Universidad Autónoma de Madrid

Escuela politécnica superior

Double Degree in Computer Science and Mathematics

Final project

CREATION OF AN APPLICATION FOR MOBILE DEVICES WITH ANDROID TO FACILITATE ACTIVITY PERFORMANCE AND MANAGEMENT OF RESULTS FOR OCCUPATIONAL THERAPISTS

Author: Pablo Patricio Mascaraque Glenn

Supervisor: Rosa María Carro Salas

July 2015

Universidad Autónoma de Madrid

Escuela politécnica superior

Doble Grado en Ingeniería Informática y Matemáticas

Trabajo fin de grado

CREACIÓN DE UNA APLICACIÓN PARA DISPOSITIVOS CON ANDROID PARA FACILITAR LA REALIZACIÓN DE EJERCICIOS Y GESTIÓN DE RESULTADOS PARA TERAPEUTAS OCUPACIONALES

Autor: Pablo Patricio Mascaraque Glenn

Tutora: Rosa María Carro Salas

Julio 2015

Abstract

Despite the general public's lack of knowledge of even the existence of the profession, occupational therapists (O.T.s) have existed now for almost a century, becoming essential for millions of people in the preservation of their physical and cognitive independence. Their job includes a varied array of tasks ranging from initial contact and evaluation of patients to development and implementation of activities for them to perform, going through constant evaluation and readjustment of therapeutic exercises.

As with many other professions, occupational therapy can greatly benefit from the use of new technologies in many aspects and, in fact, already has: computers are used for communication purposes, data registration and management and activity development; projectors allow for easy presentation of information to a whole room of patients; video game consoles, such as the Nintendo Wii©, provide entertaining sessions of physical therapy; and, for the last few years, hand-held devices such as smartphones and tablets have the potential of extending many of the uses of traditional computers by offering similar capabilities in a more portable format.

The objective of this project is the design, development and implementation of an application for Google's Android OS that enables O.T.s to carry around an easy-to-use data-recollection and management system coupled with an activity editor that allows for more personalized exercises to be created and their results to be automatically recorded for later analysis. This, in turn, eliminates the disconnection there may be between the observation of particular results or data by the O.T. and its insertion into the database in use, where the passage of time from the former event to the latter may cause incorrect or incomplete information being filed.

A user-centred approach was taken to facilitate the achievement of said goals while reducing as much as possible the user's burden of learning how to work with a new system. Target users were observed and analysed to find out what their main needs were in their professional environment and to guide the design process that followed. Finally, a series of user evaluations were conducted to validate the system and confirm its usefulness as a tool for working as an O.T.

Keywords: *user-centered design, occupational therapy, Android, application, tablet, personalize, activity, patient, evaluation, schedule*

Resumen

A pesar del desconocimiento de la mayoría de la gente sobre la existencia de esta profesión, los terapeutas ocupacionales (T.O.s) han existido durante casi un siglo, haciéndose esenciales para millones de personas en la conservación de su independencia física y cognitiva. Su trabajo incluye una variada gama de tareas que van desde el contacto y la evaluación inicial de sus pacientes al desarrollo e implementación de actividades para llevar a cabo con ellos, pasando por constantes evaluaciones y reajustes de las actividades terapeúticas.

Como muchas otras profesiones, la terapia ocupacional se puede beneficiar enormemente del uso de las nuevas tecnologías en mucho aspectos y, de hecho, ya lo ha hecho: los ordenadores son utilizados para la comunicación, el registro y administración de datos y el desarrollo de actividades; los proyectores permiten presentar información a una sala entera de pacientes de forma fácil ; las videoconsolas, como la Nintendo Wii©, proporcionan sesiones de terapia física entretenidas; y, durante los últimos años, los dispositivos portátiles como los teléfonos inteligentes y las tabletas tienen el potencial de extender muchos de los usos de los ordenadores tradicionales ofreciendo prestaciones similares en un formato más portable.

El objetivo de este proyecto es el diseño, desarrollo e implementación de una aplicación para Android, el SO de Google, que permita a los T.O.s llevar encima un sistema fácil de usar que permita la recolección y administración de datos unida a un editor de actividades que permita la creación de ejercicios más personalizados y cuyos resultados sean guardados automáticamente para un posterior análisis. Esto, a su vez, elimina la desconexión que puede existir entre la observación de ciertos resultados u otra información por parte del T.O. y su inserción en la base de datos, donde el paso del tiempo del primero al segundo evento puede resultar en la inserción de información incorrecta o incompleta.

Se utilizó un enfoque centrado en el usuario para alcanzar más fácilmente dichos objectivos a la vez que se le reducía al paciente la carga que conlleva el aprender a trabajar con un sistema nuevo. El público objetivo fue observado y analizado para averiguar cuáles eran sus principales necesidades en su entorno profesional y guiar el proceso de diseño. Finalmente, se llevaron a cabo una serie de evaluaciones con usuarios para validar el sistema y confirmar su utilidad como una herramienta de trabajo para un T.O.

Palabras clave: *diseño centrado en el usuario, terapia ocupacional, Android, aplicación,*

tableta, personalizar, actividad, paciente, evaluación, horario

Acknowledgements

I would like to express my deep gratitude to everyone who, in one way or another, has helped me along the way during all these years at university and those who have helped me during the development of this project.

I will start by thanking Rosa María Carro, my supervisor, for taking the time to listen to my proposal so many months ago and who decided to help me to make it come true. I would also like to thank my classmates for all the hours we have spent together for the last few years, both inside and outside the classes.

Next, I would like to thank all the occupational therapists who are out there, working hard for so many people who need them so much. The things O.T.s do are incredible and it has been an immense pleasure to be able to watch some of them at work and hear everything they do. Special thanks goes to those who collaborated in this project, either talking to me, replying to my e-mails or surveys and much more, including Fundación Gil Gayarre, Centro Tangram and Spanish O.T. associations, such as APTOCAM, as well as Lara and Carlota, for their invaluable insights.

Finally, I would like to thank the people closest to me: Niaṁ, my mother, for her support during all these months and the countless hours at the end checking and revising the text; Pepe, my father, whose good humour and support helped me along this whole trip; Dani, my brother, whose interest in and support for the project (and so many other things!) made it all easier; and Lara, my girlfriend, who, despite all these years, is still able to put up with me and cheer me up whenever I need it.

Thank you all.

Contents

List of Figures

List of Tables

Glossary

- **Occupation**: everyday activity
- **Occupational Therapy**: the application of techniques and the carrying out of activities of an occupational nature which tend to boost or replace diminished or lost physical or psychological functions and to orient and stimulate the development of said functions
- **O.T.**: Occupational Therapist, professional who practices occupational therapy
- **Patient**: any person who is treated by an O.T. in any aspect
- **SUS**: System Usability Scale, a simple, ten-item scale giving a global view of subjective assessments of usability
- **EER model**: Enhanced Entity-Relationship model, a conceptual data model expanded from the Entity-Relationship model
- **User-centred design**: an approach to designing a product or service (e.g. user interface design), in which the end user is placed in the center of the process
- **Usability**: how effectively, efficiently and satisfactorily a user can interact with a user interface.
- **Mental model**: the user's conception of the structure of the web application. The closer the users mental model is to the functionality of the site, the higher the site's perceived usability
- **Conceptual model**: a model that includes navigational pathways and identifies major displays and establishes rules for the consistent presentation of work products, processes and actions

Chapter 1

Introduction

1.1 Motivation

Occupational therapy began as a new approach to the treatment of patients in which people's occupations (that is, the activities in which they engage) is considered not only from a physical point of view, as had been done in most branches of medical science until then, but also from social, psychological, emotional and working (or occupational) perspectives [6], arguing that these could easily become deterring factors in the pursuit of a fully independent and stable lifestyle if incorrectly developed.

Nowadays, we can find O.T.s working with a wide variety of people, ranging from children lacking social skills to teenagers recovering from alcohol or drug abuse problems, adults suffering from psychological problems or elderly people with physical and mental deteriorations. Thus, these patients and many more depend on the work of an O.T. to develop or regain their independence in different aspects of their lives so that they may continue with their various occupations.

The last few decades have seen the introduction of computing technologies into many professions, provoking enormous changes in the way data is collected and processed and the speed at which they can be managed, and O.T.s have kept up to date with these changes. These health professionals have integrated computers into different aspects of their jobs, including specialized data-recollection programs designed for use in medical environments and ordinary editing programs which they use to make presentations and activities with which to engage with their patients.

Furthermore, in the last few years new applications have been created for O.T.s which have provided activities aimed at certain populations they might work with. These applications target certain skills that typically need to be developed by them, such as memory, attention or reading and writing skills.

However, O.T.s commonly work with many different patients, each of them typically with varied difficulties, so that they need to switch between programs in order to work on each ability. In addition to this, there may be a need for another program that houses the database where each patient's history can easily be administered and consulted.

Up until now, there has been a need for a system that encompasses the flexibility required in the creation of activities and the processing power of a computer for data administration, together with the physical mobility of the hardware on which the system is running. This has led to the development of a system for hand-held devices that covers those needs.

1.2 Objectives

The aim of this project is to provide occupational therapists with a new tool that is better tailored to their professional needs than those they have used until now, which, in any case, seem to be either inadequate, ineffective or too restrictive for them. According to the information obtained from some experts: the applications become inadequate when they are targeted at a specific group of patients which their own patients do not belong to (more often than not, applications are designed for children and are too infantilized to be used with adults); they become ineffective as a consequence of their inadequacy, as the patients will not be very motivated, making its use less practical for what the O.T. intended; and they can be too restrictive when they provide a fixed number of activities and do not allow the O.T. to personalize them. Said aim will be achieved through the pursuit of the following goals:

- The patient data collection and management must be able to be adjusted by the main users (O.T.s) so that they may adapt it to the people they work with and record the information they find relevant and useful for their style of work.
- Activity creation and management must be flexible, enabling the O.T. to tailor the content of the activities to each patient, making them more effective and easier to work with.
- The system that is developed should be as intuitive as possible for the user and its structure should be designed to fit in with the way in which O.T.s work.

In addition to this, the development of the project will also pursue other independent objectives that become desirable in this situation:

- The activity creation and management should be built in a modular way, facilitating future inclusion of new types of activities, increasing the system's capabilities for use in therapy sessions.
- The whole process should be carried out following the principles and methods of user-centred design, which will help in the pursuit of the goals presented earlier on.

- As part of the user-centred design approach, user evaluations should be performed to validate the resulting product and make sure that it is helpful to and will be used by real users (O.T.s).

1.3 Document structure

The following is the structure used for this document: this section (section 1) includes an introduction to the project and a brief description of the objectives established for it; after this, section 2 explains the current state of the art, presenting some examples of products in use nowadays and the problems O.T.s find in them; the analysis phase is detailed, together with its conclusions, in section 3, with a description of the target users explained at the end; the design and development that followed are depicted in section 4, where the system's architecture is laid out, the interactions are defined and the user interface is specified; section number 5 contains a description of the evaluation methods followed to validate the system, as well as the results obtained; the final section, section 6, includes the conclusions derived from the development of this project, as well as a few roads to pursue as future expansion. The appendices at the end include additional material used for or produced during the development of the system.

Chapter 2

State of the art

The use of new technologies has become commonplace in people's everyday lives, where simple acts such as going shopping might be precluded by checking online to see if the stores are open, what the quickest route is and if there are any gas stations, then accompanied by a checklist while the actual shopping is being done, perhaps with a quick call home to ask about a certain item on the list, and continuing with a few photos with the new purchases to upload for everyone to see.

Of course, the use of said technologies is not only used for these everyday tasks, but also to increase efficiency and effectiveness at work, where the capabilities offered by personal computers, smartphones and tablet computers allow tasks to be completed in much less time and with fewer errors than those humans are prone to commit.

Business offices make wide use of spreadsheets to organize and compute long lists of repetitive calculations easily inserted into a program; public administration workplaces use the internet to communicate with the public, as well as word processors to write documents for different purposes; and design firms make extensive use of image editing programs to create new graphic compositions.

The medical world has kept up with this trend, with many different elements being included in it: specialized equipment for use in operating theatres or tracking patients' vitals, programs designed for administration and communication inside or among medical centres and applications to be used with and by patients in order to help in the development or rehabilitation of varied abilities.

Occupational therapists are part of this group of people taking advantage of what new technologies have to offer, looking for and learning to use different systems mostly in two of the types mentioned above: those designed for administrative purposes and those to be used with their patients. In addition to this, O.T.s use their knowledge of more generic programs not targeted specifically to the medical community to satisfy some of their professional needs,

such as the aforementioned spreadsheets, word processors or image editors.

Examples of programs designed for use by health professionals include: CyT-L [24], a program developed for the creation of exercises for cognitive rehabilitation; HABITAT [20], [21], a web-based system for treatment with people with acquired brain injury; Resiplus [12], an administration software product for use in nursing homes and day care centres; Picaa [15], an iOS application designed as a support tool for learning for children with special needs; or NeuronUp [22], a web-based system for creating activities for patients, personalizing and adapting the content for each one. An extensive list of applications for cognitive training and communication widely used by several health professionals (including O.T.s) can be found in [26].

However, many O.T.s find certain deficiencies in this method of working, mainly due to three reasons:

- Most of the applications being developed nowadays centre around the patients and are created with the idea of them using them on their own or with friends or family members that can help them. The approach taken (which becomes necessary under said assumption) is to present the system with a pre-designed and limited amount of material devised with professionals so that people without any medical knowledge can use it. This lack of diversity can lead to monotonous sessions where patient motivation is very low [26, p. 29].

- As a consequence of the previous point, applications are typically created for very specific conditions or illnesses, forcing the O.T. to alternate between several programs to work on each of the goals that are being pursued with a patient.

- Those that do target the medical community rarely focus solely on occupational therapists, but as part of a larger group of professionals coordinated to work with their patients (usually on a specific type of patient), so that they centre around the information said workers would share and not so much around what might be useful to O.T.s specifically.

Based on this, the intention of this project is to develop a system that addresses these three problems, by focusing on the O.T.s during development and eliminating as much as possible any kind of specificity regarding the patients they work with.

Chapter 3

Analysis

This chapter presents the process that was carried out during the analysis phase of the project in order to determine the best way in which its objectives could be fulfilled:

- The approach taken was that of user-centred design, in order to produce a system that is adapted to the final users, and not the other way around (as happens more often than not), relieving them of any extra difficulties and allowing them to focus on their actual tasks as much as possible.
- The system is aimed at two types of users: Occupational Therapists (O.T.s), who will be the main users and will interact with most of the system; and patients, whose interaction with the system will be limited to the activity section, often aided or monitored by the O.T.
- There will be a data-management part of the system which O.T.s will be able to use to store information and later revisit to understand the evolution of their patients.
- There will be an activity part of the system that allows for creation and execution of activities for use with patients.
- The software and hardware platforms shall be appropriately chosen in order to satisfy the system requirements.

Each of these aspects is detailed in the following sections. We will start with a brief description of what user-centred design is and why it was chosen for the development of this project, continued by the user analysis, where each user type is analysed. This is then used to determine the requirements each of the main sections of the system will have. Finally, the choices of hardware and software platforms are laid out, explaining the reason for each one and its adequacy to the project.

3.1 User-centred design

As has been explained above, the approach taken for the execution of this project was that of user-centred design. The key principles of this approach, as seen in [14], are:

- Design for the users and their tasks
- Be consistent
- Use simple and natural dialogue
- Reduce unnecessary mental effort by the user
- Provide adequate feedback
- Provide adequate navigation mechanisms
- Let the user drive
- Present information clearly
- Be helpful
- Reduce errors

Because of the nature of the main final user's tasks, it would be ideal to avoid as many distractions as possible from the actual treatment of patients. This means that user-centred design is ideal for this task, since the overall objective of this approach is to produce a system that is built for the users and avoids burdening them with any additional workload [23, p. 23, 26], such as struggling for a long time with a new program in order to find out how to get it to do what they need.

3.2 User analysis

This stage of the analysis phase was focused mainly on one of the two kinds of users the system will have: occupational therapists. The reason for this is detailed in section 3.2.1, but first we will briefly explain the dual approach taken to perform this analysis, which was based on [17, p. 35-122]:

- First, a survey was designed with the Google Forms application and then distributed with the help of some O.T.s and various Spanish O.T. associations. The objective of this survey was to compile some initial statistics about O.T.s, obtaining general information regarding themselves, their personal experience with new technologies and their work environments and methods.

- Next, a series of contextual observations were carried out with different O.T.s in different workplaces (see appendix A). This was done in order to learn the ways in which O.T.s actually perform their duties and extract any relevant information that should shape the final product (i.e., typical interactions, workarounds, problems and corresponding solutions...).

The survey was completed to different degrees by 63 people, revealing a very assorted group of professionals with different ways of dealing with their duties and their environment. The 3 contextual observations performed left a similar impression, with the availability or lack of resources together with the existence of other professionals involved in the treatment of patients shaping the manner in which therapy and evaluation were performed.

3.2.1 Patients

This first group is composed of the different patients an O.T. may have, without any assumptions made regarding their medical condition or of any other kind. As was mentioned before, the main focus during the development of the system will not be on this group, as most of the system will not be used by them but by therapists. The parts they will interact with (the activities) need firstly to be usable as a therapeutic tool, although keeping in mind that patients should also want to use the application.

3.2.2 Occupational therapists

Here we present the second group of users, composed of Occupational Therapists, whose needs we try to satisfy with our final product. The aforementioned survey and contextual observations were performed to gain knowledge as to how they perform their work-related tasks and their overall attitude and familiarity with new technologies.

The information gathered has been studied and is presented here in small sections detailing the different responses obtained: technological savviness, workers, patients, therapy, schedule and tools (some graphs and tables are included in the following pages with the results obtained with some of the questions, but all other graphs with the information gathered can be seen in appendix B). At the end, the user profile that was chosen as a final user target is defined.

Technological savviness

A group of questions from the survey were intended to find out how comfortable O.T.s felt using new technologies, mainly PCs, smartphones and tablets: how often they use them, their enjoyment and difficulties with them and programs or apps they particularly like or dislike. The main results were:

- All survey respondents were familiar with and were used to using PCs, over 80% of them frequently used smartphones in their everyday lives and less than half of them were accustomed to tablets.

- These three pieces of technology were regarded as enjoyable to use by most surveyees (see figure 3.1), although they occasionally proved troublesome to them.

- PCs were mostly used with basic office software packages, with text processors (MS Word, OpenOffice Writer), presentation editors (MS Powerpoint, OpenOffice Impress) and spreadsheet processors (MS Excel, OpenOffice Calc) being the most popular. The possibility of accessing media files (images, audio and video) is also appreciated, due to the simpler manner in which information can be presented with them. Unpopular programs among respondents (Photoshop or MS Access, among others) were deemed so due to complexity of use or high frequency of errors and crashes.

- Thanks to their higher portability, smartphones and tablets were typically used to stay in constant communication (Whatsapp, e-mail apps), to connect with others socially (Facebook, Pinterest, Tumblr) and to share and easily procure information (Google, Dropbox). Once again, dislikes for programs were reported due to complexity of use or frequent errors.

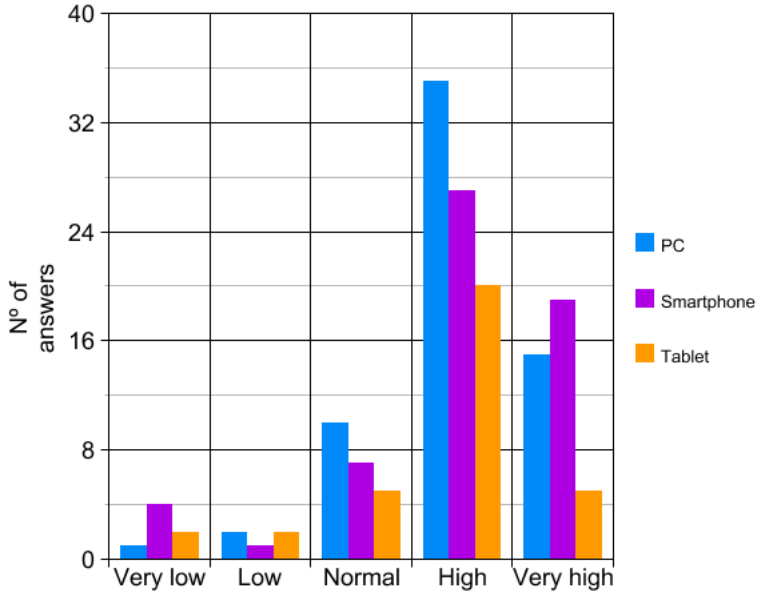

Figure 3.1: User satisfaction levels with different devices

Workers

Another piece of information extracted from the analysis phase was the independence (or lack of it) of O.T.s in their workplace: almost two thirds of surveyees were the only O.T.s in their workplace, but most of them worked in collaboration with other health professionals (psychologists, social workers, etc) and expressed different levels of coordination with them.

One of the contextual observations revealed the high interdependence that can exist in an environment with other health professionals treating the same patients: daily communication between different shifts or in the same one can become crucial for better understanding of the evolution of patients.

Patients

Patient ages can vary widely, from young children to the elderly (over 65), and also including teenagers and adults (18 to 65 years old). The two elder groups (adults and the elderly) were shown to be the most common in the survey (see table 3.1).

Regarding the number of patients treated, very few respondents had to cope with more than 120 patients, with almost half of them working with 40 or less. However, not all patients necessarily went through therapy sessions every day, and only 14 O.T.s who completed the survey said they worked with more than 40 of their patients every day.

Number of patients	Number respondents
1-40 patients	31
41-80 patients	11
81-120 patients	9
121-160 patients	6
More than 160 patients	3

Table 3.1: Number of patients treated by each O.T.

Therapy

As implied above, three quarters of surveyees worked with 40 patients or less every day and the types of sessions carried out can further be divided according to two main aspects:

- Therapy sessions can be individual or in groups. The latter were slightly more common, as seen from the results of the survey (see figure 3.2).
- On the other hand, sessions can be physical or cognitive (or a mix of both). Results showed that cognitive therapy was performed a bit more often than the physical kind (see figure 3.3).

