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# With the iPhone/iPad through the European Space Operations Centre (ESOC)

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**Bachelor Thesis**

Francisco Javier Hortal

KOM-S-0436

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TECHNISCHE  
UNIVERSITÄT  
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Fachbereich Elektrotechnik  
und Informationstechnik  
Fachbereich Informatik (Zweitmitglied)

Fachgebiet Multimedia Kommunikation  
Prof. Dr.-Ing. Ralf Steinmetz

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## Ehrenwörtliche Erklärung

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Darmstadt, den 24. Mai 2012

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Francisco Javier Hortal

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## 1. Introduction

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This thesis is framed in a joint project between the TU Darmstadt (Hessen, Germany) and the European Space Agency<sup>1</sup> (ESA), in the European Space Operations Centre<sup>2</sup> division (ESOC). Having as an objective the development of an application (commercial and free freemium plan) for the iOS operating system and their devices iPhone, iPad and iPod Touch.

The ESOC is responsible for controlling ESA satellites and space probes, the Mission Control software for most of the space projects of the ESA. Since his creation in 1967, the centre has operated in 60 European space missions.

The ESOC, as an intergovernmental company, wants to inform the European citizens about the activities within their facilities.

The goal of this thesis is to develop an application capable of scanning QR codes, giving a practical use on everyday life. In addition, the application shows a virtual tour through the facilities of the ESOC Company in Darmstadt, showing to the users the activities carried out within them.

### 1.1. Motivation

The main objective of this project is to develop software based on the iOS operating system which is operating in the Apple devices like iPhone, iPhone and iPod Touch.

Currently the development and distribution system from Apple is the most developed of the market, making this platform as a leader in its sector. Therefore we decided to use this technology to develop this application.

These devices are portable and allow users to take it with himself all times, being one of the keys aspect of their success. The users can download thousands of different applications from the App Store, many of them free or trial version. The acquisition of this equipment by the users is increasing as the development of new applications or services that cover their basic, professional, educational and entertaining needs.

For this reason, the ESOC Company proposes the development of an application that has by one hand the capacity to manage the company information and an internal productivity application. On the other hand, it has to publish and bring to the European citizen all the activities performed within the company

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<sup>1</sup> ESA: <http://www.esa.int/>

<sup>2</sup> ESOC: <http://www.esa.int/esaMI/ESOC/>

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## 1.2. Contribution

As we previously explained, the main objective of this project is to develop an informative application for ESOC using the Apple operating system. The project has two main blocks an interactive map and a QR code scanner.

The Interactive map shows the company buildings and provides for each of them information about the rooms, employees, and informational videos of the activities performed in the place (e.g. the main room, the room where the processing of received signals take place, or the room where they render images from the obtained data...).

The QR code scanner is the most complex part of the project. The scanner is associated with the camera of the iPhone or iPad 2. After creating QR codes and distributing them in the different locations of the company the scanner can be used to show further information for onside visitors. As an example we could add a QR code at the main entrance of the company that links to a promotional video, digitizing a static and traditional media such an information boards or poster. The QR codes will be distributed to identify different offices of the company. It will allow users to scan and get information, like name, email, or telephone number of a person working in a specific office. It will facilitate the communication between the company and their clients.

The previously mentioned blocks, creating the interactive map and the QR scanner code are the main goals of the project. Both blocks are combined in one application.

## 1.3. Structure Of This Project

The project is divided into five stages interconnected as detailed the following way:

The first stage of *project planning* is the analysis of specifications and requirements assigned by the ESOC company. Deciding which of these specifications are feasible with available resources for the realization.

Once determine the features that we want to add to the application, proceed to the *program design*. Trying to see through drawings on paper, an application that integrates all necessary components.

Thanks to the sketches and drawings of the application, we can proceed with the next stage, the *coding*. At this stage is undoubtedly the most extensive, in trying to transform all specifications and ideas to iOS language (Objective-C). The two main blocks will be coded and tested independently, trying to isolate all the objectives and solve them one by one.

Below we will proceed to *test* each and every one of the options built into the application with the testing program.

The last step is the *delivery of the application* to the target company, ESOC. Which shall distribute them in the AppStore if they considered appropriate.

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## 1.4. Outline

To give the reader a clear and structured first vision of the document, is presented broadly content of the 8 different sections of memory. Section 2 describes the basics of the used technologies and concepts. Section 3 performs an comparison between our application and other similar applications. Also we describe and justify the decisions and steps taken in the project. In section 4 we discuss the project implementation, evaluation of the feasibility or infeasibility characteristics in response to time constraints. Section 5 shows the first graphic designs of the final result of the application. In Section 6 we proceed to implement the features previously assigned by the Apple's programming environment called iOS SDK. We also schedule all designs of the previous section. The final tests and sample results from the final version of the application are explained in section 7. Finally, in section 8 we obtain the conclusions of the project and SWOT analysis of results.

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## 2. Background

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In this section we intended to detail and explain those aspects related to the creation of the application for the iOS operating system, the QR codes and their creation, and the possible utilities that can be given to the codes.

In order to avoid possible confusion or errors in future concepts throughout this project it is necessary take a deep look on the definitions and characteristics of the iOS App and the QR Codes. (See Figures 2.1 and 2.2).



Figure 2.1: iOS logo.



Figure 2.2: Example QR Code

### 2.1. iOS Introduction

The mobile operating system of the company Apple is called iPhone Operating System<sup>3</sup> (iOS). Is unique and exclusive of the company preventing the installation on external device.

This operating system allows the user direct manipulation of the operations through multi-touch gestures, giving the user a feeling of freedom does not depend on physical buttons in their management. Just with a few touches, pinches and gestures of our fingers the system responds to our interactions. Also includes internal accelerometers that respond to our movements of the device (such as shaking the phone to turn off an alarm).

This operating system is derived from Mac OS X, with the advantage of having one more layer than its predecessor. This layer is responsible for supporting multi-touch interface and accelerometer. (See Figure 2.2.1).

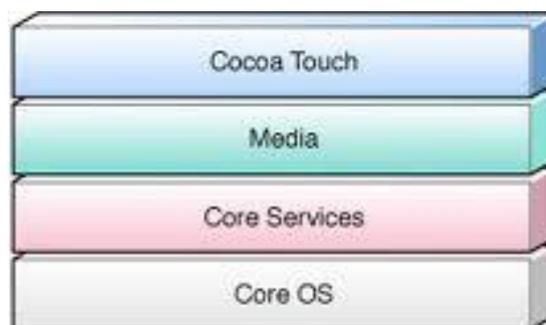


Figure 2.1.1: iOS layers<sup>4</sup>.

The iOS SDK contains code, information and tools necessary to develop, test, run, debug and adjust apps for IOS devices.

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<sup>3</sup> iOS: <http://www.apple.com/ios/>

<sup>4</sup> iOS layers info: <http://developer.apple.com/library/ios/navigation/>

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Furthermore, within this kit available on the Apple<sup>5</sup> website, there are three main applications:

- Xcode: Contains a set of tools for application development. It allows: editing, debugging and compiling the source code.
- Interface Builder: Allows creation of graphical interfaces and their links with Xcode. (Starting Xcode 4, interface builder is built on the same interface of Xcode).
- IOS Simulator: Running applications developed in a device emulator.

## 2.2. QR Codes Introduction

A QR code<sup>6</sup> (Quick Response barcode) is a system for storing information. Thanks to a matrix of points divided in a designated area.

