

Android Timer Application





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Synopsis:

This project is about the development of...

This project is about the development of an Android timer application that will ease the daily routine for both children with ASD and their guardians. Guardians use physical timers to help the children manage their activities, these timers exists in a variety of forms, colors, and amount of maximum time that they can show. Furthermore the guardians uses pictograms to inform the children, what activity is currently in progress or be used as a scheme to describe their daily routines. The timer application is developed with the goal to replace the physical timers by providing visual timers in a variety of forms, colors, and time. The timer application is developed so the guardians can attach an extra timer or single/-multiple pictograms next to the original timer.

This project is a part of the multi project group system, GIRAF. GIRAF is a system specifically developed to ease the daily routine for guardians by providing a collection of tools, here among the timer application.

Preface

This project has been produced by group SW602f12 at Aalborg University in the spring 2012 on the sixth semester of the software engineering study.

This project is written in light of developments of the timer application for the The GIRAF Project. The GIRAF Project is designed to support educators in schools for children with ASD, among these is the timer application that is built to replace the timers the institutions have provided.

The project describes the working process used to develop the product, included in this is the development method, the design, the implemented features, and the tests of the timer application.

The intent of the project is to explore the possibilities of combining tools used by educators for children with ASD, in a device which is portable and easy to use.

The project group would like to thank the educators whom helped developing and designing the timer application as well as our supervisor for the interest and cooperation in the project.

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Word Definition

- Time Timer - A visual clock. Used by parents and teachers as a tool to visualize time for children.
- Pictogram - A graphic symbol that conveys its meaning through its similarity to an object.
- Eclipse - An intelligent development environment for Java.
- ASD - Autism Spectrum Disorder.
- Children - Children refers to "Children with ASD".
- Guardians - Parents, teachers, caretakers, and educators of children with ASD.
- MVC - Model View Controller [10].
- Timer application - The end product of this individual project.
- GIRAF - The name of the project from last year, which we are developing further.
- WOMBAT - Name of the timer application, **W**ay **O**f **M**easuring **B**asic **T**ime.
- PARROT - Name of the pictogram application, **P**ictogram **A**ssisting with **R**hetoric **R**easoning **O**r **T**alking
- We - In the introduction, it refers to the whole multi project group. After the common report, it refers to the individual project group.

- Configuration - Can refer to a saved timer.
- SubProfile - In code examples, SubProfile refers to timer configurations.

Part I

Introduction

This part is a common part of the reports in the multi project groups, and in this common part there will be an introduction to the project, including background knowledge about the target platform, and knowledge about ASD. There will be an analysis of the problem followed by a system definition of the whole multi project, and the specific group project.

section 1.8 is the last section of the common report, which means that the rest of the report will be an individual part written only by the timer group.

CHAPTER 1

Introduction

In order to describe the context of the system, we – as a multi project group – will in the following state the motivation of the project, the group of people we are aiming at helping, the technological platform chosen, the used development method, followed by a problem definition, a system description and architecture, and the conducted usability test.

1.1 Motivation

As this is a student report written as part of a learning project, we are required to comply with the study regulation. The main areas of focus, according to the study regulation, are: multi-project management and quality assurance in the form of requirements analysis, requirements management, and testing. The goal is to create a comprehensive software system, across multiple project groups, in order to enhance our competences in analysis, design, implementation, and evaluation of software applications in regards to the system requirements[14].

This project builds on top of a previous project, and is further developed, with the aim of having other students continue the development. The goal of the project, we are building on top of, is to create a touch based tablet system to support children and their guardians in everyday scenarios.

1.2 Target Group

Our target group is both children and their guardians. These guardians have certain needs for special tools and gadgets that help to ease the communication between them and the children.

Five teachers and educators, who work with children, act as customers. They will provide requirements and information about the institutions' way of working to give us an insight into their daily struggles.

1.2.1 Working with Children with ASD

This section is based upon the statements of a woman with ASD [6], explaining what it is like to live with ASD, and an interview with an educator at Birken, a special kindergarten for children (see appendix 10.2 for interview notes).

People with ASD are often more visual in their way of thinking. Rather than visualizing thoughts in language and text, they do it in pictures or visual demonstrations. Pictures and symbols are therefore an essential part of the daily tools used by children and the people interacting with them. Also, children can have difficulties expressing themselves by writing or talking, and can often more easily use electronic devices to either type a sentence or show pictures, to communicate with people around them. Another characteristic of children is their perception of time. Some of them simply do not understand phrases like "in a moment" or "soon", they will need some kind of visual indicator that shows how long time they will have to wait.

Different communication tools for children with autism already exist, but many of them rely on a static database of pictures, and often these has to be printed on paper in order to use them as intended. Other tools, such as hourglasses of different sizes and colors, are also essential when working with children, and these tools are either brought around with the child, or a set is kept every place the child might go, e.g. being at an institution or at home.

There exists tools today which helps the guardians in their daily life, although – as stated in Drazenko's quote – none of them are cost-effective enough to be used throughout the institutions. From the quote, it is clear that there is a need for a more cost-effective solution.

The price of the existing solutions are not sufficiently low such that we can afford to buy and use them throughout the institution.

- Drazenko Banjak, educator at Egebakken.

1.3 Target Platform

Since we build upon last year's project, we are bound to use the platform they used, which is tablets running the Android operating system.

In this project we have been provided with five Samsung Galaxy Tab 10.1 devices[11]. The firmware on the tablets is version 3.2. This version, as of project start, is the latest stable version available for these specific tablets. [13]

1.4 Development Method

As a part of the study regulation we have been required to use the same development method in each individual group. Two methods have been considered, *XP* (eXtreme Programming) [15], and Scrum [2].

With the knowledge of both XP and Scrum, we decided in the multi project to use Scrum of Scrums, which is the use of Scrum nested in a larger Scrum project [1].

The reason for choosing Scrum of Scrums is that everyone, at all times, will be able to know what the vision of the project is, and how close every group is to achieving their individual goals of the vision.

Another element of the Scrum method is that a close contact with the customers is maintained. This helps keep the product backlog up to date and correctly prioritized. The customers are presented with the vision of the project, as well as showing the latest release when we have meetings with our customers.

We customized Scrum to fit our project. The changes are as follows:

- The sprint length have been shortened to approximately 7 - 14 half days.
- Some degree of pair programming have been introduced.
- There is no project owner because this is a learning project.
- Everyone is attending the Scrum of Scrums meetings.
- The Scrum of Scrums meetings are only held once at sprint planning.

1.5 Problem Definition

The problem statement is as follows:

How can we ease the daily life for children with ASD and their guardians, while complying with the study regulation?

This problem statement is necessarily vague to allow the individual groups some freedom in their projects, while we maintain the overall structure of the multi project, however there are limiting factors. We are limited by resources and time available, as we are only working on this project for a single semester. However, all work done in this multi project will be passed on to the next line of students, which means we can make a full system design and pass on anything we do not have the time or resources for. This also requires that our work need to be of such quality that it is understandable by students of the same educational level as ourselves.

1.6 System Description

GIRAF is a collection of applications, either fully or partially interdependent, for the Android platform, designed to be used by guardians and children. GIRAF consists of five projects with various degree of interaction. These projects are named Launcher, PARROT, WOMBAT, Oasis, and Savannah. Each of the groups have produced individual products, which are parts of a greater project, GIRAF.

Launcher handles execution of GIRAF apps, and at the same time it provides safety features to ensure that a user that is not authorized to interact with the rest of the system will not be able to do so. When the launcher executes an app, it will provide it with profile information, specifying which child is currently using the app, as well as which guardian is signed in.

PARROT is an app which provides access to pictograms – pictures with associated information such as sound and text – which can be used for communication. PARROT also gives guardians functionality for adding additional pictograms, as well as organizing the pictograms into categories for ease of access, based on the needs of the individual child.

WOMBAT is an app which purpose is to help the children to understand the aspect of time, by visualizing it. WOMBAT provides different ways of displaying time, as well as the possibility to configure the app for the needs of individual children.

Oasis locally stores the data and configuration of the GIRAF platform, and provides an API to access it. The stored data and configurations are synchronized to the Savannah server, if available. In addition, an app is provided for the guardian to access the stored data and configurations.

Savannah provides Oasis with a way to synchronize tablets running GIRAF. Furthermore, a website is provided to ease administration of the synchronized data.

1.7 Architecture

Our System architecture – shown in Figure 1.1 has been designed with simplicity in mind and was greatly inspired by the MVC pattern. This means that the architecture is divided into three layers. The lowest layer is the database where the information is stored. Above this layer is the controller layer which, in the GIRAF platform, is known as Oasis. The controller is responsible for querying the database for information needed in an app and the controller is also responsible for storing information in the database. The last layer is the apps. This division of layers give the GIRAF platform a low cohesion which makes it easier to work with individual parts of the platform independently.

We have chosen to redesign last year’s architecture [7] to make it easier to work with. We have simplified the architecture because we feel it is unnecessarily complex.

1.8 Usability Test

As stated in the motivation, quality assurance through testing of the system is required. Therefore a usability test was conducted in order to measure the current usability of the GIRAF platform as a whole, as well as of the individual parts of the platform. Furthermore, the next wave of developers will immediately be able to start correcting the found usability issues.

1.8.1 Approach

The test group consists of the five contact persons. We assess that they, as a test group, are representative. We base this on them being a mix of educators and teachers, with varying computer skills.

They have prior knowledge about the overall idea of the GIRAF platform, and although some of the contact persons had previously informally used some aspects or parts of the system, they had not been exposed to the platform as a whole, and therefore still are of value.

The invitation sent to the test persons can be found in Figure 10.4.

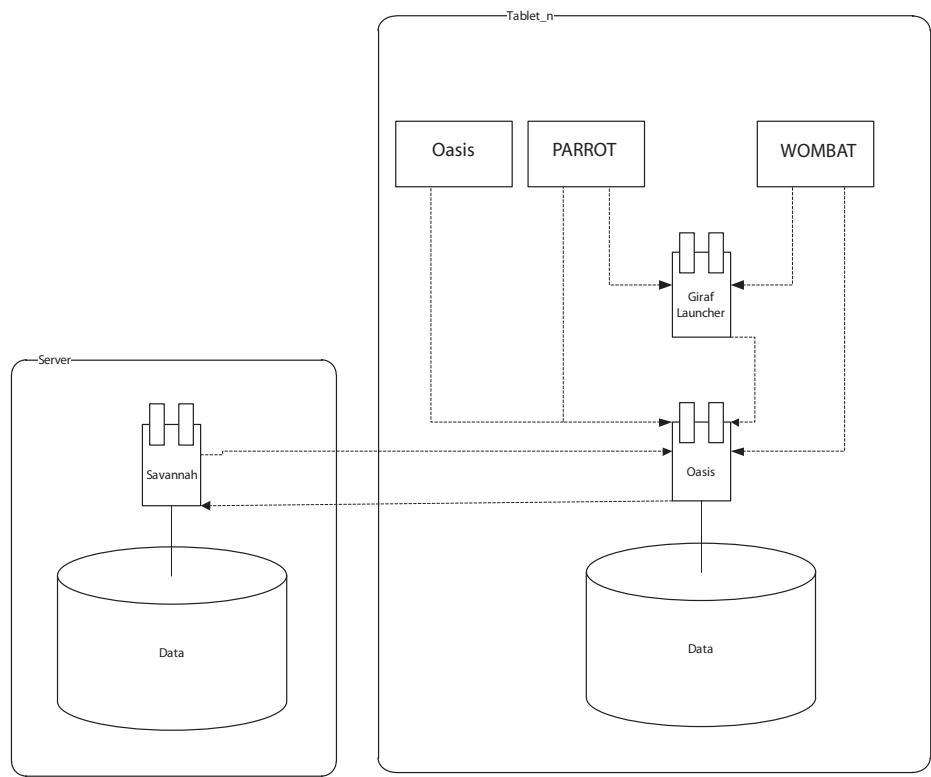


Figure 1.1: The GIRAF architecture

The Instant Data Analysis (IDA) method for usability is chosen. A traditional video analysis method could be used, but since IDA is designed for small test groups, this approach is used. [8]

Setup

The usability test is divided into two tests: A test of three user applications, and a test of two administrative applications. The user applications are: The launcher, PARROT, and WOMBAT. The administrative applications are: The Oasis app and the Savannah web application. Each test is assigned a team to accommodate the need to run two tests simultaneously. The teams are made with respect to the criteria of the Instant Data Analysis process. Each team consisted of:

- 1 x Test Coordinator

- 1 x Test Monitor

- 1 x Data Logger

- 2 x Observers

The usability lab at Aalborg University is designed with two rooms for usability testing and a control room to observe and record the tests. The two test chambers are assigned a test each and the control room is used to observe both tests as seen in figure 1.2.

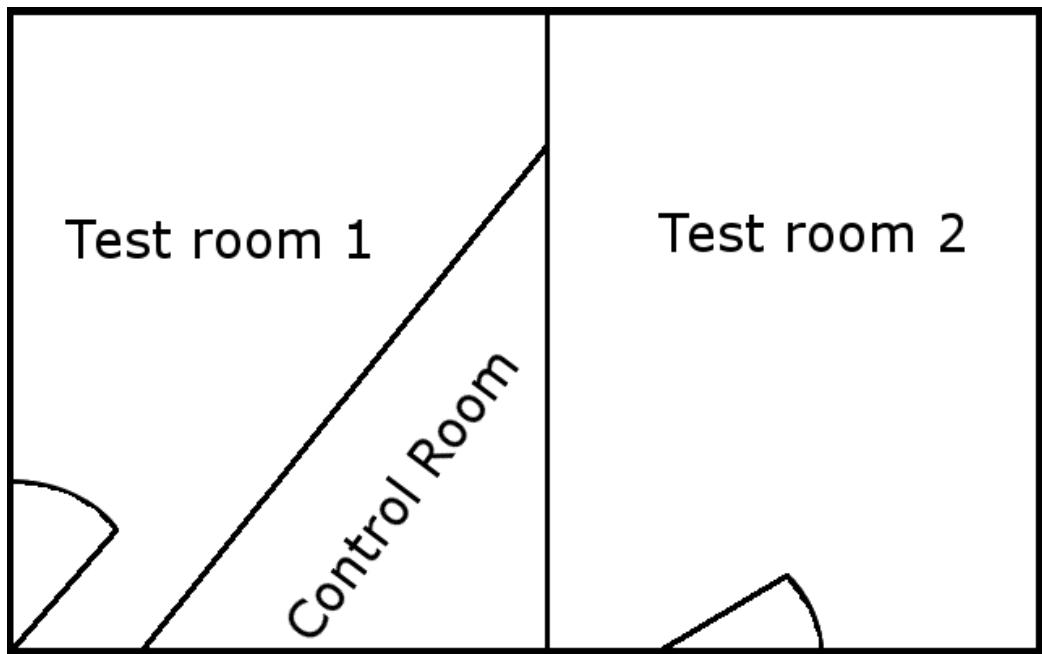


Figure 1.2: An overview of the usability lab at Cassiopeia, Department of Computer Science, Aalborg University.

