Personal Finances Mobile Application for Seniors

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Dissertation

Mestrado Integrado em Engenharia Informática e Computação

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Abstract

The world is facing a situation without precedent: older population will soon exceed the younger population. Keep these people, at extreme old age, with the deserved human conditions to live, should become a priority for our society and technology is one way to help them.

Nowadays, older adults often take great caution with their savings and the management of their everyday finances. Aging impairments, however, may convert this self-management into a difficult and cumbersome process. At the same time, older adults often find it hard to trust others to do this management for them.

Smartphones may help overcome these problems and may assist older adults by allowing them to always carry the information with them and be able to update it at any time.

This project aimed to create a mobile based finance platform, that supports features for the user to manage his own personal budget. The developed Android application was evaluated with end users in a two phases of usability tests and the combination of the test results and the feedback received have shown that in general, users can use this platform successfully, but, nonetheless, some obstacles with their relationship with technology have to be solved.
Resumo

O mundo está a enfrentar uma situação sem precedentes: a população mais velha em breve vai ultrapassar a população mais jovem. Manter estas pessoas, de idades bastante avançadas, com as condições humanas merecidas para viver, deve tornar-se uma das prioridades da nossa sociedade e a tecnologia é uma forma de o fazer.

Atualmente, os idosos tomam grande cuidado com as suas poupanças e com a gestão das suas finanças diárias. Contudo, o envelhecimento pode converter esta gestão pessoal num processo difícil e complexo. Simultaneamente, estas pessoas de uma faixa etária mais avançada, têm dificuldade em confiar em outras pessoas para fazer essa gestão por eles.

Os smartphones podem ajudar a superar estes problemas e assistir os idosos, permitindo-lhes aceder à sua informação sempre que assim o desejarem, bem como atualiza-la.

Este projeto teve como objetivo criar uma plataforma móvel de finanças, que tem funcionalidades para o utilizador a gerir o seu próprio orçamento pessoal. A aplicação Android desenvolvida foi testada com os utilizadores finais em duas fases de testes de usabilidade, e a combinação dos resultados dos testes e do feedback recebido mostram que, no geral, os utilizadores podem usar esta plataforma com sucesso, mas, no entanto, alguns obstáculos como a sua relação com as novas tecnologias tem de ser resolvidos.
Acknowledgements

To my dear Family and Friends, you know who you are.

And a special word of gratitude and appreciation to FEUP and Fraunhofer AICOS Portugal for all the opportunities.

Ana Margarida Rodrigues Ferreira
“If you don’t like where you are, then change it.
You are not a tree.”

Jim Rohn
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Abbreviations

AAL  Ambient Assisted Living
ADT  Android Development Tools
EoL  End of Life
HCI  Human-Computer Interaction
IDE  Integrated Development Environment
OS   Operating System
PFM  Personal Financial Management
SDK  Software Development Kit
SMS  Short Message Service
SQL  Structured Query Language
UCD  User-Centered Design
UI   User Interface
Chapter 1

Introduction

This is the final dissertation document that contains a detailed description of the problem. The design and respective evaluation of the solution purposed and implemented are reported here.

1.1 Context and Motivation

This dissertation was proposed by Fraunhofer Portugal and the prototype was developed in this research center. The project consists on the development of an finance manager application running on mobile phones and designed for seniors, taking in account their age-related characteristics.

Nowadays, old people around the world are getting older and healthier which leads to a bigger life expectancy comparatively to some years ago. Living longer and aging slower reflects the good state of society, in fact this represents the rising of people life’s quality [Org11]. With the evolution of medicine and technology, people’s life become better and was already scientific proven that technology has a great potential to benefit older people because it allows them to retain a high level of independence and control over their lives [Org11].

Furthermore, in digital machines world, mobile applications are gaining focus as the market of smart phones and tablets is growing. Being old and having a smart phone is now, more than ever, a reality and several studies support this statement with numbers1 2 3.

---

3The Statistics Portal: Share of adults in the United States who owned a smartphone
Introduction

The way that, nowadays, software applications, that run on mobile devices, can be accessed and used has revolutionized mobile technology and people daily lives. There are a huge number of applications launched everyday to entertain and also so satisfy people needs. Some of those needs arise in money and how it is managed 4.

Smart phones may help overcome finances management problems and may assist older adults by allowing them to always carry the information with them and be able to update it at any time.

1.2 Goals and Contribution

The main goal of this dissertation is to design and develop a personal finances manager mobile application for seniors.

- The primary objective is to conduct a research into older adults’ habits and needs regarding the management of their personal finances.

- In second, find the ideal design to communicate the necessary information effectively to the user which requires studying all the possible ways to adapt the mobile phone to a sophisticated and simple budgeting system to control personal finances.

- Do some research into Ambient Assisted Living and translating the results of this research into requirements for the application.

- Also, design and develop an mFinance application for seniors, undergoing thorough usability and user experience testing.

1.3 Document Structure

This dissertations is divided in six capters:

**Chapter 1** — The introduction is where the problem is exposed as well as its context, motivation and the main objectives behind this project.

**Chapter 2** — This chapter presents the state of the art which is an approach the target population. It starts with a review of old people’ related changes and their interaction with new technologies followed by finances’ overview.

**Chapter 3** — Details the methodology to be adopted for this project and also presents some relevant definitions to the reader, for easier reading.

**Chapter 4** — This chapter encompasses all the phases of the project, from the designs of the application to its final prototype.

---

Introduction

Chapter 5 — The results from the evaluation are presented and explained on this chapter with the necessary observations.

Chapter 6 — The last chapter addresses to the problems solutions and potencial future work as the conclusions.
Introduction
Chapter 2

Literature Review

This chapter presents the state of the art, in other words, a review of the related works is described, showing what already exists in the domain of the older adults and their personal finances.

2.1 The Older Adult

One of the greatest achievements of our society during the 20th century was the increase of average life expectancy, which is taking place alongside with other trends that affect the lives of older people. According to the World Health Organization, the population around the world is rapidly getting old. The balance between young and old people is shifting throughout the countries and to prove it, the numbers show that two billion people will be aged sixty and even older by 2050 [Org11].

Nowadays, people are less likely to be married, have fewer children and spend less time with older generations which leads to lack of family support. This demographic and family change means there will be a decrease in the number of people who take care of elderly, which means that society will need better tools to ensure the well-being of the rising number of older people [Org11].

This generation of older adults is getting closer to technology, although there are not many applications designed with the senior’s characteristics in mind.

2.1.1 The Age-Related Changes

The human being is continuously changing, from the physical to the psychological aspects. The transformations that aging causes to a person are not necessarily negative, especially in the beginning of his life, but when we talk about older adults this evolution, that involves either the human body and the human mind, does not have any positive points.
At some point the adult people start to lose some of their capabilities that make, in normal situations, their life easier. Many people are able to age in good health and keep themselves active in society, but others have physical and cognitive limitations and lose their ability to live independently.

To accommodate the older populations it is necessary to understand the age-related problems and apply that knowledge base to ensure that the use of products and systems is safe, efficient and easy [FR02].

2.1.1.1 Cognitive Changes

Cognitive and physical aging phenomena have been noticed and studied almost at the same time, but despite all the research they are still not well understood and, unfortunately, this affects the quality of life and the ability to live independently [FR02]. National Institute Aging (USA) states that cognitive functioning has the biggest decline between the ages of fifty five and sixty five.

Usually older adults do not struggle with learning and thinking, although there are some obstacles namely in cognitive ability, most notably in the speed of information processing [Org11]. Of all the many limitations identified over the years, the focus on cognitive changes is related to memory and attention.

Forgetfulness and misunderstandings are common behaviors even in young adults, however, these behaviors are highlighted with the aging and should not be ignored [Org11]. One of the first signs of aging are memory lapses which can be frustrating. “Memory loss is not an inevitable part of the aging process” because the brain is capable of producing new cells at any age and like others muscles, this organ needs to be exercised. Lifestyle and health routines have a great impact on the brain’s behaviors, preventing the damage of cognitive failures 1.

Most activities depend a lot on cognitive ability. Memory is an important capacity that allow us to retain and recall past experiences and this functions are affected by aging [KA09]. Memory can be divided in two categories: short-term memory and long-term memory.

Short-term memory also known as working memory is “the ability to hold some information consciousness” [KA09] fundamental to basic activities and it makes all the difference to successful learning. A good example of working memory is when someone rattles a phone number and tries to memorize it until it can be dialled 2, this works as a brain’s post-it that involves the manipulation of information at the present moment. Long-term memory unlike short-term memory requires information that is not in present moment

and that could have been acquired a few minutes ago or many years ago and the repository of information is held in a more permanent state.

Attention is the gateway to memory and is an ability to concentrate on something despite of other things going around. This mental process is involved in almost every daily activities except when the task has become automatic. For seniors the decline of attention capacity is a reality that hampers their focus and performance 3.

2.1.1.2 Physical Changes

Physical constraints may also affect older adults relationship with new technologies. Starting with vision problems, passing by hearing difficulties to motor skills limitations, these are the most flagrant and visible changes that age brings [ADH+02].

- **Vision** — The ability to distinguish differences between colors, contrast, light and focus are reduced when compared with young adults abilities. Changes in pupil size, lacrimal secretions, yellowing, opacity and rigidity of the lens are the main cause [Ily12] [Aut13].

- **Hearing** — The ability to hear higher frequencies, tone discrimination loss, distinguish sounds from human voices and difficult of following conversations are affected because the number of nerve cells reduce, production of cerumen and elasticity of tympanic membrane become lower [Aut13].

- **Mobility** — Older people also face motor skills limitations. The reduction of mobility as well as physical strength, co-ordination, loss of flexibility and poor balance which has its origin on muscle cells atrophying, symmetrical muscle wasting, demineralization of bones, gait changes and more [Aut13].

There are more physical characteristics that people who are aging need to face such as cardiovascular, neurological, respiratory and gastrointestinal changes which modifies their body image. The consequences of this kind of changes may affect on a negative way older people minds, and in situations like those, the psychosocial problems appear.

2.1.1.3 Psychosocial Changes

Other older adults problems show up in the domain of psychosocial science. It is not always the less ability to learn or physical inabilities [FR02] that hold seniors from keep up with new situations, there are also some factors such as motivation, persistence and personality characteristics [Sal04].

The structure of social relations can be measured in three parameters the frequency of contacts with children, relatives and friends; the diversity of social relations and social

participation [ADH+02]. Retirement can be the first barrier to all this activities, preventing a large source of social interaction [Cla07] which can also lead to one of the biggest senior’s problems, the lack of independence [RZW02].

While the changes mentioned above may not seem important to technology interaction, when analyzing the process of aging they have a negative reflection. Usually, psychosocial changes are harder to detect than the cognitive and physical changes which make them even more important.

2.1.2 Seniors Interaction with Technology

People over seventy are less likely than any other age group to use digital tools, although not all elderly people are digitally illiterate [HMW11]. It is known that senior users have less experience handling with electronic devices than younger users such as mobile phones [BWB06]. When new technologies are introduced into the elderly life’s, only certain functions are used. A good example, are cellphones whose use is restricted to the functions of calling and receiving calls [GTM11].

The relationship between old people and technology faces a complex set of barriers to digital participation such as:

- **Lack of access to Hardware and Software** — Several studies have been showing that, in general the elderly face some problems as lack of access to a computer or smart phone, and applications (e.g. email) [MMB00]. Hardware and Software high costs are the main reason why older people can not access to this kind of devices [WHH10].

- **Lack of Technology Literacy** — Elderly people often do not have experience with technology but they are willing to learn how to use gadgets. However, the senior citizen is concerned about his lack of knowledge and the fear of not being capable of learning new skills. The lack of “technical skills” to use new technologies will prevent this relationship, but some old users also point that English language skills would help them understand instructions and software functions [WHH10].

- **Lack of Interest** — Many older men and women may see no need to own a device. As expected, the value that young people give to new technology is not the same that old users give, they can not see benefit on use it because does not meet their needs [Lea11].

- **Absence of Mentoring** — The absence of relatives and other reliable people reduce the motivation for adopting a technology [HMW11] and it is family members themselves who introduce technological tools because they want to monitor their parents. It is known that social support helps to stimulate learning and family members are keen supporters.
2.2 Finances

In this section, a brief review of finances routines and personal financial manager tools is presented.

