DESIGN OF SMALL INTERFACES

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RESUM

Many modern devices with different kinds of characteristics have been invading the market in recent years and nowadays the market place is flooded with them. Users are experiencing a storm of new technology and a massive variety of new functions. This current work purposes an innovative approach for the design of small interfaces that can be used by a company to increase their own competitiveness or to develop research studies in an academic domain.

With a wide range of research about concepts, interfaces, classification, products history, market tendency, user preferences, guidelines examples and ergonomics in visual and touch channels, was developed a new and effective guideline for small interfaces. With the evaluation of two systems (tablet and smartphone), was possible to do improvements on the design in order to guarantee an effective guideline as the final result.

The guidelines that we set out to create incorporate research into human anatomy as well as behaviour when using the Tablet. This was done with volunteering test subjects as well as close observation of each user and how they reacted to the tablet and how quickly the adapted and recognised icons within the interface. We also looked into other areas such as the social implications of owning a tablet and the typical demographics of tablet users.

This research allowed use to gain a better understanding and insight into the mind of the user so we could deliver an interface to user that was not only what they needed but also one that they wanted to use.
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Part I. Introduction
1 Introduction

1.1 Objective

In the classical human-computer interaction paradigm, HCI, the computer is a well established tool. In modern times, mobile devices (smart phones, tablet PC) etc are changing the paradigm into a ubiquitous computing approach where the gestural interaction between the human and the system is the way that allows the interaction. In this context, is necessary develop and design a set of guidelines for obtain general recommendations in the design, usefulness and easy of use of these devices.

The objective of this project is creating an ergonomic guideline that can be useful in the design of small interfaces. Inside an engineering model process, we have a set of phases: requirements analysis, design, prototyping, and evaluation. Thus a guideline can be useful in order to detect problems in the design phase. In the phase of evaluation, this work shows usability testing in a laboratory with the use of three tablet PC.

1.2 Schedule

This project has a structure following these parts: Part I Introduction, Part II Materials and Methods, Part III Evaluation, Part IV Design, Part V Prototype, Part VI Conclusions and a set of Annex’s:

1) The first chapter presents the objectives of our work, the schedule of the project, a basic introduction about the state of art, the development of a classification of human machines interfaces, a time line with the evolution of tablet PC and smartphones and finally, some market relevant numbers,

2) The second chapter shows a preliminary evaluation of three tablet PC and the identification of some usability problems.

3) The third chapter shows information about human factors and ergonomics with two approaches: visual channel and touch channel. The last part of this chapter some design principles.

4) The fourth chapter presents the usability test.

5) The fifth chapter is about the design and application of the generic guideline

6) The sixth chapter presents our ideas and tools for the new interface for a Smartphone, building a prototype.

7) The seventh chapter shows our conclusions about the whole work, the assessments with these project and the work future lines.

8) Some other information is added in annex: human machine interfaces classification, smartphone and tablet timeline, guidelines references and eco design aspects.

1.3 What is a small interface?

“An interface device (IDF) is a hardware component or system of components that allows a human being to interact with a computer, a telephone system, or other electronic information system. The term is often encountered in the mobile communication industry where designers are challenged to
build the proper combination of portability, capability, and ease of use into the interface device. The overall set of characteristics provided by an interface device is often referred to as the user interface and, for computers at least, in more academic discussions the human-computer interface or HCI. Today's desktop and notebook computers have what has come to be called a graphical user interface (GUI) to distinguish it from earlier, more limited interfaces such as the command line interface (CLI). An interface device generally must include some form or forms of output interface, such as a display screen or audio signals, and some form or forms of input interface, such as buttons to push, a keyboard, a voice receiver, or a handwriting tablet.” (Rouse 2013).

A good interface is essential for any piece of modern interactive technology that must or can be operated by a human being. Some examples include:

- Tablets
- Smart phones
- Laptops and desktops
- Cooking appliances such as ovens and microwaves
- Vehicles such as cars, planes, motor bikes.

1.4 Human machine interfaces classification

In order to develop a classification of human machine interfaces, in this section were taken into account the following devices: pager (beeper), mobile phone, smartphone, PDA Personal digital assistant, PDT portable digital terminal, EDA enterprise digital assistant, multimedia player, video portable system, internet tablet, ultra mobile PC, tablet PC, e-reader, netbook, notebook, ultrabook, laptop, and finally wearable devices.

For further information, please go to the Annex A.

1.5 Small interfaces timeline

In this section some timelines are presented. The first case is the smart phone timeline in order to obtain information about the development of this current technology and understand the evolution in the design and technology related to these devices.

For a complete smart phone timeline, see Annex B.
The second case is the tablet PC timeline in order to obtain information about the development of this current technology and understand the evolution in the design and technology related to these devices.

Early tablets were designed to satisfy the necessities of the people in the business field of work. Those tablets were not easy to use and required that the user had previous knowledge of how to operate them. People liked them but they were not sure how to properly operate them. Nowadays, with the development of new technologies that advanced the hardware of the tablets as well as the development of very easy to use applications mean that almost all the population can use and operate them quite effectively.

In the beginning tablets were smaller and the people had to interact with them using a pen, some years later the screen of those tablets became larger and the people no longer needed a pen to use their tablet, all they had to do was use their fingers. In the last months of 2012 the tendency of tablet developers was to make them smaller such as the Apple Ipad mini and the new Samsung Galaxy Tab. The competition between rival tablets manufacturers has allowed users to have more choice between a large variety of prices and models. With this more people can afford them and they are becoming no longer a luxury product but a commodity device.

For a complete Tablet PC timeline, see Annex C.

![Galaxy Tab Samsung Tablet PC](image)

Figure 2. Galaxy Tab Samsung Tablet PC

### 1.6 Market

Market research is a key part of developing product. This research is about collecting information to give an insight into your customers mind. Companies and research groups can also do market research to get a better idea of market trends and what is happening in your industry sector. This market data has both objectives and is based on secondary data, numbers already published on the principals communication channels.

According to Gartner, 119 million tablets were sold in the year 2012, approximately 73 million, or 61%, were IPads. The projections are considerably aggressive. The researchers think that the Apple device will continue to dominate the tablet market through 2016, despite increased competition from the likes of Amazon and Microsoft (Gartner, 2012).
The huge range of functions such as voice control, social media, maps and navigation, and commerce, along with many other features, have created a large and rapidly growing demand of smartphones too. The latest data on smartphone sales shows that Samsung sold almost three times the number of phones of Apple, in 2012. And the difference of the two companies comparing their market shares is increasing along the years, that’s mean that Samsung is winning more smartphones clients than Apple.

When the subject of the discussion is the operation systems, it's known that in 2006, Android, iOS, Windows Phone and Bada did not yet exist and just 64 million smartphones were sold. Today, nearly 10 times as many smartphones are sold and the top mobile operating systems marketed as "smartphones" by market share is leader by Android.

<table>
<thead>
<tr>
<th>Brand</th>
<th>2011</th>
<th>Market Share</th>
<th>2012</th>
<th>Market Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samsung</td>
<td>315,052</td>
<td>17.7%</td>
<td>384,631</td>
<td>22.0%</td>
</tr>
<tr>
<td>Nokia</td>
<td>422,478</td>
<td>23.8%</td>
<td>333,938</td>
<td>19.1%</td>
</tr>
<tr>
<td>Apple</td>
<td>89,283</td>
<td>5.0%</td>
<td>130,133</td>
<td>7.5%</td>
</tr>
<tr>
<td>ZTE</td>
<td>56,682</td>
<td>3.2%</td>
<td>67,344</td>
<td>3.9%</td>
</tr>
<tr>
<td>LG</td>
<td>86,371</td>
<td>4.9%</td>
<td>58,016</td>
<td>3.3%</td>
</tr>
<tr>
<td>Huawei Device</td>
<td>40,663</td>
<td>2.3%</td>
<td>47,288</td>
<td>2.7%</td>
</tr>
<tr>
<td>TCL Communication</td>
<td>34,038</td>
<td>1.9%</td>
<td>37,177</td>
<td>2.1%</td>
</tr>
<tr>
<td>Research in Motion</td>
<td>51,542</td>
<td>2.9%</td>
<td>34,21</td>
<td>2.0%</td>
</tr>
<tr>
<td>Motorola</td>
<td>40,269</td>
<td>2.3%</td>
<td>33,916</td>
<td>1.9%</td>
</tr>
<tr>
<td>HTC</td>
<td>43,267</td>
<td>2.4%</td>
<td>32,122</td>
<td>1.8%</td>
</tr>
<tr>
<td>Others</td>
<td>555,887</td>
<td>33.6%</td>
<td>587,4</td>
<td>33.6%</td>
</tr>
</tbody>
</table>

Table 1. Tablet Sales and Market Share 2011 e 2012

As important as the analyses of the market sales, it’s necessary to study the users of the small interfaces and their behavior, preferences and needs. A research from Harris Interactive, trying to get inside the minds of consumers in 2012 in UK, reveals the first choice made and then the subsequent secondary choice of device (Harris, 2012).
Another research presents that not only is tablet traffic more valuable in terms of e-commerce and engagement, tablets have also become the primary device for mobile browsing. While Smartphones are the more common device, tablets are better for browsing and, on average, Internet users view 70 percent more pages per visit when browsing with a tablet compared to a Smartphone. After analyzing more than 100 billion visits to 1000+ websites world-wide, Adobe Digital Index has discovered that global websites are now, in 2013, getting more traffic from tablets than smartphones, 8% and 7% of monthly page views respectively (Adobe Digital Index, 2013)
Mobile analytics firm Flurry has tried to put some hard numbers on the trend too, by comparing smartphone and tablet apps usage by category. Their research is based on more than 6 billion apps sessions on around 500 million smartphones and tablets in September 2012. The most interesting chart compares time spent per app category between smartphones and tablets. Games is the most popular category on both, but there are notable differences in the percentage of time that games suck up: 39% of smartphone usage but 67% of tablet usage (Flurry, 2012).

They also discover that between 7pm and 10pm the usage of tablets is bigger than the smartphones; perhaps the smartphones are more used than tablets during the day. And while smartphone apps are used more often than tablet apps – 12.9 times a week versus 9.5 times – tablet apps are used for longer per session: 8.2 minutes on average, versus 4.1 minutes for smartphone apps (Flurry, 2012).
Figure 7. Time Spent Smartphones and Tablets
According to recent data from Nielsen, smartphones are most commonly used to find local stores, to check prices and for product research. Both tablets and smartphones are used at home. However, generally speaking, only smartphones truly make it outside and are used “on the go.” The companies have been documented how multiple devices are used throughout any given day and how user behavior is becoming truly “multiscreen” or multiplatform.
What about child? The rise of gadgets is ushering in a new generation of kids who are growing up digital. According to a Nielsen survey, 70% tablet-owning households with children under 12 said that their kids use the device and seventy-seven percent of those said children play downloaded games on their tablets and 57 percent said children used tablets to access educational apps. The portable gadget also keeps kids quiet while families are on-the-go (Nielsen, 2012).
Analyzing the age of tablets and smartphones costumers, Flurry found that while teenagers and adults below 35 years of age prefer smartphones to tablets, people above 35 years of age usually feel more comfortable using tablets as depicted in the survey above. This difference can be explained by the large size of the tablet screen which elderly people find much easier and convenient, thus offering them a better viewing experience (Flurry, 2012).

Another research from Google in 2011 say that, according to their data, tablet devices are personal. 91% of the time that people spend on their tablet devices is for personal rather than work-related activities. When a consumer gets a tablet, they quickly migrate many of their entertainment activities from laptops and smartphones to this new device. Tablet owners are building the device into their daily routine and the most frequent activities are checking email, playing games and social networking (Google, 2011).

According to them, tablets are multi-tasking devices with at least 42% of activities occurring while doing another task or engaging with another entertainment medium. Of all the activities that people do on tablets, checking email, playing games, social networking and searching are the ones most frequently done in front of the TV. Many consumers also used their tablets to check email while eating, and listen to music while cooking. Tablets are, however, mobile within the home, with the highest usage taking place on the couch, from the bed and in the kitchen.
After all this numbers, we can say that tablets market sales are growing up and this product is starting to be constantly used in the daily life activities with multiple functions. We also know that their functions are the most of times similar to the smartphone functions or other human machines interfaces, that’s why some researcher said that in a short future, tablets and smartphone functions will be integrate in one product.

The current tendency is put some functions of the smartphone into a new device called smart watch. In fact, Apple is working with a flexible interface that could be adapted to the human wrist, a new prototype called iWatch (Bracero 2013). The enterprise Samsung is working too in a future watch, some say that will be called Galaxy Altius. And Google is also in this market, beyond working in augmented reality multimedia glasses. The current market is changing quickly. For example, Windows Phone and Nokia have problems to follow the rhythm of a changing technology and there are doubts that if Blackberry can be adapted to the new technology changes.

In the last Mobile World Congress in Barcelona 2013, the users could test the I’m watch, a new watch with Italian design. This device is connected to the smartphone through Bluetooth (iOS and Android systems. In the year 2012, Sony develops the SmartWatch with similar functions and the enterprise Pebble has a watch with a electronic ink interface. Other company called Wime has the Nanowatch, in fact, is a real wrist mobile and could be connected to iOS and Android.