Execution



Figure 1.3: The schedule of the usability test.

The tests are conducted according to the schedule in Figure 1.3.

Briefing, debriefing, and questionnaire documents can be found in ??, and the results of the test can be found in section 7.4.

CHAPTER 2

Analysis

Through meetings with an educator at Birken, a kindergarten for children with ASD, we have learned about the importance of having access to well-designed communication tools when working with children with ASD.

At Birken they often use hourglasses and time timers, in different sizes and colors to visualize the progression of time to the children. The children can then associate the color and size of an hourglass with the time it represents.

Our contact person explained how the educators at the institution use pictograms to communicate with the children. The children have a schedule of the day, where all their daily activities are listed in pictograms, such that the children can always go to their schedules and find out what they are going to do next. Also activity instructions are listed with pictograms, i.e. in the bathroom there is a scheme showing what to do when going to the bathroom.

The pictograms used at Birken is from the software *Boardmaker*[9]. To use the pictograms from *Boardmaker*, the educators have to print, cut, and laminate them.

The educators have to take timers and pictograms with them, everywhere they go. Since there is supposed to be more than one specific timespan available, the timers can take up much space. Furthermore the pictograms are lightweight, which can make it difficult to use them outside when it is bad weather or windy.

2.1 System Definition

The timer application is targeted for Android tablets running Android 3.2. The use space is institutions and homes of children with ASD.

The application is a tool, such that parents and educators can visualize time in a way customized for each child by changing color schemes, symbols, forms, and save this information in profiles stored on a server. The visualization is formed as a full-screen timer, which can be customized to be shown as an hourglass, stopwatch, progressbar, or digital watch.

Furthermore the guardians should be able to add pictograms to the timer, to show them what they are going to do while the time is running, and what they are going to do when the time has expired.

Tail

Part II

Development

In this part we start with a section about project management, where we expand on the used development method and versioning. After that we describe the design, development process, implementation, and test of the WOMBAT application.

CHAPTER 3

Design

The design of WOMBAT has changed throughout the project. The design chapter presents the vision of the timer application and the tools used to design and develop the product.

3.1 Vision

Since the launcher had both a child-mode and a guardian-mode at the first period of the project, this vision relies on the initial design of the launcher project.

The idea of the WOMBAT application was, that is should be a tool for educators to illustrate time for the children.

One part is the timer application as it is implemented, from which it is possible to run timers, such as an hourglass or a digital watch. This part should be available only from the guardian-mode.

The second part of the application is a timer overlay, which is launched when other applications are launched through the GIRAF launcher. When such applications are launched through guardian mode, the user should be prompted to select if there is a time limit on the application, and what the limit should be. If a time limit is chosen, the given application, i.e. a game, is run with the timer overlay showing a custom timer with the time left (see

figure 3.1).



Figure 3.1: Example of how the timer overlay would look. Here there is an overlay on a game with about 40 minutes left.

If the launcher is in child-mode, and the child opens an application, the timer overlay is run according to settings chosen in the third and last part of the WOMBAT system; the settings application. The overlay can be used if a child is only allowed to play a game for 30 minutes a day, then the overlay can be customized to show the child how much time is left of the allowed time. When the time has expired, the application is automatically closed.

The third part of the application is only available from the guardian-mode in the launcher, and from this application it is possible to customize which applications should be run with the timer overlay. Also it is possible to define how the overlay for every child should look like, and what should happen when the time limit has been reached. Also it is also possible to set constraints for the applications, such as time constraints, i.e. certain applications can only be opened in a different timespan on the day, or when a specific application has been run for 30 minutes straight, the application is closed and cannot be opened before a certain "cooldown" has ended.

3.2 Stories

These stories are fictive, and are based on the vision of the timer system, together with an interview with our contact person.

We use a fictive person in the use cases, Trine, who acts as an educator in a special kindergarden for children with ASD.

Timer Application

Trine got an Android tablet from the kindergarden yesterday, and some of the other educators suggested that she should try out the WOMBAT timer application. Trine has planned a playing session with a few of the children, and decides to use the WOMBAT application to time the session, such that the children can see when they are done playing. They have about 30 minutes to play in, so Trine opens WOMBAT on the tablet and selects a predefined hourglass set to 30 minutes. When the children are in place and ready to play, she press the start button, and the hourglass starts. When the time runs out, a "Done" screen appear, and the children can see that they are done playing.

Timer Overlay

Trine walks in the playground while the children are playing. She sees one of the boys sitting on the ground in the corner of the playground. She walks over to him. It is Casper, he had tripped over his own feet, and hurt his knee. To get Caspers mind of his knee Trine lets Casper play his favorite computer game for the next 10 minutes. She starts the game, and gets prompted to choose a profile and the amount of time the game should allow to run. She selects Casper's profile and 10 minutes. The game starts with the timer overlay showing 10 minutes left of play time, with Casper's favorite green digital clock. When the time has run out, the game closes, and Casper is again ready to play with his friends.

3.3 Prototyping

Before the actual development started, we made a few drawings of our ideas (see figure 3.2).

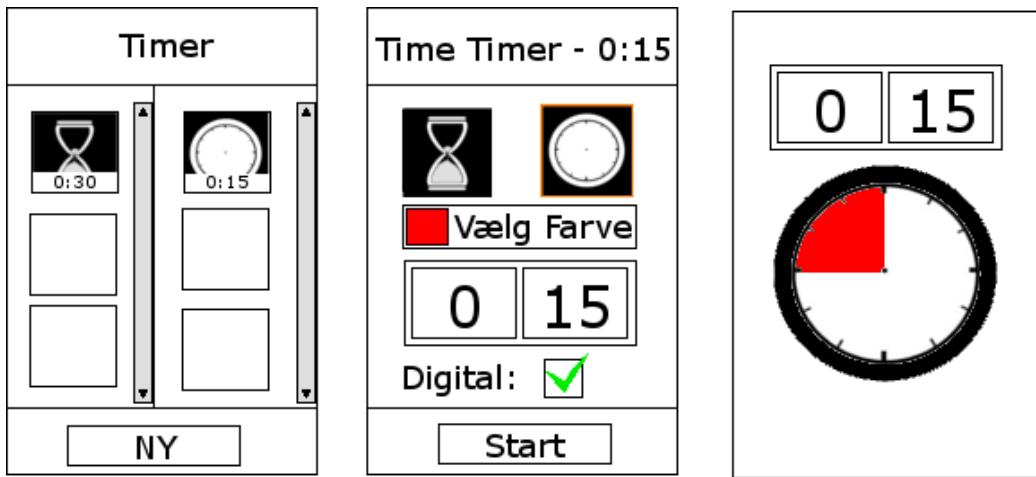
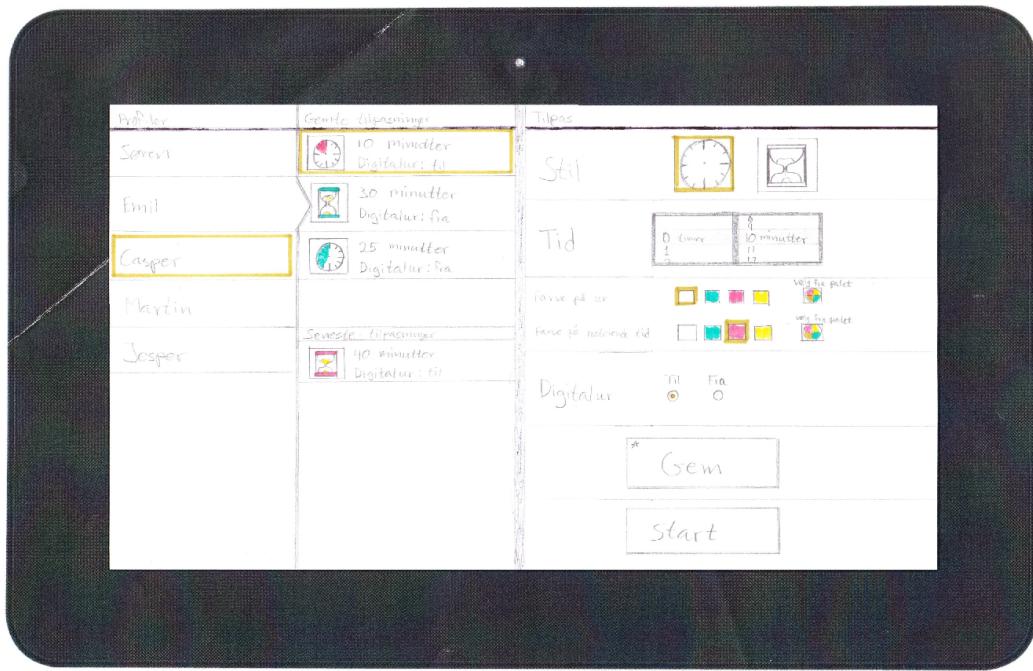


Figure 3.2: Drawing of the initial ideas of the timer application.

Paper Prototyping

Paper prototypes[3] has been used in the first iterations in the development process. The initial idea of the system design was drawn on paper, so that our contact person could give us some feedback on the design, before we started programming. In figure Figure 3.3 is a paper prototype of the menu in the timer application, and the rest of the prototypes can be found in appendix section 10.3.



* Pop-up menu, hvor man vælger hvor der skal gemmes.
For mulighed for at oprette tidlige gemte.

Figure 3.3: Scan of a paper prototype of the menu in the timer application.

Paper prototypes are produced quickly, and they capture early design ideas.

3.3.1 Metaphors

To enhance usability and learnability, we have used metaphors[3] on the buttons in the application. On the "Attach"-button, used to attach a second timer or one or two pictograms to the main timer, we have placed a paper-clip, which is known from the attach function in other programs, for example Microsoft Outlook Express. Furthermore we have used metaphors on the "Start Timer"-button, which looks like the "Play"-button known from various media players, and the "Save" and "Save As" buttons have a floppy disc icon, which is known from the save button in various word processing programs, for example Microsoft Office Word¹. In figure 3.4 examples of the implemented metaphors are shown along with screenshots of other systems they are implemented in.

¹Non-free word processor developed by Microsoft

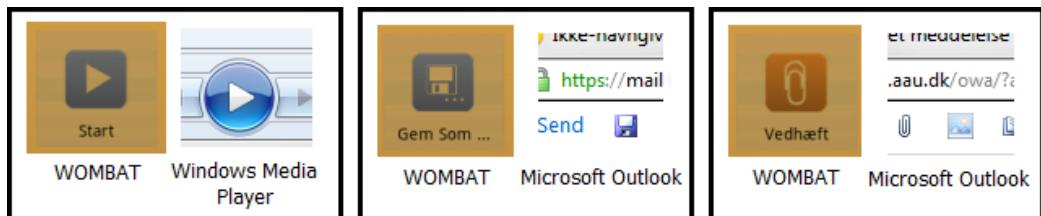


Figure 3.4: Metaphors implemented in WOMBAT and the original implementation.

CHAPTER 4

Development Process

As stated in chapter ??, the development method used in this project is a modification of Scrum, which means that the development evolve through sprints. Here is a description of the six development sprints we had, and in appendix 10.4 all sprint backlogs can be found.

4.1 Sprint Walk-through

Because it took some time for all groups to agree on a development method, we started making some design and talking to our contact person before the actual sprints started, so when the first sprint was started, we already had an idea of the functionalities we wanted to end up with.

Sprint 1

19/03 - 23/03: In the first sprint, the main objective was to set up the android project in development environment, and get the development started. At this point we were expecting to end up implementing the whole vision (see section 3.1), and a natural place to start would be the timer. We had an idea of how the design should be, and we began to implement lists for holding children and configurations.

Sprint 2

26/03 - 04/04: In the middle of this sprint the launcher group stated that they would only be able to make the guardian mode in the launcher in this semester, so we decided in the timer group, that the two last parts of the timer application, the overlay and the settings, would not be developed in this semester either, since there will be no need for them if there is no child mode in the launcher.

We continued designing and developing, and in the end of this sprint, we had the design ready for implementation. We also started to make some OpenGL development¹, as we thought that OpenGL was the best way to implement the timers.

We had a meeting with the contact person, and she suggested that when the timer in the application has exceeded, it would be possible to show two custom pictograms on the screen. Also she suggested that two different timers could run in parallel on the screen, if a child was used to one specific timer, but was learning how to use another type of timer. We added these to suggestions to the product backlog.

Sprint 3

10/04 - 19/04: We found out during this sprint, that it was more convenient to implement the timers using canvas and 2D drawings. The progress bar had been implemented in both OpenGL and on canvas, and the canvas version was the easiest to implement, and required fewer lines of code.

Sprint 4

23/04 - 04/05: In this sprint we finished drawing the timers, and a lot of the most vital functionalities, such as loading and saving configurations, highlight on list items, and the "Done" screen, were implemented.

During this sprint we had a lot of contact with the admin group, because we had difficulties implementing functions to load and save data to the database. We also integrated the timer with the launcher, and did some testing on the interaction between them.

