Design of small interfaces

Fernanda Gonzáles
Tecnologico de Monterrey
Calle del Puente 222, Ejidos de Huipulco
14380 Cidade do México - México
(34)656 702 913
fernanda.glez26@gmail.com

Kevin Garvin
IT Sligo
Ash Lane, Sligo
Sligo - Irland
Vilanova I la Geltru, Spain
(+353) 085 1123209
kevingarvin300@yahoo.com

Larissa Santos
Universidade Federal de Minas Gerais
Av. Antônio Carlos, 6627 - Pampulha 31270-901
BELO HORIZONTE, BRAZIL
+55 31 98249928
larissasm@gmail.com

Raíssa Ruegger
Universidade Federal de Minas Gerais
Av. Antônio Carlos, 6627 - Pampulha 31270-901
BELO HORIZONTE, BRAZIL
(34)633 695 528
raissarmn@gmail.com

ABSTRACT

The International Design Project Semester (IDPS) program integrates technical knowledge and professional engineering skills from a point of view of multidisciplinary and international teams. The preliminary results show that it is possible to integrate international design students in the classroom using materials and methods from human computer interaction domain.

With a wide research about concepts, interface 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 behavior 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 recognized icons within the interface. We also looked into other areas such as the social implications of owning a tablet 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 that not only they needed but also one that they wanted to use.

Categories and Subject Descriptors

Information interfaces and presentation: User interfaces – evaluation/methodology, user-centered design.

General Terms

Measurement, Design and Human Factors.

Keywords

Role playing and interactive systems.

1. INTRODUCTION

The *International Design Project Semester* (IDPS) is an innovative training program which addresses the new professional demands engineers of the future will face. The program focuses on industrial design and adheres to the learning outcomes established by the European Higher Education Area. The IDPS is a one-semester course designed to train third-year industrial design engineering students to work in international teams.

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: requirments analysis, deisgn, 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.

With the aim to reduce the gap between the research activities of industrial designers and the Human Computer Interaction HCI materials and methods, a Human Centered Design HCD subject is presented [1]. The second section explains a final degree project related to the design of small screens. In this sense, an informal evaluation study of the three tablet PC's is presented with the help of three designers in the role of users. The fourth section explain design principles that could be help us in order to define the first steps in the design of a guideline for small screens. Finally, conclusions and future lines are shown.

2. FINAL DEGREE PROJECT

2.1 The aim of this project

In the classical human-computer interaction paradigm, HCI, the computer is a well-established tool. In current days, the 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 it is necessary develop design guidelines in order to obtain general recommendations in the design, usefulness and ease of use of these devices.

The objective of this project is to create 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, evaluation. So, a guideline can be useful in order to detect problems in the design phase. In the phase of evaluation, this work shows a usability test in a laboratory with the use three tablet models.

2.2 Conducting an informal evaluation

Informal evaluations can be done with nothing more than the knowledge you have from experience [5]. With the aim to detect usability problems in the use of Tablet PC, in this section the method called five steps to a user-centered expert review is applied in the study of three Tablet PC. The Tablet 1 is a low cost 5" Spanish Tablet. The Tablet 2 is a famous and competitive 7" Tablet. The Tablet 3 is a 8" Tablet adapted to the use of e-book readers. In this chapter an informal evaluation study is presented in order to obtain usability problems in the use of three Tablet PC models.

 "…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 steps to a user-centered expert review is applied in the study of three Tablet PC. The authors of this method are Whitney Quesenbery and Caroline Jarrett.

a) Don't look at it (yet)! You never get a second chance for your "first look". Write a (short) story

b) Who is using this product?

Tablet 1: Engineering Student, girl, 22 years old

Tablet 2: Design Student, girl, 22 years old

Tablet 3: Design Student, boy, 20 years old

c) Why are they doing it?
Because we need to gain access to 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?

Tablet 1: She didn't know the brand so she expected it only to work with an intermediate quality.

Tablet 2: When she interacts with it, she expects to easily undertake tasks and gain quick access to functions.

Tablet 3: 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
Try to use it (following the story)

g) Start from "Why are they using this product?" What are they trying to do?

Tablet 1: : 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. Because it is easier to take out, turn on and operate than my computer. I can take and use it everywhere.

Tablet 2: Because it is easier to take out, turn on and operate than my computer. I can take and use it everywhere.

Tablet 3: Because it does the same thing as a laptop and is lighter and easier to carry. I do not need a bag. Only to 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 developing different style interfaces?

i) Can they find the information they need?