2.2.1 Management of Everyday Senior’s Finances

Most of people over 65 years stop having daily work routines and start to benefit of their retirements. While some seniors have comfortable and guaranteed incomes, others still feel a few difficulties with debts not yet paid, carry mortgages or interest payments and fight for the awaited security during retirement [Vil14]. With more or less money, the goal of old people, like any other age group, is to live an independent life with the quality and satisfy all their needs [JIMK03]. Seniors expenditures and how they spend money can reflect on their hobbies and activities, for instance two different realities can be pictured: a wealthy couple with money can travel around the world and a low-income couple having to choose between medicine and groceries [Vil14], but as Pamela Villarreal says, the only way to analyze old people’s world is assuming that “the truth lies somewhere in the middle”.

In general, as customers, older people habits change such as saving, consumption and investment patterns. Using data collected by Bureau of Labor Statistics’ Consumer Expenditure Survey and the Federal Reserve Survey of Consumer Finances, it is possible to compare past and current old people’s spending habits and realize that the allocation of spendings has changed [Vil14]. Today some of those expenditures identified are:

- **Health Care** — With all the medical advances, having a healthy and longer life is becoming even easier, but the need for medical care does not decrease [GS05]. Costs such as physician visits, treatments, lab tests, medical equipment, drugs and supplemental insurance still represent a substantial portion of seniors’ expenditures.

- **Entertainment** — From petting to random hobbies, this category includes all the activities that fill the trade-off between the relative availability of income and free time. Exercise equipment, photography equipment, campers, boats and other motorized recreational vehicles, electronic video games, expenses for pets and pet supplies and also toys, games, tricycles and playground equipment.

- **Transportation** — The fact that seniors are driving longer and are not giving up their cars led to an increase in the number of cars and trucks expenditures from new car purchases to vehicle finance charges. If on one hand some seniors have

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capacity to own a car, others have to find a solution to this flaw and spend money in cabs, public transportation tickets and so forth, also considered in this category.

- **Education** — It may be strange but some seniors point that some of their incomes are spent in educational issues. While adults struggle to pay their children study loans, a good percentage of seniors try to help their grandchildren debts and college saving plans. Costs associated with tuition, books and extra supplies for college or elementary, middle and high schools.

- **Basics** — This represents almost only the spendings on food, housing clothing and like other expenditures this consumptions varies a lot with the lifestyle and capacity of seniors. For instance, for some seniors the money spent in food includes meals outside home and alcohol while others just have costs of food consumed at home.

In spite the old people’s income differences that can be noticed, the ability to track their household finances may lead to unpaid bills, undeposited checks, cut-off utilities, bank foreclosure or eviction and easily become a snowball of arrears which can result in unnecessary loss of money. To solve their problems usually older people try to look for help in social services but this assistance does not always provide the needs with money management [Hya06].

Today’s seniors have a big number of spending habits, between the increase of real needs and recreational purchases the numbers show that debts in the form of mortgages and credit cards are taking place more than usually because they do not have much incentive to save [Vil14]. However, it is worrying to see that some survey’s results suggest that many of these individuals are probably unable to meet their consumption needs [BGJ05].

### 2.2.2 Finances Support in Web and Mobile Devices

Mobile banking had an explosive growth in smart phones in 2009, but quickly has stalled until 2011 because almost 40% of smart phone users considered mobile banking unsafe. With this flaw, financial institutions had decided to innovate and conquer the young consumers, who sacrifice the security’s fragilities for the every day’s rush necessities [Lea11].

In 2011, banks started to pay attention to their consumers and it was estimated that 14% of consumers do not monitor their finances. According Mark Schwanhausser, senior multichannel financial services analyst at Javelin Strategy and Research, “When consumers lack information on their money, they’re not in a position to save, to spend or to invest, they can’t assess where they are today and they can’t move forward”. On the way to help their customers solving this problem, banks offered personal financial management tools (PFM) on line and on mobile devices [Ste12].

Through the last years, new financial products and services have arisen to the market to meet the needs of consumers about their financial lives. The ability to access to this
information without all the nuisance and bureaucracy from financial institutions is the perfect alternative to busy clients [Mau10].

The main purpose of PFM tools is helping customers get a better handle on their spending and saving by accessing, tracking and manage their accounts without any excuse. In a recent survey from Javelin Strategy and Research [Ple13] was asked to 5000 US consumers about the advantages of controlling bank accounts remotely and the results show the fifth most desired features:

- **View and Updates** — View all account balance and updates on real time.

- **Reminders** — Receive financial alerts as reminders about upcoming bills, status of personal funds, risk of exceeding limits, receiving motivational updates from saving money, payed debts credit scores and others.

- **Comparison pricing** — Comparison products, prices and merchants are also pointed as a favorite feature.

- **Calendar** — View finances dates upcoming bills and account balances.

- **Cash-flow estimator** — Estimations about how much it can be saved or spent based on past information like personal pending bills, payments, salaries.

Furthermore, in the same survey, was evaluated that the PFM features consumer desires is divided in four categories: **Spend** (where the money went or goes), **Shop** (smarter shopping), **Buy** (making decisions where to apply the money) and **Plan** (track and achieve goals), and as excepted plan was the action with less supporters. When banks realized this problem, they start investing on their own PFM tools to make it them competitive advantage. The easy access to information is now a priority [Ste12] and understanding client’s needs too, like time saving. However, not everything is perfect. Nowadays, despite of these positive mobile attributes and perceptions, financial institutions have to face some problems because many people remain skeptical of the benefit of mobile financial services and remain concerned about the security risks, table 2.1.

The evolution of technology has the potential to shape and change consumers’ financial decisions and to empower the access to financial services. However, we cannot forget about the two major impediments in adopting this technologies: lack of security and privacy and the possibility of hackers remotely accessing consumers’ phones and computers [Mau10].

### 2.2.3 Existing PFM Tools

In order to extract ideas and understand what is pertinent or useless to build the right application is convenient have a overview about some of the most popular existing applications and the way they are created, developed and used. From all of applications that were analyzed, only three were choosen: Expense Manager, Toshl and Google Wallet.
Table 2.1: Concerns with mobile banking

| Concerned about the security of my financial information | 41% |
| Prefer to use computer | 28% |
| Worried about losing cell phone | 25% |
| Afraid it will cost too much | 19% |
| Cell phone screen too small | 18% |
| Unsure how it works | 15% |
| Cumbersome | 12% |
| No need | 9% |
| Do not have any concerns | 23% |

2.2.3.1 Expense Manager

In October 2010, was the Expense Manager’s first release and since then the application have been updated regularly. Expense Manager is a mobile application in Android Operation System that helps the user to keep on track all his expenses and incomes which aims “to make mobilie expense management easy”\(^5\).

Main Features

- Multiples accounts;
- Schedule and alerting payments;
- Check the budget by day, week, month and year;
- Design charts and reports;
- Import and export account activities data in multiple formats: CSV, SD Card backup and Dropbox;
- View account expenses with selected criteria such as by categories, associate payment methods, date and the entities involved;
- Integrated calculator and currency converter.

Detected Problems

\(^5\)Computer World: 10 smartphone apps that can help track your expenses, <http://www.computerworld.com/s/article/9231406/10_smartphone_apps_that_can_help_track_your_expenses> (accessed on January 10th, 2014)
Literature Review

- Extra features that do not seem to add value to users, especially to older users;
- Difficult navigation on the application;
- Too much screen information;
- Complex interface;
- Reports and charts difficult to read;
- Payed pro edition.

Expense Manager last version is 2.0 and its last update was December 2013.

2.2.3.2 Toshl

Toshl Finance Budget and Expense is an Android and Web personal finance and budgeting application that can also act as a daily expense tracker. It helps to see exactly where the user money is going, and allows to track another family members and understand what impact the user have on the family budget. Toshl also creates graphics that show how much money goes toward rent, groceries and other expenses.

- Set up repeating expenses and incomes;
- Export your expense reports into PDF, Excel, Google Docs and CSV;
- Compare the rate of spending with the time of the month;
- Move remaining funds to the next budget;

Literature Review

- Reminder for your bills as they become due;
- Convert foreign currencies;
- Automatically synchronization with multiple devices;
- Use a password to lock the application.

Detected Problems

- Registration and sign in is required;
- Reports and charts only can be accessed through the Website;
- Reports and charts too sophisticated and with to many colors for senior users;
- Some basic commands are buried and difficult to find;
- Payed pro edition;
- Pro edition has important features that seem to be essential to the application.

Toshl last version is 1.7.19 and its last update was November 2013.

2.2.3.3 Google Wallet

In September 2011, Google launched the GoogleWallet service, which allows consumers to shop, save and pay with their phone. The application has integration with users’ credit and debit card and the payments are in real time.

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Literature Review

- Notifications when the user is near a merchant with a saved loyalty program;
- Password required to access to the application;
- Real-time transfers;
- Uses NFC chip.

Detected Problems

- Registration and sign in is required;
- Interface garish colors;
- No financial management support.

![Figure 2.3: Screen shots from Paypal Application](image)

Google Wallet last version and last update was January 2014.

2.2.3.4 Summary

All the applications that were presented above can show some of the problems that will be faced. However, this PFM applications give some possible solutions and alternatives that with a few number of changes can be adapted to the old user. The next table 4.2 is a resume about the essential advantages and disadvantages that should be considered.

This three PFM applications have their pros and cons, and have shown to be sophisticated tools for financial management although this is not always a good thing if the target audience is seniors.

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## Table 2.2: Pros and Cons

<table>
<thead>
<tr>
<th>Application</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expense Manager</td>
<td>The application allows a big number of data to be annexed to an expense or income. Provides a list of terms already defined and creates repeating transactions. Plenty of bells and photo-storing feature.</td>
<td>Design is the main weakness, also hard to find some commands and reports difficult to understand even for a young adults.</td>
</tr>
<tr>
<td>Toshl</td>
<td>The unique feature of the application is cross-platform heritage which allows the syncronization of the data and the application’s use can be done in everywhere.</td>
<td>Interface animation can perturb and distract the user, and also remove the seriousness of the aplication. To use all the benifits of the aplication is required to use more than one device.</td>
</tr>
<tr>
<td>Google Wallet</td>
<td>Bank accounts integration, real payments and very easy to work with. Google Wallet is on the top of the technology with NFC chip.</td>
<td>The personal financial management is only the sum of the expenses and incoomes and only available on select Android phones. Internet is required.</td>
</tr>
</tbody>
</table>
Chapter 3

Methodology

This section provides an overview of the methodology to be used in the application’s implementation, based on User-Centered Design. The overview includes the basic definitions and terminology, and the design phases to apply this methodology.

3.1 Definitions and Terminology

Human-computer interaction is “a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them” [HV97]. The interaction between one or more humans and one or more machines is the main focus of HCI research and its special concerns came from:

- The communication between human and machine.
- The humans ability to use a machine.
- Algorithms and programing of the interface.
- The process of specification and implementation of interfaces.

In many systems, human-system interaction involves human-computer interaction associated to design issues which requires the combination of a considerable number of areas such as computer science, psychology, human factors (ergonomics), sociology, artificial intelligence, engineering, design and other fields [HV97]. As an example, nowadays it is possible to found at home a huge number of systems that require computer interaction, programming the microwave in the kitchen; record a desired television video in the family room; configure and process spreadsheet templates in the office and so on.
3.2 Design Phases

In the last years the attempt of several institutions to integrate design with technology had become a regular behavior in the development of their products. It is known that a system is created to achieve some purpose and unless it can be used properly by humans, it is worthless however sophisticated it may be. [HV97]

In 1999, was established an international standard ISO 13407 which “provides guidance on user-centred design activities throughout the life cycle of computer-based interactive systems. It is intended to be used by those managing design processes, and is concerned with ways in which both hardware and software components of interactive systems can enhance human–system interaction.” The standard describes the best practices in User-centered design and ensures that the development of software and hardware products take in account the needs of the user [JIMK03].

The four activities of User-Centered Design (figure 3.1) identified are:

(a) **Understand and specify the context of use** — Introduce a new product implies collecting relevant contextual information from the environment where the system is going to be used.

(b) **Specify user and organizational requirements** — Formulate and build the user-centered requirements for the new software which involves: identification of the range of users, prioritize requirements, acceptance of requirements by the stakeholders…. 

![Figure 3.1: User-Centered Design principles](image-url)
Methodology

(c) **Produce more than one candidate design solution** — Simulate design solutions using paper or computer-based mock-ups and explore them with feedback of real users.

(d) **Evaluate designs against requirements** — Last but not least, is indispensable evaluate the design work done before. Here are identified anomalies, defects, bugs, failures and selected the best solution for the system.

The four steps above accomplish an iterative process until design and usability goals are met which imply the understanding of users since the first step. The UCD is the base of the methodology to be adopted on development of this project which should be describe more detailed in the next four sections 3.3.