Sprint 5

07/05 - 11/05: This sprint was used to do some refactoring of the code, to make it more readable and understandable. We also implemented the last

¹Widely used 2D/3D graphics API

things from the backlog, and did some polishing to the overall design. Furthermore we started making test design and test cases for the functionalities we wanted to test in the timer application.

Sprint 6

14/05 - 18/05: In this sprint we implemented the last critical functionality.

Besides getting done with the development, we started with the acceptance test, by letting our contact person use the timer application at the institution over a period of three days.

Sprint 7

21/05 - 25/05: This sprint was used to perform and evaluate on usability test, acceptance test, and black-box test.

CHAPTER 5

Development Tools

As part of a mini project in the course *Software Engineering* we analyzed the project situation, when we had started the development process, by listing strengths, weaknesses, threats, and opportunities of the project, and discussed if some of the threats and weaknesses could be eliminated, or some strengths or opportunities could be exploited at a low cost. We here list the development tools we decided to use, and the reason for choosing them.

Pair Programming

We implemented this technique because we had done some single person programming in the start of the development process, and there was a growing need for explanation when using methods the other project members had written. Also we wanted to enhance the quality of the code we wrote, and thereby minimize the time we had to spend on debugging.

The cost of this technique was, in this case, moderate, since the project group is very small, and it makes a difference when one person is not writing code. On the other hand, the code written in pairs is not likely to be re-written, because of the higher quality, which makes the benefit high.

Refactoring

The reason refactoring was a usable technique for our project, is that we were suffering from code cluttering and code generally being difficult to un-

derstand. When debugging the system it could sometimes be difficult to know where the bug had evolved from. Since refactoring can give a better overview it would make debugging an easier task. Also this project is going to be continued by another project group next year, which requires our code to be easy to understand for the next project group to be able to smoothly proceed the development.

The cost of this technique is low, and the benefit is, for ourselves, moderate. The benefit is much higher for the project groups next year.

CHAPTER 6

Implementation

Nice...

6.1 Architecture

6.1.1 Activity(android)

6.1.2 Architecture model

The WOMBAT application is depended on the Launcher project and Oasis project, but we choose to design WOMBAT as an independent application with features from Launcher and Oasis. We choose to design WOMBAT as an independent application, that way we never have to wait for the Launcher or Oasis to release features regarding WOMBAT. You can see a dependency diagram of WOMBAT architecture. The WOMBAT architecture is a five layer architecture which enhances how you can perform testing and do collaborative work. The five layers consists of:

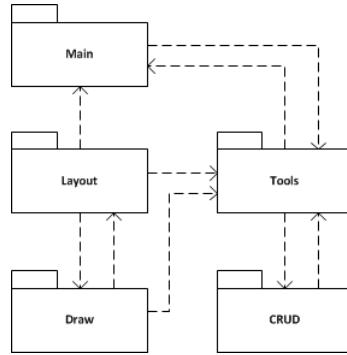


Figure 6.1: Dependency diagram of WOMBAT architecture

Main

This layer is the main activity of WOMBAT which means that it initiate the whole WOMBAT application. The main layer is depended on the Tools layer since it contains all the initiating tools.

Layout

This layer cosists of the two fragments; Profile/SubProfile fragment and customize fragment, and the custom arrayadapters which WOMBAT uses. The layout layers is depended on the Tools since it contains all the objects and methods that is required for the layout to work properly. The layout layer is also depended on the main layer, without the main layer the layout layer would never be initiated. Final but no least the layout layer is depended on the draw layer, the draw layer delivers the methods that generates the views for the timers and pictograms.

Draw

This layer contains the methods that generate the views of timers and pictograms. Draw layer is depended on the tools layer since the tools layers contain all the different types of objects that the draw layer uses. The draw layer is also depended on the layout layer, the layout layer initiate the draw layer.

Tools

This layer cosists of all the types of objects and methods that WOMBAT uses. The tools layer is depended on the main layer to initiate the proper objects, you can read more about this in subsection: ???. The tools layer is also depended on the CRUD layer which contains the connection to the Oasis library.

CRUD

This layer is responsible for saving and loading from the OasisLocal-

Database, it is depended on the tools layer because it uses the objects and method that the tool layer provides.

Library

Our original idea was to split the layers into two projects, that way it would be able to conduct tests outside the main layer. The first project would be an Android project with a main activity, WOMBAT. The second project would be an Android library which should contain all the backend functionality, TimerLib. This is how the two projects would look like:

WOMBAT

- Main layer
- Layout layer

TimerLib

- Tools layer
- Draw layer
- CRUD layer

We later decided to redesign, and make three projects instead of two projects. We choose the redesign because that we are three developers in our project whom all want to conduct independent testing. The first project, WOMBAT, would stay as it original was. The Second project would be split into two projects, TimerLib and DrawLib. TimerLib would contain the tools layer and the CRUD layer. The DrawLib would contain the draw layer.

WOMBAT

- Main layer
- Layout layer

TimerLib

- Tools layer
- CRUD layer

DrawLib

- Draw layer

The dependency diagram of the WOMBAT projects can be see on figure: 6.2.

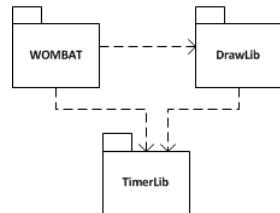
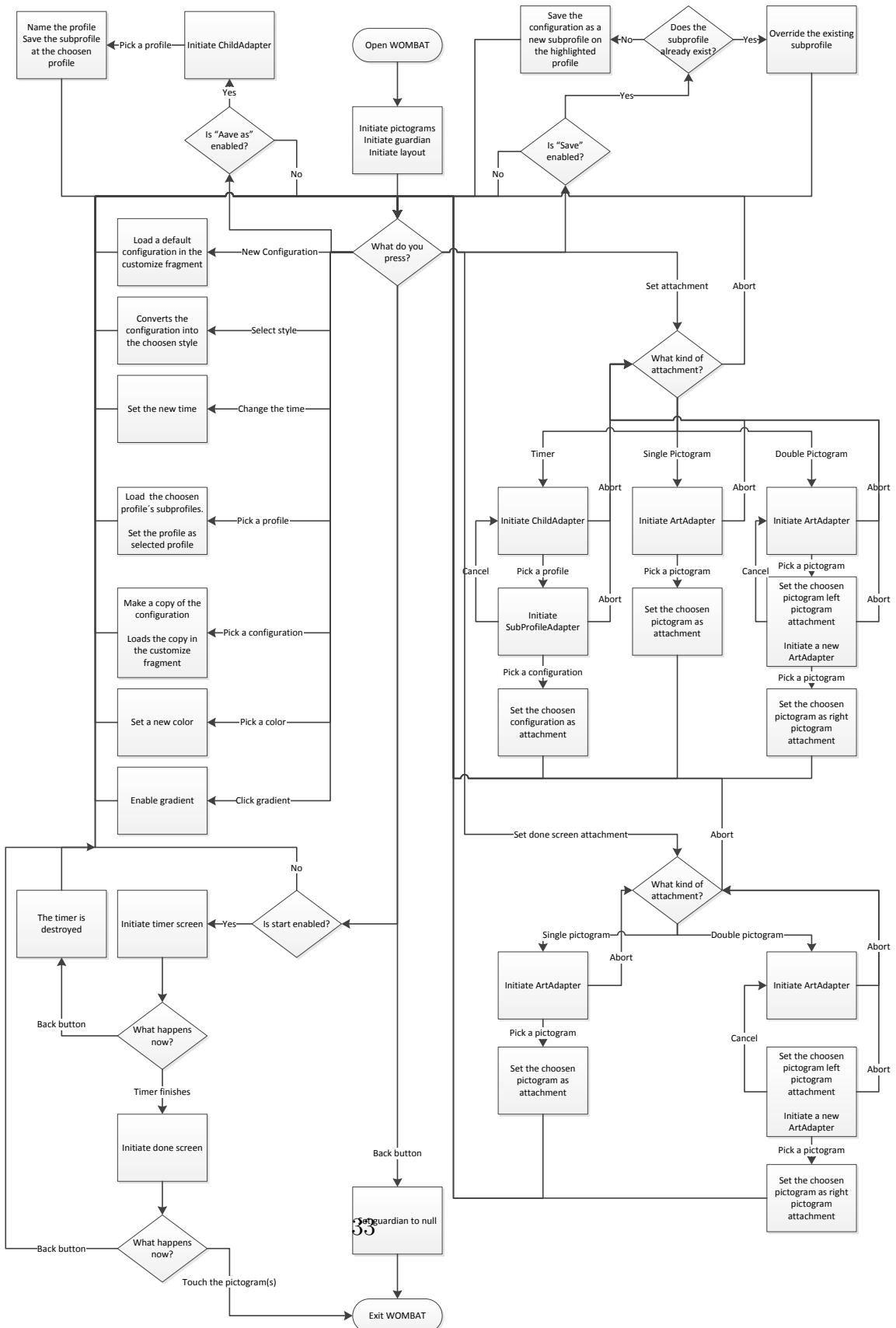


Figure 6.2: Dependecy diagram of WOMBAT projects

Wombat lifecycle

You can see a detailed flowchart over the WOMBAT lifecycle on figure:6.3. The flowchart descripts whatever that can occur while the WOMBAT application is running. The flowchart can help debug and understand the application if somebody chooses to develop futher on WOMBAT.



6.2 Fragments

To better understand fragments, a short introduction to activities is useful.

An activity[?] is a key component for android application, and it provides a screen which the user can interact with. When initiating an Android application, a main activity is used, from where the rest of the application is initiated. An Android application can use multiple activities, each activity provides a window in which the developer can draw a user interface.

A fragment in Android is an embedded activity within another activity. According to Google, the design philosophy of fragments[5] are that they support a more dynamic and versatile design of applications on devices with larger screens, such as tablets. Google states that on these kind of devices there are more room to combine and interchange interface components, compared to a handset[5]. An example of the use of multiple fragments on a large screen compared to activities on smaller handsets, is the Gmail application from Google, seen in Figure 6.4 and Figure 6.5:

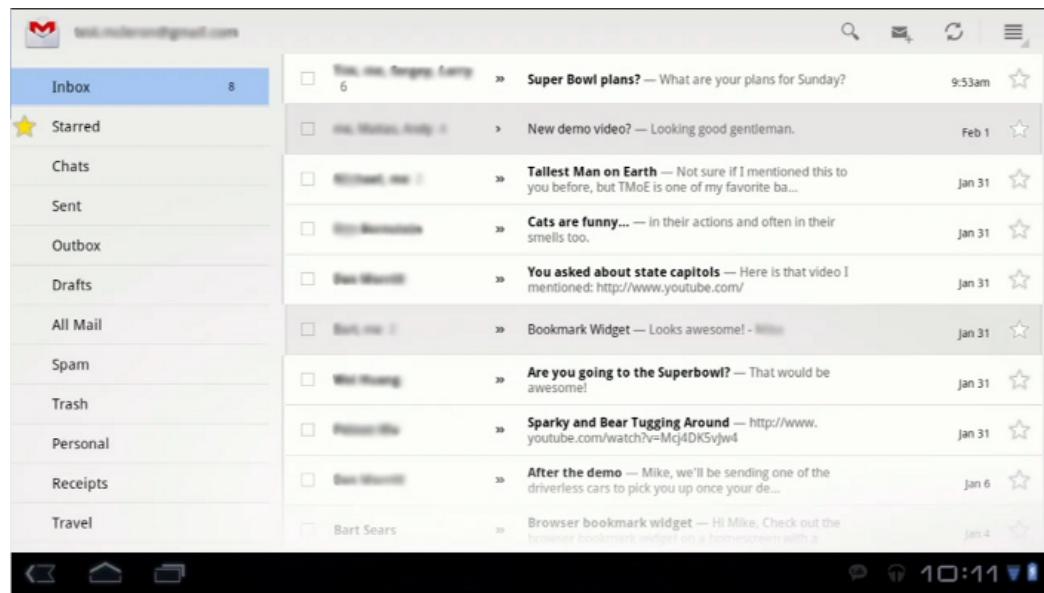


Figure 6.4: The Gmail application from Google on a tablet with fragment support.

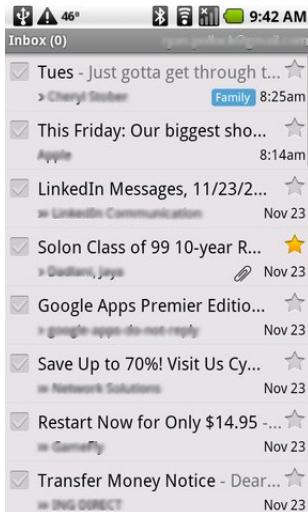


Figure 6.5: The Gmail application from Google on a handset without fragments

6.2.1 Benefits and Limitations

Fragments alone are not more powerful than activities, and fragments can not exist without activities. When combining multiple fragments in one activity, the fragments are able to create dynamic interfaces which does not require the entire activity to be reloaded when changing an object on the screen.

The Gmail application utilize this by having an overview of the email account on the left side of the device while showing specific email content on the right side, as seen in Figure 6.4.

Fragments can be reused in multiple activities, which means that a single fragment can be used in several ways depending on the platform. The main activity only have to declare which fragments it holds in the layout.

Fragments were introduced with the Android 3.0 platform (API version 11), and as of 3rd March 2011 Google has released the "Android Compatibility Package", a library which let Android 1.6 devices or newer support fragments [4].

6.2.2 Fragments in WOMBAT

In WOMBAT fragments are designed to quickly switch between multiple children and configuration templates. When developing using fragments the screen can be divided into several parts, that can update independently based

on actions in the fragments. This means that, much like the Gmail application, WOMBAT can keep an overview of all children and their personal configurations, while having a detailed configuration page open at the same time, thereby avoiding having to switch screen to load previous defined configurations. The layout of fragments in WOMBAT can be found in Figure 6.6.