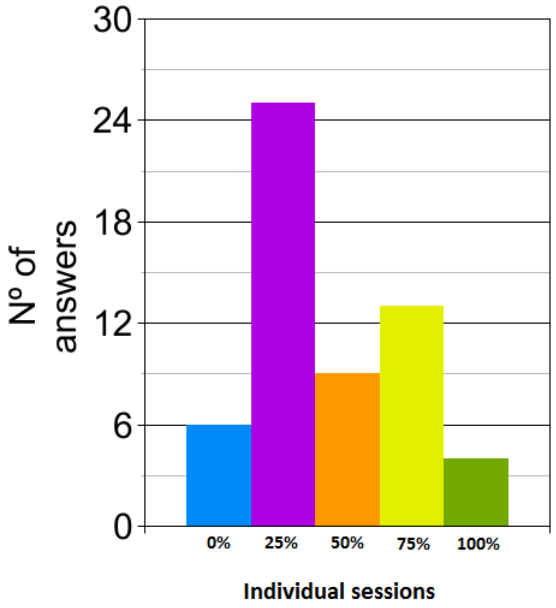

Figure 3.2: Reported approximate percentages of individual and group therapies

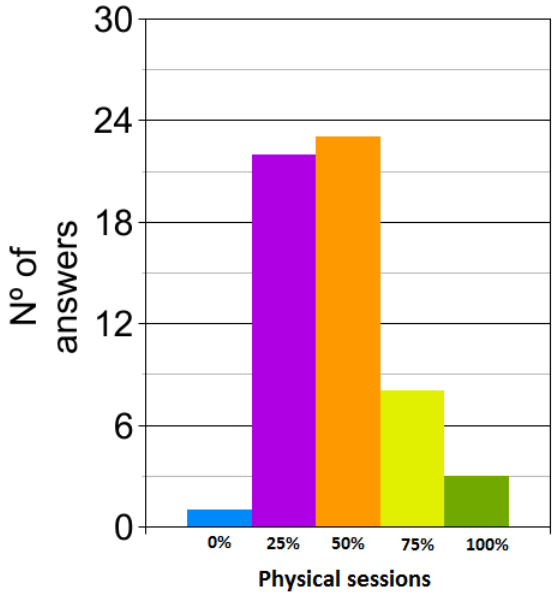

Figure 3.3: Reported approximate percentages of physical and cognitive therapies

Schedule

The manner in which O.T.s organized and planned their working days was also quite diverse, although two main patterns can be found: daily planning or weekly planning. However, in some cases a schedule was fixed months in advance and only changed every once in a while, with one respondent indicating that rarely changing it helped patients to situate themselves in both time and space.

Said schedules are typically determined in a joint manner by both the O.T.s and their respective work centres, although in some cases it is the management who arranges it and makes workers adapt to it. On the other hand we can also find situations where the O.T. decides when sessions will take place, perhaps with supervisors or even patients (or their families) slightly partaking in its arrangement.

Tools

Finally, both the survey and the contextual interviews revealed many of the different tools or equipment used during therapy sessions, which are shown to be extremely diverse. The classification given here was chosen in accordance with that given earlier on to the types of therapy, as well as being the one given by some of the respondents of the survey:

- For cognitive therapy: blackboards, picture cards, puzzles, music or video players, post-cards, dictionaries, photocopies, game consoles, question and answer cards, boardgames and plain pen and paper.

- For physical therapy: wheelchairs, chairs, pegs, ropes, balls, hoops, cones, finger ladders, game consoles, sports equipment, sacks of different weights, swings and many everyday objects.

Problems that O.T.s most often run into can be separated into three main categories:

- Wear and tear: a lot of the equipment, particularly that used for physical therapy, will wear out every once in a while. Examples of this are balls that have gone flat or pegs that have broken.

- Inappropriateness: sometimes the resources that O.T.s have are not adequate for the patient's profile, thus reducing its effectiveness. An example of this is the infantilization of some cards and documents used, which can frustrate older patients.

- Repetitiveness: the lack of resources that many O.T.s suffer can result in quick reuse of specific equipment for certain exercises. An example of this is a small number of available picture cards for a wide range of exercises.

Finally, it is worth mentioning that some O.T.s already use different programs or applications for their job, in some cases even using more than one, with each one designed for a specific objective (for example, for memory training or attention training). One that was mentioned repeatedly in the survey (and that I was able to see during one of the contextual observations) is a computer program called Resiplus, a database management system that allows health professionals to insert, share and obtain information regarding the patients they have, with a strong focus on communication between the different professionals that share patients. However, said program is designed for use in nursing homes, so that the information that can be stored and shared can become limited and using this system outside of a nursing home situation would be inappropriate and could become impractical.

User focus

As can be seen, occupational therapists have very different attitudes and approaches towards the way in which they treat their patients, so that the resources they are provided with together with the obligations their employers might impose can lead to many different ways of doing their job. This led me to decide to focus on a subset of O.T.s that would find a greater benefit in the system and whose ways of working were better aligned with the original concept from which this project stemmed.

The main reason that caused this change of focus arose from the observed levels of interdependence that some O.T.s had. Although the surveys gave a hint of this, it wasn't until the first contextual observation was performed that this could be properly appreciated: the first thing the O.T. did when arriving at her workplace was log into the computer program used by all employees and check all incidents reported by other workers regarding her patients. Of course, this exchange went both ways, and the reports and observations that she logged into the system would be of use to her colleagues later on.

The second filter applied during this phase of the analysis was related to the actual patients and was already contemplated from the beginning: certain populations dislike or feel less at ease around certain new technologies, such as smartphones or tablets. Naturally, each individual will have a different opinion, but certain generalizations can be made based on both personal experience and observations reported by O.T.s: older patients, particularly elderly people, are not used to using such tools; some of the more senior adults have similar feelings towards them, while young adults have used them very often both inside and outside of their work; most teenagers and children have fully integrated them into their everyday lives and generally find them entertaining to use (one report even talked about a 2-year-old unlocking an iPad without any help at all).

Finally, something that had also been considered from the start was the existence of both physical and cognitive therapy. While the possibility of integrating digital platforms into the former can limit the extent and variability of objectives to complete, the advantages offered to

the latter are much wider, in part due to the high amount of digital resources easily accessible online. This will lead us to focus on cognitive activities when designing activity-creation capabilities for the system.

In conclusion, the most defining traits of the subset of users we will have in mind from now on are:

- They are comfortable around computers and smartphones and can manage them with certain ease.
- They appreciate simplicity when using applications even if it reduces some of their flexibility.
- They work alone or in a small group, which gives them high levels of independence at work.
- They perform both physical and cognitive therapy sessions, as well as both individual and group ones.
- Their patients enjoy using new technologies (typically, but not necessarily, treating children, teenagers and young adults).

3.2.3 Activity analysis

In addition to all the work carried out to understand how occupational therapists actually work and what needs they may have, an analysis was also conducted of some of the activities that they might use during a therapy session. Both physical and cognitive activities were mentioned in the survey by respondents and some of them (as well as new ones) were observed during the contextual observations. Together with this, a series of books with cognitive activities designed for occupational therapy were examined to gain some more insight into how they might look and what kinds of interaction might be needed.

At this point, the idea of the project was barely formed and various paths were considered as to how an activity manager should be so that more flexibility could be gained by the users. In addition to this, complexity had to be an important factor to take into consideration both on the user's perspective as well as on the engineering perspective: if excessive on the former, the system would be useless; if excessive on the latter, feasibility could become drastically reduced.

Three possible options were considered for the activity management:

- **Option A**: a simple list of pre-designed activities with a large amount of variations regarding content.
- **Option B**: a highly-editable environment that allowed creation of activities by using objects representing concrete elements (such as a point on the screen) as well as abstract

concepts (such as different types of relationships between objects inserted into the design canvas).

- **Option C**: a point in-between, allowing for certain flexibility at creation time while maintaining implementation feasible inside some limits, through a template-based creation scheme.

These options were evaluated following a small group of factors that were considered relevant to the development and use of the project, where each one is graded from 1 to 5:

- User simplicity: how easy it could be to use the system for the user. A lower grade means harder to use.
- User flexibility: how much freedom was given when creating activities. A lower grade means less freedom.
- Repetitiveness: how repetitive it might become for the patients to use the activities included/created in the system. A lower grade means more repetitive.
- Customizability: how customizable the content of the activities could become for each patient. A lower grade means less customization.
- Engineer simplicity: how easy it could be to implement the system. A lower grade means harder implementation.

Table 3.2 shows the results of the evaluation.

Method	U. simp.	U. flex.	Rep.	Custom.	E. simp.
Option A	5	1	1	1	5
Option B	1.5	5	5	5	1
Option C	3.5	4	4	5	3

Table 3.2: Activity design options

The inclination from this point on was towards the third option: the creation of activities following certain templates. Further confirmation was given of the acceptability of this choice once results came in from the surveys and after consulting with an occupational therapist of the validity perceived of this system for the type of activities that might be performed (template examples were given to show the possibilities of this option). While the first option would not allow for any tailoring of the activities to patients (which was one of the problems that I wished to tackle with this project), reports came back of dislikes of certain programs that allowed a wide range of editing tools (such as Photoshop or Coreldraw) due to their complexity and difficulty to master, leading to the discarding of the second option.

3.3 System requirements

Now that we know what kind of users we expect to have, we can decide a series of requirements that we consider should be fulfilled in order to satisfy the needs of said users. They have been separated here into two main groups: functional and non-functional requirements.

3.3.1 Functional requirements

Here we present the functionalities the system should offer in order to satisfy the needs gleaned from the user analysis performed. They have been grouped into four categories, corresponding to the main functionalities the system should provide for the final users.

Patients

This first group refers to the set of needs occupational therapists have regarding data-management of the information they gather about their patients. The following are the actions the user should be able to perform while using the system:

FR-1 Configure the information that will be stored for each patient. The user should be able to insert new fields to the definition of a patient in order to adapt the system to the general profile of the patients treated by the user.

- Some default fields common to every kind of patient should be provided with the system.
- Allowed content should include text and numerical values.

FR-2 Insert a new patient into the system.
FR-3 Update or insert new information regarding a patient.

- Users should be able to update previously entered information.
- Users should be able to insert new entries into a blank field.

FR-4 Consult previously inserted information regarding a patient.
FR-5 Create groups and insert patients into them.

- The system should allow for any patient to be part of multiple groups.

Activities and sessions

The following requirements are related to the creation and management of activities performed with patients:

FR-6 Create new activities.

- Interactive activities are completed using the system, which carries the rules and presents the activity to the patient.
- Non-interactive activities are completed independently from the system but can be logged in it for later attendance and performance revisions.

FR-7 Organize created activities through different labelling methods:

- Categories, such as *memory*, *attention* or *spatial awareness*.
- Difficulty levels, such as *easy*, *medium* or *hard*.

FR-8 Creation of activity sessions. A session consists of a group of activities that are performed in a continuous timespan by a group of patients.

FR-9 Carry out activities or entire sessions.

- The system should automatically collect certain information regarding each performed activity (e.g., time until completion).
- The system should give the user the option of entering additional observations at the end of each session.

Scheduling

The user analysis showed that many occupational therapists have an organized schedule of their daily or weekly activities, together with occasional one-time events. The requirements for the schedule creation tool are:

FR-10 Creation of new time slots.

- A time slot consists of a starting and end time and a day of the week or specific date.

FR-11 Assignment of users and groups to time slots.

- Time slots do not necessarily have to have any users assigned to them.

FR-12 Assignment of activities to time slots.

- Time slots do not necessarily have to have any activities assigned to them.

Assessments

It was noted during the contextual observations that certain assessments are typically performed when engaging with a new patient, as well as periodically in some cases. Thus, the following requirements are presented in order to satisfy this need:

FR-13 Create assessment document. An assessment document can later be used to evaluate patients.

FR-14 Add fields to an assessment document.

- Allowed types for fields should include text and numbers.

Finally, before moving on to the non-functional requirements, figure 3.4 sums up these requirements represented as a model that is intended to mimic an O.T.'s mental model. This structure was shown to an O.T., who was able to confirm that the model correctly distributed the different tasks that the application was said to offer.

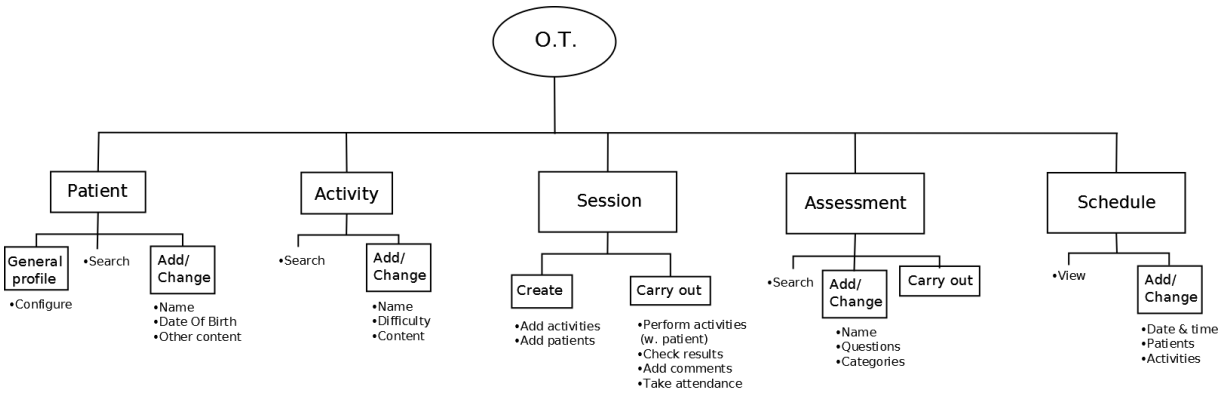

Figure 3.4: O.T. mental model of how the system should be organized.

3.3.2 Non-functional requirements

The list of requirements presented here refers to the overall behaviour of the system and the manner in which the final users perceive and use it.

Quantitative goals

Users are expected to initially configure the system to accommodate their work environment, which can take some time. However, once this is done, the system should be quick and easy to use:

NFR-1 Novice users (those who have used the system less than four times) should be able to create a new user with the most basic information in 120 seconds or less.

NFR-2 Novice users should be able to create a group of 15 users or less, by selecting the users to form the group, in under 90 seconds.

NFR-3 Experienced users (those who have used the system at least four times) should be able to find a specific patient and check the history for one of their information fields in 30 seconds or less.

Qualitative goals

NFR-4 System messages should be clear and concise: the user must easily understand what is said.

- Information should be presented in a positive manner.

NFR-5 Information should be properly safeguarded and protected: a user should log in to access the system.

NFR-6 The system should be aesthetically pleasing.

- The default colours used for the application should be pleasing to the eye.
- No more than four colours should be used in one screen.

NFR-7 The system should be consistent in the terms it uses to name elements as well as with the behaviour of similar components in different parts of the application.

NFR-8 Interactive elements should be clearly perceived as so (for example, buttons should be distinguishable from their surroundings to show they can be pressed).

NFR-9 The system will be tested with real users in order to determine how well it adapts to their line of work. Problems, errors and suggestions will be collected for correction and further development.

3.4 Technologies

Finally, with the general requirements for the system and our final user in mind, hardware and software platforms will be chosen to reach our objectives.

3.4.1 Hardware

The first choice that needs to be made is the type of hardware the system will be intended for. Although the range of hardware platforms is very diverse, we must keep in mind that the objective is to reach as many users as possible. Because of this, we have centred our study on three of the most popular hardware platforms: traditional computers, smartphones and tablets [5, 19].

A brief analysis was made considering three fundamental factors: size, mobility and interactivity. The first one is considered due to the fact that graphical information (activities, statistics, etc.) will generally need to be presented in a medium-to-large screen for easy inspection and comprehension. The second factor is important for the user because he or she will typically need to move around their workplace to use different environments for different kinds of therapies (in some cases the user might even be moving to different buildings or towns). The

last one is examined with the activities in mind, where a higher interactivity can allow for more stimulating exercises.

Table 3.3 shows this short study, where a grade was granted for each factor from 1 to 5, with a lower grade meaning less adequacy for the system's objectives. From these results the conclusion was that the hardware platform most suitable for this project would be a tablet, thanks to its light weight, medium to large screens and touchscreen capabilities.

Device	Size	Mobility	Interactivity
Computer	5	2	3.5
Smartphone	1.5	5	5
Tablet	4	4	5

Table 3.3: Hardware platform comparison

3.4.2 Software

Now that we have chosen the hardware devices we will be targeting, we need to specify the operating system for which we will be developing for and the programming language and data storage system to be used.

Regarding the first choice, that of the OS, we will once again be taking the 3 most popular options available at the moment in the market: Apple's iOS, Google's Android and Microsoft's Windows 8. Table 3.4 shows forecast data for 2014 and 2018, elaborated in November 2014 [16].

Operating System	2014 Market Share	2018 Market Share
Android	67.7%	64%
iOS	27.5%	24.5%
Windows 8	4.6%	11.4%
Other	0.2%	0.0%

Table 3.4: Tablet OS market share estimates (Nov. 2014)

Although various devices that can be classified as tablets have existed for a few decades now, it wasn't until Apple's iPad was released in early to mid 2010 that the modern concept of a tablet really became popular in the market. In February of the following year Google released Android 3.0, designed specifically for tablets, so that from then on the company would also focus on optimizing their OS for tablets and not only smartphones (as had been done until then). Of course, this time difference provided Apple with a huge advantage, so that for the first few years the iPad (and its subsequent versions) dominated the market.

However, for the last few years tablets with Android and Windows 8 (especially the former) have been sold more and more, so that iOS is no longer the dominating tablet OS (numbers differ, but many sources agree that Android is the new leader of the tablet market when considering operating systems [13, 16, 25]). Since the intention is to reach out to as many occupational therapists as possible, Android was chosen as the most adequate OS to target.

Having chosen Android as the target OS, choosing the programming language and the data storage system is quite straightforward:

- Although it is possible to develop apps using C or C++ with the Android Native Development (NDK) [2], Google encourages developers to program in Java, since using the former languages does not result in a noticeable improvement of performance, but always improves app complexity. Other SDKs can be found, such as the Corona SDK [3], but its focus is on game development and there are fees for using certain Android native APIs. Since I already have previous experience with Java and there is a vast number of libraries available for Java in Android, I decided this would be the most adequate language for the project.

- Since the amount of data that we will be managing will be substantial and there are clear relationships to be established between different pieces of data, a relational database is the best choice. Android provides full support for SQLite databases integrated into Java [11, 1], with access to a created database restricted to the code inside the application in which said database is created, making it ideal for our purpose (any confidential information regarding patients will only be accessible through the app). However, since various media files will probably be used by the final users (pictures, audio, video), a combination will be made with the use of Android's external storage (where more space is available for these larger files).

Chapter 4

Design and development

This chapter details the process that was carried out in order to obtain a design of the system's internal structure and logic, its interaction with external users (occupational therapists and patients) and the guidelines followed for the graphical interface design. The rules and framework here established will guide the implementation phase later on.

4.1 Internal logic

In this section the internal logic of the system is presented and separated into smaller components of the overall project: the patient block, the activity and session block, the scheduling block and the assessments block. First, however, we will start by giving the definitions of some of the main elements that compose this inner logic. Finally, the architecture designed to model these components is presented and explained.

4.1.1 Definitions

The following definitions belong to certain components of the system that are valued as having a relatively large importance inside the overall behaviour of the system, representing key aspects of the world being modelled:

- **Patient**: a person being treated by the O.T., with a specific name, date of birth and ID, possibly with other additional information. This element is used to keep track of a real patient's progress.
- **General Profile**: a description of the information that is to be stored regarding every patient. There is a series of fixed fields given by the system (such as name, date of birth and photo) as well as additional fields the O.T. may create to adapt the system to the type of patients she will be working with. An O.T. will define a single General Profile

that will be applied to all of her patients (for example, an O.T. who works with children could define a General Profile which includes fields for storing information related to a child's gestation and birth, whereas somebody working with adults might want to keep track of each patient's job).

- **Activity**: a task to be performed by a patient and evaluated by the system and the O.T. There are several types of activities, each one configurable via its content (which in turn can be of different types, such as textual or graphic). However, every activity will have a name and can be classified into categories and assigned a difficulty level.

- **Session**: a group of activities to be performed in one sitting by a patient. Session performances are recorded in the system together with additional comments inserted by the O.T.

- **Schedule**: an arrangement of tasks, each one assigned to a certain time and periodicity (e.g., every Monday from 10:00 to 12:00).

- **Assessment document**: a series of questions and possible answers defined in a certain order for individual patient assessment.

4.1.2 Logic

Most of the system's logic is quite straightforward, centred around storing data provided by the user as well as results collected by the system:

- General Profile: it is defined by a collection of data fields (which can be either textual or numeric) which can be organized into subgroups. Fields and field groups can be created by the O.T., with the underlying logic recording them in the database.

- Patient: the basic set of attributes assigned to a patient are always stored in the database (name, date of birth and photo). Aside from this, the system applies an O.T.'s General Profile to each of her patients, storing for each of them the content given for each field described in said profile.

- Schedule: it is divided into time slots, each one having some basic features (name, day of the week and time period) while relating patients and activities to each one, indicating an expected regular attendance and performance, respectively.

- Assessment: each document is defined by a collection of questions (with each one having either textual or numeric responses) defined by the O.T. and to be presented in a specific order.

Finally, the design for the activity and session part of the system is more elaborate than the previous points: the intention for this part is to provide a framework into which one can add new activities while modifying the parts described so far as little as possible.

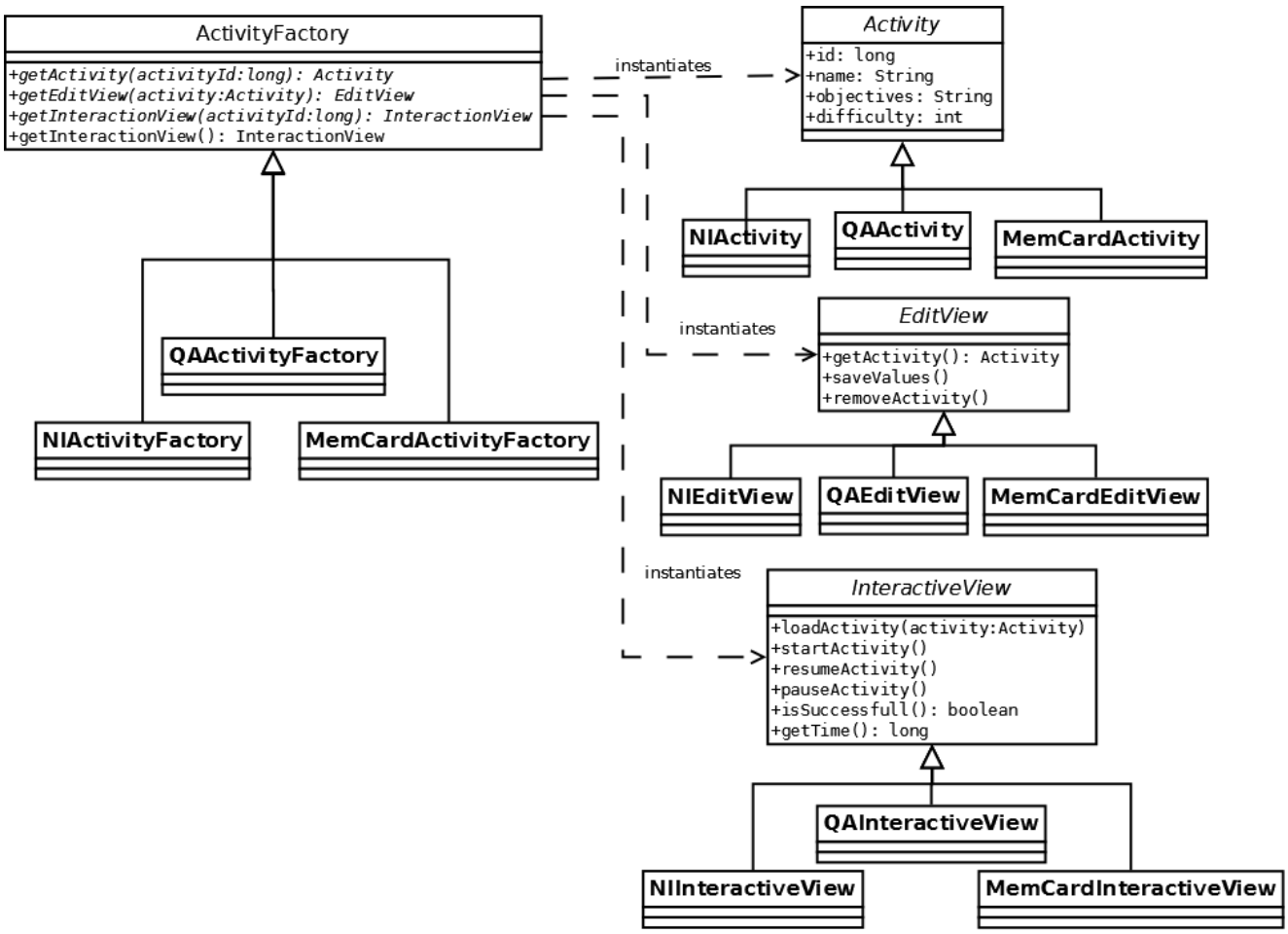

Figure 4.1: Abstract Factory pattern applied to the design

For this, the design pattern used was the Abstract Factory Pattern [10]: an abstract *ActivityFactory* interface is defined, which provides a method for getting an *Activity* object, one for getting an *ActivityEditView* object for a given *Activity* and one for getting an *ActivityInteractView* for a given activity (see figure 4.1).