### 3.3 Research Methods

#### 3.3.1 User Research

In the context of UCD, some different methods were applied in each phase. At first, in order to understand and specify the context of use, was used the User Research, a process that allows us to better understand the target audience, as our subject of study. It was made an in-depth research about their characteristics and behaviors, their relationship with new technology and also the analysis to the best practices to have in account when design for older people. All this research was based on literature review, as published papers, books and we also took advantage of the knowledge acquired in other Fraunhofer’s projects developed in the past. The purpose of this first phase, was to have enough and solid background work to proceed to the next phases, so it did not have the participation of old people yet.

#### 3.3.2 Interviews

As referenced previously, after a thorough investigation of the end-user’s limitations it was necessary to collect more detailed information and, with that, define the requirements that our application would include in order to meet the user’s needs, taking always into account their relation with practical applications. In order to accomplish this phase goals, a previous study was required about all the existing research methods. To understand how users enter information into their phones it is required to observe mobile phone users in a natural setting, from individual situations at home or out, to public situations. Choosing the right method or methods to use is a highly context-dependent and all of them have their strengths and weaknesses, so is necessary to analyze all the variables.

There are three types of research [LFH10] resumed on the table 2.1 below:

Normally, research projects include a combination of two types of investigation, but all of these three types of research methods are not totally independent, but highly intertwined [LFH10]. The first step of a research is the constructing of the description of what
## Methodology

Table 3.1: Types of Research

<table>
<thead>
<tr>
<th>Type of Research</th>
<th>Focus</th>
<th>General Claims</th>
<th>Typical Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Descriptive Investigation</td>
<td>Describe a situation or a set of events</td>
<td>X is happening</td>
<td>Observations, field studies, focus groups, interviews</td>
</tr>
<tr>
<td>(b) Relational Investigation</td>
<td>Identify relations between multiple variables</td>
<td>X is related to Y</td>
<td>Observations, field studies, surveys</td>
</tr>
<tr>
<td>(c) Experimental Investigations</td>
<td>Identify causes of a situation or a set of events</td>
<td>X is responsible for Y</td>
<td>Controlled experiments</td>
</tr>
</tbody>
</table>

is happening (a) what does not explain the why it happens. The next step is to identify relations between multiple factors (b) which rarely determines the causal relationship between factors, and to complete the research process, the final step is the identification of the causal relationships (c).

After this analysis and taking into account some variables as time to investigate, we decided to choose the combination of the descriptive Investigation and experimental Investigation, namely performing interviews and usability tests for each phase. According to Durbin (2004) [LFH10], the common way to initiate a research project is to conduct exploratory descriptive investigations to identify the key issues to be analyzed and measured. Regarding the experimental research, has been a highly effective research method that led to many groundbreaking findings in behavioral science in the 20th century and nowadays plays an important role in the human-computer interaction field because its approach made and still makes findings that can be generalized to larger populations [LFH10].

Once the types of research were defined, it was necessary to analyze all the possible research methods. Rosenthal and Rosnow (2008) [LFH10] described eight research methods and for each one, its strengths and weaknesses, which allow us to find out the best alternative to the project: Interviews.

Even though we already know how old people normally behave, because of the first phase’s research (a), we were not able to understand all their financial habits, and the ability to “go deep” is perhaps the strongest argument in favor of interviewing [LFH10]. With the right questions we could explore a wide range of concerns about the money management and with the freedom provided by the informal interview environment, the interviewees were able to go at great length that would have been lost to surveys and other methods. Thus, this phase helped us define the application and the features it could include. All the performed interviews’ details are described on the section 4.1.
3.3.3 Prototype Mock-Ups

After the data treatment collected from the interviews and the specification of the application requirements in the previous stages, the next step is to produce design solutions. Before implementing the application from scratch it was decided to start giving some shape to the system through low-fidelity prototypes: first using papers and next computer-based mock-ups. These papers and digital interfaces were created paying attention to the existing design guidelines for mobile applications aimed at older adults, that were also referred later in section 3.4.

3.3.4 Card Sorting and Usability Tests

To conclude this cycle, there is the last phase of evaluation of the work done until here from the last phases. The validation and evaluation of the application due to the target user, required a different approach compared to an usual project. Thus, in order to test the application were made usability tests and card sorting with older adults. The two methods allow us to adapt the application taking into account the user response.

Card sorting is a technique used to help design and evaluate the information architecture of a system1 and used in some areas of cognitive psychology to capture mental models of how participants organize information [CHR08]. With the objective to explore the structure of the application, combined with some lack of knowledge about the relationship between the old people and their issues with new technologies, after an analysis about some possible techniques to test, card sorting was the chosen one because all this reasons [Gaf00]:

- Almost no costs required;
- Easy to conduct;
- Identification of items that are likely;
- Enables you to understand how “real people” are likely to group items;
- Identifies items that are likely to be difficult to categorize and find;
- Identifies terminology that is likely to be misunderstood;
- Card Sorting is appropriate when you have identified items that you need to categorize.

As the card sorting technique, the usability tests were performed on the designed prototype also in collaboration with seniors which gave us a truly and faithful feedback about the application developed. The tests were made in two phases, the first one to ensure that

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we were on the right path and the second phase was executed later on the end of the development of the application.

Although all the planned usability tests were achieved, it would have been better to conduct long-term evaluation tests to actually observe a real interaction between the user and the smartphone on the field. However, we believe that the methodology and techniques applied are well implemented.

In the next chapter, all these methods described above (interviews, mock-ups, card-sorting and usability tests) and the core implementation of the personal finances application is explained in detail, from the technical specifications of the mobile device to the interaction with the interface.

3.4 Good Practices for Designing an Interface for Older Adults

The creation of any successful software requires always some concern about user-friendly aspects and when the system’s target is elderly this concerning is even bigger. To support older users is necessary to analyze and discuss the criteria behind design interfaces as guidelines for future studies [Phi11].

- **Use a big button size** — Motor limitations and vision problems justify the use of big size buttons with larger touch areas that fit to elderly users limitations [Phi11].

- **Use the full screen for the program** — Full screen programs allows to the user a bigger area to interact and do not let the user be distracted with other functionalities that are running in background.

- **Use colors with a good contrast** — One of the greatest environments aspects is the color of things colors which helps to detect and identify objects [Wij01]. The sensitivity to color contrast is lower in older people what makes difficult to distinguish most colors [Phi11] so must be a balance so the contrast is not too pronounced and provoke eye fatigue.

- **Use a suitable text** — The effects of font type and size affects on the legibility and reading time. According this study [BLM01], the official recommended 12-point size is not suitable for older people interaction, it was found that 14-point size is more legible and serif fonts were generally less preferred than sans serif fonts.

- **Avoid few navigations techniques** — In small screen such as mobile phones the information and operations can usually be limited. The the use of big buttons and texts affects screen layout which may complicate the actions to perform a task. The use of scroll bars, seek bars, spinners, tabs and pickers should be avoided or well thought because most of old people are not familiarized with it [Phi11]. Commonly this type of navigation through the program requires a big agility of movements, some of them are presented in the figure 3.2.
All guidelines presented above help older users on their interaction with digital machines, especially smart phones but this is still not enough. Designers do not care about the design software regarding older user’s characteristics and usually think in very simple interface with just bigger size buttons and texts. There are much more design characteristics that should be taking in account [Phi11] and are planned to be studied further on, such as:

1. Is every icon distinct from all others?
2. Does it make clear how it differs from all others it might be confused with?
3. Is the image striking and vivid?
4. Is it clear where one icon ends and another begins?
5. Are secondary design elements clearly subdued relative to primary subject matter?
6. Are the objects in the icon ones familiar to the user?
7. Are objects common in the user’s home environment?
8. Can users apply what they know about the real-world object to its use in the icon?
9. Is the icon always displayed with sufficient foreground-background contrast?
10. Are icons legible at real reading distances?
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11. Can users with common visual defects, such as myopia, astigmatism, presbyopia, and color blindness still recognize the icon?

12. Are all these icons necessary? Are they really the best way to meet the need?

13. Does the image use harmonious colors, patterns, and values?

14. Will users still recognize the image if it is smaller?
Chapter 4

Developing Personal Finances Mobile Application for Seniors

After a detailed study of the literature review and methodologies’ definition of the project in last chapter 3, the following section is a full description of the application development process. Initially is described an accurate report of the interviews, then a specification of the prototype’s requirements is presented and also a detailed description of the prototype’s evolution.

4.1 Gathering knowledge from the User

The purpose of this section is to provide a detailed description of the entire process that involved the interviews.

4.1.1 Type of Users

In the first phase of the project the main goal was to gather as much information as possible about the routines and habits of older people regarding their financial management. To achieve this goal, it was decided to get in contact with seniors through interviews with the Fraunhofer AICOS’s COLABORAR program, which has an available contact network of centers where seniors spend most of their daily time where it was easier to reach the target audience.

With the help of a specialized nurse and already taking advantage of her prior knowledge of the lifestyle and consequently the financial situation of the selected people for the interviews, it was decided to split the interviews into two groups: people with own financial management and people without any control over their money.
At the beginning of each interview it was necessary to present the goals of every question and explain its reasons to obtain their consent to use their data. Since this is a sensitive issue, especially for people whose financial management is not controlled by them, we had some difficulties to get some answers and also to notice if they were fleeing or not from the truth.

**Own Managers** are considered the people who have total knowledge of their financial situation. They are responsible for their situation and not supported by anyone on almost all the daily activities. Own managers make their own choices, purchases and pay expenses. They also can easily compare values, be critical about it and be aware about every banking operation and movements of their account.

Over time we noticed that people classified as managers when questioned about more challenging tasks as doing taxes (IRS) and other exercises as handle with ATM features (deposit or withdraw money and check bank balances), they reveal the need for technical assistance. These kind of challenges was not treated like an evidence of lack of money managing because it is caused by their handicap of dealing with new technologies. This situation can be seen in the real world and was noticed as expected in our sample.

**Non Managers** are consider the people who do not have any control of their financial issues. Almost all of their expenses and purchases are carried out by a family member, someone of trust or day care center assistance. It was noticed that with the aging process, normally, seniors cease to take care of their own finances, which starts with major amounts. When it comes to money responsibilities we have observed some reasons for this drop of care:

- First, our sample show us that non managers are always people whom their financial situation is not self-sustainable economically;
- We also noticed that in this type of people, familiar members desire to takeover the control of their own people;
- Non managers are normally more confortable and secured in this situation;
- Finally, the lack of knowledge or the fact that they are no longer able to deal with new technologies.

Against all our expectations it was not found a sign of laziness or lack of concern in any of our participants, as the main reason to do not care about the money management.

### 4.1.2 Interview Preparation

The interview script has about fifteen questions and the ultimate goal was always achieved, even if some deviations on the script were made during the conversations. This happens
because, according to the type of interviewee, it was required that each interview has to be adjusted to the senior involved.

With all the details that must be addressed, appropriate planning and preparation are obviously important [LFH10]. A pilot-testing was made with an ordinary person to check if all the questions made sense and there were not any gaps about it, also this pilot testing give us some idea of the potential length of an interview which was a very helpful practice [LFH10].

Although there were two kinds of guides for the two types of interviewees, all the prepared questions had the same final goal, understand how is the relation with their money and perceive which are their major concerns about it. There were not any question that had the intention to know the values or the dimensions of the interviewee bank account, so any value that was evoked is study’s propriety and cannot be disclosed without the participant authorization.

The method performed for the creation of the interview script, was to specify a list of pre-requirements that we believe will be useful for the application implementation.

Despite the interviews were elongated and the time to point out the answers was reasonable, we thought it would be better prevent and record the interview’s audio, with the pre-consent of the interviewees, as a backup of the same. As expected, this audio was quite useful because the review of the interviews allows us to notice some “lines” that during real time were not possible to perceive.

The original interview guide is presented on the MSc Thesis’ Appendix A.

4.1.3 Collected Data & Data Treatment

The interviews were conducted on different days over a period of two weeks in four different places, in which only one of them was held in the house of one of the couples involved. A total of thirteen interviews with people aged 65 to 86 years, nine females and four males were performed and identified seven own managers and six non managers of their financial resources.

The raw interviews’ data are presented in the form of audio records which required the difficult cost of transcription and interpretation. As stated by Robson (2002) turning a single hour of recorded conversations into text took several hours and generated a massive amount of content. After listening and transcribe all the interviews to text, for the analysis of the information collected was used NVivo qualitative data analysis software (QSR International Pty Ltd. Version 10, 2012), a software platform for analyzing all forms of unstructured data, where the interviews and its data are sorted with nodes, in other words, different areas. This approach to the analysis of interview data involves the organization of comments and responses into various categories, which were defined prior to analysis of the content as recommended once again by Robson (2002): prior coding [LFH10].