Once known all the necessary concepts about QR codes, we can understand the value that resides in its correct use.

The purpose of these QR codes in the company is to provide a more direct relationship between customers and employees, saving time and facilitating contact between them. Usually a client doesn't know the email or phone number of an office user but just scanning the QR code placed at the entrance of the company, the client will have access to all such existing information within the QR code like an employee email.

The QR codes can store information like a link to a promotional video. The company could place a giant QR code at the entrance to their facilities and everyone that want to know what contains this code, should only have to scan it and automatically the device will show him the company's promotional video. A clear example of this utilization is shown in the following figures: (Figure 2.2.1 and Figure 2.2.2)



Figure 2.2.1: QR code Example1.



Figure 2.2.2: QR code Example2.

Since the creation of the first bar code, different techniques of storage information have been exist on this type of codes. As shown in the figure below (See Figure 2.2.3).

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<sup>5</sup> Apple website: <https://developer.apple.com/devcenter/ios/index.action>

<sup>6</sup> QR code: [http://en.wikipedia.org/wiki/QR\\_code](http://en.wikipedia.org/wiki/QR_code)

All these characteristics of the QR codes could be exploited by the marketing department of ESOC to find out other form of advertising to get in touch to more people.

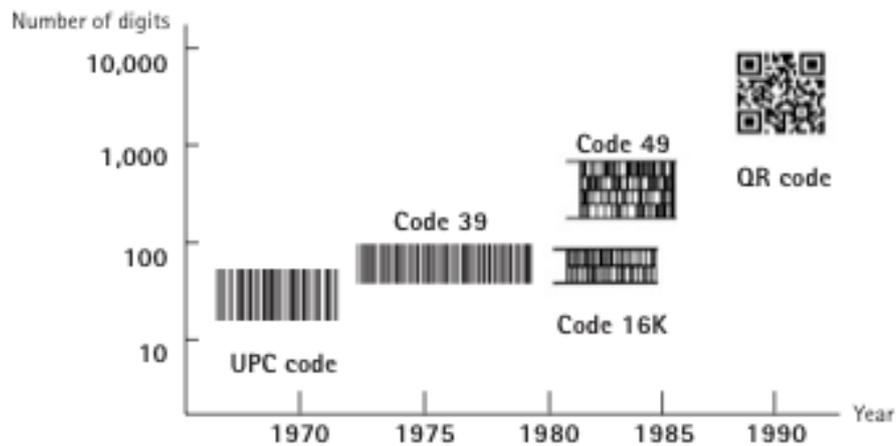


Figure 2.2.3: The history of the symbols<sup>7</sup>.

At the beginning these codes were reserved for industrial use, helping to identify different parts for the inventories of companies through codes readers.

Today, due to increased technical capabilities of mobile phones, appears a new category called Smart Phone. Devices are capable of offering the user a variety of benefits with different applications. These applications can be developed by the manufacturer or different entities, as in this case we do. There is a huge increase in the Smart Phones industry to satisfy the user needs as for example, develop a software capable of reading QR codes in mobile phones. The users have no need to enter data manually because thanks to the QR codes readers the device can do it automatically. There are several examples of the benefits of it. It can be used to insert the company URL address in a simple code near to your logo. Another great example is to add a QR code on business cards, saving time in the creation of a new contact in the phonebook of a mobile phone.

There are many programs that let you generate your own QR code and export the result as an image for further dissemination.

For the creation of QR codes, the program has been used is QR Encoder<sup>8</sup>, downloaded from App Store<sup>9</sup> of Apple. The program allows user to encode text and transform it into a QR Code, obtaining as a final result an image. (See Figure 2.2.4).

<sup>7</sup> History of the symbols: [http://qrbcn.com/imatgesbloc/Three\\_QR\\_Code.pdf](http://qrbcn.com/imatgesbloc/Three_QR_Code.pdf)

<sup>8</sup> QR Encoder: <http://itunes.apple.com/mx/app/qrencoder/id452695239?mt=12>

<sup>9</sup> App Store: <http://store.apple.com/>



Figure 2.2.4: QR Encode.

Some of the differences between QR codes and other two-dimensional codes, regardless of the increase in the amount of information it can hold, are the following:

- All-Direction (360°) High-Speed reading.

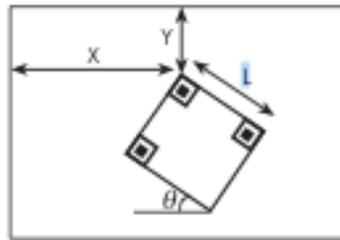


Figure 2.2.5: Rotated QR Code.

- Resistant to distorted symbols.

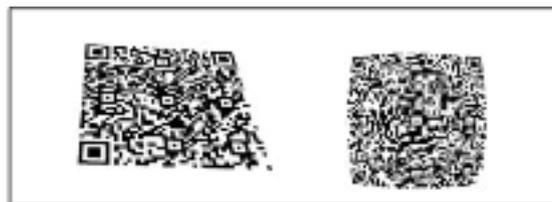


Figure 2.2.6: Distorted QR Codes.

- Resistant to Smudge or Damaged Symbols.



Figure 2.2.7: Damaged QR Codes.

Within the illegible to the human eye appearance of QR codes, they have very definite guidelines about where to place the information within the code. (See Figure 2.2.8).

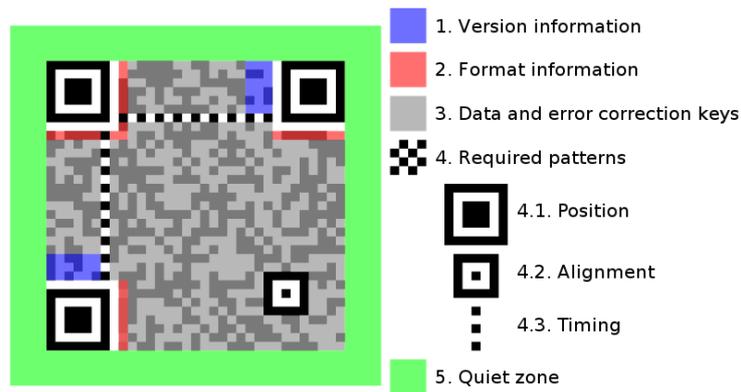


Figure 2.2.8: QR Code structure.

### 2.3. Context Aware Technologies

Another thing that it could add into the project is the use of geolocation technology. Allowing to device know the exact location of the user within the company facilities. This system could make the visit more interactive without having to scan a QR code because the device would know exactly which is the location of the user is and show him the necessary information.

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### 3. Related Work

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Various applications are presented in this section, related to two major characteristics of our project (The QR codes and maps or virtual tours), exposing different applications available for iOS devices, their similarities and differences with the application to develop.

#### 3.1. Related Applications

Below, shows some of the most popular applications in the Apple App Store connected with the characteristics of this project. To do this, we will focus on QR codes and virtual maps.

##### 3.1.1. App's For QR Code Scanning

We can differentiate three applications available on the App Store, capable of scanning the QR codes.

The first to comment on is the application "i-nigma"<sup>10</sup>. Perhaps one of the most popular because of their optimal performance, ease of use and price. Being a free application, its popularization is more warranted if it was of payment. This type of free versions are often used to promote to the developing company, to be known in the market in the near future to make other payment applications and obtain benefits. (See Figure 3.1.1.1).