Thus, when designing a new type of activity, the developer must provide: a concrete class that inherits from the *Activity* object; a visual interface for creating and editing the new activity (with input methods for content configuration) as a subclass of *ActivityEditView*; a visual interface for interacting with and carrying out the new activity as a subclass of *ActivityInteractView*; an ER entity describing the data to be stored that describes the new activity which

can be plugged into the system's EER model as a subclass of the *Activity* entity; and a concrete class inheriting from *ActivityFactory* that unifies the above.

The initial version of the system has been built with three types of activities included: a Non-interactive activity, which is provided to allow the O.T. to record activities carried out with her patients independently from the system (physical therapy, for example); a Question & Answer activity, allowing for the construction of a simple task that poses a question and provides a series of possible answers from which the patient must choose; and a Memory Card activity, offering the possibility of personalizing the pictures shown in the cards.

4.1.3 Architecture

As mentioned earlier, most of the system is quite straightforward, making it mostly an interface for the database designed to accommodate an O.T.'s needs. Thus, this subsection gives a brief explanation of how each block of the application (patients, activities and sessions, schedule and assessment) is structured, together with the section of the EER diagram designed [9, Chapter 4]. Before all this, though, figure 4.2 shows a structural diagram for the system's architecture, where we can see how an O.T. has full access to all the system's functionalities and indirect interactions with the whole database. Patients, on the other hand, will only have access to the part of the system concerning the interaction and completion of activities.

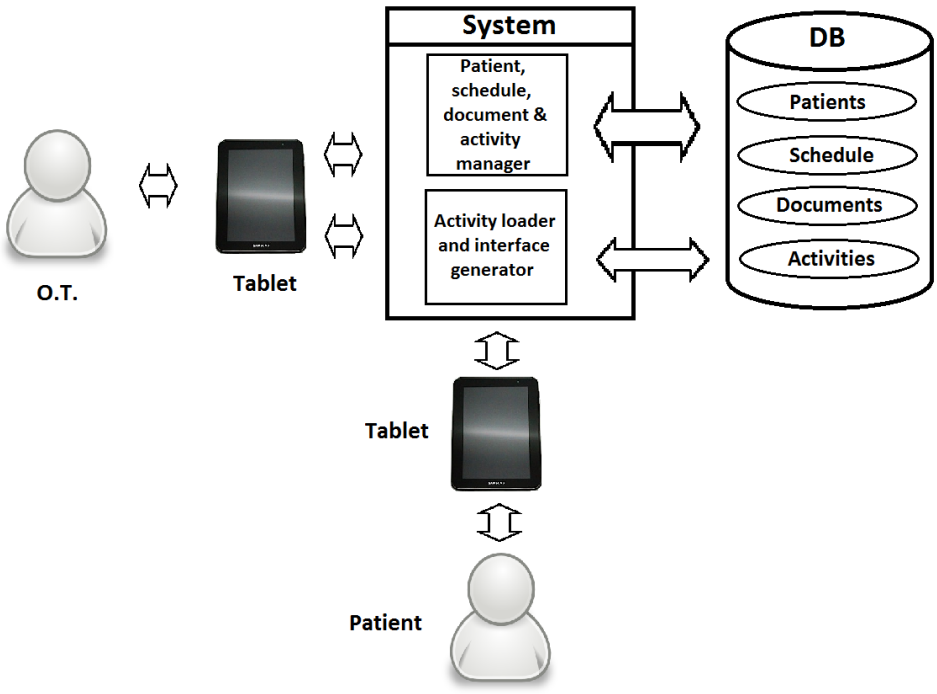

Figure 4.2: Architecture structure diagram

First we have the description of a patient (see figure 4.3):

- On the one hand, it is assumed every patient has a name and surname, a date of birth and that a picture can be taken of him or her. These are the fixed attributes that are assigned to the *Patient* entity in the diagram. Figure E.2 shows a use case of this.

- On the other hand, the O.T. will be able to configure a general profile common to every patient she has, storing textual and numeric data. This configuration is done through the creation of data fields (*Field* entity, with its two subclasses *TextField* and *NumericField*), which can be organized in groups (*FieldGroup*). Figure E.1 shows a use case of this.

- When editing the information for a specific patient, a new entry in *TextEntry* or in *NumericEntry* is created or updated. For our current purposes, an n:m relationship between the *Patient* and the *TextField* or *NumericField* entities would suffice. However, a weak entity representing this relationship was created for future application updates, bearing in mind the possibility of multiple entries for a patient in a same field (the idea behind this is to allow a certain tracking of a patient's characteristics, such as his weight, being registered periodically). This entity introduces the registry date (in reality date and time) into the primary key, where the pair of primary keys coming from the other two entities (*Patient* and a *Field*) would be insufficient to distinguish entries.

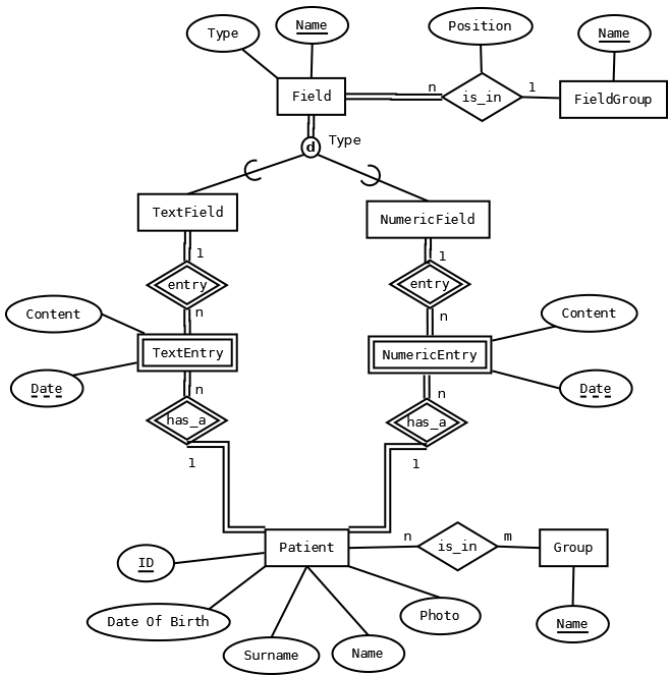

Figure 4.3: EER diagram for the patient section of the system

Next, we present the description of the activities and sessions (see figure C.2):

- An activity is uniquely identified by its ID. Other than this, every activity is expected to have a name, a set of objectives and a series of classifiers that can be set by the O.T. (initially, the system will allow for two types of classifiers: categories and difficulty, although the *Classifier* entity was designed in this way to ease any new classifiers that may be introduced in the future, as it is expected than an O.T. will create many activities and might need further filtering options).

- Three subclasses of the *Activity* entity are included in the first version of the system. There cannot be an instance of the *Activity* entity that is not also one of the defined subclasses.

- A session is simply a collection of activities to be performed in a single sitting (figure 4.4 presents the use case of an O.T. going through a session from beginning to end).

- Activities and sessions are performed by patients and evaluated by both the system (success of the performance of an activity and duration of activities and sessions) and the O.T. (comments and observations). A *missed* relationship is created due to the importance of attendance checking that was noted in some of the contextual observations. It is established for activities and not for sessions due to the fact that patients sometimes arrive late to sessions and perform only some of the activities (particularly in group sessions).

Following this, the definition given for the assessment documents (see figure C.3):

- An assessment document consists of a series of questions, each of which allows only one type of answer (textual or numeric). Each document is uniquely identified by its name.

- Documents can be organized into different groups, also created by the O.T. and identified by a name.

- Questions, which are identified by the document they belong to and the position they occupy in it, can be textual or numeric, and numeric questions can also be ranged. These types merely define the type of answers allowed by each, which in the diagram translates into different relationships with a value of a different type in each case.

- A response to a document is identified by the patient it refers to, the document being filled in and the date on which the response was given. A response will have a series of answers to the different questions contained in the document.

Finally, following is a brief description of the schedule section of the system, together with its EER diagram. It also includes an *OT* entity, describing an O.T. registered in the system. All of this can be seen in figure C.1.

Session

- **Primary actor**: occupational therapist and patient.
- **Stakeholders and objectives**:
  - Occupational therapist: wants to evaluate a patient while performing a series of activities.
  - Patient: is being treated by the O.T. and is interested in performing said activities and being observed and evaluated by the O.T.
- **Preconditions**: the O.T. has logged into the system and navigated to the appropriate screen. The activities to be performed have been previously created in the system and the patient has been registered.
- **Postconditions (success guarantees)**: the session is completed successfully (regarding application functionality, not the patient's actual results). The O.T. indicates what the final performance results were and the system saves the information and makes it available for later consulting.
- **Basic success flow**:
  1. The O.T. selects the *New session* button.
  2. The O.T. inserts the patients expected for the session.
  3. The O.T. selects the activities to be performed during the session.
  4. The O.T. selects the *Start* button.
  5. The O.T. patients perform each activity, choosing to go to the next one when finished with the current one or going back if a change in the state of an activity needs to be made.
  6. Eventually, the patients finish the last activity and select the *Finish* button.
  7. The system presents the results collected (total time and outcome of each activity).
  8. The O.T. edits said results where necessary, adjusting them to each patient, and writes any additional comments for selected patients when needed.
  9. The O.T. selects the *Save and finish* button.
- **Extensions**:
  a) Cancel session:
  * At any time during the session the O.T. selects the *Cancel session* button.

  b) The O.T. does not want to save the results.
  8. The O.T. selects the *Finish* button, discarding the results.
- **Frequency**:
  - Very often (typically several times a day on work days).

Figure 4.4: Use case: preparing, carrying out and saving the results of a session

- A schedule is determined in a weekly manner, together with a list of one-time events, and is composed of a series of time slots, each one having a a start time and day of the week or a specific date uniquely identifying it. As an additional restriction, weekly time slots cannot overlap, and neither can one-time events (this can be checked with the start and end time attributes).

- Patients expected to attend regularly and activities that are usually repeated every time in a certain time slot can be associated to this time slot.

- An O.T. will have a certain timetable, patients and a general profile created by them (described by the *Field* and *FieldGroup* entities).

4.2 Interaction

The main functionalities offered by the system to the O.T. are presented here organized in smaller blocks, corresponding to each of the four main sections the application will centre around: patients, activities and sessions, schedules and assessment.

4.2.1 Patients

The system provides the O.T. with the tools for patient configuration, creation and administration. The first task is related to the system profile, while the other two refer to the patients:

- Configuration: the first time an O.T. uses the system, they are expected to configure the profile element to adapt it to the kind of patients they work with. They will create new fields (either textual or numeric field) that will be added to every patient's description.
- Creation: every patient an O.T. has should be registered in the system so that proper recording and evaluation can be performed.
- Administration: once some patients have been inserted into the system, the O.T. will be able to view their information, as well as organize them in different groups, which can help to get a better picture of everyone they work with as well as facilitate further use of the application (e.g., for finding a specific patient or including a whole group in a session).
- Edit: the information describing a patient can be updated or parts of it deleted.

The flowchart seen in figure 4.5 shows the main actions the O.T. will be able to perform inside the system's patient block: create, edit and consult information regarding each patient (personal information as well as assessment and session results).

4.2.2 Activities and Sessions

The O.T. can design new activities adapted to each patient's particularities, using one of the templates provided by the system and completing it with content useful for interaction and evaluation with said patient. Activities can also be modified and administered, while sessions can group activities in order to carry them out with a patient:

- Creation: the system provides the O.T. with a series of templates she can use to create new activities. Each one has various components that need to be filled in for the activity to be considered valid by the system. The type of content that can be included will depend on the component (textual, numeric, graphical...), but inside each type the O.T. is free to adapt the activity to her target patients (e.g., cars and aeroplanes for children).

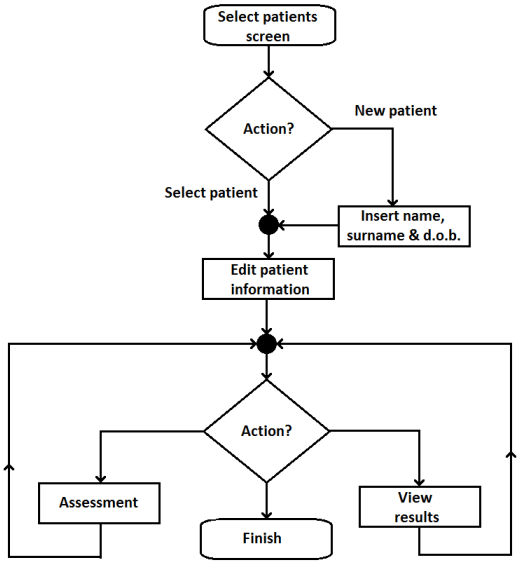

Figure 4.5: Flowchart for the system's patient block.

- Administration: activities can be labelled through two main divisions: categories, which establishes the kind of activity one is dealing with from a therapeutic point of view; and difficulty level, which gives an assessment on how difficult the activity is considered to be (once again, from the O.T.'s professional point of view).

- Completion: activities are completed by the patient during a session, in which more than one activity can be carried out, one after the other. The time of completion and its successfulness are automatically tracked by the system and presented at the end of the session to the O.T., who can modify some of the results (the system grades the result in a binary manner, but the O.T. can also select an intermediate value) and add an overall comment on the session.

- Edit: activities can be modified by changing their description or by updating their content (text or audiovisual information included in the activity). It will also be possible to erase an activity from the system, which would also remove derived information (such as results recorded for the activity).

Once a new activity has been created and configured, the O.T. will use it as part of a therapeutic session with one or more patients. This activity execution process is described in figure 4.6 , where a flowchart indicates the path followed for the performance of a session.

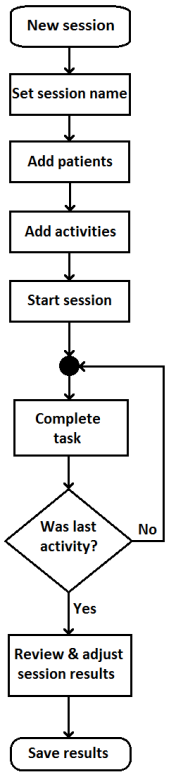

Figure 4.6: Flowchart for performing a session.

4.2.3 Schedules

The O.T. will be able to store her schedule in the system, arranging the different tasks, patients and activities she works with regularly:

- Creation: a new time slot can be created with the scheduling system, assigning it a time period (start and finish times) and the title assigned to the general activity performed during this time (e.g., *Group 2 cognitive session*). Time slots can be weekly (they are assigned a day of the week, meaning it is performed every week on said day) or one-time events (they are assigned a date), such as a special field trip.

- Configuration: other than the usual information expected from a timetable (date, time, etc.), a time slot in the system can be configured in two different ways: through its patients and through its activities. Adding the former indicates expected attendance, while including the latter expresses regular performance (e.g., a certain set of warm-up activities one might always perform at the beginning of a weekly session).

- Administration: the O.T. can check her schedule, selecting a day of the week or the

one-time events and viewing all corresponding time slots in order.

- Edit: schedules can be rearranged, with patients and activities moving around together with their assigned time slot.

4.2.4 Assessment

The assessment block of the system is intended for the design and completion of evaluation documents that can either be used once, perhaps for an initial assessment of a new patient, or with a certain regularity, facilitating the tracking of patient evolution:

- Creation: questions can be added to a document, with its corresponding answer being assigned a specific type (either textual or numeric). The order in which they will be later posed is established during this creation process.

- Completion: patient evaluations can then be performed through documents created earlier on by answering each of the questions designed for the questionnaire.

- Comparison: recorded evaluations can be revised in order to compare previous results with current ones.

- Edit: created assessment documents can be modified (questions changed, moved around or removed).

4.3 Interface

The process followed for designing the user interface is detailed in this section. This description is separated into two subprocesses: the conceptual model design and the screen design standards. Current Android interface design paradigms will also be explained, together with the reasoning behind the design paradigm chosen.

4.3.1 Conceptual model design

Before presenting the conceptual models created, there are a few main points that need to be explained as to how the system is being considered regarding the interface design:

- **Ease-of-use and Ease-of-learning** [18]: the main users, O.T.s, will be expected to learn quite a few things in order to get to use the full potential of the system. Since their use of the application would be repeated and continuous for a long period, ease-of-use has become the main focus.

- **Product- and Process- oriented** [17, p. 193]: most of the system will behave as a product-oriented one. Patients, activities, assessment documents and schedules are created and interact with each other. However, carrying out a session, which is composed of a series of activities, would have a behaviour more similar to that of a process-oriented system.
- **Primary and secondary products** [17, p. 193]: following up on the previous point, the product-oriented parts of the system can have subdivisions as to what products are considered to be primary and which ones are secondary. Those mentioned above (patients, activities, assessment documents and schedule time slots) would be the primary objects in the system, whereas all other products (typically supporting the primary ones, such as data fields and groups, document questions or activity classifiers) will be considered to be secondary.

Having said all this, we can move on to presenting the first conceptual model that was designed. Figure 4.7 shows some of the drawings for this first model - the main screen and those related to the patient section of the application, where numbers in red indicate the screen each widget leads to (screens are also numbered in red). The complete model can be seen in appendix D.

This initial model was hand-drawn and was intended mainly for two objectives: confirming that the task organization model generated during the analysis phase was being correctly captured in the user interface and that the major navigational pathways devised were not unnatural or confusing. It was only possible to present the model to one O.T., who confirmed that said goals were mostly being achieved, with two exceptions: first, assessing a patient should be done from the patient screen (in the first model one had to find the document,select it and choose a patient to assess); next, attendance should be taken for each activity, and not for whole sessions, since patients sometimes arrive late and miss only a few of the activities (the latter caused changes reflected in the activity section design presented earlier on).

4.3.2 Android interface design

First presented together with Android 5.0 at the Google I/O conference on 25$^{\text{th}}$ June, 2014, Material Design [4] (from now on, MD) is the design language promoted by Google as the one to try to adjust to when developing apps for Android. Some of the definitions given by MD were used when designing the system (especially the most noticeable and common ones users will probably have encountered when using other Android apps), while trying to maintain as much simplicity as possible and avoiding overcrowding the screens with new elements the users may be unfamiliar with.

As detailed in the next subsection, the most distinct elements taken from MD are the buttons (raised, flat and floating action buttons) and dialogs. Although some of the size definitions were

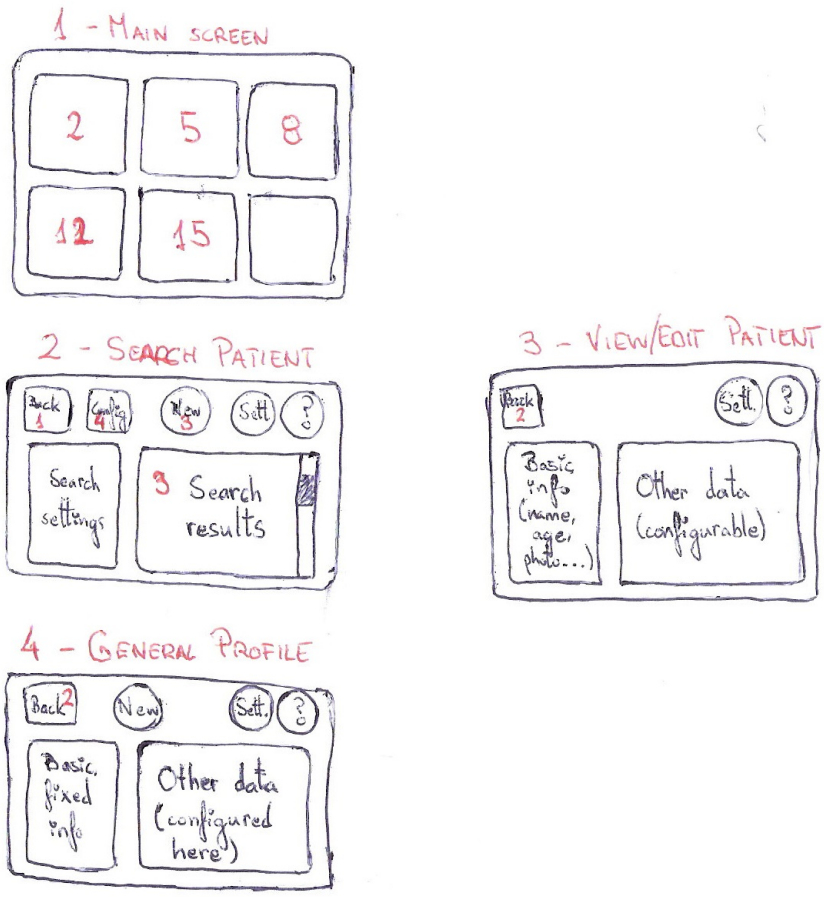

Figure 4.7: First conceptual model - Main screen and patients

adjusted to MD rules, in cases where they did not seem as appropriate as they should they were discarded (the large size of a tablet's screen can make some of the size definitions seem too small, since they are taking up relatively less space in the screen and one is typically positioned further away from it than from one would usually be from a smartphone).

4.3.3 Screen design standards

A document was elaborated with the main screen design standards that would be followed when designing the user interface, with rules regarding certain control standards, primary product screen standards and process screen standards.

The control standards imposed were the following:

- Text fields:
  - Short text: single-line.

  - Long text, up to 5 lines, adjusting to screen space.