The functioning mode requires to bring the smartphone in the bag and the smartwatch in the wrist. The new events could be send into the watch and it not necessary look for the smartphone into the bag. The basic problem is that the combination of watch and smartphone with an Internet connection and Bluetooth increases the battery consumption.
Also an important tendency is the development of big smartphones. For example, Samsung is preparing the launch of Galaxy S4 and Galaxy Mega. A new functionality is added to Galaxy S4 with the aim to use gestural interaction (the user could change a song moving a hand) and while the user is watching a video, if the user turn the head, the video is in pause mode; when the user is paying attention again to the interface, the video is in play mode again. The Galaxy Mega are a set of smartphones with a 5.8 inches and 6.3 inches. This last model is the bigger smartphones in the current market (April 2013) (Samsung, 2013).

Other future line is the Interactive visualization technology displays data, it is using interactive images with the color, brightness, size, shape and motion of visual objects representing aspects of the dataset being analyzed. These products provide an array of visualization options including heat maps, geographic maps, scatter plots and other special-purpose visuals. These tools enable users to extract insights from the data by interacting with its visual representation. An example of applying this is the Researchers at Queen's University in Ontario Canada, unveiled a prototype of their "paperphone," a smartphone that has a flexible e-paper display instead of an LCD/TFT touchscreen.

The convergence of 3D location and contextualization, natural language question and answering systems, speech-to-speech translation, gesture recognition, eye tracking and facial recognition may lead to the emergence of a truly intelligent human-robot interface. This could spawn a new generation of robots that are able to navigate in various physical environments, perform complex mechanical tasks (including taking care of the aged and the young) and communicate effectively with humans.

With cloud computing providing scalability and Internet class computing, robots can access vast amounts of processing power and remotely gain new skills and behavior. This approach will allow robots to offload computationally intensive tasks like image processing and voice recognition to the cloud and even download new skills instantly. By offloading heavy computing tasks to the cloud, hardware will be easier to maintain and Central Processing Unit (CPU) hardware upgrades will be hassle-free. Robots will have longer battery life and have less need for software pushes and updates.
Part II. Material and Method
2 Conducting and informal evaluation

In this chapter an informal evaluation study is presented in order to obtain usability problems in the use of three Tablet PC.

2.1 Five steps to a user-centred expert review

“…Some people take a less rigorous approach to the process of heuristic evaluation or expert review by following a checklist. Informal evaluations can be done with nothing more than the knowledge you have from experience. Perhaps one person on the team inspects the product and reports the findings informally in a memo or in a meeting. Perhaps several people conduct the inspection independently and then get together to share their findings informally. For a really informal but powerful way to do an expert review, see the Five Steps Method”
Carol M. Barnum
“Usability, Testing, Essentials: Ready, Set…Test!”
Elsevier, 2011

With the aim to detect usability problems in the use of Tablet PC, in this section the method called five step to a user-centred expert review is applied in the study of three Tablet PC. The authors of this method and Whitney Quesenbery and Caroline Jarrett.

a) Don’t look at it (yet)!
You never get a second chance for your “first look”

b) Who is using this product?
Samsung: Design Student, girl, 22 years old
Prixton: Engineering Student, girl, 22 years old
Fnac: Design Student, boy, 20 years old

c) Why are they doing it?
Because we need to access information, entertainment and services. They use the tablet to study, play games, listen to music, watch videos, take photos, etc.

d) How do they feel about it?
It is useful and easy to carry and turn on. The screen is bigger than the screen of a smartphone for example. It’s a good product.

e) What do they expect to happen?
Samsung: When she interacts with it, she expects to easily undertake tasks and quick access to functions
Prixton: She didn’t know the brand so she expected it only to work with an intermediate quality
Fnac: He didn’t know the brand so he expected it only to work however the finish of the tablet suggested somewhat good quality.

f) How are they different from us? No

g) Try to use it (following the story)
Start from “Why are they using this product?” What are they trying to do?
Samsung: Because it is easier to take out and use than my computer and turn it on. I can take and use it everywhere.
Prixton: I am not using it so much, because I have a good smartphone and I know how to do the things that I need quickly on it. I use the tablet more when I need a big screen, for example, to show images to others in class or in work groups
Fnac: Because it does the same thing as a laptop and is lighter and easier to carry. I do not need a bag. Only click a button and it works.

h) What questions do they have? What else do they want to know? Why do tablets have this shape? Why are the brands always competing and fighting each other and coming up with different style interfaces?

i) Can they find the information they need?
Samsung: Yes. The quality of Wi-Fi connection is not always good as it is in my computer.
Prixton: Not everything. For example: how to switch the camera? Why does it spend a long time to load some apps and pages on the internet? Why sometimes you click and it doesn’t work or the menu that you selected, vanishes.
Fnac: Yes. Sometimes it is not possible to see videos on this mobile device.

j) Now look at it (now that you’ve had a chance to use it)
Think about relationship, conversation, interaction and appearance

Relationship. How did user goals and business goals align?
Our principal goal is: have the information at hand

Conversation: Were headings and text helpful and informative?
Samsung: Sometimes. The icons are very clear so the title doesn’t have to be that big. The manual is small with little information.
Prixton:
Fnac: Sometimes the relevant things are written and other times not. Some icons and titles are different than the standard template. The manual it full of text and has few pictures

Interaction: Could the user find a good “first click” or know how to use an interactive feature?
Yes. We all have the background to use it and all the tablets have intuitive functions.

Appearance: Did the visual design help or hinder?
The visual design helps to choose a tablet to use and know the functions and what you can do with it.
Samsung: the size is similar to Prixton but with less external connections.
Prixton: thicker than the others and with a gaudy brand on the front of it.
Fnac: the biggest one and the only one with the brand at back. Has a lot of connections such as Prixton.

Report: What are the problems you saw?
Samsung: it’s a little bit difficult to personalize the menu, screen, etc.
Prixton: it does some tasks that you don’t order it to do.
Fnac: the buttons to turn on/off and control volume are not in a good position. Doesn’t show you clearly that an app is being downloaded.

k) Find at least one positive point
Samsung: Do not need to understand how it works.
Prixton: Easy to use, you do not spend so much time learning how to use it.
Fnac: Fast to use.
2.2 Usability problems in the use of three Tablet PC

A comparative time task table is presented in this section with a set of tasks over three tablets. In this case, a single user does these tasks while a facilitator logs the time tasks.

<table>
<thead>
<tr>
<th>Time to do Tasks with the 3 tablets</th>
<th>Fnac</th>
<th>Samsung</th>
<th>Prixton</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Turn on</td>
<td>33.9</td>
<td>40.5</td>
<td>45.0</td>
</tr>
<tr>
<td>2. Unlock</td>
<td>2.1</td>
<td>15.3</td>
<td>3.2</td>
</tr>
<tr>
<td>3. Change the language: put the Tablet in Japanese, after continuous the test with the Tablet in English</td>
<td>41.6</td>
<td>81.5</td>
<td>85.0</td>
</tr>
<tr>
<td>4. Connect on the Internet</td>
<td>26.0</td>
<td>23.4</td>
<td>22.7</td>
</tr>
<tr>
<td>5. Open on page on the internet and search one video at youtube. Enjoy the music.</td>
<td>106</td>
<td>115</td>
<td>76.0</td>
</tr>
<tr>
<td>6. Increase the volume</td>
<td>9.1</td>
<td>6.1</td>
<td>8.4</td>
</tr>
<tr>
<td>7. Put it in full screen</td>
<td>4.8</td>
<td>8.1</td>
<td>3.3</td>
</tr>
<tr>
<td>8. Find the rest of applications</td>
<td>20.4</td>
<td>10.3</td>
<td>51.2</td>
</tr>
<tr>
<td>9. Take a picture with the camera</td>
<td>12.3</td>
<td>24.9</td>
<td>39.1</td>
</tr>
<tr>
<td>10. Change the camera (back camera to the camera that you can see yourself) and take a picture</td>
<td>12.1</td>
<td>13.2</td>
<td>___</td>
</tr>
<tr>
<td>11. Make a video</td>
<td>24.1</td>
<td>22.5</td>
<td>22.3</td>
</tr>
<tr>
<td>12. Watch the video</td>
<td>14.3</td>
<td>36.1</td>
<td>18.3</td>
</tr>
<tr>
<td>13. Find an app to download</td>
<td>120.4</td>
<td>130.5</td>
<td>180.0</td>
</tr>
</tbody>
</table>

Table 3. One user developing a set of tasks within the three Tablet PC

From the point of view in the assessment of these devices, here we have the comments of the user:

- The Fnac was easy to use and handle with minimal icons and a clear simple interface however it takes time to turn it on;
- With the Samsung it’s a totally different interface thus was alot harder to figure out the buttons but once you get used to it quite nice;
- The prixton was very similar to the Fnac as I was able to pick out and recognize however they were much smaller and sometimes hard to see and press

<table>
<thead>
<tr>
<th>Name</th>
<th>Prixton Tablet PC T7003C PRIXTON</th>
<th>Sumsung Galaxy Tab 2 7.0</th>
<th>Fnac Tablet Fnac 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price (€)</td>
<td>120.00</td>
<td>180.00</td>
<td>170.00</td>
</tr>
<tr>
<td>Operative system</td>
<td>Google Android 4.0</td>
<td>Android Ice Cream Sandwich 4.0</td>
<td>Android 4.1</td>
</tr>
<tr>
<td>RAM memory DD3</td>
<td>1GB</td>
<td>1GB</td>
<td>1GB</td>
</tr>
<tr>
<td>Intern memory</td>
<td>4GB</td>
<td>8GB</td>
<td>16GB</td>
</tr>
<tr>
<td>Velocity (GHz)</td>
<td>1.6</td>
<td>1</td>
<td>1.6</td>
</tr>
<tr>
<td>Dimensions (mm)</td>
<td>195<em>116</em>10</td>
<td>122,4<em>193,7</em>10,5</td>
<td>199<em>155</em>98</td>
</tr>
<tr>
<td>Battery (mAh)</td>
<td>3.000</td>
<td>4.000</td>
<td>5.000</td>
</tr>
<tr>
<td>Camera</td>
<td>VGA</td>
<td>3M</td>
<td>2M</td>
</tr>
<tr>
<td>Weight (g)</td>
<td>-</td>
<td>344</td>
<td>438</td>
</tr>
</tbody>
</table>

Table 4. Tablets Settings
3 Human Factors

The aim of this chapter is find information about the relationship between human factors engineering and small interfaces design. In this context, the section 3.1 show the human aspects relevants for this work, and section 3.2 show how to add the human factors in the design of a guideline of small interfaces.

In the design of gestural interaction is necessary design for the human body. That is study basic kinesiology (muscles, joints and motions), ergonomics of interactive gestures, ergonomics of motion (fingers, hands) and visual feedback (eye) or other multimodal inputs (auditory for example). It’s out of scope of this project a deep development of these matters and we pay attention to basic aspects. For further information please read (Saffer, 2009) and (Nielsen et. al, 2004).

The human factors related to the design of small interfaces could be focused in two aspects: visual channel and touch/haptic channel. For example in the first case, information about users such as their visual acuity color deficiencies and eye anthropometric characteristics (information relevant to eye position). In the second case information about users such as anthropometrics characteristics of human hand and fingers.

Figure 14. Use of one finger, one hand or two hands

3.1 Visual Channel

Through our eyes we see the world around us. We can see the different colours and shapes that make up our world, look out for danger, judge facial expressions and emotions and interact with the world around us. Because of this it our eyes are vital for our interaction with modern technology.

From smartphones, tablets to computer screens we need our eyes to see the interface, they help use interact with it and allow us to be stimulated by the information that we gain from them. From games to just choosing the correct setting our eyes allow us to know which one to choose and locate the controls and features present.

Because of this when designing an interface especially an interface for small screens with limited space taking into account the human eye and features that it responds well to such as light, colour or orientation of features or controls is highly important.

The eye works by absorbing light that must enter through the cornea and pupil where it eventually comes into contact with the retina. There the retina refracts (or in other words bends) the light so that images of what the person is staring at come into focus on the retina.

Meanwhile the iris controls the amount of light that enters the eye by contracting or dilate the size
of the pupil (the black dot in the middle of the eye) to adjust to the amount of light needed and to adjust to the current environment. For instance a dilated pupil usually means a you are in a low light environment while a contracted one means you are in a well-lit environment such as a bright room for example.

The retina is made up of nerve cells and photoreceptors that are sensitive to light. In the human eye alone we have two types of photoreceptors, rods and cones. While rods reside in the peripheral region of the retina the cones on the other had are situated in a small pit called the fovea.

“Many rods share a common optic nerve fiber, which pools their stimulation and aids sensitivity to lower levels of light. In contrast, cones have a more or less one-to-one relationship with optic nerve fibers, which aids their image resolution, or acuity. Vision accomplished primarily with cones is called photopic vision, and vision accomplished primarily with rods is called scotopic vision. Only in photopic vision do people actually perceive colors. In scotopic vision, the weak lights are visible, but not as colors. Instead all wavelengths are seen as a series of greys.” (Source: HCI designing for the GUI, Chapter 10 small screen interfaces Maunley, Masterton 2008, accessed: 15-4-2013)

When designing an interface one must be considerate of various elements that will dictate the success or failure of a device. Especially when it comes to the design of a small interface such as those found on tablets and smartphones that have limited screen size and must display relevant information in a clear and obvious manner that does not clutter or confuse the user.

It is a task for today’s designers to design interfaces such as those found on small screens to be easy to use and operate, display relevant information in order to allow the user to easily control and modify the device by using the limited space in a clever and practical manner, an example of this would be the settings menu were you can change language, brightness and so on. An interface must also appealing to the eye and it is vital to take into account the eye movements and habitual usage of the user.

