot of documentation in the *iOS Dev Center*.

The first step to use this parser was obviously to delete all the code related with the parser that came by default in the "connectionDidFinishLoading" method of the main generated file. All this code was replaced by the next two code lines.



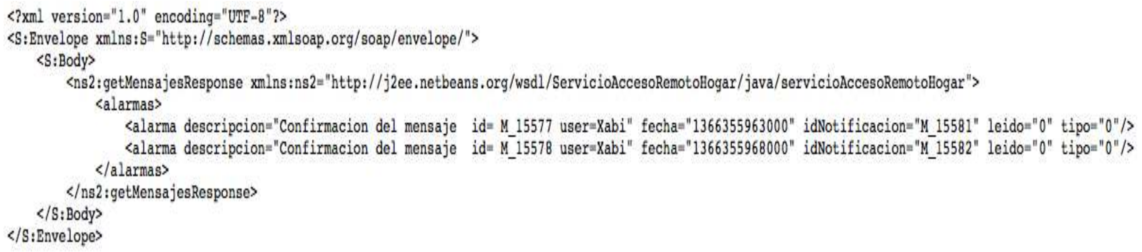
```
NSXMLParser *parser = [[NSXMLParser alloc]initWithData:
    responseData];
[parser setDelegate:self];
```

An instance of the parser is initialized with the information stored in the *responseData* variable which was previously read in the "didReceiveData" method. Then, as usual, the current class' delegate is set.

Apart from creating an instance of the parser, it is also necessary to read all the elements in the message received from the web service. For that purpose, the method "didStartElement" was used.

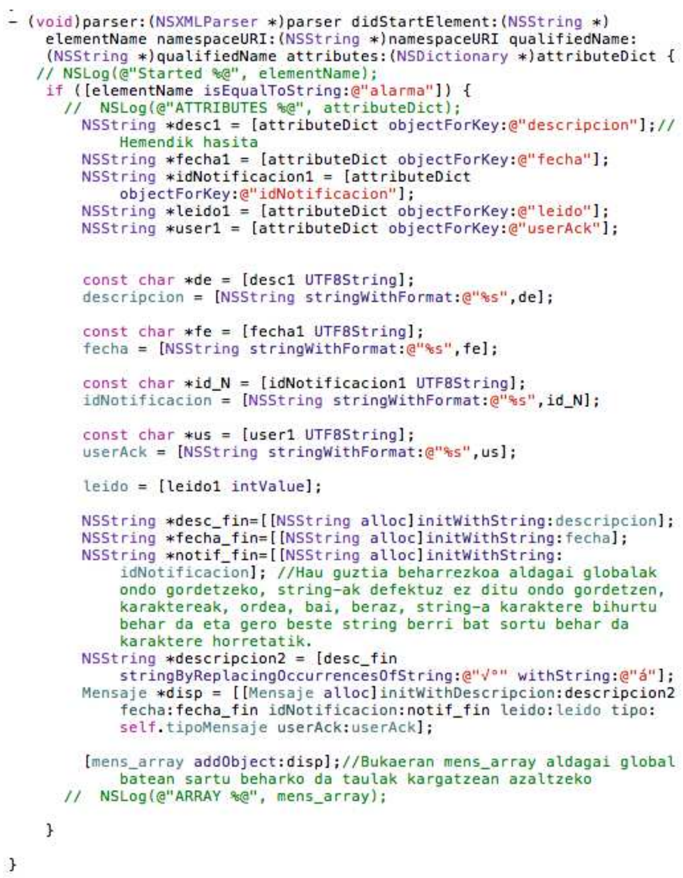
The web service returns a different element name depending on the user's request. If the user wants to see the messages list the element's name will be "alarma". If he/she wants to check for the devices' status, the web service will return "estadoDispositivos" and the same will happen for each request. As a result, each method will compare a different string for the current element name. The current element will have some attributes that will be read by using the "objectForKey:string" method of the *NSDictionary* class. These attributes will be saved and a new element will be created using them. This new element will be an object that can be a message, a device, etc. The classes for these objects must be previously defined in the project.

Figure 13 and Figure 14 show the implementation of the "didStartElement" method for the "getMensajes" request and the SOAP response represented in the web service. The reserved word for the messages type is "alarma" so just those elements are going to be treated.



```
<?xml version="1.0" encoding="UTF-8"?>
<S:Envelope xmlns:S="http://schemas.xmlsoap.org/soap/envelope/">
    <S:Body>
        <ns2:getMensajesResponse xmlns:ns2="http://j2ee.netbeans.org/wsdl/ServicioAccesoRemotoHogar/java/servicioAccesoRemotoHogar">
            <alarmas>
                <alarma descripcion="Confirmacion del mensaje  id= M_15577 user=Xabi" fecha="1366355963000" idNotificacion="M_15581" leido="0" tipo="0"/>
                <alarma descripcion="Confirmacion del mensaje  id= M_15578 user=Xabi" fecha="1366355968000" idNotificacion="M_15582" leido="0" tipo="0"/>
            </alarmas>
        </ns2:getMensajesResponse>
    </S:Body>
</S:Envelope>
```

Figure 13 "getMensajes" SOAP response



```
- (void)parser:(NSXMLParser *)parser didStartElement:(NSString *)
    elementName namespaceURI:(NSString *)namespaceURI qualifiedName:
    (NSString *)qualifiedName attributes:(NSDictionary *)attributeDict {
   // NSLog(@"Started %@", elementName);
    if ([elementName isEqualToString:@"alarma"]) {
      //  NSLog(@"ATTRIBUTES %@", attributeDict);
        NSString *desc1 = [attributeDict objectForKey:@"descripcion"];//
            Hemendik hasita
        NSString *fecha1 = [attributeDict objectForKey:@"fecha"];
        NSString *idNotificacion1 = [attributeDict
            objectForKey:@"idNotificacion"];
        NSString *leido1 = [attributeDict objectForKey:@"leido"];
        NSString *user1 = [attributeDict objectForKey:@"userAck"];


        const char *de = [desc1 UTF8String];
        descripcion = [NSString stringWithFormat:@"%s",de];

        const char *fe = [fecha1 UTF8String];
        fecha = [NSString stringWithFormat:@"%s",fe];

        const char *id_N = [idNotificacion1 UTF8String];
        idNotificacion = [NSString stringWithFormat:@"%s",id_N];

        const char *us = [user1 UTF8String];
        userAck = [NSString stringWithFormat:@"%s",us];

        leido = [leido1 intValue];

        NSString *desc_fin=[[NSString alloc]initWithString:descripcion];
        NSString *fecha_fin=[[NSString alloc]initWithString:fecha];
        NSString *notif_fin=[[NSString alloc]initWithString:
            idNotificacion]; //Hau guztia beharrezkoa aldagai globalak
            ondo gordetzeko, string-ak defektuz ez ditu ondo gordetzen,
            karaktereak, ordea, bai, beraz, string-a karaktere bihurtu
            behar da eta gero beste string berri bat sortu behar da
            karaktere horretatik.
        NSString *descripcion2 = [desc_fin
            stringByReplacingOccurrencesOfString:@"√°" withString:@"á"];
        Mensaje *disp = [[Mensaje alloc]initWithDescripcion:descripcion2
            fecha:fecha_fin idNotificacion:notif_fin leido:leido tipo:
            self.tipoMensaje userAck:userAck];

        [mens_array addObject:disp];//Bukaeran mens_array aldagai global
            batean sartu beharko da taulak kargatzean azaltzeko
      //  NSLog(@"ARRAY %@", mens_array);

    }

}
```

Figure 14 "didStartElement" for "getMensajes" request

4.3.3 Received data

Once all the data is downloaded and parsed, what follows is to deal with all the messages and arrange them in different lists. For this purpose, global variables have been used. In each method, a local array is filled with the read data from the web service. After reading all the elements and saving them in a local array, in the “connectionDidFinishLoading” the global array is filled with the elements of the local array. When the method is called by the user, the global variable will be already filled and all the data will be ready to be used.

There is a fact to take into account when reading messages. There are three different types of messages (alarms, alerts and notifications) and all of them use the same method to get the messages. The user will not need to load all types of messages all the time; it is possible to ask just for alarms, for example. For this reason, three different arrays have been created in the global variables store, one for each type of message, so after loading one kind of message, only that message type’s array is filled and later read. If the user needs all the messages at the same time (when launching application, for example), the three arrays will be filled in the next order so that they don’t get mixed: alarms, notifications and alerts. When the three of them are filled, an array with the sum of them will also be created.

4.3.4 Customizing the SOAP request

When the user makes a call to a method in the generated file from the *WSDL*, the first thing the method will do is to create a SOAP request. We had some problems when sending requests, as the requests that were created by default with *wsdl2ObjC* were not valid for our web service and this returned always null messages. For this reason, we had to replace some code lines in the “main” method of each interface.

The first thing is to get the input parameters and put them in an *NSDictionary*. Then, the entire SOAP message will be saved in a string by using the “serializedFormUsingHeaderElements” method with the header elements and the body elements. Finally, all this data will be sent via HTTP using the “sendHTTPCallUsingBody” method. For this method, the input parameters will be the recently created string and a string that will have this format: “nameOfMethod_action”. If the format of the string is not correct, the web service will not recognise the requested action and will return a null value. The format of the SOAP request must be exactly the same as if the request was done from an internet browser. To check if the requests were identical to the ones made from a browser we used the *Wireshark* packet-analyzer.

4.3.5 Used libraries and tools

This subchapter explains the libraries and tools used to develop the sample socket-based application.

NSStream: This is the library used to read from the communication manager or write on it. In every loop the method read of this library is executed. If the house answered something or an alarm has been simulated, this method will return some bytes and these bytes will be treated. If there is an error while reading data from the socket, this function will return -1. In this case, an exception will be thrown and this data will not be evaluated.

Wireshark: This open-source packet analyzer is used for network troubleshooting, analysis, software and communications protocol development, and education. We used the tool in order to see where and why the synchronization in the socket connection was lost. It was also used to see if the user’s requests were made in the proper format.

This information has been taken from the *Wikipedia.org* (2013) website.

5 MSECURITY *IOS* APPLICATION

In the fifth chapter the final application is described. The application's name is *mSecurity*. There are some subchapters inside the fifth chapter. The first one describes the application requirements. The second one talks about the user interface. In this section the main problems during the user interface design and some specific features for this project are explained. In the fourth section, the implementation of the socket connections is described. In the middle, the architecture of the whole application is explained. There are some screen captures showing the design of the different screens in the application and some class diagrams defining all the communications between the device, the Services Centre and the house.

5.1 Application requirements

mSecurity is a socket-based application. It will be used to protect the users home even when the user is away. For that, user will be able to choose between four scenes (home, away, night and holiday). In each scene, the sensors in the house will have a different status. A table with the list of items' status can be seen by touching the scene icon. For example, if the user is away, the movement detector will be on and will send an alarm if someone is getting into the house. If the user is at home, the detector will be off, and alarms will not be sent.

User will also be able to change the status of a device in any of the four scenes. These orders will be sent to the server and the server will change the status of the devices. When the order is executed, the server should return a notification to the mobile device notifying if the action has been finished successfully or not. Notifications will be divided in three groups. Alarms, system alerts and notifications. When an alarm comes to the device, a pop-up window will be raised, even if the app is in the background mode. In this case, a universal pop-up will be raised first and then, if the "OK" button is pressed the app will be "launched" with the pop-up view controller. If not, the first notification will stay in the device's notification pane. If several notifications come and the user does not open any of them, the first one that will appear will be the oldest notification.

User will be able to see all the messages received, divided in 5 groups (alarms, system alerts, notifications, pictures, and all the messages). The last group will store all the messages, but user will not be able to see each message's details from here. On the other hand, the rest of the groups will have a detail view controller to see each message's details by clicking on a cell. If a message is still not read, that message's cell will be darker. Once the detail's view controller is opened, that selected cell in the table will be brightened.

When an alarm comes to the device, a pop-up window will appear. This window will show the user some details of the new alarm, such as the description, the time, or the date. When user skips these view controllers, he/she will have the chance to send an e-mail, make a phone call, or ask for some pictures. After the user makes the acknowledgement by clicking on a couple of buttons, the app will go back to the messages screen and the new alarm will appear in the alarms table view.

The app will always be active, obviously, except the first time that it is launched. For the app’s first launch the app will load all the data from the web service, including scenes, devices status or users’ information. User will need to authenticate by writing a four-digit pin number in the login view controller. The valid pin number will come from the web server. The web server will return a different number depending on the MAC number of the mobile device, which will be registered in a database. If the MAC number of the device is not registered, the pin will not be transmitted and login will not be possible. Once the user has entered the valid pin number, the system will open the socket connection and if authentication goes well and there is not a problem with the connection, the scenes view controller will be shown. If a problem occurs, the app will keep loading until socket connection is opened. If the application is executing and internet connection is lost, app will keep connecting until the connection returns. At this point, authentication process will be repeated. Appendix II provides a more detailed description of the application resources.

5.2 User I/F

This chapter explains the solution to the different problems that appeared during the development process related with the user interface design.

5.2.1 The autorotation problem

Xcode gives the developer the chance to use the “*autoresize*” tool, which is an interesting tool to auto rotate basic elements, such as text areas, buttons or labels. However, it is more complicated to rotate other elements like text fields or alert views (frequently used in our *app*). This task must be done programmatically as an alert view (for example) is not drawn in the storyboard, and it is probably one of the biggest challenges in the project. There is a main method in *iOS* library that helped us manage the autorotation in the different views, “willRotateToInterfaceOrientation”. In this method, a variable is defined depending on the new rotation. Alert views are also taken into account in this method, as it is not the same to treat a screen with or without an alert view. If there is not an alert view in the screen we just set the value of the variable. However, if there is an alert view on the screen and we rotate the display, it is necessary to make some changes.

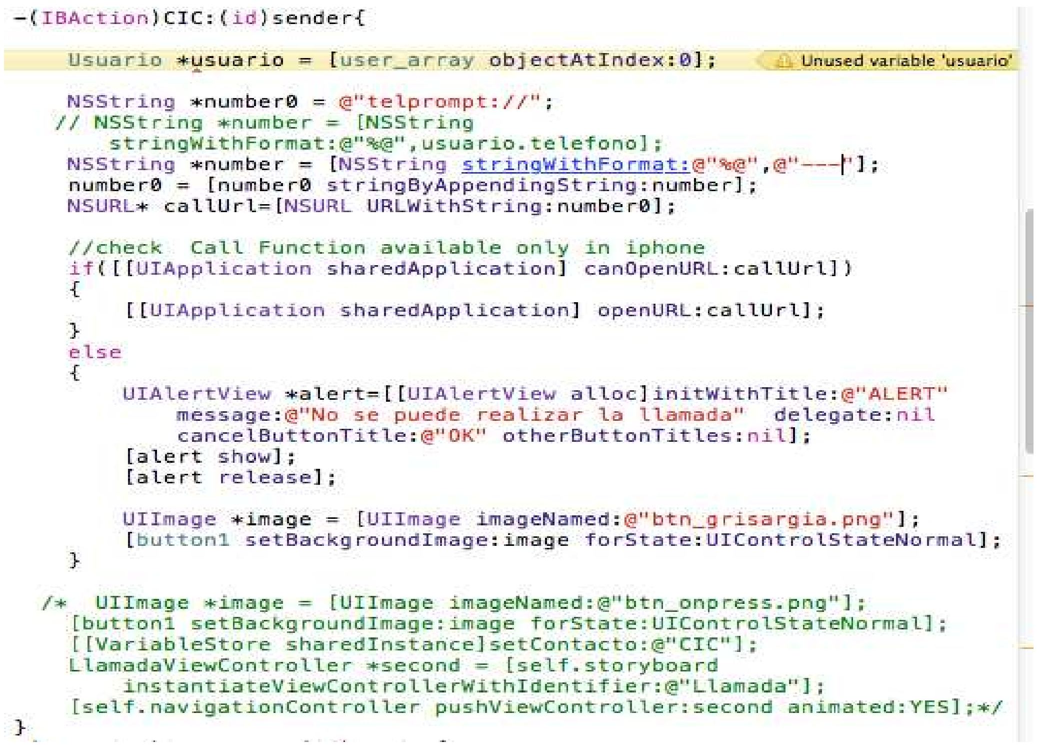
The first step is to dismiss the previous alert view to create a new one, so every time the display is rotated, the current alert view will dismiss. Afterwards, the same alert view must be created with the same style but with different size and position. For this reason, we needed to check for the new screen position and then, call to an earlier created method that would launch the new alert view. In this method, new alert view is customized depending on the screen orientation. There might be more than one different alert views, for example, the label is not necessary the same in all the alert views, so more than one methods were used in some cases. To manage this, a global variable was defined in the current class, so the text in the alert view became variable.

Besides alert views, text fields also needed to be implemented programmatically. The same steps were followed to implement the text fields. The “viewWillRotateToInterfaceOrientation” function was used. Depending on the next screen orientation, the text area would have a different size and position, and so as the background image. Apart from this, it was necessary to check for the screen orientation when the view is loaded. For this purpose, the "interfaceOrientation" attribute was used. When this attribute's value was *UIInterfaceOrientationPortrait*, the text field had a value, and when it was either *UIInterfaceOrientationLandscapeRight* or *UIInterfaceOrientationLandscapeLeft*, the value was different.

5.2.2 Phone calls

There are some libraries used to show the user the phone call screen. However, there is an important fact to take into account. This is the *Apple* rejection risk. There are some libraries that might be rejected. The one we used is a quite common one and it's easy to use (just a few lines).

There are some different numbers to call in this *app*, so when the user presses a button a different number is called. Each button has its sender; Figure 15 shows the code to open the phone call screen if the "CIC" button is pressed and Figure 16 the appearance of a phone call made with an *iPhone*.



```
-(IBAction)CIC:(id)sender{

    Usuario *usuario = [user_array objectAtIndex:0];        Unused variable 'usuario'

    NSString *number0 = @"telprompt://";
   // NSString *number = [NSString
      stringWithFormat:@"%@",usuario.telefono];
    NSString *number = [NSString stringWithFormat:@"%@",@"---"];
    number0 = [number0 stringByAppendingString:number];
    NSURL* callUrl=[NSURL URLWithString:number0];

    //check  Call Function available only in iphone
    if([[UIApplication sharedApplication] canOpenURL:callUrl])
    {
        [[UIApplication sharedApplication] openURL:callUrl];
    }
    else
    {
        UIAlertView *alert=[[UIAlertView alloc]initWithTitle:@"ALERT"
            message:@"No se puede realizar la llamada"  delegate:nil
            cancelButtonTitle:@"OK" otherButtonTitles:nil];
        [alert show];
        [alert release];

        UIImage *image = [UIImage imageNamed:@"btn_grisargia.png"];
        [button1 setBackgroundImage:image forState:UIControlStateNormal];
    }

  /*  UIImage *image = [UIImage imageNamed:@"btn_onpress.png"];
    [button1 setBackgroundImage:image forState:UIControlStateNormal];
    [[VariableStore sharedInstance]setContacto:@"CIC"];
    LlamadaViewController *second = [self.storyboard
        instantiateViewControllerWithIdentifier:@"Llamada"];
    [self.navigationController pushViewController:second animated:YES];*/
}
```

Figure 15 Designing a phone call screen programmatically

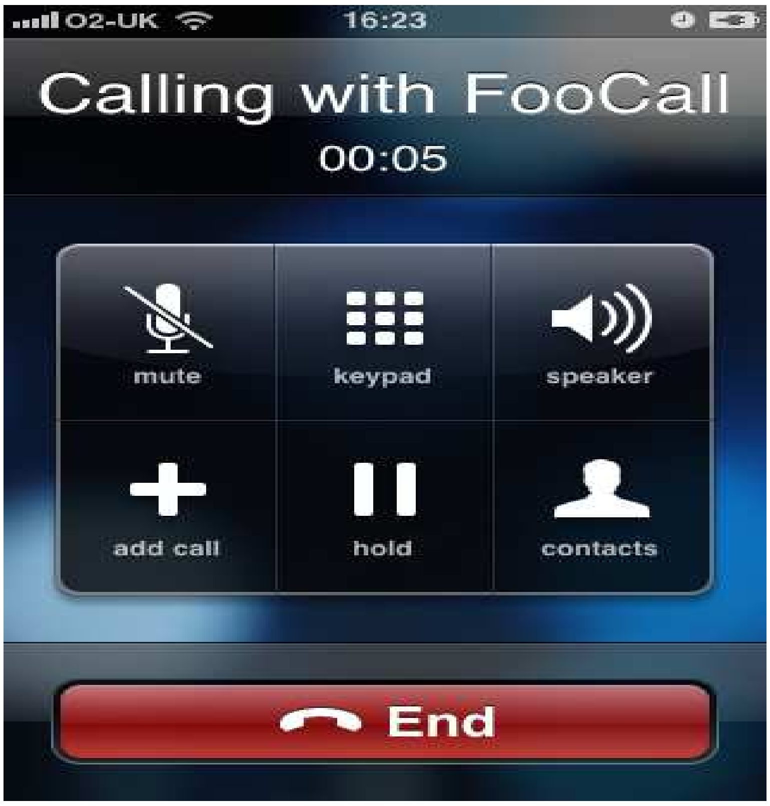
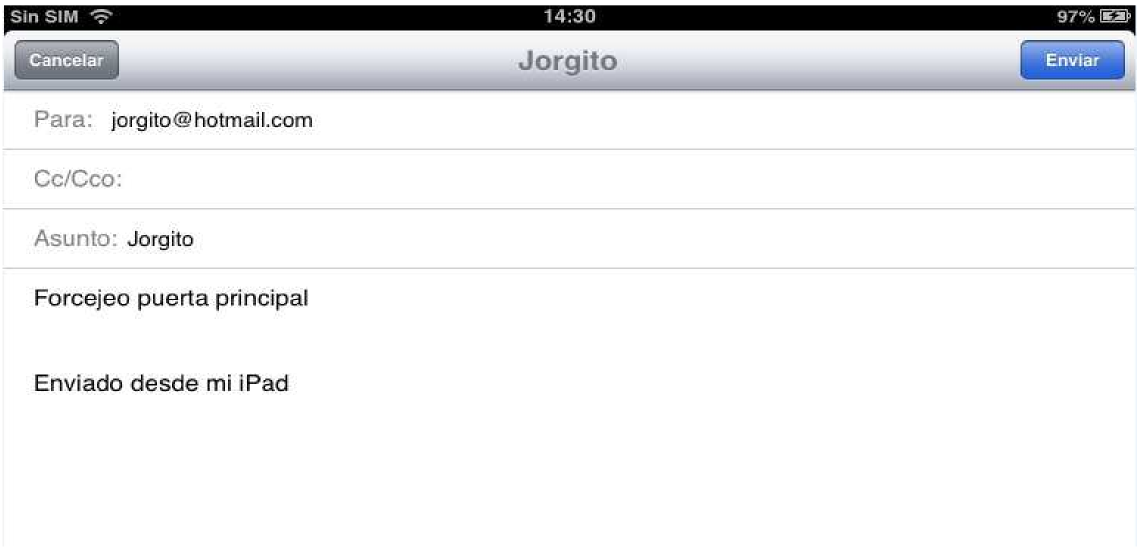


Figure 16 Making a call from an *iPhone*

5.2.3 E-mail

There is also a simple library to implement the e-mail screen. While the library for phone calls is unofficial, this one is shown by *Apple*, so we decided that it was the easiest and comfortable option to develop the e-mail screen. There is a main function called “didFinishWithResult” in the *MFMailComposeViewController* where four different cases are taken into account: message cancelled, message saved, message sent, and message failed. Each of them will return a string and depending on the string returned the *app* will go to the previous or the next string. For example if the result is “message sent” then, the *app* will show an alert view telling the user that the message has been said. On the other hand, if there has been an error sending the message, the app will show an alert view warning the user that something has gone wrong.