With this App you can share all the QR codes that you scan, through Facebook, Twitter and other social networks, email or SMS. You can create QR codes on the screen for scanning and sharing with other devices. Scan Geo barcodes and open them on Map. This App is multi lingual: English, French, Spanish, German, Italian, Portuguese, Russian, Hungarian and Thai.

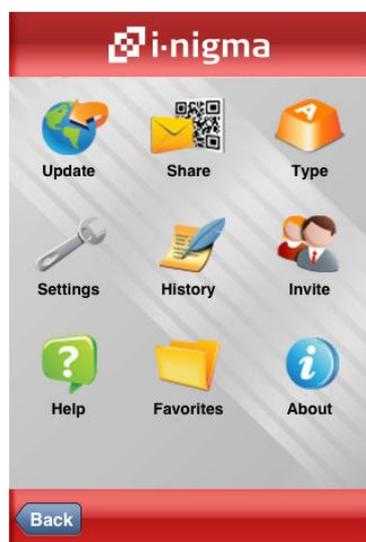


Figure 3.1.1.1: i-nigma menu.

Another popular applications related to reading QR codes, is the application "QuickMark"<sup>11</sup>. This not only reads QR codes and displays the information to the user, but allows for further diffusion through the social networks of their content. Giving the user the freedom to interact with their own codes, as well as

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<sup>10</sup> 1 i-nigma: <http://www.i-nigma.com/i-nigmahp.html>

<sup>11</sup> QuickMark: <http://www.quickmark.cn/En/basic/index.asp>

its content. As shown in Figure 3.1.1.2, this application has a price of 0.79 € that the user should pay to install on your device. Notwithstanding the above, can lead to sporadic users of this kind of codes to do not feel attracted with the idea of paying money for an application that would use rarely.

The main characteristics of this App are the preview of web links and maps, access to a web link, send an email, add a phone contact, navigate Google Maps to a specific POI, add event to Calendar or read it later. (See Figure 3.1.1.2).



Figure 3.1.1.2: QuickMark menu.

Last but not less important, we present the application "ZBar"<sup>12</sup>. Maybe is not as well-known between the regular users of QR codes, but it is one of the most reliable applications at the time of working with her as a designer of your own application. This is a code reader free codes allowing the designer, have all their internal programming to add it to different projects. (See Figure 3.1.1.3).

This app can scan many different barcode formats: EAN-13/UPC-A, UPC-E, EAN-8, Code 128, Code 93, Code 39, Interleaved 2 of 5, DataBar, DataBar Expanded and QR Code. With this App you can search for products using Google, Amazon and the Internet UPC Database. But like the creators says, "This is not a Shopping app" It's just about scanning many diferent kind of barcodes and creating links based on the data"<sup>1</sup>



Figure 3.1.1.3: ZBar menu.

<sup>12</sup> ZBar: <http://zbar.sourceforge.net>

### 3.1.2. Related Applications, Virtual Tour App's

In this application called "Virtual Stadium Newcastle United Tour"<sup>13</sup>, you can see perfectly all the stadium facilities and characteristics of the English football team Newcastle United. This is quite similar to the main idea that we want to achieve with our interactive map, showing the various facilities of the company and its characteristics.

With this application the developer company intends to show to the fan soccer club a different view of the stadium, thanks to images, information, maps and other graphics resources that give us an idea of how is the stadium although we never have been in it. This application have tabs that allow showing different type of information (such as the screen, a gallery of images as a virtual tour, map of geographic location or simply get in touch with the staff of the stadium). (See Figures 3.1.2.1 and 3.1.2.2).

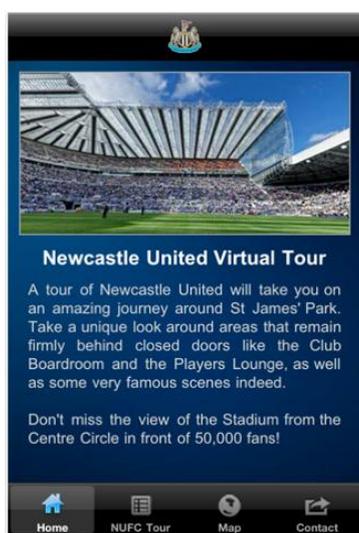


Figure 3.1.2.1: NUFC Tour menu1



Figure 3.1.2.2: NUFC Tour menu2

The next application that we want to show is called "Chichen Itza"<sup>14</sup>. Which allows us as users travel back in time and visit virtually the golden age of the Maya, discovering one of the new Seven Wonders of the World. This application not intended to be a simple guide typical, this is a true 3D virtual tour, showing the before and now of the city itself.

Like previously, this application also makes a virtual tour, but not limited to images, 360-degree images, maps or text. With this application we can make a real virtual tour of the city, using a three dimensional recreation. On the other hand, sounds are added while you travel, giving more realism to the recreation. Also included is a small quiz, so that makes handling more entertaining. (See Figures 3.1.2.3 and 3.1.2.4).

<sup>13</sup> <http://itunes.apple.com/us/app/newcastle-united-virtual-stadium/id399087717?l=es&mt=8>

<sup>14</sup> <http://itunes.apple.com/us/app/timetours-chichen-itza/id417634504?mt=8>



Figure 3.1.2.3: Chichen Itza menu1



Figure 3.1.2.4: Chichen Itza menu2

One of the App's that we saw as a model, was the App of "ESA"<sup>15</sup>, since we were going to develop an application for the division of ESOC, we used it as a reference. In this App you can read the news, watch the videos or find the locations of its facilities around the world.

But we used it more for their appearance than their characteristics. (See Figures 3.1.2.5 and 3.1.2.6).

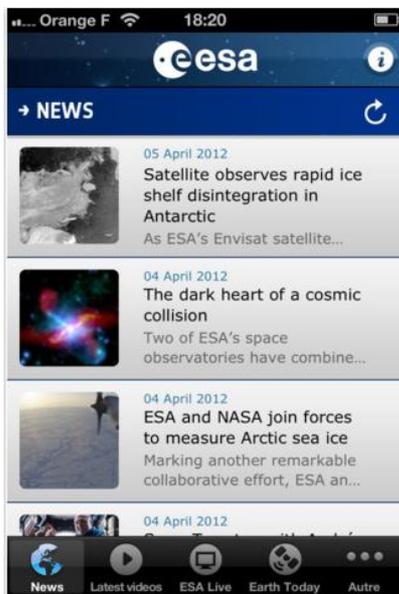


Figure 3.1.2.5: ESA menu1



Figure 3.1.2.6: ESA menu2

### 3.2. Comparison Of Related Work

There are a large number of utilities that can be given to the management of QR codes, as well as interactive maps. As many as oneself is willing to develop, but this project has clear objectives.

In these objectives is not contemplated the storage of images taken with the camera, sharing these codes through social networks or by sms. Nor is it necessary the further processing of the code, since it is a presential utility, requiring only be in front of QR code to get their information instantly.

Therefore, our QR codes scanner simply must be able to recognize the codes and display their information in the device's screen, without post-process the information for future use. If a user wants to send an email to an email address, which resides within a QR Code, all you should do is scan the code and use

<sup>15</sup> ESA: <http://itunes.apple.com/us/app/esa-european-space-agency/id441518639?mt=8>

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your email manager to send an email to the recipient. If instead you want to make a phone call, you can scan the code looking for the phone number and make the call.