A study by Enquiro eye tracking research found that people who owned tablets scanned web pages and search engines such as Google, Bing or Yahoo in an F-shaped pattern.

“Enquiro eye tracking research revealed website users’ eyes scan Google, Yahoo or Bing search engine result pages (SERPs) in an ‘F’-shape pattern. The above image is a SERP on which eye-tracking research is conducted. Red areas indicate where users’ eyes focus most, orange and yellow areas the next most. Eye tracking confirms a web visitor’s eyes focus first on a SERP’s upper left-hand corner: move to the right, down a bit, to the left, a little lower, over to the right, and drop off. Eye tracking heat maps show how readers search for keywords and phrases relevant to their Internet search. How closely one’s eye movements resemble the F-scan pattern depends on video, image and online content placement.” (Source: tumbleweed, marketing analytics: 2011 accessed: 15-4-2013)
One of the first steps in small-screen design is to determine the characteristics of the screen itself. From Muto and Maddox (in press):

- User characteristics: Information about users, such as their visual acuity, color deficiencies (colour blindness for example), and anthropometric characteristics (particularly information relevant to the position of the eyes) should be collected. These characteristics will be a source of requirements used to define screen characteristics. A practical way to collect this information is to note how users differ from the general population and use published measurements of the general population for instances in which there are no differences.

- Position(s) of display: Information about possible positions and locations of the display.

- Position(s) of eye: Information about the user’s eye positions relative to the display is very important. Knowledge of the farthest distance from the display that should be accommodated in the design is very important for computing the appropriate size of
characters and objects presented on the display. Knowledge of the widest angle of view that should be accommodated in the design is also valuable for ensuring the proper choice of display technology.

- Lighting and environmental conditions: Information about lighting in the expected environment is useful. If a range of environments is expected, identify the extremes and ensure that the display properties are satisfactory in those extremes.

- Type of information to be displayed: The type of information to be displayed should drive the characteristics of the display, such as resolution, size, and color range. For example, if fine detail needs to be displayed, a screen with high resolution will be needed. But if purely alphanumeric characters need to be displayed, a low-cost segmented display may be sufficient.

The minimum size of any object displayed on a screen is dependent on the visual angles, contrast, and brightness.

![Figure 17. Visual metrics](image)

Viewing distances can vary greatly, but the minimum viewing distance should be greater than 12 inches. It can be assumed that most office workers have a corrected, or uncorrected, visual ability for comfortable reading at 30.5 to 40.6 cm (ANSI/HFS 100–1988, 1988).

Character heights of 20 to 22 arc minutes are preferred for readability, while the threshold for readability is 16 to 18 arc minutes. Large character heights, more than 24 arc minutes, may inhibit readability by reducing the number of characters that may be viewed per fixation (ANSI/HFS 100-1988, 1988).

Based on the uppercase letter H without serifs (the small lines extending from the main strokes of a letter), the width-to-height ratio should be between 0.5:1 and 1:1. For better legibility and readability, it should be between 0.6:1 and 0.9:1 (BSR/HFES 100, 2006).

Characters are made up of lines, called strokes. The stroke width of characters should be from 1/6 to 1/12 of the maximum character height (BSR/HFES 100, 2006).

The spacing between characters without serifs should be at least equal to the stroke width, and preferably 25 percent to 60 percent of the width of the uppercase letter H. The spacing between characters with serifs should be at least 1 pixel (BSR/HFES 100, 2006).

The space between lines of text, including diacritics, should be at least 1 pixel and preferably at least 15 percent of the maximum character height. For users with partial vision, use larger spacing, or 25 percent to 30 percent of the character height (BSR/HFES 100, 2006).

The spacing between words should exceed the spacing between characters, and preferably be at least half the width of an uppercase letter H without serifs (BSR/HFES 100, 2006).
The display should be capable of producing a luminance of at least 35 cd/m², and preferably, 100 cd/m². Users often prefer a high luminance (>100 cd/m²), as reading speed and accuracy increase with increasing luminance, and legibility decreases when luminance falls below 35 cd/m² (BSR/HFES 100, 2006).

Muto and Maddox (in press), in their review and summarization of that research, recommend the following:

- For displays of high resolution (>150 DPI), serif fonts are more readable for tasks that require extended reading.
- For displays of lower resolution (<80 DPI), sans serif fonts are often preferred by users.

To help avoid overlapping categories and miscategorization of the entire menu structure, studies have shown that menu organizations generated by user data are superior to those generated by designer intuition (Hayhoe, 1990; Roske-Hofstrand & Paap, 1986).

For within-menu placement, items can be arranged in several ways (Marics & Engelbeck, 1997; Paap & Cooke, 1997):

- Alphabetically
- Temporally (days of week, months of the year)
- According to size (small, medium, large)
- Consistently (if items appear in multiple places throughout, keep the order the same)
- Categorically
- According to frequency of use (place the most commonly accessed items at the top)

Frequency of use is often the preferred choice.

Lee and Raymond (1993) note two factors that cause difficulty for users of menu systems:

- A disproportionate number of errors occur at the top menu levels.
- Menu systems can be tedious, ineffective, and simply boring for experienced users.
Menu keywords can help in both scenarios. These systems associate a keyword with each menu, allowing experienced users to avoid the troublesome upper levels and reduce keystrokes to directly access lower levels.

The majority of studies conducted on this issue, however, have focused primarily on evaluating structures of relatively frequent shapes (the same number of items per level). Few have looked at the shape of the structure. Norman and Chin (1988) and Bernard (2002b) examined differently shaped structures, including a constant breadth (same number of items per level), a shrinking structure (more items in upper levels than in lower levels), an increasing structure (more items in lower levels than in upper levels), a concave or hourglass like structure (more items in top and bottom levels, fewer items in middle levels), and a convex structure (more items in middle levels, fewer items in top and bottom levels). Both studies found that concave structures are more navigationally effective than relatively frequent shapes of similar size and depth. Thus, they assert that broad menus at the middle levels will contribute to more menu selection mistakes.

They found that with mobile phones and PDAs, the most effective hierarchy has only four to eight items with every level, and if a large number of items is needed, it is better to increase the number of levels than to increase the number of items per level.

MacGregor (1992) found that when icons show an example of an item in that category, they reduce the number of errors by 40 to 50 percent. The generalizability of this result, however, is dependent on the design of the icons and its success at unambiguously representing a category member. Icons are also extremely useful in menus as a way to achieve incidental learning for later use in toolbars or other isolated conditions (Dix, 1995).

Baecker and colleagues (1991) asserted that the meaning of an icon should be obvious to experienced users and recognizable to inexperienced users. They declare that many icons do not meet the former criterion, and most do not meet the latter. As a result, they evaluated the impact of animated icons in reducing this problem, and found that animated icons were very useful and easier to understand. In every case in their study where a static icon was not understood, the animated icon
was always a success. Again, the generalizability of this result is dependent on the design of the animated icon in question.

3.2 Touch Channel

The person’s posture and the design of the tablets’ case also affect the experience and comfort of the user, these factors will help to develop new ergonomic guidelines. The principal postures that users adopt while they are using a tablet are: Lap-Hand: tablet held on the lap; Lap-Case: tablet placed on lap in the case at its lower angle; Table-Case: tablet placed on a table with the case at its lower angle setting; and Table-Movie: tablet placed on a table in the case at its higher angle setting. This study was made by by the Harvard School of Public Health and Microsoft Corporation in 2012.

![Postures researchers studied](image)

Figure 20. Postures researchers studied in lab.

With these postures the user’s head and neck are in more flexed positions than when they are using desktop or notebook computers, the result of long periods of time with the head down and the neck flexed can result in neck pain. The study of this positions can help to improve the ergonomics of the tablet’s touchscreen interface.

In an article called “Activity Zones for Touchscreen Tablets and Phones” Dan Saffer, an interaction designer, shows the places where the controls of the tablets best match to the ergonomics of the hands while holding them, particularly in the joint of the thumb, with the ability to roll in a 45° sweep. To access other parts of the screen requires the use of the index finger or an extension of the thumb to access it. The high-use controls must be placed in the Easy zones and controls that are less used or can be accidentally pressed in the Reach zones.

![Tablet Activity Zones](image)

Figure 21. Tablet Activity Zones

In most of the tablets the user’s principal tool to interact with the tablet are his fingers so is important to take in account the anthropometrics of the human hand and evaluated in a wide range the areas from finger input properties. On the screen, percussive input commands such as typing on a multi-touch system have been studied (Thom-Santelli and Hedge, 2005). Dynamic gesture inputs such as clockwise rotation, expand (enlarge) and swipe, have been described as screen touch contact patterns and movement directions in the multi-touch gesture dictionary (Elias et al., 2010).

David J. Feathers, Ph.D. and Han Zhang, M.S. make a study in order to know the role of the stabilizing hand, wrist, and forearm when using a tablet. They test eleven healthy adults 6 females; 5 males, all right handed. The results were three different positions.
Although the exact percentage is unknown, studies have suggested that 7% to 10% of adults are left-handed. Most gestural interfaces should be optimized for the 90% of right-handers. Adjust the layout for lefties can be a good design practice (Saffer, 2009).

The ‘Flat Hand’ posture was adopted by three individuals. The MCP III placement ranged from 32-43% of the device length across all conditions for individuals adopting a ‘flat hand’ stabilizing posture.

The ‘Thumb Wrap’ posture was exhibited across four individuals, with an additional person adopting this posture for the rotation gesture. The flexion of the interphalangeal joint of the thumb to wrap around the lateral edge of the tablet. MCP III placement across individuals was modeled at 20-38% of device length. Extended medial digits were present for all participants in this posture.

The ‘Thumb Extended with Thenar Support’ posture was present across four participants, with one individual switching to a thumb wrap posture for the rotation gesture movements. MCP III translation showed a proximal orientation, ranging from 28-40% of device length. However, the MCP III was positioned laterally with respect to the tablet for all participants in this posture.

The size of the touch targets in the interface must be design according with the size of human fingers and the part of them that is used. A small target make users work harder because they require more accuracy to hit. Users need to reorient their finger, from finger pad to fingertip, to hit the target with clear visual feedback. Using the finger pad would cover the entire target, making it impossible for users to see the target they’re trying to hit. Users use the fingertip to hit small touch targets because it gives them the visual feedback they need to know that they’re hitting their target accurately. But when users have to reorient their finger, it slows their movement down, and forces them to work harder to hit their target.
When small targets are grouped near each other the user can hit another one accidentally because the user’s finger overlaps on the neighboring buttons. These errors are usually made when the thumb finger is used, because the thumb is larger than the target. Some users won’t always have two hands free when they’re on their mobile device. Many prefer the convenience of using only one hand and their thumb. Users shouldn’t have to switch from using one hand to two hands, or from their thumb to their index finger to hit a target accurately.

An MIT Touch Lab study of Human Fingertips to investigate the Mechanics of Tactile Sense found that the average width of the index finger is 1.6 to 2 cm (16 – 20 mm) for most adults. This converts to 45 – 57 pixels, which is wider than what most mobile guidelines suggest because it allows the user’s finger to fit snugly inside the target. They’re also able to hit and move to their targets faster due to its larger size. This is consistent with Fitt’s Law, which says that the time to reach a target is longer if the target is smaller. A small target slows users down because they have to pay extra attention to hit the target accurately.

For the thumb, the average width of an adult is 2.5 cm, which converts to 72 pixels. With this size users don’t have to reorient their thumb to the very tip to see it hit the target or tilt their thumb to the side to hit it.

A Target Size Study for One-Handed Thumb Use on Small Touchscreen Devices found that user errors declined as the target size increased. Users were able to tap the target faster without having to make intentional physical accommodations to increase accuracy such as reorienting the thumb, which would have slowed performance.

3.3 Guidelines

There are some points in which the guidelines focus in order to create a good software interface design. The important thing is to ensure the flow of the information from screen to screen, make it logical, that completes the user expectations and follow task requirements.

The first one is consistency in the icons, colors and terminology between screens; the second one is the simplicity of the tasks using familiar icons, objects and words; the third one is the human memory limitations so the information has to be organized and provide reminders, feedback and warnings; the forth one is about cognitive directness, use appropriate visual cues; the fifth point is to provide the correct feedback to the user; the sixth one is about providing clear messages to the users avoiding ambiguous terms; and the seventh is to avoid the attribution of human characteristics to objects (anthropomorphization).

There are also more principles for the design and implementation of effective interfaces such as the anticipation, autonomy, color blindness, consistency, defaults, efficiency of user and visible navigation.

A useful guideline that would help us to understand more the actual interface of the tablets is one made specifically for the developers of applications. This guideline provide information about the style of the devices and displays, themes, touch feedback, metrics and grids, typography, color, iconography and writing.

The Design of Everyday Things, Donald Norman defines the paradox of technology as follows: “Whenever the number of functions and required operations exceeds the number of
controls, the design becomes arbitrary, unnatural and complicated” (1998:29). Understanding what the user wants the device to do should be the first step in the simplification process.

The designer should agonize over the addition of each individual feature to the design no matter where it falls on the frequency of use scale (37signals, 2006). Bear in mind that each additional feature makes the overall product more complex and more difficult to use.

The interface should be kept both narrow (fewer choices at each level) and shallow (fewer levels of choice to the bottom of the hierarchy). As discussed in Section 10.4, if the number of options must exceed a narrow and shallow hierarchy, then it is more efficient to design a deeper structure than a wider one.