Tablet 1: Not with 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 have just selected suddenly vanishes.

Tablet 2: Yes. The quality of Wi-Fi connection is not always good as it is in my computer.

Tablet 3: Yes. Sometimes it is not possible to see videos on this mobile device.

Now look at it (now that you've had a chance to use it)

Think about relationship, conversation, interaction and appearance

j) Relationship. How did user goals and business goals align?

Our principal goal is: have the information at hand

k) Conversation: Were headings and text helpful and informative?

Tablet 1: Sometimes are informative, but sometimes just don't have, only a feel times I can't understand what the text is trying to inform.

Tablet 2: Sometimes. The icons are very clear so the title doesn't have to be that big. The manual is small with little information.

Tablet 3: 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

l) 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.

m) 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.

Tablet 1: thicker than the others and with a gaudy brand on the front of it.

Tablet 2: the size is similar to Tablet 1 but with less external connections.

Tablet 3: because it is the biggest one and the only one with the brand at back. It has a lot of connections such as Tablet 1.

Report

n) What are the problems you saw?

Tablet 1: it does some tasks that you don't order it to do.

Tablet 2: It's a little bit difficult to personalize the menu, screen, etc.

Tablet 3: The buttons to turn on or off and control the volume are not in a good position. Doesn´t show you clearly that an app is being downloaded**.**

o) Find at least one positive point

Tablet 1: Easy to use, you do not spend so much time learning how to use it.

Tablet 2: I do not need to understand how it works.

Tablet 3: It is fast to use.Efficiency comparison

The objective of the test is to study the quality of use of a Tablet PC. The focus isn't on the user behavior but on usability problems with the use of new technologies. The group that was interviewed was a sample of 12 EPS students with ages ranging from 19 to 25 years old. Each student had to complete 16 tasks on each tablet, and after answer 7 questions about the posture preference, the preferred tablet, finger part used, etc. 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. Follow the table with the tasks and the second one with the average time of each task with the three tablets, then a graphic comparing the data of the table.

Table 1. Set of tasks

ITEM	TASK
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
15	Close all applications
16	Turn off

Table 2. Time to do tasks within three tablets

ITEM	Average time of each task		
	Tablet 1	**Tablet 2**	**Tablet 3**
1	17,77	26,00	21,69
2	6,18	3,47	5,13
3	25,02	24,64	23,45
4	8,90	10,28	15,43
5	14,70	20,86	15,02
6	22,13	17,67	19,82
7	21,62	14,55	7,70
8	8,87	17,22	15,79
9	8,72	6,66	9,44
10	10,18	12,74	4,97
11	10,72	11,58	9,84
12	10,25	12,18	7,05
13	15,59	7,40	6,69
14	15,84	6,63	9,79
15	5,73	8,96	7,86
16	11,53	9,05	10,44

Figure 2. Average time

Average time of each task
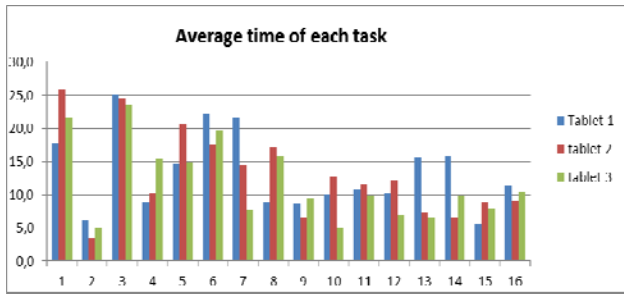
2.2.1 Results:

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.
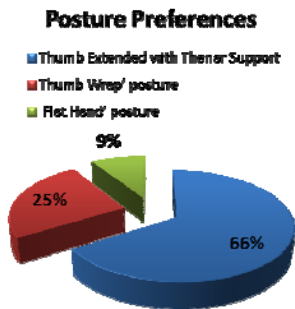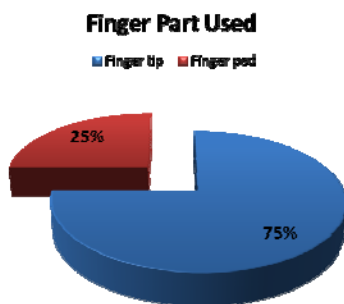
Figure 3. Posture preferences

Posture Preferences

Figure 4. Finger part most used

Finger Part Used

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 Tablet 1 targets.

c) 50% has vision problems with Tablet 1, 17% with Tablet 3 and nobody has with Tablet 2, 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% sad that prefer Tablet 2, 34% Tablet 3 and only 8% Tablet 1.