- Numeric fields: act like a short text.
- Dates: Android DatePicker or act like a short text. When using the DatePicker, use the system default one, since it is generally the one the user is used to.
- Times: Android TimePicker. Once again, when using the TimePicker, use the default one, for it will generally also be the one the user is used to.
- Navigation:
  - Fixed navigation: based on MD, raised buttons.
  - Variable navigation: list entries.
- Item creation: based on MD standards, floating action buttons are used for creating items. A common colour will be used for these buttons which contrasts with the colour used in its environment, so that the users will easily see that the screen they are in is displaying and allows for creation of some kind of item (the context will determine the kind of item that the button creates).
- Item selection:
  - Fixed number of items: radio buttons or drop-down list.
  - Variable number of items: list.
- Selected items: different background than the rest of the list, easily distinguishable and locatable.
- Dialogs: based on MD standards, a simple, white background, an optional title in bold letters, two MD flat buttons on the lower right corner and the main content above the buttons (and below the title, if there is one).

On the other hand, we have the primary product screen standards that were defined for the system:

- Product search: the left quarter of the screen displays the different groups that categorize the products; the other three quarters show the products belonging to the currently selected group.
- Product editing: the left side of the screen shows fixed information imposed by the system, including any data that must be filled in by the user; the right side is taken up by variable information, which may depend on the specific type chosen from those the product in question can be assigned to.

Finally, the process screen standards are as follows:

- Preparation: an optional initial configuration screen, which does not need to adjust to a specific standard, but simply to accommodate the kind of process that is being prepared.
- Execution: the different steps of the process are shown in one single screen, with navigation arrows on the left and right sides to move through said stages. An optional cancellation button can be placed at the top right corner of the screen.
- Finalization: an optional final screen for any additional data to be shown and optional simple modifications to be introduced by the user.

It was also established that a different colour should be used as the main theme for each section of the system: patients, activities, sessions, schedule and assessments, to make it easier for users to know where they are in the system at any time.

4.4 Development

As determined by the software analysis explained in the previous section, the system was implemented in the Java programming language, in order to be able to use all the libraries available for the Android environment.

The database models designed were developed with SQLite, separating the process into two main parts: a contract class was created to define all the table and column names, together with the SQL statements that would create them in the database; and a helper class, which executes the creation statements the first time the system tries to access the database, as well as a series of public methods allowing for CRUD interactions with it.

Other classes would access the database through the helper class, which returns the information through a series of Java objects that correspond to certain elements in the database model.

As for the interfaces, Android allows developers to define them in two different ways: using XML documents where the layouts and components can be positioned, or programmatically in Java at the time of creation. In this case, all the screens and dialogs were designed using XML files. Although most of the interface elements defined in Android have default views, additional classes or libraries were used when a more personalized or specific behaviour was intended.

Finally, the different types of *Activity* and *Fragment* classes offered by Android are subclassed to define the communication between the users (who interact with the interface) and the database (through the helper class), in effect using the Model-View-Controller pattern.

Regarding the Abstract Factory pattern used for the activities, the use of these classes defined earlier on is as follows:

- When editing an activity, the first thing the system will do is obtain an *ActivityFactory* object and load the activity being edited. Both views are loaded, the *ActivityEditView* with the *Activity* object received from the factory and the *ActivityInteractView*, which is initially empty (it is hidden). The O.T. will have a button to toggle between edit and preview modes: when switching to the latter, an *Activity* with the current configuration is requested from the *ActivityEditView* object and passed to the *ActivityInteractView* to show how it would look.

- The *ActivityEditView* and *ActivityInteractView* classes are Android fragments, so that their views can be easily embedded into certain screens in the application.

- When carrying out a session, an array is kept with the *ActivityInteractView* objects, which are generated passing them their activity's ID as an argument (the view is responsible for loading the activity from the database in this case). If the patient chooses to go on to the next activity, the current one is paused and its layout destroyed (only the layout is destroyed, the view object is kept in memory with the activity's state; this allows us to keep the state of the activity while freeing up the layout's resources, while still allowing for quick reconstruction if necessary). When moving on to a new activity, its *startActivity()* method is called, while *resumeActivity()* is run if the activity had been started previously.

- On updating the activity, the *ActivityEditView*'s *saveValues()* method is called, with the *removeActivity()* one being invoked on deletion (the system removes the entry in the *Activity* table in the database, where triggers could be used to automatically start the removal of the subclassed activity attached to it: the *ActivityEditView* is expected to remove any additional information that isn't configured to be removed through any triggers in the database).

As for any resources (images, videos, etc) used in the system, they can be classified into two different groups:

- The resources set initially as part of the system, such as the arrows used in the session screen, the back of the cards in memory card activities or the stars used to rate activity performances.

- Any other resources that the O.T.s want to use for activities, such as photos or audio and video files, need to be stored previously in the device, as the system will simply store references to their locations and retrieve them when needed, avoiding unnecessary overhead in the SQLite database.

Having established all these criteria and guided by the conceptual model design (which we could consider to be a first low-fidelity prototype), the coding began. Because of all the planning that had been done and the validation received for the conceptual model design, few

changes had to be made to the following prototype, which would, in fact, be very similar to the final version.Figures 4.8, 4.9 and 4.10 show some of the screens in the application.

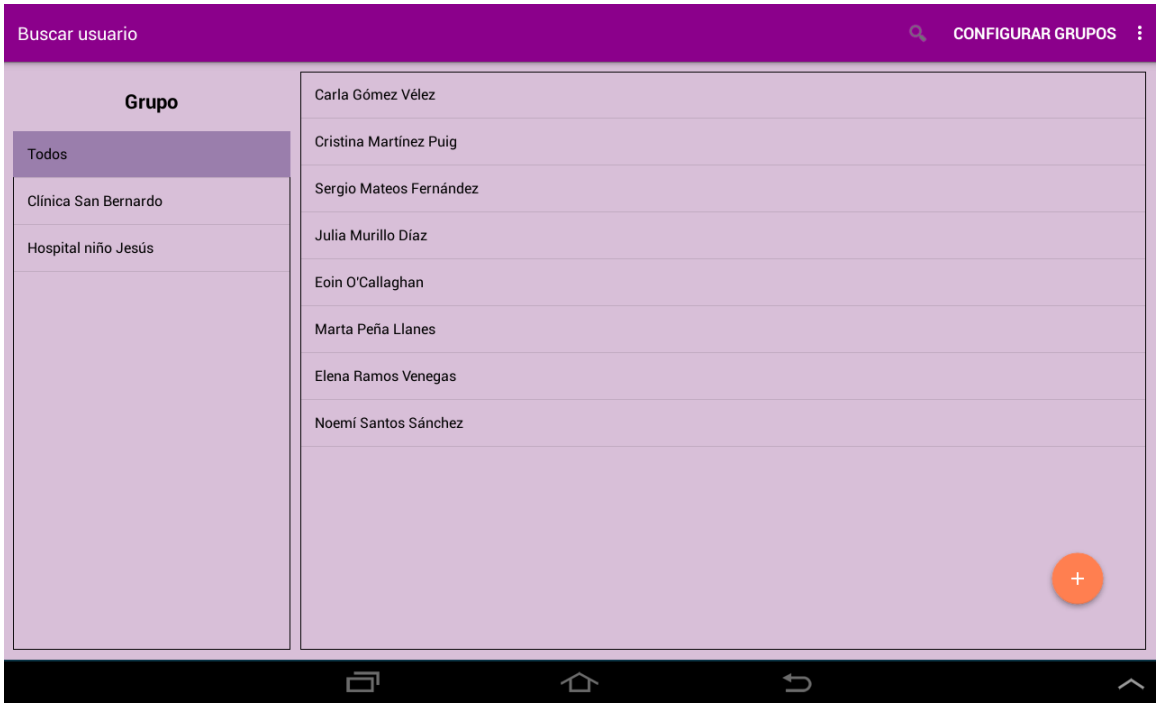

Figure 4.8: Patient searching screen

Figure 4.9: Question & Answer activity during a session

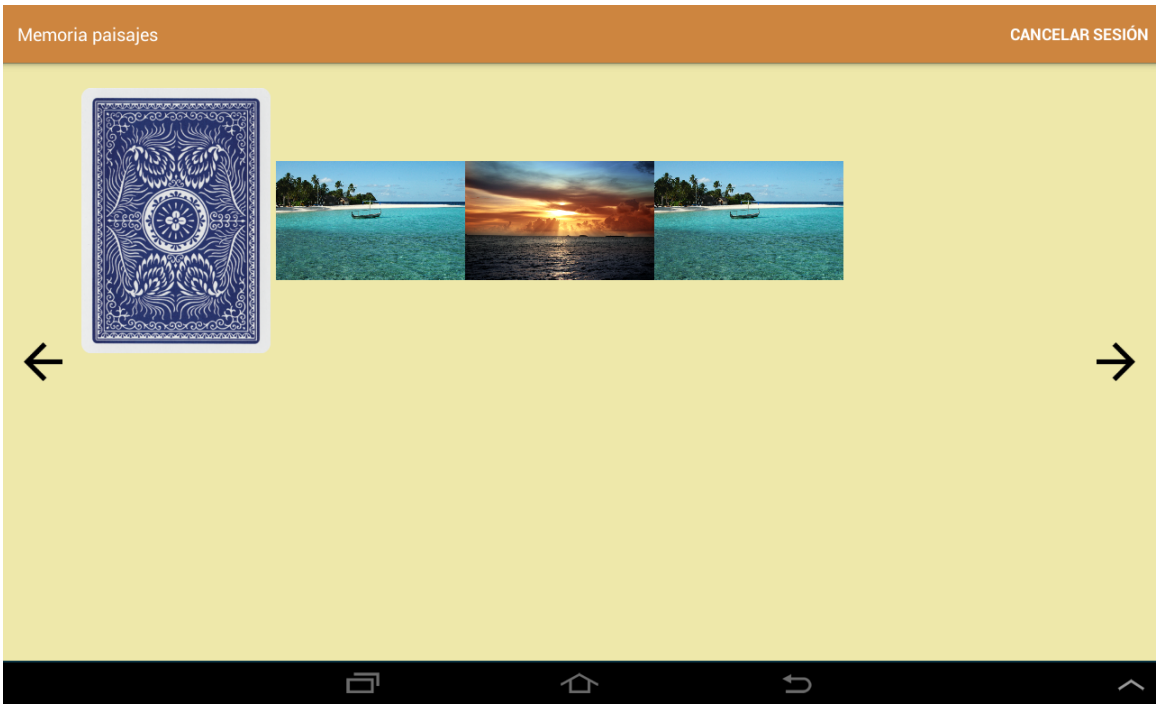

Figure 4.10: Memory card activity during a session

Chapter 5

Evaluation

This chapter describes the process used to evaluate the system that was developed. Part of it consisted of a self-evaluation following certain criteria and part is real testing with actual users: four different O.T.s were able to try out the application, as well as three patients who performed some activities created with it. The latter part (user evaluations) should be given higher validity, not only because the former can easily bring in unconscious biasing, but also because following the principles of user-centred design is one of the main objectives of this project and user evaluation is most beneficial for said paradigm.

5.1 Self-evaluation

5.1.1 Unit and integration testing

As the system was divided into several different blocks (patients, activities, sessions, schedule and assessment), each one was built independently and tested through white box testing. Once every part was working correctly, the links between the different parts were built and checked to verify that input and output was valid in all directions.

5.1.2 Requirements satisfaction

Once all the components had been tested and everything was connected and working properly, the requirements that had been set initially were checked. The functional ones were considered satisfied once the unit and integration testing was completed, so only the non-functional ones remained. Those referring to user performance were validated later on, during the user evaluation stage.

Any deficiencies found at this point (non-helpful error messages, buttons hard to see, etc.) were corrected until the system was considered to satisfy all the requirements originally estab-

lished.

5.1.3 Additional usability verification

The self-evaluation process was carried out using Ben Shneiderman's *Eight Golden Rules of Interface Design* [28, p. 74-75], examining the application to determine to what point each of these rules was fulfilled:

1. **Strive for consistency.** The control and screen design standards that were established during the design stage (see 4.3.2) were devised with this principle in mind. The main product screens (patients, activities, time slots and assessment documents) all follow certain rules to make their fundamental aspects similar (for example, all search screens have groups on the left and the actual products on the right). Names of components also maintain this consistency, so that an item does not have its name changed from screen to screen.

2. **Enable frequent users to use shortcuts.** No concrete shortcuts were included in the system for two reasons: the first one is that most of the actions in the application can already be performed in very few clicks; the second one is that screen simplicity was one of the main goals pursued in order to avoid users getting confused, so that including extra buttons in some of the screens could potentially lower their confidence using the system (in fact, some users commented positively on the simplicity of the screens).

3. **Offer informative feedback.** Error messages have been written trying to inform the user about the problem encountered and how to fix it (typical errors would be empty fields that need to be filled in, start and end times in the wrong order or invalid values given to assessment document responses, in which case the accepted values are explained).

4. **Design dialog to yield closure.** Creation sequences in the system usually have one dialog screen requesting the basic information needed to build the item in question. After this, the product is created and shown on screen, which allows the user to confirm it was constructed properly.

5. **Offer simple error handling.** Inputting incorrect information during creation or editing of the main products is rarely a problem, since the user will always be able to re-edit to change the information back again or alter it as originally intended. Deleting items is permanent, which could be more problematic if done accidentally: for this reason, permanent deletion actions are always accompanied by a confirmation dialog to avoid removing anything by mistake.

6. **Permit easy reversal of actions.** We refer to the explanations given for the previous point: since editing is always available for all the main products, one can go back and

correct mistakes made due to incorrect input.

7. **Support internal locus of control.** The user is always the initiator of actions when using the system and new screens and dialogs are only prompted by user activity.

8. **Reduce short-term memory load.** The system tries to help the user as much as possible in this sense, showing any information considered relevant in each context (for example, when selecting patients for a session, previously selected ones will not be shown as selectable, avoiding confusion if the user cannot remember who had already been included).

5.2 User evaluation

5.2.1 Occupational therapists

User evaluation tests were conducted with four different O.T.s. The outcome of the trial process is detailed in section 5.3, but first, the procedure followed to carry out these tests is explained.

The method used to perform user evaluation consisted of three distinct parts:

- Pre-test data collection: before using the app, some basic information relevant to the testing was collected that could help to better understand the results later obtained.

- The test: the main phase of the evaluation was itself subdivided into three parts. During the first one, I presented the system to them and gave them a detailed tutorial of the different functionalities it offered, in some cases creating small examples to illustrate how it worked. After this, the tester was given the application to experiment with until he or she felt confident enough to go on to the tests. Finally, a list of specific tasks were given to be completed in order while being timed.

- Post-test user evaluation and observations: the tester fills in a System Usability Scale form [8] and can offer any observations that may have been made during the whole process.

These steps were carried out in each of the four evaluations, although the actual documents used for the first one had a slight variation with the rest, as it was also used as a trial evaluation in which the tester provided feedback regarding both the application and the tests themselves. Any potential problems were then corrected in the evaluation documents for use in the following tests. Appendix F presents the final versions of the documents used for the steps described below.

Pre-test data collection

For this first stage of the evaluation process, a brief questionnaire was filled in by the tester in which he or she provided basic details relevant to the evaluation, such as their age range, experience as an O.T. or knowledge of Android systems. There are two main goals this information can help us accomplish:

- The first purpose of said questionnaire is to get a better understanding of the user that may help to comprehend the reason behind some of the results during the test and determine to what extent the application should be considered responsible for some of the problems that may arise. An example of this would be the time of completion of some of the tasks that are performed, which can easily be greater in people whose technological savviness is lower and are slower at typing or locating certain symbols on the screen keyboard.

- The other reason is to find out if there are significant differences in the results given by different population groups inside the O.T. community. An example in this case could simply be the various age groups, where not only younger people tend to feel more at ease with new technologies, but the way in which occupational therapy is taught has changed throughout the years, perhaps making the app fit better in this sense with a certain generation.

Test

As mentioned above, the central stage of the evaluation process was divided into three sections:

- First of all, the whole application was presented and explained in detail to the tester, showing each of the screens, their functionality and the navigation flow followed to move around the different parts of the system. During this time the O.T. could ask questions and in some cases even made suggestions as to how some things could be extended in the future. The time it took to go through this section could vary, depending on the ease with which the O.T. understood each part and the number of questions posed, but it typically lasted between 15 and 30 minutes.

- After this, the O.T. was allowed to use the application and get the feel of it, exploring directly (and not just watching) how the system really worked. There was no time limit set to this experimentation phase: since there is a high interest in achieving ease-of-use, the test attempts to emulate this.

- Once the O.T. has been shown the application and is familiarized with it, we move on to the last step. A list of 19 tasks to be completed in order is given to the tester, who will announce when each one will start and end. The completion time of each task was

recorded, together with any relevant observations made during each one. The number of 'clicks' (in this case main touch interactions) it took to complete the task was also noted down to discover possible ways of increasing their efficiency and find any other problems, especially the most glaring ones in which the tester clearly diverted too much from the intended path (see figure 5.1).

Nº	1
Tarea	Datos de usuario. Crear un nuevo apartado: - Nombre: Familia. - Campo 1: Padre, t. textual. - Campo 2: Madre, t. textual. - Campo 3: Hermanos, t. num.
Tiempo	
Nº clicks	
Observaciones	

Figure 5.1: Sample table of the document used for noting the times, clicks and observations

Post-test user evaluation and observations

Finally, once the tests had been completed and objective data had been recorded, the testers were given the opportunity to express the impression they had of the application they had just tried out. This was collected in two different ways:

- On the one hand, a System Usability Scale (SUS) questionnaire was filled in where several aspects were covered with respect to the application. This is a standard usability scale that addresses general goals one tries to pursue when building a system using a user-centred approach, such as perceived complexity and willingness to use it in the future. The answers are given following a Likert scale, choosing one of five options that range from *Strongly agree* to *Strongly disagree*. Answers are then converted to numerical values and normalized to a range of 0-100 (for more details, see appendix F).

- On the other hand, the O.T.s were asked to give their opinion on the application, what they liked and disliked, what future additions they would appreciate and what the problems they noticed the most were.

5.2.2 Patients

User evaluations were conducted with three different patients, who were able to carry out brief sessions on the system to see how some of the activities worked. Each one did this while sitting in their usual therapy room together with their O.T. and me observing how they managed with it, whether they were able to work each activity out and if they enjoyed using it or quickly got bored.

Before each test, the patients were briefed on what was happening (why I was there and what we were going to do) and how their opinion was appreciated (whether it was fun, if the sizes and colours were OK, etc.). Then, they would be given the tablet with a prepared session for them to try out, during which they could give their impressions. Once they had finished, they were asked for any additional comments they had and any changes they would like to see.

5.3 Results

5.3.1 Occupational therapists

As mentioned previously, the evaluation tests were carried out with four different O.T.s. Three of the testers were close to the target profile chosen in the analysis phase: they had shown themselves to be at ease around new technologies (and in fact used tablet computers), worked mostly alone and with small groups or single patients at a time and they worked with children or teenagers, performing both physical and cognitive therapy (although one of them did mostly physical therapy).

The other tester was further away from the original target profile in some of the aspects described, showing certain discomfort and uneasiness around new technologies and having worked mostly with elderly people. However, the comments and reactions shown by this last tester helped to see to what extent O.T.s outside of the target profile could still benefit from using the system.

Pre-test data collection

The following information was extracted from the responses to the pre-test questionnaire:

- The test users were in the lower age ranges: two of them were between 18 and 25 years old and had six months to one year of experience as O.T.s; the other two were in the 26-40 range, with more than five years of experience as O.T.s.

- Those who had been working longer in the field also showed more contact with computer applications for O.T.s, including Android.

- Finally, the use of tablet computers or Android-run systems outside the scope of occupational therapy did not seem to be linked to any of the other factors, but merely to each tester's personal life. Three of the testers expressed having a lot of experience with tablets, with the other one having very little; the use of Android was quite varied, with each O.T. reporting a different level of experience.

Test

Table 5.1 summarizes the results obtained during the testing part. The numbered tasks can be seen in appendix F. It is important to note that:

- Tester number 1 (who performed the trial evaluation) had been present in several stages of the development of the project and in fact felt confident enough not to need to spend any time trying out the application after the initial demonstration I gave, since he had already tried it out during its evolution.
- Tester number 2 was the one who spent the longest time trying it out, going into every screen that had been explained to experiment with the full system.
- Testers 3 and 4 had a quick look around on their own, in some cases trying out a specific functionality but mostly just looking at the screens and locating where everything was.

Since the application is intended for long-term continuous use, the behaviour of the two first testers is the one that interested me the most, as it gave a better insight into how successfully the ease-of-use goal (which was one of the main goals) was being achieved. However, the reactions and results from the other two testers helped to find out how users with very little experience might try to work out certain functionalities offered by the system.

There were some observations made during the testing phase worth mentioning which are in fact reflected in the results. Measured times that were very far off from the expected ones are shown in a bold font, and those underlined reflect partial completion of the corresponding task (where the changes with respect to the instructions were small and did not alter the results in a manner that could greatly affect the O.T. later on in a real life situation). The time for the performance of the 13^{th} task by tester number 4 has been omitted because the final result that was given had some errors that would eventually become problematic until solved in a realistic situation.

It is clear that the part of the system that most confusion causes initially is that of the general profile, apparently for three different reasons: the first one seems to be its level of abstraction compared to the rest of the components, which can easily be identified with more concrete things in an O.T.'s environment; the second one is that the screens in which it can be modified are a bit harder to reach than those of the main products (patients, activities, etc.); the third and last one is the confusion that can easily arise from the similarity between the

screens for editing patients and those for changing the general profile, with some testers going into a user's information screen to try to edit the general profile.

Once they had finished the tests, some testers commented on the tasks related to this part, explaining how they thought they had grasped the concepts and navigation correctly during the presentation of the system but later realized they had not completely. However, they reported that having run into problems with it and having found out how to overcome them, they felt they now truly understood the concepts involved and how to work with them in the application.

Task number	**Tester 1**	**Tester 2**	**Tester 3**	**Tester 4**
1	1' 14"	**1' 40"**	1' 02"	**2' 28"**
2	0' 32"	**1' 00"**	0' 20"	**0' 47"**
3	0' 41"	**1' 25"**	**2' 08"**	0' 30"
4	2' 29"	2' 06"	2' 23"	2' 31"
5	1' 08"	1' 12"	1' 06"	1' 20"
6	0' 40"	0' 35"	0' 30"	**1' 51"**
7	0' 22"	0' 22"	0' 27"	**1' 12"**
8	0' 10"	0' 08"	0' 08"	0' 08"
9	1' 40"	1' 32"	1' 56"	1' 49"
10	0' 57"	0' 52"	1' 03"	0' 56"
11	1' 00"	0' 53"	1' 08"	1' 13"
12	1' 30"	0' 58"	1' 24"	1' 00"
13	1' 23"	1' 44"	1' 46"	**-**
14	0' 20"	0' 33"	0' 24"	**1' 04"**
15	0' 34"	0' 32"	0' 41"	0' 32"
16	0' 30"	0' 45"	0' 26"	0' 40"
17	0' 18"	0' 24"	**0' 33"**	**0' 43"**
18	0' 07"	0' 10"	0' 12"	0' 12"
19	0' 06"	0' 13"	0' 06"	0' 09"

Table 5.1: Test results: completion times

It is also worth mentioning the other problems reflected in table 5.1, although they do not seem as widespread as those described above:

- Tester 4 had some trouble getting into the group configuration screens, although the first time he tried to use the correct button he accidentally touched a button next to it and did not try again for a while, believing that it was a button for something else.
- The same tester also felt a bit confused when asked to modify a one-time event in task 14, seeing it as an activity or a session to be performed and thus looking in the corresponding

screens before realizing the instruction was referring to the scheduling block.