The principle of simplicity extends not only to the overall ease of use of the device but also to the complexity of each individual screen. Typically, small-screen applications are simpler than traditional applications; thus customization is less important even to advanced users.

Perhaps the most powerful tool in interface simplification is progressive disclosure. Progressive disclosure involves breaking down complex tasks into separate understandable parts. Each step in the task is split into screens that lead the users toward their goal (Buyukkokten, Garcia-Molina, & Paepcke, 2001).

With a flat list of options, the user is forced to decide between myriad (often ambiguous) options. It takes time for the user to decide which option to choose and, if the chosen option is incorrect, the user must scan the long list and choose again. A properly designed progressive disclosure employs mutually exclusive (orthogonal) choices at each step to ensure that the user is always progressing forward toward her goal. On a small-screen device, progressive disclosure is even more important than in traditional applications because of the limited screen space available to display information.

User input is an even more difficult design challenge than visual output for small-screen devices. This impediment implies that the designer must be thoughtful whenever adding user input widgets to the interface. If possible, avoid user input all together.

Ideally screens should be designed so that there is no need for scrolling of any kind. The small-screen designer does not have this luxury and instructional text should be less necessary since functionality is normally simpler on the small screen. A design that requires lengthy textual instructions is an indication that the interface is too complex and should be revised.

The beauty of the hyperlink is its ability to hide details while still making them available to those who want more information. Hyperlinking is especially useful in cases where users may see the same text many times.
Simplified content can sometimes lead to confusion if taken to an extreme. Error messages need to be helpful even on the small screen. Ideally an error message contains three distinct parts: (1) a unique error identifier, (2) a description of the problem, and (3) possible solutions. Item 1 is important in the case where the user is unable to quickly figure out a solution. A unique identifier allows users to easily seek help about their specific problem from an external source (e.g., a website or customer service). Items 2 and 3 need to be written without technical jargon and in a language that the user can understand. Properly written error messages can make a significant difference in the usability of a complicated system.

Users need to be made continually aware of what the system is doing while they interact with the device. Identify the information that is critical to the user’s needs and present only that information to the user. The use of alternative forms of feedback can be very powerful on small-screen devices (often in contrast to traditional computer applications). Using sound and tactile feedback is a standard technique on many small-screen devices because the user’s attention is rarely focused exclusively on the device.

However, the decision to use alternative feedback should not be made lightly. Users do not want their attention diverted unless an important event has occurred.

“User interface response time should be, at worst, 200 ms (1/5 of a second) or better. If an operation is expected to take a long time (e.g., a text search or a database query), then it should be executed in the background” (Research in Motion, 2003).

If for some reason a long task cannot be performed in the background and the user is forced to wait, ensure that detailed feedback is presented. Ideally such feedback includes an estimate of the amount of time the process will take to finish. The progress bar widget is an ideal feedback control for such situations since it gives the user an indication of how long the process will take and provides feedback that the process is still moving forward. For any process that forces the user to wait, even with strong feedback, ensure that you provide a way to cancel the task.

The design should begin with existing standards. Many of the more advanced small-screen devices (such as the Windows Mobile platform) have detailed interface guideline documents that are created to ensure consistency across all platform applications. Existing real-world metaphors that translate into the world of software are some of the most powerful user interface paradigms. Take for example the play, pause, track forward, and back buttons found on almost all digital music players.

Due to the limited amount of attention users give to their small-screen devices, it is important to respect the amount of both mental and physical effort the user must employ to interact with the interface. Instead of forcing the user to do the work, a good design will make the user’s tasks almost effortless. For example, several cameras provide panorama modes that aid the user in the creation of panoramic pictures by showing the side of the previous picture on the screen to help the user line up the next picture in the series (Isaacs & Walendowski, 2002).

The software wizard is a potent navigation paradigm that embodies the guideline of progressive disclosure and reduces the user’s memory load by splitting up complex tasks into multiple steps. For example, if the interface is capturing an address, ask for the ZIP/postal code first, then prepopulate the city and state fields with the appropriate data to reduce user input.

When using a small-screen device, users typically have a single task in mind and they want to complete that task as quickly as possible. Multitasking is a powerful tool, but it should be used primarily by the system and not by the user.
Part III. Evaluation
4 Usability testing with tablet

4.1 Experimental study with IDPS students

The objective of the test is study the quality of use of Tablet PC. The focus isn’t on the user behaviour but on usability problems with the use of new technologies. The group of interviewed were a sample of 12 IDPS and EPS students from 19 to 25 years old. Each student had to do 16 tasks on each tablet and time was measured. This experimental test has a duration time of 45 minutes. The analysis and the results were completely anonymous and all data only were for academically purposes.

Tasks:
1. Turn on
2. Unlock
3. Change the language: put the Tablet in Spanish.
4. Change the language: put the Tablet in English
5. Connect on the internet
6. Open YouTube browser
7. Search for the video: “IPhone 5 (Parody)”
8. Open the video IPhone 5 (Parody)
9. Increase the volume
10. Put in full screen
11. Stop the video and exit internet
12. Access to the rest of applications of your Tablet
13. Take a picture with the camera
14. Access to the gallery folder with the aim to watch your picture
15. Close all applications
16. Turn off

Results:
a) 66% of the interviewed prefer the posture Thumb Extended with Thenar Support, 25% prefer Thumb Wrap’ posture and 9% prefer Flat Hand’ posture and 75% of the interviewed use fingertip, the rest, 25%, use finger pad.
b) 50% of the respondents have problems with the size of the targets, the majority think that it is small, against 42% that don’t have problems. Furthermore, 8% of the students complain only about Prixton targets.

c) 50% has vision problems with Prixton, 17% with Fnac and nobody has with Samsung, and also 33% don’t have vision problems at all.
d) One of the questions was about the preference of the tablets, and the respondents have to analyze everything that is involved and justify. 58% said that prefer Samsung, 34% Fnac and only 8% Pritxton.

![Tablets Preferences](image)

**Figure 26. Preference of Tablets**

f) Moreover, 33% of them prefer other devices to develop similar tasks.

g) Half of the respondents didn’t have previous knowledge about mobile devices and 75% don’t use tablets, but 25% said that depending of the tasks the tablet is not the first choice, for example to work and research the computer is still preferred.

h) Another data is that 58% of the respondents prefer Samsung tablets, 34% Fnac and only 8% Pritxton.

i) If we compare the average time of the 16 tasks that the user did with the 3 tablets, it’s almost the same, the fastest one is Fnac (3 minutes in total), then Pritxton and Samsung with the same time (3.4 minutes). This means that although one of the biggest complaints was about the feedback time of the tablets, in the end they are almost the same. In other words, all of them software has to be improved.
4.2 Effectiveness, efficiency and satisfaction

The SUS – System Usability Scale is a tool used to know the user’s opinion about the define product. It was developed by John Brooke at Digital Equipment Corporation in the UK in 1986 as a tool to be used in usability engineering of electronic office systems. Furthermore, measurements of usability have several different aspects:

- effectiveness (can users successfully achieve their objectives)
- efficiency (how much effort and resource is expended in achieving those objectives)
- satisfaction (was the experience satisfactory)

Table 6. Timetable Usability Test

<table>
<thead>
<tr>
<th>ITEM</th>
<th>TASK</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PRIXTON</td>
</tr>
<tr>
<td>1</td>
<td>Turn on</td>
<td>17,8</td>
</tr>
<tr>
<td>2</td>
<td>Unlock</td>
<td>6,2</td>
</tr>
<tr>
<td>3</td>
<td>Change the language: put the Tablet in Spanish.</td>
<td>25,0</td>
</tr>
<tr>
<td>4</td>
<td>Change the language: put the Tablet in English</td>
<td>8,9</td>
</tr>
<tr>
<td>5</td>
<td>Connect on the internet</td>
<td>14,7</td>
</tr>
<tr>
<td>6</td>
<td>Open Youtube from the browser.</td>
<td>22,1</td>
</tr>
<tr>
<td>7</td>
<td>Search for the video: “IPhone 5 (Parody)”</td>
<td>21,6</td>
</tr>
<tr>
<td>8</td>
<td>Open the video IPhone 5 (Parody)</td>
<td>8,9</td>
</tr>
<tr>
<td>9</td>
<td>Increase the volume</td>
<td>8,7</td>
</tr>
<tr>
<td>10</td>
<td>Put in full screen</td>
<td>10,2</td>
</tr>
<tr>
<td>11</td>
<td>Stop the video and exit internet</td>
<td>10,7</td>
</tr>
<tr>
<td>12</td>
<td>Access to the rest of applications of your Tablet</td>
<td>10,3</td>
</tr>
<tr>
<td>13</td>
<td>Take a picture with the camera</td>
<td>15,6</td>
</tr>
<tr>
<td>14</td>
<td>Access to the gallery folder</td>
<td>15,8</td>
</tr>
<tr>
<td>15</td>
<td>Close all applications</td>
<td>5,7</td>
</tr>
<tr>
<td>16</td>
<td>Turn off</td>
<td>11,5</td>
</tr>
</tbody>
</table>

**total (minutes)** | 3,4 | 3,4 | 3,0

Table 7. SUS Test

<table>
<thead>
<tr>
<th>Item</th>
<th>Statement</th>
<th>strongly disagree</th>
<th>disagree</th>
<th>no opinion</th>
<th>agree</th>
<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I think that I would like to use this system frequently</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I found the system unnecessarily complex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>I thought the system was easy to use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>I think that I would need the support of a technical person to be able to use this</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>I found the various functions in this system well integrated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>I thought there was too much inconsistency in this system</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>I would imagine that most people would learn to use this system very quickly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>I found the system very cumbersome to use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>I feel very confident using the system</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>I needed to learn a lot of things before I could get going with this system</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The SUS has been widely used in the evaluation of a range of systems worldwide and provide a score at the end 0 – 100. A SUS score above a 68 would be considered above average and anything below 68 is below average. Even though a SUS score can range from 0 to 100, it isn't a percentage. While it is technically correct that a SUS score of 70 out of 100 represents 70% of the possible maximum score, it suggests the score is at the 70th percentile. A score at this level would mean the application tested is above average. In fact, a score of 70 is closer to the average SUS score of 68. It is actually more appropriate to call it 50%.

The SUS was applied to 12 IDPS and EPS students from UPC after they operated 3 different tablets and some conclusions were made based on the data. All students disagree or strongly disagree with this 3 sentences: 4- I think that I would need the support of a technical person to be able to use this system, 8 - I found the system very cumbersome to use, 10 - I needed to learn a lot of things before I could get going with this system. All students agree or strongly agree with this sentence: 5 - I found the various functions in this system well integrate.

The users found some difficulties on the operation of the system because sometimes the interface and what they are supposed to do is not so clear, so they agree that they have to get used to the interface first and then they can operate quite well, but they recognize that the tablets are an excellent tool for business, studying or entertainment.

The test shows that the tablets have an average score of 78.8. The best way to interpret your score is to convert it to a percentile rank through a process called normalizing, considering the graphic below, so the tablets average score is approximately 80%. It can be interpreted as a grade of a B. You'd need to score above an 80.3 to get an A (the top 10% of scores). This is also the point where users are more likely to be recommending the product to a friend. The “FDCBA” scale indicates the level of satisfaction of the user with the device, in witch the highest level is A that means that the user highly recommend the product with out receiving any reward from a company and the lowest level is F that means the user is not satisfied with the product.

![SUS Score](image)

Figure 27. SUS Score
Another way to look at the data is to see what the SUS scores are for promoters and detractors. Promoters have an average SUS score of 82 while detractors have an average score of 67 (p <.01). If you're looking for a SUS score to aim for, I'd say anything above an 80 would put you safely in the promoter range.
Part IV. Design
5. Guideline design for small interfaces

In this chapter will be present a guideline for small interfaces. The guideline was based on the work on Zwick (Zwick et. al, 2012) and the purposed document has two parts. The first one is a set of heuristics and the second part is the evaluation of these heuristics.

5.1 Heuristics

### 1. Architecture

#### 1.1 List of applications

The user can look and decide how to arrive on one screen.

Is there a map in mobile applications?

- **H1** There is a list of applications [YES NO] [5 0]

#### 1.2 Number of levels

The number of levels shows the depth and the amplitude of the interface. In some occasions it is easy to access with a few number of clicks (access to camera, whatsapp), in other occasions the number of clicks is higher (configuration, language).

- **H2** Number of levels [le=4 4<le<8 le>8] [5 3 0]

#### 1.3 Menus

An architecture is defined together with the type of menus. The pull-down menus are useful and the nested pull-down menus should be avoided on small screens.

- **H3** The nested-pull-down are avoided [YES NO] [5 0]

### 2. Navigation

The system bars are screen areas dedicated to the display of notifications, communication of device status, and device navigation.
Guideline for small interfaces.

For example, we can use the next pattern for navigating to a subscreen or sequence of subscreens that guide the user through a more complex setup process.

- If navigating to a single subscreen, use the same title in both the subscreen and the label navigating to it.

- If navigating to a sequence of subscreens (as in this example), use a title that describes the first step in the sequence.

✓ H4 Buttons that allow users move from one page to another to understand the information fragment and all the content. [YES NO] [5 0]

✓ H5 Navigation and interaction elements in a touch screen are located in the bottom area of the screen. [YES NO] [5 0]

✓ H6 It avoids double row of horizontal tabs. [YES, NO] [5 0]

✓ H7 Dynamic organization of the space with the aim to enlarge the part that the user is paying attention. [YES NO] [5 0]

3. Distribution

3.1 Model comparison

The interface uses a template.