As for the virtual map, a good reference for this project was the application "Newcastle United Stadium Virtual Tour" being a clear and concise example of what to display. In the same way that we show in our application, the application "Virtual Newcastle United Stadium Tour" uses images, text and contact information. A good example is the Figure 3.2.2.1, a piece of the stadium with an image and text below.

The application "Chichem Izca" is visually spectacular but at the same time complex, escaping from the possibilities of realization of the current project, though not discarded for future updates. The Quiz about the Mayan culture is very interesting, one could carry out a small quiz about the company ESOC, sending the user information about the company in a more entertaining way.

All these applications have contributed greatly to the creation of ideas used in our application.

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## 4. Requirement Analysis

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The following section describes the characteristics that the application will have when it's finished.

### 4.1. Design features

These requirements should be taken as reference in the next stage of development.

1. The application must be easy to use by the user, in order to bring accessibility and don't make it difficult to the different sectors of the population who use it.
2. The style of an Apple App should be similar to the other App Store applications, so the user will be familiar with navigation and use of the application.
3. The initial screen should be simple and elegant, welcoming the user to the application and should keep consistency with the other windows.
4. With the aim of don't make the user wait while the application is loaded, it should be add a loading screen with the logo of the company.
5. The navigation within the application through the different windows should be manage using different tabs.
6. An important aspect to consider will be to prevent the user from getting stuck in a window and cannot return to the main menu, forcing the user to restart the application. To reach this goal the application is organized hierarchically using the options Apple has prepared for this case.

### 4.2. Technical Features

1. The internal code of the application must be distributed in different blocks easily distinguishable and identifiable through comments added by the creator to facilitate reading and understanding of it to future administrators of the application.
2. The App should contain a section in which it launches a scanner capable of reading different QR codes. The scanner is linked to the iPhone or iPad camera, so when the user request to reading a code, a new window automatically appears responsible for reading

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the QR code. In this way the user don't need to take a picture and later scanning. The own scanner detects the code and shows the information contained therein with the iPhone screen.

3. Within QR codes, is intended to introduce useful information about the company or employees. As names, email, phone or links to different web pages of the company. Which are provided by ESOC.
4. The App should contain an interactive map. With the interactive map is intended that the user of the application can take a virtual tour of the facilities and get information about the activities therein.
5. Two information buttons should be placed in the application, with the intention of helping the user.
  - The first button displays different information about the company.
  - The second button, it's created with the avoidance of doubt about the correct use of the scanner opening a popup window, which shows on the screen a few tips on using a code scanner.

In these objectives is not contemplated the storage of images taken with the camera, sharing these codes through social networks or by SMS. It's not necessary to processing of the code, since it is a presential utility, requiring only be in front of QR code to get the information instantly.

Therefore, our QR codes scanner, must be able to recognize the codes and display their information in the device's screen, without post-process the information for future use. If a user wants to send an email to an email address, which resides within a QR Code, the user can scan the code and use your email manager to send an email to the recipient. If instead of that the user want to make a phone call, he can scan the code looking for the phone number and make the call.

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## 5. Design

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The following section describes the characteristics of the application, both those require personal presence inside of ESOC, but can be enjoyed from anywhere in the world thanks to the virtual tour on the company.

The objectives of this application are clearly distinguishable and are divided into two blocks.

The first block provides the application internal productivity, improving communication with their clients through the incorporation of a QR Code Scanner, which shows data of different departments of the company.

The second objective is informative, trying to show to the users of the application wherever they are, all the facilities that the company has, as well as additional information about it.

The main menu is an information screen about the company that shows three different options:

- **Home.**
- **Scanner.**
- **Map.**

### 5.1. Design concepts

This section is intended to show to the user a general idea of the design work that resides behind a project like this.

Once finished the planning phase, we proceeded to the designing phase of the different characteristics of the application.

The initial design of the application was made in sketches on paper trying to show all the options distributed in the different tabs. This is done with special templates that allow you to distribute the different buttons in the space of the iPhone screen. (See figure 5.1.1).

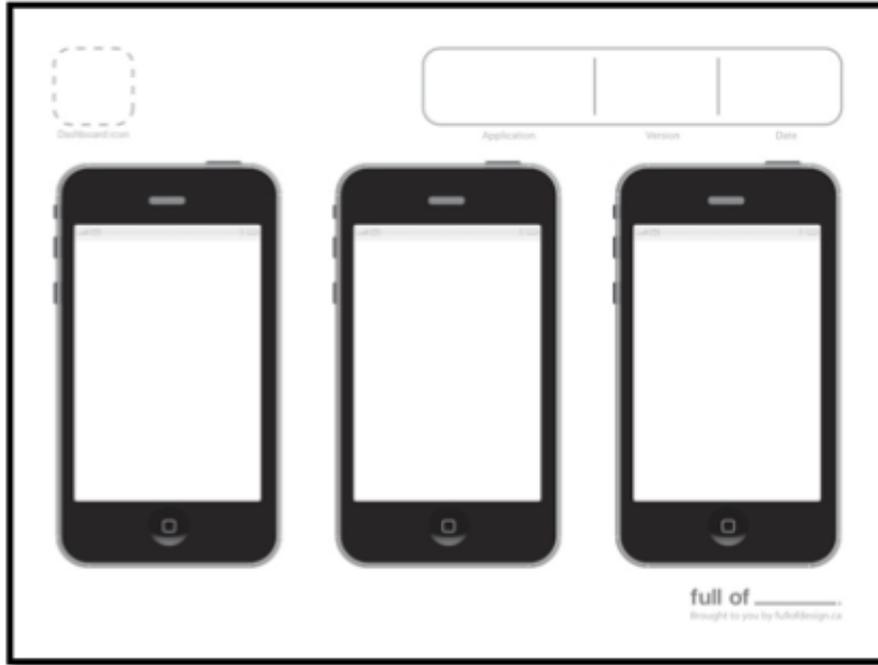


Figure 5.1.1: Templates of iPhone.

The intended of these first steps is not to show the final appearance of the application, it's to establish the basic concepts that define the application.

Once the paper design sketches it's done, a graphic design has been made by the Interface Builder<sup>16</sup> tool included in the IOS SDK provided by Apple.

All the elements added in this stage of the project, such as buttons, images, tabs... will be connected to their respective computer functions on coding stage.

In this App we will have three different tabs, called "Home", "Scanner" and "Map". We choose three icons to represent it. The icons had been taken from the web page Glyphish<sup>17</sup> As you can see in the following figures (Figure 5.1.2, Figure 5.1.3 and Figure 5.1.4).



Figure 5.1.2: Home icon.



Figure 5.1.3: Scan icon.



Figure 5.1.4: Map icon.

<sup>16</sup> Interface Builder: <https://developer.apple.com/technologies/tools/>

<sup>17</sup> Gluphish: <http://glyphish.com/>

## 5.2. Main Screen

The main screen of an application is the space tab that loads the program to initialize the device. In our project, this tab has been called "Home".

Once finished the initial loading screen mentioned in paragraph 4.2, the user will access to the application start menu. This tab, called "Home" is intended to teach the key company concepts through a promotional video clicking on the button "Play", opening the video player provided by default in the iPhone.

In this screen has been added an information button in the upper right corner of the screen, as discussed in paragraph 4.2, provide to the user a direct contact with the company (as for example a direct access to the website or the company telephone number).