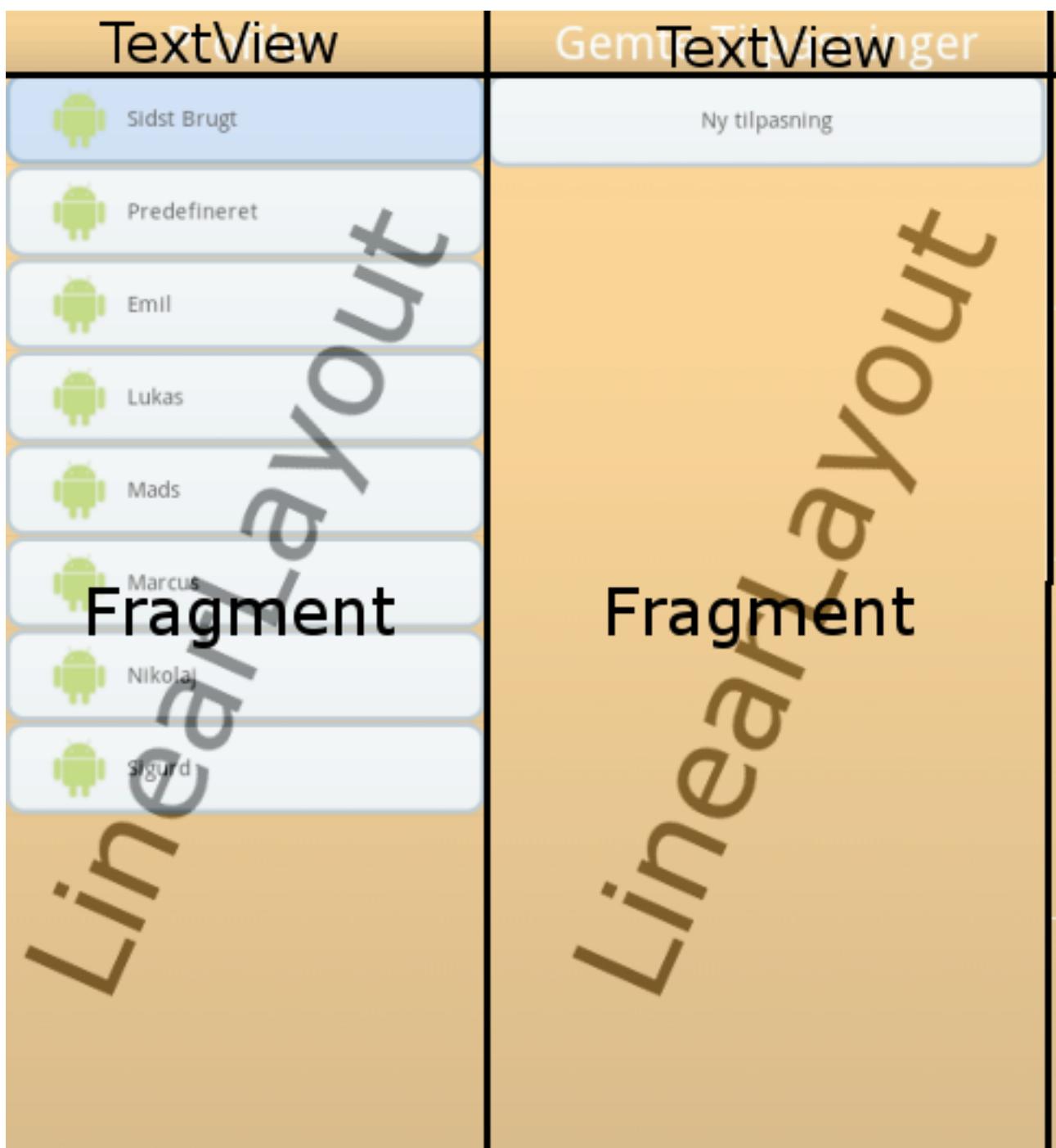


Figure 6.6: The layout of fragments in WOMBAT.

Having developed WOMBAT with fragments means that it is possible to create a handset version with few modifications, since it only requires the

"Android Compatibility Package" library and some new activities to handle the fragments on a smaller screen.

6.3 Lists

Android provide a built-in **ListView**, which can be modified to match any list, that the developer wish to create, as shown in Figure 6.7.



Figure 6.7: Three examples of how **ListView** can be modified.

6.3.1 Benefits and Limitations

The advantage of a **ListView** is, that it can be modified to whatever the developer want it to look like. This is done by making an adapter with the changes the developer want to make to the design. An example of how to use this adapter can be seen in Figure 6.8.

```

1 View v = list_item_view;
2     if (v == null) {
3         LayoutInflator li = (LayoutInflater) getContext().getSystemService(
4             Context.LAYOUT_INFLATER_SERVICE);
5         v = li.inflate(R.layout.profile_list, null);
6     }
7     Child c = items.get(position);
8     if (c != null) {
9         ImageView iv = (ImageView) v.findViewById(R.id.profilePic);
10        TextView tv = (TextView) v.findViewById(R.id.profileName);
11
12        if (iv != null) {
13            iv.setImageResource(R.drawable.default_profile);
14        }
15        if (tv != null) {
16            if (c.name == "Last Used") {
17                tv.setText(R.string.last_used);
18            } else if (c.name == "Predefined Profiles") {
19                tv.setText(R.string.predefined);
20            } else {
21                tv.setText(c.name);
22            }
23        }
24    }

```

Figure 6.8: The WOMBAT implementation of a `ListView ArrayAdapter` modified to use a list of profiles.

The `ListView` have an interface, `OnItemClickListener`, which works like any other clickable item in Android.

6.3.2 Lists in WOMBAT

Figure 6.8 is the actual implementation of the child list in WOMBAT. The difference from the `ArrayAdapter` used in the profile list and the configuration list, is that the configurations is designed to use a text field with a description of the timer. The configurations list only requires another layout to be constructed, this layout contains the extra `TextView`.

The `OnItemClickListener` of the child fragment ensures that the configuration and customize fragments are updated. Figure 6.9 is an example of the `OnItemClickListener` of the child fragment.

```

1     public void onListItemClick(ListView lv, View view, int
2         position, long id) {
3             // Update the fragments
4             SubProfileFragment detf = (SubProfileFragment)
5                 getFragmentManager()
6                     .findFragmentById(R.id.subprofileFragment);
7             CustomizeFragment custF = (CustomizeFragment)
8                 getFragmentManager().findFragmentById(R.id.
9                     customizeFragment);
10            custF.setDefaultProfile();
11
12            if (detf != null) {
13                // Marks the selected profile in the guard singleton
14                guard.profilePosition = position;
15                guard.publishList().get(position).select();
16                guard.profileID = guard.publishList().get(position).
17                    getId();
18                detf.loadSubProfiles();
19            }
20        }

```

Figure 6.9: Example of the `OnClickListener` of the child fragment.

6.4 Customize

The customize fragment is where the configurations are generated and altered.

As stated in chapter 2 the timers our contact person use has different sizes and colors, these customization options are essential for the timer application. The list of customization features are as follows:

- Change style of the timer.
- Change the timespan of the timer.
- Change the color of the timer and background.
- Change the color of the timer to be changing gradiently.
- Attach one or two pictograms, or a timer.
- Change the default done pictogram to one or two pictograms.

- Save the timer.

- Start the timer.

6.4.1 Architecture of Customize

The customize fragment consists of four main elements, the first element is the style picker where the user can change the style of the timer. The second element is the time wheels where the user can change the timespan of the timer. The third element is the color pickers where the user can change the colors of the time left, the frame, and the background of the timer. The fourth element is the menu where the modifications like attachment is found. Figure 6.10 show architecture of the fragment.



Figure 6.10: An outline of the architecture of the customize fragment.

All functionality of the items in the customize fragment is placed in the customize class. For further development a refactoring of the entire class is advised such that all buttons in WOMBAT is handled like the `WDialog`, which can be found in section 6.4.1.

To be able to get an overview of the items in the customize fragment all items are assigned a method, these methods are then referenced from the `onCreate` method in Figure 6.11. An example of one of these methods is the

style chooser in Figure 6.12.

```
1 public void onCreate(Bundle savedInstanceState) {
2     super.onCreate(savedInstanceState);
3     currSubP = new SubProfile("", "", 0xff3D3D3D, 0xffFF0000, 0
4         xffB8B8B8,
5         0xff000000, 600, false);
6     currSubP.save = false;
7     currSubP.saveAs = false;
8
9     //***** TIME CHOSER *****/
10    initStyleChoser();
11
12    //***** TIMEPICKER *****/
13    initTimePicker();
14
15    //***** COLORPICKER *****/
16    initColorButtons();
17
18    //***** ATTACHMENT PICKER *****/
19    initAttachmentButton();
20
21    //***** BOTTOM MENU *****/
22    initBottomMenu();
23}
```

Figure 6.11: The `onCreate` method, which calls the button initializers in the same order as they are shown in the layout.

```

1    private void initStyleChoser() {
2        hourglassButton = (Button) getActivity().findViewById(
3            R.id.houglassButton);
4        hourglassButton.setOnClickListener(new OnClickListener() {
5
6            public void onClick(View v) {
7                selectStyle(formFactor.Hourglass);
8            }
9        });
10
11        timetimerButton = (Button) getActivity().findViewById(
12            R.id.timetimerButton);
13        timetimerButton.setOnClickListener(new OnClickListener() {
14
15            public void onClick(View v) {
16                selectStyle(formFactor.TimeTimer);
17            }
18        });
19
20        progressbarButton = (Button) getActivity().findViewById(
21            R.id.progressBarButton);
22        progressbarButton.setOnClickListener(new OnClickListener() {
23
24            public void onClick(View v) {
25                selectStyle(formFactor.ProgressBar);
26            }
27        });
28
29        digitalButton = (Button) getActivity().findViewById(R.id.
30            digitalButton);
31        digitalButton.setOnClickListener(new OnClickListener() {
32
33            public void onClick(View v) {
34                selectStyle(formFactor.DigitalClock);
35            }
36        });

```

Figure 6.12: The style chooser initialization method, which utilize the `selectStyle` that changes the style of the timer and highlights the button.

Buttons in Customize

There is four kinds of buttons in the customize fragment:

- Start, save, and style buttons.

- Time picker wheels.
- Color picker.
- Attachment and done pictogram button.

Start Button

The style, save, start, and attachment buttons are default Android buttons with a picture attached on top. The differences of these buttons is the `onClick` event handler, figure 6.13 is the source code of the start button.

```

1 private void initStartButton() {
2     startButton = (Button) getActivity().findViewById(
3         R.id.customize_start_button);
4     Drawable d;
5     if (currSubP.saveAs) {
6         d = getResources().getDrawable(R.drawable.thumbnail_start);
7         startButton.setOnClickListener(new OnClickListener() {
8
8     public void onClick(View v) {
9         currSubP.addLastUsed(preSubP);
10        guard.saveGuardian(currSubP);
11        currSubP.select();
12        Intent i = new Intent(
13            getActivity().getApplicationContext(),
14            DrawLibActivity.class);
15        startActivity(i);
16    }
17 });
18 } else {
19     ...
20 }
21 });
22 }
23
24 startButton
25     .setCompoundDrawablesWithIntrinsicBounds(null, d, null, null);
26 }
```

Figure 6.13: The source code of the start button, which sets the top image of the button to the drawable `thumbnail_start_gray`

Time Picker Wheels

The time picker is a widget[16]. All functionality of the wheel widget is handled by the widget itself and only requires the widget to be imported to Eclipse and added as a project library, which is a built-in feature in the Android development environment.

WOMBAT is limited to timers on 60 minutes, therefore we implement a functionality which sets the seconds wheel to zero whenever the minutes wheel is set to 60, this can be seen in figure 6.14.

```

1 private int previousMins;
2 private int previousSecs;
3 private void initTimePicker() {
4     /* Create minute Wheel */
5     mins = (WheelView) getActivity().findViewById(R.id.minPicker);
6     mins.setViewAdapter(new NumericWheelAdapter(getActivity()
7         .getApplicationContext(), 0, 60));
8     mins.setCyclic(true);
9
10    /* Add on change listeners for both wheels */
11    mins.addChangingListener(new OnWheelChangedListener() {
12        public void onChanged(WheelView wheel, int oldValue, int
13            newValue) {
14            updateTime(mins.getCurrentItem(), secs.getCurrentItem());
15
16            if (mins.getCurrentItem() == 60) {
17                previousMins = 60;
18                previousSecs = secs.getCurrentItem();
19
20                secs.setCurrentItem(0);
21                secs.setViewAdapter(new NumericWheelAdapter(getActivity()
22                    .getApplicationContext(), 0, 0));
23                secs.setCyclic(false);
24            } else if (previousMins == 60) {
25                secs.setViewAdapter(new NumericWheelAdapter(getActivity()
26                    .getApplicationContext(), 0, 60));
27
28                secs.setCurrentItem(previousSecs);
29                secs.setCyclic(true);
30                previousMins = 0;
31            }
32        }
33    });
}

```

Figure 6.14: The time picker wheels.