Anyway, before this step an instance of *MFMailComposeViewController* must be created as shown in Figure 18. This is done when the user presses a button to send a message. The library’s “canSendMail” function checks if the device is able to send mails (for example, there is no network, or when using a simulator). If answer is yes, then a new delegate is created and the body of the mail is filled (subject, CC, BCC, text) depending on the data we got before opening the view. Data can be changed manually before sending the message. After pressing the button the e-mail screen will be shown (Figure 17). The screen will have the same appearance that has the *Mail* application in *iOS*. If the device cannot send an e-mail, an alert view will appear in instead of the new view.



Sin SIM 14:30 97%

Cancelar **Jorgito** Enviar

Para: jorgito@hotmail.com

Cc/Cco:

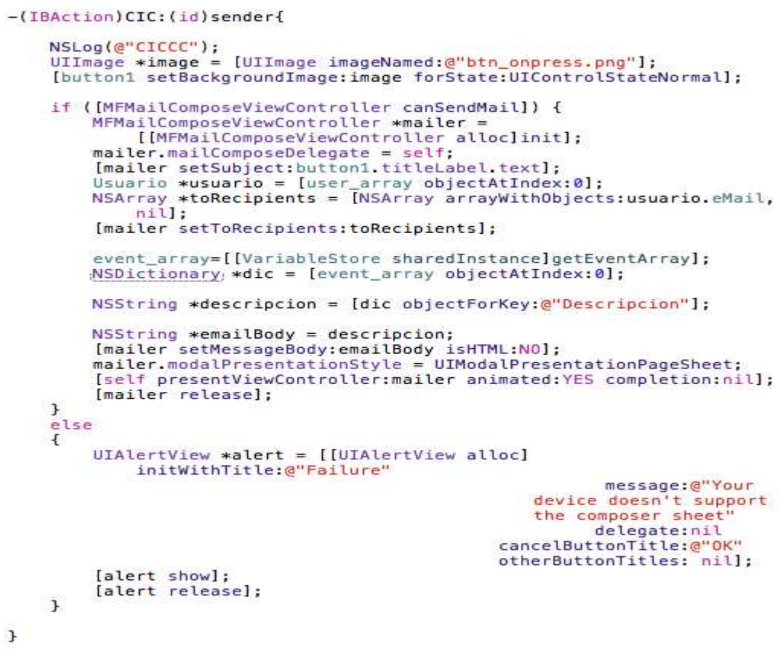
Asunto: Jorgito

Forcejeo puerta principal

Enviado desde mi iPad

Figure 17 E-mail screen appearance

The sent e-mails will be saved in our mailbox in *Mail*. For sending e-mails it is necessary to have our e-mail account properly configured in our device's *Mail* app. Otherwise, the presented tool will not work and the application will show us an alert view telling us that the device is not ready to send messages.



```
-(IBAction)CIC:(id)sender{

    NSLog(@"CICCC");
    UIImage *image = [UIImage imageNamed:@"btn_onpress.png"];
    [button1 setBackgroundImage:image forState:UIControlStateNormal];

    if ([MFMailComposeViewController canSendMail]) {
        MFMailComposeViewController *mailer =
            [[MFMailComposeViewController alloc]init];
        mailer.mailComposeDelegate = self;
        [mailer setSubject:button1.titleLabel.text];
        Usuario *usuario = [user_array objectAtIndex:0];
        NSArray *toRecipients = [NSArray arrayWithObjects:usuario.eMail,
            nil];
        [mailer setToRecipients:toRecipients];

        event_array=[[VariableStore sharedInstance]getEventArray];
        NSDictionary *dic = [event_array objectAtIndex:0];

        NSString *descripcion = [dic objectForKey:@"Descripcion"];

        NSString *emailBody = descripcion;
        [mailer setMessageBody:emailBody isHTML:NO];
        mailer.modalPresentationStyle = UIModalPresentationPageSheet;
        [self presentViewController:mailer animated:YES completion:nil];
        [mailer release];
    }
    else
    {
        UIAlertView *alert = [[UIAlertView alloc]
            initWithTitle:@"Failure"
                                                              message:@"Your
                                                       device doesn't support
                                                       the composer sheet"
                                                             delegate:nil
                                                    cancelButtonTitle:@"OK"
                                                    otherButtonTitles: nil];
        [alert show];
        [alert release];
    }

}
```

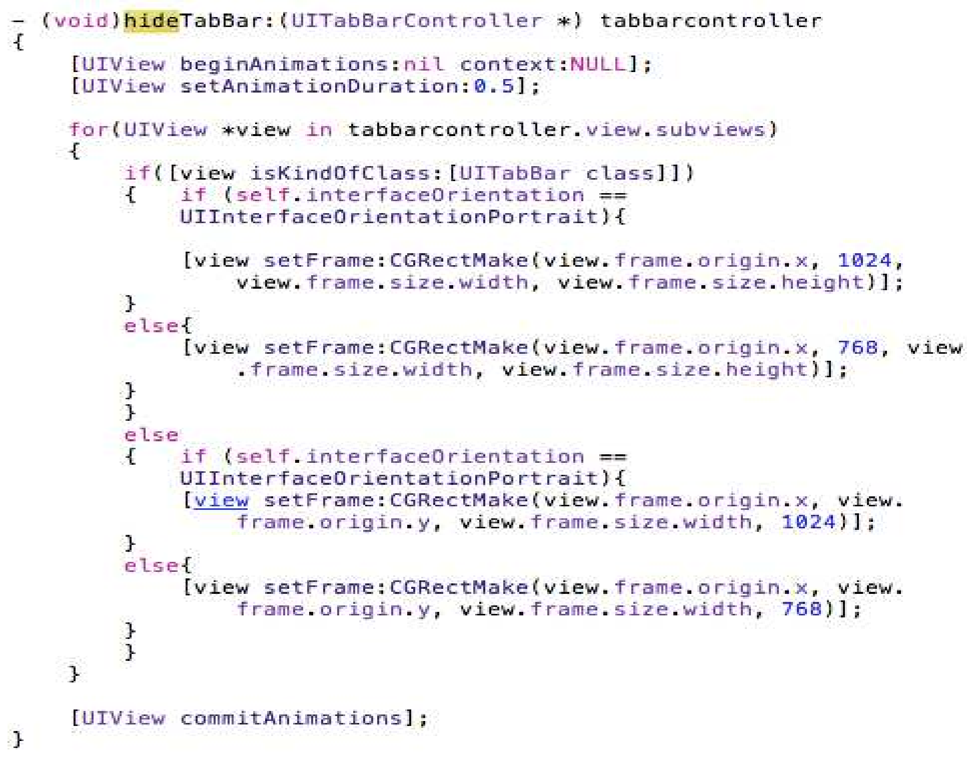
Figure 18 Creating an instance of *MFMailViewController*

5.2.4 Porting from *iPhone* to *iPad*

Before starting with this task, I looked at some different tutorials for porting an *app* from *iPhone* to *iPad*. The most repeated feature in those tutorials was the *"autoresizing"* tool in *Xcode*, but as I explained before this is just useful for simple elements. So the task resulted hard if we had to take into account all the little facts in the *iPhone app*, most of them forgotten when the *iPad app* needed to be developed. The main difference between both applications was the tab bar's size (bigger in *iPad*).

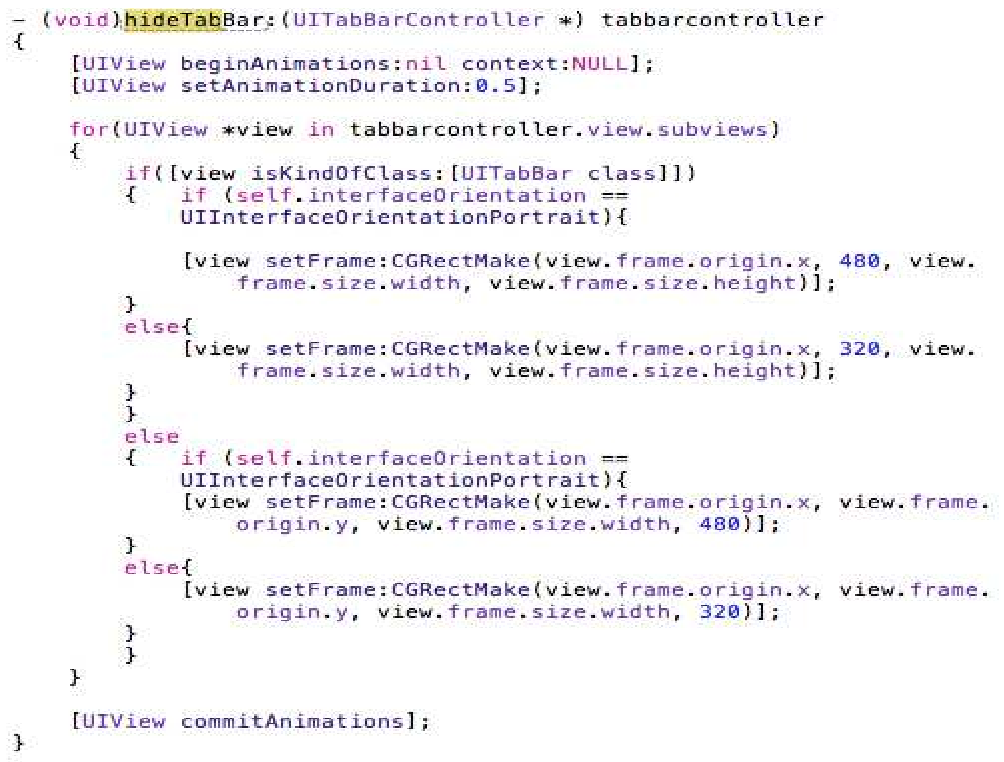
As it was explained before, two main methods were used to manage the tab bar, *"showTabBar"* and *"hideTabBar"* which are shown in Figure 19 and Figure 20. The methods are the same for both devices; the only difference is the amount of pixels for the tab bar in each device. The next figure shows us the difference between a method for *iPhone* and a method for *iPad*.

Apart from this, alert views must also be treated, so these ones were treated the same way as the tab bar. The only thing that changes is the resolution in the alert view elements, for example, the text, the buttons, or the background image.



```
- (void)hideTabBar:(UITabBarController *) tabbarcontroller
{
    [UIView beginAnimations:nil context:NULL];
    [UIView setAnimationDuration:0.5];

    for(UIView *view in tabbarcontroller.view.subviews)
    {
        if([view isKindOfClass:[UITabBar class]])
        {   if (self.interfaceOrientation ==
            UIInterfaceOrientationPortrait){

            [view setFrame:CGRectMake(view.frame.origin.x, 1024,
                view.frame.size.width, view.frame.size.height)];
        }
        else{
            [view setFrame:CGRectMake(view.frame.origin.x, 768, view
                .frame.size.width, view.frame.size.height)];
        }
        }
        else
        {   if (self.interfaceOrientation ==
            UIInterfaceOrientationPortrait){
            [view setFrame:CGRectMake(view.frame.origin.x, view.
                frame.origin.y, view.frame.size.width, 1024)];
        }
        else{
            [view setFrame:CGRectMake(view.frame.origin.x, view.
                frame.origin.y, view.frame.size.width, 768)];
        }
        }
    }

    [UIView commitAnimations];
}
```

Figure 19 "hideTabBar" method for *iPad*



```
- (void)hideTabBar:(UITabBarController *) tabbarcontroller
{
    [UIView beginAnimations:nil context:NULL];
    [UIView setAnimationDuration:0.5];

    for(UIView *view in tabbarcontroller.view.subviews)
    {
        if([view isKindOfClass:[UITabBar class]])
        {   if (self.interfaceOrientation ==
            UIInterfaceOrientationPortrait){

            [view setFrame:CGRectMake(view.frame.origin.x, 480, view.
                frame.size.width, view.frame.size.height)];
        }
        else{
            [view setFrame:CGRectMake(view.frame.origin.x, 320, view.
                frame.size.width, view.frame.size.height)];
        }
        }
        else
        {   if (self.interfaceOrientation ==
            UIInterfaceOrientationPortrait){
            [view setFrame:CGRectMake(view.frame.origin.x, view.frame.
                origin.y, view.frame.size.width, 480)];
        }
        else{
            [view setFrame:CGRectMake(view.frame.origin.x, view.frame.
                origin.y, view.frame.size.width, 320)];
        }
        }
    }

    [UIView commitAnimations];
}
```

Figure 20 "hideTabBar" method for *iPhone*

5.2.5 Used libraries

Libraries in *Objective-C* are called frameworks. There are different frameworks for *Mac* or for *iOS*. The frameworks used for user interface were the next ones: *CoreGraphics, Foundation,* and *UIKit*. Each of them has some header files inside, which contain pieces of code revised by *Apple*. These headers can be used wherever in the code just by writing the name of the file before the method we want to use. For example, if we want to use "UIAlertView.h", we would use the next format [UIAlertView nameOfTheMethod:parameters]; The most important framework for this phase of the project has been UIKit, as it contains most of the headers for the graphical interface, such as *NSText, UIAlertView, UILabel* or *UITabBarController*. Without them, nothing would be able to implement and this is one of the main differences between *Android* and *iOS*.

For this reason, it is not possible to port directly a Graphical User Interface based on *Android* to *iOS*. While *Android* uses *Java* libraries, *iOS* uses *Objective-C* ones. However, as we are going to see later, in the *servers'* part, there are some libraries that are portable from one operative system to the other one.

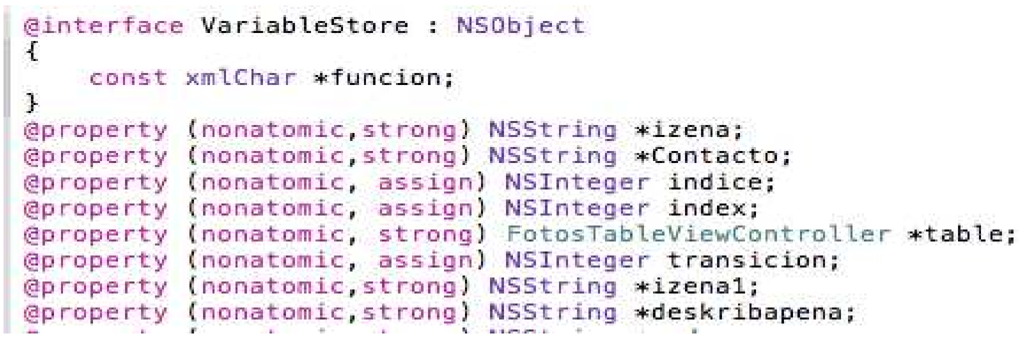
5.2.6 Using a singleton to manage global variables

The singleton pattern is a powerful way to share data between different classes and parts of the code. Singleton classes exhibit a really useful design pattern. Many of the core *Apple* classes follow this pattern, such as [UIApplication sharedApplication].

The singleton class must be initialized as an object and the first step is to create an instance of it that will always be managed as a “single shared instance”. Once the instance is created, we can make as much calls as we want to that instance’s methods from every class.

This class has been used in this project to manage global variables. It is important to design this class in a tidy way. Creating this class in a wrong way may cause little memory leaks, and as the class is called frequently the result can be application crashing. The next figures show how the singleton is initialized and used.

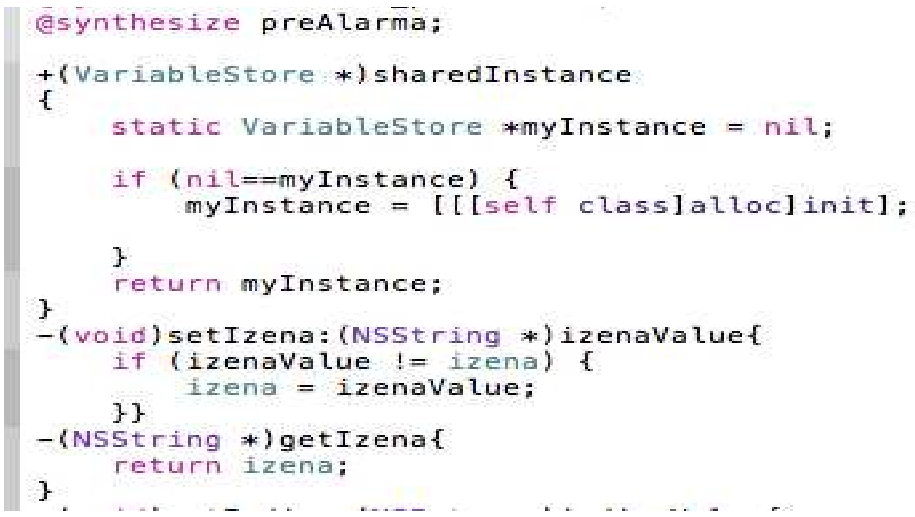
The interface is created as any other class. All the elements that will be used are defined in Figure 21.



```
@interface VariableStore : NSObject
{
    const xmlChar *funcion;
}
@property (nonatomic,strong) NSString *izena;
@property (nonatomic,strong) NSString *Contacto;
@property (nonatomic, assign) NSInteger indice;
@property (nonatomic, assign) NSInteger index;
@property (nonatomic, strong) FotosTableViewController *table;
@property (nonatomic, assign) NSInteger transicion;
@property (nonatomic,strong) NSString *izena1;
@property (nonatomic,strong) NSString *deskribapena;
```

Figure 21 Variable Store definition

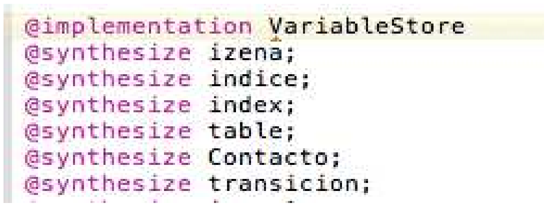
Each object in the singleton will have a “get” and a “set” function, so that there is a chance to read or write a global variable all the time (Figure 22).



```
@synthesize preAlarma;

+(VariableStore *)sharedInstance
{
    static VariableStore *myInstance = nil;

    if (nil==myInstance) {
        myInstance = [[[self class]alloc]init];

    }
    return myInstance;
}
-(void)setIzena:(NSString *)izenaValue{
    if (izenaValue != izena) {
        izena = izenaValue;
    }}
-(NSString *)getIzena{
    return izena;
}
```

Figure 22 Setters and getters in the singleton

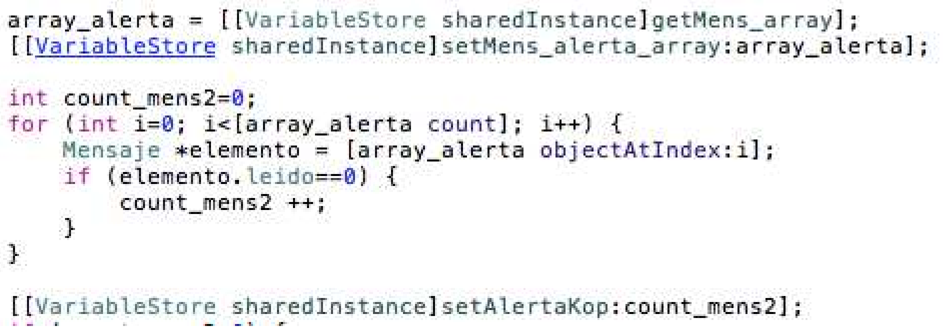
As usual in every class, it is necessary to synthesize all the elements (Figure 23).



```
@implementation VariableStore
@synthesize izena;
@synthesize indice;
@synthesize index;
@synthesize table;
@synthesize Contacto;
@synthesize transicion;
```

Figure 23 Synthesizing the elements

Figure 24 shows how to use a singleton class. The first code line reads from a previously created array (messages array) and the last line writes the number of existing alerts in a global variable. The second line writes the output of the messages array in the alert type messages array.



```
array_alerta = [[VariableStore sharedInstance]getMens_array];
[[VariableStore sharedInstance]setMens_alerta_array:array_alerta];

int count_mens2=0;
for (int i=0; i<[array_alerta count]; i++) {
    Mensaje *elemento = [array_alerta objectAtIndex:i];
    if (elemento.leido==0) {
        count_mens2 ++;
    }
}

[[VariableStore sharedInstance]setAlertaKop:count_mens2];
```

Figure 24 Reading and writing

5.3 Architecture

The architecture of this project is divided in three parts; the user's device (*iPhone/iPad*), the Services Centre and the house. The part of the architecture where we have been working has been the connection between the device and the Services Centre, this means that the link between the Services Centre and the house has been designed by other departments.

5.3.1 User interface's class diagrams (storyboard)

As I explained before, after the fourth version storyboards can be used in *Xcode*. It is a simple way to create a link between a view controller created graphically and the code created for it. Figures 25 to 32 show some parts of the storyboard in this project.

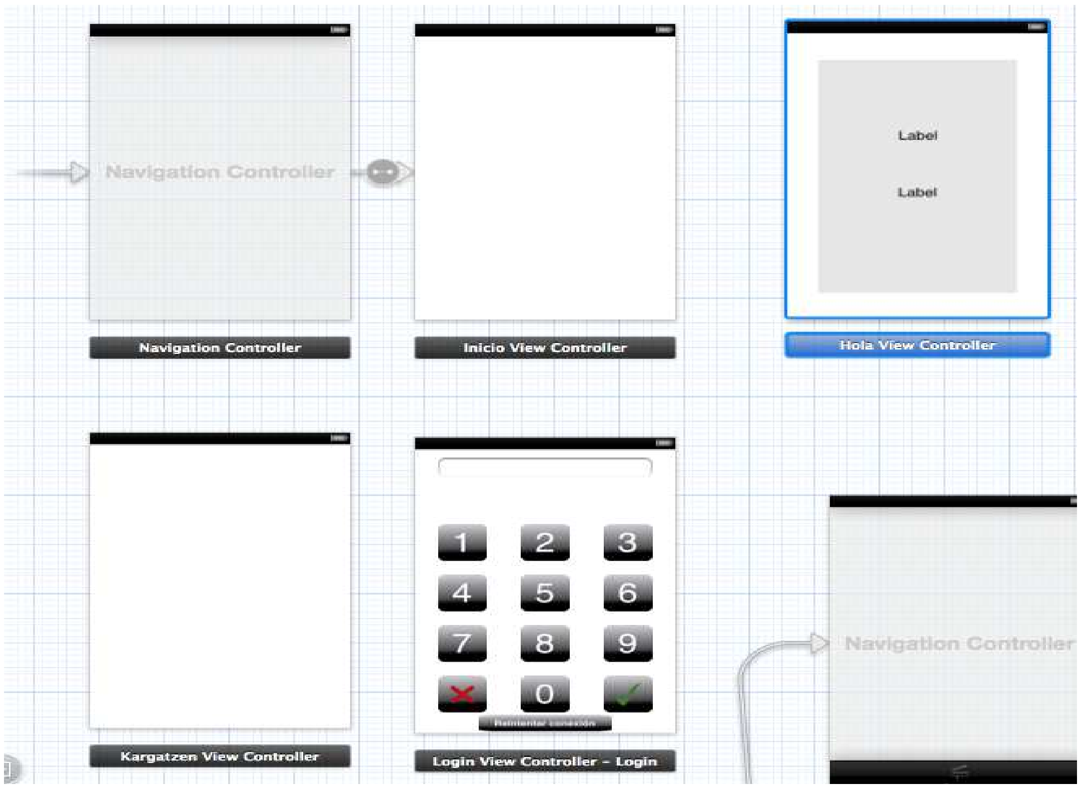


Figure 25 First Screens

Figure 25 shows us the design of the first screens. Navigation controller is completely necessary to be able to push from one view to another programmatically. The arrow before the navigation controller means that it is the first view controller. “Inicio View Controller” and “Kargatzen View Controller” are empty because the activity indicator view (loading) is created programmatically. “Login View Controller” contains 10 buttons for digits, one for rubbing the text field, and one to accept the introduced pin number, and a button for retrying the connection in case something went wrong in the previous attempt. Then, “Hola View Controller” will show a greeting message with the name of the user.

Figure 26 shows the structure of the “Tab Bar Controller” with its respective three navigation controllers, one for each tab. The name and the picture for the tab are defined here, but can be changed programmatically if needed.