**Figure 5. Preference of Tablets**

Tablets Preferences
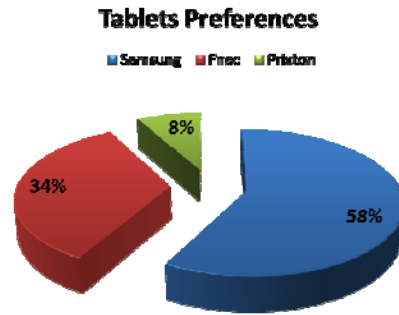
e) Moreover, 33% of them prefer other devices to complete similar tasks.

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

g) Other data shows that 58% of the respondents prefer tablet 2, 34% Tablet 3 and only 8% Tablet 1.

h) 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 Tablet 3 (3 minutes in total), then Tablet 1 and 2 with a similar 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 the software has to be improved.

Figure 6. Average total time
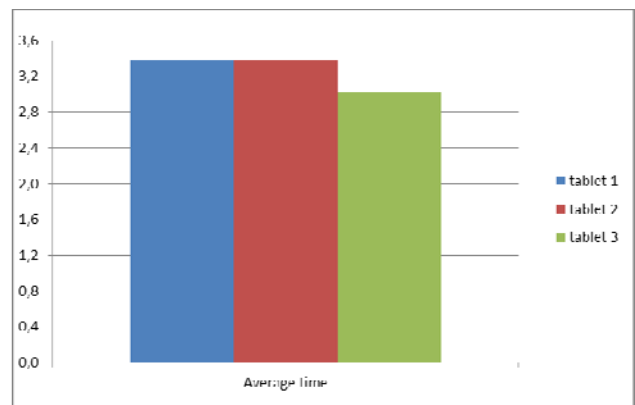
From the point of view in the assessment of these devices, here we have the comments of the user:

T1) Tablet 1 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.

T2) It is 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 it's appropriate because is easy to read without making zoom in. The graphics and design are excellent. The gestures are so natural that it allows you to manipulate the objects of the screen very easy. You need only one or two days to get used to it.

T3) Tablet 3 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.

A discussion with the three users shows that the weight of Tablet 3 is considerable and is difficult to hold the Tablet. For one female user she had difficulty trying to hold the Tablet 3 with two hands and completing tasks because she has a small hand and it was a physical effort trying to use her fingers [8]. [9]. So it's important to take into account some human factors related to the use of the Tablets. And it's necessary to establish a relationship between the human factors related to visual and tactile channels with others aspects related to the Tablet (form, functions, interface, use). The next section tries to analyse the benefits of the development of a guideline for small interfaces.

2.2.2 Effectiveness, efficiency and satisfaction

The SUS – System Usability Scale is a tool used to know what is the user opinion about the usability of a 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 3. SUS test

Statement
I think that I would like to use this system frequently
I found the system unecessarily complex
I thought the system was easy to use
I think that I would need the support of a technical person to be able to use this system
I found the various functions in this system well integrated
I thought there was too much inconsistency in this system
I would imagine that most people would learn to use this system very quickly
I found the system very cumbersome to use
I feel very confident using the system
I needed to learn a lot of things before I could get going with this system

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 10 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 it 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 76.94. 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.
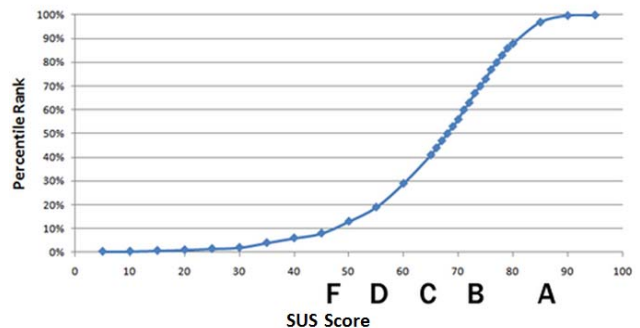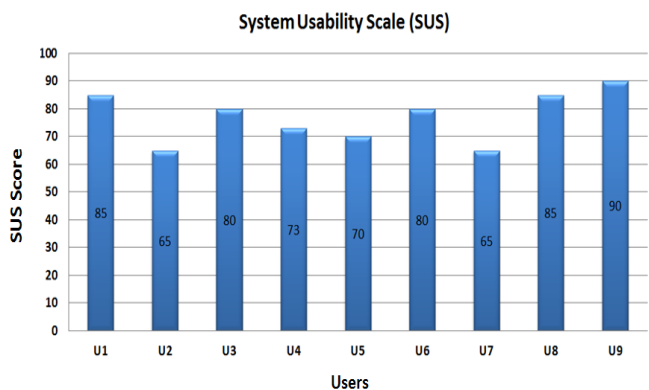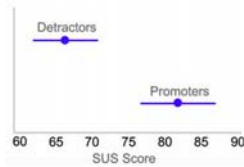
Figure 7. SUS Score

Figure 8. SUS Score Results

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.