Once the coding task was completed, it was required a reliability check to ensure that the coding is consistent. In order to accomplish this, we included a brief comparison
between the collected data and the previous literature review information. Below, in the section 4.1.4, the quantitative results of the most relevant questions are presented.

### 4.1.4 Results and Observations

However, the interview guide has a large amount of questions, most of them had the same goal which allows us to group the information in the more complex queries that are displayed as follows.

- **Where do you keep your daily money?**

![Bar chart showing the distribution of responses for where senior citizens keep their daily money.]

- **Which of these do you use? Card, Cardeneta or None.**

![Bar chart showing the distribution of responses for the preferred method of payment among senior citizens.]

- **Number of Seniors**

- **Managers**

- **Non Managers**
• When do you withdraw your money?

![Bar chart showing different withdrawal methods]

• Where do you spend more money?

![Bar chart showing different expenditure categories]

• Do you often forget or lose about your bills?
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- Who deals with the difficult bills like for instance: IRS?

- Do you bring money with you? How much?
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- Do you have any money leftover?

- Do you keep your receipts and invoices?
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After a more detailed analysis of the interviews and the complementation with our natural observation, it was possible to understand some other insights about the collected data. Here are some points to consider carefully:

- On some questions, including those related to loss of money and forgetting bills, was observed that the responses do not correspond entirely to the truth, because it was possible to realize that over the conversations, people would eventually confess about those times that just forgot where they kept the money and also forgot to pay some bill. Another clear indication of this behavior is the way that they would address these shortcomings by creating their own routines and reminders around the house to not forget.
• Regarding other questions related to discounts, coupons and promotions, was ex-
pected that this matter was a central area to explore for the development of this
project, however, it soon became clear the disinterest of people interviewed on these
issues and their concerns in other areas.

• People who do not manage their money did not always know the answers to the
questions, which is the reason why the total number of responses does not reach
the total of the interviewed people.

The presented data summarizes the most important aspects, but for more detailed
information, the interview guide is attached (on Appendix A) and the transcripts of audio-
recorded are stored on Fraunhofer’s AICOS server.

4.2 Requirements Specification

In order to implement the *PersonalFinancesApp*, after the analysis of the interviews’ data
it was necessary to turn all the categorized information into real requirements. First, the
non functional requirements followed by the functional requirements.

4.2.1 Non Funtional Requirements

To ensure a proper and an efficient system, it became clear that we needed to offer an
application that could be usable and enjoyable to the senior population. According to
IEEE stantard[COM97], non-functional requirement is defined as “a software require-
ment that describes not what the software will do, but how the software will do it” and
“non-functional requirements are usually evaluated subjectively”. The non functional re-
quirements were clearly established at the beginning of the requirements specification,
however it was far from easy to know how best to implement and to evaluate it.

As expected from our study on the literature review, seniors have different requisites
from younger people, so we had to adapt our non functional requirements. Next, are the
requirements that were adopted during the system implementation:

• **Usability** The key point of our system. It should follow the design guidelines for
the target users, aiming to make the adaptation to the software easier.

• **Security** This requirement becomes important due to the constant input of infor-
mation. The system must ensure the integrity of the information flowing through
the application, in order to protect all the user data. Since this software is going to
be a kind of notebook and memory aid, a security breach could have catastrophic
consequences.

• **Extensibility** The system should provide an easy way to integrate new feature as
to edit and update the existing ones. E.g. Our application is prepared to add more
actions to the Main Menu, where already can be shown five implemented features.
4.2.2 Functional Requirements

As stated on [BE11] “the first step in a successful software project development is to properly identify and specify the software requirements”. The following sections describe all the process performed until the actually requirements were chosen and defined.

4.2.2.1 Initial Requirements

At first, a brainstorming, of all the features that could be implemented on our unborn financial application was performed, which was complemented with the use of other similar applications. The original requirements are:

- Record incomes and expenses
- Assign the incomes and expenses into different categories
- Take and save a picture of receipts
- Schedule and get reminders about payments
- Import and export account transactions
- Keep records of financial movements such as expenses and incomes
- View categorized transactions reports (date, categories)
- Choose the desired currency
- Customize default categories (edit, add and delete)
- Help tutorial for every feature
- Budget by day, week, month and/or year
- Set month’s budget limits
- Backup/Restore data
- Search expenses and incomes
- View statistics of expenditure and incomes
- View historic of transactions
- Compare monthly budget
- Customize language
- Customize currency
- Weekly and Monthly reports as charts and graphs
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- Support tool as Calculator
- Support tool as Currency converter
- Support tool as Calendar
- Advanced Settings
- Access with a password
- Estimations for the future

4.2.2.2 Final Requirements

After analyzing the interviews’ results it was important to understand exactly what should make sense or not for our target users’ needs. With this additional data, the requirement list presented above has changed, because we noticed that their wishes were the same, but as expected it needed to be fitted to their struggles.

Requirements such as Import and export account transactions, Backup/Restore data, Search expenses and incomes, Customize language, Customize currency and Advanced Settings for younger users may seem strictly necessary but were the first ones to be removed because of their complexity. Afterwards, having in mind that the remaining features could turn the application into a robust system, we still had to reduce the number of features and implement a software available and easily adaptable to seniors. First, to make sure we were excluding the right features, it was made a priority list with the most important ones and thereby reach the following final requirements to be implemented:

- Record incomes and expenses
- Assign the incomes and expenses into different categories
- Take and save a picture of receipts
- Schedule and get reminders about payments
- Keep records of financial movements such as expenses and incomes
- View categorized transactions reports (date, categories)
- View statistics of expenditure and incomes
- View historic of transactions
- Support tool as Calendar
- Access with a password
4.2.3 Use Cases

The use case model presented in the next section 4.2.3.2 helps to describe the scenario in which the user has to interact with the system. This is a graphical view of all the features that the senior can accomplish.

4.2.3.1 Actors

The original system has only one actor, but is expected in a future version to have two kinds of users, as described in section 6.3: the Senior User and the Caregiver. In figure 4.2 we can see the Use Case diagram describing the features that the system presents to the Senior User.

![Use Case Actor](image1)

Figure 4.1: Use Case Actor

4.2.3.2 Use Case Diagram

In Figure 4.2, the senior’s use cases are presented.

![Use Case Diagram](image2)

Figure 4.2: Use Case Diagram
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4.3 Interface Development

Repeating what was stated before, the study from the literature review allows us to conclude that seniors have different requisites from younger people, when it becomes to software features. Though keeping in mind the android guidelines, was not always easy to respect it, because the interface physical appearance applied to our application needed some care.

4.3.1 Mock-ups: Low-fidelity and High-fidelity Prototypes

After the most important features were defined, which were the result of the prioritization, had to be developed one at a time. But before start programming, we needed to prepare and find the best way to implement its interface with low-fidelity prototypes: the mock-ups. Low-fidelity prototypes are generally limited function and limited interaction, and are constructed to depict concepts, design alternatives and screen layouts rather than to model the user interaction with a system [RSI96].

The mock-ups were constructed quickly and demonstrated the general look and feel of the interface, which was a determining factor in the prototype development, since Heaton believes that rapid prototyping should solve 80% of the major interface problems.

For the high-fidelity prototypes was considered a series of static windows that show visuals, including colors, icons and the placement of controls, but no details such as navigation and interaction, since all the available softwares that allow us to simulate the flow of the application are paid.

Figure 4.3: Password Screen

Figure 4.4: Main Menu Screen

Given these low-fidelity and high-fidelity screens, is possible to notice that for some interfaces, there are a few options to be considered. Since some of the work done on Fraunhofer’s projects had tested similar problems, once again we took advantage of this situation and all the user tests in this phase have been dismissed.
4.3.2 Card sorting

Once the general requirements and a few mock-ups of the project were defined, it was time to start understanding if the relationship between the user and the work done until
here was right and explore alternatives before starting programming the prototype.

The technique used was based in Card Sorting but with some adaptations considering the target involved. Each test was composed by two distinct parts with different purposes: the first one has the goal to figure out if the meaning of the images to use on the application was the intended and the second one was to understand the right flow of some features.

Card sorting was the appropriate technique that we found to identify items that we needed to categorize, and the best way to have the feedback that we wanted from who will use it. In this process it was important to develop a “game” structure that would maximize the probability of senior users being able to find the wanted items.

All the category icons were tested with the elders using the same adapted card sorting technique called closed card sorting. The closed card sorting is used to evaluate the effectiveness of the “content” of each given task, in other words, it has the goal to understand where users will look for different types of information. In this case, when asked for certain money expenses category, the participants had to choose between a range of five to eight images the one that seemed the most suitable, as shown in the figures 4.13; 4.14; 4.15; 4.16 and 4.17.

---

To facilitate the process and keep the “game” exciting between our participants, we choose to group them in groups of five people, in a concurrent in-person session. Each participant sorts a set of cards independently, and all the sets are equal. The only cons of a “group/independent” technique are the costs involved to have as many sets of cards as the number of participants, which due to this situation was not a problem because the set of cards was replaced by paper cards. Because our participants are old age and being mindful of participant fatigue, we had to limit the number of cards, even if it was tempting to want the participant to sort all kind of cards that we had in mind. This challenge was
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Figure 4.15: Grocery Category

(a) Cash Register  (b) Grocery List  (c) Shopping Cart  (d) Bag
(e) Grocery  (f) Basket  (g) Grocery

Figure 4.16: Transports Category

(a) Bus  (b) Car  (c) Oil Station  (d) Odometer
(e) Rocket  (f) Steering Wheel  (g) Tickets  (h) Tire
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(a) Rudder  (b) Note  (c) Chess  (d) Bingo

(e) Walking  (f) Cards  (g) Cards  (h) Domino

(i) Dice  (j) Fishing  (k) Ball

Figure 4.17: Leisure Category
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repeated for two groups and the results are as follows 4.18; 4.19; 4.20; 4.21; 4.22:

Figure 4.18: The chosen image is 4.13c

Figure 4.19: The chosen image is 4.14e

Figure 4.20: The chosen image is 4.15c

Figure 4.21: The chosen image is 4.35b

Figure 4.22: The chosen image is 4.17f

In order to test the flow of one of the main features of the application, it was also used a kind of card sorting technique. As before, participants had their own deck of cards, but
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this time, the aim of the “game” was to sort the cards’ content by importance, in order to understand the most appropriate flow 4.23.

![Pie chart showing the best flow order for adding an expense/income or alarm chosen is the Date-Value-Category order.]

Figure 4.23: The best flow to add an expense/income or alarm chosen is the Date-Value-Category order.

4.3.3 Evolution to the Final Prototype

With the choice of icons and the flow of the features defined and tested with a sample of end-users, everything was ready for application development. The transformation from high-fidelity prototype to the final prototype required a previous study of the Android Operating System.

4.3.3.1 Android Operating System

Android is a Linux-based operating system for mobile devices such as smartphones and tablet computers. It is developed by the Open Handset Alliance, led by Google\(^2\). Android has a large community of developers who contribute with applications that extend the functionality of the devices, and PersonalFinancesApp is just another example. The main reasons that prove that Android platform is the best available choice for the development application are followed:

- **Google releases the Android code as open-source**, under the Apache License: which means that the software is free to use and is accessible to everyone, what leads to a larger community.

- **Android has been updated frequently since the original release**: allowing the platform evolution with the fixing of bugs and the adding of new features, keeping close the competition.

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- **Google Play Store** is an online software store developed by Google for Android devices where users browse and download apps easily without any restrictions (except money issues).

- **Number one sales** since 2009 [But11] in Android smartphones and tablet devices: this market penetration inevitably reach a higher number of users.

Android applications code in a customized version of Java. The Java language has already been used by the *PersonalFinancesApp* developer, so this was not a development obstacle, the Android concept on the other hand, required an all new learning from the beginning.

Our Android application was developed in the Java language using the Android Software Development Kit (SDK) that includes a comprehensive set of development tools: debugger libraries, handset emulator, original documentation supported with samples code and tutorials. The integrated development environment (IDE) used was Eclipse Keptler (4.3.2) for Windows, with the Android development tools (ADT) plugin.

The *PersonalFinancesApp* prototype was developed and tested on devices running versions ICE CREAM SANDWICH - Android 4.0 (API level 14) or newer of the Android OS, compatibility code was produced in order to support the versions under 14 as well, but this has not been tested. The Android application does not require any type of other standard application to run.