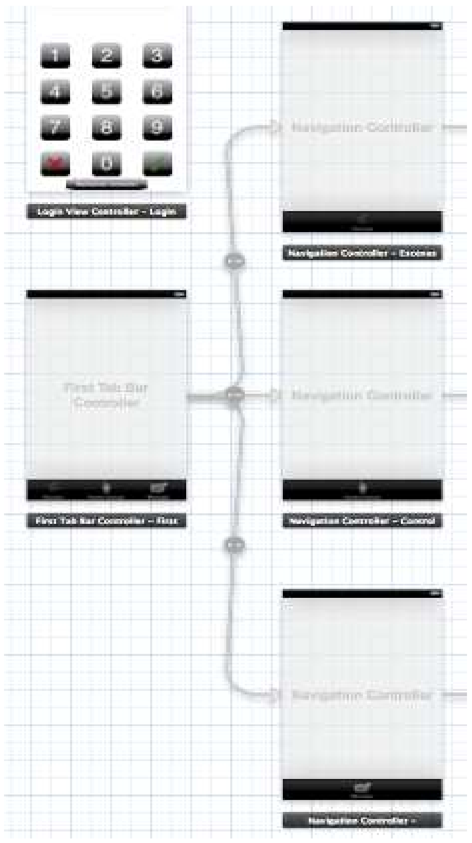

1
2
3
4
5
6
7
8
9
0
Login View Controller – Login
Navigation Controller
Navigation Controller – Escenas
First Tab Bar Controller
Navigation Controller
First Tab Bar Controller – First
Navigation Controller – Control
Navigation Controller
Navigation Controller –

Figure 26 Tab Bar Controller

Figure 27 and Figure 28 show the structure of the three main screens (scenes, manual control and messages). They are all child view controllers of the tab bar controller and their respective navigation controller.

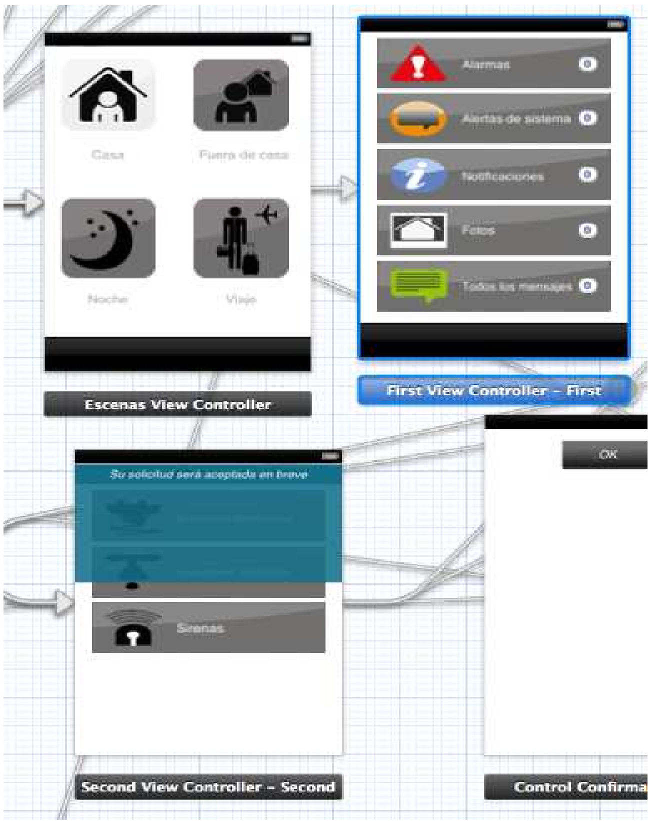


Figure 27 Scene, manual control and messages view controllers

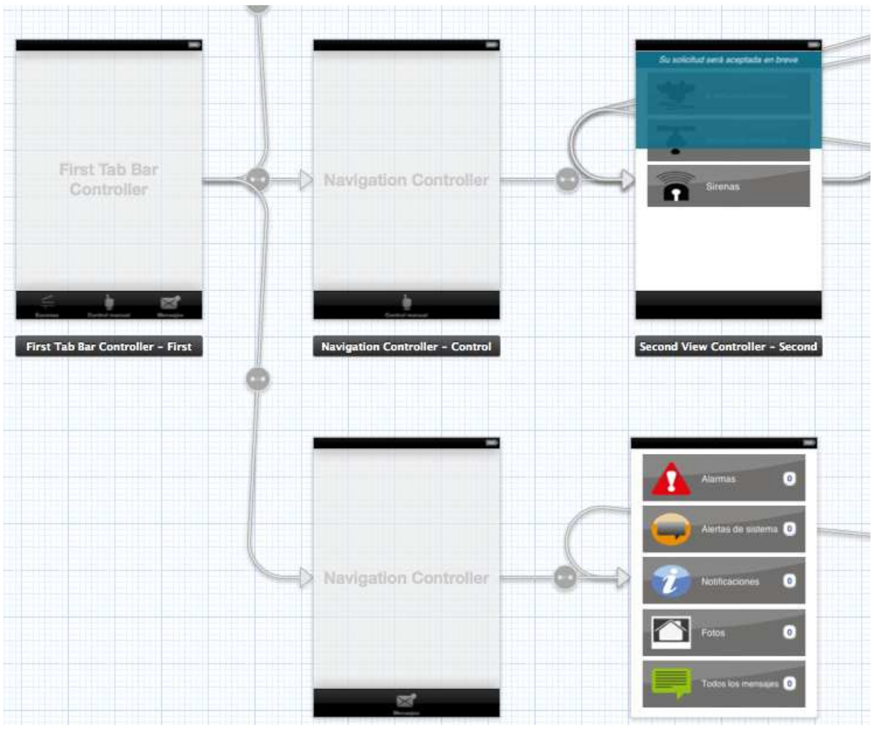


Figure 28 Relationship between tab bar, navigation and view controllers

Inside the messages group, there are some different message types. For example, alarm type messages. This is the structure of its table view and detail view controller, where we can see that the "share" screen with its buttons is visible in the storyboard (just visible when pressing "share" button in the *app*). As some facts have been customized programmatically, there is a "custom" segue between them (Figure 29).

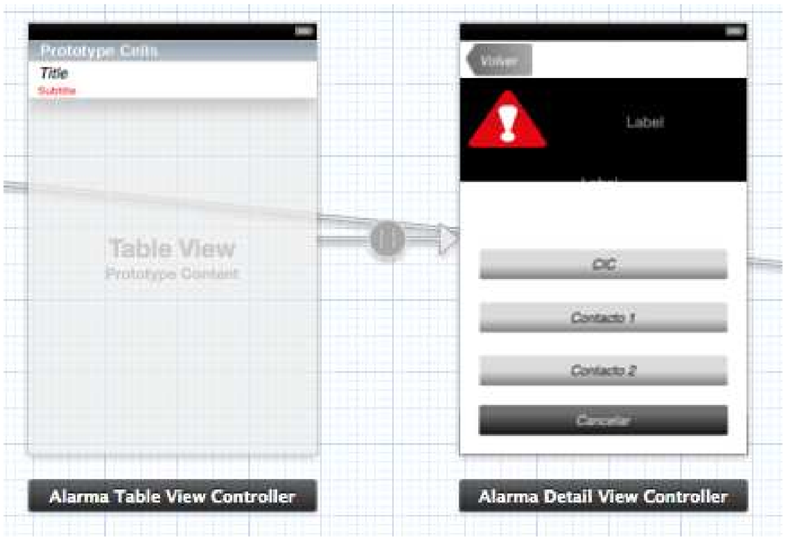


Figure 29 Alarma table view controller and alarma detail view controller

As mentioned before, the new alarm pop-up is not an alert view, but a simple view controller. The next figure shows the design of the pop-up dialog. It has a navigation controller in the beginning to make possible to navigate between screens. The label's values are written programmatically and so as the design of the "slide to unlock" as shown in Figure 30.

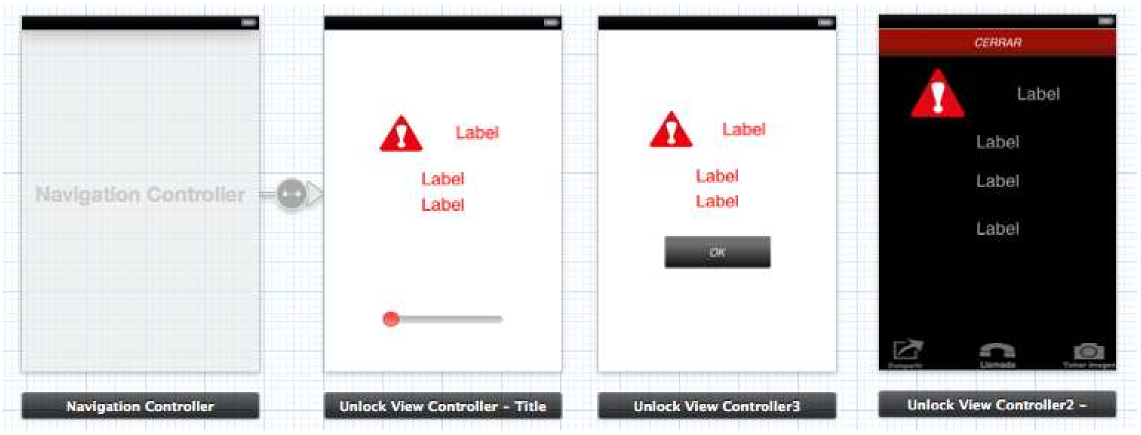


Figure 30 New alarm dialog

In Figure 31 the scene change progress is visible. When pressing a scene icon a pop-up will appear in a new window “Confirmacion Casa View”. If the user clicks the cancel button the *app* will go back to the main screen. However, if the user presses the send button the *app* will go to “Espera Casa View” and will wait until the socket gives an answer (if it does). If the scene change has been successfully done, the next time the user presses that scene’s button, in instead of a pop-up, a table will appear showing the state of all the devices in that scene (devices’ state can be changed in control manual).

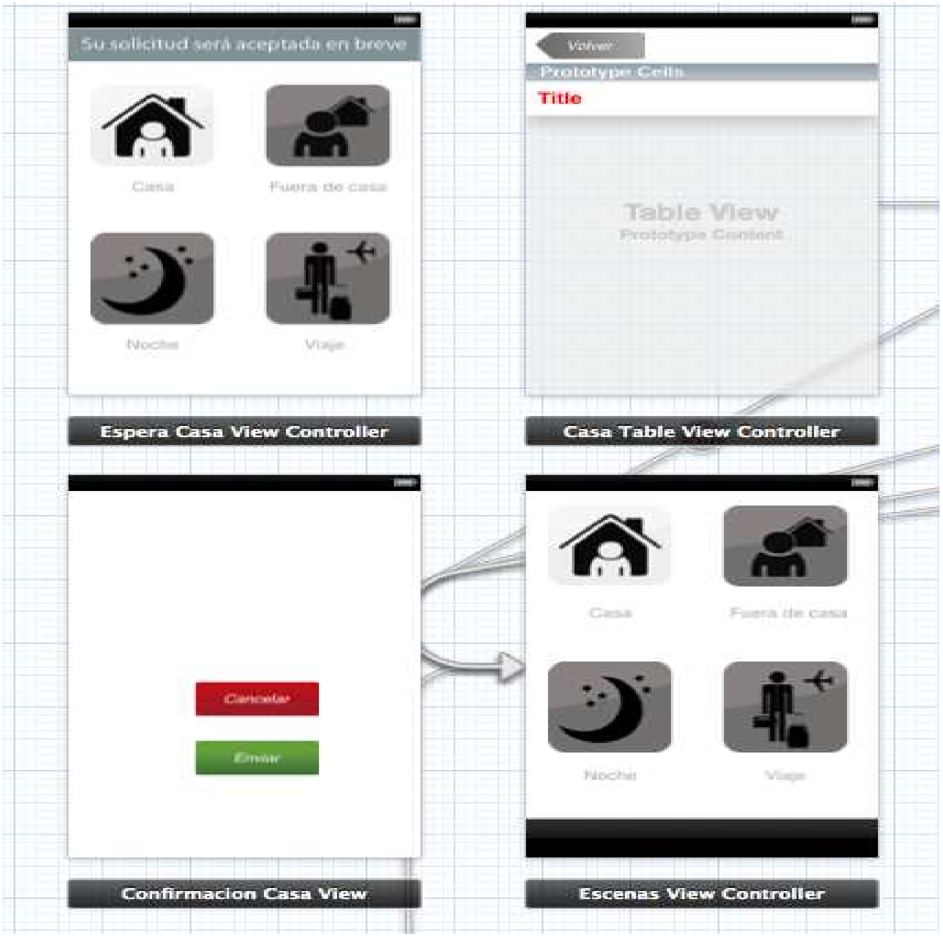


Figure 31 Scene change process

Although photos have still no interaction with the web service and have not a real functionality, the user interface has been designed. The user receives some pictures from the web service and has the chance to see the details of the pictures and send them via e-mail. As in the rest of messages types, when user clicks on a table’s element the details of that picture’s group will be shown (Figure 32).

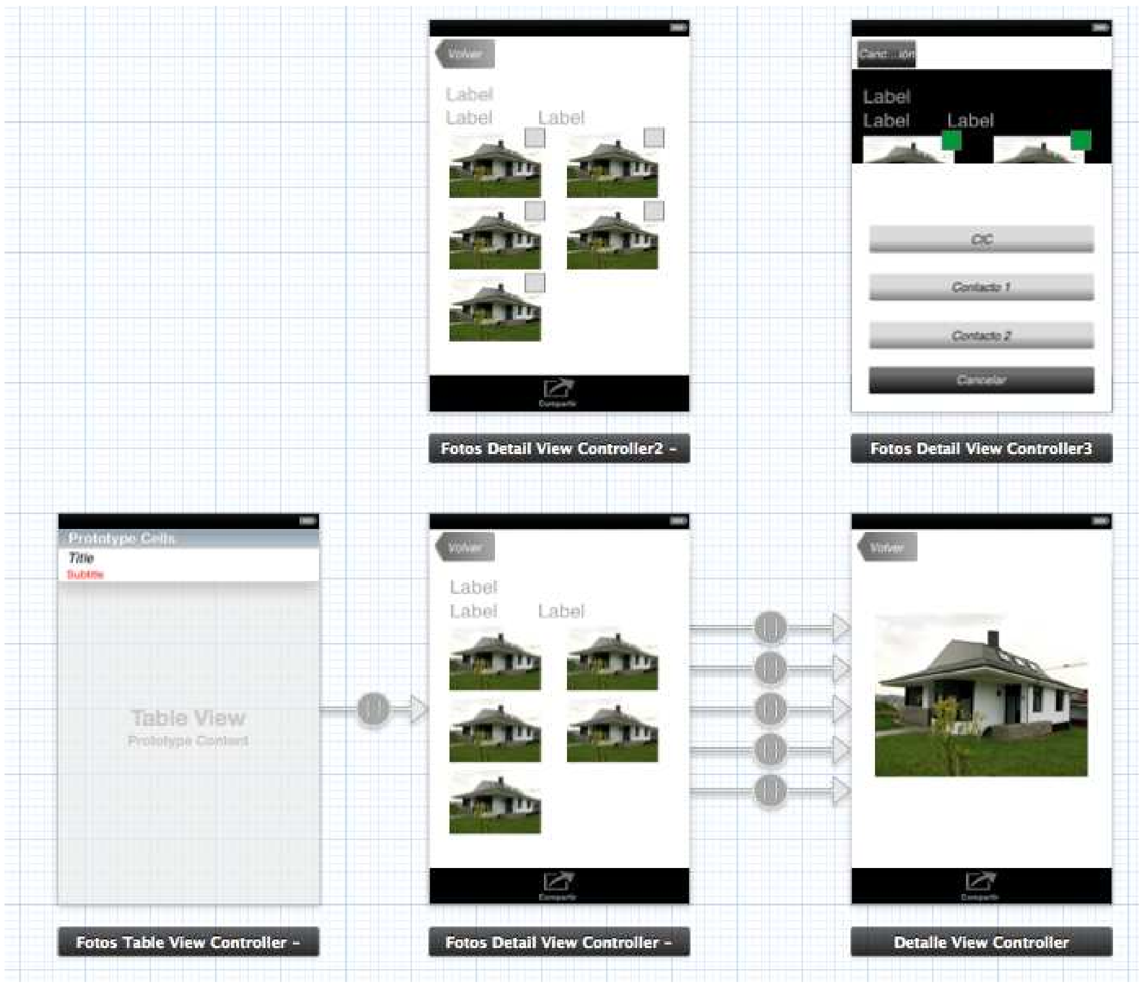


Figure 32 Pictures management

5.3.2 Socket server's class diagrams

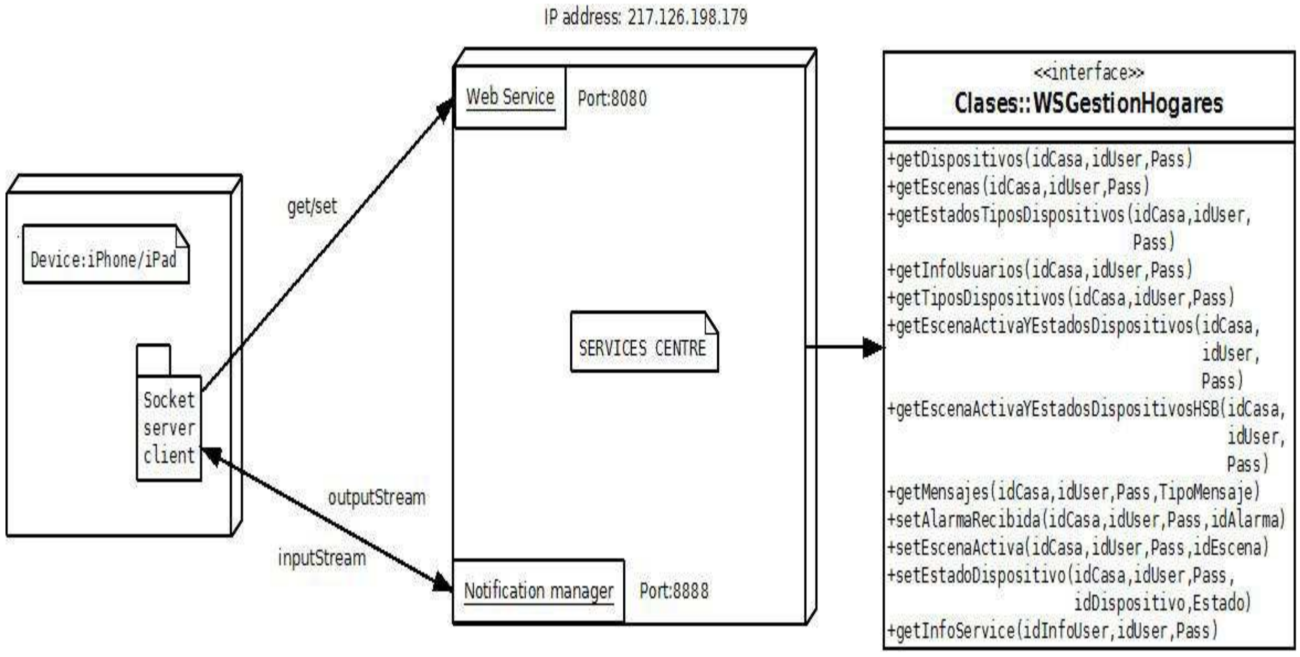
The Services Centre is located in the 217.126.198.179 *IP* address. The Web Service that will manage the devices' status and the messages' list is located in the port 8080. The notification manager that will deal with the messages sent via socket is located in the port 8888. When the user makes a request to get some information from the database or wants to change the status of a device, he/she is making a call to the 8080 port. The services centre will then answer with an order identifier.

If the request is a status change, the user will have to parse and save that identifier until the same identifier comes from the notification manager confirming that the asked request has been made. If there is no answer in a 30-second time the request is rejected.

If the user is asking the Services Centre for information about devices, messages or whatever, the Services Centre will "display" all the information and the client will need to parse all the data in that moment.

The Services Centre needs to be connected to the house associated to the user, so if there is no connection between the house and the Services Centre, this will display the last status of the house before losing the connection. If the user wants to set a new scene or change a device's status, the Services Centre will not send an identifier back to the user, and the user will realise that there is no network connection between the Services Centre and his/her house.

A class diagram is displayed in Figure 33 and Figure 34 shows the state machine of the socket connection.



IP address: 217.126.198.179
Device:iPhone/iPad
Socket server client
get/set
outputStream
inputStream
Web Service
Port:8080
SERVICES CENTRE
Notification manager
Port:8888
<<interface>>
Clases::WSGestionHogares
+getDispositivos(idCasa,idUser,Pass)
+getEscenas(idCasa,idUser,Pass)
+getEstadosTiposDispositivos(idCasa,idUser, Pass)
+getInfoUsuarios(idCasa,idUser,Pass)
+getTiposDispositivos(idCasa,idUser,Pass)
+getEscenaActivaYEstadosDispositivos(idCasa, idUser, Pass)
+getEscenaActivaYEstadosDispositivosHSB(idCasa, idUser, Pass)
+getMensajes(idCasa,idUser,Pass,TipoMensaje)
+setAlarmaRecibida(idCasa,idUser,Pass,idAlarma)
+setEscenaActiva(idCasa,idUser,Pass,idEscena)
+setEstadoDispositivo(idCasa,idUser,Pass, idDispositivo,Estado)
+getInfoService(idInfoUser,idUser,Pass)

Figure 33 Relationship between the device and the services centre

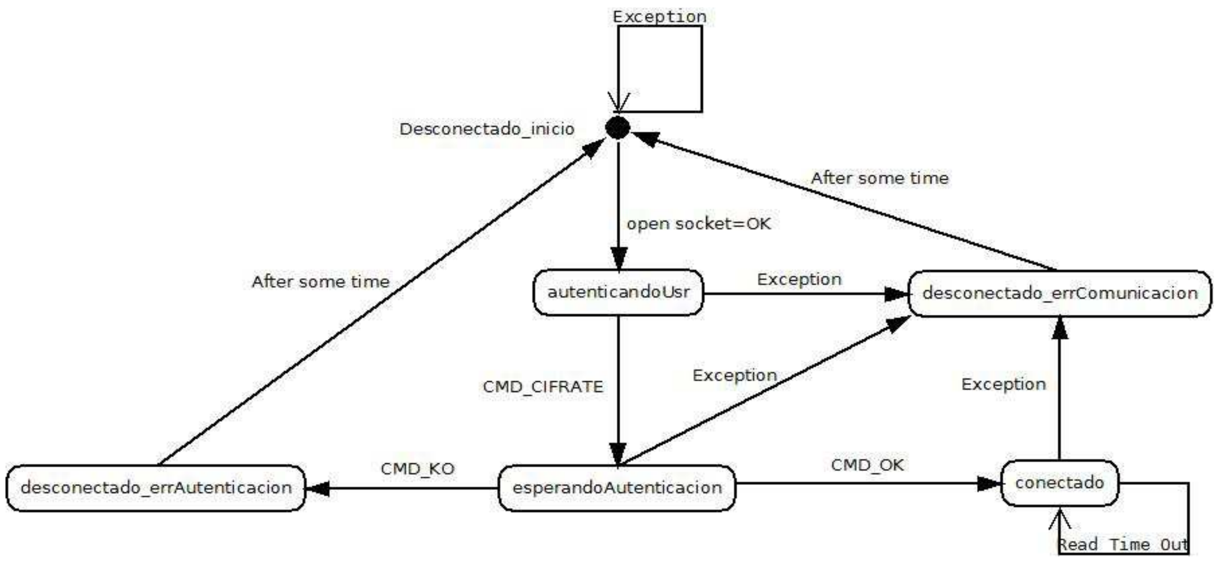
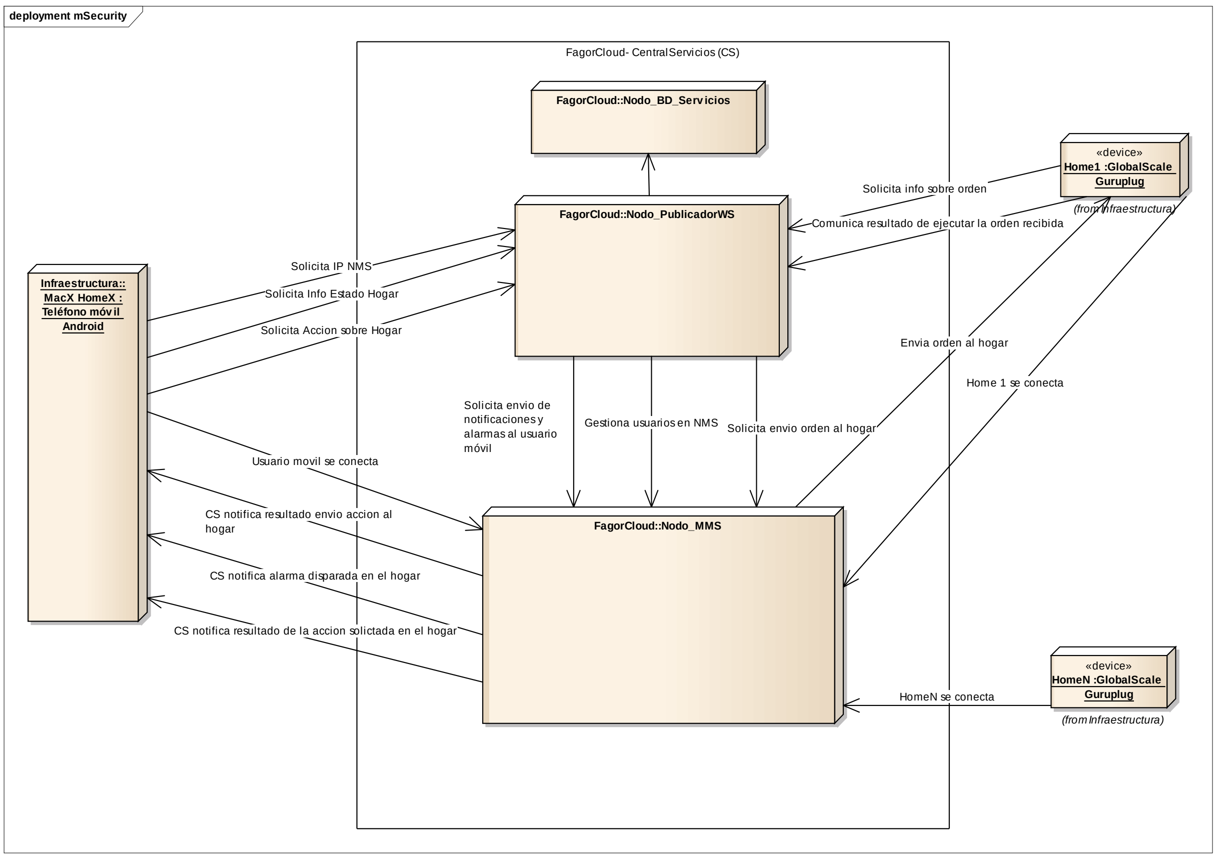


Figure 34 State machine

As it was mentioned before, the socket connection has six different states. The first state is “Desconectado_inicio” and it is the current state until the socket connection is opened successfully. Afterwards, the authentication progress starts and the system starts to encode the user name, password and the nonce. If there is something wrong in one of these three parameters, an exception raises and the new state will be “desconectado_errComunicacion” (the same will happen if an error occurs in the rest of the states, except in “esperandoAutenticacion”). If not, the connection state will change to “esperandoAutenticacion” where the authentication will start. If the credentials are incorrect, the authentication will fail and the new status will be “desconectado_errAutenticacion”. If everything went well in the authentication progress the connection’s state will be “conectado” and it will keep connected unless there is a communication error (network coverage loss, for example).