Color Picker

Just like the time picker wheels we utilize the widget functionality in Android to implement a widget called AmbilWarna¹, to handle the color picker[12]. The color picker widget is a custom dialog which returns the color picked by

¹AmbilWarna means "Take Color" in Indonesian

the user in the widget, the implementation of the color picker widget can be found in Figure 6.15.

```
1 colorGradientButton2 = (Button) getActivity().findViewById(
2     R.id.gradientButton_2);
3 setColor(colorGradientButton2.getBackground(), currSubP.
4     timeSpentColor);
5 colorGradientButton2.setOnClickListener(new OnClickListener() {
6     public void onClick(View v) {
7         AmbilWarnaDialog dialog = new AmbilWarnaDialog(getActivity()
8             ,
9             currSubP.timeSpentColor, new OnAmbilWarnaListener() {
10            public void onCancel(AmbilWarnaDialog dialog) {
11                }
12
13            public void onOk(AmbilWarnaDialog dialog, int color) {
14                currSubP.timeSpentColor = color;
15                setColor(colorGradientButton2.getBackground(),
16                    currSubP.timeSpentColor);
17            }
18        });
19    }
});
```

Figure 6.15: The color picker widget implemented on the second "Time Left" color button

Attachment Button

The attachment buttons are implemented like the start button, the difference is that they make use of a custom dialog in WOMBAT. This custom dialog, `WDialog`, is created because the standard dialogs in Android are very different from the rest of the WOMBAT design. Also the standard dialogs limit the programmer to use exactly the buttons defined in the dialog API. The custom dialog is implemented because the standard dialogs are inconsistent with the WOMBAT design and the custom dialogs are much more versatile when adding buttons. Figure 6.16 is an example of how a dialog could be specified.

```

1 final WDialog attachment1 = new WDialog(getActivity() ,
2     R.string.attachment_dialog_description);
3
4 ModeAdapter adapter = new ModeAdapter(getActivity() ,
5     android.R.layout.simple_list_item_1 , mode);
6
7 attachment1.setAdapter(adapter);
8
9 attachment1.addButton(R.string.cancel , 1 ,
10    new OnClickListener() {
11
12        public void onClick(View arg0) {
13            attachment1.cancel();
14        }
15    });

```

Figure 6.16: Initialization of the dialog, that appears when the attachment button is clicked, the `OnItemClickListener` is not shown here because of lack of space on the page.

6.5 Backend Library

The libraries in WOMBAT each control the storage and drawing functionality of the application. These functionalities have been imported as Android project libraries, because this gives the developer the ability to create an external project and test the library, without being dependent on a working main project.

Furthermore is a benefit that the libraries works like modules which can be changed to handle e.g. OpenGL instead of canvas in the `DrawLib`.

6.5.1 TimerLib

`TimerLib` contains the functionality that store and manage all the different objects that WOMBAT uses. The main goal of `TimerLib` is to provide a set of simple methods and objects which the rest of WOMBAT can use without knowledge of how `TimerLib` works. This goal is achieved by being strict about visibility of attributes and methods.

Classes

The `TimerLib` classes are described in the following.

Guardian

The `Guardian` class is an object that represent the guardian in our system. The idea of the GIRAF system is that only one guardian can be logged in at a given time, that is why the `Guardian` class use a singleton pattern to enforce WOMBAT to never have more than one guardian logged into the application. There are two `getInstance` methods in the `Guardian` class, and when initiating the `Guardian` class for the first time, it is important to use the method seen in code snippet 6.17. The method will always return the same guardian due to the singleton pattern.

```
1 private static Guardian _instance = null;
2
3 public static Guardian getInstance(long m_childId, long
4     m_guardianId, Context c, ArrayList<Art> artList){
5     if(_instance == null){
6         _instance = new Guardian();
7         _instance.ArtList = artList;
8         TimerHelper help = new TimerHelper();
9         _instance.profileID = m_childId;
10        _instance.guardianId = m_guardianId;
11        _instance.m_context = c;
12        _instance.oHelp = new Helper(c);
13        long appId = _instance.findAppId();
14        _instance.guardianId = _instance.findGuardianId();
15        _instance.createChildren();
16        _instance.crud = new CRUD(appId, c);
17        _instance.crud.loadGuardian(_instance.guardianId);
18        help.loadPredef();
19        //_instance.crud.initLastUsed(_instance.m_oGuard.getId());
20        _instance.publishList();
21        //crud.retrieveLastUsed(m_guardianId);
22    }
23    return _instance;
}
```

Figure 6.17: Code snippet to initiate the `Guardian` object.

Whenever the back button is pressed while WOMBAT is on the main screen, WOMBAT calls the reset method which resets the `Guardian` and exits the application. The reset method can be seen in code snippet 6.18. The reset method sets the `Guardian` instance to null, such that next time the `getInstance` method is called it will create a new

Guardian object, we are doing so because Java has a garbage collector and therefore we can not manually destroy an object.

```
1 public void reset() {
2     _instance = null;
3 }
```

Figure 6.18: Code snippet to reset the **Guardian** object.

The **Guardian** class creates a **Guardian** if WOMBAT does not receive a valid **Guardian** id, this is to ensure that WOMBAT can run outside the GIRAf launcher. In code snippet 6.19 you can see the method which checks and creates a new **Guardian**.

```

1  private long findGuardianId() {
2      if(guardianId != -1){
3          // Does the original guard exist
4          m_oGuard = oHelp.profilesHelper.getProfileById(guardianId)
5          ;
6      } else {
7          m_oGuard = null;
8      }
9      // If not, try the default guard
10     if(m_oGuard == null){
11         for (Profile p : oHelp.profilesHelper.getProfiles()) {
12             if(p.getFirstname().equals("John") && p.getSurname().
13                 equals("Doe")){
14                 m_oGuard = p;
15                 break;
16             }
17         }
18         // If that's not valid either, make the default guard
19         if(m_oGuard == null){
20             m_oGuard = new Profile("John", "Doe", null, 1, 88888888,
21                 null, null);
22             m_oGuard.setId(oHelp.profilesHelper.insertProfile(
23                 m_oGuard));
24             oHelp.appsHelper.attachAppToProfile(m_app, m_oGuard);
25             oHelp.profilesHelper.setCertificate("jkkxla ... hfwsh",
26                 m_oGuard);
27         }
28     }
29     return m_oGuard.getId();
30 }

```

Figure 6.19: Code snippet to create a default **Guardian**.

The **Guardian** class also creates a list of profiles if the current **Guardian** has no relation to any profiles. The code snippet ?? shows how this is done.

```

1  private void createChildren() {
2      if(oHelp.profilesHelper.getChildrenByGuardian(m_oGuard) .
3          isEmpty()){
4          List<String> names = new ArrayList<String>();
5          names.add("Sigurd");
6          names.add("Marcus");
7          names.add("Emil");
8          names.add("Lukas");
9          names.add("Mads");
10         names.add("Nikolaj");
11
12         for (String s : names) {
13             Profile newProf = new Profile(s, " ", null, 3, 99999999,
14                 null, null);
15             newProf.setId(oHelp.profilesHelper.insertProfile(newProf
16                 ));
17             oHelp.profilesHelper.attachChildToGuardian(newProf,
18                 m_oGuard);
19             oHelp.appsHelper.attachAppToProfile(m_app, newProf);
20         }
21     }
22 }
```

Figure 6.20: Code snippet to create default profiles.

The **Guardian** class generates an list, of the object type **Child**, from three lists; last used, predefined, and the profiles related to the **Guardian**. In code snippet 6.21 you can see how this list is generated. It is important to know that any changes made on this list will not be saved. Last used is always in the top of the list and right after is the predefined and after that the profiles are listed alphabetically.

```

1    public ArrayList<Child> publishList() {
2        if (_sortedList == null) {
3            _sortedList = new ArrayList<Child>();
4        }
5        _sortedList.clear();
6        Child lastUsedChild = new Child("Last Used");
7        lastUsedChild.setProfileId(-3);
8        lastUsedChild.SubProfiles().addAll(reverse(lastUsed()));
9        lastUsedChild.setLock();
10       lastUsedChild.lockDelete();
11       _sortedList.add(lastUsedChild);
12
13       Child predefChild = new Child("Predefined Profiles");
14       predefChild.setProfileId(-2);
15       Collections.sort(predefined());
16       predefChild.SubProfiles().addAll(predefined());
17       predefChild.setLock();
18       predefChild.lockDelete();
19       _sortedList.add(predefChild);
20       if (_guard != null) {
21           Collections.sort(_guard);
22           for (Child p : _guard) {
23               Collections.sort(p.SubProfiles());
24           }
25           _sortedList.addAll(_guard);
26       }
27       return _sortedList;
28   }

```

Figure 6.21: Code snippet to generate the list containing last used, predefined, and the profiles related to the `Guardian`.

Child

The `Child` class is an object that represent either last used, predefined, or a profile. The `Child` object, no matter what it represents, has a collection of `SubProfiles`, which is a list of configurations. The user is not allowed to save or delete from the last used and predefined list, the `Child` class therefore provides two kinds of locks, a save lock and a delete lock. When the save lock is true, you cannot save a configuration on the `Child` object. When the delete lock is false, you cannot delete configurations from the `Child` object. Both delete and save lock is read only for projects outside `TimerLib`, this is because the WOM-BAT should never lock any `Child` objects that are loaded from the

`OasisLocalDatabase`. The lock methods can be seen in code snippet 6.22.

```
1  /**
2  * Used to check if you can save on a specific Child
3  * @return boolean , if true , you cannot save on the child. if
4  *         false you can save.
5  */
6  public boolean getLock(){
7      return _lock;
8  }
9  /**
10 * Enables the lock
11 */
12 void setLock(){
13     this._lock = true;
14 }
15 /**
16 * Enable delete lock , so you cannot delete from a certain
17 * child .
18 * This will always be used on lastUsed and predefined .
19 */
20 void lockDelete(){
21     _deleteCheck = false;
22 }
23 /**
24 * Used to check if you can delete a subprofiles on a specific
25 * child
26 * @return boolean , true = you can delete: false = you cannot
27 *         delete .
28 */
29 public boolean deleteCheck(){
30     return _deleteCheck;
31 }
```

Figure 6.22: Code snippet of how the locks work.

The `Child` class contains a `select` method that selects a certain profile so it can be reused later. The `select` method is called whenever the user highlights a profile in the WOMBAT application. To use a selected profile, a method, `getChild`, is called from the `Guardian` object. The idea of this method is to make it easier to work with the same `Child` object across multiple projects.

The `Child` class provides methods for saving and removing. The `save`

method saves a certain `SubProfile` either as a new `SubProfile` or overrides a old `SubProfile`, the `save` method calls `addChild` from `Guardian` to make sure it is saved in the `OasisLocalDatabase`. The `remove` method removes a certain `SubProfile` from the `Child` and calls `removeSubprofileFromProfileId` from `Guardian` to delete the `SubProfile` from the `OasisLocalDatabase`. You can see `save` and `remove` method in code snippet 6.23.

```

1   public SubProfile save(SubProfile p, boolean override){
2
3     if (!override){
4       p.setDB_id(getNewId());
5       p.setId(guard.getId());
6     }
7     this.SubProfiles().add(p);
8     guard.addChild(this, p);
9
10    return p;
11  }
12
13  public void remove(SubProfile p) {
14    _profileList.remove(p);
15    guard.crud.removeSubprofileFromProfileId(p, this.
16      getProfileId());
17 }
```

Figure 6.23: Code snippet of how to `save` and `remove` `SubProfile`.

SubProfile

The `SubProfile` class is a super class for all the different kinds of timers which WOMBAT supports. The idea of having a super class that represent the timers is to make it possible to have a collection of all types of timers. Originally the `SubProfile`, and the classes which inherits from it, should contain methods to draw the timers, find more in section 6.1. See code snippet 6.24 for an example of how `SubProfile`, and classes which inherits from it, was meant to work.

```

1 Hourglass hourglass = new Hourglass("Timeglas - 30 sek", "Timeglas - (0:30)", 0xff3D3D3D, 0xffffffff, 0xffB8B8B8, 0
2 xff000000, 30, false);
3 ProgressBar progressbar = new ProgressBar("ProgressBar - 30 sek", "ProgressBar - (0:30)", 0xff3D3D3D, 0xffffffff, 0
4 xffB8B8B8, 0xff000000, 30, false);
5 DigitalClock digitalclock = new DigitalClock("DigitalClock - 30 sek", "DigitalClock - (0:30)", 0xff3D3D3D, 0xffffffff
6 , 0xffB8B8B8, 0xff000000, 30, false);
7 TimeTimer timetimer = new TimeTimer("Ur - 30 sek", "Ur - (0:30)", 0xff3D3D3D, 0xffffffff, 0xffB8B8B8, 0xff000000,
8 30, false);
9 ArrayList<SubProfile> timers = new ArrayList<SubProfile>();
10 timers.add(hourglass);
11 timers.add(progressbar);
12 timers.add(digitalclock);
13 timers.add(timetimer);
14 for (SubProfile sp : timers){
    View v = sp.draw();
}

```

Figure 6.24: Code snippet of how **SubProfile** was meant to work.

All **SubProfiles** got two different ids. The first id is used internal in the **TimerLib**, this id is used to check if the **SubProfile** already exists in the last used list and check if the **SubProfile** already exist on a certain **Child** object and thereby overriding that **SubProfile**. The internal id is provided by the **Guardian** class. The other id matches the **SubProfile**'s id in the **OasisLocalDatabase**, the id is used for deleting a **SubProfile** in the **OasisLocalDatabase**.

WOMBAT loads a copy of a configuration into the customize fragment. The idea of using a copy is because, we want to allow the user to change options on a configuration and start the timer without saving. If the user saves the modified configuration, this will replace the original configuration.

It is possible to change the type of a **SubProfile** by using one of the four object convert methods. You can see these four methods in code snippet 6.25.

```

1    public SubProfile toHourglass() {
2        Hourglass form = new Hourglass(this.name, this.desc, this.
3            bgcolor, this.timeLeftColor, this.timeSpentColor, this.
4            frameColor, this._totalTime, this.gradient);
5        form.setId(this.getId());
6        form.setAttachment(this._attachment);
7        form.setDoneArt(this._doneArt);
8        return form;
9    }
10
11   public SubProfile toProgressBar() {
12       ProgressBar form = new ProgressBar(this.name, this.desc,
13           this.bgcolor, this.timeLeftColor, this.timeSpentColor,
14           this.frameColor, this._totalTime, this.gradient);
15       form.setId(this.getId());
16       form.setAttachment(this._attachment);
17       form.setDoneArt(this._doneArt);
18       return form;
19   }
20
21   public SubProfile toTimeTimer() {
22       TimeTimer form = new TimeTimer(this.name, this.desc, this.
23           bgcolor, this.timeLeftColor, this.timeSpentColor, this.
24           frameColor, this._totalTime, this.gradient);
25       form.setId(this.getId());
26       form.setAttachment(this._attachment);
27       form.setDoneArt(this._doneArt);
28       return form;
29   }
30
31   public SubProfile toDigitalClock() {
32       DigitalClock form = new DigitalClock(this.name, this.desc,
33           this.bgcolor, this.timeLeftColor, this.timeSpentColor,
34           this.frameColor, this._totalTime, this.gradient);
35       form.setId(this.getId());
36       form.setAttachment(this._attachment);
37       form.setDoneArt(this._doneArt);
38       return form;
39   }

```

Figure 6.25: Code snippet of the four object converters.