In this figure, there is an example of layout. Where zone 1 is the main action bar, 2 is view control, 3 is content area and 4 is split action bar.

✓ H8 Model comparison [a m na] [5 3 0]
3.2 Flow process

Longer actions are divided into steps inside dialog boxes. The users know the steps number to finish.

✓ H9 Flow [YES NO] [5 0]

3.3 Density

The number of applications fill the full screen. This is an example of high density.

✓ H10 Density [a m na] [5 3 0]

4. Color

There are colors combinations (red-green, blue-yellow, green-blue, red-blue) that is necessary avoid. In web applications the experts explain that for novice users they recommend 4 colours, and for expert users they recommend the use of color primarily for emphasis. The colors must fit with the task and provide good contrast between visual components. Note that red and green may be indistinguishable to color-blind users.

Blue is the standard accent color in Android's color palette. Each color has a corresponding darker shade that can be used as a complement when needed.

✓ H11 Absence of non-appropriate combinations [YES NO] [5 0]

4.1 Contrast

✓ H12 Contrast [a m na] [5 3 0]

4.2 Relationship with text

✓ H13 Relationship with text [a m na] [5 3 0]
Guideline for small interfaces.

5. Text

✓H14 Font number [l<4 f>4] [5 0]

The application allows continuous zooming and free selection of the focus point.

✓H16 Zoom [YES NO] [5 0]

6. Icons

An icon is a graphic that takes up a small portion of screen real estate and provides a quick, intuitive representation of an action, a status, or an app.

The style is pictographic, flat, not too detailed, with smooth curves or sharp shapes. If the graphic is thin, rotate it 45° left or right to fill the focal space. The thickness of the strokes and negative spaces should be a minimum of 2 dp.

About the status representativeness, notification icons must be entirely white. Also, the system may scale down and/or darken the icons.

✓H17 Homogeneous icons and symbols [a m na] [5 3 0]

Since the user can change the “Home” screen’s wallpaper, the launcher icon must be clearly visible on any type of background.

✓H18 Visibility [a m na] [5 3 0]

When a user taps a target, it’s a good idea to confirm by asking the user to verify that they truly want to proceed with an action they just invoked. The confirmation can be presented along with a warning or critical information related to the action that they need to consider. The acknowledgment information must be presented with an option to undo the action.

✓H19 Confirm user action [YES NO] [5 0]
7. Visual perception

7.1 Proximity
The law of proximity states that elements which are arranged closely together are perceived as a group or unit.

✓ H20 Proximity [YES NO] [5 0]

7.2 Similarity
The law of similarity maintains that elements with similar properties are perceived as belonging to a group or unit.

✓ H21 Similarity [YES NO] [5 0]

7.3 Closure
This law of closure states that our perception skills will supplement incomplete elements.

✓ H22 Closure [YES NO] [5 0]

7.4 Good form
The law of good form maintains that human perception will look for the greatest degree of simplicity, clarity and regularity and then interpret this form as a coherent element.

✓ H23 Good form [YES NO] [5 0]

7.5 Symmetry/Regularity
This law asserts the tendency of human perception to search for regular forms. These regular patterns can be created by equal gaps or by mirrored axes.

✓ H24 Symmetry/Regularity [YES NO] [5 0]

7.6 Figure/Ground
The law states that a striking element will be perceived as the relevant form, and any surrounding space is considered to be the background.

✓ H25 Figure/Ground [YES NO] [5 0]
Guideline for small interfaces.

7.7 Continuity

The law maintains that the human perception system does not analyze each new component afresh, but instead draws conclusions based on what it has already seen or experienced.

✓ H26 Continuity [YES NO] [5 0]

8. Interaction

In two hand held devices:

✓ H27 The device has a trackball. [YES NO] [5 0]

✓ H28 The device has a mini joystick with two degrees of freedom. [YES NO] [5 0]

Touch screen

✓ H29 The can distinguish the user actions between a click and a roll-over. [YES NO] [5 0]

9. Interaction techniques

9.1 Instant Feedback

Each user action has a quickly answer (auditive, visual). If the system answer is slow, we need warn the user with a message

✓ H30 Instant feedback to the user [YES, NO] [5 0]

9.2 Natural mapping

Location of control elements related to the screen. For horizontal elements: reading direction from left to right:

- Confirm, next operation (right position)
- Change, back operation (left position)
- Additional information (center position)
Guideline for small interfaces.

✓ H31 Appropriate horizontal natural mapping. [YES NO] [a m na]
   For vertical elements, increase to decrease. (Increase the volume: up. Decrease the volume: down)

✓ H32 Appropriate vertical nature mapping.
   [YES NO] [5 0]
   Gestures allow users to interact with the tablet by manipulating the screen objects. These gestures should be natural and comfortable to the user.

✓ H33 Gestures supported [a m na] [5 3 0]
5.2 Application of the guideline

The aim of this chapter is the application of the designed guideline (previous defined in chapter 4) to Tablet PC and smartphones. With the results of the evaluation and the guideline we have a complete vision of the problems and improvements that we have to do.

### GUIDELINE FOR SMALL INTERFACES

**Version 1**  
May 2013  
K Garvin, F. González, R. Neves, L. Santos, P. Ponsa

<table>
<thead>
<tr>
<th>HEURISTIC</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
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<tr>
<td>1 ARCHITECTURE</td>
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<td>2.4 The dynamic organization of the space is a characteristic, considering the lack of space on smaller screens</td>
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<td>3,3</td>
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<td>1,7</td>
<td>0,0</td>
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<td>1,7</td>
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<td>5</td>
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<td>5 TEXT</td>
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<td>6 ICONS</td>
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<tr>
<td>6.1 The interface has homogeneous icons and symbols</td>
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<td>6.3 The icons are representative</td>
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<tr>
<td>6.4 The are confirming and acknowledge messages about the user action</td>
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<tr>
<td>7 VISUAL PERCEPTION</td>
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<tr>
<td>7.1 The elements which are arranged closely together are perceived as a group or unit.</td>
<td>(5, 0)</td>
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<td>5</td>
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<tr>
<td>7.2 The elements with similar properties are perceived as belonging to a group or unit.</td>
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<td>0</td>
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<tr>
<td>7.3 The users perception skills could supplement incomplete elements.</td>
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<tr>
<td>7.4 There is a good form with great degree of simplicity, clarity and regularity</td>
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<td>7.5 The interface presents symmetry</td>
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<td>7.6 It is possible to distinguish the principal content from the background</td>
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<td>7.7 It is possible to draw conclusions based on what were already seen or experienced instead of analyze each new component afresh</td>
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<td>8 INTERACTION</td>
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<td>8.1 In two hand devices: The device has a trackball</td>
<td>(5, 0)</td>
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<tr>
<td>8.2 In two hand devices: The device has a mini joystick with two degrees of freedom</td>
<td>(5, 0)</td>
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<td>8.3 The touch screen can distinguish the user actions between a click and a roll-over</td>
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<td>9 INTERACTION TECHNIQUES</td>
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<td>9.1 The system gives instant feedback to the user</td>
<td>(5, 0)</td>
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<td>9.2 The system has an appropriate horizontal natural mapping</td>
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<td>9.3 The system an appropriate vertical natural mapping</td>
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<td>9.4 It is possible to manipulating the screen objects</td>
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</tr>
</tbody>
</table>

**GLOBAL VALUE**

|    | 3.0 | 2.9 | 2.7 | 1.9 | 3.9 | 3.4 | 2.5 |

Table 8. Guideline for small interfaces
Informal explanations about the grades:

1 ARCHITECTURE

1.1 There is a list of applications.
S1) Samsung Galaxy Ace2: it's very easy to find the app. There is a button in the first page.
S2) Iphone4: on "Settings", it is possible to find the app list.
S3) BlackBerry Curve: no, there is no list of application; you have to enter to your account in the App World to see which applications have been downloaded.
S4) Nokia S5: yes, there is a list of applications in the main menu screen that allows access to messaging, calls, and other features.
T1) Samsung Galaxy Tablet: yes, in the settings menu you can consult all the applications that the tablet has.
T2) Fnac Tablet: yes, the main screen has a list of applications that were pre-installed or downloaded available on the device.
T3) Prixton Tablet: in the settings menu.

1.2 There is a limited number of levels.
S1) Samsung Galaxy Ace2: the maximum level is 5.
S2) Iphone4: there are activities with 7 steps, for example, access the license term.
S3) BlackBerry Curve: yes, some actions have more than 3 levels but most of them are very simple to reach.
S4) Nokia S5: yes, the device is rather straightforward so within three clicks you can manipulate the device to the applications you desire.
T1) Samsung Galaxy Tablet: yes, you can get quickly to the target you want.
T2) Fnac Tablet: the number of levels is minimal however the steps required to complete certain tasks are rather long and time-consuming.
T3) Prixton Tablet: the number of levels is not too much

1.3 The nested-pull-down menus are avoided.
S1) Samsung Galaxy Ace2: there is no menu like these.
S2) Iphone4: there is no menu like this, only pull-down menus.
S3) BlackBerry Curve: yes, it doesn’t have this kind of menu, instead it leads you to a new screen each time you select one option.
S4) Nokia S5: no they occasionally pop up throughout the interface particularly in the web browser.
T1) Samsung Galaxy Tablet: yes, it doesn’t have any of these menus, each time you tap an option it leads you to another screen where you can select another one.
T2) Fnac Tablet: no nested menus are part of the main interface and have to be used sometimes to complete specific tasks.
T3) Prixton Tablet: yes, there is some nested pull down menus.

2 NAVIGATION

2.1 The double row of horizontal tabs are avoided.
S1) Samsung Galaxy Ace2: there is double row only on the internet.
S2) Iphone4: just appear one horizontal tab.
S3) BlackBerry Curve: yes, they are avoided in most of the menus but it’s easy to select them using the trackball.
S4) Nokia S5: to an extent they are avoided however they do appear throughout the interface depending on the action such as in the settings menu and so on.
T1) Samsung Galaxy Tablet: there are some horizontal tabs in the internet browser, for example, and it’s very hard to tap them.
T2) Fnac Tablet: no the horizontal tabs are evident throughout the interface.
T3) Prixton Tablet: no the horizontal tabs.

2.2 There are buttons that allow users move from one page to another.
S1) Samsung Galaxy Ace2: (physical button) yes, the navigation buttons are very straight forward and easy to manipulate
S2) Iphone4: usually, there is a sign, arrow (-->), that indicates the way to move
S3) BlackBerry Curve: yes, you can do it with the buttons and the trackball too.
S4) Nokia S5: yes, the navigation buttons are very straight forward and easy to manipulate.
T1) Samsung Galaxy Tablet: yes, it’s easy to go back or home from any screen.
T2) Fnac Tablet: Yes there is a well-structured navigation set up on the interface that allows easy navigation through different elements.
T3) Prixton Tablet: you can go back or forward easily.

2.3 There are interaction elements in the bottom area.
S1) Samsung Galaxy Ace2: 3 physical buttons = to come the previous page, main page and settings.
S2) Iphone4: the circle button moves to the main screen anytime you want, and the others buttons are well located too.
S3) BlackBerry Curve: yes, the navigation buttons are in the bottom area, the phone doesn’t have a touch screen so these buttons never disappear making easier to manipulate.
S4) Nokia S5: no they are virtually non-existent and the use of manual navigation through the pages is required.
T1) Samsung Galaxy Tablet: yes, they are always located in the bottom so it’s easy to navigate from one page and return no another.
T2) Fnac Tablet: yes, interaction elements are located around the bottom to navigate to the main page or go backwards.
T3) Prixton Tablet: yes.

2.4 The dynamic organization of the space is a characteristic, considering the lack of space on smaller screens.
S1) Samsung Galaxy Ace2: depends of the app or the internet page
S2) Iphone4: sometimes, the screen is too full of information and there is no space, making it impossible to understand
S3) BlackBerry Curve: some menus are full of information, the space is limited but without organization it would confuse the user.
S4) Nokia S5: for a screen that is smaller than most found on more modern phones the distribution of icons and space is very well organized and easy to find.
T1) Samsung Galaxy Tablet: yes, you can personalize it but the templates given make them look always clear and well structured.
T2) Fnac Tablet: the interface is well structured and uses space intelligently while leaving space for other features.
T3) Prixton Tablet: the interface is well structured and you can visualize all information on the screen.

3 DISTRIBUTION

3.1 The interface uses a template.
S1) Samsung Galaxy Ace2: all Galaxys use the same template.
S2) Iphone4: with clock, battery level, company, sign, and wifi (transparent bar).
S3) BlackBerry Curve: it has different templates depending on the menus, but it doesn’t have a fixed one.
S4) Nokia S5: the interface does not conform to a set template and at times appears and lacks consistency.
T1) Samsung Galaxy Tablet: yes, it uses the Android template.
T2) Fnac Tablet: yes, the tablet uses the standard Android template.
T3) Prixton Tablet: yes, the tablet uses the standard Android template.

3.2 The actions are divided into steps inside dialog boxes and appear the steps number to finish.
S1) Samsung Galaxy Ace2: no clear steps are shown and it’s really up to the users own intuition on how many steps they need to complete the action in question. Only in the photos gallery appear the steps.
S2) Iphone4: only to access the photos (gallery)
S3) BlackBerry Curve: yes, each time you install a program, for example, a dialog box appear indicating the steps and the condition of the installation.
S4) Nokia S5: no clear steps are shown and it’s really up to the users own intuition on how many steps they need to complete the action in question.
T1) Samsung Galaxy Tablet: yes, it always indicates you in which part of the process you are.
T2) Fnac Tablet: the actions feel natural and are easy to navigate to and from.
T3) Prixton Tablet: there is not dialog box showing the steps to finish an activity.