- Finally, the additional time needed by testers 3 and 4 to finish the 17^{th} task was due to the fact that they had forgotten about the possibility of checking a patient's activity history and kept trying to get the session history screen to produce the activity results.

On the other hand, all other timings are considered to be well within acceptable ranges and even when testers could not find the exact screen they were looking for, they were indeed searching in the correct section of the application (for example, when trying to configure the general profile, some of them went back to the main screen, but kept going back into the "Patients" section, as that is where they felt it should be). This indicates that the navigational structure given to the application seems to fit in with the conceptual model constructed during the analysis phase to represent the mental model of the users.

Post-test user evaluation and observations

Table 5.2 shows the responses given by the testers to the SUS evaluation (the questions can be seen at the end of appendix F), where a 1 represents a *Strongly disagree* answer and a 5 means they *Strongly agree*. The last row shows the normalized grade after the standard conversion (see appendix F for more details).

To interpret the normalized grade, we refer to a couple of studies that tried to get a better understanding of how to decipher the meaning behind SUS normalized results:

- Jeff Sauro presents in [27] some highlights on the research he did into SUS scores, where he indicates that 68 is the average score and that having a score over 80.3 translates into being in the top 10% of the scores collected in his study, making it more likely that users would recommend the system to their friends.

- Bangor, Kortum and Miller show in their study [7] a correlation between SUS scores and adjectives used to rate the same system. They indicate that products determined by surveyees as being the *Best imaginable* corresponded to those given a mean SUS score of 90.9, with a standard deviation of 13.4 points.

Thus, we can conclude that despite the difficulties some of them encountered, the testers were generally very satisfied with the system. In fact, if we look at the answers given to the first question in the SUS questionnaire, we can see that all testers would like to use the system again.

After the tests were done and the SUS questionnaire had been completed, the testers gave their overall impression of the application, suggesting possible additions and explaining what had confused them and why, if so. The following are some of the most relevant ones:

Question	Tester 1	Tester 2	Tester 3	Tester 4
1	5	5	5	5
2	2	1	1	2
3	4	4	5	5
4	1	2	2	1
5	4	5	5	5
6	2	1	1	5
7	5	5	5	5
8	1	1	1	2
9	4	5	5	5
10	1	2	1	2
Normalized grade	**87.5**	**92.5**	**97.5**	**92.5**

Table 5.2: Results of the SUS scale document

- One of the testers remarked that she would probably feel a higher sense of security if there were *Save* buttons in the editing screens, instead of simply pressing the *Back* button, which saved everything automatically. However, other testers seemed to appreciate the current state of the system, being able to move around quickly without having to save everything all the time. Additional evaluations would have to be carried out in order to make a decision as to whether said button should be added or left out.

- The colour-coding of the different sections of the application was viewed positively and the tones and intensities used were deemed good.

- There was some confusion with the schedule part, with some testers initially assuming that adding a time slot while having a certain day of the week selected would automatically set it as the new time slot's day (in fact, this is the task that was performed incorrectly by tester number 4). I considered this to be a reasonable assumption and will change this part of the system in the future, since it should not pose a problem for those who did not make said assumption (the latter group would usually edit the day of the week once the time slot was created, so that giving it a different default value depending on the context should not cause any confusion).

- Despite the difficulties encountered during the tests, the general profile section of the system received positive remarks, with a high appreciation for the possibility of adapting the system to the particular patient population the O.T. is working with.

- One of the testers commented on the fact that he frequently used PDF files during what we have called non-interactive activities (those performed mostly independently from the

tablet, typically physical therapy; the current version accepts photos and audio and video files). However, he himself added that since he typically used them for the images they contained, he could also simply extract said pictures and add them to a non-interactive activity as photos.

- One of the testers expressed appreciation for the activity creation and edition screens, remarking that he found it very intuitive. I had already noticed this during the tests, where the testers rarely hesitated when creating activities, and after seeing the recorded times for the tasks related to this.

5.3.2 Patients

As mentioned above, I was able to test the application with three different patients during their therapy sessions to see if the activities and sessions aspect of it could really become useful to O.T.s.

The professional opinion of the O.T.s was followed as to which activities could be tried out: in all cases, the activities tested were of the *Memory Card* type, as it was in fact something they often used with the patients during ordinary sessions (but with real cards). However, some of the O.T.s said that they believed that the *Question and answer* type would be very useful to help some of their patients (who were children) with their work for school. Regarding *Non-interactive* activities, they are in fact designed to be used mainly by O.T.s, not by the patients themselves, and they all understood how they worked and several even immediately mentioned activities they themselves would insert as being of this type.

All three patients liked the application and they all used it easily, since they had played memory card games before. They really appreciated the possibility of personalizing it to show things they liked and seemed very motivated once they saw pictures of things they recognized and liked (images had been taken from video games they liked). In fact, once it had been tested and they had given their opinion, some of the patients asked to use it again.

In general terms, the patients were able to use the application easily, understanding very quickly how to interact with it. The only problem encountered was the limitation imposed by the size of the screen: if too many cards are added to the activity and too few cards are chosen to be shown in each row, the patient needs to scroll down to see some of the cards. There is a compromise to be made between the size of the cards and the number of cards on the screen at once, where the size of the tablet computer becomes a restriction.

Chapter 6

Conclusions and future development

6.1 Conclusions

The aim of this whole project was to make it easier for O.T.s to work by taking advantage of new technologies and filling a gap in the list of applications available to them. It was seen that most programs were too restrictive in some way, forcing O.T.s to work with many different ones in order to satisfy their needs, and the systems that are flexible in some aspects are lacking in others.

Thus, the problem was that the existing systems did not have O.T.s as their specific user targets, or those that did were not meeting the requirements most O.T.s had, typically producing a system for a more specific context (for use with children, for people with autism, etc.), not allowing creation or configuration of activities to adapt them to their target patients. Therefore, it was concluded that a user-centred approach had to be taken in order to create something that could be used by as many O.T.s as possible and which satisfied their professional needs.

The survey and the contextual observations turned out to be the most helpful tools of this approach, as they were a great help in understanding how O.T.s really worked, what they needed to make their job easier and how to help them to become more effective and efficient.

Once the potential users had been studied and a target profile was established, the direction in which the design had to go was much clearer and the mental model that had been extracted from the analysis phase helped in determining the system's structure.

In addition to all this, several ideas from the initial concept I had had for the project were still part of it, so that, among other things, it was important to build a modular system that would allow for easier and quicker expansion in the range of types of activities available. This was achieved through the use of the Abstract Factory pattern, as was detailed in 4.1.2.

Once the analysis was carried out and its results used to compose a design that would be able to satisfy the needs of the users and allow for easy expansion, the first prototype was built. The work done previously would pay off at this point, as the validation performed showed that few things needed to be changed, making the prototype very close to the final version.

In conclusion, the user-centred approach was the most appropriate one for the situation, as it resulted in a better understanding of the target users. The outcome was a system that was able to fit in with their line of work (and not the other way around, which was the problem until now), satisfying their professional needs and speeding up the process of collecting and managing the information collected from their patients.

After evaluating the system with several O.T.s and some of their patients, it seems clear that the usability objectives were indeed satisfied: the O.T.s indicated that the application was most definitely useful and the observations made during their use of it showed that their intuition as to how it should work was in compliance with how it actually worked; the patients were able to use it easily and showed great enjoyment in seeing that the activities they were working on had been adjusted to their personal likes, motivating them to keep on using it.

6.2 Future development

There are some additions that can be made to the system that were considered from the beginning of the project but that were temporarily discarded in order to take a manageable approach for the time and resources available for the development process. The observations and comments extracted from the last stage of the user evaluation tests provided more insight into how the system could be even further adjusted to satisfy some of the needs an O.T. can encounter during his or her everyday work.

Some of the possible changes are details inside some bigger components that are already part of the system, while others are more noticeable additions that can quickly enrich the user's experience while using the application. Below are presented a few of these possible future additions:

- The first and most obvious one is the inclusion of new types of activities. The initial version that was tried out with the testers contained three types, but the design was made to make it easier to plug in new designs by following a few simple rules.

- The scheduling part of the system can presently be used to view and check what activities and patients the O.T. is supposed to be working with at each time. However, one of the expansions that can be introduced into this consists of linking it to the session process so that the system checks the current date and time when preparing a new session; if they coincide with an entry in the schedule, it would be able to ask whether the O.T. is carrying

out said event and can automatically include pre-scheduled patients and activities into the new session.

- Since many evaluation tests with numeric entries typically add all the values at the end to present a result that is then associated to a qualitative value, a simple sum functionality could become helpful when assessing patients using previously created evaluation documents.

- In some cases a numeric response to a question in an assessment document is accompanied by a textual description or comment. Right now this can be done by simply configuring the question to accept textual values, where any characters can be inserted. However, if the change described in the previous point is applied, numeric (and ranged) questions would need to have an extra textual field where comments can be inserted while still allowing the system to add up all numerical values.

- Sharing is an enriching experience in almost any environment, so the possibility of importing and exporting activities can help O.T.s quickly increase the size of the activity database each one uses if others share their creations.

References

[1] Saving Data in SQL Databases. Google, Android Developers, 2008. Available online: http://developer.android.com/training/basics/data-storage/databases.html [Last visited: 30/06/2015].

[2] Android NDK. Google, Android Developers, 2009. Available online: https://developer.android.com/tools/sdk/ndk/index.html [Last visited: 30/06/2015].

[3] Corona SDK. Corona Labs, 2013. Available online: https://coronalabs.com/ [Last visited: 30/06/2015].

[4] Material Design. Google, Android Developers, 2014. Available online: http://www.google.com/design/spec/material-design/introduction.html [Last visited: 30/06/2015].

[5] S. Anthony. In 2015 tablet sales will finally surpass PCs, fulfilling Steve Jobs' post-PC prophecy. *Extreme Tech*, 2014. Available online: http://www.extremetech.com/computing/185937-in-2015-tablet-sales-will-finally-surpass-pcs-fulfilling-steve-jobs-post-pc-prophecy [Last visited: 30/06/2015].

[6] APTOCAM. ¿Qué es la TO?, 2011. Available online: http://www.aptocam.org/contenido/que-es-la-to [Last visited: 30/06/2015].

[7] A. Bangor, P. Kortum, and J. Miller. Determining what individual SUS scores mean: Adding an adjective rating scale. *Journal of Usability Studies*, Vol. 4(Issue 3):pp. 114–123, 2009.

[8] J. Brooke. SUS - a quick and dirty usability scale. P. W. Jordan and B. Thomas and B. A. Weerdmeester and A. L. McClelland (eds.), Usability Evaluation in Industry:pp. 189–194, 1996.

[9] R. Elmasri and S. Navathe. *Fundamentals of Database Systems*. Pearson/Addison Wesley, 5th edition, 2006.

[10] E. Gamma, J. Vlissides, R. Johnson, and R. Helm. *Design Patterns: Elements of Reusable Object-Oriented Software*. Addison-Wesley, 1st edition, 1994.

[11] D. R. Hipp. SQLite, 2000. Available online: `https://www.sqlite.org/` [Last visited: 30/06/2015].

[12] ADD Informática. Resiplus, 2001. Available online: `http://www.addinformatica.com/en/` [Last visited: 30/06/2015].

[13] P. King. Global tablet OS market share: Q4 2014. Technical report, Strategy Analytics, 2015. Available online: `https://www.strategyanalytics.com/default.aspx?mod=reportabstractviewer&a0=10546` [Last visited: 30/06/2015].

[14] MultiMedia LLC. Key principles of user centred design, 2006. Available online: `http://www.usabilitynet.org/management/b_design.htm` [Last visited: 30/06/2015].

[15] A. Fernández López, M.J. Rodríguez Fórtiz, and M.L. Rodríguez Almendros. Plataforma móvil de apoyo al aprendizaje en educación especial. *Revista Educacao, Formacao & Tecnologias*, Num. extra:pp. 14–23, 2010.

[16] I. Lunden. IDC: iPad sees first-ever decline as wider tablet shipment growth drops 7.2 *Techcrunch*, 2014. Available online: http://techcrunch.com/2014/11/25/idc-ipad-sees-first-ever-decline-as-overall-tablet-shipment-growth-drops-7 -2-in-2014-to-235-7m-units/ [Last visited: 30/06/2015].

[17] D.J. Mayhew. *The usability engineering lifecycle. A practitioner's handbook for user interface design*. Morgan Kaufmann, 1st edition, 1999.

[18] D.J. Mayhew. Ease of learning vs. ease of use - they aren't the same thing. *Bestica UX Community*, 2013. Available online: `http://community.bestica.com/profiles/blogs/ease-of-learning-vs-ease-of-use-they-aren-t-the-same-thing` [Last visited: 30/06/2015].

[19] R. Murtagh. Mobile now exceeds PC: The biggest shift since the internet began. *Search Engine Watch*, 2014. Available online: `http://searchenginewatch.com/sew/opinion/2353616/mobile-now-exceeds-pc-the-biggest-shift-since-the-internet-began` [Last visited: 30/06/2015].

[20] E. Navarro, V. López-Jaquero, and F. Montero. HABITAT: a web supported treatment for Acquired Brain Injured. *ICALT '08. Eighth IEEE International Conference on Advanced Learning Technologies*, pages pp. 464 – 466, 2008.

[21] F.J. Navarro, E. Navarro, and F. Montero. HABITAT: a tool for interactive activities in the treatment of Acquired Brain Injury. *Conference: Proceedings of the 13th International Conference on Interacción Persona-Ordenador*, page Article number 5, 2012.

[22] NeuronUp. Neuronup, 2012. Available online: `https://www.neuronup.com/` [Last visited: 30/06/2015].

[23] J. Nielsen. *Usability Engineering.* Morgan Kaufmann, 1st edition, 1993.

[24] F.J. Moreno Pérez and A. Aguilera Jiménez. Rehabilitación cognitiva en sujetos discapacitados mediante el empleo de nuevas tecnologías. el programa CyT-L. *II European Conference on Information Technologies in Education and Citizenship*, 2002.

[25] E. Protalinski. How Android beat iOS in 2014, and vice versa. *VentureBeat*, 2014. Available online: `http://venturebeat.com/2014/12/31/how-android-beat-ios-in-2014-and-vice-versa/` [Last visited: 30/06/2015].

[26] C.I. Delgado Santos and L. Pérez-Castilla Álvarez. *APPS gratuitas para el entrenamiento cognitivo y la comunicación.* CEAPAT. Tecnología y Comunicación, 2015.

[27] J. Sauro. Measuring usability with the system usability scale (SUS). Technical report, 2011. Available online: `http://www.measuringu.com/sus.php` [Last visited: 30/06/2015].

[28] B. Shneiderman and C. Plaisant. *Designing the user interface. Strategies for effective human-computer interaction.* Pearson/Addison Wesley, 4th edition, 2005.

Appendix A

Contextual observations

This appendix presents the contextual observations performed during the analysis phase of the project. Each one is presented with a description of the physical environment in which the observations were carried out as well as the tasks that were performed by the observed O.T. during the session. Information that was considered highly relevant is *italicized*, although not all of it has reached the final design.

A.1 Nursing home.

A.1.1 Physical environment

The contextual analysis was performed in a nursing home. The Occupational Therapist has a couple of rooms assigned specifically for therapy sessions, although a substantial part of her works takes place outside of them.

The larger of the two therapy rooms has many chairs and several tables as well as shelves with therapy tools (games, books, etc.) on one of the walls and a blackboard-covered wall. The smaller room has a few chairs and some computers to use during therapy. The rooms are connected and there is a small storage room next to the large one where the O.T. and the multicultural activity coordinator store other work equipment.

Individual sessions were carried out in the single rooms in which the residents lived. Each room visited was an en-suite single room with a large bed, a window and some other furniture (in some cases owned and brought in by the residents or their families).

A reasonably large amount of time was spent between the dining-room and the living-room, either helping residents around (to go to or come back from their rooms or therapy sessions) or talking to other workers to get updates or specific information regarding certain residents.

The O.T.'s office is part of the large therapy room, with a large desk, a computer and an organizer in a corner of the room. However, she reported spending a considerable amount of

time in the psychologist's office, where many discussions regarding residents took place and where the only printer available was located.

The offices and therapy rooms are located in the basement, the dining and living room are on the ground floor and the single rooms are on the higher floors.

A.1.2 Work shift

The first thing the O.T. does in the morning is meet up with the psychologist to discuss some of the residents they have been tracking lately, as well as those that have shown an unusual or critical (both positive or negative) behaviour. Weekend follow ups are read for some of these residents. It is a Monday, so the week's timetable is *adjusted* and printed. While discussing some of the information, the psychologist is reluctant to close a document on her computer for *fear of having to open it soon and not being able to find it.*

Every week the whole team (O.T., psychologist and social worker) carries out a series of individual reports on a small number of residents (each one is evaluated every six months), so they briefly talk about this week's reports. The O.T. *writes down* the names of the residents to be evaluated. *She carries these notes with her for the rest of the day.*

Next, she goes up to accompany many residents down to the dining room to have their breakfast. She *remembers to lead a resident* who has already had breakfast down to the physiotherapy room, due to his tendency to become very nervous if he has to wait very long. Many residents who have finished their breakfast are taken to the living room and a computer is set up with a projector to play some music for them. *It takes a while for the computer to start and to get the music working.* During one of these trips a *resident tells her it is her birthday* and that she is going out for the day.

During this time, she talks to the head of the nursing assistants to *find out who she must speak to* to get the information she needs for this week's individual reports. The names of the nursing assistants are *written down* on the notes mentioned earlier on. She also looks for the nurse to ask for some material she has run out of and *forgot to order more of.*

After this, she goes down to her office to print out last week's calendar (for future auditing) and to gather some information for the group cognitive therapy session she has later on. She *checks the database system on the computer* to find out the rooms of the residents she must go up to.

Once she is finished with the computer, she goes up to visit some residents in their own rooms, with whom she has individual therapy sessions. Most of them are similar, including a hand massage with some cream which smells of flowers which she uses to stimulate them and physical exercises that can be done in bed (typically hand and arm movements). She carries around a portable loudspeaker with a USB drive in which she has music to play during the sessions. One session was interrupted and was never completed later (the resident had left his

room) and another one was *postponed* (the resident wasn't in the room from the start).

While moving from room to room, the O.T. runs into one of the nursing assistants she must speak to and *writes down* what she tells her regarding a resident in the notes mentioned at the beginning.

Having finished all the individual sessions, she heads down to the living room and gathers the residents with whom she has group therapy. They all move down to the larger of the two therapy rooms, where they sit on chairs in a large circle.

The group therapy starts with the O.T. asking the residents what the date is and writing it down on the blackboard-covered wall. The session is divided into two parts:

- The first part consists of physical exercises the residents must do while seated: moving hands, feet, arms, legs, neck...
- The second part is a cognitive session: in this case, the therapist has prepared some information on Eurovision and gets the residents to engage in the conversation, talking of their own memories regarding today's theme. She *constantly searches for information* (text, audio, video...) that comes up during this group conversation.

A few distractions come up during the session (the phone rang once and a few residents arrived late), but she is generally able to continue the therapy without interruption, since it all takes place in the same room. She also has to *leave the room at one point to fetch the laptop*, which was in the living room, where it had last been used.

The session finishes at lunch time and residents go up (in some cases they are helped up) to the dining room. A *map of the dining room* has to be checked in order to seat one of the residents (nobody could remember her seat). Before she stops to have lunch, the O.T. has a brief meeting with the psychologist to talk about a new resident and to know how the sessions went today, sharing any problems that particular residents may have had.

After lunch, the O.T. uses the computer in her office to log reports into the database system the residence uses (Resiplus). She shows me how the system works and how she can *insert and share information among colleagues*, as well as call the roll on the system to write down *resident attendance*. She *relies on her memory* to remember notable events that need to be logged. She says she usually remembers everything, although she thinks she would have more trouble if she had to work with more residents in one day.

In addition to all this, the O.T. noted the relatively frequent use of standard assessment tests for evaluation of residents' condition and evolution. She also mentions how making her own short tests could be useful for tracking more specific aspects of her residents.

A.1.3 Conclusions

- The O.T.'s work here is very dynamic, with frequent trips from floor to floor and room to room, with her destination at each moment easy to forget or mix up.

- There is a high level of collaboration and reliance on the work of her colleagues (psychologist, social worker, physiotherapist, etc.).
- A general timetable is used each week, with each individual time slot prone to inside changes (for example, the order in which the individual sessions are performed change depending on different circumstantial factors each day).
- Cognitive therapy and stimulation tend to have a medium-to-high reliance on the use of technological devices, typically the laptop, which can become cumbersome to carry around the residence.
- There is a very high reliance on memory for future reports, which could lead to occasional errors in the reporting system (incorrect or incomplete data).
- Reminders could become helpful for certain tasks, due to how easily one's current action can become interrupted to help with or manage a problem with a higher priority.
- Having to go down to the computer to quickly check some information (for example, the location of patients' rooms) can amount to quite a lot of time and energy wasted that could be avoided if all the information could be carried around.

A.2 School.

A.2.1 Physical environment

This contextual observation was carried out in a children's school. The occupational therapist uses various rooms in the building, depending on the group she is working with and the availability at each time. The two work shifts observed took place in two different rooms: a classroom and a psychomotricity room.

The classroom is an ordinary, medium-sized classroom, with several groups of tables arranged in squares, with 6 to 8 chairs per group. The walls are covered in posters and drawings, and there are a few lockers with toys, most of them in a corner of the room. About a third of the room has its floor covered with soft mats, and this is where the therapy sessions took place.

The psychomotricity room is much larger, between two and three times the size of the other one, with only a few tables and chairs on one side and the rest of the floor cleared to be used for games and exercise. Half of one of the walls is covered in mirrors, while another one is mostly taken up by large floor-to-ceiling shelves, where most of the materials used are kept (building blocks, ropes...). In one of the corners there is a pile of soft mats, together with big soft blocks with different shapes, made of the same material. A big basket, next to the tables and chairs mentioned earlier on, is filled with balls and poles.

A.2.2 Work shift

As was mentioned above, the observation took place during two different work shifts: the first one was three hours long, consisting of *three different sessions* with a *different group of children each time*, lasting around an hour each; the second one was two hours long, corresponding to two sessions, again about an hour each.

The O.T. meets up with the parents or the teachers (some sessions take place during school hours) at the beginning and end of each session, sometimes speaking to some of them about any *updates or incidents* that may have taken place. Once all the children have arrived, they all walk to whichever room the therapy session is going to take place in and get ready (take off their shoes, go to the bathroom first if necessary...). Meanwhile, the O.T. gets her things ready, chatting to the children, asking about their day, *the last session* they had together or what they feel like doing today.