Whenever a configuration is started it will be added to the last used list, if the configuration already exist in the last used list, it will be removed and added again, that way we ensure that the configuration

in the last used list is the newest version of the configuration, and it is placed in the top of the last used list. You can see the method for adding a configuration to the last used list in code snippet 6.26.

```

1  public void addLastUsed(SubProfile oldProfile){
2      if(oldProfile == null){
3          guard.addLastUsed(this);
4      } else {
5          this._id = oldProfile._id;
6          this.refPro = oldProfile.DB_id;
7          long ref = 0;
8          for(Child c : guard.Children()){
9              for(SubProfile p : c.SubProfiles()){
10                  if(p.getId() == this.getId()){
11                      ref = c.getProfileId();
12                  }
13              }
14          }
15          for(SubProfile p : guard.predefined()){
16              if(p.getId() == this.getId()){
17                  ref = -2;
18              }
19          }
20          this.refChild = ref;
21          guard.addLastUsed(this);
22      }
23  }

```

Figure 6.26: Code snippet of how to add a configuration to the last used list.

A configuration may contain an attachments which will be placed next to the active timer. Furthermore it is possible to change the default done screen pictogram, which is also treated as an attachment. You can read more about the **Attachment** class later in this section.

OasisLocalDatabase saves the configuration as a hashmap, for that **SubProfile** provides a method for generating a hashmap with all the needed attributes. You can see this method in code snippet 6.27.

```

1  public HashMap<String , String> getHashMap(){
2      HashMap<String , String> map = new HashMap<String , String>();
3      map . put( "db_id" , String . valueOf( this . getDB_id() ) );
4      map . put( "type" , this . formType(). toString() );
5      map . put( "Attachment" , String . valueOf( this . _AttaBool ) );
6      map . put( "Name" , this . name );
7      map . put( "desc" , this . desc );
8      map . put( "bgcolor" , String . valueOf( this . bgcolor ) );
9      map . put( "timeLeftColor" , String . valueOf( this . timeLeftColor ) )
10     ;
11     map . put( "timeSpentColor" , String . valueOf( this . timeSpentColor )
12         );
13     map . put( "frameColor" , String . valueOf( this . frameColor ) );
14     map . put( "totalTime" , String . valueOf( this . get_totalTime() ) );
15     map . put( "gradient" , String . valueOf( this . gradient ) );
16     map . put( "save" , String . valueOf( this . save ) );
17     map . put( "saveAs" , String . valueOf( this . saveAs ) );
18     map . put( "refChild" , String . valueOf( this . refChild ) );
19     map . put( "refPro" , String . valueOf( this . refPro ) );
20     map . put( "timeKey" , String . valueOf( this . timeKey ) );
21     if( this . _doneArt != null ){
22         map . put( "doneArtType" , String . valueOf( this . _doneArt .
23             getForm() ) );
24         switch( this . _doneArt . getForm() ){
25             case SingleImg:
26                 map . put( "doneArtPic" , String . valueOf( this . _doneArt .
27                     getImg() . getId() ) );
28                 map . put( "doneArtLeftPic" , String . valueOf( -1 ) );
29                 map . put( "doneArtRightPic" , String . valueOf( -1 ) );
30                 break;
31             case SplitImg:
32                 map . put( "doneArtPic" , String . valueOf( -1 ) );
33                 map . put( "doneArtLeftPic" , String . valueOf( this . _doneArt .
34                     getLeftImg() . getId() ) );
35                 map . put( "doneArtRightPic" , String . valueOf( this . _doneArt .
36                     getRightImg() . getId() ) );
37                 break;
38             }
39         } else {
40             map . put( "doneArtType" , String . valueOf( formFactor . undefined
41                 ) );
42             map . put( "doneArtPic" , String . valueOf( -1 ) );
43             map . put( "doneArtLeftPic" , String . valueOf( -1 ) );
44             map . put( "doneArtRightPic" , String . valueOf( -1 ) );
45         }
46         // TODO: Attachment this needs some testing and remember to
47         // add it to the crud!!!!
48         if( this . _AttaBool ){
49             map = this . _attachment . getHashMap( map );
50         } else {
51             Attachment tempAttachment = new Attachment();
52             map = tempAttachment . getHashMap( map );
53         }
54         return map;
55     }

```

Figure 6.27: Code snippet for generating a hashmap with the needed at-

TimeTimer - Hourglass - ProgressBar - DigitalClock

These four classes inherit from `SubProfile`, and it currently the only type of timers WOMBAT supports.

Attachment

The `Attachment` class is a super class and does only contain the base methods of the inherited classes. The idea of having a super class is for making `TimerLib` more dynamic.

Timer

The `Timer` class inherits from the `Attachment` class. The `Timer` class represent a `SubProfile` as an attachment. The `Timer` class were made to simplify the attachment methods and only display the methods other projects might need. The `Timer` class supports all types of `SubProfile` objects. The `Timer` class contains a method which returns a hashmap, that is used when saving a configuration with an attachment into the `OasisLocalDatabase`. You can see the method in code snippet 6.28.

```
1  public HashMap getHashMap(HashMap map){  
2      //Defines what kind of attachment it is  
3      map.put("AttachmentForm", String.valueOf(this.getForm()));  
4  
5      //Timer  
6      map.put("timerForm", String.valueOf(this._form));  
7      map.put("_bgColor", String.valueOf(this._bgColor));  
8      map.put("_frameColor", String.valueOf(this._frameColor));  
9      map.put("_timeLeftColor", String.valueOf(this._timeLeftColor))  
10     );  
11     map.put("_timeSpentColor", String.valueOf(this.  
12         _timeSpentColor));  
13     map.put("_gradient", String.valueOf(this._gradient));  
14  
15     //SingleImg  
16     map.put("singleImgId", String.valueOf(-1));  
17  
18     //SplitImg  
19     map.put("leftImgId", String.valueOf(-1));  
20     map.put("rightImgId", String.valueOf(-1));  
21  
22     return map;  
23 }
```

Figure 6.28: Code snippet of how to generate a hashmap of an attachment.

SingleImg

The `SingleImg` class inherit from `Attachment`. This class represents one object of the type `Art`, you can read more about the `Art` class later in this section. The `SingleImg` object can be set either as an attachment next to a timer, or as a pictogram for the done screen. `SingleImg` contains a hashmap method with same structure as the one in the `Timer` class.

SplitImg

The `SplitImg` class inherit from `Attachment`. This class represents two objects of the type `Art`. The `SplitImg` object can be set either as an attachment next to a timer or as pictograms for the done screen. `SplitImg` contains a hashmap method with same structure as the one in the `Timer` class.

Art

The `Art` class is used for generating pictograms as objects in `TimerLib`. The `Art` class constructor takes three arguments; The first argument is the path to the pictogram, the path is an integer that is the id from the resource class in Android. The second argument is a caption which is a string, that is used to add text to a pictogram. The last argument is a unique identifier as an integer. The id need to be the position it got in the `ArtList` from `Guardian`. In future development, this id should be set by the `TimerLib` and not by the WOMBAT project. If one was to implement sounds into WOMBAT, the `Art` class would be the place to do it.

formFactor

The `formFactor` class is a `enum` class which is used to manage object types. It contains nine `enums` which are; `undefined`, `SubProfile`, `Hourglass`, `TimeTimer`, `ProgressBar`, `DigitalClock`, `Timer`, `SingleImg`, and `SplitImg`. They all represent their own kind of object.

TimeHelper

The `TimeHelper` class contains two functions; the first function is its main function, to generate the predefined configurations. The second function is a method which generates test data.

CRUD

The `CRUD` class responsibility is to create, retrieve, update, and delete `Guardian`, `Child`, and `SubProfile` objects in the `OasisLocalDatabase`. The `CRUD` class is only called from within the `Guardian` class. This is

done to make it easy to change the way WOMBAT create, retrieve, update, and delete objects, if WOMBAT was ever to be released as a fully independent application.

Class diagram

You can see a simplified class diagram on figure: 6.29.

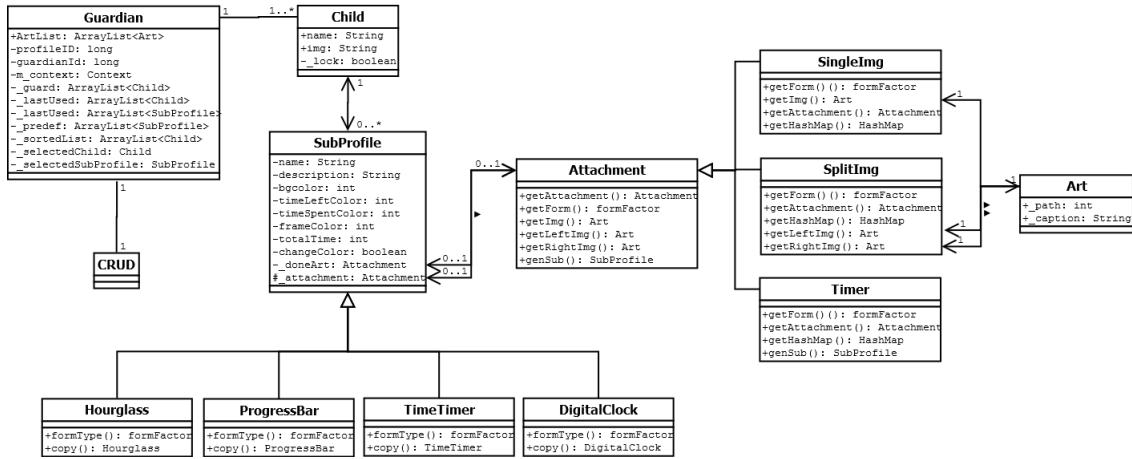


Figure 6.29: Dependecy diagram of WOMBAT projects

6.5.2 DrawLib

DrawLib contains the functionality that draws timers according to the settings set in the main activity. The main functionality in the DrawLib is that it can be either full screen, if there is no timer or pictogram attached, or it can be split screen if there is a timer or pictogram attached. This is done by creating the view layout programmatically instead of a static layout, figure 6.30 is an example of this functionality with a full screen timer, figure 6.31 is an example of the functionality with a split screen timer. In both figures the method `genDrawView` is a method which returns the draw view, that matches the timer specified in customization, figure 6.32 is a code example of `genDrawView`.

```

1 public void onCreate(Bundle savedInstanceState) {
2     super.onCreate(savedInstanceState);
3     requestWindowFeature(Window.FEATURE_NO_TITLE);
4     View main_layout = findViewById(android.R.id.content).
5         getRootView();
6     main_layout.setSystemUiVisibility(View.STATUS_BAR_HIDDEN);
7     Guardian guard = Guardian.getInstance();
8     SubProfile sub = guard.getSubProfile();
9
10    // Get display size and store it in static variables
11    WindowManager wm = (WindowManager) getSystemService(Context.
12        WINDOW_SERVICE);
13    Display disp = wm.getDefaultDisplay();
14    frameHeight = disp.getHeight();
15    frameWidth = disp.getWidth();
16
17    if (sub.getAttachment() == null) {
18        /* Set the drawing class (which extends View) as the content
19           view */
20        View v = genDrawView(sub, frameWidth);
21        v.setKeepScreenOn(true);
22        setContentView(v);
23    }
24    ...
25}

```

Figure 6.30: Example of how DrawLib sets just one timer view.

```
1 LinearLayout frame = new LinearLayout(this);
2 frame.setKeepScreenOn(true);
3 GradientDrawable gd = new GradientDrawable(GradientDrawable.Orientation.TOP_BOTTOM, new int[] {sub.bgcolor, 0xFF000000});
4 ...
5 ...
6 switch(sub.getAttachment().getForm()){
7 case Timer:
8     frameWidth = frameWidth/2;
9     firstView = genDrawView(sub, frameWidth);
10    frame.addView(firstView, frameWidth, frameHeight);
11
12    secondView = genDrawView(sub.getAttachment().genSub(), frameWidth);
13    frame.addView(secondView, frameWidth, frameHeight);
14    break;
15 case SingleImg:
16     ...
17 case SplitImg:
18     ...
19 }
20 ...
21 setContentView(frame);
```

Figure 6.31: Example of how DrawLib sets two timers in one view

```

1 private View genDrawView(SubProfile sub, int frameWidth) {
2     switch (sub.formType()) {
3         case ProgressBar:
4             return new DrawProgressBar(getApplicationContext(), sub,
5                 frameWidth);
6         case Hourglass:
7             return new DrawHourglass(getApplicationContext(), sub,
8                 frameWidth);
9         case DigitalClock:
10            return new DrawDigital(getApplicationContext(), sub,
11                frameWidth);
12        case TimeTimer:
13            return new DrawWatch(getApplicationContext(), sub,
14                frameWidth);
15        default:
16            return null;
17    }
18}

```

Figure 6.32: The genDrawView, which generates the draw view matching the timer

Canvas and OpenGL comparision

The timers in DrawLib are drawn with the Android canvas object, this could also have been done by creating and modelling an object in OpenGL. The major difference between the two approaches is that OpenGL is used to draw three dimensional objects and Android canvas can only draw in two dimensions. Drawing on a canvas is like drawing on coordinates, while drawing in OpenGL varies in the way that one will be drawing in triangles. Drawing in OpenGL is therefor much different from the way one would normally draw, thereby more time consuming. Since all timers in WOMBAT can be modelled in two dimensions, the only benefits of OpenGL compared to canvas is that one would be able to move the camera around or change the lighting in OpenGL.