5.3.3 The link between the Services Centre and the house (class diagram)

The next class diagram (Figure 35) shows the link between the Services Centre and the house. When the user reads a device status, there is no communication between these parts, but when he/she asks to change the status of a device, the Services Centre sends the house the request identifier via socket and receives the house’s answer via the web service. In the case that an alarm is sent by the house, this alarm will be sent via socket.



deployment mSecurity
FagorCloud- CentralServicios (CS)
FagorCloud::Nodo_BD_Servicios
FagorCloud::Nodo_PublicadorWS
FagorCloud::Nodo_MMS
Infraestructura:: MacX HomeX : Teléfono móvil Android
«device» Home1 :GlobalScale Guruplug
(from Infraestructura)
«device» HomeN :GlobalScale Guruplug
(from Infraestructura)
Solicita IP NMS
Solicita Info Estado Hogar
Solicita Accion sobre Hogar
Usuario movil se conecta
CS notifica resultado envio accion al hogar
CS notifica alarma disparada en el hogar
CS notifica resultado de la accion solictada en el hogar
Solicita envio de notificaciones y alarmas al usuario móvil
Gestiona usuarios en NMS
Solicita envio orden al hogar
Solicita info sobre orden
Comunica resultado de ejecutar la orden recibida
Envia orden al hogar
Home 1 se conecta
HomeN se conecta

Figure 35 Communications class diagram

First of all, the houses are connected to the notification manager (NMS). Then, the user launches the application and gets connected to the notification manager. The user then has two options. The first one is to check the home status information. In this case, the web service will return a SOAP message giving the answer to the requested method (data will be read from the database). The second one will be to change the status of a specific device. In this case, the user's device will ask for an action identifier and will give the details of the requested action. The web service will then send all this data to the notification manager, and this will send the data to the house. The house will make all the asked changes and then, will send the answer of the requested action to the web service. If an error occurred in the house, the error will be notified. Afterwards, the web service notifies the house's answer to the notification manager and the notification manager will send this message to the user's device, mentioning if the status change has been successfully done or not.

If the house detects an alarm, it will send an alarm type message straight to the notification manager and all the information related to this alarm message will be added to the database. Once the alarm message arrives to the notification manager, the message is sent to the user's device and the device will look for new alarm messages in the database before showing the alarm dialog in the screen.

It must be said that the architecture and communication between these two elements has been designed by third parties, but it is really important to understand this communication in order to find and solve as soon as possible all the errors that may occur in this part.

5.4 Communications

The presenting chapter talks about communications between the three parts of the architecture (device, Services Centre and house). It focuses on the socket part and the use of the *j2ObjC* tool to port some parts of code from *Java* to *Objective-C*. Finally, it shows the progress for parsing the data received from the web server using the *wsdl2ObjC* tool.

5.4.1 Sockets

The socket part has been one of the most important parts of this project. In this chapter, the socket connection is extensively described; putting special attention to the main run loop, the types of messages received from the socket server and the background mode restrictions.

5.4.1.1 Initial objectives and background

The application's main task is the connection between a mobile device a Services Centre and a house. The objective was to create all these connections following an order and trying to make those connections as fast as possible. In this side, sockets were one of the easiest ways to implement such a simple connection as they provide simplicity and high-speed. One side of the socket would be the notification manager in the Services Centre and the other side would be the device.

The first step to test a socket was installing a socket server locally in a PC, and simulating a series of orders there. For this purpose, I installed a *Windows* virtual machine in a *MAC OS X* computer, where I launched the socket server. The first trials of the *app* went against this server as we needed to be sure that the authentication in the socket server was successful. There were many different difficulties when trying to connect to the socket server that will be explained deeply later on.

After being sure that the connections were made properly, the next step would be to try to connect to the real socket server in the Services Centre. After this, our *app* would be ready to receive orders from the socket.

5.4.1.2 Extended description

There are five different states in the connection between the socket server and the user. When an instance of “ClienteDelServidor” is created, the system gets into an infinite loop and gets into the first state.

The first state is called “desconectado_inicio”. In this state the system tries to open a socket connection in a specific *IP* address. To create a socket connection the official *CFStream* library was used. The function used from this library is called “CFStreamCreatePairSocketToHost” and has five input parameters. The first parameter is for the allocator identifier; in our case we used the current default allocator so the value was “NULL”. The second parameter is the host address; in this case the address is the Service Centre’s *IP* address. The third one is the port number which is “8888” and the fourth and fifth parameters are the input and output streams that will be created in this moment. The type for these streams is “CFWriteStreamRef”, but after creating them, two new streams are casted from the ones created before. After casting the first two streams, the new streams will be of type “NSInputStream”, in the input stream case and “NSOutputStream”, in the output stream case. After the two streams are scheduled in the current run loop and opened, the input stream is ready to listen to the server. The “NSStream” class has also an event handler that checks if new bytes are received from the socket, or if an error occurred. Every time the server sends data this event handler is executed and returns and answer that is evaluated in the “desconectado_inicio” state. If an error occurred, then an exception is thrown and the system tries to reconnect again. On the other hand, if some data is sent from the server, the connection is opened and the current state is changed to “autenticandoUsr”. The server should have sent a four byte sequence which is called the “nonce” and is used to keep synchronization between the client and the server.

In the second state, the user name, the password and the received nonce are sent to the server. Before being sent, this data is going to be coded in “SHA-256” format and if the length of the data is valid the system will go into the next status “esperandoAutenticacion”. However, if the input data is not valid (for example, nonce is “null”), the new state will be “desconectado_errComunicacion” and after making some checking the state will go back to “desconectado_inicio”.

Once the state has changed to “esperandoAutenticacion” the client is ready to listen to the server’s answer. If the authentication was right, the server will send an 8 byte sequence that will include an “OK\r\n” message. First of all, the server’s answer must be decoded with the “transform” function. Before this, if the answer is not an 8 byte sequence, the client automatically knows that the authentication went wrong and goes into the state “desconectado_errAutenticacion”. Once the answer is decoded, the answer is checked and if the received string contains “OK\r\n”, the new state will be “conectado”. If it does not contain the mentioned string, the new state will be “desconectado_errAutenticacion”.

When the state gets into “conectado”, the server starts sending an “echo” message every minute to notify that the connection keeps alive. If the “echo” is not send, then the connection is “closed” and the state goes back to “desconectado_errComunicacion”. In each loop, the system will check if the device is connected to a network. If network connection is lost, the system will go into “desconectado_errComunicacion”. If everything goes well, the client will be all the time listening to the server. When the server sends an order, the client will decode that order and check what it contains. The next chapters describe each type of message received from the server.

5.4.1.3 Types of possible messages received from the socket server

The next points describe the different types of messages that the server will send depending on the action remaining.

5.4.1.3.1 Echo (Keep alive)

It is the most repeated message. If the connection is alive the server sends an “echo” message every minute. This type of message has no effect in the final user; it is just a tool that helped us to check if the connection is alive while developing the product.

5.4.1.3.2 Or

This message comes when the socket server gives the device an answer to a certain order that was sent previously. When the user gives an order, the Services Centre’s web service gives back immediately an order identifier to the user that will be saved until the “or” type message is received, or until 30 seconds have gone if the user did not received the “or” message in that period of time.

If the “or” message is sent from the socket server in time, then the user’s order (scene change, device status change, etc.) is made successfully. If not, the status of the house will keep the same as before and the system will notify the user about the error. The values of several variables are changed when this message is received.

When a message of this type is received, the messages list gets refreshed as a change in the house status has been done. A new message is added in the database to the notification type messages confirming the status change. As the database changed, the *app* needs to read the new values of the database. As fast as the “or” message is received the *app* loads all the data from the database so that when the user checks the message list, the list is already updated.

At the same time, the current scene or the changed device’s status is also updated, so all this data must be checked in the database.

5.4.1.3.3 Notification

This type of message is sent by the socket just before the “or” message is sent. It is also sent after an “alarm” message. When an alarm comes to the device, the status of some devices is changed and this event must be notified to the user. For each alarm, there might be between zero and three notifications depending on the devices that have been changed. For example, if two alarms are forced one after the other, the first one will contain three notification messages, as three devices’ status have been changed, and the second alarm will not contain any notification message, as all the devices are already on and their status have not changed.

Every time a notification type message arrives, a new element will be added to the notification’s messages list.

5.4.1.3.4 Alarm

This type of message is sent by the socket server immediately after a new “alarm” type message is added to the database. As fast as the alarm is received, the alarm list in the database is read by the application to see if there is an alarm that has not been read by the user yet. This is done by setting a global variable that controls the type of message received, in this case an “alarm” message type. The non-read alarm’s features are read and loaded before the alert view is shown. Afterwards, the notification starts getting ready to be showed.

There are some properties that are defined in this moment. These properties are the sound name or the alert body. After this, the local notification is sent, but before treating the pop-up dialog, there are some variables that need to be changed. The number of pending dialogs must be incremented in the case that the current dialog is different from the previous ones and must be added to a queue if there is another dialog being showed at the moment of receiving the alarm. Then, the pop-up variable is “unlocked” and the “didReceiveLocalNotification” in the “appDelegate” starts executing.

All the properties that were defined previously are used when the notification is shown. When application is in the background mode, the local notification rises immediately, but when the application is in foreground, the local notification waits until all the properties of the alert view are loaded. This may take a couple of seconds depending on the network connection. Afterwards, the system checks if another alarm is being watched by the user. If there are not other alarms to be watched, then the current alarm is shown by pushing the “UnlockViewController” screen and the iteration is finished.

5.4.1.4 Managing background and foreground modes

One of the most important requirements of the application is that it needs to keep alive all the time after it has been launched for first. The code needed to be executing all the time in case that a new message arrived from the socket server. For this reason, we decided to add a location manager to the app, so that it keeps always executing the infinite loop of the socket server.

In the “appDelegate” class a new instance of *CLLocationManager* was created. This instance is created when the application enters in background mode. When the user presses the home button in the device the “applicationDidEnterBackground” of the mentioned class is executed giving the chance to make all the necessary configurations for the application's new status.

In this part of the code the "startMonitoringSignificantLocationChanges" of the *CLLocationManager* is called and the "setActive" variable is set to zero. When the application goes to the background mode the location icon will appear in the top-side of the device screen after asking the user if he/she wants to use the location services to keep the *app* alive.

If an alert is sent by the server when the application is in the background mode, a local notification will be shown in the user's device. If the user clicks on the "OK" button the application keeps in the same status. However, if the user selects the "unlock" button the application goes back to the foreground mode and the "applicationDidBecomeActive" method in the "appDelegate" is executed. The variable "setActive" is set to one and some variable are checked before showing the alarm dialog. If there was a previous dialog that is waiting to be read, the new dialog goes to a queue and is showed immediately after the first dialog is closed.

On the other hand, if there is no any previous dialog to be shown, the current alarm dialog is shown immediately when the application is active. In other words, the "UnlockViewController" screen must be pushed as soon as the application is restored.

5.4.1.5 Using *j2ObjC* to translate code

j2ObjC is a command-line tool created by *Google Inc.* to translate *Java* code into *Objective-C* code. The files generated by the tool do not need to be modified so *j2ObjC* enables *Java* code to be part of the *iOS* application's build. This way we can translate most of the non-UI (data-access, or application logic) code that is created for an *Android* application. *J2ObjC* supports most *Java* language and runtime features required by client-side application developers, including exceptions, inner and anonymous classes, generic types, threads and reflection.

j2ObjC is still not completely developed, but it is a *beta* version. There are still some bugs that need to be fixed. As there are many different ways to write code in *Java*, the tool has not translated all the paths yet. As I said before, the tool does not provide any UI-toolkit because *iOS* interface design must be done using *Objective-C* and storyboards or *NIB*s.

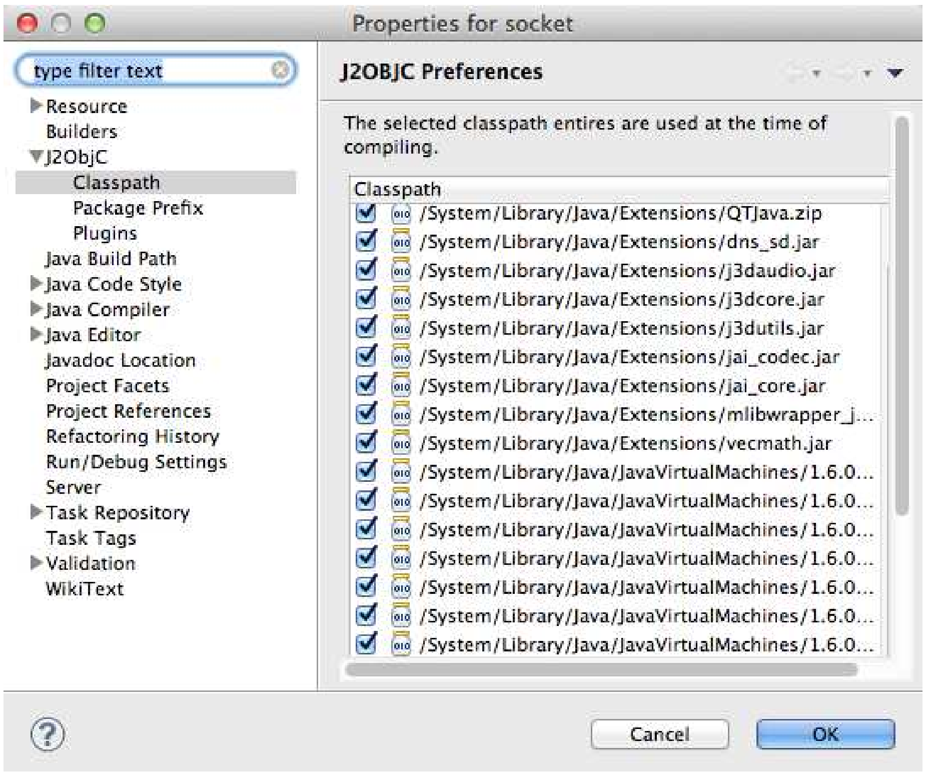
The requirements for using *j2ObjC* are the next ones: having installed *Xcode 4.0* or higher, using *iOS 5.0* or higher, and having installed *Java* environment for *OS X*.

The first step for using *j2ObjC* is to download the current distribution of the tool (in this *app*, the 0.6). After saving the package in a directory we are ready to use the tool, although there are many facts that we will have to take into account.

First of all, it must be said that we decided to use *Eclipse IDE* to translate our files because integrating the *j2ObjC* tool in *Xcode* gave us some errors with different libraries that were difficult to manage. The version of *Eclipse* used was *Eclipse Indigo* and we integrated the *j2ObjC* extension here. This plugin requires *MAC OS X* to be installed as *j2ObjC* only runs on *Mac*.

From the “install new software” tab we searched for the plugin, download it, and install it. After restarting *Eclipse* the new tool was installed successfully. The next step was to define the path where the *j2ObjC* files will be saved. In global preferences of *Eclipse* we looked for the j2ObjC tab and browsed for the *j2ObjC* directory.

It was supposed that the tool was successfully installed, but after making some trials there were some errors with the compiler because of the classpath configuration. In the project’s properties>j2Objc>classpath all the *jar* files must be selected as shown in Figure 36, if not, the compiler cannot find the necessary files to build the project and gives a compilation error. Once this task is done, the tool is ready to be used.



The selected classpath entires are used at the time of compiling.

Classpath
- ✓ /System/Library/Java/Extensions/QTJava.zip
- ✓ /System/Library/Java/Extensions/dns_sd.jar
- ✓ /System/Library/Java/Extensions/j3daudio.jar
- ✓ /System/Library/Java/Extensions/j3dcore.jar
- ✓ /System/Library/Java/Extensions/j3dutils.jar
- ✓ /System/Library/Java/Extensions/jai_codec.jar
- ✓ /System/Library/Java/Extensions/jai_core.jar
- ✓ /System/Library/Java/Extensions/mlibwrapper_j...
- ✓ /System/Library/Java/Extensions/vecmath.jar
- ✓ /System/Library/Java/JavaVirtualMachines/1.6.0...
- ✓ /System/Library/Java/JavaVirtualMachines/1.6.0...
- ✓ /System/Library/Java/JavaVirtualMachines/1.6.0...
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- ✓ /System/Library/Java/JavaVirtualMachines/1.6.0...
- ✓ /System/Library/Java/JavaVirtualMachines/1.6.0...

Figure 36 Adding all the *jar* files to the classpath

Obviously, the translator will not do its job if the *Java* code has errors. As the *Android* code owned several classes, many of them inherited from *Java* libraries, all the imports were deleted. Many of them were not necessary for our purposes so we could avoid some issues with the compiler. However, deleting imports to other classes created another trouble. All the references that were made in the code to those classes needed to be ignored, so the first step was to comment all this references and try to edit the previous *Java* code few times. After several attempts, we could get a code with no errors and finally the *j2ObjC* translator gave us the new *Objective-C* code for the input files. The last step was to import all these generated classes into our destination project in *Xcode*.

The most important file translated was the "ClienteDelServidor" file. This file is the one used to connect to the socket server. It has some references to other classes, for example, some variables were defined in other classes, and the initial parameters were also defined in different packages. To link all these classes we imported manually all the referenced classes after translating the code.

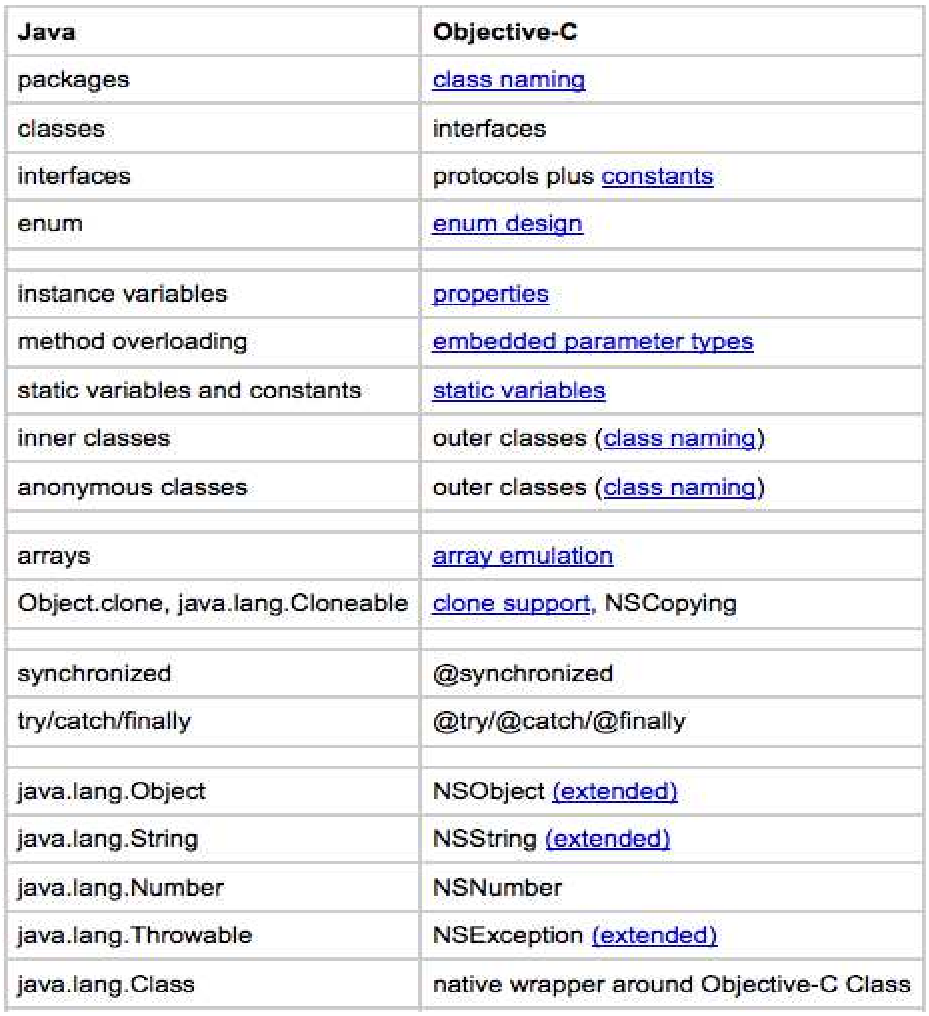
We also had an issue with some *Java* classes that were not accepted in *Xcode* even if they were accepted by the compiler. It is the case of the socket timeout exception class of *Java*, which does not have a specific class in *Objective-C*. This issue resulted into a big problem as we had to make all the timeouts manually, using timers and background executions.