4 COLOR

4.1 Absence of non-appropriate combinations.
S1) Samsung Galaxy Ace2: the colors are well thought out and do not clash. This makes items and features easy to identify.
S2) Iphone4: rarely, appear the combination blue-yellow.
S3) BlackBerry Curve: it is hard to read the text with some backgrounds in the main screen.
S4) Nokia S5: the colors are well thought out and do not clash. This makes items and features easy to identify.
T1) Samsung Galaxy Tablet: yes, the colors are well used so the object in the screen is very clear.
T2) Fnac Tablet: yes, the color scheme is rather simple but effective and gives a clear definition of various features and navigation.
T3) Prixton Tablet: the colors are right used.

4.2 There is a minimum quality of contrast.
S1) Samsung Galaxy Ace2: some icons don't have the appropriate contrast, it's depends of the app.
S2) Iphone4: the quality of contrast can be improved.
S3) BlackBerry Curve: the icons and objects have good contrasts, most of the menus backgrounds are on withe and the text black.
S4) Nokia S5: sometimes the white text was hard to determine as it would clash with specific background such as the wall paper on the main screen however other features were rather well defined with good contrast.
T1) Samsung Galaxy Tablet: the color makes good contrast with the background and with the other elements of the interface.
T2) Fnac Tablet: sometimes the color of the icons would blend into that of the background and some backgrounds were rather confusing and offered a distraction.
T3) Prixton Tablet: not every time this combination is good, can be improved.
4.3 It is noticeable the relationship among colors and text, aiming good visualization.
S1) Samsung Galaxy Ace2: sometimes it was hard to see the text when using some backgrounds.
S2) Iphone4: This can be improved also.
S3) BlackBerry Curve: yes colors are well used and and it’s easy to identify the icons.
S4) Nokia S5: sometimes it was hard to see the text when using some backgrounds.
T1) Samsung Galaxy Tablet: yes, the text in the icons has good size so it’s easy to read them and match with the colors of the icons.
T2) Fnac Tablet: yes, the color allows the user to find objects and functions clearly however on some occasions it did not always work.
T3) Prixton Tablet: not every time, sometimes it’s difficult to see on the screen.

5 TEXT

5.1 The font number was chosen to enable the reading.
S1) Samsung Galaxy Ace2: yes.
S2) Iphone4: The icon title is too small.
S3) BlackBerry Curve: It has the possibility to change the size of the font but the one that comes predetermine with the phones its good, clear to understand it.
S4) Nokia S5: Hard to read the text sometimes limiting the user.
T1) Samsung Galaxy Tablet: Yes, and you can also personalize the size that you prefer.
T2) Fnac Tablet: The font size can be enlarged or minimalized according to preference.
T3) Prixton Tablet: The font size can be enlarged or minimalized according to preference.

5.2 It allows continuous zooming and free selection of the focus point.
S1) Samsung Galaxy Ace2: can't do the zoom in the main screen and the app screen.
S2) Iphone4: the zoom work well, although sometimes you want to zoom but you can’t (for examples, in the main screen).
S3) BlackBerry Curve: it doesn’t have the option to zoom in while you’re navigating through the menus of the phone, only in the internet browser you can do it.
S4) Nokia S5: this feature is virtually non-existent with no option given.
T1) Samsung Galaxy Tablet: yes, it’s possible to zoom in.
T2) Fnac Tablet: it is possible to zoom on an area of interest.
T3) Prixton Tablet: can be improved also.

6 ICONS

6.1 The interface has homogeneous icons and symbols.
S1) Samsung Galaxy Ace2: the interface has universal icons that are easy to recognize however some are quite vague and hard to determine.
S2) Iphone4: the icons can be improved.
S3) BlackBerry Curve: yes, all of the icons have the same kind of graphics but some of them can confuse the user.
S4) Nokia S5: the interface has universal icons that are easy to recognize however some are quite vague and hard to determine.
T1) Samsung Galaxy Tablet: yes the interface use universal icons that can be understand easily.
T2) Fnac Tablet: yes the interface makes good use of universal and easy to recognize icons.
T3) Prixton Tablet: it’s good, but maybe need some changes.
6.2 The icons enable the clear visualization.
S1) Samsung Galaxy Ace2: the icons are easy to identify and determine.
S2) Iphone4: the screen provides a high definition of the image.
S3) BlackBerry Curve: yes, they have the correct colors to make a good contrast.
S4) Nokia S5: the icons are easy to identify and determine in the interface.
T1) Samsung Galaxy Tablet: yes, the colours and the text make them clear.
T2) Fnac Tablet: yes the icons are easy to read and recognize.
T3) Prixton Tablet: yes.

6.3 The icons are representative.
S1) Samsung Galaxy Ace2: depends of the app, sometimes they aren't representative.
S2) Iphone4: some icons can be more representative (for example: messages, pictures, camera, videos, browser, etc).
S3) BlackBerry Curve: some icons are not clear.
S4) Nokia S5: yes, the icons represent clearly the function intended.
T1) Samsung Galaxy Tablet: yes, it’s easy to recognize witch action they are supposed to perform.
T2) Fnac Tablet: the icons represent the function clearly.
T3) Prixton Tablet: it’s good, but maybe need some changes.

6.4 They are confirming and acknowledge messages about the user action.
S1) Samsung Galaxy Ace2: yes.
S2) Iphone4: maybe can exist more messages, or levels of feedback that the user can select according to his preference.
S3) BlackBerry Curve: yes, it has an instant feedback.
S4) Nokia S5: it does not confirm if the user has completed the action in a clear manner and must be checked manually.
T1) Samsung Galaxy Tablet: yes, a dialog box appears each time you’re performing an important change.
T2) Fnac Tablet: yes, acknowledgement messages appear at the right time when needed such as when deleting an item.
T3) Prixton Tablet: yes, a dialog box appears.

7 VISUAL PERCEPTIONS

7.1 The elements which are arranged closely together are perceived as a group or unit.
S1) Samsung Galaxy Ace2: I can move the icons, so I can create the group if I want.
S2) Iphone4: It is possible to form groups or not.
S3) BlackBerry Curve: this is not clear on the interface.
S4) Nokia S5: Some elements may look similar but perform different action.
T1) Samsung Galaxy Tablet: yes, the controls are arranged that way.
T2) Fnac Tablet: yes, this is clearly defined in the Fnac interface.
T3) Prixton Tablet: not every time.

7.2 The elements with similar properties are perceived as belonging to a group or unit.
S1) Samsung Galaxy Ace2: I can move the icons, so I can create the group if I want.
S2) Iphone4: It was not possible to identify relationship between the icons that are closely
S3) BlackBerry Curve: yes, the similar ones are grouped together.
S4) Nokia S5: this is not evident on the Nokia interface.
T1) Samsung Galaxy Tablet: yes, similar elements are grouped together and you can also personalize them.
T2) Fnac Tablet: Yes this is evident in the interface.
T3) Prixton Tablet: not clear.

7.3 The user’s perception skills could supplement incomplete elements.
S1) Samsung Galaxy Ace2: they could however due to the simple nature of the interface it would not be possible or is already laid out.
S2) Iphone4: not always, but when it is necessary.
S3) BlackBerry Curve: this interface doesn’t have elements with this property
S4) Nokia S5:
T1) Samsung Galaxy Tablet: yes, the interface it’s easy to understand and easy to complete.
T2) Fnac Tablet: For certain areas yes like in settings however the interface is well thought out and well designed so everything is self-explanatory.
T3) Prixton Tablet:

7.4 There is a good form with great degree of simplicity, clarity and regularity
S1) Samsung Galaxy Ace2: yes, the interface is simple with no complex icons or properties thus making it rather straight forward.
S2) Iphone4: the interface is clear.
S3) BlackBerry Curve: the interface is simple and clear.
S4) Nokia S5: yes, the interface is simple with no complex icons or properties thus making it rather straight forward.
T1) Samsung Galaxy Tablet: yes, it’s very easy to get in use with this interface, its simple and you don’t need previous knowledge to understand it.
T2) Fnac Tablet: yes, the interface is rather straight forward and easy to use and figure out especially for novice users.
T3) Prixton Tablet: it is simple and regular but not too clear.

7.5 The interface presents symmetry:
S1) Samsung Galaxy Ace2: yes, the interface is very well laid out and symmetry is evident throughout the interface.
S2) Iphone4: the icons have the same size such as the titles, letter, buttons, etc.
S3) BlackBerry Curve: yes, the symmetry is clear throughout the interface.
S4) Nokia S5: yes, the interface is very well laid out and symmetry is evident throughout the interface.
T1) Samsung Galaxy Tablet: yes and this symmetry make the elements look more organized.
T2) Fnac Tablet: there is a good level of symmetry in the interface.
T3) Prixton Tablet: good level of symmetry.

7.6 It is possible to distinguish the principal content from the background.
S1) Samsung Galaxy Ace2: except when the background has a strong brilliant color
S2) Iphone4: except when the background has a strong brilliant color or is white/clear.
S3) BlackBerry Curve: yes, the background makes contrast with the text and icons.
S4) Nokia S5: Yes the interface has a clearly defined icon pattern and the background does not interfere with it.
T1) Samsung Galaxy Tablet: yes, and this is more clear if the background it’s dark.
T2) Fnac Tablet: yes, the icons stand out from the main background and are easily distinguishable.
T3) Prixton Tablet: except when the background has a strong brilliant color.

7.7) It is possible to draw conclusions based on what were already seen or experienced instead of analyze each new component afresh.
S1) Samsung Galaxy Ace2: yes, the icons and functions of the device are clearly laid out and
easy to recognize so no text is required for certain actions.
S2) Iphone4: the interface follows standard rules.
S3) BlackBerry Curve: yes, it’s easy to recognize the actions that each object can perform.
S4) Nokia S5: Yes the icons and functions of the device are clearly laid out and easy to recognize so no text is required for certain actions.
T1) Samsung Galaxy Tablet: yes, in order to manipulate it you have to make very natural movements that make easy to use them without having previous information.
T2) Fnac Tablet: yes, the interface is well planned and designed and users can easily make conclusions on what step to make next if it isn’t evident on the design.
T3) Prixton Tablet: the interface doesn’t follow standard rules.

8 INTERACTION

8.1 In two hand devices: The device has a trackball.
S1) Samsung Galaxy Ace2: don’t have trackball.
S2) Iphone4: it is not necessary.
S3) BlackBerry Curve: yes the main button acts like a mouse however the system lacks any page navigation method.
S4) Nokia S5: yes, the main button acts like a mouse however the system lacks any page navigation method.
T1) Samsung Galaxy Tablet: no.
T2) Fnac Tablet: this is not evident on the interface.
T3) Prixton Tablet: no.

8.2 In two hand devices: The device has a mini joystick with two degrees of freedom.
S1) Samsung Galaxy Ace2: don’t have joystick.
S2) Iphone4: It is not necessary.
S3) BlackBerry Curve: yes, and it’s very easy to navigate with it.
S4) Nokia S5: no this feature is not available in the device.
T1) Samsung Galaxy Tablet: no, the navigation buttons are on the screen.
T2) Fnac Tablet: this feature does not exist on the modern screen of the Fnac.
T3) Prixton Tablet: no.

8.3 The touch screen can distinguish the user actions between a click and a roll-over.
S1) Samsung Galaxy Ace2: yes.
S2) Iphone4: yes, clearly distinguish.
S3) BlackBerry Curve: yes, it’s easy to click you have to push the trackball and to roll over only move it.
S4) Nokia S5: again this action is not available on the device as it has a rather outdated interface.
T1) Samsung Galaxy Tablet: yes, the interface is able to distinguish between these actions.
T2) Fnac Tablet: the interface is able to distinguish between these actions.
T3) Prixton Tablet: yes.

9 INTERACTION TECNIQUES

9.1 The system gives instant feedback to the user.
S1) Samsung Galaxy Ace2: sometimes it takes a couple of seconds or operates rather slowly compared to more modern devices so data feedback is not instantaneous.
S2) Iphone4: clearly distinguish.
S3) BlackBerry Curve: yes, with important actions a dialog box appears to confirm it.
S4) Nokia S5: sometimes it takes a couple of seconds or operates rather slowly compared to
more modern devices so data feedback is not instantaneous.
T1) Samsung Galaxy Tablet: yes, it plays some sounds to notify a change
T2) Fnac Tablet: yes, feedback is instantaneous for the user.
T3) Prixton Tablet: good feedback when exist.

9.2 The system has an appropriate horizontal natural mapping.
S1) Samsung Galaxy Ace2: the back operation button is physical and it is located on the right position.
S2) Iphone4: text from left to right, but the back operation button many times is on the right position and not on left. The inverse occurs with the next operation button. The additional information sometimes is on the extremities.
S3) BlackBerry Curve: yes, the things appear from left to right.
S4) Nokia S5: This is not evident on the interface.
T1) Samsung Galaxy Tablet: yes, the order is from left to right.
T2) Fnac Tablet: horizontal mapping is evident throughout the interface.
T3) Prixton Tablet: yes, the things appear from left to right.