All timers are classes which inherits the view class, the view class draws in a method called `onDraw` which is called the first time it is opened and whenever the method `invalidate()` is invoked. The timers draw inside the `onDraw` method, as seen in figure 6.33.

```

protected void onDraw(Canvas c) {
    super.onDraw(c);

    ... // Initialization of time + Draw Background and frame

    /* Draw the backgroundcolor inside the frame */
    paint.setColor(background);
    r.set(r.left + 2, r.top + 2, r.right - 2, r.bottom - 2);
    c.drawRect(r, paint);

    /* Draw the timespent color (on the right) on top of the
       timeleft */
    paint.setColor(timespent);
    r.set(left + 3, top + 3, left + width - 3, top + height - 3);
    c.drawRect(r, paint);

    if (endTime >= System.currentTimeMillis()) {
        timenow = endTime - System.currentTimeMillis();
        double percent = (timenow) / totalTime;

        paint.setColor(timeleft2);
        r.set((int) ((left + 3) + ((width - 5) * (1 - percent))), top
              + 3, (left + 3) + width - 5, top
              + height - 3);
        c.drawRect(r, paint);
    }

    /* Draw the gradient color */
    ...

    /***** IMPORTANT *****/
    /* Recalls Draw! */
    invalidate();
} else {
    paint.setColor(timespent);
    r.set(left + 3, top + 3, left + width - 3, top + height - 3)
    ;
    c.drawRect(r, paint);
}
}

```

Figure 6.33: The onDraw method of the progress bar.

The progress bar and the hourglass both draws according to how many percent of the total time is left, while the digital watch and the time timer draws according to the exact time left. All timers evaluates the time left

according to the number of milliseconds elapsed, which is provided by the system timer.

Drawing can be time consuming and to optimize the timers, the background and frame is painted and stored as a bitmap file at the initialization of the view. The stored bitmap can then be redrawn on the canvas without having to be recalculated, this was especially useful when drawing the digital watch since all numbers has to be redrawn every time the view is reevaluated. With the bitmap it is possible to draw the numbers once and then blank out the lines not needed when reevaluating.

CHAPTER 7

Test

The WOMBAT application is tested through dynamic black box testing, which means that we run the application, and test the functionality through the user interface, without viewing the code. We have made test design and test cases for some of the most important functionality, so that we could outsource the test to one of the other project groups, if they had time to help us. This was not the case, so we did the testing ourselves.

7.1 Test Design

The test designs are split into four schemes, which are listed in this section.

Identifier Save and load.

Feature Saving and loading configurations.

Approach NB! Check if the configuration has changed in the database by closing the application and resetting the memory (RAM).

- Create a configuration in three ways:
 - Click "New Template" and click "Save As".

- Edit a current configuration and click "Save As".
- Check if it is possible to "Save As" a configuration in "Predefined" or "Last Used".
- Check if loaded settings are the same as the when they were saved.
- Edit and save (by clicking "Save") each of the configuration:
 - Check if it is possible to save configurations in "Predefined" or "Last Used".
 - Check if they have the settings they were saved with.
 - Check if there is any duplicates of any of the configurations.
 - Check if any other configuration was changed while editing.

Test case ID

1. Check save as functionality - *saveAs#1*
2. Check save functionality - *save#1*

Pass/fail criteria Pass

- It is possible to create a new configuration by clicking "New Template" and "Save As".
- It is possible to make a new configuration by clicking "Save As" on any configuration.
- No profiles in "Last Used" or "Predefined" is editable.
- It is not possible to save new profiles to "Last Used" or "Predefined".

Fail

- If any of the above does not hold.
- When saving with "Save" the configuration is being duplicated.
- When saving another configuration is being altered.

Identifier Last used is updated correct

Feature When a timer has been used, it should lie in the top of the list of last used configurations.

Approach

1. Start any timer
 - Check if the timer has been added to the last used list
2. Repeat step [1] 7 times with different timers
3. Start any of the timers in "Last Used" and check if it is being moved to the top of the list.

Test case ID

1. Check "last used" functionality - *checkLastUsed#1*

Pass/fail criteria Pass

- Every time a timer used, it is saved on the top of the "Last Used" list.

Fail

- If, in any case, a timer is not saved in the "Last Used" list after it has been used.
-

Identifier Highlight is working

Feature When choosing a child or a configuration this should be highlighted, and when Wombat is started from the GIRAf launcher a child is chosen, this should be highlighted.

Approach

1. Test if children and configurations is being highlighted when they are chosen.
2. Test if the child chosen in the GIRAf launcher is being highlighted in Wombat.
3. Test if the child chosen is still highlighted after saving.

NOTE! An element in the child list is chosen if there is configurations in the configurations list, and an element in the configurations list is chosen if there is loaded a configuration in the edit screen.

Test case ID

1. Check if list elements is highlighted when clicked - *hOnClick#1*
2. Check if child is still highlighted after save - *stillHAfterSave#1*
3. Check if the right child is highlighted after launch through the GIRAf launcher - *hChildOnLaunch#1*

Pass/fail criteria Pass

- If list elements are always highlighted when selected.

Fail

- If a child is selected and it is not highlighted.
- If a configuration is selected and it is not highlighted.
- If nothing is highlighted when starting Wombat from the GIRAf Launcher

Identifier Deviation in time on done activity

Feature When the timer has run out, the "Done" screen will appear.

Approach

1. Run a timer with any timespan, and wait for the "Done" screen to appear
 - Use an independent stopwatch to verify the time it takes to show the "Done" screen.
 - Verify that there is no more than a 2 second deviation in time, from the time has run out until the "Done" screen appears.
2. Repeat step [1] 3 times with different timespans.
3. Do step [2] again with any timer with a "Digital Watch" attached.
4. Start a timer with any timespan, click the "back" button, and verify that the "Done" screen do not show up randomly.

Test case ID

1. Check if timer matches real-life time - *checkTimerTime#1*
2. Check if the done screen appears when it should - *checkDoneFunc#1*

Pass/fail criteria Pass

- If the "Done" screen appears no more than two seconds after the time has run out.
- If any timer is not deviating more than two seconds from real-world time.

Fail

- The "Done" screen appears even though the timer is not running anymore or the timer is not finished.
-

7.2 Test Cases

Identifier *saveAs#1*

Test item Functionality to save customized timers in specific lists.

Input spec.

1. Click "New Template", choose a timer type, click "Save As", and choose name and location. Check if the profile was saved in the chosen location and with the chosen name.
2. Choose any configuration, edit the settings, click "Save As", and choose name and location. Check if the profile was saved in the chosen location and with the chosen name.
3. Create a new configuration with random settings and use "Save As" to save it. Go to the saved configuration, and check if the settings has changed since the save.

4. Choose an existing configuration or create a new one, and do step 1. with "Predefined" and "Last Used" as save locations.
5. Do step 1-3 again, but clear the tablet memory before the correctness is checked.

Output spec.

1. Configurations is saved in the chosen locations, unless the chosen locations is "Predefined" or "Last Used".
2. Configurations is saved with the chosen name.
3. Configurations is saved with the chosen settings.

environmental needs

- Tablet running Android 3.2.
 - Timer application installed.
 - OasisLocalDatabase installed.
 - One staff member to perform the test.
-

Identifier *save#1*

Test item Functionality to save customized or predefined timers in the highlighted child, without having to choose name and location.

Input spec.

1. Check if it is possible to save configurations in "Predefined" or "Last Used" by choosing one of the configurations in each list, edit some settings, and press "Save".
2. Select a child, edit the settings, and press "Save". Check if the chosen settings were saved.
3. Select a child, select a configuration among the child's configurations, edit the settings, and press "Save". Check if the chosen settings were saved in the same configuration.

4. Select a child, edit the settings, and press "Save" two times and see if two identical configurations are saved on the given child.
5. Highlight another configuration than the one you have just saved, then highlight the one you just saved and press "Save". Check if there is now saved a duplicate of the first saved configuration.
6. Do step 2-3 again and check if any other configuration was changed during the saving process.

Output spec.

1. Configurations is saved in the highlighted child.
2. When "Predefined" or "Last Used" is highlighted, nothing is saved when the "Save" is pressed.
3. New configurations are saved with the chosen settings.
4. When selecting and saving existing configurations, they are updated with the edited settings.

environmental needs

- Tablet running android 3.2.
 - Timer application installed.
 - OasisLocalDatabase installed.
 - One staff member to perform the test.
-

Identifier *checkLastUsed#1*

Test item Functionality to save timers into the "Last Used" list every any timer has been run.

Input spec.

1. Run 3 different timers, and see if they were saved on top if the "Last Used" list.
2. Repeat step 1, but clear the tablet memory before "Last Used" is inspected.

Output spec.

1. Whenever a timer has been used, it is saved on top of the "Last Used" list.

environmental needs

- Tablet running android 3.2.
 - Timer application installed.
 - OasisLocalDatabase installed.
 - One staff member to perform the test.
-

Identifier *hOnClick#1*

Test item Functionality to highlight list items when they are clicked.

Input spec.

1. Select three different list items in both the child list and the configuration list and see if they stay highlighted.

Output spec.

1. When a list item is selected, it is highlighted, and it stays highlighted until another list item is selected.

environmental needs

- Tablet running android 3.2.
- Timer application installed.
- One staff member to perform the test.

Special procedural requirements

- The configurations on every child will always be visible when a child list has been selected. Therefore, make sure that the highlighted child has at least one configuration before testing.
 - There is no element in the configuration list if no element in the child list has been selected.
-

Identifier *stillHAfterSave#1*

Test item Functionality to highlight list items after a save procedure.

Input spec.

1. Select a child and a configuration, edit the settings for the configuration, and click "Save". See if the selected list items stay highlighted after it has been updated.

Output spec.

1. When a child and configuration is selected, and the settings for that configuration is changed and saved, the child list item and configuration list item is still highlighted.

environmental needs

- Tablet running android 3.2.
- Timer application installed.
- One staff member to perform the test.

Special procedural requirements

- The configurations on every child will always be visible when a child list has been selected. Therefore, make sure that the highlighted child has at least one configuration in the list before testing.
- There is no element in the configuration list if no element in the child list has been selected.
- When a configuration is selected, the settings for that configuration is always shown set in the "Customize" menu.

Intercase dependencies *save#1*

Identifier *hChildOnLaunch#1*

Test item Functionality to highlight list items according to the chosen child when the application is launched through the GIRAf launcher.

Input spec.

1. Start the GIRAf launcher and open the timer application.
2. Select a child and note the name of the child.

Output spec.

1. The child selected in the GIRAf launcher is highlighted and the configurations belonging to this child is loaded.

environmental needs

- Tablet running android 3.2.
- Timer application installed.
- GIRAf launcher installed.
- One staff member to perform the test.

Special procedural requirements

- The configurations on every child will always be visible when a child list has been selected. Therefore, make sure that the highlighted child has at least one configuration before testing.
 - There is no element in the configuration list if no element in the child list has been selected.
-

Identifier *checkTimerTime#1*

Test item Functionality which draws and updates the timer according to the time left and ensures the timer ends when the time is up.

Input spec.

1. Run four different timer styles with a static timespan (fx 20 minutes).
2. Each time a timer is started, start a precise independent stopwatch.
3. When the timer reaches zero stop the independent stopwatch.

Output spec.

1. The stopwatch must deviate no more than two seconds from the time selected in **input spec.** step [1].

environmental needs

- Tablet running android 3.2.
 - Timer application installed.
 - Stopwatch.
 - One staff member to perform the test.
-

Identifier *checkDoneFunc#1*

Test item The "Done" screen appearing when the time has run out.

Input spec.

1. Start a timer at any timespan and let the time run out. See if the "Done" screen appears within two seconds after the time has run out.
2. Start a timer at any timespan and click the "back" button, and wait at least the amount of time the timer would have run, to verify that the "Done" screen do not show up anyways, if the timer has been interrupted.

Output spec.

1. When a timer has been run, and not interrupted, the "Done" screen appears about two seconds after the time has run out.
2. The "Done" screen is only shown if the timer is not interrupted, and the time has run out.

environmental needs

- Tablet running android 3.2.
- Timer application installed.
- Stopwatch.
- One staff member to perform the test.

Intercase dependencies Test case: *checkTimerTime#1*

7.3 Test Results

Test Case ID	Pass	Fail	Notes
<i>saveAs#1</i>	X		
<i>save#1</i>	X		
<i>checkLastUsed#1</i>		X	When tablet memory is cleared, the last used timers disappears.
<i>hOnClick#1</i>	X		
<i>stillHAfterSave#1</i>	X		
<i>hChildOnLaunch#1</i>	X		
<i>checkTimerTime#1</i>	X		
<i>checkDoneFunc#1</i>	X		

Table 7.1: Test results of the black box testing of the WOMBAT application.

7.3.1 Reflections

We did not outsource the test, so we did the testing ourselves. This is not the best way to do testing, because we wrote the program, and the test design and test cases, and thereby have a deeper knowledge about the features we want to test, and therefore we may have done things different than persons with no knowledge about the application would have done.

The only test that did not pass was known beforehand (*checkLastUsed#1*). We had trouble implementing the "Last Used" together with the features of the database developed by the admin-group. This resulted in sporadic system failure, so we decided to only use the tablet memory to save the last used timers, and save the correct implementation of this feature to future development.

During the test we stumbled upon a few vague formulations, which could have lead to misunderstandings and different testing method, if the tests had been outsourced. We learned that it is a good idea to run the test ourselves at first, so that we could correct any formulation errors we found, and then the test could be outsourced. This would require even more time, and is not likely to be done in large scale projects, but could have been done in our case.

7.4 Usability Test

In this section we explore the results of the usability test, which was described in section 1.8. We focus only on the results for the Timer application, since we are not going to need the results for the other parts of the GIRAF system.

7.4.1 Results and Observations

Through the IDA method, we found six problems with the application, and they are categorized in table 7.2.

All the problems found, besides the color palette, are design related, and can be corrected without changing any of the implemented functionality. They could be solved by slightly changing the design of buttons and adding more confirmation messages.