This display is intended to be simple and provide to the information about the ESOC Company.

The graphic design of the Home screen was performed using the Interface Builder tool. All the items added to this window, such as buttons, images, tabs ... will be subsequently connected to their respective computer functions in the following section, the coding. (See Figure 5.2.1).



Figure 5.2.1: Menu "Home".

### 5.2.1. Design Of The Scanner

The next menu, it's called "Scanner". In this section we proceed to explain the steps taken during the realization of it.

This part of the project does not require a lot of graphic design with the Interface Builder, the complexity of this section resides in the internal programming that will be developed later. In the "Scanner" menu we will add a button called "Scan", when button is pressed by the user the iPhone's camera will be activated to scan QR codes . (See Figure 5.2.1.1).



Figure 5.2.1.1: Menu "Scanner".

Because the Interface Builder is a digital emulation of the behaviour of the iPhone, has no camera to test the functionality. It shows a warning message instead of the images captured by the camera. (See figure 5.4.2.1.2).

If the user decides to cancel the scanning operation, he can always return to the previous menu pressing on the "Cancel" button. (See figure 5.2.1.2).



Figure 5.2.1.2: Scanner screen.

For many users the use of QR codes can be a bit complex. With the aim of solve these problem we added a second information button that display a help window with scanning tips and a link that opens with the Safari browser the QR codes section of the website Wikipedia. (See Figure 5.2.1.3).



Figure 5.2.1.3: Help menu of QR Codes.

## 5.2.2. Design Of QR Codes

Below we can see some of the codes generated with the program *QR Encoder*<sup>1</sup>, used in the application, as well as the result after the scanning process. If you have the application installed on your device; can directly scan QR code and check the result displayed. (See Figures 5.2.2.1-5.2.2.4).



Figure 5.2.2.1: QR code, info data.



Figure 5.2.2.2: Result of QR code, info data.



Figure 5.2.2.3: QR code, Youtube1 data.

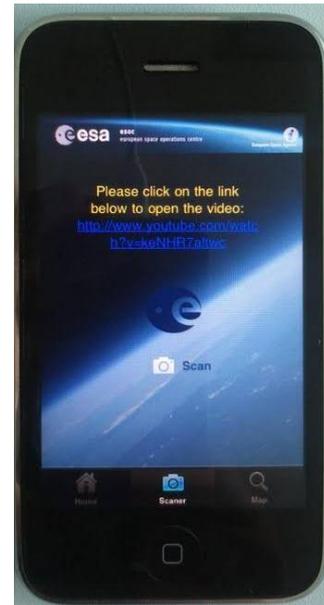


Figure 5.2.2.4: Result of QR code, Youtube data.

### 5.2.3. Menu Of Interactive Map

ESOC should not limit its radius of advertising action only to people who visit their facilities through guided tours with the company staff. Therefore, it has posed to create an interactive map of their facilities, in order to report about activities undertaken in them to all persons who cannot visit the company personally. This interactive map shows images and data of their facilities that allow users to get an idea of what the company makes them.

In this section, the application shows to the user the different facilities that the ESOC Company has through an interactive map where user can click on the desired area of the map and the application will open a window with information about that area such a detailed description, gallery of images or videos.

As the main plane of the facilities is decided to use the following image (See figure 5.2.3.1)

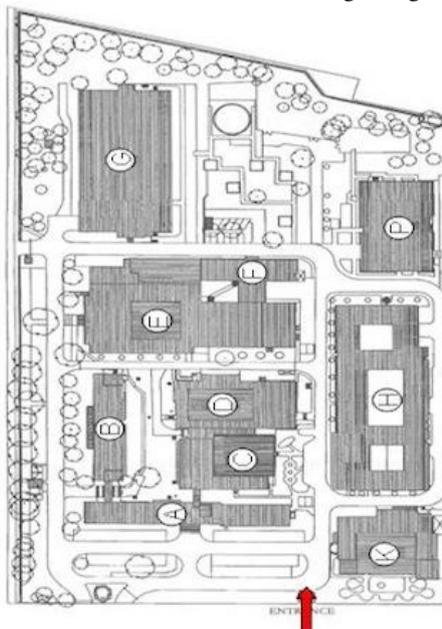


Figure 5.2.3.1: Main map.

This map will serve as the basis for future development of the different rooms and buildings (as seen in the map above). The following step is adjust the image size to the resolution of the iPhone screen.

In the creation of the different submenus associated with the main map it was decided to use pictures of the facilities themselves. These are spectacular and allow users to view with all kinds of detail the facilities. Some of the clearest examples are shown below. (Figure 5.2.3.2 and Figure 5.2.3.3).



Figure 5.2.3.2: Main room.



Figure 5.2.3.3: The Rosetta Engineering Model.

In some of the submenus of the map will be used other elements apart from the images such as promotional videos.

An important aspect when performing submenus is allow the user to return to the previous menus, with the aim of not block the user. Therefore it has been used buttons to return called "Back". (See figure 5.2.3.5).



Figure 5.2.3.5: Back button.

There were created two different icons with different colors in order to represent the different states of the button, pressed and not pressed.

---

Likewise also was created the buttons that calling the video player of the device. With the symbol "play" in it. (See figure 5.2.3.6).



Figure 5.2.3.6: Play button.

### 5.3. Design Application Icon

The design of the main icon of the application is a very important part of the project because represents the image of the Company. On one hand the icon is a way to visualize the application when the user is considering to download it and may be considered as a way to capture them. In addition, once downloaded our application on your device iPhone / iPad, user should select our icon to access the application and will be a part to more visible to the user.

Some aspects to consider are:

- Do not use words in the icon because of their small size of the device. The user cannot read it.
- The default brightness employee applying the iPhone, not always be as desirable as it can be applied in a manner not desired. Therefore, we have applied the brightness manually using the program Photoshop CS3<sup>18</sup>. You can appreciate the differences in the following two figures. (See Figure 5.3.1 and Figure 5.3.2).



Figure 5.3.1: Original logo



Figure 5.3.2: Custom logo.

---

<sup>18</sup> Photoshop CS3: <http://www.adobe.com/es/products/photoshopfamily.html>

---

Is clearly visible the differences between the two icons. Getting the icon in Figure 5.3.2 a look typical of iPhone applications.

Being an application related to the company ESOC it's quite obvious to use the logo itself. Because otherwise it could lead to confusion and we can use the logo as a way to advertise the company.

---

## 6. Implementation

---

The goal of this project is to develop an application in the iOS platform able of transmitting to users all the actions performed in the company ESOC. It also gives to the application an internal use within the company, by reading QR codes strategically placed within the facility.

Equipment's used during the implementation of this project were as follows:

- Mac Mini computer.
- iPhone 3GS and 4GS.
- Developer account authorized of Apple company, under the license obtained by the communication lab of the TU university.
- iOS SDK software provided by Apple.

### 6.1. Coding Of The Skeletal

The first part of the program to be coded is the skeleton of the application. We will use this skeleton as a basis for our project, by adding the basic programming that allows navigation between different windows. We used Xcode<sup>19</sup> and created a View-Based Application for our project. We called to this project "ESOC.xcodeproj". The project consists on an App with three different Tab's, with their respective files for each tab. This files are the implementation (.m), the header (.h) and the nib file (.xib).