9.3 The system an appropriate vertical natural mapping.
S1) Samsung Galaxy Ace2: this is not evident.
S2) Iphone4: From up to down always.
S3) BlackBerry Curve: yes, the order is from up to down.
S4) Nokia S5: This is not evident.
T1) Samsung Galaxy Tablet: yes, the order is from up to down.
T2) Fnac Tablet: This is evident throughout the interface.
T3) Prixton Tablet: yes, the order is from up to down.

9.4 It is possible to manipulating the screen objects.
S1) Samsung Galaxy Ace2: yes, the interface allows you to manipulate the icons as well as backgrounds and basic setup.
S2) Iphone4: not every time that the user want/need, maybe could be included some other manipulating action.
S3) BlackBerry Curve: it doesn’t have a touch screen.
S4) Nokia S5: yes the interface allows you to manipulate the icons as well as backgrounds and basic setup.
T1) Samsung Galaxy Tablet: yes, it’s easy to manipulate because the gestures are very natural and simple.
T2) Fnac Tablet: as it is a touch screen it is possible to manipulate almost any on the screen.
T3) Prixton Tablet: not so much liberty to operate.

Comments about the smartphones

S1) Samsung Galaxy Ace

Its interface has silky smooth animations and well-rendered icons. The usual Phone, Messaging and Applications icons are located at the base of the screen, and underneath those are three physical buttons: Back, Menu and Home. The smooth and responsive user interface, really gives the Galaxy Ace 2 a higher-class feel. At the base of the touchscreen is Samsung's tablet-shaped physical home button, flanked by two touch keys -- menu and back. This light up when you tap them but are also marked on the plastic so you know which is which.
S2) Iphone 4

The Iphone 4 is an excellent product because the use is very intuitive and simple. The interface is clean and regular; only with relevant information and this fact transmit more comfort to the user. This product is quicker that the others and has better hardware, which improves the quality of its service. Of course it is not perfect and as the others deserve some improvements on the interface, specifically, on the combination of colors.

S3) BlackBerry Curve

The Blackberry Curve has a good interface if we consider that it’s an old version of this company. Sometimes it’s difficult to read mails and internet pages because the screen is small but you can zoom in whenever you want. It’s easier to write with this keyboard because you have an instant feedback when you feel the keys, this help to write faster. With the trackball and the other physic buttons it’s easy to go back or go home because they never disappear. It’s very hard to find the apps, images or documents that you download because the icons of some menus are not clear.

S4) Nokia

The Nokia phone is rather simple compared to the tablet its graphics are dated and simple and sometimes it’s hard to read the screen as the back ground clashes with the text. Despite this it’s a really rugged reliable device and can survive a trip down a stairs or a muddy field with its screen intact while a lesser device would have broken.

Comments about the tablets

T1) Samsung Galaxy

It’s easy to understand how this tablet works, the interface is very intuitive. The icons are very clear and simple. You can personalize to avoid losing time searching the apps that you want to use. There are some menus that are hidden and if you don’t have previous knowledge it’s hard to find them. The tabs of the internet browser are small and they force you to use the tip of the finger and press them many times. The size of the screen its appropriate because is easy to read without making zoom in. The graphics and design are excellent. The gestures are so natural that allows you to manipulate the objects of the screen very easy. You need only one or two days to get used to it.

T2) Fnac

The Fnac tablet was a pleasure to use and operate. Its interface was smooth and well thought out with excellent graphics and design. Its navigation was smooth and its camera was in excellent condition. My only criticism was that it was rather hard to turn on as I had to refer to the manual on more than one occasion as well as this its battery life wasn’t very desirable.

T3) Prixton

The Prixton tablet does some functions very well like other devices, but sometimes it is not a trustable product because some commands don’t work very well and others took so long to process. Maybe the principal problem of this device is not only the interface but hardware problems such as screen definition, loading speed, etc.
Part V. Prototype
6 Prototyping

There is an interesting work line in the development of small screens prototypes. We can make usability studies directly with the interfaces or with a software prototype. For this second scenario, there are tools that can allow us to create a prototype. One of these tools is called “Justinmind Prototyper” that makes easier the creation of high quality prototypes. (Justinmind 2013). Another is the one that Dotan Saguy is developing, a powerpoint template that allows you to easily create realistic mockups or prototypes of interfaces.

Here is an example of a prototype for a smartphone interface changing some aspects that would make easier the interaction between the user and the phone. Starting with the top toolbar, there is a standard icon that informs the user about the phone signal, name of the user and the internet signal. It is significant for the user to have the most relevant information displayed on their phone, because of this it will be shown first on the small screen and then it will displayed on every screen. After this there is a red icon with a number, it informs the user on updates on the phone, for example, new emails, messages, missed calls, etc. It is a simple and clear icon that shows you what has not been viewed or opened on the smartphone.

Besides the essential basic functions that display the operational status of the smartphone the user can also access secondary functions such as the clock, the alarm and the ringtone of the phone for example the user can also put the phone into silent mode. At the end of the top toolbar the battery is displayed and the exact amount of battery life left, for instance in the example the battery is shown at 90%. The number and percentage is important as it allows the user to easily see the battery level and understand the information on the screen as the icon alone does not transmit this information. Whenever the user is operating the phone this information is always and should always be displayed.

In the second picture shown below is an example of an email screen, the important thing that should be noticed is the simplicity of the controls. One button allows you to come back to the inbox page, if the page is changed the function of the button changes too but will always allow you to come back to the main page, the information of the email the user is currently reading and two arrow keys that allows the user to easily navigate through the emails.

With the same principle, in the future, we will be able to develop a prototype of an interface with some improvements, according with our previous research and studies. This new interface would help for a faster adaptation to the system especially to users that have a tablet for the first time. It would be easier to recognize symbols and icons that every user can relate and recognize regardless of the language or orientation of the screen.

We also set out to make an interface that is inclusive to all users especially to mature users and people with disabilities that will have the same advantages as people without. It would have a simple design and layout that’s easy to follow and navigate such as clearly marked out drop down menus and minimize the amount of nested menus because we found that users don’t use them. And finally considerate of the use of colour, focusing on users that have difficulty recognising colours such as those with colour blindness, hide features that should only be used if necessary as to avoid user error especially among novice users and increase the target size to minimize the error probability to the user.

Some examples of the characteristics of the new interface are:

- Show the battery level in percentage
- Adapt the color of the apps title according to the wallpaper to enable the reading
- Increase the size of the apps title and others text
- Put the interaction elements only in the bottom area
- Create a new template with relevant information, maybe the user can personalize it
- Put the number of steps to finish an operation inside dialog boxes
- Put an appropriate horizontal natural mapping (all the information from left to right)
- Put an appropriate vertical natural mapping (all the information from up to down)
- Improve the representativeness of the icons. Example below.

![Figure 30. New Icons](image)

![Figure 31. Prototype](image)
Part VI. Conclusions
8. Conclusions

8.1 Work Conclusions

Essentially we wished to create not just an generic interface for small screens but an enjoyable experience that is stress free not just on the mind but also on the body focusing on the eyes and hands of the user. With this our goal was to create an improved interface that will aid the next generation of smartphone and tablet technology as well as aid well established companies, on the open market by giving them independent guideline requirements that are not held by government or institutional means.

Focusing on the usability test analysis, we can conclude that the targets must be bigger and more distant, since half of the respondents complained about it. The target size of controls definitely influences error rate. When targets get too small, error rates shoot up, in these cases the average size finger is bigger than the average size control, and when you put those two together it doesn’t always work out so well. We can accomplish this by:

**Space**: space out controls more in touch mode, make them easily touchable

**Auto**: turn on touch mode automatically when a touch input is detected; i.e., if someone is editing text, the interface can see that they are using a finger and space out controls accordingly for ease of input.

**Size**: the fingers need a bigger landing pad than a mouse does, so make controls that will play to this rather than against it.

![Figure 32. Target Size (Fonte: Intel 2012)](image)

Furthermore, we have to take into account that the interviewed people are young aged around 20, they don’t have any physical problems and they are accustomed with touch screens.

8.2 Our assessment

We found the project Design of small interface to be a challenging and rewarding experience. Through it we gained valuable experience in areas such as teamwork, time keeping, work sharing, and responsibility. We learned more about my own skills and strengths throughout the course of the
project and learned how we could bring them to the table and benefit the team. We believe it was an excellent experience that allowed us to learn from other people and get an insight into different ways of thinking, cultures and work ethics. We meet many interesting people and feel we gained from their experience and knowledge in different fields and backgrounds.

We felt this project was rewarding as it deals with the current and future rise of smart technology a subject we show great interest in and enjoy learning more about. The project allowed us to dive right into the world of interface design and help us develop our skills as a designer while aiding areas were our strengths do not rest. The project make us become more competent in areas such as human centered design, an important topic for any designer, and gained not just as a designer and engineers but as a person also.

8.3 Future lines

For the future we would like to develop the complete prototype of our interface, test it and compare with the ones that already exist. We can prove that the changes we propose to do really improve the interaction between users and tablets. The constant updating of the research and market trends is really important in order to continue an efficient the design work.
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Annex

Annex A: Human machine interfaces classification

A human machine interface is an interface which permits interaction between a human being and a machine.
ULTRA MOBILE PC

Is a hand-held computing device capable of running a Windows operating system. A UMPC is larger than a personal digital assistant (PDA) but smaller than a laptop.

MOBILE INTERNET DEVICE

Is a multimedia-capable mobile device providing wireless Internet access. They have been described as filling a niche between smartphones and Tablet PCs.

PORTABLE MEDIA PLAYER

Is a consumer electronics device that is capable of storing and playing digital media such as audio, images, video, documents, etc. The data is typically stored on a hard drive, microdrive, or flash memory.
**Handheld Game Console**

Is a lightweight, portable electronic device with a built-in screen, game controls, speakers and replaceable and/or rechargeable batteries or battery pack.

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**Personal Navigation Assistant**

Is a portable electronic product which combines a positioning capability, such as GPS, and navigation functions.

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**E-Book Reader**

Is a mobile electronic device that is designed primarily for the purpose of reading digital e-books and periodicals.

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**Wearable Computer**

Miniature electronic devices that are worn by the bearer under, with or on top of clothing.
MOBILE PHONE

It’s a device that can make and receive telephone calls over a radio link while moving around a wide geographic area. It works by connecting to a cellular network provided by a mobile phone operator, allowing access to the public telephone network.

SMARTPHONE

A smartphone is a mobile phone that includes advanced functionality beyond making phone calls and sending text messages. Most smartphones have the capability to display photos, play videos, check and send e-mail, and surf the Web. Modern smartphones, such as the iPhone and Android-based phones, can run third-party applications, which provides limitless functionality.

POCKET COMPUTER

A pocket computer is a small calculator-sized handheld programmable computer.
Beepers

This pagers were the first and are the simplest form of paging.

Voice/Tone

This pagers provide the ability to listen to a recorded voice message when an alert is received.

Numeric

This pagers contain a numeric LCD display capable of displaying the calling phone number or other arbitrary numeric information generally up to 10 digits.

Alphanumeric

This pagers contain a more sophisticated LCD capable of displaying text and icons.

Response

These pagers are alphanumeric pagers equipped with built-in transmitters, with the ability to acknowledge/confirm messages.

Two-way

These pagers are response pagers with built-in QWERTY keyboards.
**Full-size Laptop:**
Is a personal computer that provides the full capabilities of a desktop computer while remaining mobile.

**Subnotebook**
A subnotebook or ultraportable is a laptop designed and marketed with an emphasis on portability, small size, low weight and often longer battery life, that retains performance close to that of a standard notebook.

**Ultrabook**
A very thin version of a laptop usually less than an inch thick.

**Netbooks**
Are laptops that are light-weight, economical, energy-efficient and especially suited for wireless communication and Internet access.
Annex B: Smartphone Timeline

"3 Objects were considered essential across all participants, cultures and genders: keys, money and mobile phone." ~ Jan Chipchase, Nokia

1970-1980

Pye Telecommunications

1972

The first true mobile phone, developed in 1972, was built by Pye Telecommunications and featured a wearable battery pack.
Motorola Dynatac 8000
1982

Nicknamed the brick this phone was large and chunky however kickstarted the revolution of the demand for wireless telecommunications.

Motorola MicroTAC 9000X
1989

This device featured a flip out design and an LED display plus a lighter easy to carry construction. It is considered a collector’s piece today.
1995  
**Nokia 2100**

In 1995 Nokia released the Nokia 2100. It featured a user-friendly button interface and received positive reviews while also starring in movies such as "The Matrix.

1999  
**Nokia 3210**

In 1999 Nokia released a new model the Nokia 3210. It was one of their most popular models featuring a lightweight design and a sturdy construction at an affordable price bringing mobile technology into the 21st century.

2000  
**Nokia 3310**

The Nokia 3310 debuted in the year 2000 and was one of the most popular models Nokia ever produced. It received the name the "Indestructable Phone" due to its rugged design and shares similar features to the 3210.
MOTOROLA RAZR V3
2005
Motorola launched the razr V3 in 2005. It features a flip out design and a coloured interface. One of the slimmest phones at the time, it also featured a camera and internet access.

MOTOROLA CHOCOLATE
2006
The Motorola Chocolate was unique as it showed that it was more than just a gadget but a fashion accessory putting mobile design at the forefront of mobile technology.

APPLE IPHONE
2007
Launched in 2007, the iPhone was a revolutionary new product from Apple and set the standards for smartphones today. It eliminated the need for chunky button displays with a touch screen and built-in GPS.