There was also another trouble with different threads. *Java* still uses threads for multitasking, but in the last versions of *iOS* there are some different ways to manage with different threads. When initializing the socket connection the *j2ObjC* tool returned a "JavaLangThread" which would be initialized, and then, all the actions would execute in this thread. Nevertheless, this provoked the *app* to crash, so after some searching, we realised that it was the thread type the one that was making the *app* crash. In instead of using the class translated by *j2ObjC*, a new background thread was created to keep executing all the time. We tried executing the application for some minutes and saw that the problem was solved.

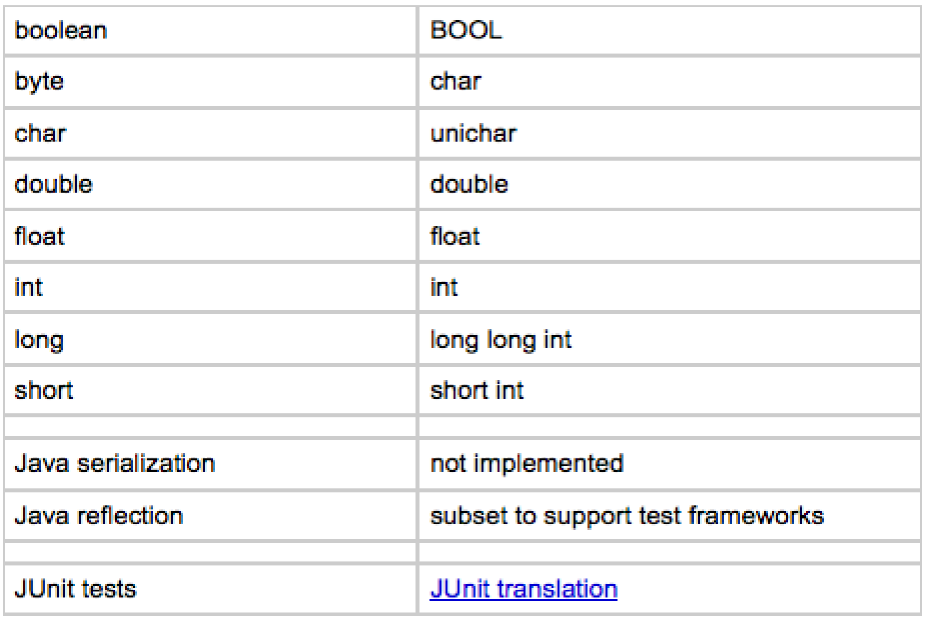
As a result of using *j2ObjC* we gain lots of time, but there were some facts that made our work more difficult. It is not easy to translate a big piece of code in *Java* using this tool because there might be some problems in the execution of application that are difficult to find debugging, but it is a very useful tool if we want to translate simple code.

5.4.1.6 Ported libraries and code from *Java*

The next table (Table 3) shows the translations that can be made actually in the current version of *j2ObjC* (0.7). Most of the basic libraries can be translated automatically, for example objects, strings, digits arrays or exceptions. However, there are still not libraries like *Java.NET*, *Java.Util.Calendar* or *Java.Util.Date* available. This means that all the code related with networks cannot be translated (this includes the socket connection), and dates must also be treated manually.



Java	Objective-C
packages	class naming
classes	interfaces
interfaces	protocols plus constants
enum	enum design
instance variables	properties
method overloading	embedded parameter types
static variables and constants	static variables
inner classes	outer classes (class naming)
anonymous classes	outer classes (class naming)
arrays	array emulation
Object.clone, java.lang.Cloneable	clone support, NSCopying
synchronized	@synchronized
try/catch/finally	@try/@catch/@finally
java.lang.Object	NSObject (extended)
java.lang.String	NSString (extended)
java.lang.Number	NSNumber
java.lang.Throwable	NSException (extended)
java.lang.Class	native wrapper around Objective-C Class



boolean	BOOL
byte	char
char	unichar
double	double
float	float
int	int
long	long long int
short	short int
Java serialization	not implemented
Java reflection	subset to support test frameworks
JUnit tests	JUnit translation

Table 3 *Java* to *Objective-C* translation (available libraries in *j2ObjC 0.7*)

5.4.1.7 Used libraries and tools

CFStreamViewController: This is an *Apple*'s official library. It is used to establish a socket connection in an easy way. The method of this library used for this project has been "CFStreamCreatePairWithSocketToHost". It creates readable and writable streams connected to a TCP/IP port of a particular host. Next, there is an extended description of the input and output parameters. More information about this library is available in the developer's section of the *Apple*'s website.

```
void CFStreamCreatePairWithSocketToHost (
   CFAllocatorRef alloc,
   CFStringRef host,
   UInt32 port,
   CFReadStreamRef *readStream,
   CFWriteStreamRef *writeStream
);
```

alloc is the allocator used to allocate memory for the *CFReadStream* and the *CFWriteStream*.
host is the host name to which the socket streams should connect. The host can be specified using an IPv4 or IPv6 address or a fully qualified DNS host name.
readStream is an output parameter. It is a readable stream connected to the socket address in port.
writeStream is an output parameter. It is a writable stream connected to the socket address in port.

CLLocationManager: This class defines the interface for configuring the delivery of location- and heading-related events to an application by default. In our application's case, we used it to keep the app alive for more than 10 minutes in the background mode and the application does not include any related features.

As we are going to see later on, *Apple* defines some conditions for the application for being accepted in the *App Store*. However, there are not requirements if the application is for personal use.

These are the steps remarked by *Apple* to use location manager services properly.

1. - Always check to see whether the desired services are available before starting any services and abandon the operation if they are not.

2. - Create an instance of the `CLLocationManager` class.

3. - Assign a custom object to the *delegate* property. This object must conform to the *CLLocationManager* protocol.

4. - Configure any additional properties relevant to the desired service (Not necessary in this project).

5. - Call the appropriate start method to begin the delivery of events (in our case, "startUpdatingLocation").

NSStream: It is an abstract class for objects representing streams. It contains two specific subclasses: *NSInputStream* and *NSOutputStream*. For this application, the previously received *CFReadStream* and *CFWriteStream* are casted into these classes so that the event handler event in the *NSStream* class could be used. The delegate receives a message when a given event has occurred in a given stream.

- (void)stream:(NSStream *)*theStream* handleEvent:(NSStreamEvent)*streamEvent*

Reachability: This sample application is developed by *Apple*. It demonstrates how to use the *SystemConfiguration* framework to monitor the network state of an *iPhone* or *iPod touch*. The package contains some interesting methods, such as "reachabilityWithHostName", "reachabilityWithAddress", or "reachabilityForInternetConnection". The last one is the only one that has been used for this application. When calling this method, it will return a Boolean (yes or no) depending on the network status. In the socket connection's infinite loop, for each loop, the application asks this method if the network connection keeps alive. If the answer is yes, the application keeps in the connected status. On the other hand, if the answer is no, the connection has been lost and the new status will be "desconectado_inicio".
This method is also used when the user is trying to send an e-mail or is trying to connect to the Web Server.

```
-(BOOL)reachable {
    Reachability *r = [Reachability
reachabilityForInternetConnection];
    NetworkStatus internetStatus = [r currentReachabilityStatus];
    if (internetStatus == NotReachable) {
        return NO;
    } else {
        return YES;
    }
}
```

UILocalNotification: *UILocalNotification* is an *Apple*'s official library that is used to represent notifications that an application can schedule for presentation to its users at specific dates and times. Unlike *push* notifications, local notifications do not need to be connected to a remote server to deliver the notifications. A local notification can be delivered even if the application is not running. In our *app*'s case, when the application is active, the local notification is not delivered. The new alarm dialog is immediately pushed instead. This is made by using the "cancelLocalNotification" method, which is called when the *app*'s "applicationState" attribute is "UIApplicationStateActive". However, the following code used to push the new screen is executed after loading the necessary data.

If the application is in the background mode, then, the local notification is showed, and gives the user the chance to keep "outside" the application, or to see the current alarm dialog in the app by pressing the "unlock" button.

The *UILocalNotification* object contains some attributes that are set as soon as the alert type message is received. The most important attributes are alertAction, fireDate, soundName or alertBody. Figure 37 shows the appearance of a local notification.

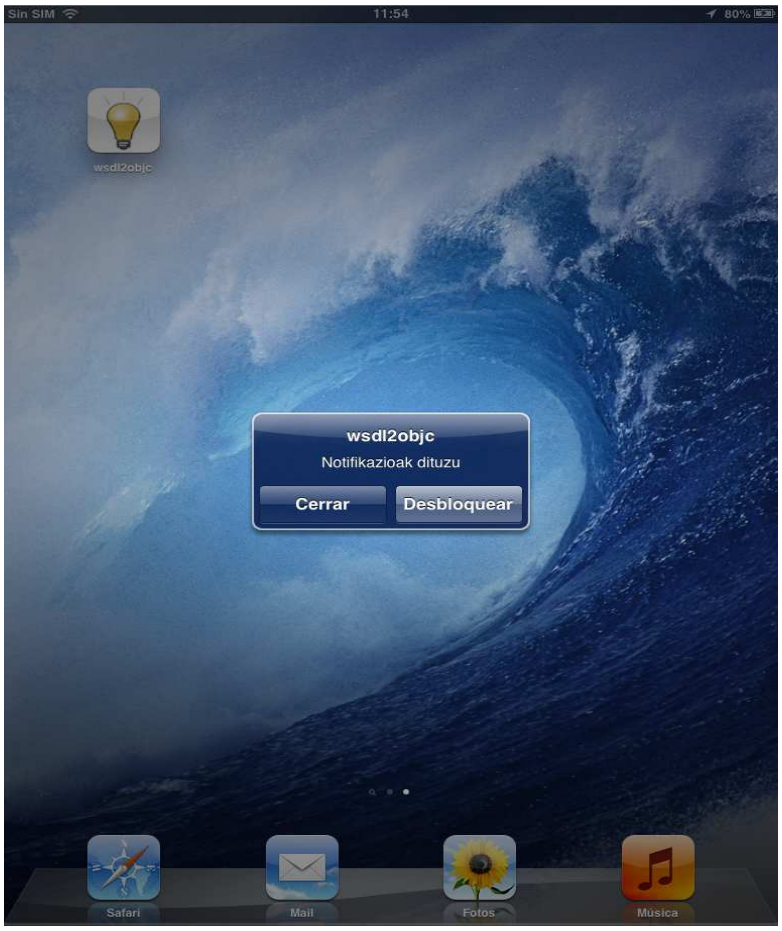


Figure 37 Local notification pop-up in *iPad*

5.4.1.8 Final results

Finally, we managed to create a socket-based connection although there were some problems to achieve the result we expected in the beginning.

When an alarm comes the socket gets desynchronized as there is a lot of traffic in a few seconds. There is no time for the nonce to get incremented. The quantity of messages that the user receives depends on the duration of the alarm. If the alarm is short, just one “alarm” type message will be received and the socket probability of getting desynchronized will be small. Furthermore, if the alarm simulation in the house lasts more than a few moments, the socket client will receive up to three alarms followed by three notification messages each of them. The socket will lose synchronization and will not send readable messages for the user, then, whatever the user asks to do, he/she will not receive an “or”, “alarm”, or “notif” type message and all the requests he/she makes will be rejected. This might be caused by a bug in the socket server code or a bug in the client side; anyway, we have not been able to find the cause of this issue.

The second main problem in this project is related with the above mentioned *Apple*'s restrictions to upload the *app* to the *App Store*. The reviewers remarked that it is compulsory to add location features to the *app*, but we were not really interested in adding these features to the *app* as there were not really necessary for the user, so the *app* has not been finally uploaded to the *App Store*. After searching in some official forums (iTunes Connect forum, for example), we realised that it was difficult to get our *app* accepted by *Apple* as they did not allow infinite-length tasks in the background (10 minutes limit) unless the application implements *VoIP*, location services, audio, communication with an accessory or communication using CoreBluetooth.

5.4.2 Web service

5.4.2.1 Initial objectives and background

This part is maybe the most important one in this project. It is the connection between the Services Centre and the devices of the physical house. This part of the application has been made by third parties, but it was necessary for us to understand how it worked and what errors could occur. As the logic was not totally defined in the beginning, the initial objectives and implementations were changed after some time. The first idea was to use a real house with its devices to test the status changes or the generated alarms, but as there was only one house available to use (for the *Android app*), we made the entire test with a simulator, using a *GuruPlug.*

The Service Centre and the house would be connected by an ADSL line. As I will explain in the final results, we had some problems with the network and the used routers.

5.4.2.2 Extended description

The connection between the Services Centre and the house is the main part in the server side. The Services Centre has two elements that will share an *IP* address, the socket server and the web service. When the user gives an order, the socket server takes that identifier and sends it to the house. Once the house receives that identifier, it asks the Services Centre about the type of the order that the user has sent and at the same time it notifies that it is ready to make any changes. The Services Centre, then, sends all the details of the user's order and the house changes its status. In addition, it sends the order identifier to the Services Centre, notifying that the status change has been done successfully. Once the Services Centre has received the identifier from the house, this identifier is sent to the user's device via the socket connection after a "notification" type message.

However, if something goes wrong the user will not receive any messages and the given order will be discarded. There are some cases in which there can be a connection error.

If there is a network error between the Services Centre and the house, the house will not be able to get the user's order and it will not be able to change the status of the requested device. There can be also a problem in the opposite direction. This means that the house can receive the current order, but it is not able to communicate this to the Service Centre. This is one of the main troubles we had during the tests. The house was not able to notify the Service Centre that the order had been received, due to a network restriction and the user's order got lost.

There is another case in which the status of a device in the house is changed, but the notification is not sent to the Service Centre. In this case, the user thinks that the device status could not be change but has been actually changed. When the user refreshes the device's status, the user will be able to see the real status of the device.

One of our biggest issues when testing the application was the memory management in the used router for communication between the Service Centre and the house. As there were many computers connected to the router, the router assigned little memory space to each of the machines connected, so after making some orders the router got stacked and the user's requests got lost. The solution was always to reboot the router, but the problem was still there. To prevent this in the future, we decided to restrict the users that could connect to the router so that there was fewer data traffic through the router. After this, we tested the system for several hours and all the connections kept alive, so every time the user made a request, the socket server was able to send an answer with the sent order identifier.

5.4.2.3 From the *WSDL* to the parsed data

To parse the data we used the method explained in the 4.3 chapter, where the sample application has been explained. The steps followed to parse the data in the security application have been exactly the same.

5.4.3 The house

The house is the third part of the project's architecture. The house used to make the tests and the official demo has been a *GuruPlug* which is a compact and low power plug computer running Linux. All the data of the house is stored here, and it is accessible from the same network as it works as a kind of server. The *GuruPlug* is connected to a router. This router will have a wired or wireless connection. If we want to accede to the *GuruPlug*, we need to be connected to the same router. Once the house is reachable, we can check the current scene or the status of each device. A new alarm can also be simulated obeying a rule. The current scene must be "night" and the living room's light must be on. After this, if we click on the "simulate alarm" button, the user's device will receive an alert type message (more than one in some cases, as the duration of each alarm is still not defined).

The application used to check the house's status is located in the 8090 port and in the *DeviceUI* subfolder so the address needs to have the next format "*IpAddress*:8090/DeviceUI". There is a *Java* application which looks for *GuruPlug*s connected in the network and returns its current *Ip* address. Depending on that address we will search for that address in our browser. The *GuruPlug* needs approximately one minute to get completely loaded, in this period of time it will not be reachable. Figure 38 is a picture taken to the *GuruPlug* device used for this project.

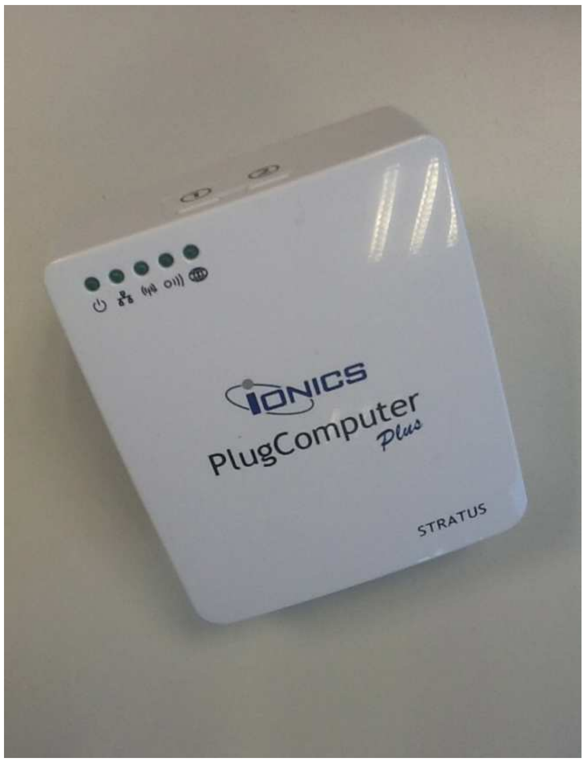


Figure 38 The *GuruPlug* device used in this project

The Services Centre and the house are on different networks and are connected via *ADSL*. For this reason, there might be several connection errors between both sides. One of the problems we had was that the address of the *ADSL* router we were using was changed due to contractual reasons. At that point, the Services Centre could not establish a connection with the house, and we had to reconfigure the router from the beginning.

Apart from this, there was another issue with the mentioned *ADSL* router. If there were many people using it at the same time, there was only a few space for each of them to use, so the house could not answer the Services Centre's requests if that space was full. The temporary solution was to reboot the router, but afterwards, we thought that it was better to restrict the access to the router to some other users so that the assigned space for each user would be bigger. After this, we managed to keep the socket connection "alive" for a longer time.

Each user must have one house assigned. This is done by assigning the user device's *MAC* address to the house. Each house can have more than one user assigned, so if the house responds with a notification (a scene change, for example), all the users will receive that notification and will see that change in their devices. On the other hand, if a user sees a notification message, the other one will not see that message as read, until he/she reads the message. The same happens with the alarm dialogs. If there is any network problem with the house, the user will see the last status of the house before losing the connection, and, obviously the requests will not be answered by the house.

6 CONCLUSIONS AND FUTURE LINES

6.1 Final Results

Obviously, final results have not been the ones we expected before starting with the project. There are many functionalities that have not been designed, for example, photographs, so there are not useful for the final user. The first idea was to make an exact version of the *app* for *Android*, but we decided to make it similar, as there are some facts that are not possible to imitate like the initial screens or alert views. One of the main differences between the *Android app* and the one for *iOS* has been the new alarm presentation. While *Android* version uses a little pop-up to notify the user that there is a new alarm, *iOS* version pushes a new window upon the other ones. It has been made this way because it is a difficult job to design well-customized alert views, so we thought it was better to create a new view controller for a new alarm. Apart from the lack of simplicity in an alert view design, it was also difficult to manage different pop-ups at the same time, many queues needed to be implemented causing memory loss and *app* crashing.

The main handicap in the project has been to design the customized alert views and manage their autorotation and manage the autorotation of each screen itself. There would be no problem if alert views were the standard ones from *Apple* as their size and autorotation is automatic. Some of the alert views that were not expected to be used before have been created this way, as we did not have a specific design for them (some of them are not used in the *Android app*).

The way the *app* launches is not completely the same in *Android* and *iOS*. When uploading the *app* to the *App Store*, members from *Apple* rejected our application because it kept loading all the time in the beginning, and they think this is not attractive to the users, so in instead of keeping the same screen all the time until the data from the web service was loaded, we decided to give the system five attempts to get the data from the web service. If after the five attempts the data was not loaded, then the login screen appeared with a “try again” button in the bottom of the screen. When user presses this button the system tries to get all the data again, and after some time, it returns an alert view, notifying the user about the answer. If data is loaded, user is ready to write the password. On the other hand, the *Android app* keeps in the same screen until all the data is loaded.

There are some other parts where simple views have been used in instead of alert views, for example in the e-mail sent confirmation. In this part, the first idea was to implement an e-mail client, but this task was too complicated and we decided to use the *Apple*’s standard interface.

In the messages part, it would be interesting for the user to be able to delete some messages, but this has not been designed yet, as the messages would need to be deleted also from the database causing some possible errors. For this reason, all the messages keep listed until the responsible of the database decides to delete some of them.

6.2 Personal conclusions

It has been a very interesting career-end project for me. I am very interested in mobile devices, and I think this project has been an amazing chance to know more about them (performance, coding, functionalities, etc.), and obviously, creating an application for *iOS* on my own has been something that I would not expect previously. When I saw the list of the different projects in the university, I thought that this field (software development) of the computer science was the most interesting one for me, that’s why I chose this project. Apart from this, I wanted to work in a company, so that I could learn how the team work is in a company, and be ready for my professional life in the near future. I think that software development is an expanding field because lots of mobile devices and new platforms are being created nowadays. For all these reasons, I had a big motivation for the project.

This job has been in some cases stressful. In the beginning, programming in *Objective-C* resulted a bit difficult for me as it was a new programming language for me. After some weeks, I could acquire skills programming in *Objective-C*. Nevertheless, there were some problems that could not be resolved. It has been difficult to port some of the functionalities in the *Android* application as *iOS* and *Android* have a completely different behaviour and I had to use some tricks that are not very smart. There were other cases in which the network did not work properly, and during the testing I could not check if the problem was in the code, or it was a communication failure. Fortunately, I have been helped by my workmates. There were some fields in which I did not have many experience and they were always ready to help me solve my problems. However, there were other cases in which the architecture was not completely defined (several people in the company were working in other projects apart from this one), so I had to wait until these aspects were defined.

In spite of all these problems, after finishing my project I am feeling proud of my application. I think that it is a very interesting and useful application for the user, although it is still a *beta* version. However, I think that after some additions it will be a good application to sell and a big progress in the security of a house.

To sum up, I could say that I have learned a lot of things about software development in the last seven months, but I also think that I have lived a great experience working together in a team, and fortunately, I had the chance to meet lots of kind people in the company and thanks to them I grew up both as a software developer and a person.

6.3 Future lines

The first thing to improve in the *mSecurity* application would be to design and implement all the missing functionalities that are described above in this report (pictures management, delete stored messages from the device, etc.). Some of them are easy to implement, but some others need a longer time. A great step would be to manage to upload the application to the *App Store* as it is the way to expand the application to the world. For this purpose, it would be necessary to change a little bit the design of the *Android* application (for example, delete the login screen, which is not accepted by *Apple*). It would also be interesting to improve the responding time of the server when there is several data stored in the database. Apart from this, we realised that *Apple* can be really strict with the multitasking, and that it is difficult to keep an application in the background mode for longer than ten minutes, this is a fact that would be very interesting to deal with in the future as the application needs to keep its code always running.