Database

The Android platform has embedded an Open Source Database which uses SQLite (a powerful and light relational database engine). SQLite is available on every Android device and this technology does not require any database setup or administration, one of the reasons why we opted for this data storage. In our application a simple SQL database was created, only with one table as presented in figure below:

The database’s creation and its updates only have to be defined with SQL statements, which can be automatically managed on the Android platform. Furthermore, it is important to note that SQLite supports the data types [Vog10]:

- **TEXT**, similar to String in Java;
- **INTEGER**, similar to long in Java;
- **REAL**, similar to double in Java;

---

All other types must be converted into one of these fields in order to save them in the database. An example, is the dates that had to be converted in String or TEXT, on Java and SQL respectively.

**Architecture**

The structure of the Android platform is divided into five layers and each one provides different features that together complete an operation system, as depicted in figure ???. The Android OS consists of a kernel based on the Linux Kernel, with middleware, libraries and APIs written in C and an application framework that includes Java compatible libraries.

Applications are then created by stringing together multiple activities through which the user can navigate. At the high level, “Applications”, as the name suggests, is where the set of pre-installed and other downloaded applications reside. An Android application may contain four main components:

- **Activities** are designed to present a graphical user interface to the user and to capture the user’s interaction through that interface. For example, a single thing, like dialing a phone number or entering contact information for a single person.

- **Services** run in the background so there is no need for services to have user interfaces. Instead of that, services have two main purposes. First, they can perform long running operations, typically away from the main UI thread, and second, they provide a way for different processes to request operations and share data. For example, the music application has a number of different user interface screens that

---

show different application features. If it starts playing a song, and then the user wants to do something totally different, like check your email, the music application does not have to stop playing music. In this case, Android handles by using a service to play the music.

- **Broadcast Receivers’** listen for and respond to events. Essentially they play the role of the subscriber in the publish/subscribe pattern. For example, the messaging application is one example application that makes use of broadcast receivers. When a SMS message is sent by someone, Android will put a notification icon in the notification bar to let the user know that an SMS message has arrived. So Android has some software that just sits and waits for SMS messages to arrive. And when they do that, software broadcasts an SMS received intent.

- **Content Providers** are essentially databases that allow applications to store and share structured information. For example, the phone application can access stored contact information and use it to dial a phone number. This is possible because the contact information is stored in a content provider. Thus, content providers are designed to work across applications.

Each of these components serve a different purpose in the Android ecosystem. In our application, we only use the first component, Activities.
4.3.3.2 Final Prototype Implementation

Only after an introduction to the design and implementation of Android applications for handheld systems, such as smartphones and tablets, it was possible to start programming. The demand for application development skills required to learn the details of this specific mobile application platform, Android. After a successful cover of the fundamental programming principles, software architecture and user experience there were decisions to make.

**Colors:** As previously stated, the seniors decline in visual acuity affects the ability to percept all the colors. We had to choose colors that prevent glare and the combination between buttons, labels, background screens and text fields had to have a high contrast of colors. We also considered color-blind users, who may not distinguish the red and green color.

The colors used are white, black, gray and green (Fraunhofer Image Manual). Although, the colors had created an unique style, is a close approximation to the original Android Theme Style: Holo Light, as it can be seen in the following figures 4.26; 4.27.

![Gmail in Holo Light](image)

![PersonalFinancesApp in Original Theme](image)

The table 4.1 shows the colors that were used in PersonalFinancesApp.

---

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<table>
<thead>
<tr>
<th>Components</th>
<th>Hexadecimal Color</th>
<th>Color Identifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text and Icons Color</td>
<td>#000000</td>
<td>Black</td>
</tr>
<tr>
<td>Background Screen Color</td>
<td>#FFFFFF</td>
<td>White</td>
</tr>
<tr>
<td>Selected Items, buttons and relevant information Color</td>
<td>#218559</td>
<td>Green</td>
</tr>
<tr>
<td>General buttons Color</td>
<td>#C0C0C0</td>
<td>Gray</td>
</tr>
</tbody>
</table>

Table 4.1: Application’s colors

**Icons:** An icon is a graphic that should provide a quick and intuitive definition of what is intended, an action or a status. All the icon’s decisions have been made before on section 4.3.2. On the Android OS, because the applications may be installed on multiple devices with different resolutions, it is important to provide a variety of sizes for each resolution. Once again, we invested in other solution, based in user observation interaction. It was noticed a learning curve that shows us that seniors, after learning how to swipe, could navigate perfectly on the application, but when leading with small icons the difficulty to understand it was higher. So, we choose to have an only one size to our icons, the big enough to be understood for every superior and inferior resolutions.

An example:

![Possible alarm icons resolutions](http://ikons.piotrkwiatkowski.co.uk/)

(a) 32x32  
(b) 64x64  
(c) 128x128

Figure 4.28: Possible alarm icons resolutions

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6IKONS: 300 FREE vector icons from Piotr Kwiatkowski, [http://ikons.piotrkwiatkowski.co.uk/](http://ikons.piotrkwiatkowski.co.uk/) (accessed on Mar 27th, 2014)
**Brightness:** The screen brightness is measured by the Android platform that provides sensors that monitor relative ambient humidity, pressure and temperature. The brightness changes automatically having in account this parameters, which makes sure that the screen is as bright as it should be, compensating the seniors problems.

**Typography:** The Android design language relies on traditional typographic styles with readable space, alignment and scale. The adopted settings are:

<table>
<thead>
<tr>
<th>Component</th>
<th>Size</th>
<th>Style</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 4.29a</td>
<td>22sp</td>
<td>Roboto Thin</td>
</tr>
<tr>
<td>Figure 4.29b</td>
<td>40sp</td>
<td>Roboto Bold</td>
</tr>
<tr>
<td>Figure 4.29c</td>
<td>30sp</td>
<td>Roboto Bold</td>
</tr>
</tbody>
</table>

Table 4.2: Application’s typography

![Possible alarm icons resolutions](image)

**Labels:** All the labels needed to be well thinking. The terms used for the labels were defined having into account two things: terms used by the older people’s interviews and observations, and the terms that we had more difficulty to choose were analyzed in section 4.3.2.

**Buttons:** Subsequently, the buttons’ design was also tested in the usability tests of the same section. The application’s buttons can be divided in two types: icon-text and text-only buttons. The Android standards states that both an icon and text is most appropriate when they complement each other 4.30a and text alone is most appropriate for actions that would be difficult to represent visually 4.30b.

---

Navigation: A consistent navigation is an essential requirement in an user experience, keeping him from becoming frustrated and bored when performing tasks. Probability, this was the hardest thing to overcome, because most of our final users are not that used to handle smartphones or tablet devices on their daily and move from one screen to another, as “go back” or “move forward” actions are not intuitive, which was most noticed on these buttons.

The use of buttons implies that the user interacts with the device with only one gesture, the touch or tap action as showed in figure 4.31. However, to complement buttons, the user can navigate inside the application by using the swipe or drag gesture 4.32. Despite the gesture, not being always intuitive to the senior user, because implies three actions: press, move and lift, we used it on our application due to the necessity to display big size icons and letters.
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**Full Screen:** The Android OS offers the experience full screen that is usually used for videos, games, books or even images. For the PersonalFinancesApp application, we choose a full screen perspective to engage users more deeply with content. This option allows us to conclude that the visual distractions are minimised and otherwise the action bar did not contain any app controls so it was removed.

![Screen with Action Bar](image1.png)  ![Screen without Action Bar](image2.png)

**Pickers:** Pickers have changed a lot from the first versions. Despite, the swipe picker version is the most recent one, it is not the more intuitive to the senior users, so it was implemented a similar old version picker, that with only a touch changes the state.

![Recent Date Picker](image3.png)

![Recent Date Picker](image4.png)

Figure 4.33: Screen with Action Bar  Figure 4.34: Screen without Action Bar

Figure 4.35: Recent Date Picker
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What did not work, but have not been tested?

- Tabs
- Switchers
- Spinners
- Dialogs
- Seek Bars

All this Android UI components have not been tested with senior users, because we assumed, by elimination, that they were too hard to deal with, due to the fact that it requires complicate gestures or for being small sizes, which needs an accurate technique.

After reviewing all the important details of the Android interface components that were used, it is time to present the evolution and the final screen results of their aggregation.

Password Screen The Password Screen is the first screen interface that the user sees every time the application is turned on. Here, is presented a costumed dial and a bottom button that allows the user to insert his secret code and also to erase it. The main goal of this feature is to represent a similar screen as the ATM machines and become the most familiar as possible to the users. From the empty and full circles, to the simple dial with only the digits 0 to 9 that are needed.
Main Menu The Main Menu interface comprises all the actions that the user may do: add an expense or income, set an alarm, check the calendar and analyze the account’s current state. All the alternatives, are into a GridView layout that allows, in the cases of large enough screens, to be just one-click away from doing the pretended.

Add Expense Assuming that “Adicionar Despesa” option is selected, the Main Menu is replaced with a new interface screen. This task has three activities, which the flow was
tested before (on section 4.3.2). At first, is presented to the user a costumed dial containing
digits from 0 to 9 and a “comma” or “dot” button, allowing the typing of decimal values.
Then, the user has to choose the category in which the expense belongs by selecting from
the ListView the right one. At last, the final phase of the process asks for a date when the
expense was spent. The back and forward option are always presented until the expense
is saved.

Add Income Assuming this time that “Reforma & Outros” option is selected, the in-
terface process is similar to "Add Expense" action, whereas the only change is the list of
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categories displayed. The following figures show what happened over time:

- **Choose Date**: The user can choose the date by changing the day, month and year fields. Over the time the “date” activity underwent the following modifications:

  ![Low-fidelity Mockups](image1)
  ![High-fidelity Mockups](image2)

  ![First Version Screenshot](image3)
  ![Second Version Screenshot](image4)
  ![Final Version Screenshot](image5)

- **Select Category**: This activity allows the user to select the right category from amongst the predefined set that was defined before in the section 4.1.
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Figure 4.54: Low-fidelity Mockups

Figure 4.55: High-fidelity Mockups

Figure 4.56: First Version Screenshot

Figure 4.57: Final Version Screenshot

- **Type Value**: This activity has not changed much over the time as it can be seen in the following figures.

  **Set Alarm** The “Marcar Alarme” option, when selected, sends the user through the same structure and sequence as the two features above described: type the value, select the category and set the date of the expense/income. In this feature, only one more step has to be done by the user: choose when to be notified. After the background study, we
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Figure 4.58: Low-fidelity Mockups

Figure 4.59: High-fidelity Mockups

Figure 4.60: First Version Screenshot

Figure 4.61: Final Version Screenshot
decided that the reasonable choices where to warn the user in one year, one month, one week, everyday until the date or only on the actual day.

Figure 4.62: Low-fidelity Mockups
Figure 4.63: First Version Screenshot
Figure 4.64: Second VersionScreenshots
Figure 4.65: Final Version Screenshot

View Calendar The “Calendário” option, when selected, presents to the user a list of the movements that occurred at the date displayed. By default, the calendar shows to
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the user the current date and its corresponding transactions. Over the time, the calendar view has changed its layout as it can be seen on the above figures. On the first attempt, to structure the calendar we had three activities, a lineup of the years 4.74, followed by a lineup of the months 4.70 and finally the list of all expenses and incomes, despite being simple, the number of touches that the user had to do and the depth of screens were too much for our target users. The second and third attempts derive one from another. Both of them were just one-click way from the pretended, and all the information was aggregated on only one screen. The second attempted, had the year, month and week displayed, but in smaller resolutions we noticed that the three components would fill the screen and the list of movements would not be found intuitively. To overcome this problem, we choose to remove the week component and present the expenses and incomes on the same screen and directly to the user 4.77.

![Figure 4.67: Low-fidelity Mockups](image)

![Figure 4.68: High-fidelity Mockups](image)

![Figure 4.69: First Version Screenshot](image)

![Figure 4.70: First Version Screenshot](image)
Overview

The overview option is the “Histórico” section where the user is allowed to check the current state of his account. After searching the best way to display the data we opted to group the expenses by category and arranged in the form of horizontal graph bar. The category expenses values are ordered, from the highest to the lowest, which may vary over time with the insertion of new expenses and incomes.

Save Data

In the end of Add Expense, Add Income or Set Alarm, the system asks to the user to check all the data and confirm if the pretended action is to save or eliminate the information. The following figures shows this activity’s evolution.
4.3.4 Summary

The Personal Finances App does not require internet connection, and is available for Android versions 4.0 and above, which means that the minimum API level is 14, ICE CREAM SANDWICH and the maximum and target API level is 19, KITKAT.

Also, is important to refer a brief summary of all the good practices tested in this application, and what should be taken into account when developing an advanced version.
First of all, the prioritization of the information is essential to the software show only the important data, in other words, having little information but the enough.

Buttons are an important interface item, so it is relevant to have these noticeable to the user, because they do not always get its existence by mistaking it with labels or icons.