After everyone is ready, they start the session. Each observed session consists of 5 or 6 different activities, some of them related to previous ones and some reusing materials they have been using during the session. The O.T. had explained to me previously that she would typically have *some plans* regarding the activities she is going to perform each time, but it all *depends on the children's moods*. Because of this, she would not usually spend any time writing down any plans for following days, simply having a few ideas in her head as to what she would like to do each day.

First day

The first and third sessions performed during the first day consisted of six different activities, while the second one had five. They are typically presented to the children as games, in order to get them to participate more willingly.

The first session, which took place in the psychomotricity room, consisted of the following activities:

- A simple game of tag, where the game area is limited by a line of cones dividing the room in half. However, the children soon start to ignore this division and after a while they get tired of playing and pretend to fall asleep and stop running around.
- A game for developing balance, where the children ride a semicylindrical soft pad as if it were a motorbike and the O.T. tries to get them to fall off by rocking it. After a while, the children take turns to help the O.T. rolling it around while the rest try to stay on it.
- Each child is assigned an ingredient and soft pads are used as slices of bread: the O.T. then selects ingredients to make a sandwich, piling them up and closing it with the pads.
- A kind of free-for-all tag where the children try to eliminate the rest by hitting their backs with pillows.

- Tug o' war, played several times with different teams (including the O.T.).
- Building a house with soft blocks and later breaking it down.

During the second session we moved to the classroom described earlier, where the games played were:

- Air-land-sea: a bench is set in the middle of the pads and the O.T. says out loud one of three words, "air", "land" or "sea". For each one the children must get into a different position: on top of the bench, below it or simply standing on the soft pads.
- A small slide is built with the soft pads and a table for the children to go down taking turns.
- Spring rolls: each child is rolled up in one of the soft pads, pretending to be a spring roll. They must then try to wriggle out of the pad on their own.
- Plastic food is mixed up and hidden inside a box of lentils. Each child must then sit down with his back to the box and, without turning completely around (simply rotating their upper body), feel their way inside the box with their hands to extract the food and give it to the animal toys they have chosen.
- At the end of the session, each child gets a massage with a ball while trying to keep relaxed and quiet.

The activities performed in the psychomotricity room during the third and last session of this first day were the following:

- One child starts by improvising some move (such as a jump, a kick in the air, getting on his knees...). The next one must copy this move and invent a new one after that. The following child must repeat the previous moves and add a new one at the end, and so on and so forth.
- The children have to race from one end of the room to the other while crawling.
- The children all lie down on the floor at a distance from each other and try to roll a ball around, passing it to each other, first saying the name of the person they are going to roll it to.
- A net with a ball inside it is hung from the ceiling and the children, who are arranged in a circle, try to hit it with a pole to pass it around.
- The children form a circle around a small trampoline, with one child bouncing on it (they take turns to do this). The rest sing a song while passing a ball around.

- Two or three dozen hoops of different colours and sizes are spread on the floor around the room and the O.T. *puts on some music*. The children must hop around the hoops while the O.T. starts removing them one by one. When she stops the music, she says a colour out loud and the children must find a hoop of said colour and jump inside it. Whoever is left without a hoop is eliminated (similar to musical chairs).

Second day

The first sessions carried out on the second day had six activities, while five were performed during the second session. Once again, each activity is explained to the children as a game.

The same classroom was used as the previous day for the first session, in which the O.T. and the children played:

- Bouncing around on hop balls *with music*, stopping as soon as the music stops.
- Rocking on a semicylindrical soft pad (see the second activity performed during the first session on the first day).
- Pretending to be sandwich ingredients (see the third activity performed during the first session on the first day).
- Treasure cave: they hide beneath a blanket and pass around small sacks with different weights inside. The last child puts them inside a box (the treasure chest). It later develops into another game where the box is set at a distance from a table, from which the children throw the sacks to get them into the box.
- Little balls with a hole in each one are picked up with a small stick and fit onto a small plaque with holes on it. The balls have different colours, so the children try to make small drawings.
- A small plastic toy kitchen is used to pretend to cook and then some invisible drinks are served around.

For the final session, we went over to the psychomotricity room, where the activities carried out were:

- A swing is hung from hooks on the ceiling, with one child getting on it and swinging back and forth. Another child is positioned in front of the first one, at a certain distance, waiting with a large bouncy ball. The latter rolls the ball over to the former, trying to time it so that he can kick the ball while swinging forward.
- Taking turns, the children lie down on the swing (facing down) and try to swing around in circles.

- Again face down while lying on the swing, the rest are divided into two groups, with one of them having the sacks used in the previous session. The one on the swing tries to move from one group to the other, acting as a messenger who passes the small bags from one group to the other.
- The soft pads are piled up and moved around together with the soft blocks, with each child constructing a simple slide for all of them to go down.
- One child pretends to be a wolf, while the rest are positioned on one side of the room. The children then ask out loud "Wolf, wolf, what time is it?". The wolf then announces a number of hours and the rest must take the same number of jumps with their feet together. This is repeated until they all cross the room.

In addition to all of this, the O.T. would do a great deal of additional work on her trips to and from the school (between three and four hours a day) and by having occasional meetings with some of the parents of the children she worked with, as well as extra work she might do at home. I was able to gain some more insight into how she worked at these times and to extract some helpful facts:

- She is in contact with the children's parents and with her coordinator both *by phone and in person.*
- The use of standardized tests is not very common, with a great deal of evaluation information being gained simply through observation. However, she will sometimes use some tests, such as one called the *Sensory profile*, although they might be used in a *more informal manner*, due to a lack of time and resources.
- She keeps most of the information she collects in her *tablet computer*, typically keeping a Word document per child where she includes *evaluation results and specific events* she might want to record for some reason. She will occasionally elaborate documents summarizing some of this in a comprehensible manner so that the child's parents can understand how the therapy is progressing and what information is being gleaned.
- The main things she keeps tabs on are: any relevant *observation made during a session* (*not per activity*), particular events or changes, *attendance* at therapy sessions, each child's group and timetable, family contact information, dates of each exchange made with each family (e-mails, meetings, etc.) and *assessments performed* (results and date).
- Her coordinator, together with the teachers, will determine which children can benefit from occupational therapy, after which the O.T. will have an initial interview with the

child's parents, where she would explain what she does and they can tell her what they have seen in their child's behaviour. An *initial evaluation document* is usually filled in at this point by the parents to give the O.T. their impression on the matter and allow her to get a better understanding of the situation with the new child.

A.2.3 Conclusions

- Although not as constant as was seen in the nursing home (see previous section), the O.T. has to move around quite a lot during her shift, mostly at the beginning and end of each session, when she accompanies the children back to their parents or teachers or collects them to take them to wherever therapy will take place.
- Because of the previous point, she needs to be able to move around easily and comfortably. She is also very aware of the limitations imposed on her by having to use public transport to go to and come back from work, making it very cumbersome to carry any heavy objects used for therapy.
- There is a fixed weekly timetable which determines the groups the O.T. works with and the time and place for each one.
- Planning individual sessions each day is not as useful as one would usually expect, due to the fact the some of the children might be in a bad mood and may decide that they do not want to participate in some of the activities.
- Groups are relatively small (those seen during the contextual observations had between two and six children each), so that the O.T. can more easily modify any plans she might have made regarding the activities she is performing in order to have everyone join in (and thus solving the problem explained in the previous point).
- It is important to take attendance, so that further on it is possible to determine whether the progress being made is what is expected and is adequate.
- Standardized tests can sometimes be too resource- and time-consuming, whereas smaller, more informal and adjusted versions can become feasible while still being useful.

A.3 Foundation

A.3.1 Physical environment

The third and final set of contextual observations made took place in a foundation dedicated to the education, training and integral development of people of all ages intellectually and

developmentally disabled. Four days were dedicated to this centre, where the different activities performed and the work with people of each age group was shown.

First day

On the first day the observations were carried out with two different groups: the first one consisted of people aged 45 and over and the second one was at the occupational centre, in a workshop for adults of all ages.

The work with the first group is done in a big, open room with different areas. As soon as one comes into the room, one faces the foundation's printing, photocopying and other reprographic services centre. At the far end, one corner has a group of chairs and sofas where group communication sessions take place and another corner has a few chairs and tables, together with folders, files and computers used by the O.T.s and their co-workers. A small room off the larger room, also used by the health professionals. Finally, the rest of the room is mostly taken up by tables and chairs separated into a few groups, where the patients spend a great deal of their time during therapy hours.

The workshop where the second group works is a fairly simple room, with a set of tables and chairs for the patients to work at and a few cupboards and cabinets where most of the materials are kept. There are also several old pieces of furniture around the room, waiting to be restored (it is a furniture restoration workshop). Separate from all this, next to the door, there is a small table with a chair and a sofa next to it, where the O.T. can do whatever she needs to do for her job that is not concerned with furniture restoration (mostly paperwork).

Second day

The second day was spent again at the occupational centre, this time with a different group which was given support for more specific situations.

The first part of the day was spent in a small room with a few tables set together and chairs around them. Large cabinets along one of the walls are used to keep the materials for the therapy sessions (mostly games, cards and notebooks) and the end of the room has a single table and chair with a computer, used as a small office by the O.T. The rest of the day was spent at some padel tennis courts nearby.

Third day

I was shown around the day centre on the third day, and accompanied the group on the scheduled morning trip to an environmental education centre close by.

The day centre has a main room at its entrance, with many chairs and sofas along the walls for everybody to sit down on first thing in the morning while the O.T.s and other co-workers discuss and plan the day's events. A hallway leads out from the room to several smaller rooms

(the communication rooms), where the patients go once they have been divided into smaller groups. The communication room I was led to had several chairs and tables, cork boards on the walls with photos and drawings, a tap and a microwave for snack time, a few cabinets and a large floor-to-ceiling shelf on one side.

The environmental education centre we went to consisted of many small gardens where different plants were grown, including flowers, fruit and vegetables. There are information panels around the area and a few sheds or tool cabinets, as well as material to be recycled for different uses in the gardens.

Fourth day

The observations on the last day took place in the education centre, with the students aged 16 to 21, who are being prepared for adult life.

This observation all took place in the same room, which was in fact the classroom where the students were taught during the year. It is similar to a primary school classroom, with cork boards, calendars, drawings and photos on the walls, as well as several cabinets where teaching material is kept. On one side of the room there are a few office products (paper shredder, binding machine...) and there is a small computer station for the teacher on another side of the room. There are also folders kept, one for each student, with documents filled in by the teacher, the students or their parents.

A.3.2 Work shift

First day

The morning started with the group having a communication session in the sofa area (see physical environment described above), followed by academic ability sessions, which are interrupted by a break for a mid-morning snack. Every day, six people from the group (not always the same six, they rotate) have some activity outside the centre (such as swimming).

Those that stay are divided into smaller groups, each one sitting at the small sets of tables spread around the room. The *activities vary both between groups and inside each one*, since each person has individual needs and capabilities: some fill in *reading and writing*, *attention or memory* activity pages, others simply paint *drawings* they are given and other make their own drawings. The photocopies they are given are *eventually repeated*, although they might receive different instructions each time as to how to deal with them. Arts and crafts activities are also common, where they have made bracelets and necklaces, as well as piggy banks and other decorative items.

The O.T. works together with a psychologist, and at the time also had an O.T. student helping and learning how they worked there. As mentioned, a great part of the materials they work with are photocopies and have been used repeatedly throughout the years, and it was

mentioned how it is *hard to find anything that is not themed for children.* After they are filled in, they are kept in a binder, one per patient, where they can be consulted later on (however, it cannot be endlessly kept, as it eventually takes up too much space, so that once in a while *space is cleared and some of the pages are thrown away*).

Although some of the patients prefer to write on paper, which helps them to get a sense of accomplishment, *others have tried out and enjoyed using tablet computers* on a few occasions and would like to use them more often (this section of the foundation has a tablet computer, but they have a *bad WiFi connection* and rarely use it).

I was explained that their work centred around what they call Individual Development Plans (PDIs, for their phrasing in Spanish, Planes de Desarrollo Individual), in which each person attending the centre sets a series of goals they would like to pursue during the year, with the foundation helping them to achieve them. Other than some basic information and the aforementioned binders, no more data is recorded regarding the patients by the O.T., with the psychologist collecting anything relevant to the PDIs and to be presented during the next follow-up meeting.

At midday I went over to the furniture restoration workshop, where the O.T., another O.T. student and the patients were all busy at work sanding, varnishing or painting. The patients are separated into smaller groups, according to their skills and what they enjoy working on most.

The O.T. here explained that they also use PDIs, although they had *no systematic collection of data* and tended to simply keep any relevant information in their heads, getting to know each person gradually. She is assigned the position of workshop master and has monthly or bimonthly meetings with the masters of other workshops and the group delegates, as well as meetings with a social worker, a psychologist and each patient to do *follow-ups* on the latter's PDI.

Second day

The work shift on the second day at the foundation was briefer than the rest, due to the fact that it was the first day after a holiday and there were still a lot of people who had not returned yet. Only the first of the usual therapy sessions was carried out, where two out of the usual five patients attended. The O.T. was working with one of the two, helping with a *memory card game* she was playing, while watching the other patient, who was trying to copy a small construction made of building blocks using the rest of the blocks that were left.

Once the session was over and after seeing how few people had come to the centre today, the O.T. and the rest of the co-workers decided to put them all together in one group and take them to the padel tennis courts nearby, where they take classes some mornings, although in different groups and timetables.

As in the other sections of the foundation I had been at, the O.T. told me that they also

followed the PDI plan, having at least one meeting for it once a year, as well as smaller follow-up meetings every two months with a psychologist and a social worker. With regard to the PDIs, patients can choose to attend different seminars where they can learn things they have declared an interest in at the beginning of the year when establishing their PDI. There are also workshop meetings, although several therapists have gradually been changing this so that meetings are centred around a patient rather than a whole workshop group.

Although the O.T. knows about several *different evaluation documents* that can be used to follow up on patient progress, he explained that *many of them were not completely adequate* for some of the patients he worked with.

As for day-to-day activities and planning, there is usually a fixed *timetable which is established every semester*, where the different workshops and seminars are organized. An O.T. would usually work with more than one group every day and he or she would *take attendance* each time to know who has been missing often and how this is affecting their progress. The O.T. I was with, who worked as a support worker, would meet up with the other two support workers every Monday and Friday to discuss the patient each one is supposed to keep track of (they do not work with each one all the time, since the groups move around for different activities).

Third day

The third day, at the foundation's day centre, began with the different co-workers (O.T., psychologist, special needs teacher, etc.) organizing the day's activities, while waiting for everyone to arrive. After this, they divide into smaller groups and have communication sessions, where they *take attendance*, talk about what they are going to do that day and what they are eating for lunch later on, as well as determining what the date is (which helps them to situate themselves in time). Some pictures were also shown with examples on a sign language the centre has developed, which they teach to many of the patients so they can communicate easily if they find it hard to speak.

Once this is finished there is a break for a small snack (breakfast for some), after which the activities start. Each day there would typically be two activities, lasting around an hour each. Some days, however, a bigger activity is organized that will take up the rest of the morning. On the day I did my contextual observation we did the latter: a field trip was organized to an environmental education centre nearby, where they had planned for some weeding and planting.

Back at the day centre, the workers keep a common *incidence notebook for any serious events*, with some of the more disruptive patients having a separate file dedicated to them. They were also at some point discussing some of the *patient's diets*, to make sure they were being given the correct food at the centre and to speak to the kitchen workers for any adjustments if necessary. In addition to all of this, each patient carries a diary where they keep track of what they eat at home and at the foundation, which can also be used to communicate between the

health professionals and the families.

Fourth day

The last day was spent at the education centre, with a group of students aged 16 to 21 who were being prepared for adult life. They have various subjects that help them both academically and in their everyday lives, including mobility, *reading and writing*, *spatial orientation*, *time orientation*, *mathematics*, *money management*, household chores and emotions, as well as times for everyone to talk about whatever they feel like. They also have sports and other outdoor activities, performed with a different teacher, not the O.T.

On the day I was there, the O.T. worked with the students on something they called "intimacy circles", through which the students learn what kinds of relationships they can have with the different people in their environment and how each one (both the students and the rest of the people) should behave in each case. After this, there was a group discussion where each student talked about what they would like to work as, who they would like to live with, what they would like to do with their free time, etc.

There are several professionals working with each student other than the O.T., such as physiotherapists or speech therapists, and each one will write an *evaluation report* regarding each student's objectives and the progress that has been made during the school year. These are given to the O.T., who acts as the class's overall supervisor and is in charge of gathering all this information and sending it to the student's parents.

As was seen in the rest of the foundation, the PDI system is also followed here, with the students determining what their dreams and goals are and what they would like to achieve during the school year that is about to start. This is kept in each student's information folder, together with the minutes of the meetings and evaluation reports (there are usually at least *three each year*, at the beginning, middle and end, with some filled in by the O.T., some by the student, some by the parents and some by more than one).

A.3.3 Conclusions

- The whole foundation works around Individual Development Plans, where each patient determines what their dreams and goals are for the coming year or further on, and the centre tries to help them to progress as much as possible towards achieving them.

- There is a high amount of collaboration between the O.T.s and the rest of the health professionals in the centre (social workers, psychologists...).

- Each section in the foundation (day centre, school, etc.) has a weekly timetable which is usually fixed for every six months or longer, although the individual plans inside each

time slot can vary partially or fully (in some sections part of the day is always the same and in others all the activities are fixed).

- In some sections they carry out evaluation reports using certain documents and tests, but others do not due to the inadequacy of the documents to their patient profiles.
- There is a great variation on how patient progress is managed and recorded, depending on the section: in some places there is little or no recording other than basic information (name, age, family contact information...), with the O.T.s and their co-workers taking mental note of overall progress and particular events; in others notebooks are kept for recording individual incidences outside of the usual or tolerable; and other keep large folders with abundant information on each person, writing reports periodically to keep the families informed.
- While some of the O.T.s work with the same group of patients every day, some of them will work with a different one each day, or even with many groups on a single day.
- Attendance is usually taken every day to keep track of how long people are missing from the foundation and to take action when necessary. Because of the previous point, this might be done an by O.T. once or several times a day, depending on the number of groups each one works with.
- In some cases, the materials used for certain activities are limited or not completely adequate for the patient's profile, so that they may become repetitive or might not be as beneficial as they should be.

Appendix B

Survey results

This appendix presents a series of tables which sum up the results obtained from the survey that were not included in this document's analysis section.