We created a folder called ZbarSDK to add in all the files relating to the library belonging to the scanner. These contents have been downloaded from the website of Zbar<sup>20</sup>.

In order to have the workspace clean and well organized, the first thing we do is to sort the classes by a group structure. Separating each element in different folders.

#### 6.1.1. Tabs

The tabs are managed in the application by the object of type UITabBar, acting as a main controller of the application and taking charge of calling the appropriate drivers for each of the tabs. This UITabBar is added within the file MainWindow.xib. (See Figure 6.1.1.1)

---

<sup>19</sup> Xcode: <https://developer.apple.com/technologies/tools/>

<sup>20</sup> Zbar: <http://zbar.sourceforge.net/download.html>

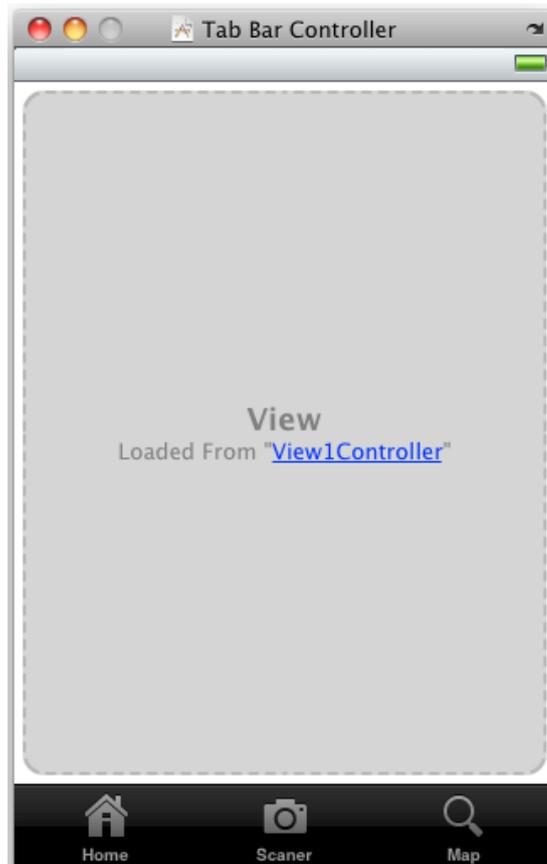


Figura 6.1.1.1: UITabBarController of MainWindow.xib.

Once added the three controllers that will be control the tabs, we proceed to customize and specify what nib file (.xib) will load the controller:

- The Home tab, immediately connect to the file View1.xib.
- The Scanner tab, immediately connect to the file View2.xib
- Finally the Map tab, concatenated with the file View3.xib.

For the customization of the tabs we created different visual elements that have to be added to the application. We created icons for each of the tabs (See chapter 5.1 Design Concepts), added a start picture and hides the top status bar of the device thus having more space on the application.



*Figure 6.1.1.2: Icon added.*

For the Home tab, we choosed the symbol of a house because of its clear relation with it. (See Figure 6.1.1.2).

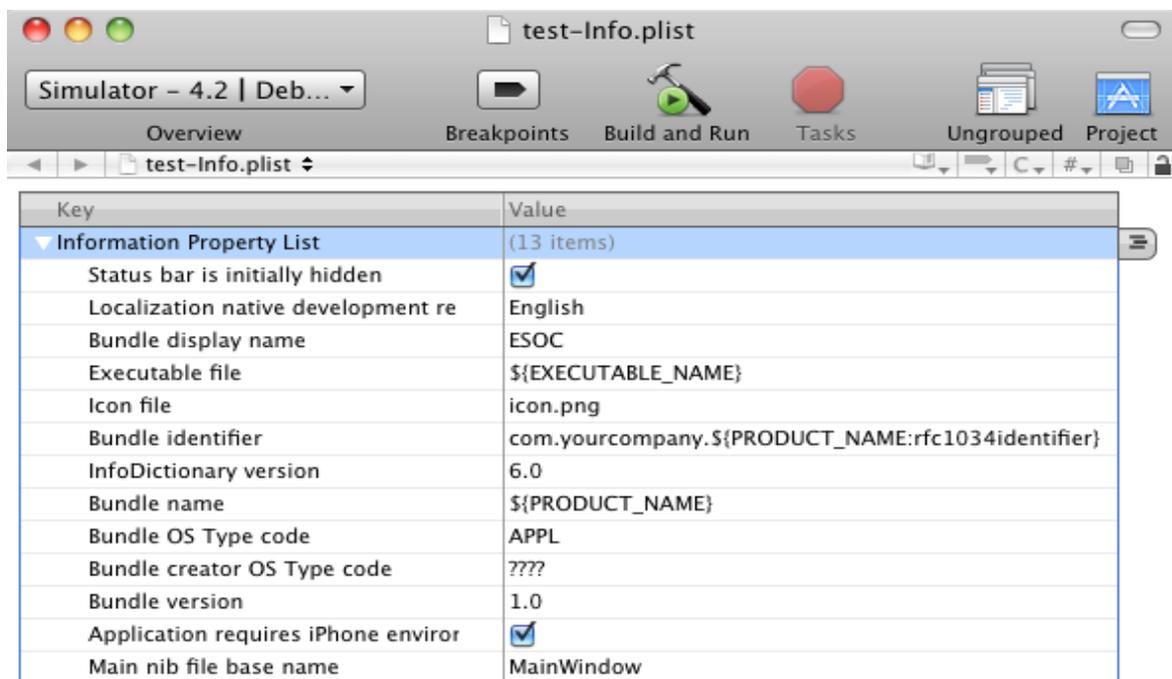
For the Scanner tab, we decided to take the symbol of a camera because the codes are scanned with a camera built into the device itself.

The last tab called Map, is represented by a magnifying glass because the idea is to look for information on the interactive map of the company.

## 6.1.2. Main Icon And Loading Screen

The main icon, created during the design phase (See chapter 5.4.5 Designed Application Icon) of the interface will be added by editing the “info.plist” (See figure 6.1.2.1). In this way we edit the following options:

- In the name of the application, in line “Bundle display name”, we introduce "ESOC".
- The image to display as an icon of the application, in line “Icon file” must have the name "icon.png" mandatory.
- We disable the default brightness applied to the main icon.
- Hide the status bar of the device, making check in paragraph Status bar is initially hidden.



The screenshot shows the Xcode interface with the 'test-Info.plist' file open. The 'Information Property List' is expanded, showing the following key-value pairs:

Key	Value
Information Property List	(13 items)
Status bar is initially hidden	<input checked="" type="checkbox"/>
Localization native development re	English
Bundle display name	ESOC
Executable file	\${EXECUTABLE_NAME}
Icon file	icon.png
Bundle identifier	com.yourcompany.\${PRODUCT_NAME:rfc1034identifier}
InfoDictionary version	6.0
Bundle name	\${PRODUCT_NAME}
Bundle OS Type code	APPL
Bundle creator OS Type code	????
Bundle version	1.0
Application requires iPhone enviro	<input checked="" type="checkbox"/>
Main nib file base name	MainWindow

Figure 6.1.2.1: Info.plist.