Sizes and colors can quickly render the application unusable for elderly. The best way to test these kind of technical features, is to evaluate a several hypotheses with the real user, and then obtain the right choices: big sizes, but not that big and no more than 3 or 4 colors, that mixed have the proper contrast.

As the previous, the best way to test icons and labels is with the real users, but another important point of these items is the fact that they must always be together because they complement each other.

At last, the gestures. The "tap gesture" is the obvious for the elderly, but create an application with only this kind of navigation can become a boring experience and not always easy to perform. The project developed, had identified a great learning curve, particularly with the "swipe gesture", that when trained, its related struggles can be overpassed.
Chapter 5

Final Evaluation - Usability Tests

After the implementation and before starting to take hasty conclusions, we needed to be sure that the software were what we wanted and filled our users’ needs, in other words, testing. We could not really tell how good or bad our interface was without getting people to use it [LR93].

5.1 The first phase

When implementing the first feature of the application, we noticed that before the whole system got set, we needed to do some user testing to have some clue about what would be right to design or not in the other features, to avoid falling into the same mistakes and seek new solutions right away.

The test was performed only by six people, that were on previous phases of the project, interviews and card-sorting. The test was considered quite simple and only took three to five minutes (time to clarify the context and explain the task not included) for each senior, which left draw conclusions about the fatigue level of the users. This time, however, has any deep analysis has been made for the performed tests, due their simplicity and the low number of people testing, therefore, all the problems, errors and observations detected were enumerated in a list in order to rectify it immediately. Despite all, this test also was used as the basis of example for the future tests.

The feature chosen to test was the one that we considered the main one: Add expense. At that time, the implemented screens were the following (figure 5.1).

The participant task instructions are presented below in the table 5.1 as the respective test results 5.2.
Add an expense (“20.50”, “Supermercado”, “24”, “Maio”, “2013”)

Ideal Flow: [Choose “Adicionar Despesa” -> Enter Value -> Choose “Seguinte” -> Enter Category -> Enter Day -> Enter Month -> Enter Year -> Choose “Seguinte” -> Choose Button “Sim”]

Table 5.1: First experimental test

<table>
<thead>
<tr>
<th>Test ID</th>
<th>Instruction Task</th>
<th>Observations</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UT_001</td>
<td>Find the “Adicionar Despesa” choice on Main Menu</td>
<td>Swap “Adicionar Despesa” and “Adicionar Receita”. Select the wrong button.</td>
<td>Confusion between plus and minus symbol. Being swayed by the word “Adicionar”. Thought that was to click below “Adicionar Despesa”.</td>
</tr>
<tr>
<td>UT_002</td>
<td>Insert the number “20.50”</td>
<td>Comma/point character not selected.</td>
<td>Forget the comma/point character. Button not well visible.</td>
</tr>
<tr>
<td>UT_003</td>
<td>Select the category “Supermercado”</td>
<td>Select wrong category</td>
<td>Small category dimensions</td>
</tr>
<tr>
<td>UT_004</td>
<td>Choose the date “24-May-2013”</td>
<td>Can not change values of date fields. Confused what was date is it.</td>
<td>Could not understand the swipe movement. Swaping the pretended date for the first one that appears.</td>
</tr>
<tr>
<td>UT_005</td>
<td>Save expense data</td>
<td>Forgot that have to save the expense data.</td>
<td>Not expecting to have to save.</td>
</tr>
<tr>
<td>UT_006</td>
<td>Transactions “Seguinte” and “Voltar”</td>
<td>Click on the “Voltar” instead of “Passo Seguinte” button.</td>
<td>Confused by the difference between “Voltar” and “Passo Seguinte”. Could not understand the flow of the screens.</td>
</tr>
</tbody>
</table>

Table 5.2: First experimental test results

From here, it was possible to extract some enriching results that we were not expecting. In order to give response to the feedback collected by the test results, were made some modifications to the interface:
Final Evaluation - Usability Tests

- At first, the icons that were linked to the “Adicionar Despesa” and “Adicionar Receita” were amended by a “plus” icon for the “Adicionar Despesa” and “banknotes” icon for the “Adicionar Receita”. To avoid the users’ tendency to choose the “Adicionar Receita” instead of “Adicionar Despesa” only because of the “Adicionar” expression intuition, we changed to “Reforma & Outros”;

- In order to escape to the error of clicking below “Adicionar Despesa” text, we decided to give more highlight to the buttons;

- The most common problem of forgetting the comma/point character was solved with the expanding of the dimensions, which was also the solution to the selection of the wrong category;

- The date interface has to change to an old version of the date pickers, where only one current date is displayed and the changing date movement is a tap instead of a swipe.

- The most difficult and unexpected issue was the phase transitions between the screens, which was not at all intuitive for the users. The “Passo Seguinte” button changed to “Seguinte” and was highlighted in a different color; on the Category screen, the go forward button was removed and the save screen was also removed and replaced by only one button on the last phase of the add expense task.

After these changes, we were ready to start implementing the remaining features, with more information in mind.

5.2 The final phase

Having all the wanted features implemented, it was time to test and get real feedback from our target users, the seniors. Subsequently, in the usability tests we created a group of tasks to be performed which were reported in detail in the Fraunhofer’s testing protocol (on Appendix B).

For this evaluation, we recruit ten participants and each one performed the requested tasks alone. The end users were 60 years old and older and all of them with some consciousness of their financial situation. However, it was expected that some participants do not have all the control about their money expenses which is not a problem for this tests.

According the statements of Jackob Nielsen, who once reported that the best results in usability tests come from testing no more than five users [Nie00] and also with the limited time that we had, the number of testers became ten. Jackob stated that ten people will found about 90% of the usability problems.

The evaluation took place at “Centro de Convívio/Centro de Dia do Bonfim” and Fraunhofer AICOS’s offices. The first location is where most of the participants took the
Final Evaluation - Usability Tests

tests and was chosen for being the most convenient for them because is where they are accustomed to spend most of their day. The second one is intended for other participants who do not attend social centers, but it is a place where they are used to perform this kind of tests for Fraunhofer’s past projects and simulates the normal context of use. The application has been designed to be used in the environment that our participants are in, so the set is almost perfect for the tests. Still, some aspects like daily activities outside of the social center and home can not be fully tested on this tests.

For all the participants the evaluation of the PersonalFinancesApp application was performed on a Motorola Mobility smartphone, Moto G with a 4.5” WXGA (1280 x 720) screen, in standard color mode and automatic brightness.

We had to follow a test procedure that has already been studied and tested in other Fraunhofer’s projects. At first, the participants should receive a general information regarding the project, in order to contextualize them. Again the details can be found on Appendix A, on section “3. Test procedure”. Next, the tasks to be achieved were explained and all the doubts were elucidated.

It is important to note that the application were already populated with fake data to simulate an account to give the user the possibility to execute the pretended tasks. When we were ready to move forward, the participants would be asked to do the following tasks:

---

Check Overview

**Ideal Flow:** [Choose “Estado Actual” -> Search for “Supermercado” category -> Note the matching value -> Choose “Voltar”]

---

The test results of the first task can be found on the following table 5.4.

<table>
<thead>
<tr>
<th>Test ID</th>
<th>Instruction Task</th>
<th>Observations</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UT_007</td>
<td>Find the “Estado Actual” choice on Main Menu</td>
<td>Choose the “Histórico” option</td>
<td>Chose the more intuitive term</td>
</tr>
<tr>
<td>UT_008</td>
<td>Search for “Supermercado” category</td>
<td>Can not find the “Supermercado” category. No observations</td>
<td>Could not understand on his own the needed to swipe. No causes</td>
</tr>
<tr>
<td>UT_009</td>
<td>Say out loud and take note of the category value</td>
<td>No observations</td>
<td></td>
</tr>
<tr>
<td>UT_010</td>
<td>Go back to Main Menu</td>
<td>Could not find the “Voltar” button.</td>
<td>The default android back button was selected</td>
</tr>
</tbody>
</table>

---

Table 5.4: First test results

For the first and third tasks, the main goal was to show the user where it can be seen the current state of the account and to demonstrate the change of the values when an expense
or income is added. In order to understand the right terms to this feature, another field was created on the Main Menu, giving the user the opportunity to choose the one that seem the best. Some modifications to the interface were made:

- Due the fact that over 50% of the people choose the “Histórico” field instead of “Estado Atual” field, we replace the feature name to “Histórico”;
- Only three people used the default android back button, so we let the two options in open.
- Finally, it was not found the alternative to the swipe movement but, when analyzing the users learning curve, it is possible to assert that the seniors would overcome this problem with practice.

The second task was 5.5:

**Add an expense** (“20.50”, “Supermercado”, “24”, “Maio”, “2013”)

<table>
<thead>
<tr>
<th>Test ID</th>
<th>Instruction Task</th>
<th>Observations</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UT_011</td>
<td>Find the “Adicionar Despesa” choice on Main Menu</td>
<td>No observations.</td>
<td>No causes.</td>
</tr>
<tr>
<td>UT_012</td>
<td>Insert the number “20.50”</td>
<td>Comma/point character not selected.</td>
<td>Forget the comma/point character. Button not well visible.</td>
</tr>
<tr>
<td>UT_013</td>
<td>Select the category “Supermercado”</td>
<td>No observations.</td>
<td>No causes.</td>
</tr>
<tr>
<td>UT_014</td>
<td>Choose the date “24-May-2013”</td>
<td>No observations.</td>
<td>No causes.</td>
</tr>
<tr>
<td>UT_015</td>
<td>Save expense data</td>
<td>Forgot that have to save the expense data.</td>
<td>Not expecting to have to save.</td>
</tr>
<tr>
<td>UT_016</td>
<td>Transactions “Seguinte” and “Voltar”</td>
<td>Click on the “Voltar” instead of “Passo Seguinte” button.</td>
<td>Could not understand the flow of the screens.</td>
</tr>
</tbody>
</table>

Table 5.6: Second test results

This task was performed before, on the first experimental usability test, and after some interface changes we noticed better results. Still, we have some details to solve, like, find a
way to become more intuitive on the transitions between the screens and the save action, and also to give some highlight to the “comma/point” button in order to avoid forgetfulness.

The third task was:

**Check Overview**

**Ideal Flow:** [Choose “Estado Actual” -> Search for “Supermercado” category -> Note the matching value -> Check if the value has changed -> Choose “Voltar”]

Table 5.7: Third test

And the test results can be found on the following table 5.8:

<table>
<thead>
<tr>
<th>Test ID</th>
<th>Instruction Task</th>
<th>Observations</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UT_016</td>
<td>Find the “Estado Actual” choice on Main Menu</td>
<td>Choose the “Histórico” option</td>
<td>Chose the more intuitive term</td>
</tr>
<tr>
<td>UT_017</td>
<td>Search for “Supermercado” category</td>
<td>No observations</td>
<td>No causes</td>
</tr>
<tr>
<td>UT_018</td>
<td>Say out loud and take note of the category value</td>
<td>No observations</td>
<td>No causes</td>
</tr>
<tr>
<td>UT_019</td>
<td>Go back to Main Menu</td>
<td>Could not find the “Voltar” button.</td>
<td>The default android back button was selected.</td>
</tr>
</tbody>
</table>

Table 5.8: Third test results

This task was also performed before, on the first task. The instructions for the two tasks, had not changed, and the main goals to repeat this action, are to show the senior user, in a practical example, how the application works and evaluate their learning curve. After this, we could conclude that the term “Histórico” is more appropriate than the “Estado Atual” because almost all the users clicked first “Histórico” term twice; and we can also conclude, once again, that the difficulties to find the “Supermercado” label were overcome by the understanding of swipe gesture.

The fourth task was:

**Add an income (“850”, “Reforma”, “10”, “Fevereiro”, “2014”)**

**Ideal Flow:** [Choose “Reforma & Outros” -> Enter Value -> Choose “Seguinte” -> Enter Category -> Enter Day -> Enter Month -> Enter Year -> Choose “Seguinte” -> Choose Button “Sim”]

Table 5.9: Fourth test

And the test results can be found on the following table 5.10.
Final Evaluation - Usability Tests

<table>
<thead>
<tr>
<th>Test ID</th>
<th>Instruction Task</th>
<th>Observations</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UT_020</td>
<td>Find the “Reforma &amp; Outros” choice on Main Menu</td>
<td>No observations.</td>
<td>No causes.</td>
</tr>
<tr>
<td>UT_021</td>
<td>Insert the number “850”</td>
<td>Comma/point character not selected.</td>
<td>Forget the comma/point character. Button not well visible.</td>
</tr>
<tr>
<td>UT_022</td>
<td>Select the category “Reforma”</td>
<td>No observations.</td>
<td>No causes.</td>
</tr>
<tr>
<td>UT_023</td>
<td>Choose the date “10-Fev-2014”</td>
<td>No observations.</td>
<td>No causes.</td>
</tr>
<tr>
<td>UT_024</td>
<td>Save income data</td>
<td>Forgot that have to save the expense data.</td>
<td>Not expecting to have to save.</td>
</tr>
<tr>
<td>UT_025</td>
<td>Transactions “Seguinte” and “Voltar”</td>
<td>Click on the “Voltar” instead of “Passo Seguinte” button.</td>
<td>Could not understand the flow of the screens.</td>
</tr>
</tbody>
</table>

Table 5.10: Fourth test results

In this test, the modifications to the interface are the same that the second test.