B.1 Section

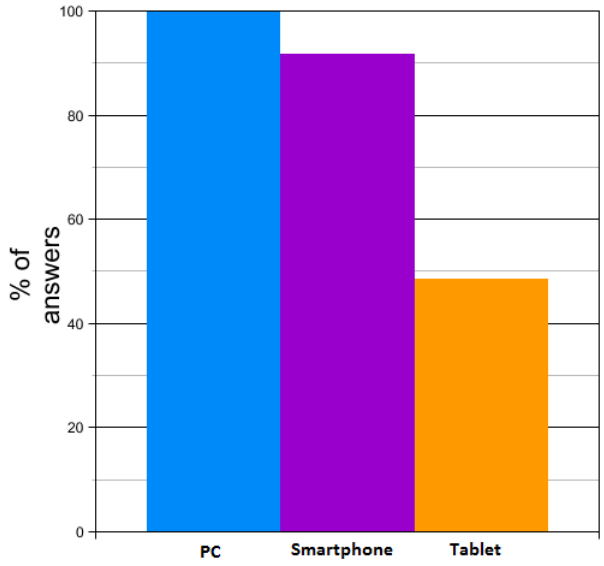

Figure B.1: Personal use of devices

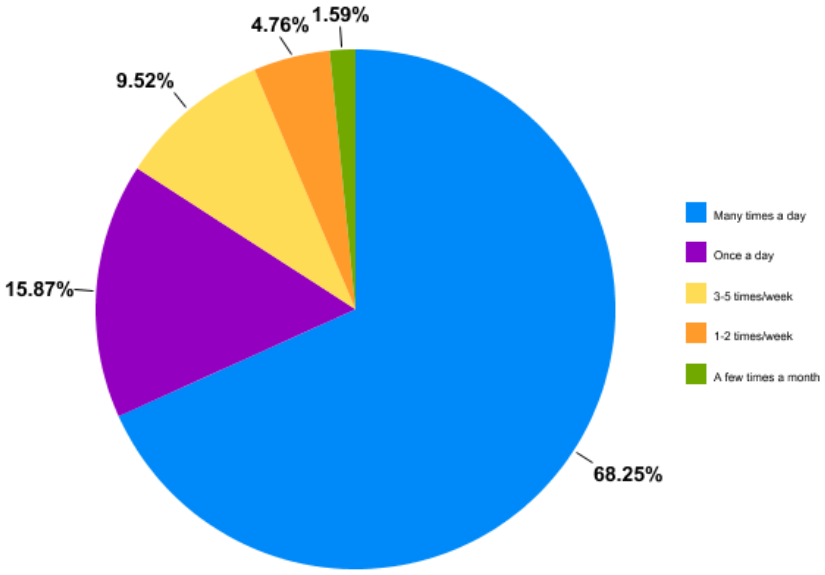

Figure B.2: Personal use of a computer

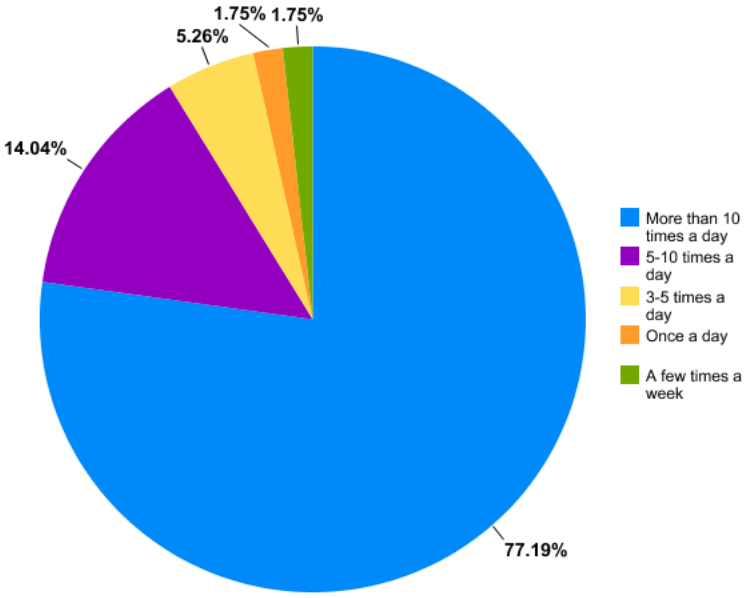

Figure B.3: Personal use of a smartphone

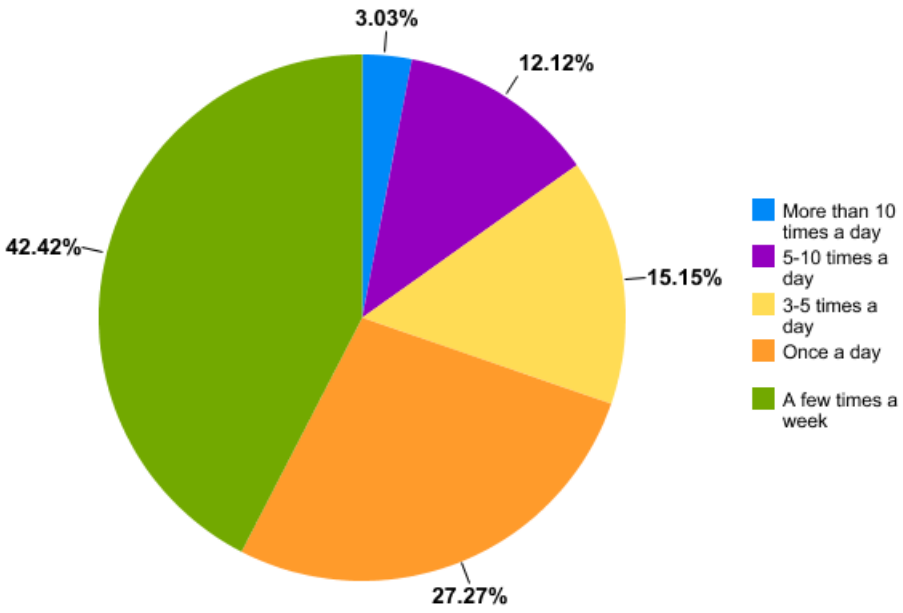

Figure B.4: Personal use of a tablet

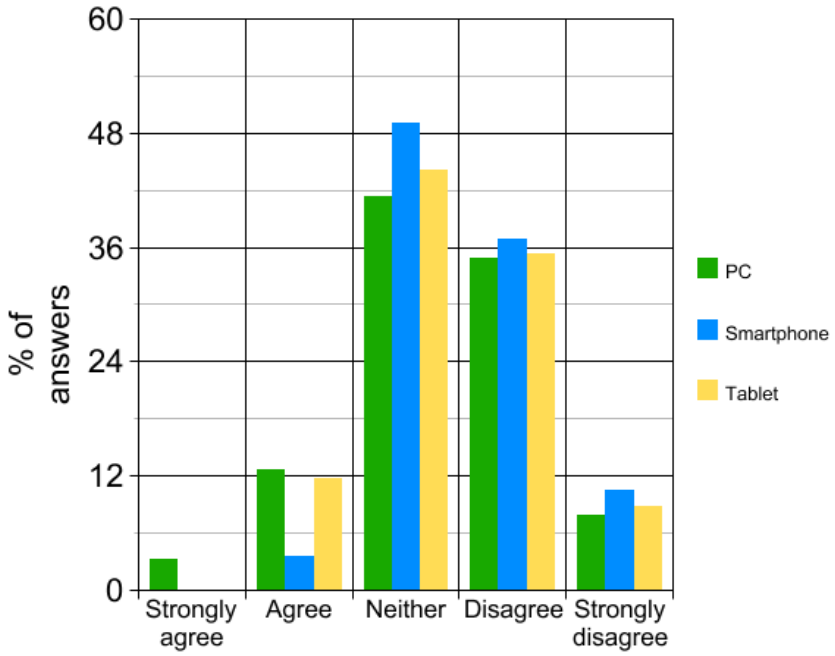

Figure B.5: Devices cause problems to the users

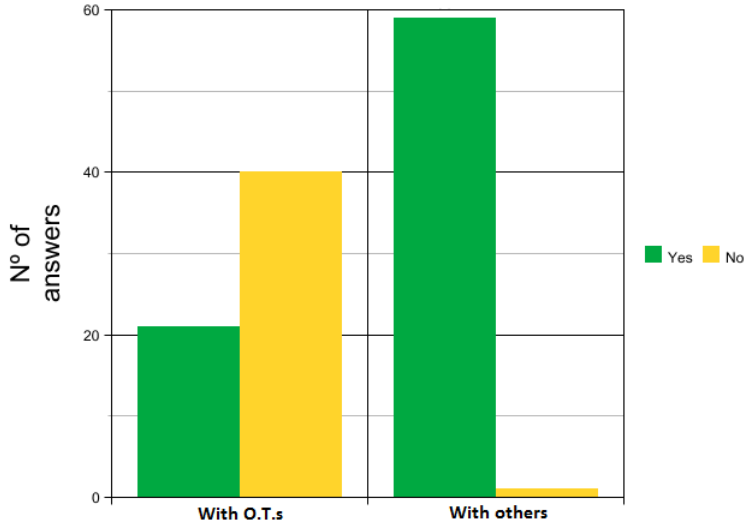

Figure B.6: Coordination with other workers

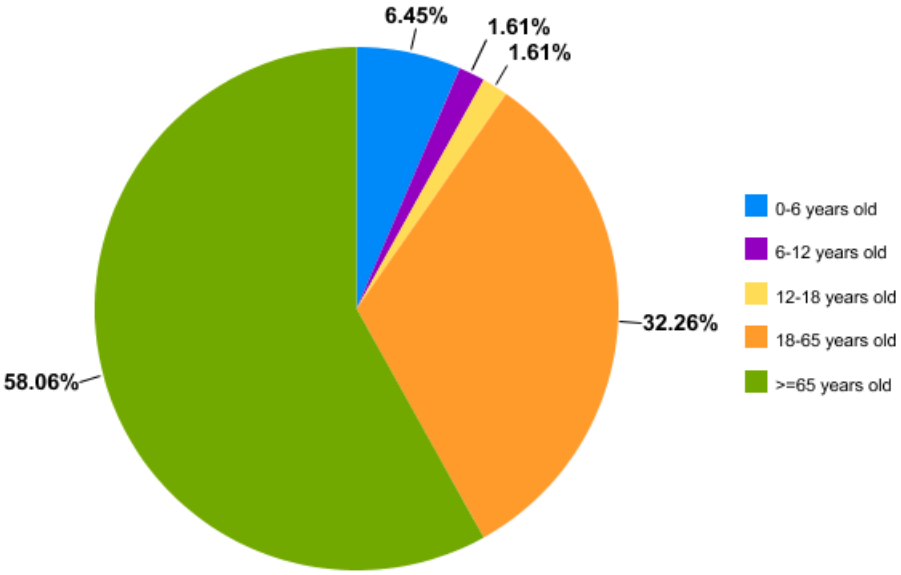

Figure B.7: Age of patients

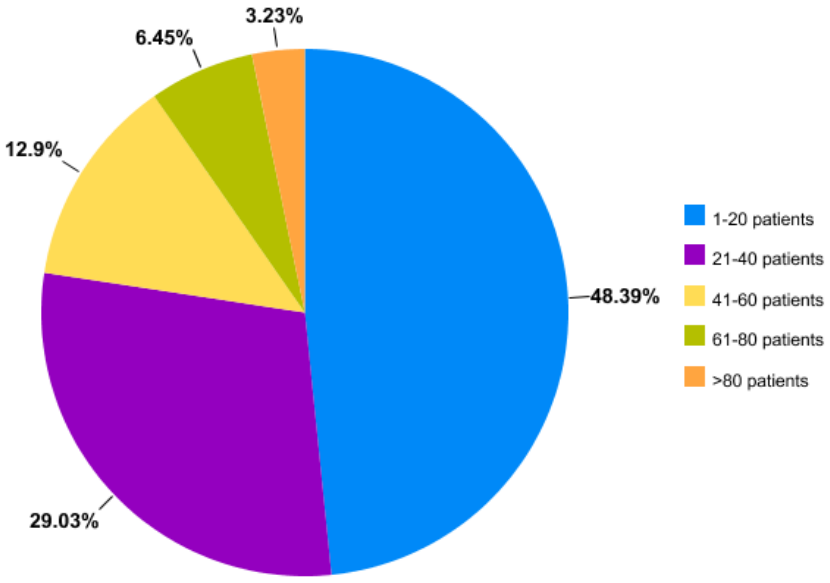

Figure B.8: Number of daily patients

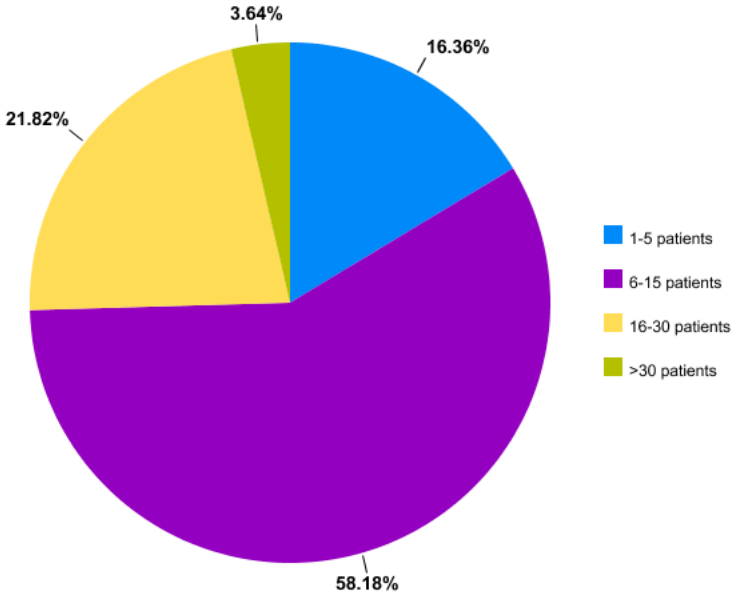

Figure B.9: Size of patient groups

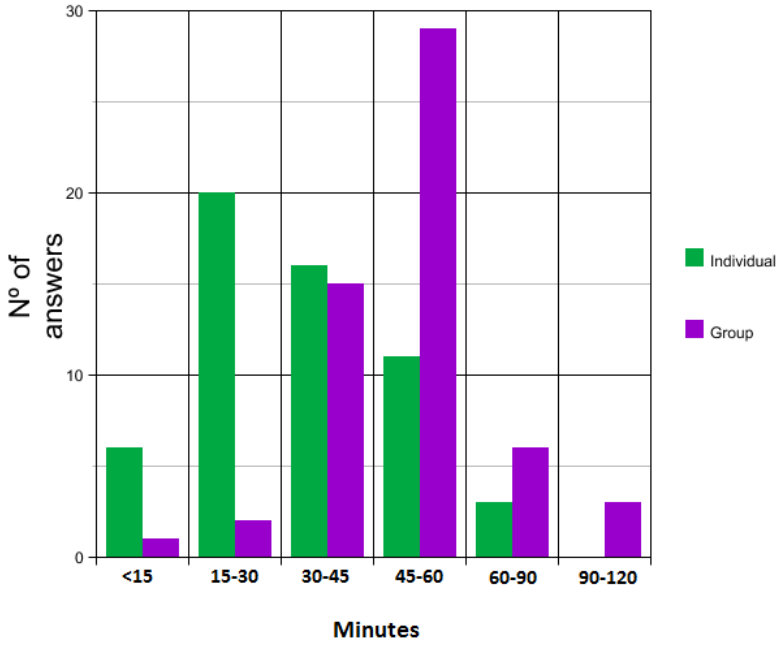

Figure B.10: Duration of sessions

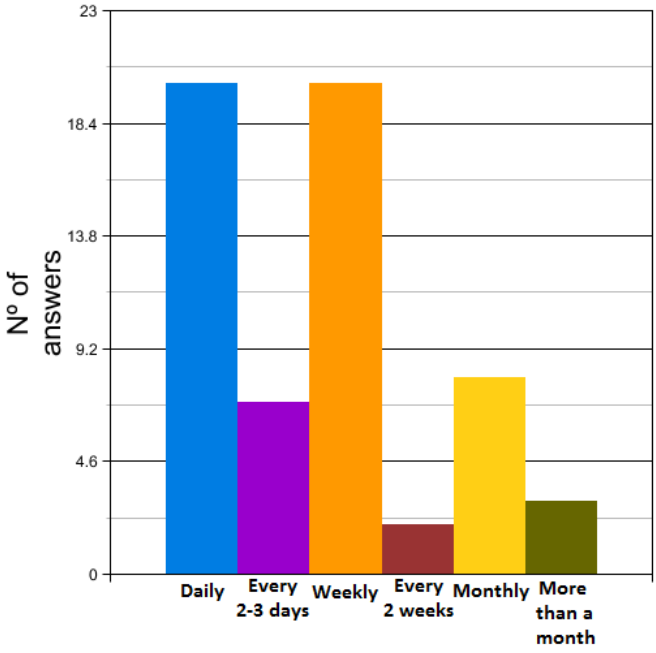

Figure B.11: Frequency of schedule planning

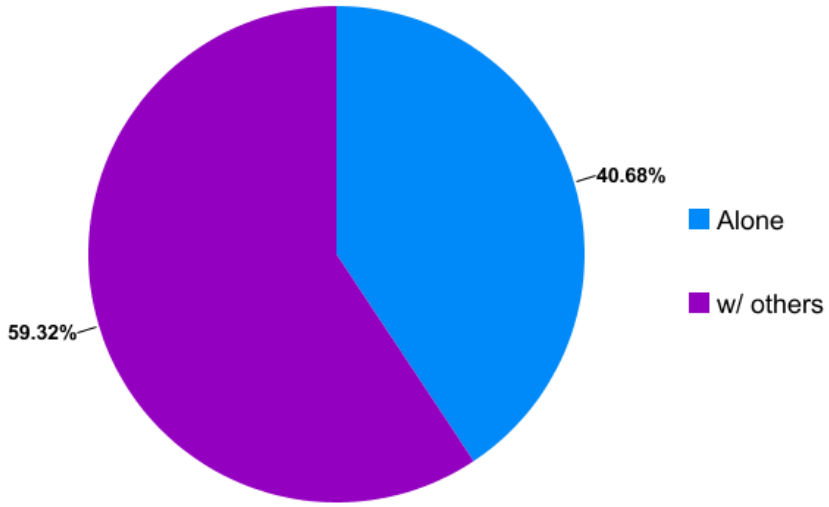

Figure B.12: Coordination of schedule planning

Appendix C

EER diagrams

This appendix includes the EER diagrams that were not included in the main body of the text.

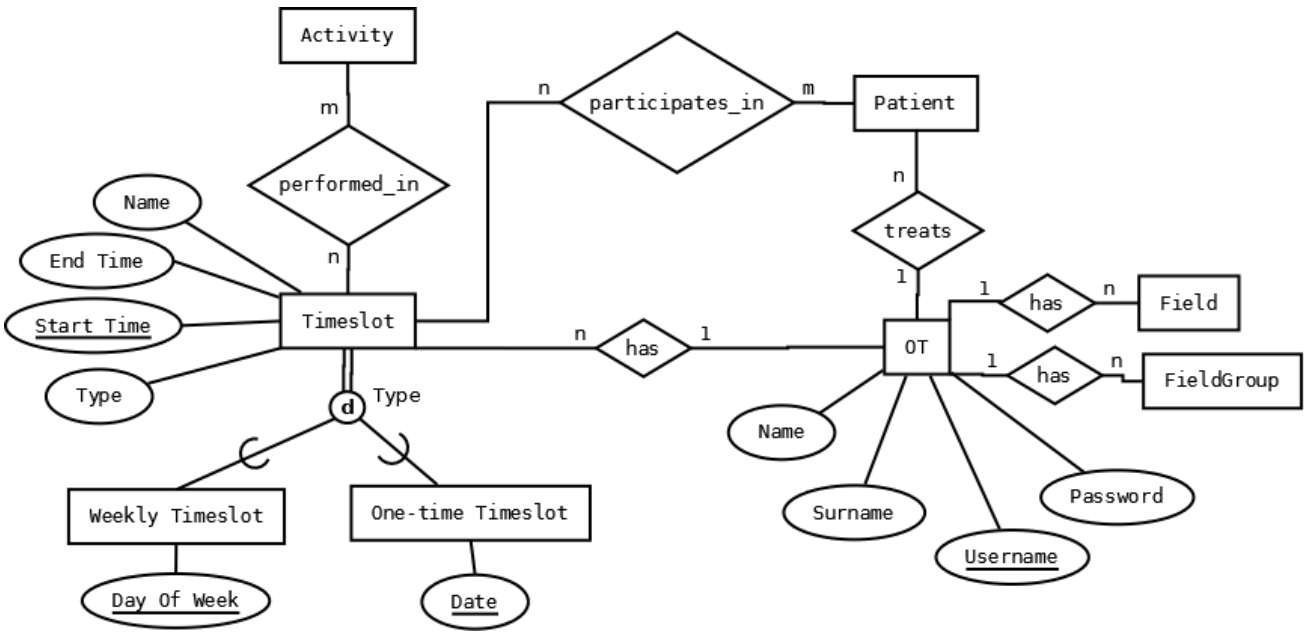

Figure C.1: EER diagram for the schedule section of the system, settings and O.T. accounts.

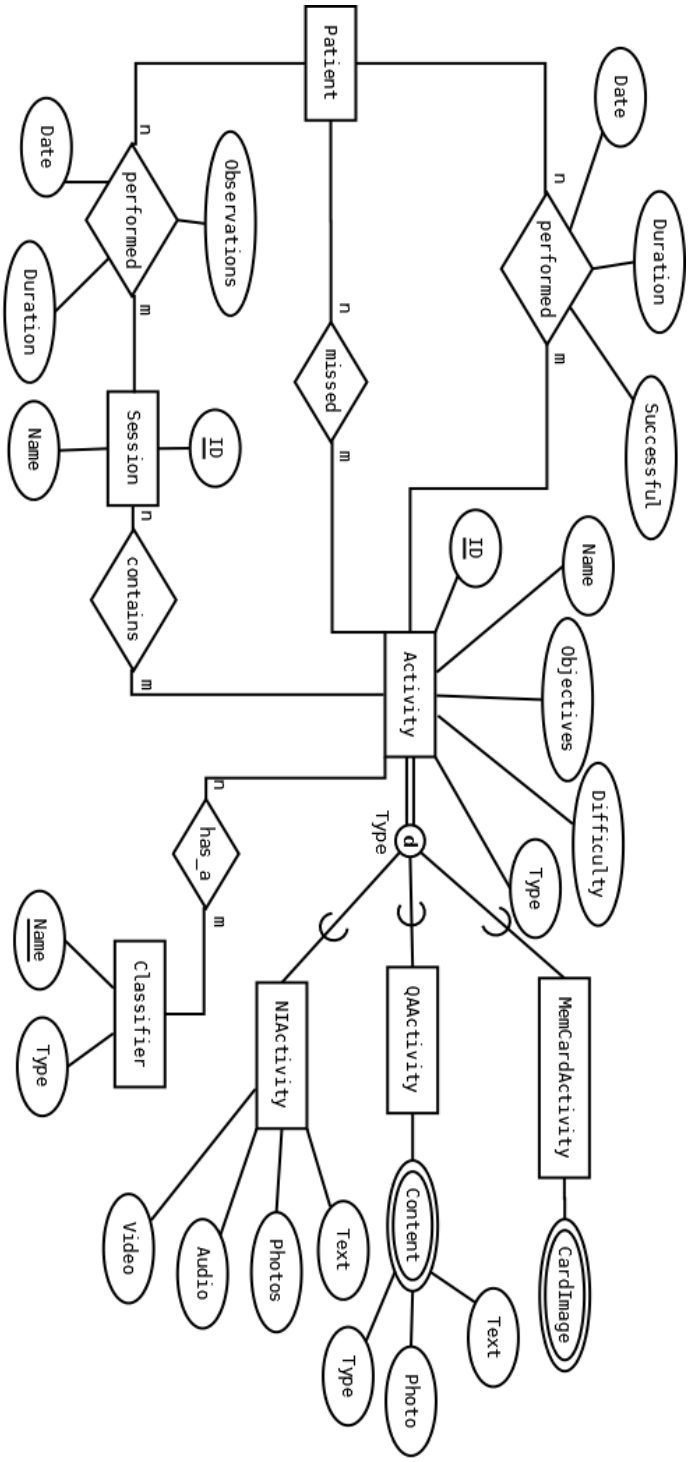

Figure C.2: EER diagram for the activities and session section of the system.

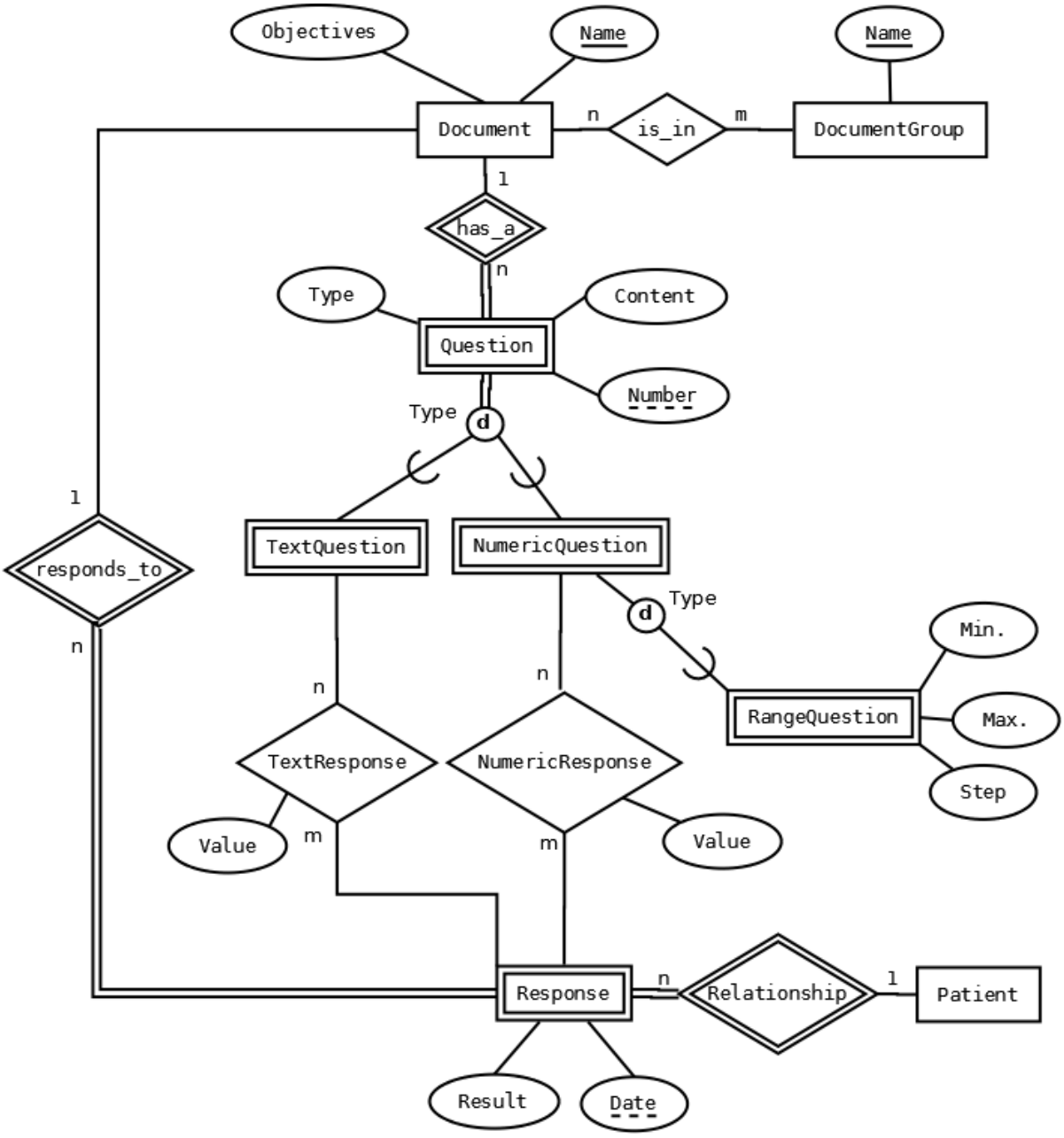

Figure C.3: EER diagram for the assessment section of the system.