Figure 9. SUS Analysis

3. GUIDELINES

There are many 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.

3.1 Principles

In this paper we will be considering the next principles: design for simplicity, design with the small screen in mind, provide user feedback and the use of existing standards.

3.1.1 Design for simplicity

Understanding what the user wants the device to do should be the first step in the simplification process [10].

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 [11]. Bear in mind that each additional feature makes the overall product more complex and more difficult to use.

From the point of view of architecture, the interface should be kept both narrow (fewer choices at each level) and shallow (fewer levels of choice to the bottom of the hierarchy). 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.

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 [12]

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 their 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.

3.1.2 Design with the small screen in mind

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.

3.1.3 Provide user feedback

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.

Following the words of Research in Motion: "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" [13]. 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.

3.1.4 Use existing standards

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 [14].

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.

3.2 Heuristics

The guidelines has two parts. The first one is a set of heuristics, The second part is how evaluate these heuristics.

3.2.1 Set of 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 too 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.

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

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

-        If navigating to a sequence of sub-screens (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 to. [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 that 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 colors, 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]

5. Text

✓H14 Font number [f<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 it 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]

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 warm 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)

✓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]

3.2.2 Application of the guideline to three Tablet PCs

The aim of this chapter is the application of the design guideline to three Tablet PC. With the information of the informal evaluation and now with the information of the guideline (if a tablet pass or not a heuristic) we will have a complete vision of the problem.

Table 5. . Guideline for small interfaces

HEURISTIC		T1	T2	T3
1 ARCHITECTURE				
There is a list of applications	[5, 0]	5	5	5
There is a limited number of levels	[5, 3, 0]	5	5	3
The nested-pull-down menus are avoided	[5, 0]	0	5	0
		3,33	5,00	2,67
2 NAVIGATION				
The double row of horizontal tabs are avoided	[5, 0]	0	0	0
There are buttons that allow users move from one page to a	[5, 0]	5	5	5
There are interaction elements in the bottom area	[5, 0]	5	5	5
The dynamic organization of the space is a characteristic,	[5, 0]	5	5	5
considering the lack of space on smaller screens		3,75	3,75	3,75
3 DISTRIBUTION				
The interface uses a template.	[5, 3, 0]	5	5	5
The actions are divided into steps inside dialog boxes and	[5, 0]	0	5	5
appear the steps number to finish		1,7	3,3	3,3
4 COLOR				
Absence of non appropriate combinations	[5, 3, 0]	5	5	5
There is a minimum quality of contrast	[5, 3, 0]	3	5	3
It is noticeable the relationship among colors and text, aimin	[5, 3, 0]	3	5	3
		3,7	5,0	3,7
5 TEXT				
The font number was chosen to enable the reading	[5, 0]	0	5	5
There is absence of small fonts	[5, 0]	5	0	0
It allows continuous zooming and free selection of the focus	[5, 3, 0]	5	5	5
		3,3	3,3	3,3
6 ICONS				
The interface has homogeneous icons and symbols	[5, 3, 0]	0	5	5
The icons enable the clear visualization	[5, 3, 0]	3	5	3
The icons are representative	[5, 3, 0]	3	5	5
The are confirming and acknowledge messages about the us	[5, 0]	5	5	5
		2,75	5,00	4,50
7 VISUAL PERCEPTION				
The elements which are arranged closely together are percei	[5, 0]	0	5	5
The elements with similar properties are perceived as belong	[5, 0]	0	5	5
The users perception skills could supplement incomplete ele	[5, 0]	5	5	5
There is a good form with great degree of simplicity, clarity	[5, 0]	5	5	5
The interface presents symmetry	[5, 3, 0]	5	5	5
It is possible to distinguish the principal content from the ba	[5, 0]	0	5	5
It is possible to draw conclusions based on what were	[5, 3, 0]	5	5	5
already seen or experienced instead of analyze each new		2,9	5,0	5,0
8 INTERACTION				
In two hand devices: The device has a trackball	[5, 0]	0	0	0
In two hand devices: The device has a mini joystick with tw	[5, 0]	0	0	0
The touch screen can distinguish the user actions between a	[5, 0]	5	5	5
The system gives instant feedback to the user	[5, 0]	5	5	5
9 INTERACTION TECHNIQUES				
The system has an appropriate horitzontal natural mapping	[5, 3, 0]	0	5	5
The system an appropriate vertical natural mapping	[5, 3, 0]	0	5	5
It is possible to manipulating the screen objects	[5, 3, 0]	5	5	5
		2,1	3,6	3,6
GLOBAL VALUE		**2,9**	**4,2**	**3,7**