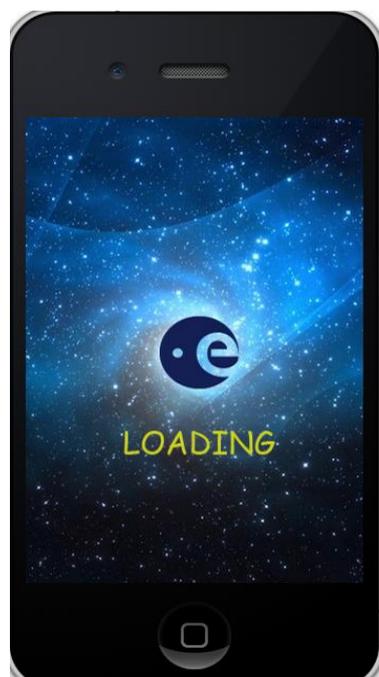
This way when executing our application, our icon appears in the following way. (See Figure 6.1.2.2)



*Figure 6.1.2.2: Main icon.*

The starting image is an image loaded by the application when the user initializes it, before being loaded the rest of views. This image is the first thing that is displayed to the user and was created as an image for them in the design phase with the letters "loading" and the company logo. (See figure 6.2.2.3).

The name of the image is "default.png", the application automatically searches this file before loading anything else and cannot have another name. In another way the program will not load this picture (See figure 6.1.2.3).



*Figure 6.1.2.3: Splash screen.*

---

## 6.2. Coding Of “Home”

In the second phase of implementation, we added all the features of the first tab, “Home”. Remembering:

- A button that when pressed to plays a promotional video for the company with the default video player installed on the device.
- “Other information” button to show us the contact details of the company.

The following part is the coding used to achieve these objectives.

### 6.2.1. Home Header File (.h)

The header files contain classes, types, functions and constant declaration. The basic idea of this type of file is tell the computer in the header file what kinds of command are executed in the implementation file. Example of this header file:

```
#import <UIKit/UIKit.h>
#import <MediaPlayer/MediaPlayer.h>

@interface View1Controller : UIViewController {
}
- (IBAction)information;
- (IBAction) Video;
@end
```

As you can see, there are two IBAction. They are related to two “actions” (buttons in this case) from the Interface Builder. One is called the “information”, which refers to the button of information, and the other is called “Video”.

These actions are defined in the following section.

### 6.2.2. Home Implementation File (.m)

In contrast to the header files, the Implementation files contain the lines that make use of precoded materials. In the implementation file, you perform all necessary operations with the elements already set. The following code example show's how to launch the default video player of the iPhone device.

```
//Launch the video called ESOC.mp4
- (IBAction) Video
{
    NSBundle *bundle = [NSBundle mainBundle];
    NSString *moviePath = [bundle pathForResource:@"ESOC" ofType:@"mp4"];
    NSURL *movieURL = [[NSURL fileURLWithPath:moviePath] retain];
    MPMoviePlayerController *theMovie = [[MPMoviePlayerController alloc] initWithContentURL:movieURL];
    theMovie.scalingMode = MPMovieScalingModeAspectFill;
    [theMovie play];
    MPMoviePlayerViewController *moviePlayer = [[MPMoviePlayerViewController alloc]
initWithContentURL:movieURL];
    [self presentMoviePlayerViewControllerAnimated:moviePlayer];
}
```





Figure 6.2.2.2: Info menu.

### 6.3. Coding Of "Scanner"

This section has a QR code scanner. It is more directed for the company ESOC and will provide internal productivity to the application. But still the external user can also use the scanner with any QR code that is in your daily life.

In the coding of this part of the project we had the help provided by a library Zbar. To make this work correctly QR codes scanner, we followed the instructions received from their own website<sup>21</sup>:

1. Drag the ZBarSDK folder into your Xcode project. In the dialog that appears, you should choose to copy the SDK into your project by checking the box. The target that you want to link with the library should also be selected in the target list. (See Figure 6.3.1).

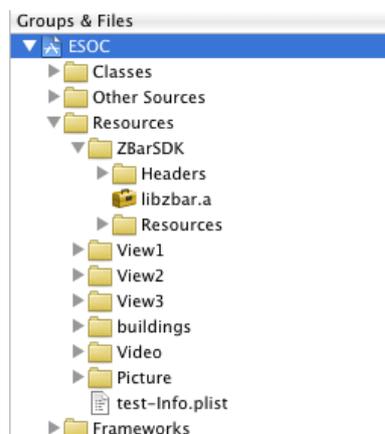


Figure 6.3.1: Group files.

<sup>21</sup> Zbar instruction: <http://zbar.sourceforge.net/iphone/sdkdoc/tutorial.html>

2. Link the following additional frameworks to any targets that link with the ZBarSDK. You should set the first three to use weak references and configure an appropriate deployment target if you still need to support iOS 3. (See Figure 6.3.2).

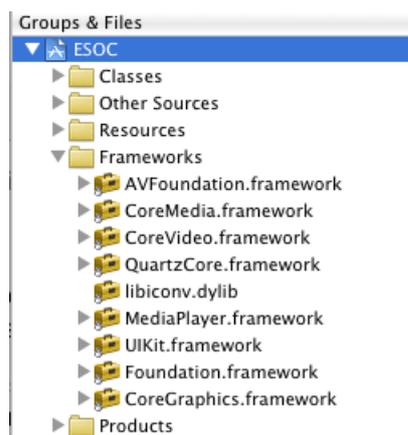


Figure 6.3.2: Frameworks files.

3. Import the SDK header from your prefix header to make the barcode reader APIs available.

```
#import "ZBarSDK.h"
```

4. Declare support for the delegate protocol in ReaderSampleViewController.h:

```
@interface View2Controller : UIViewController < ZBarReaderDelegate >
```

5. Open the View2Controller.xib and Drag a Round Rect Button into the view and title it "Scan"
6. Drag a Text View into the view and size it to fill the remaining space. (See Figure 6.3.3).

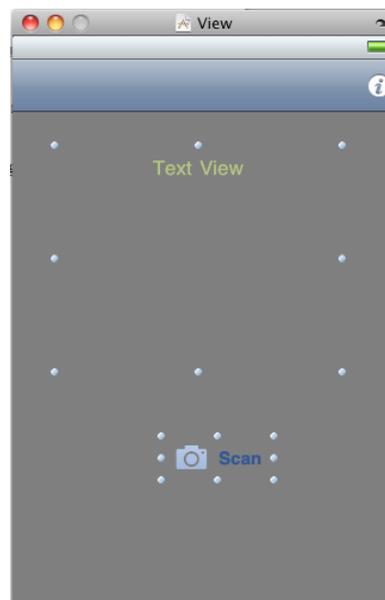


Figure 6.3.3: View2Controller.xib

- 
7. Add connections to the interface elements in the code; open View2Controller.h and change the interface to:

```
@interface View2Controller : UIViewController
{
    UITextView *resultText;
}

@property (nonatomic, retain) IBOutlet UITextView *resultText;

- (IBAction) scanButtonTapped;

@end
```

8. Now we can finish the interface connections - open View2Controller.xib and make these connections:

- α. Connect View2Controller resultText outlet to the TextView.
- β. Connect View2Controller scanButtonTapped action to the RoundedRectangleButton(Scan) event TouchUpInside.