The fifth task is in the table 5.11.

Set an alarm(“Contas de Casa”, “6”, “Junho”, “2014”, “Todos os dias”)

Ideal Flow: [Choose “Marcar Alarme” -> Enter Category -> Enter Day -> Enter Month -> Enter Year -> Choose “Seguinte” -> Choose reminder -> Choose “Seguinte” -> Choose Button “Guardar”]

Table 5.11: Fifth test

And the test results can be found on the following table ??:

As it can be notice from the table above, due the fact this task structure were already performed in two tasks behind: add expense and income, the users got used to the interface and therefore have not found many obstacles. So, the modifications to the interface are the same that the second and fourth test.

Finally, the sixth and last task was:

And the test results can be found on the following table 5.14:

At last, the sixth test had the purpose to evaluate the ease and intuition of finding an expense, income or alarm that already been set before. The only struggle found was for few seniors that can not understand where they have to touch to change the date.
Final Evaluation - Usability Tests

<table>
<thead>
<tr>
<th>Test ID</th>
<th>Instruction Task</th>
<th>Observations</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UT_026</td>
<td>Find the “Marcar Alarme” choice on Main Menu</td>
<td>No observations.</td>
<td>No causes.</td>
</tr>
<tr>
<td>UT_027</td>
<td>Select the category &quot;Contas de Casa&quot;</td>
<td>No observations.</td>
<td>No causes.</td>
</tr>
<tr>
<td>UT_028</td>
<td>Choose the date “6-Jun-2014”</td>
<td>No observations.</td>
<td>No causes.</td>
</tr>
<tr>
<td>UT_029</td>
<td>Choose the reminder routine</td>
<td>No observations</td>
<td>No causes</td>
</tr>
<tr>
<td>UT_030</td>
<td>Save alarm data</td>
<td>No observations</td>
<td>No causes</td>
</tr>
<tr>
<td>UT_031</td>
<td>Transactions “Segueinte” and “Voltar”</td>
<td>Asks every time if it the action to take</td>
<td>Could not understand the flow of the screens.</td>
</tr>
</tbody>
</table>

Table 5.12: Fifth Test Results

Check Calendar (“Contas de Casa”, “31”, “Junho”, “2014”)

Ideal Flow: [Choose “Ver Calendário” -> Enter Month -> Enter Year -> Back]

Table 5.13: Sixth test

<table>
<thead>
<tr>
<th>Test ID</th>
<th>Instruction Task</th>
<th>Observations</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UT_032</td>
<td>Find the “Ver Calendário” choice on Main Menu</td>
<td>No observations.</td>
<td>No causes.</td>
</tr>
<tr>
<td>UT_033</td>
<td>Choose the right month and year</td>
<td>Can not change month and year values.</td>
<td>Could not find where is the trigger to change values.</td>
</tr>
<tr>
<td>UT_034</td>
<td>Find the alarm seted up before</td>
<td>No observations</td>
<td>No causes</td>
</tr>
<tr>
<td>UT_035</td>
<td>Go back to Main Menu</td>
<td>No observations</td>
<td>No causes</td>
</tr>
</tbody>
</table>

Table 5.14: Sixth test results

5.3 Summary

During the evaluation, two facilitators participated, one to mediate the communication with the participant and the other to collect data, since the test included several tasks and we encouraged participants to use the think aloud method. To evaluate the usability of the system we measured effectiveness, efficiency and satisfaction.
5.3.1 Effectiveness

To measure the effectiveness of the system, it was taking into account four parameters: task completion rate, deviations, errors and assistances.

- Each task was divided into several steps that form the ideal flow to completion (see Participant task instructions). The accomplishment of these tasks will allow the calculation of task completion rate.

- Deviations are defined as alternative flows to the completion of the task, that, while not being the ideal flow, still enable the participant to achieve task completion.

- An error will be counted every time the participant performs an action that does not contribute to task completion.

- An assistance is considered every time the participant requests the assistance of the facilitator in order to perform the task. If the assistance is required because the task was not well explained it should not be considered as assistance in task completion; if the participant forgot the following step of a task that should be noted, since it may not be a problem with the system’s usability but instead with the formulation of the task.

5.3.2 Efficiency

To measure the efficiency of the system it was evaluated taking into account only one parameter: task completion time.

- The amount of time required for a participant to complete a task leads to the calculation of the actual or estimated completion time. For this parameter it will be used other similar developed application to compare the actually differences and where the differences are expected.

5.3.3 Satisfaction

The satisfaction of the system it was measured through the SUS questionnaire administered after the test. Additionally, all the comments made by the participants during the test as well as in the informal conversation that followed will be registered.
Final Evaluation - Usability Tests
Chapter 6

Conclusions

This chapter contains the description of the solution proposed and a brief overview about the main points that may be considered to follow during the next project’s development.

6.1 Contribution - The Solution

The main aim of this MSc Thesis is designing, developing and evaluating a mobile application system regarding the management of seniors personal finances. The process that led to the building of the current application, required the conduction of an in-depth research on the older adult's habits, an overview about HCI methodologies and the performance of usability tests. PersonalFinancesApp is just the prototype that marks the beginning of a new project and the research of another way to get at senior population, through software. Due to the received feedback from our sample of older adults, we are allowed to believe that this system has the potential to improve their lives in the field of finance management which we look forward to complement it. The solution proposed is based on an Android application that was tested by real users whose results could be a bit deviated because were performed in an “experimental environment”.

6.2 Challenges - Lessons Learned

Create a solution able to senior users was entirely challenging and with this work some lessons can be drawn.

- We do not figure out how things work. We muddle through [Kru00]: Unlike what Steve Krug (2006) [Kru00] supports about software gadgets’ users, we did not observe it on our sample of users. Steve noticed, whether testing software, that most of the people use things all the time without understanding how they work. In our case, seniors prove us quite the reverse, in fact. Before any test, they all asked for a
Conclusions

quick introduction about what will happen and required us to explain slowly what they had to do on the task, exactly. These facts, allow us to conclude that when people are not on their comfort zone, they try to prepare for what is going to happen.

- KISS (Keep It Short and Simple): Does not matter if the task that we are willing to solve is too hard or too easy to accomplish, the result has to be simple and less ambiguous as possible. This was noticed when the first usability test was performed in only one feature. Create a complex assignment, it only will result in complicate the user and developer’s life.

- Too much information, limited space: When trying to address the user needs, we found our biggest struggle: where to put so much information? Trying to allocate data to a restricted screen, it was the major challenge of all. It is always too easy to overload and create chaos without even trying, so the solution that we found is to prioritize the requirements and choose only the important ones, which leads to the above said.

- Observation feedback from seniors: Everything counts. Beyond the interviews and usability tests, there are information and feedback that should not be lost. Normally, this feedback is indirect and very hard to write down with a standard structure. This happens because of two reasons: the users try to express themselves in the best way possible but, they do not know the correct way to do it, and when they actually try to hide something for any personal reason, the body ends up to express in contrary.

6.3 Future Work

Citing Ben Linders, “Given that software development is still young (...) there is a need to continuously improve the development of software”, we can say that this platform is way far from being perfect and finished. Firstly, there is always room for some improvements even on the already implemented features. Since this application is the beginning of a new area of research, the work done until here is just the first of many experiences and a different starting point to reach senior population through software.

We believe that, based on the received feedback, even though the current state of the application is premature, it already seems to help the older people in their daily financial management. The next step to take would be to expand the system in order to complement it with the several needs that seniors still have, having into account that the application complexity will not get bigger. In the case this complexity shows up inevitably to increase, we hope the best way to overcome this struggle is to evaluate the learning curves of our target users.

Then, another future improvement that would be a gain to our system, is to find a way to help the Non Manager Users to have any control of their finances. Maybe the best solution is to create another similar application that matches their needs in a better way
Conclusions

and to complement it create a double profile, the real user and the caregiver, who will have access to the data: add expenses that the user is not responsible for, update the account values and also set limits that the senior could receive per day, week or month.

Another important point is the integration with a bank account, which might raise other issues as security problems and negotiation with the banks themselves, but would give the user a real perception of their account money with all the real details that maybe cannot be achieved with our application.

At an advanced stage, the application could also be a means to get information about the user behavior changes and from then detect early disease principles that are so common at those ages. Lastly, there are always the usability changes and enhancements that are inextricably linked to the system’s features changes that can completely change the functioning form of the app.

As a final note, it will be a positive point and an advantage to have a bigger test group, in other words, share it in large communities that would use the PersonalFinancesApp in real situations for a reasonable period of time which will give a real database of financial habits, transactions and more feedback.
Conclusions
References


REFERENCES


REFERENCES


Appendix A

Interview Guide

A.1 Enquadramento

Recolher informação ao nível financeiro de forma a perceber como é feita a gestão do dinheiro no dia-a-dia.

A.2 Propósito da Entrevista

- Perceber onde se gasta o dinheiro?
- Estarão a geri-lo da melhor forma? Se sim, como o fazem? Se não, o que pode ser melhorado?
- Perceber qual o controlo que têm sobre as suas finanças.
- Descobrir se existem melhores formas de gastar o dinheiro, onde e quando o fazer.
- Se existe a possibilidade de terem mais autonomia no respeita a esta gestão.
- Encontrar a ferramenta correta para auxiliar na sua gestão pessoal.

A.3 Texto Introdutório

Boa tarde Sr. ___, eu estou a desenvolver um projeto informático na área de finanças e para conseguir construí-lo preciso de explorar e perceber a forma como as pessoas gerem o seu dinheiro no dia-a-dia. Gostava de obter resposta a umas dúvidas relativas à situação financeira de pessoas como você, de uma idade mais avançada, de forma a perceber como é que consegue dosear, gastar e poupar o seu dinheiro da maneira mais correta. Se tiver sucesso, no fim terei a informação necessária para o ajudar a descobrir se tem o controlo que devia ter sobre o seu dinheiro e mostrar-lhe que existem melhores formas de gastar o dinheiro, onde gastá-lo e quando faze-lo.
A.4 Questões

- **Gestão Geral** A sua reforma é geralmente depositada na sua conta bancária todos os meses, no entanto quando precisa de dinheiro tem que ir levantá-lo.

1. Onde tem/guarda o dinheiro?
   - Casa;
   - Banco;
   - Não são eles que guardam;
   - Outros

2. Quando levanta dinheiro?
   - Quando necessário;
   - Apenas o que precisam para um dia/semana;
   - Totalidade da reforma;
   - Outros

3. Utiliza algum destes formatos?
   - Cartões;
   - Cadernetas;
   - Outros

4. Perda de dinheiro
   - Raramente;
   - Frequentemente;
   - Em que situações?

5. Rotinas diárias/semanais/mensais

- **Micro Gestão** Para além da sua reforma existem também pequenas quantias de dinheiro que movimenta ao longo de um mês, umas variam como por exemplo pagar o IRS, outras não, as contas da água, luz, telefone…

1. Despesas Fixas
   - Quais as despesas fixas que tem?
   - Periodicidade das mesmas;
   - Representam grande ou pequena parte da reforma?
   - De que forma são pagas estas despesas?

2. Despesas Extraordinárias
   - Que despesas fora das habituais tem?
Interview Guide

Periodicidade das mesmas.

3. Esquecimentos e Alertas
   Lembra-se das datas limite de pagamento das contas?
   Alguém o relembra?
   São datas fixas e já está habituado?
   Como memoriza a data de uma despesa extraordinária?

4. Cupões e Descontos
   Guarda-os?
   Usufrui deles? Se não, porquê? Esquecimento ou por não lhes dar utilidade?

5. Dinheiro de Sobra
   Tem o que precisa?
   Gasta este dinheiro ou guarda como poupanças?
   Consegue prever a quantidade de dinheiro que sobra ao fim do mês?

- Registos
  Desde a ida a uma farmácia ou a compras do supermercado surgem muitas mais despesas e receitas que é preciso controlar, registando-as.