Explanations about the grades:

1 ARCHTECTURE

1.1 There is a list of applications.

T1) in the settings menu.

T2) yes, in the settings menu you can consult all the applications that the tablet has

T3) yes, the main screen has a list of applications that were pre-installed or downloaded available on the device.

1.2 There is a limited number of levels.

T1) the number of levels is not too much.

T2) yes, you can get quickly to the target you want.

T3) the number of levels is minimal however the steps required to complete certain tasks are rather long and time consuming.

1.3 The nested-pull-down menus are avoided.

T1) yes, there is some nested pull down menus.

T2) 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.

T3) no nested menus are part of the main interface and have to be used sometimes to complete specific tasks.

2 NAVIGATION

2.1 The double row of horizontal tabs are avoided.

T1) no the horizontal tabs.

T2) there are some horizontal tabs in the internet browser, for example, and it's very hard to tap them.

T3) no the horizontal tabs are evident throughout the interface.

2.2 There are buttons that allow users move from one page to another.

T1) you can go back or forward easily.

T2) yes, it's easy to go back or home from any screen.

T3) Yes there is a well-structured navigation set up on the interface that allows easy navigation through different elements.

2.3 There are interaction elements in the bottom area.

T1) yes.

T2) yes, they are always located in the bottom so it's easy to navigate from one page and return no another.

T3) yes, interaction elements are located around the bottom to navigate to the main page or go backwards**.**

2.4 The dynamic organization of the space is a characteristic, considering the lack of space on smaller screens.

T1) the interface is well structured and you can visualize all information on the screen.

T2) yes, you can personalize it but the templates given make them look always clear and well structured.

T3) the interface is well structured and uses space intelligently while leaving space for other features.

3 DISTRIBUTION

3.1 The interface uses a template.

T1) yes, the tablet uses the standard Android template.

T2) yes, it uses the Android template.

T3) 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.

T1) there is not dialog box showing the steps to finish an activity.

T2) yes, it always indicates you in which part of the process you are

T3) the actions feel natural and are easy to navigate to and from.

4 COLOR

4.1 Absence of non-appropriate combinations.

T1) the colors are right used.

T2) yes, the colors are well used so the object in the screen is very clear.

T3) yes, the color scheme is rather simple but effective and gives a clear definition of various features and navigation.

4.2 There is a minimum quality of contrast.

T1) not every time this combination is good, can be improved

T2) the color makes good contrast with the background and with the other elements of the interface.

T3) sometimes the color of the icons would blend into that of the background and some backgrounds were rather confusing and offered a distraction.

4.3 It is noticeable the relationship among colors and text, aiming good visualization.

T1) not every time, sometimes it's difficult to see on the screen.

T2) yes, the text in the icons has good size so it's easy to read them and match with the colors of the icons.

yes, the color allows the user to find objects and functions clearly however on some occasions it did not always work.

5 TEXT

5.1 The font number was chosen to enable the reading.

T1) The font size can be enlarged or minimalized according to preference.

T2) Yes, and you can also personalize the size that you prefer.

T3) The font size can be enlarged or minimalized according to preference.

5.2 It allows continuous zooming and free selection of the focus point.

T1) can be improved also to zoom in.

T2) yes, it's possible

T3) it is possible to zoom on an area of interest.

6 ICONS

6.1 The interface has homogeneous icons and symbols.

T1) it's good, but maybe need some changes.

T2) yes the interface use universal icons that can be understand easily.

T3) yes the interface use universal icons that can be understand easily.

6.2 The icons enable the clear visualization.

T1) yes.

T2) yes, the colours and the text make them clear.

T3) yes the icons are easy to read and recognize.