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APPENDIX I
BASIC *Objective-C* EXPERIENCES

1 Extended description....1
2 Creating a project with storyboard in *Xcode 4.6* 1
3 Creating new view controllers....3
4 Programmatically referencing elements 6
5 Creating and managing a Tab Bar Controller....8
6 Alert Views....10

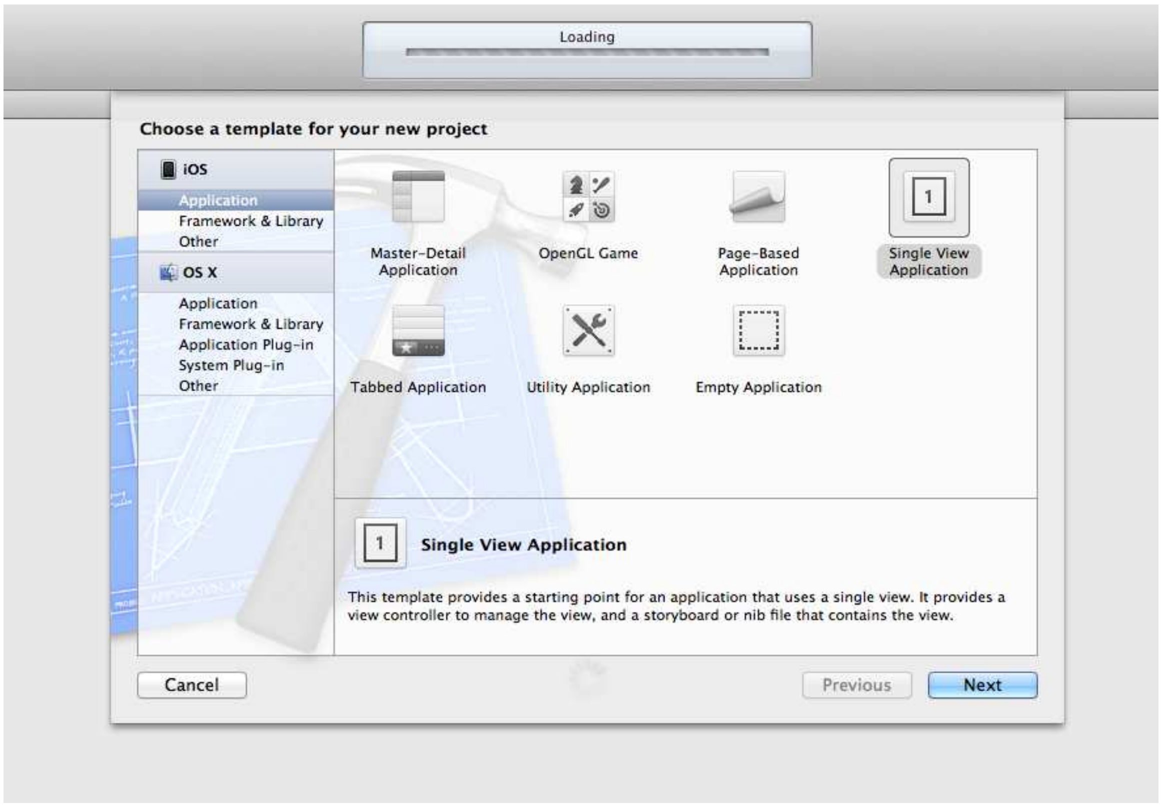
1 EXTENDED DESCRIPTION

The Integrated Development Environment (IDE) used for the Graphical User Interface has been Xcode. Xcode is an application that is integrated in the MAC OS X operative system, but it is necessary to reinstall it if operative system is upgraded. It is an intuitive tool to create good-looking user interfaces for Apple devices, but it can be annoying if the developer wants to create a more universal user interface. The version of Xcode used for this project is Xcode 4.6, so this report will be based in this version. It must be said that we started working with previous versions, but we needed to upgrade to this one, as the devices we had available to make tests used iOS 6.1, and previous versions of Xcode did not have the SDK for iOS 6.1, so the app could not be launched in those devices.

2 CREATING A PROJECT WITH STORYBOARD IN *XCODE 4.6*

Older versions of Xcode used a interface builder that forced the developer to create most of the views programmatically, but, after Xcode 3.0, storyboards were available making things much easier to the app developer. For this reason, storyboards have been the tool we used to create our user interface.

The first step is to create a new project in Xcode. For that purpose, we will go to the file tab and then select New>Project. Then, we used the “Single View Application” simple as shown in Figure 1.



Choose a template for your new project

Single View Application

This template provides a starting point for an application that uses a single view. It provides a view controller to manage the view, and a storyboard or nib file that contains the view.

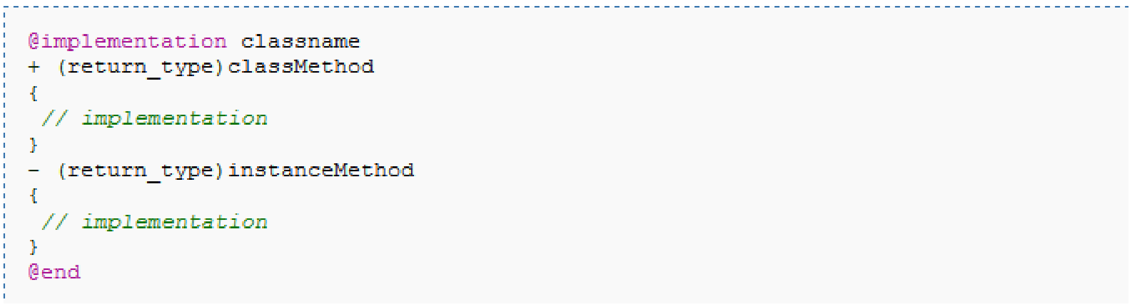
Figure 1 Creating a single view application

After defining a product name, and the target device family for the *app*, we saved the workspace folder in the desktop. As we would have to use it every day, we needed it to be visible. After this, the new project is already created. *Xcode* then creates by default five files. Before talking about these files it is important to explain that *Objective-C* creates for each class two different files (.h and .m). The ".h" file contains the interface of the class, while the ".m" file contains the implementation (see Figures 2 & 3, from Wikipedia).

```
@interface classname : superclassname {
 // instance variables
}
+ classMethod1;
+ (return_type)classMethod2;
+ (return_type)classMethod3:(param1_type)param1_varName;

- (return_type)instanceMethod1:(param1_type)param1_varName :(param2_type)param2_varName;
- (return_type)instanceMethod2WithParameter:(param1_type)param1_varName param2_callName:(param2_type)param2_varName;
@end
```

Figure 2 Interface declaration



```
@implementation classname
+ (return_type)classMethod
{
 // implementation
}
- (return_type)instanceMethod
{
 // implementation
}
@end
```

Figure 3 Implementation file

Two (.h and .m) are for the app *delegate*. This class defines how the application will launch, close and some other configurations, such as showing local notifications.

Another important class is the *storyboard*. It will be an image with the description of all the views that will exist in the *app*.

Finally, first View Controller's classes will be created. This way, the default appearance of the storyboard will be a single View Controller, as we decided when we created this project. There are some other project templates available in *Xcode*, if needed (see Figure 5).

Once we had the project created, we could start creating views with their interfaces and their implementation files.

3 CREATING NEW VIEW CONTROLLERS

There is no a standard order to create view controller's. We decided to start creating a "UIViewController" for the main storyboard picking the symbol in the right bar of *Xcode* and dragging it into the storyboard (Figure 8).

There is a chance to define different transitions between view controllers picking the origin view controller from the storyboard and while pressing "ctrl", dragging the cursor within the destination view controller. Anyway, this is a fact that will be described later on.

The second step is to create a file to define all the elements that will appear in the View Controller (see Figure 4). This is done by right-clicking on the project's name, and then, selecting new file. For our case, *Objective-C class* is selected in all the cases.

The next menu gives the developer the chance to choose the desired type of class as Figure 6 shows (NSObject, UIViewController, UITabBarController, etc.). Once the name for the new View Controller is chosen, the View Controller's ".h" and ".m" files are created automatically.

The next step would be to create a link (Figure 7) between the UIViewController in the storyboard and the interface element created in the ".h" file by selecting the custom class of the element. The view type must be the same, if not, *Xcode* will not recognize the interface element and the files and the UIViewController will not be linked.

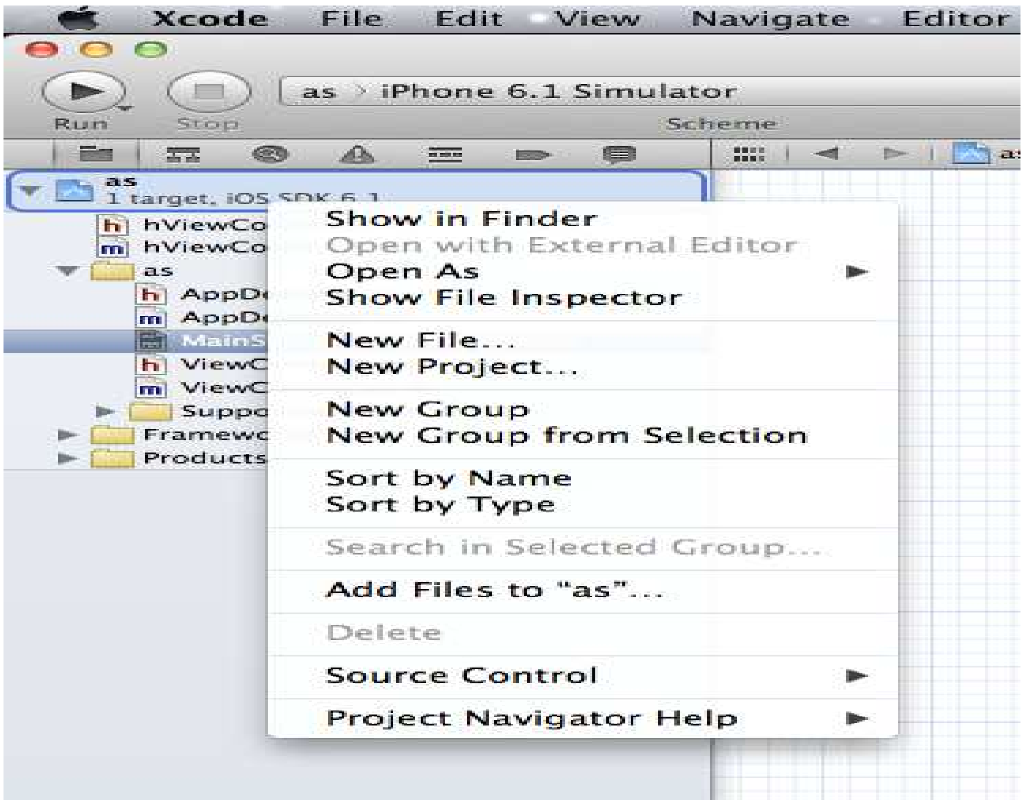


Figure 4 adding a new file

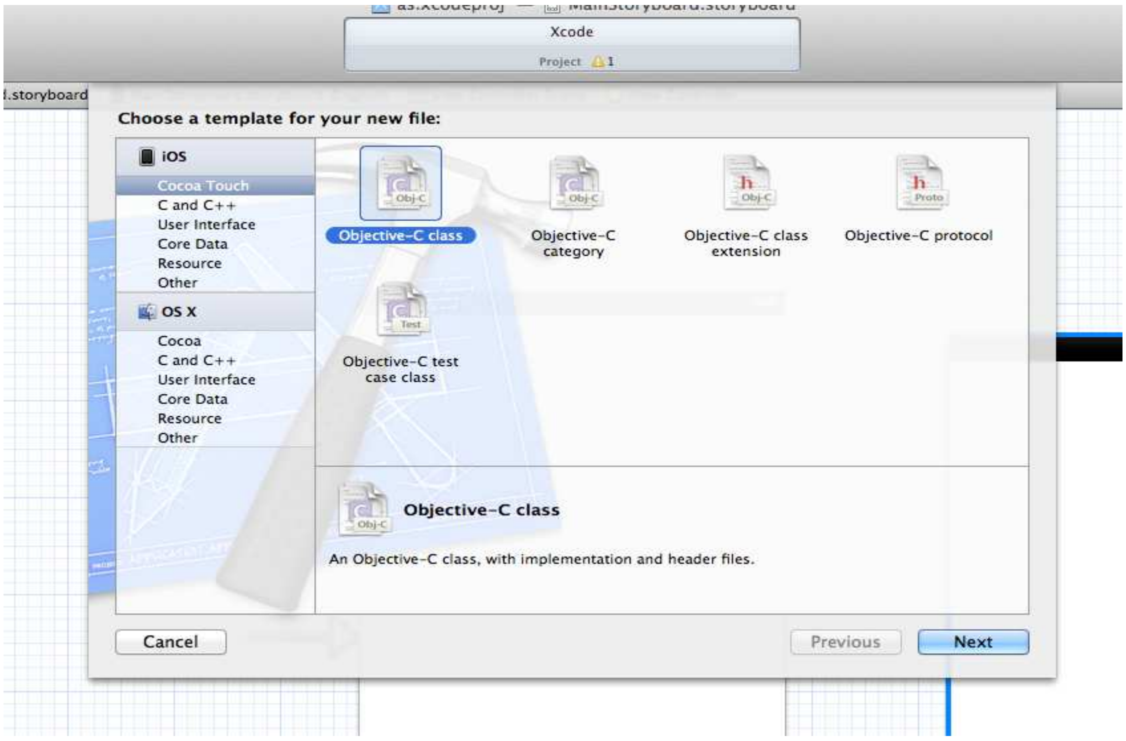
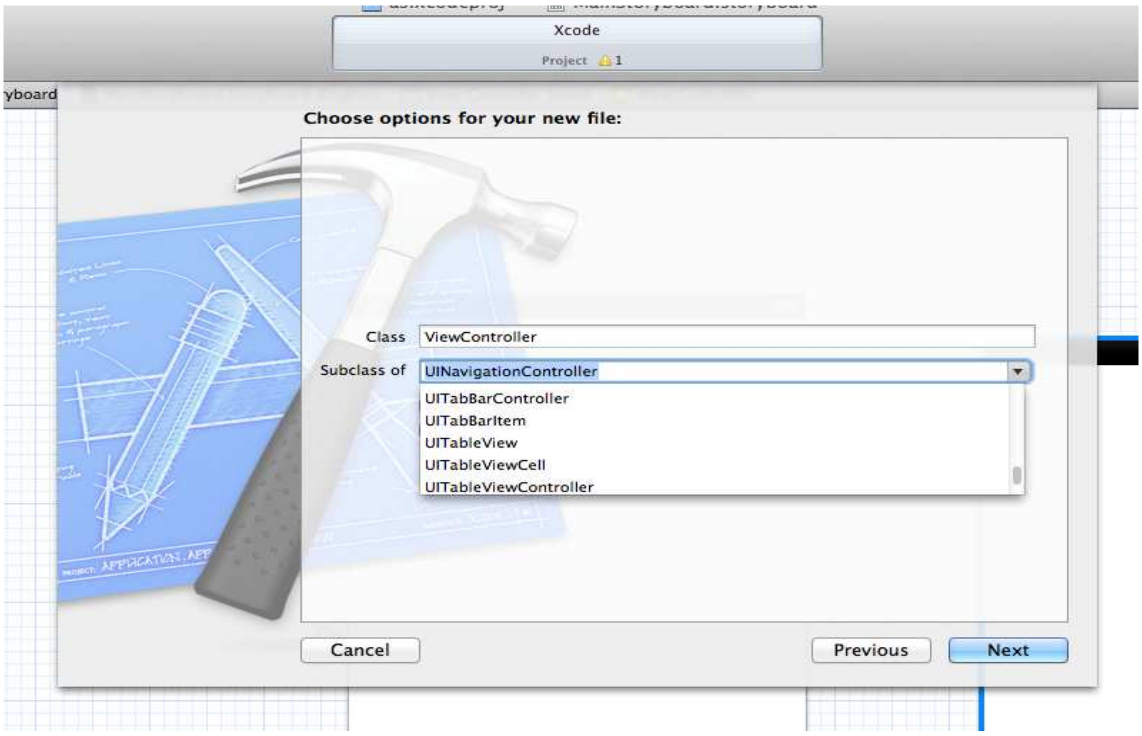


Figure 5 Selecting *Objective-C* class type for the new class


Xcode

Project ⚠1

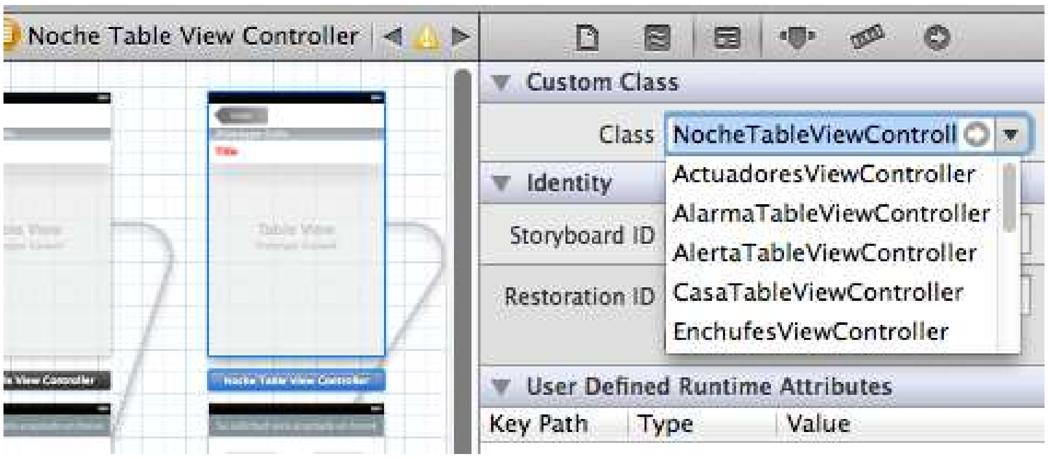
Choose options for your new file:

Class ViewController

Subclass of UINavigationController

UITabBarController
UITabBarItem
UITableView
UITableViewCell
UITableViewController

Figure 6 Selecting the subclass and name for the new file


Noche Table View Controller

Custom Class

Class NocheTableViewControll

ActuadoresViewController
AlarmaTableViewController
AlertaTableViewController
CasaTableViewController
EnchufesViewController

Identity

Storyboard ID

Restoration ID

User Defined Runtime Attributes

Key Path Type Value

Figure 7 Linking the View Controller in the Storyboard with the recently created file

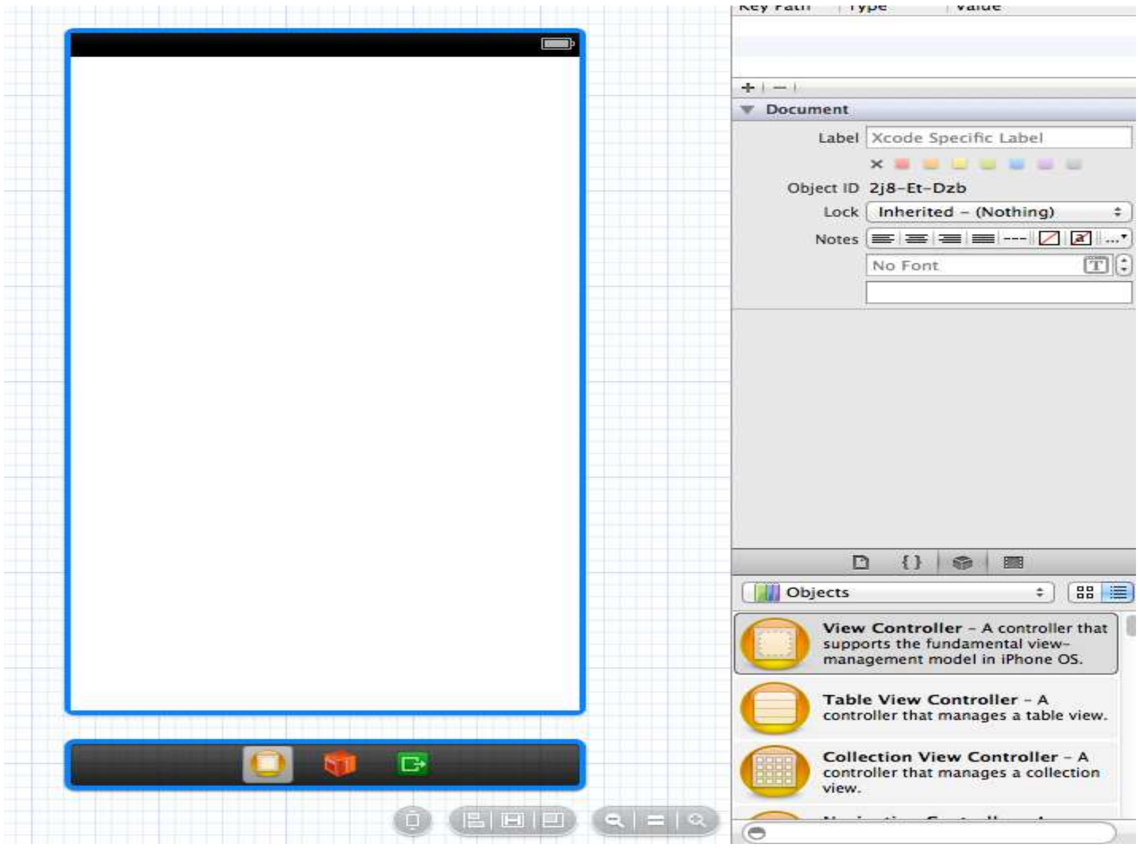

Document
Label
Xcode Specific Label
Object ID
2j8-Et-Dzb
Lock
Inherited - (Nothing)
Notes
No Font
Objects
View Controller - A controller that supports the fundamental view-management model in iPhone OS.
Table View Controller - A controller that manages a table view.
Collection View Controller - A controller that manages a collection view.

Figure 8 Creating a view controller in the Storyboard

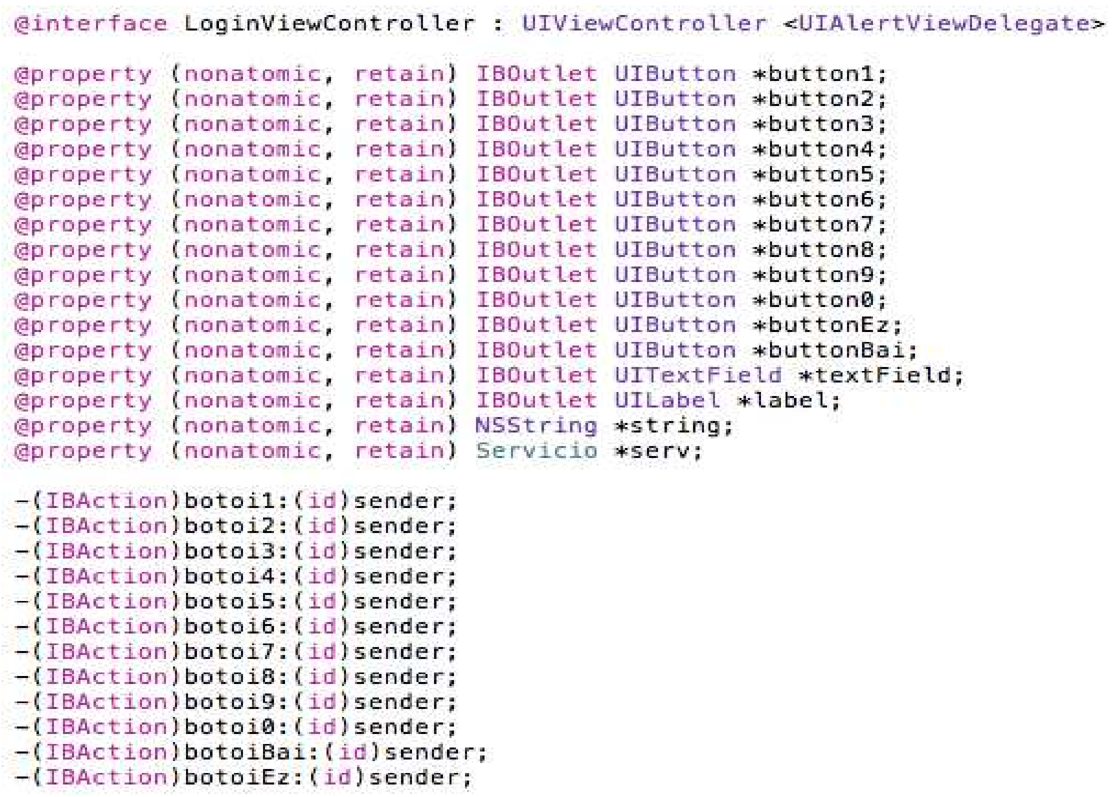
Once the link has been successfully done, it is possible to create different graphical elements (labels, text fields, images, tables, etc.), and reference them programmatically.

4 PROGRAMMATICALLY REFERENCING ELEMENTS

It is possible to create links between View Controller's elements and element's created in interface and implementation files. This is used to manage our objects (for instance, we can define the text written in a label programmatically, or we can decide to create an event when a button is clicked).

The first step is to define the element in the interface file. Figure 9 shows an example of our *app*'s login window's interface file. There, we can appreciate that the buttons are defined as *IBOutlet*s which means that they will response to events. If the referenced element does not response to an event, this must not be written, or the *app* will crash. On the other hand, if we try to define a button that will need to response to an event and *IBOutlet* is not defined, that button will response to the event, but will not execute the method we assigned to it before.