9. Finish the implementation in the View2Controller.m

```
@synthesize resultText;

- (IBAction) scanButtonTapped
{
    // ADD: present a barcode reader that scans from the camera feed
    ZBarReaderViewController *reader = [ZBarReaderViewController new];
    reader.readerDelegate = self;
    reader.supportedOrientationsMask = ZBarOrientationMaskAll;

    ZBarImageScanner *scanner = reader.scanner;
    // TODO: (optional) additional reader configuration here

    // EXAMPLE: disable rarely used I2/5 to improve performance
    [scanner          setSymbology: ZBAR_I25
                    config: ZBAR_CFG_ENABLE
                    to: 0];

    // present and release the controller
    [self presentViewController: reader
                          animated: YES];
    [reader release];
}

- (void) dealloc
{
    self.resultText = nil;
    [super dealloc];
}

- (BOOL) shouldAutorotateToInterfaceOrientation: (UIInterfaceOrientation) interfaceOrientation
{
    return(YES);
}
```

## 6.4. Coding of “Map”

This is the last part to code. In this section, was programmed everything related to the interactive map. That is, both the main map and the different buildings and rooms. It shows the user all the facilities of the company.

For the creation of the interactive map, we used a background image representing a map of the facility. Above the area surrounding each installation we added different transparent buttons. In this way if the user wants to obtain more information about the main room, only have to touch the finger on the area. These buttons will be linked to other independent windows. As shown in the following figure 6.4.1.



Figure 6.4.1: Main map.

### 6.4.1. Map Header File (.h)

The header file of the Map contains the links to the different buildings and rooms of the facilities of ESOC. Also has the “back” button from this links to the main map.

The following code explains this concept:

```
#import <UIKit/UIKit.h>
#import "Building1.h"
#import "Building2.h"
#import "Building3.h"
#import "Building4.h"
...
@interface View3Controller : UIViewController
{
}

-(IBAction)switchView1;
-(IBAction)switchView2;
-(IBAction)switchView3;
-(IBAction)switchView4;
...
```

## 6.4.2. Map Implementation File (.m)

For the implementation file we coded the “go back” button to the main map of the different submenus of the map. Because all the rooms and buildings have their own files (See the next chapter). The next code shows how we implemented the “back” button, with the animation transition:

```
-(IBAction)switchView1{
Building1 *screen = [[Building1 alloc] initWithNibName:nil bundle:nil];
screen.modalTransitionStyle = UIModalTransitionStyleCoverVertical;
[self presentModalViewController:screen animated:YES];
[screen release];
}

-(IBAction)switchView2{
Building2 *screen = [[Building2 alloc] initWithNibName:nil bundle:nil];
screen.modalTransitionStyle = UIModalTransitionStyleCoverVertical;
[self presentModalViewController:screen animated:YES];
[screen release];
}
```

## 6.4.3. Creation Of The Different Buildings And Rooms

In the creation of the content of the rooms and buildings, we used the program Interface Builder, due to the big advantages to create an interactive space to show information to the user.

Bellow we show some examples of these designs with the Interface Builder. (See Figures 6.4.3.1 and 6.4.3.2).



Figure 6.4.3.1: Main room



Figure 6.4.3.2: Second building

---

## 7. Testing and Results

---

The best way to see the result of an iOS application is showing the App in the device or through a video. For the presentation of this video we have used the program Camtasia<sup>22</sup> to record the computer screen and capture the images of the iPhone Simulator<sup>23</sup>. To play this video, a copy has been uploaded to Youtube<sup>24</sup>, with the link:

---

<http://youtu.be/UMFmnHjXHUc>

---

In order to get a feedback with the company ESOC, we made a questionnaire with the aim of showing the application and whether we were on the right way. We sent an email to Bernhad L. von Weyhe.

The questionnaire is in the appendix 1.

---

<sup>22</sup> Camtasia: <http://www.techsmith.com/camtasia.html>

<sup>23</sup> iPhone Simulator: <https://developer.apple.com/programs/ios/develop.html>

<sup>24</sup> Youtube:<http://www.youtube.com/>

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## 8. Conclusions

---

This section is an analysis on the objectives achieved during this project, gaining an overview of the developed application.

### 8.1. Objectives Accomplished

On one hand, it complies a personal goal to the student. As a joint project between the university TU Darmstadt and the company ESOC, one of the main objectives of this project is to train students (in his time as a student), trying to this reach an academic and personal development.

In that sense, It has been purchased a solid knowledge about the use of the iOS platform. It also gives you the chance to make a stay abroad, allowing students to meet other people, cultures, and languages, expanding its academic horizons.

On the other hand, we find the goal that has the application itself. After completing the project, It has achieved an application capable of improving internal communications between the ESOC employees and their customers.

In addition, It is obtained an interactive map of the facilities, which shows all operations performed in the application, to the users.

The QR code scanner as the interactive map has been tested on different devices and It has been found to work properly.

In this way, the application is fully functional and ready to use, remaining only Its distribution phase (work which will be taken over by the company requesting the project, once it is delivered).

### 8.2. Analysis Of SWOT

To analyse the project, it has been decided to use the following system of analysis, SWOT (Strengths, Weaknesses, Opportunities and Threats). It is shown below the analysis of the effectiveness of the application.

#### 8.2.1. Strengths

One of the main strengths of this project is the use of the interface provided by Apple, allowing the user to familiarize with it due to its look "iPhone".

In addition to the style proper to Apple devices, the interface of this application has been developed trying to have a simple use and avoiding to limit to the users the complexity in handling the application.

---

### **8.2.2. Weaknesses**

A weakness of this project concerns with the language itself. Being designed in English, all users who do not speak, it might feel uncomfortable with the application. Therefore is proposed for a future update, add different languages such as German, French, Spanish or Italian. Thus becoming the main advantages and disadvantages, and have to be in the previous section.

### **8.2.3. Opportunities**

It exist a great opportunity to grow up this project through the division of the ESA group in different departments.

This application is designed and customized for the division ESOC, but could get designed as different application for each section of the company, thereby obtaining many more clients and users of this project.

A growth opportunity would be the development of this application for the Android system, arriving in this way arriving to more users.

### **8.2.4. Threats**

The greatest threat to this project is the limitation of its action range. Since this is, only the devices controlled by the operating system iOS (iPhone, iPhone and iPod Touch). If this application was developed for other operating systems like Android, this threat would cease to be and become an opportunity.

Today this threat is not significant but due to the recent growth of the Android platform devices in the future it can become a bigger problem.

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---

## 10. Appendix 1

---

1. Do you like the Main Icon / Name of the App?



2. Do you like the Icons of the tabs?



3. What kind of backgrounds do you prefer for the App?

4. Do you like the Up Bar customize?



5. What do you want to appear on the Main Menu? (In the other menu?)



**6. Do you like the loading screen?**



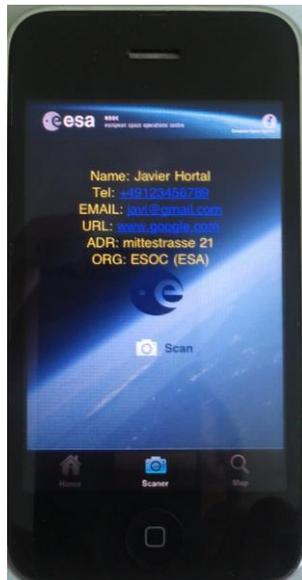
**7. How do you prefer show the videos: inside or online (youtube)?**

**8. The way of show the images: Like Map or Gallery?**

**9. What do you want to appear when you scan the QR Code?**

E.g:

As you can see in the picture, if you touch in the blue letters. Automatically you can make a phone call, send an email or open the web browser.



*Please i accept all the suggestions.*