6.3 The icons are representative.

T1) it's good, but maybe need some changes

T2) yes, it's easy to recognize witch action they are supposed to perform.

T3) the icons represent the function clearly.

6.4 They are confirming and acknowledge messages about the user action.

T1) yes, a dialog box appears.

T2) yes, a dialog box appears each time you're performing an important change.

T3) yes, acknowledgement messages appear at the right time when needed such as when deleting an item.

7 VISUAL PERCEPTIONS

7.1 The elements which are arranged closely together are perceived as a group or unit.

T1) not every time.

T2) yes, the controls are arranged that way.

T3) yes, this is clearly defined in the interface.

7.2 The elements with similar properties are perceived as belonging to a group or unit.

T1) not clear

T2) yes, similar elements are grouped together and you can also personalize them.

T3) Yes this is evident in the interface.

7.3 The user's perception skills could supplement incomplete elements.

T1) yes

T2) yes, the interface it's easy to understand and easy to complete.

T3) For certain areas yes like in settings however the interface is well thought out and well designed so everything is self-explanatory.

7.4 There is a good form with great degree of simplicity, clarity and regularity

T1) it is simple and regular but not too clear

T2) yes, it's very easy to get in use with this interface, its simple and you don't need previous knowledge to understand it.

T3) yes, the interface is rather straight forward and easy to use and figure out especially for novice users.

7.5 The interface presents symmetry:

T1) A good level of symmetry.

T2) yes and this symmetry make the elements look more organized.

T3) there is a good level of symmetry in the interface.

7.6 It is possible to distinguish the principal content from the background.

T1) except when the background has a strong brilliant color.

T2) yes, and this is more clear if the background it's dark.

T3) yes, the icons stand out from the main background and are easily distinguishable.

7.7) It is possible to draw conclusions based on what were already seen or experienced instead of analyze each new component afresh.

T1) the interface doesn't follow standard rules.

T2) yes, in order to manipulate it you have to make very natural movements that make easy to use them without having previous information.

T3) 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.

8 INTERACTION

8.1 In two hand devices: The device has a trackball.

T1) no

T2) no.

T3) this is not evident on the interface

8.2 In two hand devices: The device has a mini joystick with two degrees of freedom.

T1) no

T2) no, the navigation buttons are on the screen.

T3) this feature does not exist on the modern screen.

8.3 The touch screen can distinguish the user actions between a click and a roll-over.

T1) no

T2) yes, the interface is able to distinguish between these actions.

T3) the interface is able to distinguish between these actions.

8.4 The system gives instant feedback to the user.

T1) good feedback when exist.

T2) yes, it plays some sounds to notify a change.

T3) yes, feedback is instantaneous for the user.

9 INTRACTION TECHNIQUES

9.1 The system has an appropriate horizontal natural mapping.

T1) yes, the things appear from left to right.

T2) yes, the order is from left to right.

T3) horizontal mapping is evident throughout the interface.

9.2 The system an appropriate vertical natural mapping.

T1) yes, the order is from up to down

T2) yes, the order is from up to down.

T3) This is evident throughout the interface.

9.3 It is possible to manipulating the screen objects.

T1) not so much liberty to operate.

T2) yes, it's easy to manipulate because the gestures are very natural and simple.

T3) as it is a touch screen it is possible to manipulate almost any on the screen.

4. CONCLUSIONS

4.1.1 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 10. Target Size (Fonte: Intel 2012)
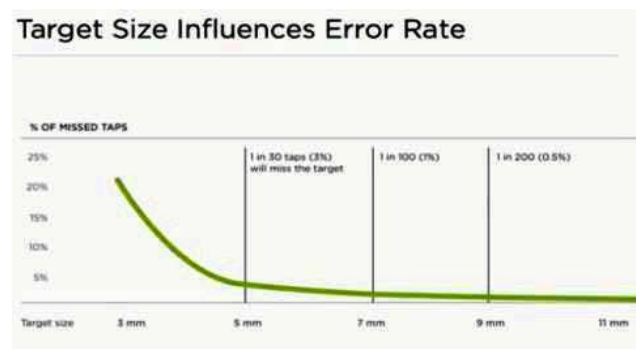
Furthermore, we have to take into account that the interviewed people are young aged around 20, they don't have any physical problems and they are accustomed with touch screens.

4.1.2 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.

4.1.3 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 the tablets. The constant updating of the research and market trends is really important in order to continue an efficient the design work.

5. ACKNOWLEDGMENTS

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