1. Frequência dos registos
   Quando efectua um gasto?
   Quando chega a casa?
   Final de cada dia?
   Só regista despesas de grande valor?
   Raramente/Quase nunca?
   Alguém o faz por si.

2. Forma dos registos
   Lista de registos?
   Categorizados?
   Papel?
   Fotografia?
   Electronicamente?

3. Dados registados
   O que registam? Data, produto, valor monetário?
   Guarda facturas?
   IRS? Pede a alguém para o fazer por si?
   Porque razão regista algo?
Interview Guide

- Perguntas auxiliares a pessoas que não fazem a sua gestão financeira

1. Quem faz a gestão das suas finanças?
   - Alguém conhecido de confiança;
   - Familiar;
   - Outro
2. Porque razão não gere o seu dinheiro?
   - Não se sente capaz?;
   - Simplesmente deixou de o fazer?;
   - Sente-se mais confortável que seja outra pessoa a faze-lo?
3. Considera que esta situação é a ideal?
   - O que mudava?;
   - Gostava de voltar a fazer a sua gestão na totalidade?;
   - Só de algumas despesas?
4. Sabe sempre a sua situação financeira?
   - Pergunta frequentemente?
   - Ou só tem conhecimento quando lhe dão informações?
Appendix B

ISO/IEC 25062 Usability Test Protocol
ISO/IEC 25062 Usability Test Protocol – *PersonalFinancesApp*
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1. **Users**

For this evaluation, it is expected to recruit 10 participants. Each one will perform the requested tasks alone. The end users are expected to be 60 years old and older and with some consciousness of their financial situation. However, it is expected that some participants don’t have all the control about their money expenses which is not a problem for the tests.

2. **Context of product use in the test**

2.1. **Test facility**

The evaluation will take place at “Centro de Convívio/ Centro de Dia do Bonfim” and Fraunhofer AICOS’s offices. The first location is where most of the participants will take the tests and was chosen for being the most convenient for them because it is where they are accustomed to spend most of their day. The second one is intended for other participants who do not attend social centers, but it is a place where they are used to perform this kind of tests for Fraunhofer’s past projects and simulates the normal context of use. These usability tests are under the development of the PersonalFinancesApp and are the way to understand if the application is being well implemented and what needs to be changed to be in the right way. The application has been designed to be used in the environment that our participants are in, so the set is almost perfect for the tests. Still, some aspects like daily activities outside of the social center and home can’t be fully tested on this bunch of tests.

2.2. **Display devices**

For all the participants the evaluation of the PersonalFinancesApp application will be performed on a Samsung Galaxy Note with a 5.3” WXGA (1280 x 800) screen, in standard color mode and automatic brightness.

3. **Test procedure**

3.1. **Participant general instructions**

The participants should receive the following general information regarding the project:

PersonalFinancesApp is a project being developed by a FEUP’s student under a master thesis together with Fraunhofer AICOS - Portugal. Older adults often take great caution with their savings and the management of their everyday finances. Smartphones may assist older adults by allowing them to always carry the information with them and be able to update it at any time. The proposed mobile-
Based system could work as a first experience between older people and mobile money management.

Regarding the prototypes, the participants should be given the following information:

The system is an android application that allows the user to store expenses and have a global overview of his current financial situation. The user adds expenses and incomes values, categorizes them and sets the corresponding date. On the application the user creates reminders of their bills by setting the alarm for a specific period. The user also can visualize his calendar where are stored all the expenses and alarms done previously.

Do you have any question regarding the procedure?

Regarding the test:

First of all, I would like to ask you to read and please sign this informed consent form to allow me, as a Fraunhofer’s Student Researcher, use and work on the results of this test.

The goal now is to evaluate the usability of this product and for that, it will be asked you to perform some tasks using the application prototype. I will explain each task separated from the others, you can ask me anything you don’t understand about it and then can try to accomplish the task. Try to do it as if no one is here, but if you feel that you are stuck you can ask me for assistance. You can also voice your opinions regarding any aspect of the prototypes. Remember that we are testing the application and not the user, and that there is no right or wrong way to perform a task. Also, we are looking for both good or bad feedbacks so don’t refrain from expressing a bad opinion or point out any errors that you may encounter. They are expected and we appreciate it if you let us know.

After the test and questionnaire:

Do you have any questions or comments? Thank you very much for your participation in this test, your opinion is very valuable to us.

3.2. Participant task instructions

The participants will be asked to perform the following tasks:

1. Check Overview
   Ideal Flow: [Choose “Estado Actual” -> Search for “Supermercado” category -> Note the matching value -> Choose “Voltar”]
2. Add an expense ("20.50","Supermercado","24","Maio","2013").
   Ideal Flow: [Choose “Adicionar Despesa” -> Enter Value -> Choose “Seguinte” -> Enter Category -> Enter Day -> Enter Month -> Enter Year -> Choose “Seguinte” -> Choose Button “Sim”]

3. Add an income ("850","Reforma","10","Fevereiro","2014").
   Ideal Flow: [Choose “Reforma & Outros” -> Enter Value -> Choose “Seguinte” -> Enter Category -> Enter Day -> Enter Month -> Enter Year -> Choose “Seguinte” -> Choose Button “Sim”]

   Ideal Flow: [Choose “Marcar Alarme” -> Enter Category -> Enter Day -> Enter Month -> Enter Year -> Choose “Seguinte” -> Choose reminder -> Choose “Seguinte” -> Choose Button “Guardar”]

5. Check Calendar ("Contas de Casa","31","Junho","2014")
   Ideal Flow: [Choose “Ver Calendário” -> Enter Month -> Enter Year -> Back]

6. Check Overview
   Ideal Flow: [Choose “Estado Actual” -> Search for ”Supermercado” category -> Note the matching value -> Check if the value has changed -> Choose “Voltar”]

After the tasks, participants must be given the SUS questionnaire (see appendices) to complete.

4. Performance and satisfaction metrics

4.1. Criteria and measurements

During the evaluation, two facilitators will participate – one will mediate the communication with the participant and the other will collect data. Since the test includes several tasks and we will encourage participants to use the think aloud method. To evaluate the usability of the system we will measure effectiveness and satisfaction.
4.2. Metrics for effectiveness, efficiency and satisfaction

4.2.1. Effectiveness

To measure the effectiveness of the system, it will be evaluated taking into account four parameters: task completion rate, deviations, errors and assistances.

- Each task will be divided into several steps that form the ideal flow to completion (see Participant task instructions). The accomplishment of these tasks will allow the calculation of task completion rate.

- Deviations are defined as alternative flows to the completion of the task, that, while not being the ideal flow, still enable the participant to achieve task completion.

- An error will be counted every time the participant performs an action that does not contribute to task completion.

- An assistance is considered every time the participant requests the assistance of the facilitator in order to perform the task. If the assistance is required because the task was not well explained it should not be considered as assistance in task completion, if the participant forgot the following step of a task that should be noted, since it may not be a problem with the system’s usability but instead with the formulation of the task.

4.2.2. Efficiency

To measure the efficiency of the system it will be evaluated taking into account only one parameter: task completion time.

- The amount of time required for a participant to complete a task leads to the calculation of the actual or estimated completion time. For this parameter it will be used other similar developed application to compare the actually differences and where the differences are expected.

4.2.3. Satisfaction

The satisfaction of the system it will be measured through the SUS questionnaire administered after the test. Additionally, all the comments made by the participants
during the test as well as in the informal conversation that followed will be registered.

5. Appendices

5.1. SUS Questionnaire in Portuguese

Usando a escala abaixo, por favor coloque um círculo no número mais próximo da palavra que mais se aproxima aos seus sentimentos acerca do sistema avaliado.

Por favor considere como sistema a aplicação de smartphone e o protótipo do microscópio.

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<thead>
<tr>
<th>Question</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Penso que gostaria de usar este sistema frequentemente</td>
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<td>Discordo fortemente</td>
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<td>Concordo fortemente</td>
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<td>2. Achei o sistema desnecessariamente complexo</td>
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<td>Discordo fortemente</td>
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<td>3. Achei o sistema fácil de usar</td>
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<td>4. Penso que precisaria do apoio técnico para conseguir usar o sistema</td>
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<td>Discordo fortemente</td>
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<td>5. Achei que as várias funções do sistema estavam bem integradas</td>
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<td>6. Achei que havia demasiadas inconsistências neste sistema</td>
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<td>7. Imagino que a maioria das pessoas consegue aprender a usar este sistema muito rapidamente</td>
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<td>Discordo fortemente</td>
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</table>
8. Achei o sistema muito incômodo de usar

   Discordo fortemente  1  2  3  4  5 Concordo fortemente

9. Senti-me muito confiante ao usar o sistema

   Discordo fortemente  1  2  3  4  5 Concordo fortemente

10. Precisei de aprender muitas coisas antes de conseguir começar a usar o sistema

    Discordo fortemente  1  2  3  4  5 Concordo fortemente
5.2. Participant general instructions – Portuguese Translation

Os participantes devem receber as seguintes informações sobre o projecto:

PersonalFinancesApp é um projecto que está ser desenvolvido por um aluno da FEUP no âmbito da sua dissertação de mestrado em conjunto com a Fraunhofer AICOS Portugal. Os idosos tomam grande cuidado com as suas poupanças e com a gestão das suas finanças diárias. Os smartphones podem ajudar os idosos permitindo-lhes aceder à sua informação sempre que assim o desejarem, bem como atualizá-la. A aplicação móvel proposta pode funcionar como uma primeira experiência entre as pessoas idosas e a gestão do seu dinheiro via telemóvel.

Em relação aos protótipos os participantes devem receber a seguinte informação:
O Sistema é uma aplicação móvel que permite o utilizador guardar as despesas e ter uma visão global da sua situação financeira. O utilizador pode adicionar despesas e receitas, categorizá-las e registar a respectiva data. Na aplicação o utilizador pode criar lembretes das suas contas através da marcação de alarmes para um período específico. O utilizador pode visualizar seu calendário onde se encontram guardadas todas as despesas e alarmes feitos anteriormente.
Tem alguma questão em relação a este procedimento?

Em relação ao teste:
Em primeiro lugar, gostava de lhe pedir para ler e por favor assinar este consentimento para me permitir, como Fraunhofer’s Student Researcher, utilizar e trabalhar com os dados resultantes destes testes.
O nosso objectivo agora é avaliar a usabilidade deste produto e para isso vou pedir-lhe que efectue algumas tarefas utilizando o protótipo da aplicação no telemóvel Eu irei explicar cada uma das tarefas individualmente, pode perguntar-me qualquer coisa que não tenha percebido e depois poderá tentar efectuar a tarefa. Tente fazer a tarefa como se eu não estivesse aqui, mas se achar que realmente não sabe como prosseguir pode pedir-me ajuda. Também pode dar a sua opinião em voz alta sobre qualquer aspecto dos protótipos. Lembre-se que estamos a testar a aplicação e não o utilizador, e não existe uma forma correcta ou errada de efectuar uma tarefa. Para além disso, estamos à procura de opiniões boas e más por isso não se contenha de expressar uma má opinião ou apontar algum erro que encontre. Problemas são expectáveis e nós agradecemos se nos informar sobre eles.

Após o teste e o questionário SUS.
5.3. Participant task instructions – Portuguese translation

The participants will be asked to perform the following tasks:

1. Ver estado actual
   Ideal Flow: [Escolher "Estado Actual" -> Procurar pela categoria "Supermercado" -> Visualizar o valor correspondente -> Escolher "Voltar"]

   Ideal Flow: [Escolher "Adicionar Despesa" -> Introduzir valor -> Escolher "Seguinte" -> Selecionar a categoria -> Escolher dia -> Escolher mês -> Escolher ano -> Escolher "Sim"]

   Ideal Flow: [Escolher "Reforma & Outros" -> Introduzir valor -> Escolher "Seguinte" -> Selecionar a categoria -> Escolher dia -> Escolher mês -> Escolher ano -> Escolher "Sim"]

   Ideal Flow: [Escolher "Marcar Alarme" -> Selecionar a categoria -> Escolher dia -> Escolher mês -> Escolher ano -> Escolher "Seguinte" -> Selecionar o aviso -> Escolher "Seguinte" -> Escolher "Guardar"]

5. Visualizar calendário ("Contas de Casa", "31", "Junho", "2014")
   Ideal Flow: [Escolher "Ver Calendário" -> Escolher mês -> Escolher ano -> Voltar]

6. Ver estado actual
   Ideal Flow: [Escolher "Estado Actual" -> Procurar pela categoria "Supermercado" -> Visualizar o valor correspondente -> Verificar se o valor mudou -> Escolher "Voltar"]
6. References