Appendix D

Interface design

This appendix groups the documents elaborated during the interface design process, including conceptual models and screen design standards.

D.1 Conceptual model

Following this paragraph are the hand-drawn sketches of the first conceptual model developed during the course of this project, where the main goals pursued were checking the appropriate translation of the task organization model into a user interface and a set of navigational paths that seem correct and do not confuse the user.

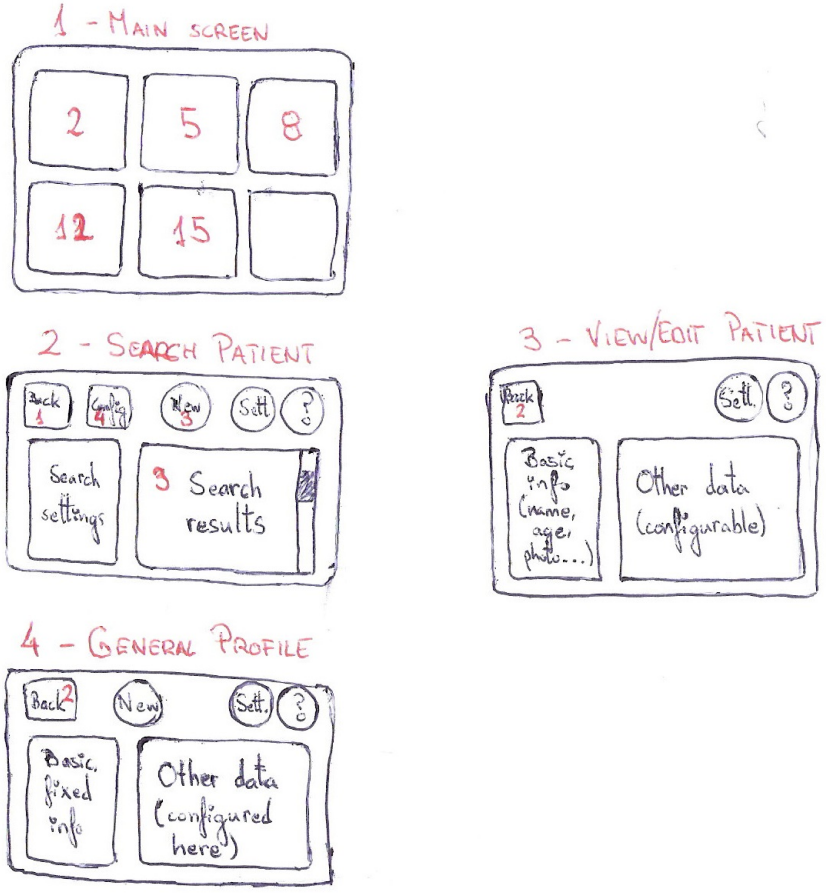

Figure D.1: First conceptual model - Main screen and patients

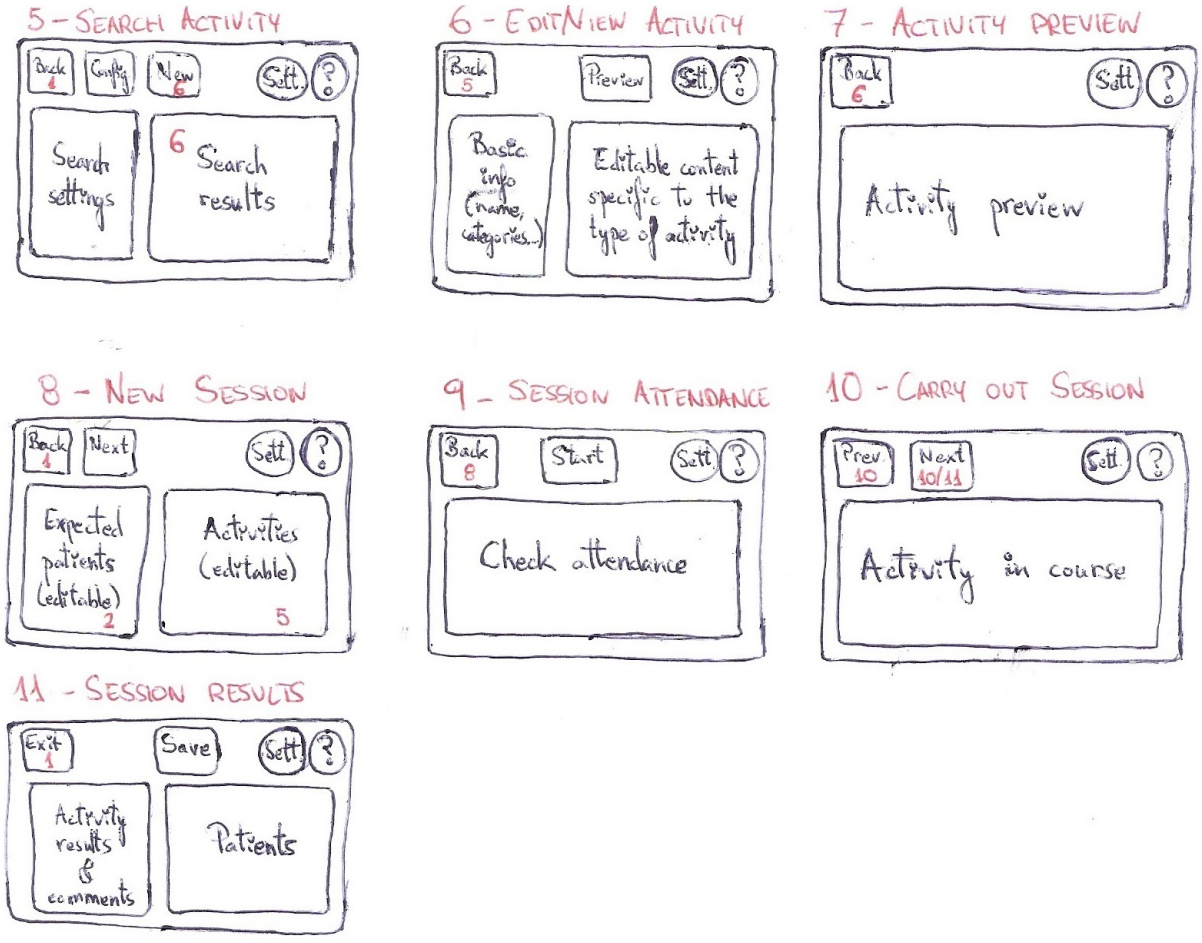

Figure D.2: First conceptual model - Activities and sessions

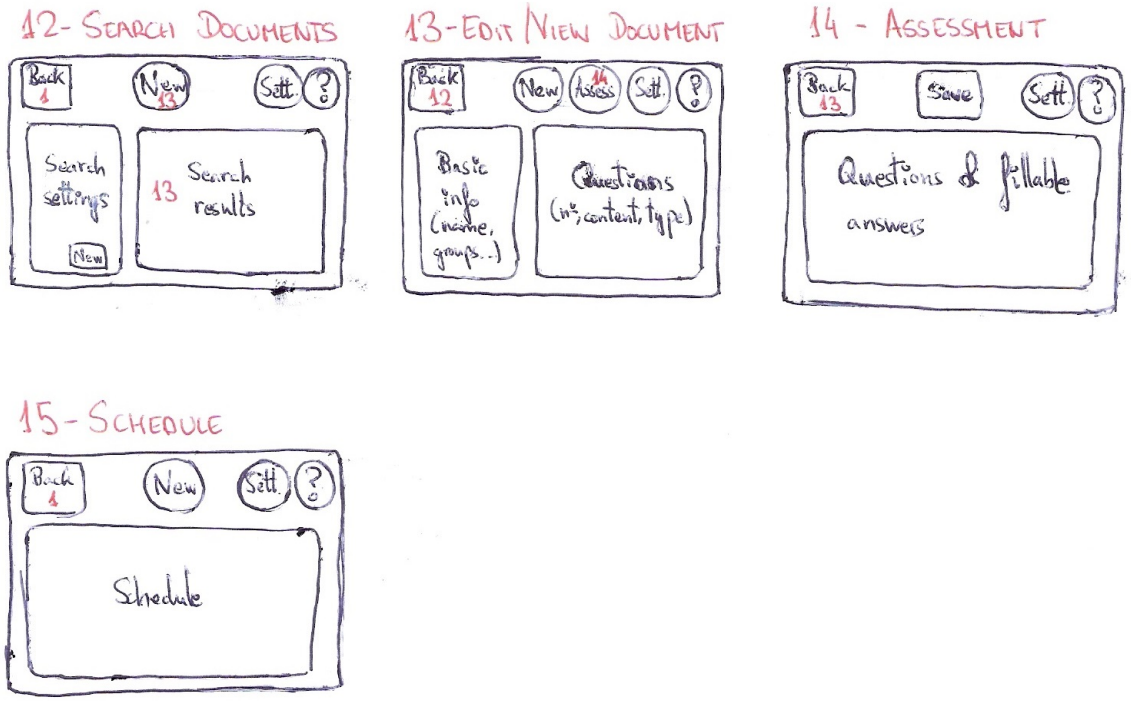

Figure D.3: First conceptual model - Assessment documents and schedule

Appendix E

Use cases

A series of use cases have been included in this appendix describing some of the core functionalities offered by the system, other than the session case shown in 4.4

E.1 General profile configuration

- **Primary actor**: occupational therapist.
- **Stakeholders and objectives**:
  - Occupational therapist: wishes to configure the kind of information she will be able to store for each patient.
- **Preconditions**: the O.T. has logged into the system and navigated to the appropriate screen.
- **Postconditions (success guarantees)**: new fields are created with the names and types specified by the O.T., which become part of the description of every patient the O.T. manages.
- **Basic success flow**:
  1. The O.T. selects the *New field* button.
  2. The O.T. inserts the name for the new field and the type of content it will accept (text or numeric).
  3. The O.T. selects the *Accept* button.
  4. The O.T. goes back to step 1 if she wants to add any more fields.
  5. The O.T. selects the *Finished* button.
- **Extensions**:

  a) The O.T no longer wants to create a new field.
  * At any time before the *Accept* button is selected, the O.T. can select the *Cancel* button.

  b) The input name is invalid.
  2. The O.T. inserts a name for the field that is already in use.
  3. The system informs the O.T. of the problem and asks for a different name.
- **Special requirements**:
  - The system must show the new field on screen almost instantly.
- **Frequency**:
  - Very often at the beginning, when the O.T. is setting up the application for the first time. Very rarely afterwards.
- **System extensions**:
  - New types for the fields, other than numeric and text, such as audio or photos.

Figure E.1: Use case: configuring the general profile

E.2 Create a patient

- **Primary actor**: occupational therapist.
- **Stakeholders and objectives**:
  - Occupational therapist: want to insert a new patient into the system to administer his or her information in a unified manner.
  - Patient: is being treated by the O.T. and is interested in being included in the registry so that his or her information is properly maintained.
- **Preconditions**: the O.T. has logged into the system and navigated to the appropriate screen.
- **Postconditions (success guarantees)**: the new patient is successfully inserted into the system.
- **Basic success flow**:
  1. The O.T. selects the *New patient* button.
  2. The O.T. inserts the new patient's basic information (name, surname and age).
  3. The O.T. selects the *Accept* button.
  4. The O.T. fills in the rest of the fields defined from the general profile screens.
  5. The O.T. selects the *Finished* button.
- **Extensions**:
  a) Quick creation:
     4. The O.T. selects the *Finished* button and postpones the insertion of the rest of the information for later.

  b) The O.T. no longer wants to create a new patient.
     * At any point before pressing the *Accept* button, the O.T. selects the *Cancel* button.
     * At any point after selecting the *Accept* button, the O.T. selects the *Remove* button.

  c) The input data is invalid.
     3. When clicking on the *Accept* button, a warning message is shown detailing the problem with the input data and asks the user to address it, going back to step 2 of the basic success flow.
- **Special requirements**:
  - The system must show the new patient on screen almost immediately.
- **Frequency**:
  - Very often at the beginning when configuring the system for the first or every time there is a new large set of patients. Less often (in some cases rarely) the rest of the time.

Figure E.2: Use case: creating a patient

E.3 Create an activity

- **Primary actor**: occupational therapist.
- **Stakeholders and objectives**:
  - Occupational therapist: want to create a new activity for later use during sessions.
  - Patient: will be performing the activity at some point during a session.
- **Preconditions**: the O.T. has logged into the system and navigated to the appropriate screen.
- **Postconditions (success guarantees)**: the new activity is successfully created and is selectable for use in sessions.
- **Basic success flow**:
  1. The O.T. selects the *New activity* button.
  2. The O.T. inserts the new activity's basic information (name and type of activity).
  3. The O.T. selects the *Accept* button.
  4. The O.T. fills in the rest of the information common to all activities (difficulty, objectives) and configures the activity's content (this varies with the type of activity).
  5. The O.T. selects the *Finished* button.
- **Extensions**:
  a) The O.T. no longer wants to create a new activity.
  * At any point before pressing the *Accept* button, the O.T. selects the *Cancel* button.
  * At any point after selecting the *Accept* button, the O.T. selects the *Remove* button.
- **Special requirements**:
  - The system must show the new activity on screen almost immediately.
- **Frequency**:
  - Very often at the beginning when configuring the system for the first time. Fairly often the rest of the time.

Figure E.3: Use case: creating an activity

Appendix F

Evaluation documents

This appendix includes the evaluation documents that were used during the user evaluation process, as well as the results recorded from the tests. The documents are in Spanish because the tests were performed with Spanish-speaking O.T.s. Four different documents were used: one before, two during and another after users tested the application:

- The first one is a pre-test questionnaire filled in by the user, where some basic information relevant to the test is requested. The questions, in order, ask about the tester's age, experience as an O.T., with computer applications for O.T.s, with tablet computers, with the Android O.S. and with Android applications for O.T.s.

- The second one contains a table for each task to be performed by the tester, including the task number, its instructions and three empty rows to fill in the time, number of clicks (touch interactions) and observations for each task performed by the tester. It includes what would be considered to be the most important and most common tasks an O.T. will probably perform at some point or other. This document is used by the system developer, while the tester will have the document described in the next point.

- The third document contains each task to be performed by the tester, including only each task's number and instructions. This document is used by the tester.

- The final document is a System Usability Scale that is filled in by the user. The questions included here are not about specific parts of the system, but general questions that can be asked about any system. Answers are given following a 5-value Likert scale, ranging from *Strongly agree* to *Strongly disagree*, which are given values from 5 to 1 respectively. Once it has been completed, we subtract 1 from odd answers, subtract even answers from 5 and add them all up, which will result in a value ranging from 0 to 40. The result is then normalized to obtain a value between 0 and 100.

Cuestionario pre-test

Nº usuario: _____
Fecha: _____
Hora: _____

Preguntas:

1.- Edad:
- ___ **18-25**
- ___ **26-40**
- ___ **41-55**
- ___ **>55**

2.- Experiencia como terapeuta ocupacional:
- ___ **Menos de tres meses**
- ___ **Entre tres y seis meses**
- ___ **Entre seis meses y un año**
- ___ **Entre un año y cinco años**
- ___ **Más de cinco años**

3.- Experiencia con aplicaciones informáticas para terapia ocupacional:
- ___ **Ninguna** (nunca he utilizado una)
- ___ **Baja** (he probado alguna, pero durante poco tiempo)
- ___ **Media** (he aprendido a utilizar alguna)
- ___ **Alta** (he alcanzado bastante dominio con alguna)
- ___ **Muy alta** (he alcanzado bastante dominio con varias)

4.- Experiencia con tablets:
- ___ **Ninguna** (nunca he utilizado una)
- ___ **Baja** (me manejo lo mínimo, rara vez uso una)
- ___ **Media** (me manejo bien, suelo utilizar una varias veces al mes)
- ___ **Alta** (he manejo bastante bien, suelo utilizar una varias veces a la semana)
- ___ **Muy alta** (me manejo muy bien, utilizo una a diario)

5.- Experiencia con Android:
- ___ **Ninguna** (nunca lo he probado)
- ___ **Baja** (lo he probado, pero nunca en un dispositivo propio)
- ___ **Media** (tengo un dispositivo Android, aunque lo uso para las cosas básicas)
- ___ **Alta** (tengo un dispositivo Android con el que uso varias apps más allá de las básicas)
- ___ **Muy alta** (uso frecuentemente un dispositivo Android con el que utilizo muchas apps)

6.- Experiencia con aplicaciones Android para terapia ocupacional:
- ___ **Ninguna** (nunca he utilizado una)
- ___ **Baja** (he probado alguna, pero no la he llegado a utilizar en terapia)
- ___ **Media** (alguna vez utilizo o he utilizado alguna en terapia)
- ___ **Alta** (utilizo o he utilizado alguna en terapia)
- ___ **Muy alta** (utilizo o he utilizado varias en terapia)

Tareas a realizar con la aplicación

Tarea 1

Datos de usuario. Crear un nuevo apartado:
- Nombre: Familia.
- Campo 1: Padre, t. textual.
- Campo 2: Madre, t. textual.
- Campo 3: Hermanos, t. num.

Tarea 2

Datos de usuario. Reordenar apartados para dejar así:
- Primero: Familia.
- Segundo: Historial médico.
- Tercero: Tratamientos.
- Cuarto: Deportes.

Borrar “Tratamientos”.

Tarea 3

Reordenar campos en “Deportes” para dejar así:
- Primero: Nº de actividades.
- Segundo: Actividades
- Tercero: Horas semanales totales.
- Cuarto: Horario.

Cambiar nombre de apartado a “Actividades extraescolares”.

Tarea 4

Crear un nuevo usuario:
- Nombre: Jorge.
- Apellidos: Loma Ruiz.
- F. de nac.: 18/04/2003.
- Familia:
  + Padre: Jaime Loma.
  + Madre: Soraya Ruiz.
  + Hermanos: 2.
- Actividades extraescolares:
  + Nº de actividades: 2.
  + Actividades: Fútbol, Natación.
  + Horas semanales totales: 6.
  + Horario: L,X: 17:00 – 19:00. M,J: 17:30-18:30.

Tarea 5

Editar usuario “Marta Peña Llanes”:

- F. de nac.: 01/08/2007.
- Actividades extraescolares:
  + Nº actividades: 2
  + Actividades: Fútbol, Tenis.
  + Horas semanales totales: 6.
  + Horario: L-J: 17:30 – 19:00.

Tarea 6

Crear un nuevo grupo de usuarios:

- Nombre: Clínica Villalba.
- Usuarios:
  + Carla Gómez Vélez.
  + Jorge Loma Ruiz.
  + Eoin O'Callaghan.
  + Noemí Santos Sánchez.

Tarea 7

Modificar el grupo de usuarios “Hospital niño Jesús” para que quede de la siguiente manera:

- Usuarios:
  + Jorge Loma Ruiz.
  + Cristina Martínez Puig.
  + Noemí Santos Sánchez.
  + Elena Ramos Venegas.

Tarea 8

Borrar el usuario “Julia Murillo Díaz”.

Tarea 9

Crear una nueva actividad:

- Nombre: Reyes católicos.
- Tipo: Pregunta y respuesta.
- Dificultad: Fácil.
- Pregunta: ¿Quiénes fueron los Reyes Católicos?
- Respuesta correcta: Isabel y Fernando
- Respuestas incorrectas:
  + Isabel y Pedro
  + Juan Carlos y Sofía
  + Felipe y Letizia

Tarea 10
Crear una nueva actividad:
- Nombre: Memoria flores.
- Tipo: Cartas de memoria.
- Dificultad: Media.
- Añadir dos cartas de flores de la galería de imágenes (darles los nombres que se quiera).

Tarea 11
Crear una nueva actividad:
- Nombre: Toboganes de colchonetas.
- Tipo: No interactiva.
- Dificultad: Media.
- Materiales: Colchonetas.
- Descripción: Se utilizan colchonetas para construir pequeños toboganes.
- Fotos: elegir foto de colchonetas

Tarea 12
Crear un nuevo documento de evaluación:
- Nombre: Entrevista inicial.
- Preguntas:
  + *Tipo textual.* Hobbies.
  + *Tipo textual.* Rutinas matutinas.
  + *Tipo textual.* Preferencias alimenticias.

Tarea 13
Anotar nueva franja horaria en el horario:
- Psicomotricidad viernes tarde
- Día de la semana: Viernes.
- Hora: 17:30 – 18:30.
- Usuarios:
  + Jorge Loma Ruiz.
  + Cristina Martínez Puig.
  + Noemí Santos Sánchez.
  + Elena Ramos Venegas.
- Tareas:
  + Toboganes de colchonetas.
  + Columpio elástico.
  + Sillas musicales.

Tarea 14
Modificar la fecha del evento “Excursión al huerto”, cambiándola del 18/06/2015 al 22/06/2015 y añadir a Jorge Loma Ruiz al evento.

Tarea 15
Comenzar una nueva sesión:
- Nombre: Sesión 4 mes de junio
- Usuarios:
  + Marta Peña Llanes.
- Actividades:
  + Memoria jugadores fútbol.
  + Memoria paisajes.
  + Memorias animales.

Tarea 16
Al finalizar la sesión, ajustar los resultados:
- Observaciones: Un poco distraída al principio.
- Mem. jug. fút.: 0 estrellas.
- Mem. paisajes: 1.5 estrellas.
- Mem. animales: 3 estrellas.

Guardar los resultados.

Tarea 17
Consulta:
- ¿Cuándo fue la última sesión de Noemí Santos Sánchez?
- ¿Cuál es su historial con la actividad “Memorias animales”?

Tarea 18
Consulta:
- ¿Hay hueco para empezar sesiones de terapia los martes de 17:00 a 18:15?

Tarea 19
Consulta:
- ¿Cuántas cartas distintas se usan actualmente en la actividad “Memoria animales”?

Evaluación de la usabilidad del sistema

	Completamente de acuerdo				Completamente en desacuerdo
1.- Me gustaría utilizar este sistema con frecuencia.					
2.- El sistema es innecesariamente complejo.					
3.- El sistema es fácil de usar.					
4.- Necesitaría la asistencia de personal técnico para poder utilizar este sistema.					
5.- Encuentro las diversas funciones del sistema bien integradas.					
6.- Me pareció que había demasiadas inconsistencias en el sistema.					
7.- Imagino que la mayoría de la gente aprendería a utilizar este sistema rápidamente.					
8.- Me pareció que el sistema era muy engorroso de utilizar.					
9.- Me sentí confiado utilizando el sistema.					
10.- Tuve que aprender muchas cosas antes de poder empezar a utilizar el sistema.					