MOTOROLA MILESTONE
2009
Small enough to fit in your pocket and running on Android, this device was the mobile phone companies' answer to take on the laptop as the primary tool for work.
SAMSUNG
GALAXY
2011

The phone to beat in 2011. It has built-in GPS and a 8MP camera as well as all the functions a modern phone owner needs as well as standard calls and text.

SONY
EXPERIA
2012/2013

The latest on smartphone technology. Released by Sony in 2012 the Experia has built in radio, GPS and internet connection and is at the current cutting edge of smartphone technology.
Annex C: Smartphone Tablets

Tablets Timeline

2005 - 2003

Microsoft Smart Display

The tablet-like Windows Smart Display was a touchscreen LCD monitor that connected to a PC via Wi-Fi. Without much success penetrating the market, it was canceled by the end of the same year.

Nokia 770

This tablet gave an internet experience on the go and is an early model that formed the foundation of modern smartphones.

Motion Computing

Though attaching physical keyboards to tablet PCs was a trend by 2005, some devices remained touchscreen-only.

SAMSUNG Q1

It was designed for business users that needed a PDA with more features akin to a full PC.

ASUS P2H

It's an Ultra-mobile computer device powered by INTEL celeron M processor.

ModBook

A sort of forerunner to the iPad, this tablet PC ModBook is a MacBook that's been converted into a tablet PC (but was not produced by Apple). Axiron charges $300 for the ModBook, but the customer has to provide his/her own MacBook.

ThinkPad

It's an ultraportable notebook in which Lenovo combines engineering with design, delivering systems that help lower the total cost of ownership.

Dell Latitude XT

Is a convertible tablet with a design that makes it ultra-portable and simple to use. Its service and support make it cost-effective and convenient to own.
The HP Slate boasts some features the iPad lacks, such as Flash player compatibility.

Hailed by Apple as a "magical and revolutionary" device. Reviewers have raved about the product, but at the market was a success.

It has sold over a million units to date worldwide as a very complete tablet carried by Google and multiple carrier support.

Smart terminal that enable easy access to a variety of cloud services in conjunction with its VIERA digital televisions.

Is the second generation iPad, it is slightly lighter than the first iPad and battery last 7 hours, 37 minutes while playing a video continuously.
Motorola XOOM
It was the first tablet to be sold with Android 3.0 Honeycomb, an OS dedicated to the tablet form.

BlackBerry PlayBook
The first device to run BlackBerry OS but it also supports Android applications. Reviews about it were mixed saying that the hardware was good but several features were missing.

Dell Streak 7
Is a smartphone/tablet hybrid that uses the Android. It received a tepid reaction from one reviewer due to its poor display and software bugs at launch.

HP TouchPad
In the HP TouchPad we see web OS 3.0 for the first time. Some reviews say that was half a generation or a generation behind the iPad and so that wasn’t going to drive volume.

Sony Tablet S
Is the first tablet computer released by Sony. The Tablet S runs Google’s Android Ice Cream Sandwich 4.0.
iPad 3
The third device in the iPad line of tablets, it added a Retina display, which is a term that Apple uses for devices and monitors that have a resolution and pixel density so high (300 or more pixels per inch).

Google Nexus 7
This 7-inch tablet was the first launched under Google's own Nexus brand.

Amazon Kindle Fire HD
It improves upon the Kindle Fire, sporting a superb display, superior speakers and improved performance. It remains one of the best 7-inch tablets available.

Infinity TF700
Is the first Android tablet on the market with a full HD screen it also boasts a new quad-core Nvidia Tegra T33 processor and upgraded cameras.

Fuhu Nabi
The Fuhu Nabi 2 is a child-friendly tablet, with intuitive parental control options, dual-mode functionality and a powerful Tegra 3 processor to boot.

iPad mini
Is a mini tablet computer, 7.9 inches, developed by Apple. It features similar internal specifications to the iPad 2, including its display resolution.
The fourth-generation iPad, Apple updated the iPad not once but twice, adding a 2048 x 1536 Retina display.

This tablet enters the big-screen tablet wars with a display that's even sharper than the iPad's Retina display. Running Android 4.2, the Nexus 10 also offers robust photo editing features and Siri-like Voice Search.

It improves upon its predecessor with the addition of a microSD card slot, front-facing speakers, long battery life, a bright display and you can use the tablet as a smart remote.

Lenovo has announced three new Android Jelly Bean 4.1 tablets at the ongoing Mobile World Congress trade show.

HP Slate 7 is targeted at the budget segment.

One of the biggest tablet launch at Mobile World Congress, it brings the S Pen stylus into iPad mini territory.
Annex D: Guidelines references

D.1 Generic websites:
UI Style Guides
A collection of UI guidelines
http://www.idemployee.id.tue.nl/g.w.m.rauterberg/lecturenotes/ui-guideline-collection.htm
Included: Web style guides and Accessibility Guidelines
UI Guidelines for mobile and tablet web app design
http://www.mobilexweb.com/blog/ui-guidelines-mobile-tablet-design
User Interface Guidelines for Mobile and Tablet Devices
http://www.simonwhatley.co.uk/user-interface-guidelines-for-mobile-andtablet-devices

D.2 Small interface and platform:
● Apple
● Android
● Windows Phone
● BlackBerry
● Symbian
● MeeGo

APPLE
iPhone
iOS Human Interface Guidelines.

Accessibility in iPhone
and “Accessibility Programming Guide for iOS”.

iPad
Accessibility on iPad:

ANDROID
User interfaces guidelines
Web Apps Overview
Best Practices for Web Apps
Accessibility
Designing for Accessibility:
http://developer.android.com/guide/practices/design/accessibility.html
Visual disability:
Mobile Accessibility and other accessible Android apps:

Windows Phone
“Microsoft Developer Network Platforms (msdn)”.

Blackberry
Blackberry Design Guidelines - Tips on Designing the User Interface.
http://berrytutorials.blogspot.com/2010/01/blackberry-design-guidelines-tips-on.html
BlackBerry Smartphones UI Guidelines for 6.0
Developer’s guide for Blackberry and RIM wireless handhelds. UI Engine API. version 2.1.
Blackberry - PlayBook Tablet. UI Guidelines for 1.0

Symbian
Design and User Experience Library

MeeGo
http://developer.meego.com/guides/designing-your-application
Nokia N9 UX Guidelines.
http://www.developer.nokia.com/swipe/ux/
Annex E: Usability test

Usability testing
Kevin Garvin, Fernanda González, Raissa Neves, Larissa Santos, Pere Ponsa
[May 2013]
Usability testing

1. Presentation

Dear colleagues,

We are working in the IDPS project called Design of small interfaces. Part of your project is developing an experimental study taking into account the needs and the opinion of the users. The objective is study the quality of use of Tablet PC. We are not studying the user behaviour, we are studying usability problems with the use of new technologies.

Your collaboration is highly appreciated. This experimental test has a duration time of 45 minutes. The analysis and the results are completely anonymous. We will have use of this data only for academically purposes (final report of the IDPS project and scientific publications in international conferences or journals).

Thank you.

2. Instruction

In the table in front of you there is a Tablet PC. Please, follow the following instruction.

**TASK 1 (15 minutes)**
1. Turn on
2. Unlock
3. Change the language: put the Tablet in Spanish.
4. Change the language: put the Tablet in English
5. Connect on the internet
6. Open Youtube from the browser
7. Search for the video: “IPhone 5 (Parody)”
8. Open the video IPhone 5 (Parody)
9. Increase the volume
10. Put in full screen
11. Stop the video and exit internet
12. Access to the rest of applications of your Tablet
13. Take a picture with the camera
14. Access to the gallery folder with the aim to watch your picture
15. Close all applications
16. Turn off
Please wait a minute

TASK 2 (15 minutes)
Repeated the Task 1 with a new Tablet (your facilitator provides it).

Please wait a minute

TASK 3 (15 minutes)
Repeated the Task 1 with a new Tablet (your facilitator provides it).

Please wait a minute

3. Evaluation

Please, answer the following questions
Fill the SUS questionnaire

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### USABILITY TEST - TIME TABLE

<table>
<thead>
<tr>
<th>ITEM</th>
<th>TASK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turn on</td>
</tr>
<tr>
<td>2</td>
<td>Unlock</td>
</tr>
<tr>
<td>3</td>
<td>Change the language: put the Tablet in Spanish</td>
</tr>
<tr>
<td>4</td>
<td>Change the language: put the Tablet in English</td>
</tr>
<tr>
<td>5</td>
<td>Connect to the internet</td>
</tr>
<tr>
<td>6</td>
<td>Open the following webpage: Youtube.com</td>
</tr>
<tr>
<td>7</td>
<td>Search: iPhone 5 Parody</td>
</tr>
<tr>
<td>8</td>
<td>Open the video iPhone 5 (Parody)</td>
</tr>
<tr>
<td>9</td>
<td>Increase the volume</td>
</tr>
<tr>
<td>10</td>
<td>Put in full screen</td>
</tr>
<tr>
<td>11</td>
<td>Stop the video and exit internet</td>
</tr>
<tr>
<td>12</td>
<td>Access to the rest of applications of your Tablet</td>
</tr>
<tr>
<td>13</td>
<td>Take a picture with the camera</td>
</tr>
<tr>
<td>14</td>
<td>Access to the gallery folder with the aim to watch your picture</td>
</tr>
<tr>
<td>15</td>
<td>Close all applications</td>
</tr>
<tr>
<td>16</td>
<td>Turn off</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>TIME (mm's)</th>
<th>PHIXON</th>
<th>SAMSUNG</th>
<th>FNAC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
QUESTIONNAIRE

ID:  AGE:

1. While you are using the Tablet, which hand posture do you prefer?

<table>
<thead>
<tr>
<th>Option A: Flat Hand</th>
<th>Option B: Thumb Wrap</th>
<th>Option C: Thumb Extended with Thenar Support</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Flat Hand" /></td>
<td><img src="image2.png" alt="Thumb Wrap" /></td>
<td><img src="image3.png" alt="Thumb Extended" /></td>
</tr>
</tbody>
</table>

2. While you are using some applications in the Tablet: which finger part are you using often?

<table>
<thead>
<tr>
<th>Option A: Finger tip</th>
<th>Option B: Finger pad</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image4.png" alt="Finger tip" /></td>
<td><img src="image5.png" alt="Finger pad" /></td>
</tr>
</tbody>
</table>

3. What do you think about the size of the targets?
   Your answer:
4. Do you have vision problems with the use of the Tablets? (Vision problems: difficulties for reading, difficulties with color contrast, etc.)
   Your answer:

5. Which Tablet do you prefer? Explain the reasons of your choice.
   Your answer:

6. Do you prefer other device in order to develop similar tasks? Explain the reasons of your choice.
   Your answer:

7. Do you have previous knowledge about mobile devices? Are you a Tablet user? Can you write the name/model of your device?
   Your answer:
Annex F: Ecodesign Aspects

The term “Eco-design” implies taking into account in the process of design all the environmental impact of a product during its live cycle. To know if a product is “eco-friendly” or not it’s necessary to analyze: What materials are used? Where did the materials come from? How was the product manufactured with regard to worker conditions and pay? Energy usage and potential pollution? Where did the packaging come from and how was it made? How energy efficient is the device? How easy it is to recycle and what waste products will it leave behind at the end of its life cycle?

Our project is focused in the design of small interfaces for tablets and smartphones, this is an important part of the eco-design for this product because with a good interface we can extend its life cycle.

To make tablets and smartphones more eco-friendly we can use the Eco Design strategy wheel. It is a “New concept development” in which different functions are integrated. Using tablets to read are making a big difference in the amount of paper wasted to print. The 41 percent of tablet users said they viewed print reduction as a “main benefit” of tablet adoption, according to the survey.

Among respondents who said they printed significantly less, 79 percent chose decreased printing as the key benefit of the tablets. Digital books, newspapers, magazines, articles do not waste paper. You can download them within seconds after purchase, no paper required and they are reducing the amount of energy, water and paper that it takes to make them. It also saves the user’s time that would be otherwise spent going to the bookstore.

The companies are more conscious in the “Selection of low-impact materials”. For example an American company Pixel QI who specializes in low-power consumption screens, is currently making plans to replace standard existing screens with a solar powered tablet. They’ve developed a way to power a tablet entirely from the sun by installing a solar panel that generates 1W of energy this is enough to power both the screen and the motherboard.
There is also a “Reduction of materials usage” in which major technology companies are working mainly to reduce in the energy that the product uses during its life cycle. Apple had reduce the average power consumed by their product by 40% designing power adapters that draw very little power when not in use and program their hardware and software to work together to conserve energy.

The “Optimization of distribution system” it’s a strategy that the companies can adapt easily by modifying the packaging of their product. Samsung has developed reusable packaging technology by replacing paper and polystyrene with Expanded Polypropylene and Apple is making their packaging thinner, lighter, and more material efficient products so they can reduce their footprint and ship the product in smaller packaging. An efficient packaging design can reduce materials and waste and it also helps reduce the emissions produced during transportation.

Finally one of the most important factors to consider is the “Optimization of end-of-life system” e-waste is becoming a major problem to the environment, so now we have to reduce, reuse, and recycle. Reduce the generation of e-waste through smart procurement and good maintenance. Reuse still-functioning electronic equipment by donating or selling it. Recycle those components that cannot be repaired. Most electronic devices contain a variety of materials,
including metals that can be recycled

The story behind Apple’s environmental footprint.