In this example, there are twelve buttons and a text field. Apart from the numbers, the "X" button will clear the text field, and the "✓" will send the application the request to check the inserted *pin* number with the one sent by the Web Service. All of the elements in this view need to respond to an event, even the text field that needs to compare the *pin* number.



```
@interface LoginViewController : UIViewController <UIAlertViewDelegate>

@property (nonatomic, retain) IBOutlet UIButton *button1;
@property (nonatomic, retain) IBOutlet UIButton *button2;
@property (nonatomic, retain) IBOutlet UIButton *button3;
@property (nonatomic, retain) IBOutlet UIButton *button4;
@property (nonatomic, retain) IBOutlet UIButton *button5;
@property (nonatomic, retain) IBOutlet UIButton *button6;
@property (nonatomic, retain) IBOutlet UIButton *button7;
@property (nonatomic, retain) IBOutlet UIButton *button8;
@property (nonatomic, retain) IBOutlet UIButton *button9;
@property (nonatomic, retain) IBOutlet UIButton *button0;
@property (nonatomic, retain) IBOutlet UIButton *buttonEz;
@property (nonatomic, retain) IBOutlet UIButton *buttonBai;
@property (nonatomic, retain) IBOutlet UITextField *textField;
@property (nonatomic, retain) IBOutlet UILabel *label;
@property (nonatomic, retain) NSString *string;
@property (nonatomic, retain) Servicio *serv;

-(IBAction)botoi1:(id)sender;
-(IBAction)botoi2:(id)sender;
-(IBAction)botoi3:(id)sender;
-(IBAction)botoi4:(id)sender;
-(IBAction)botoi5:(id)sender;
-(IBAction)botoi6:(id)sender;
-(IBAction)botoi7:(id)sender;
-(IBAction)botoi8:(id)sender;
-(IBAction)botoi9:(id)sender;
-(IBAction)botoi0:(id)sender;
-(IBAction)botoiBai:(id)sender;
-(IBAction)botoiEz:(id)sender;
```

Figure 9 Sample of "Login View Controller" interface file defining the objects and methods

Apart from referencing elements in this file, methods are also referenced. In this case, each button will have a method (it is not necessarily a one-to-one relationship) that will be called when a button is clicked. For instance, when "button1" is clicked, the method "botoi1" will be called and executed. This method will write a zero in the text field after the last character or in the middle if there was not another character previously.

This is not enough to make buttons respond to events. It is also necessary to assign a method to each button in the storyboard (Figure 10). To do so, it is needed to right-click on the desired button and select from the list of methods that appear. These methods are taken from the previously defined interface file. Once the method is assigned to the button, every time the button is pressed the method will be called.

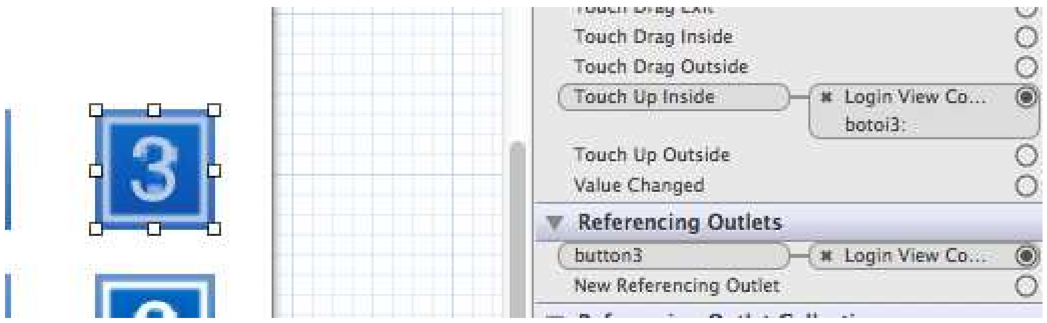
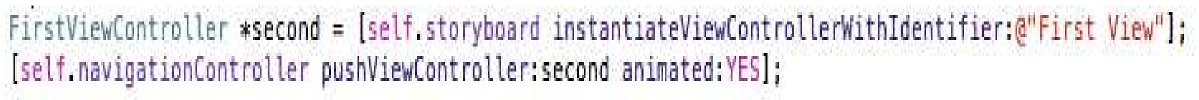


Figure 10 Setting a button's event

Buttons are also used to change from one view to another in our application. Although this method is not usually used to make such action in this *app*, storyboards give the chance to make this transition with just a click. It is enough with assigning a "segue" to a button and, that will be the button used to go backwards or forwards in the *app*.

We therefore make the transitions between views programmatically. The main reason for this is that we can define some global variables while the view change is being done. This way, we can set, for example, the text that a label will show depending on a previously set value.

The transition is performed by instantiating a View Controller using its interface and its identifier in the storyboard. Immediately, the previously instantiated View Controller is pushed using a Navigation Controller, which is defined in the storyboard (Figure 11).



```
FirstViewController *second = [self.storyboard instantiateViewControllerWithIdentifier:@"First View"];
[self.navigationController pushViewController:second animated:YES];
```

Figure 11 Making a transition programmatically

5 CREATING AND MANAGING A TAB BAR CONTROLLER

As it was said before, the *app* is based-on a Tab Bar Controller that will manage the three tabs (scenes, manual control and messages). Creating a Tab Bar Controller is quite easy in *Xcode*. In the right pane of the workspace there is a Tab Bar Controller icon. It just needs to be dragged into the storyboard. By default, the system creates two tabs, but we can create as much view controllers as needed and link them to the Tab Bar Controller. After this, each of the view controllers created will have a tab bar with the respective tab selected. There is also a chance to create a Navigation Controller for each tab. This way, it is easier to control our tabs' attributes programmatically. Figure 12 shows a part of the storyboard and the scheme used for this *app*.

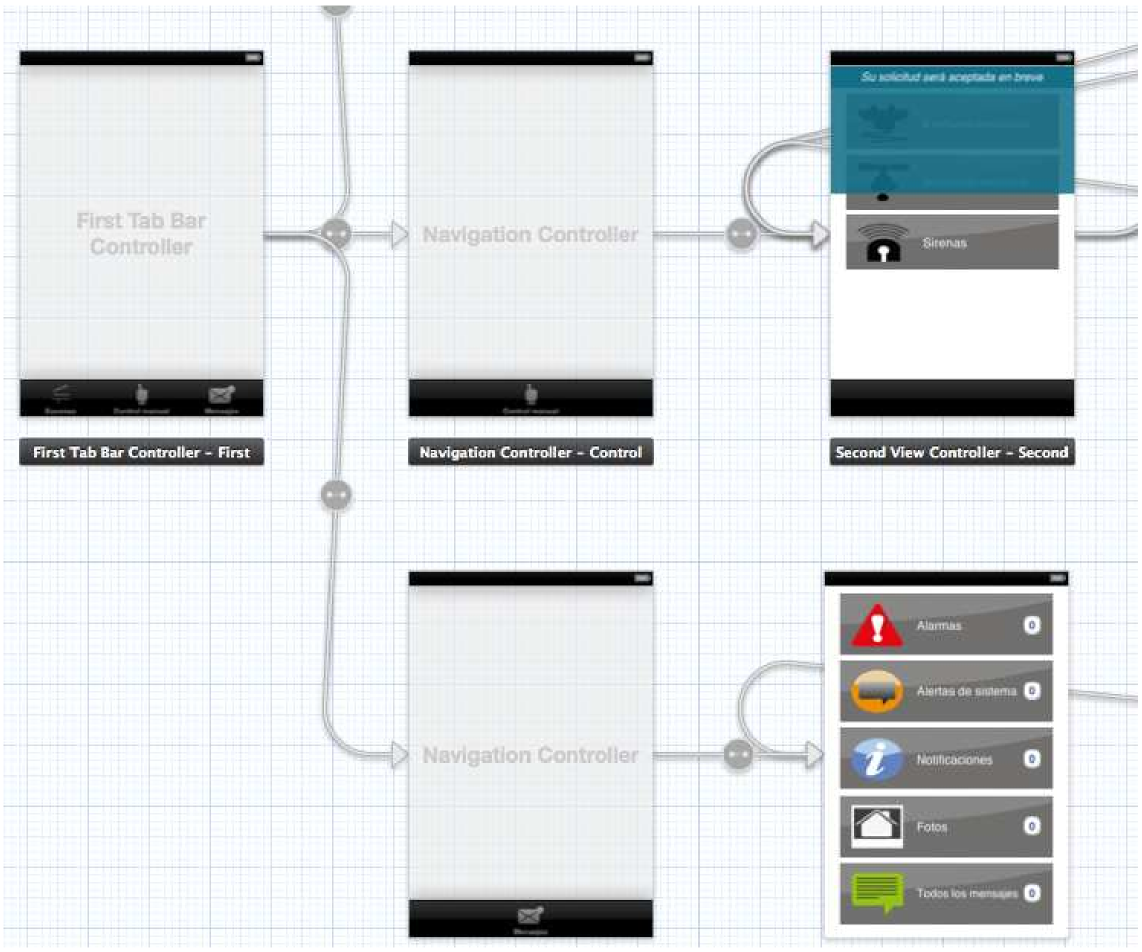


Figure 12 Tab Bar Controller scheme

There is a chance to change the selected tab bar programmatically. This is used after closing the alarm dialog, when we need to show the messages tab. For that purpose, before closing the alert view and pushing the tab bar controller, the next code needs to be written:

“[self.tabBarController setSelectedIndex:2];

The tab bar needs to be hidden in some cases in the *app*. To do this, we created two methods which are implemented in all the view controllers. These methods are called “showTabBar” and “hideTabBar”. When we need to hide the tab bar, we just make the screen bigger, and give the *app* the appearance that the tab bar does not exist. For the opposite step, we used “showTabBar” which will make the screen resolution smaller. To change the resolution the *UIView* library contains a method which is called “setFrame”. Table 1 shows the resolutions set in both *iPhone* and *iPad*.

Function and device	**Resolution**
hideTabBar (*iPad*)	1024x768
showTabBar (*iPad*)	975x719
hideTabBar (*iPhone*)	480x320
showTabBar (*iPhone*)	431x271

Table 1 Resolutions

The “hideTabBar” function sets the resolution to the standard one in each device. On the other hand, the “showTabBar” removes 49 pixels from the screen to add the tab bar that must have that size according to *Apple*[1].

It is also necessary to take care of the current interface orientation, as resolution is the opposite in portrait mode and landscape mode. To check this, the “interfaceOrientation” attribute of the view controller gives us the chance to see the current interface orientation which will be one of these: “*UIInterfaceOrientationPortrait*”, “*UIInterfaceOrientationLandscapeRight*” and “*UIInterfaceOrientationLandscapeLeft*” in our *app*. Both landscape modes have been treated the same way.

In the case we want to hide the tab bar, when we are pushing the new view controller, we apply the method to the instantiated view controller ([newViewController hideTabBar:newViewController.tabBarController];). We do the same if we want to show again the tab bar.

6 ALERT VIEWS

iOS operative system has its own alert view style. It is typically dark blue. For this *app*, we needed to customize our alert views. The process of showing an alert view is always the same. This is done by creating an instance of a *UIAlertView* and then, showing it and releasing it. The most difficult part is customizing the created alert view. There are some things that we need to keep in mind when dealing with a customized alert view. First of all, it is necessary to determine a size for the alert view. There is a method in the *UIAlertViewDelegate* that gives the alert view the size we want. This method is called *willPresentAlertView* and will have the alert view as parameter. This way, we can set the frame or size of the alert view. We will need to check if the current orientation is portrait or landscape, so when the view is loaded we check this, and save the value in a global variable. Depending on the orientation, the alert view will have different values for its frame. We will also need to change the alert view’s frame when the screen rotates. Every time the screen is rotated the variable described before will change, and a call to a method will be done. This method will be the one that creates, shows, and releases the alert view. Before executing this method, the previously shown alert view will be dismissed. In the mentioned method, we will customize the alert view. In our case, we added some buttons (for example, send or cancel) to the view controller, and then we set a frame for them, so that they were located in the right place. We also took

[1] http://www.idev101.com/code/User_Interface/sizes.html

into account rotation for these buttons. As the buttons are not linked to the alert view, we defined actions to the buttons with *IBAction* and these actions would make the *app* show us the previous or the next screen. This is also the time to make any initializations or everything we need in the next screen.

Before this, we had to add a background image to the alert view. This had to be done programmatically. We created a view and added it as a sub view to the alert view. The frame had to be exactly the same to the alert view’s one. The next step was to add an image to the recently created view and the alert view would have the desired style. Like in all the other elements in the alert view, rotation had to be treated also in this sub view.

Finally, there were some other facts to define in the alert view such as the text in the alert view, its color, its number of lines or its frame. Unlike the rest of the elements, rotation may not be treated in the *UILabel* case.

This was probably one of the hardest tasks in the entire project, as the frames needed to be defined programmatically, so the way to check if the position and size of the alert view were the right ones was to launch the app several times until the alert view had a perfect appearance.

APPENDIX II
APPLICATION USER MANUAL

1 INTRODUCTION 1

2 EXTENDED DESCRIPTION 1

3 FACTS TO KEEP IN MIND...6

1 INTRODUCTION

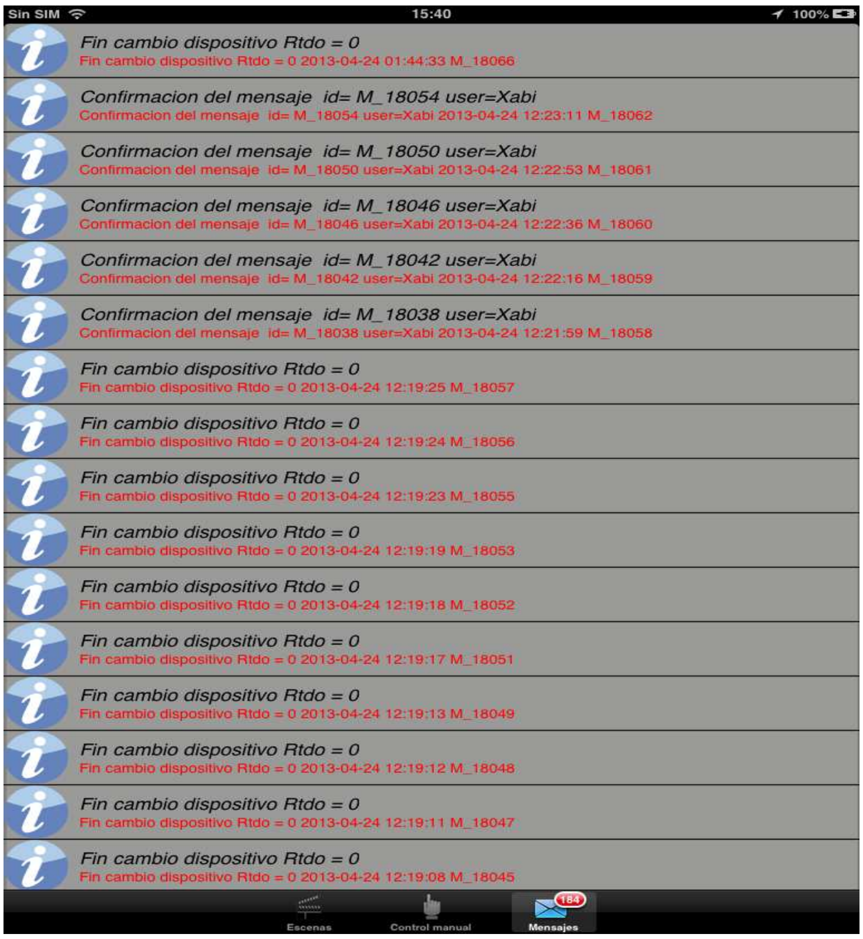
This manual explains the user all the functionalities that are available in the *iOS* application and how to use them.

2 EXTENDED DESCRIPTION

Once the application is installed user must tap the application icon in from the application's list in the device. The first screen shows a "loading" message. The application is now loading all the data stored in the database. Once all the data is loaded the application will show a login screen. The user will need to introduce the PIN number assigned. If the introduced code is wrong, the application will not lend the user to enter. If the introduced PIN is the right one, the application will then show another "loading" screen and after some seconds, the application will show the scene's screen. The current scene's image will be shown brighter than the others. If this image is clicked, the status of all the devices in the house will be shown in a table. If any other image is clicked, a request will be send to the server. This request will be a scene change. The application will need some time to change the current scene, and the user will receive in a few seconds the answer from the server. Afterwards, the current scene will be automatically changed if the request was successfully made.

The second tab (manual control) is used to change manually the status of the devices (note that when a scene change is done, some devices' status is automatically changed). The devices are divided in three groups ("sirenas", "actuadores" and "enchufes"), and each of them has at least one device. The devices can have three different statuses, standby, on, and unknown. The standby mode is identified by a red sign, the on mode by a green one, and the unknown status by a gray sign. The device will change its status some seconds after the request is send if everything runs successfully.

Finally, the third tab shows the user the received messages from the server (notification list is showed in Figure 1). There might be different kinds of messages (alarms, alerts, notifications, pictures, etc.).



Fin cambio dispositivo Rtdo = 0
Fin cambio dispositivo Rtdo = 0 2013-04-24 01:44:33 M_18066

Confirmacion del mensaje id= M_18054 user=Xabi
Confirmacion del mensaje id= M_18054 user=Xabi 2013-04-24 12:23:11 M_18062

Confirmacion del mensaje id= M_18050 user=Xabi
Confirmacion del mensaje id= M_18050 user=Xabi 2013-04-24 12:22:53 M_18061

Confirmacion del mensaje id= M_18046 user=Xabi
Confirmacion del mensaje id= M_18046 user=Xabi 2013-04-24 12:22:36 M_18060

Confirmacion del mensaje id= M_18042 user=Xabi
Confirmacion del mensaje id= M_18042 user=Xabi 2013-04-24 12:22:16 M_18059

Confirmacion del mensaje id= M_18038 user=Xabi
Confirmacion del mensaje id= M_18038 user=Xabi 2013-04-24 12:21:59 M_18058

Fin cambio dispositivo Rtdo = 0
Fin cambio dispositivo Rtdo = 0 2013-04-24 12:19:25 M_18057

Fin cambio dispositivo Rtdo = 0
Fin cambio dispositivo Rtdo = 0 2013-04-24 12:19:24 M_18056

Fin cambio dispositivo Rtdo = 0
Fin cambio dispositivo Rtdo = 0 2013-04-24 12:19:23 M_18055

Fin cambio dispositivo Rtdo = 0
Fin cambio dispositivo Rtdo = 0 2013-04-24 12:19:19 M_18053

Fin cambio dispositivo Rtdo = 0
Fin cambio dispositivo Rtdo = 0 2013-04-24 12:19:18 M_18052

Fin cambio dispositivo Rtdo = 0
Fin cambio dispositivo Rtdo = 0 2013-04-24 12:19:17 M_18051

Fin cambio dispositivo Rtdo = 0
Fin cambio dispositivo Rtdo = 0 2013-04-24 12:19:13 M_18049

Fin cambio dispositivo Rtdo = 0
Fin cambio dispositivo Rtdo = 0 2013-04-24 12:19:12 M_18048

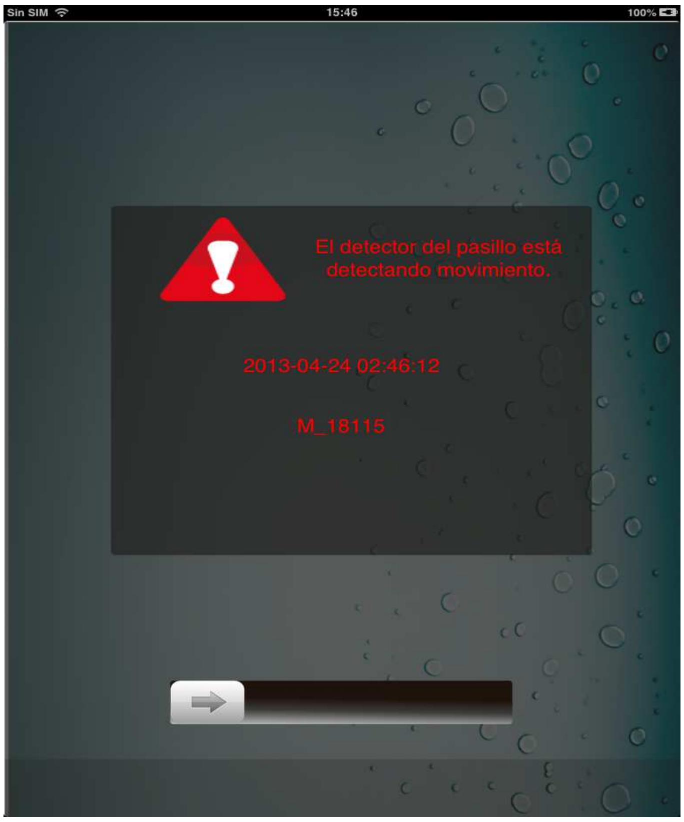
Fin cambio dispositivo Rtdo = 0
Fin cambio dispositivo Rtdo = 0 2013-04-24 12:19:11 M_18047

Fin cambio dispositivo Rtdo = 0
Fin cambio dispositivo Rtdo = 0 2013-04-24 12:19:08 M_18045

Figure 1 Notifications list

Inside the notifications messages there can also be different kinds of messages such as scene change, device status change or received notification. If the user taps any of the messages, a new screen will appear showing the messages' details (date, time, description) and there is also a chance to share each message to the list of users registered in the database (there are three users available) by tapping on the "compartir" button. After selecting a user from the list, a new screen with the appearance of the "*Mail*" application will be opened and the description of the message and the destination address will appear depending on the selected user. This message can be completely customized as long as the destination e-mail is valid. In the case the destination address is invalid an alert will be shown and the sending e-mail will be saved as a draft in the "*Mail*" application of the device.

When an alarm message arrives from the server the user's device will change automatically its showing screen and will go into the screen in Figure 2.



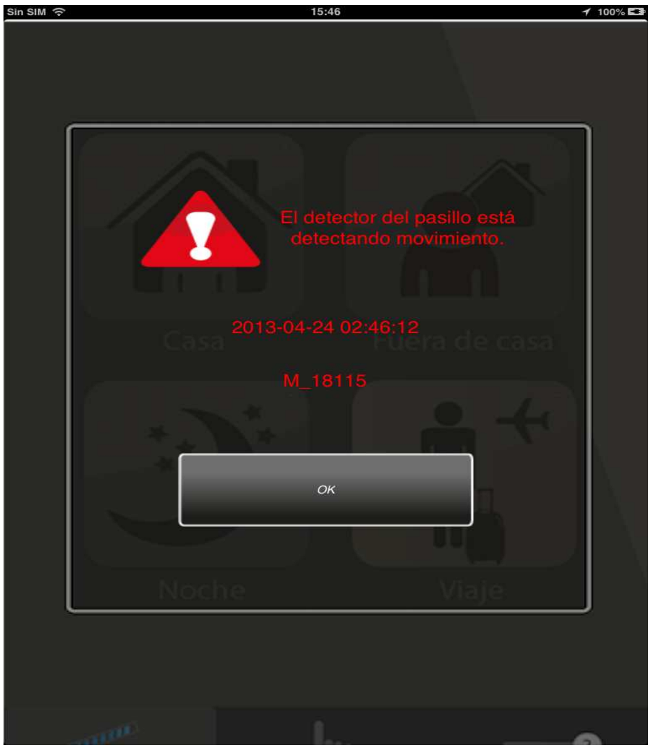
El detector del pasillo está detectando movimiento.

2013-04-24 02:46:12

M_18115

Figure 2 New alarm dialog

After sliding the unlock bar, the application will turn into the next screen, but before clicking on the “OK” the user will need to wait until the application loads some data from the server, for that reason the mentioned button will be disabled for a while. When all the new data is received from the server, the user is able to click the button. The details of the alarm will be shown above the button. Figure 3 and Figure 4 show the alarm dialog consecutive screens.

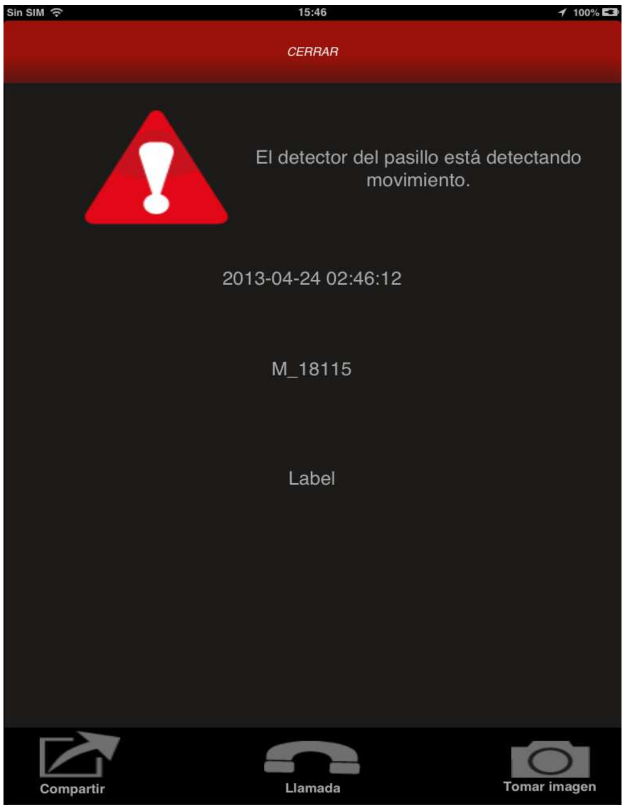


El detector del pasillo está detectando movimiento.

2013-04-24 02:46:12

M_18115

Figure 3 New alarm dialog (second screen)



El detector del pasillo está detectando movimiento.

2013-04-24 02:46:12

M_18115

Label

Figure 4 New alarm dialog (third screen)

The third screen of the alarm dialog gives the user four different options.

The “cerrar” button closes the alarm dialog and shows a new alarm dialog if there is any in the queue. If there are no more pending alarms, the next showing view will be the message’s tab, where there will be new notifications, confirming the status change of some devices, for example, if there is an alarm in the house, the siren will be switched on automatically.

The “compartir” button gives the user the chance to share the details of the current alert to any of the users appearing in the database. This functionality is already explained above in the messages point.

The “llamada” button is used to make a call to any of the user’s associated in the database. When tapping on this button a new dialog will be shown and a list of three names will appear on the screen (Figure 5). If the user taps one of these names, the device will start making a phone call to the number associated to this contact in the database without dialling.

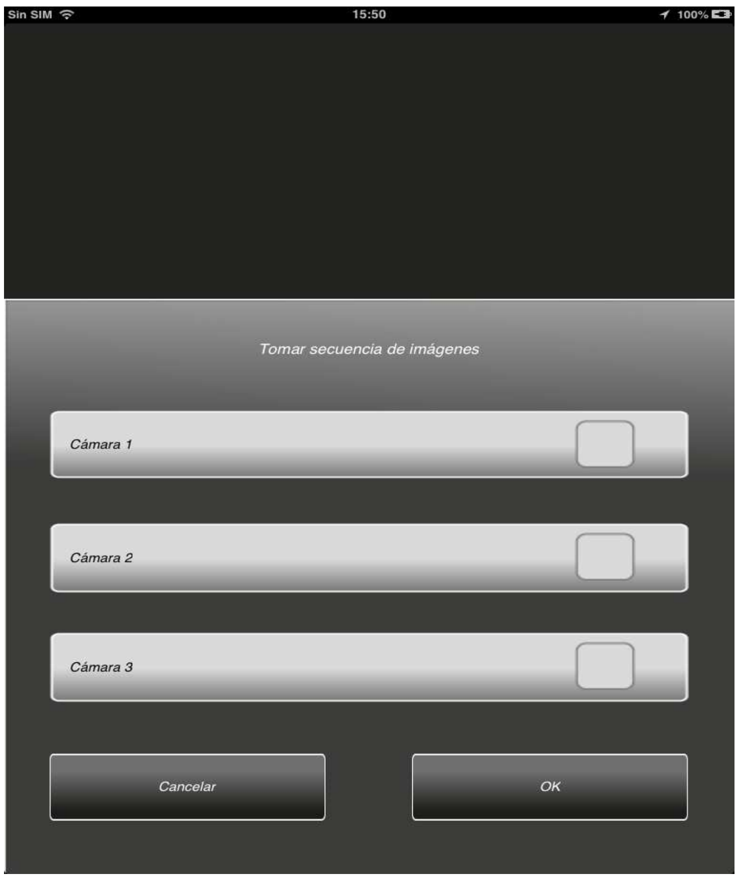


Figure 5 Example of a checking box to select a camera

Finally, the “tomar imagen” shortcut does not have a real functionality implemented as the application is a “beta” version and the pictures’ functionalities are still not defined, so there is no chance to take pictures of the house and send them.

3 FACTS TO KEEP IN MIND

The application needs to download data from the server in some cases. For this reason, when the user makes any change that will alter the database, the changes will not be shown immediately in the application, so the current state of a device or the activated scene will appear in the screen automatically some seconds after the alert view has appeared.

There can also be a delay when launching the application while the screen shows the “loading” message. This means that the device cannot be connected properly to the server, or that the device has not network connectivity. As explained before, the same thing can occur while the application is active. In this case, there will be an error message in the scenes screen and any requests done by the user will not be answered.

APPENDIX III
APPLICATION INSTALLATION MANUAL

1 INTRODUCTION 1

2 PRINCIPAL REQUIREMENTS 1

3 STEPS TO FOLLOW 2

1 INTRODUCTION

This manual explains the user the steps to follow to install the application successfully.

2 PRINCIPAL REQUIREMENTS

The application is available for *iPhone* and *iPad*, so it is necessary to own an original device made by *Apple*. The *app* has been tested on *iOS 5* and *iOS* 6. Some services such as *Location Manager* are only available after *iOS 4.0*. Autorotation can be also excluded in older versions of *iOS* as the code has been changed through the years.

There are also some devices that so not support multitasking or background execution, especially the ones that run initially *iOS 4.0* or earlier. To check this, user will need to check his/her device's serial code to see if the device supports multitasking. If the device is too old for this, the most important functionality of the application will not be available, although application will launch normally.

There must also be a correlation between the version of *iOS* running in the device and the *Xcode* version that will be used to install the application in the device. To this day, the latest version of *Xcode* is *6.1* and this version only supports devices using from *iOS 4.3* to *iOS 6.1*, so if we have a device with an earlier operative system, *Xcode* will not let us install our *app* in that device. Table 1 shows this relationship specifically:

Version of *Xcode*	***iOS SDK***	**Deployment target**
4.3	*iOS 5.0*	Earlier than *iOS 4.3*
From 4.3.1 to 4.4.1	*iOS 5.1*	Earlier than *iOS 4.3*
From 4.5 to 4.5.2	*iOS 6.0*	From *iOS 4.3* to *iOS 6.0*
4.6	iOS 6.1	From *iOS 4.3* to *iOS 6.1*

Table 1 Correlation between *Xcode* and *iOS* versions

It is also necessary for the user to be able to connect to an internet network in order to connect the device to the central server. This can be made via 3G or via WiFi. If the application is active and the network connection is lost, the application will show the user a message (Figure 1) in the scenes screen until the network connection is restored.

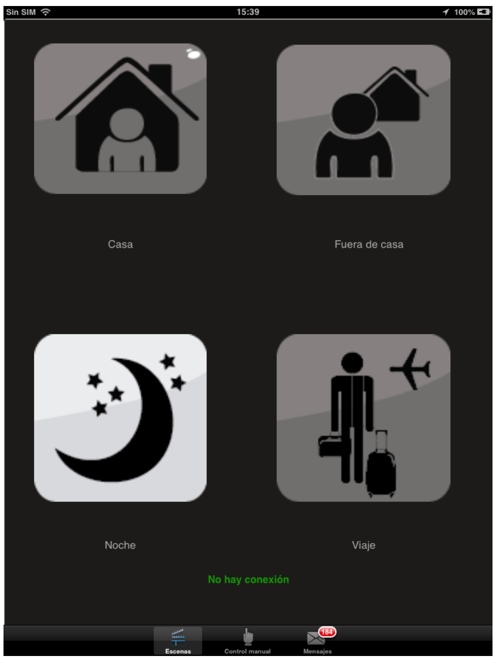


Figure 2 No connection message in the scenes screen

After this, the socket connection starts with the authentication progress.

3 STEPS TO FOLLOW

The first step for using the application is to install it in the device. To achieve this, the user will need a *Mac OS X* computer and a USB cable. When the link between the computer and the device is established the application is run in *Xcode* and it is automatically installed in the device. After checking that the application is correctly installed, it will appear in the application's list with the name “wsdl2objc” and the application will be correctly installed in the device.

APPENDIX IV
UPLOADING AN APP TO THE APP STORE

1 INTRODUCTION 1

2 STEPS TO FOLLOW...1

3 RESTRICTIONS 4

1 INTRODUCTION

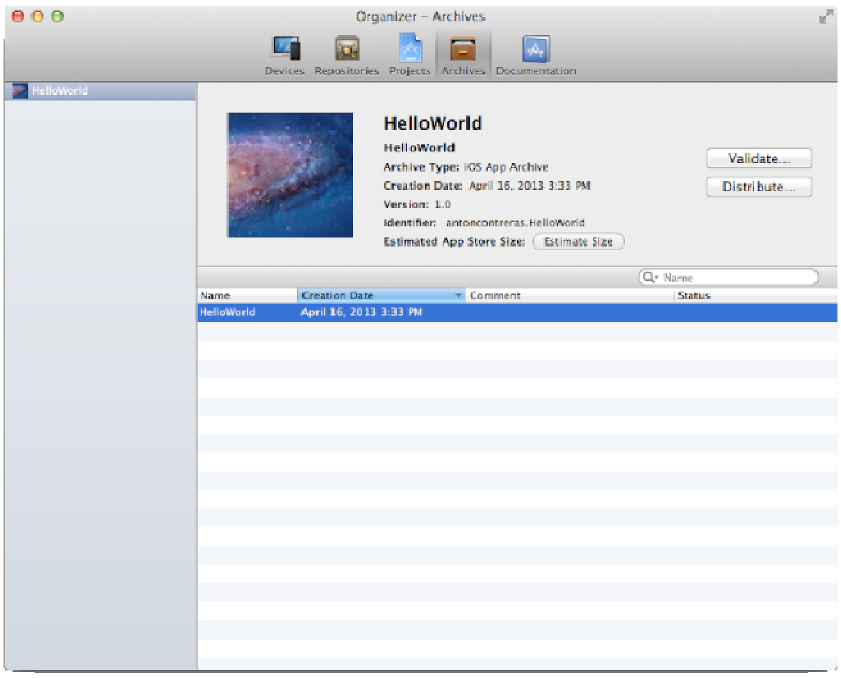
We have not been able to upload our application to the *App Store* due to some restrictions defined by *Apple*. Some of the most common restrictions will be described later on. Before that, the main steps to upload an *iOS* application to the *App Store* will be explained. Note that the specific restrictions that made us impossible to upload our application are defined in the body of the report.

2 STEPS TO FOLLOW

Once we have a development certificate (this was done before starting working in the project), the next step is to launch the app in the device to test all the *app*'s functionalities. It is recommendable to test the application in different devices with different *iOS* versions. A simulator doesn't run all threads that run on devices, and launching apps on devices using *Xcode* disable some of the watchdog timers. For this reason, it is necessary to test the app on all the devices available.

The next step is to configure our application (*Xcode* project) for distribution. We first need to know the device's ID (UUID code), which can be obtained using *iTunes* when the device is connected to the computer. Next, in the *Apple*'s Member Center, in the devices tab the obtained device ID must be written. The system automatically will recognize our device with the name that we have previously defined for the device (for example, "My iPhone").

Once the device we are going to use for testing is registered, the next step is to create an *iOS App Store Package*. Before starting, it must be said that it is not possible to create an archive inside a simulator build. In the current project in *Xcode*, we choose product>archive and a window similar to this (Figure 1) will appear (check if there are no compilation errors before doing this).



HelloWorld

HelloWorld

Archive Type: iOS App Archive

Creation Date: April 16, 2013 3:33 PM

Version: 1.0

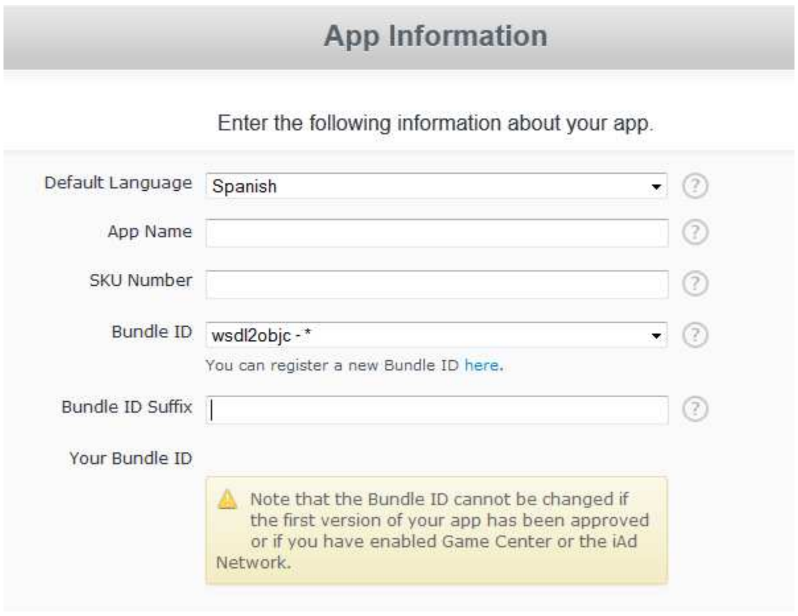
Identifier: antoncontreras.HelloWorld

Estimated App Store Size:

Name	Creation Date	Comment	Status
HelloWorld	April 16, 2013 3:33 PM		

Figure 1 Archives list window

Xcode gives us two options (validate and distribute) that will be used after creating an account in *iTunes Connect*. Once the account is created we click on "Manage your apps" and we can start an *app* record (Figure 2) using the "create new app" button.



App Information

Enter the following information about your app.

Default Language	Spanish
App Name	
SKU Number	
Bundle ID	wsdl2objc - *
	You can register a new Bundle ID here.
Bundle ID Suffix	
Your Bundle ID	

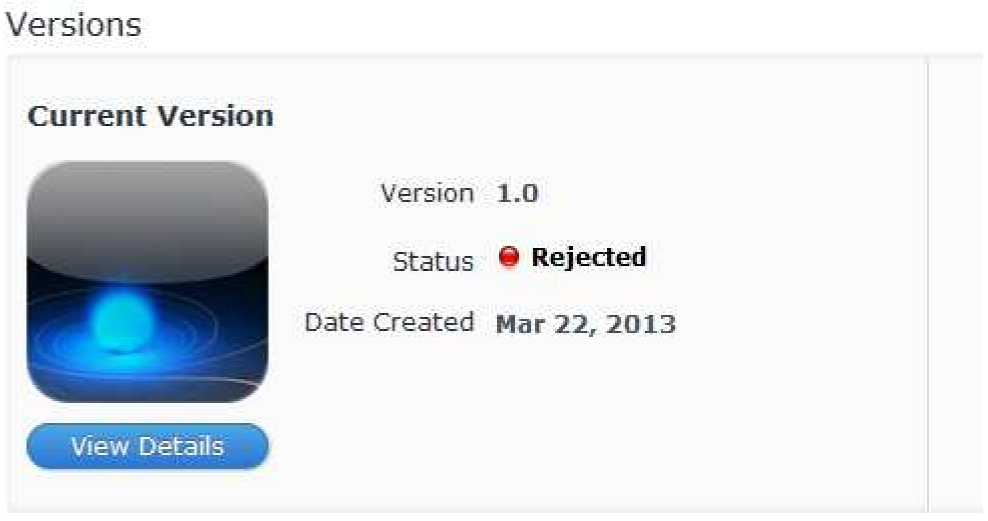
Note that the Bundle ID cannot be changed if the first version of your app has been approved or if you have enabled Game Center or the iAd Network.

Figure 2 App information questionnaire

The “app name” and the “SKU Number” fields will be the ones that we want to appear in the *App Store*. The “Bundle ID” list will be a list of suffixes stored in the *Xcode* projects saved in our computer. This is usually the name of the project so both values the Bundle ID and the App ID must match. The “Bundle ID Suffix” depends on the version of the project that we have done, in our case we used a different suffix for the *iPhone* and the *iPad* application.

After this, *Apple* will ask us to fill a form with a brief description of our application’s functionalities and some other facts that will help them to set a recommended age range to use this application. When this form is completely filled, we have to define if the application will be free or we will set a prize for each sale. After adding some screenshots and the icon that will appear in the *App Store*, the application is ready to be uploaded (a message with a yellow point will appear beside the *app*’s icon) and we can go back to the archive window in *Xcode*.

The first step is to validate the project to check if there are not compilation errors such as missing pictures. *Xcode* will then ask to introduce out *iTunes Connect* credentials and later, it will validate the project. Once the project is validated, the next step is to click on the “Distribute” button. The process will be the same as in validation, but in this case it will be longer as the project will need to be uploaded to *iTunesConnect*. To ensure that the application has been uploaded correctly, we go back to the *iTunes Connect* and in the “Manage your app” section the application status (Figure 3) will appear as *Waiting for Review*.


Versions

Current Version

Version 1.0

Status ● Rejected

Date Created Mar 22, 2013

Figure 3 Current status of the application

This state will keep some days until the application is reviewed (usually, 5 days), after this period of time *Apple* reviewers will give us an answer, and in the case the application is rejected, they will answer the reasons of the rejection.

3 RESTRICTIONS

There are some restrictions that *Apple* has set for uploading an *iOS app* to the *App Store.* Below, some of them are described:

Matching icons: Apple is now requiring the 512×512 iTunes Store icon match the 57×57 icon displayed on the iPhone. This means that the icons don't have to be identical, but there should be something shared between the two.

Simulating failures: *Apple* does not like the developer to simulate a failure or crash in the *app* by displaying a cracked screen, for instance.

Closing the *app* with a button: *Apple* does not accept to show an exit button in the *app* as an *app* can only be completely closed using the device's standard method (double-click on the "home" button, and pressing the stop signal of the application icon).

Bandwidth usage over cellular networks: It is usually recommended not to exceed 4,5Mbytes in a five-minute time. This amount of data can be checked in the "usage" section of the device.

Ensuring the app description is accurate: This description is the only one that the reviewer will have about the application. If the description is ambiguous, the reviewer may reject the *app* because he/she things that it does not make the functionalities expected.

Brief description when updating the app: Every time the *app* is updated, it is necessary to make a brief description about what has been changed.

Operative System compatibility: When uploading the *app, Apple* asks the developer to claim which *iOS* versions the *app* supports. So it is better to say that the developed application supports few versions, as it is easier to test the application in fewer devices. If there is any compatibility failure, the application will be rejected.

App crashing: *Apple* will not accept any application that crashes in a normal situation.

Screenshots must reflect the *app* in use: Some screenshots must be uploaded with the application and all these screenshots must show some of the functionalities of the *app*.

Including trademarks icons: An application can be rejected for including trademarks icons such as the *Apple* icon.

Including price in the *app*'s description: According to *Apple* this will create confusion between users as prices might be written in different currencies.

Use of animated violence icons: This is obviously one of the main reasons why an *app* is rejected. There are different levels of ratings depending on the recommended minimum age for users, but some images might be completely censored.

Use of public figures: Introducing celebrities' pictures in the *app* may result into rejection of the *app*.

Beta *apps*: Applications that are "beta" or "trial" versions will be rejected. This can happen when there is a button that has not functionality. In these cases, it is better to delete these buttons until they do not have a real functionality defined.

APPENDIX V
GLOSSARY

1 Definitions 1

1 DEFINITIONS

This glossary defines the meaning of some words than can be strange to the reader in the project's report.

IDE: It is the acronym for *Integrated Development Environment*. It is a software application that provides facilities for software development. These applications usually integrate compilers builders, interpreters, and always a source code editor. Some popular *IDE*s are *Eclipse, NetBeans, or Microsoft Visual Studio*.

API: It is the acronym for *Application Programming Interface*. An *API* is a protocol intended to be used as an interface by software components to communicate with each other. An example of this is to import a library defined in a programming language, and then use it in a method.

Pop-up: It is a message shown in a new window that appears responding to an action made by the application's user. It will notify that something important has occurred or changed in the application.

MAC address: The acronym of *MAC* is *Media Access Control*. It is a unique identifier for each network card of a device. *MAC* addresses are used in the media access control protocol sublayer.

Plugin: It is a software component that adds a specific feature to an existing software application. Some popular applications (browsers, IDEs, media players) support plugins. This is made to add easily new features to an application or to allow third-party developers to extend the application, for instance.

SDK: It means *Software Developer Kit*. It is a set of software development tools used to create applications from a development platform. In this project's case, we used the *Android* and *iOS SDK*s which have been used to create our applications from the *Java* and *Objective-C* frameworks.

Debugging: Debugging is the process of running a piece of code while the developer is trying to find and reduce the number of bugs in the code. If the app crashes, debugging is a quite pretty method to discover in which part of the code the app crashes, or to check the value of the variables in the different run loops.

Binding: It is the process of associating an Internet socket to a local port number or *IP* address.

HTTP protocol: It is the acronym for *Hyper Text Transform Protocol*. This protocol is the foundation of data for the *World Wide Web*. *HTTP* works as a request-response protocol in the client-server computing model.

TCP: Its meaning is *Transfer Control Protocol*. It is one of the two original code protocols of the *IP* architecture. *TCP* protocol ensures reliability, order, and error-checked delivery of all the streams running through a program connected to internet. For this reason, streams need more time to be transferred than in *UDP*.

UDP: Its meaning is *User Datagram Protocol*. It is the second original code protocol of the IP architecture. It is “opposite” to *TCP* as there is no guarantee of delivery, ordering or duplicating protection. It is used for *VoIP*, online gaming, or *DHCP* as these applications and protocols need speed over reliability.

Client-Server architecture: It is a distributed application structure where there are two different hardware types (server and clients), but they share the same system and protocols in order to communicate over a computer network. The server is always waiting for a request from a server, and if it is answering to a previous request sends the new request to a queue to process it later. Clients can make requests asynchronously.

Framework: A software framework is a group of different libraries combined to enable development of a specific project or solution. It includes support programs, compilers, tools sets and *API*s.

Library: A library is a collection of subprograms used to develop software. A program invokes a specific library via a mechanism of the language in which it is written. Library code is organized in such a way that it can be used by multiple programs that have no connection to each other.

Dismiss: It is the action of closing a pop-up dialog. It can be made responding to a user-action event or responding to a system event.

Memory leak: It occurs when a program manages incorrectly memory allocations. This happens when an object is allocated in memory but cannot be accessed by the running code. This fault can be only diagnosed by the developer when debugging the code.

SHA-256: It is part of a group of cryptographic hash functions. It transforms a text file into a single fixed length value. This transformation is made to secure data that travels through the internet, so that the legible text file cannot be traduced for bad purposes by a packet analyzer in a remote computer.

AppDelegate: The *App Delegate* is a custom object created at app launch time. The primary job of this object is to handle state transitions within the app. It is responsible for launch-time initialization and handling transitions to and from the background.

Bug: It is an error in the code that produces an incorrect or unexpected result. Some failures are caused by developers in the source code or design and others can be caused due to the compiler which is producing incorrect code.

Storyboard: It is a new characteristic in *iOS 5* that is used to design navigation-based applications graphically, in instead of programmatically as in earlier versions of *iOS*.

Thread: A thread of execution is the smallest sequence of programmed instructions that can be managed independently by an operating system scheduler. Each operative system use different ways to manage different threads. In most cases, a thread is contained inside a process.

DNS: It is the acronym for *Domain Name System*. It is a hierarchical distributed naming system for computers, services, or any resource connected to the Internet or a private network. It translates domain names to numerical *IP* addresses. *DNS* is an essential component of the functionality of the Internet.