To solve the color palette problem, a custom palette could be implemented instead of the imported Android palette, or there could be a number of predefined colors the user can choose from.

[H]

Category	Notes
<i>Cosmetic</i>	1: the users were not sure whether the attachments were selected, when they had chosen the attachments. 2: the user had difficulties finding the "Start"-button.
<i>Serious</i>	1: the user had difficulties using the imported Android color palette. 2: deletion by long-click is not intuitive. 3: the "Last Used" list was difficult to find.
<i>Critical</i>	1: when the background of the Timer application had a certain color, the "Gradient"-button was invisible.

Table 7.2: Problems found from the usability test of the WOMBAT Timer application.

7.5 Acceptance Test

The purpose of an acceptance test[3] is to test if the system fits into the context it is designed for. In this case the main objectives is to find out if it feels natural for the educators to use the timer application instead of their regular hourglasses and time timers, and to find out if the children understand the digital version of the different timers.

To test for acceptability, the system needs to be tested in the context it is developed for, and therefore the contact person borrowed the tablet with the timer application for a few days, so that she could use the system in real life scenarios.

7.5.1 Results and Observations

The contact person wrote a diary, to keep track of her experiences with the application. The contact person used the timer application herself, and she let some of the other educators try it as well. The diary can be found in appendix 10.5.

They wrote in the diary that the children understood the meaning of both the timers and the pictograms shown on the tablet. One of the children was more interested in watching the digital timer count down than in the activity he was meant to do, but beyond that there were no problems understanding the system.

Beside the diary, we can analyze on the timers they have used in the acceptance test by looking in the "Last Used" list (see appendix 10.5).

We can see in the list that they have used different timers with different "Done"-pictures and times, only one out of eight timers had a slightly different color. This could indicate that changing the colors on the timers is not very intuitive, or they do not need the functionality anyway.

Tail

Part III

Evaluation

Head

CHAPTER 8

Discussion

8.1 Evaluation of Development Method

In this section, we evaluate on the development method described in section 1.4.

Agile Development In the beginning of the project we worked towards the vision described in section 3.1. Because other parts of the multi project changed, we had to alter the focus of our project. These changes occurred when we had begun developing, and since we used an agile development method, it was possible for us to change direction instead of starting all over.

Meetings The meetings have been useful, since the individual projects changed when the development begun, and these changes was presented at the meetings. This helped the groups adapt their project to fit in the multi project.

Sprint Length Since meetings were only planned in the beginning and end of each sprint, and these meetings were used to present backlogs and discuss overlapping concerns, it was important that the sprint length was short (7-14 days). This was an appropriate length, because it was possible to stay updated on the progress of the multi project, and adapt the individual project to it.

Product Owner Since we had no product owner, we did not have one person to manage the multi project, and therefore all decisions were made democratically by the multi project groups. This lead to several time consuming discussions of minor details regarding the project.

8.2 Development Tools

As described in chapter 5, we have used pair programming and refactoring. We evaluated on our use of these methods as part of a mini project in the course *Software Engineering*, this evaluation is included here.

8.2.1 Pair programming

We did some pair programming, but we were unable to do all programming in pairs. Since we are three persons in the group, we would either have to work three around one computer, or exclude one person from the pair programming. We chose to exclude one person from the pair programming, also because it would be a waste of resources to work in groups of three since the efficiency does not match the cost, when adding the third person.

One of the downsides of the pair programming technique is that we have been unable to work in pairs outside the university, i.e. when two group members are doing pair programming on a specific part of the code, and one of them got sick, the programming would be continued by only one group member, the third group member would join the programming and thereby pause the tasks he was doing, or the programming of the specific part of code would be paused until both group members would be gathered again.

The code written in pairs, is of higher quality than the code written before we implemented the pair programming technique, and the higher quality code is more readable, and thereby has no need for refactoring. We therefore believe that the use of the pair programming technique has been beneficial. This technique could be useful in our future careers.

8.2.2 Refactoring

There are two main reasons for the need for the code to have high readability and understandability. One reason is that the project will be handed over to the students of next year for further development, so to help them we strive to write understandable code. The other reason is that we are three persons in the group, and we have not all been included in developing every part of

the program, so with understandable code it is easier for the other group members to understand the parts they did not participate in writing.

Some of the refactoring we have done is renaming variables and objects to match the content of them. Also all private variables and objects has been refactored to always start with either "m" or "_" .

The use of this technique has helped ourselves to better understand the code, and we believe that when the project is passed on to the next project groups, it will be easier to familiarize themselves with it. We have learned that refactoring is very useful when several people are developing on the same product, and since we are very likely to work in groups later in our careers, we will probably use this technique again.

CHAPTER 9

Conclusion

The problem definition in ?? **Problem Definition i common report** is as follows:

How can we ease the daily life for children with ASD and their guardians, while complying with the study regulation?

To comply with the study regulations did the five project groups create one unified system. The project groups have been using the same development method to ensure that all project groups have had the possibility to keep abreast of the multi project, section 1.4.

The groups did together make the system GIRAF, a collection of the projects of the semester, of which this project has focused on the timer application, WOMBAT. The timer application is designed to replace the physical timers that the guardians use today, section 2.1 and chapter 3.

The usability test proves that the application is user friendly for the educators in the test group, section 7.4. Furthermore does the acceptance test prove that the children, understand the meaning of the timers and attached pictograms, section 7.5. The pictograms is a new feature that the educators did not have available previously with the physical timers, ?? **Der hvor mette foreslår det!.**

The timer application is configurable to match any timer the educators use today, subsection 6.4.1, further can the educators attach pictograms or

timers to the timers as an extention to the physical timers, section 6.4.1.

The timer application is easy to use, as proven by the tests, as well as being physically smaller than the current timers, therefore do we conclude that the timer application can ease the daily life for children with ASD and their guardians.

CHAPTER 10

Perspective

10.1 Future Work

In this section we will list some ideas for further development on the WOMBAT application.

—Test changes—

10.1.1 Ideas based on the usability and acceptance test

In this subsection we will briefly describe changes we would like to implement based on the usability test and the acceptance test.

Color picking

WOMBAT is currently using a color palette which the guardians uses to picking colors with, we would like to change this into a list of predefined colors and an advanced button where they would be able to define new colors with a color palette. This change would make ease the color picking.

Gradient button

The gradient button is hard to spot, it is therefore necessary to improve the layout. It might help if the button layout looks the same as all the other buttons in WOMBAT.

Improve customize fragment buttons

The buttons in WOMBAT need to be redesigned to appear more like buttons. The attachment buttons visual effect after attaching an attachment needs to be improved so it is more clear for the user, when an attachment has been attached.

Delete

It is not intuitive how to delete a SubProfile. It might help to remove the long-click and make a delete button on each SubProfile. Figure: 10.1 illustrates how such a button might look like.



Figure 10.1: Illustration of possible delete button

Last used and Predefined layout changes

The usability test showed that the last used and predefined category were hard to find, these two categories need a design change to look more outstanding compared to the children. This could be achieved by changing the background color of these two categories.

Done screen picture lockdown

The acceptance test showed that it is necessary to improve the lock on the done screen picture. The done screen unlocks by a single touch on the screen, which is issue, should be changed to a long-click instead.

-Ideas-

10.1.2 Ideas

In this subsection we will briefly descrip ideas which can be used for future development of WOMBAT.

Handset Version

It is, at the moment, not possible to install and run the WOMBAT application on an Android handset, but there are several reasons for considering making a handset version of the application as well. This is some of the reasons:

- It might be more convenient to bring a handset than a tablet, when the guardians and children is on a trip.
- There are more smartphone users than tablet users.
- Der er flere damer? Vi er nok nød til at finde paa en grund mere.

Improved Graphics

WOMBAT is currently using canvas for drawing all the timers, which is simple 2d graphic. It is possible to improve the graphic by using OpenGL instead. OpenGL is used for drawing detailed 3d objects. The benefit of improving the graphic in WOMBAT is to make the timers more realistic and look like the timers which the children already uses. There have been conducted a comparison between canvas and OpenGL which can be read about in subsection: 6.5.2.

Overlay timers

This idea is based on the second part of our original idea, which can be seen in section: 3.1. When you exit the timer screen while a timer is running, that timer will be destroyed. Instead of destroying the timer, it should enable an overlay timer which should continue from where the timer left off. The overlay timer should always appear on top of all the other application that might be running. This would make it possible for the guardian to conduct multiple tasks without stopping a timer. When the guardian enters WOMBAT again, it should remove the overlay and continue the timer normally.

Code Architecture

The draw features which is a part of the DrawLib, were originally designed to be a part of the TimerLib, the decision of this can be read in section: 6.1. The ideal architecture would be to import the draw methods into each timer class, that way you could call the method on a certain timer object and

return a view. By doing so, you would not have to check on which object you were handling and choose a specific. Check figure: 10.2 and figure: 10.3.

```

...
2     switch(sub.getAttachment().getForm()) {
3         case Timer:
4             frameWidth = frameWidth/2;
5             v = genDrawView(sub, frameWidth);
6             frame.addView(v, frameWidth, frameHeight);
7             v2 = genDrawView(sub.getAttachment().genSub(), frameWidth
8                 );
9             frame.addView(v2, frameWidth, frameHeight);
10            break;
11        case SingleImg:
12            frameWidth = frameWidth/2;
13            v = genDrawView(sub, frameWidth);
14            frame.addView(v, frameWidth, frameHeight);
15            i = new ImageView(this);
16            i.setImageResource(sub.getAttachment().getImg().getPath
17                ());
17            i.setBackgroundDrawable(gd);
18            frame.addView(i, frameWidth, frameHeight);
19            break;
20        case SplitImg:
21            frameWidth = frameWidth/2;
22            v = genDrawView(sub, frameWidth);
23            frame.addView(v, frameWidth, frameHeight);
24            frameWidth = frameWidth/2;
25            frameWidth = frameWidth - 15;
26            i = new ImageView(this);
27            i.setImageResource(sub.getAttachment().getLeftImg()
28                .getPath());
29            i.setBackgroundDrawable(gd);
30            frame.addView(i, frameWidth, frameHeight);
31            i2 = new ImageView(this);
32            i2.setImageResource(sub.getAttachment().getRightImg()
33                .getPath());
34            i2.setBackgroundDrawable(gd);
35            frame.addView(i2, frameWidth, frameHeight);
36            break;
37    }
38    setContentView(frame);
...

```

Figure 10.2: Code snippet of how DrawLib checks for object form to generate the corresponding view.

```
1 LinearLayout frame = new LinearLayout(this);
Guardian guard = Guardian.getInstance();
3 frame.addView(guard.getSubProfile().draw());
setContentView(frame);
```

Figure 10.3: Example of how WOMBAT would generate timer view, if DrawLib was apart of TimerLib.

Last used

WOMBAT do not save the SubProfiles in the last used list, this is because it is not implemented to work together with OasisLocalDatabase. When the WOMBAT activity is destroyed or the memory of the device is cleared, the last used list will be empty. In the future this function should be reimplemented to work together with the OasisLocalDatabase.

Delete and save

There is a bug which occurs when you create three or more new timers on the same profile. When you try to delete these timers it will delete them randomly and might even force WOMBAT to crash due to it is trying to delete a non existing setting in the OasisLocalDatabase. This is a bug in the application that needs to be future developed on.

New Design Features

Noget med en skuffe?

Tail

Part IV

Appendix

Appendix

10.2 Notes from Interview

This is notes from an interview with Mette Als Andreasen, an educator at Birken in Langholt, Denmark.

Naar tiden loeber ud (kristian har tage et billede):
Faerdig - symbol
Gaa til skema - symbol
Taget fra boardmaker

Kunne vaere godt hvis man kunne saette egne billeder ind som start/stop symboler.

Roed farve = nej, stop, aflyst.

De har saadan et ur paa 60 minutter hvor tid tilbage er markeret med roed, og saa bipper den lige kort naar den er faerdig.
Det ville vaere fint hvis de kunne bruge sort/hvid til dem der ikke kan haandtere farver, men ogsaa kan vaelge farver.

Stop-ur:
en fast timer paa 60 minutter + en customizable som ikke ser helt magen til ud, som f.eks, kan vaere paa 5, 10 eller 15 minutter for en hel cirkel.

timeglas:
skift farve paa timeglassene, men ikke noedvendigvis goere dem stoerre.



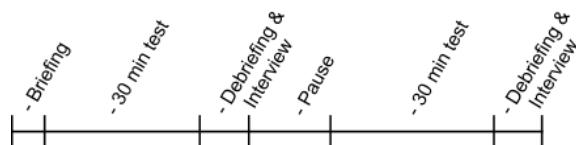
Kære ekspert

Vi vil gerne invitere dig til at deltage i den første brugervenligheds test af GIRAF, en Android applikation bygget til børn med autisme. Formålet med denne test vil være at undersøge hvor brugervenlig applikationen er og hvor nemt eller svært det er at bruge den. Derfor er det helt fint hvis du aldrig har set eller hørt om denne applikation før nu, da vi gerne vil observerer, hvordan første gangs brugere så vel som brugere med kendskab til applikationen, har det med denne applikationen.

Bemærk venligst at vi er ikke tester din kendskab til applikationen eller evner med en tablet, men derimod om GIRAF applikationen er nem at bruge, vi har kun interesse i at kende til de svagheder der ville være i applikationen. Dette betyder også at du ikke kan give nogle forkerte svar, da du er eksperterne.

Derfor vil vi gerne invitere dig ud i vores brugervenligheds laboratorie, hvor vi kan studere din brug af applikationen. Under brugervenligheds testen vil du blive givet en række opgaver, som skal udføres. Yderligere vil du blive bedt om at tænke højt og fortælle alle tanker, indtryk og valg du tager ved brug af applikationen under testen. Under testen af applikationen vil der blive optaget både video og lyd, til at studere testen senere.

Dagen kommer til at bestå af:



Vi vil meget gerne høre fra dig hvis du har lyst og tid til at deltage i denne brugervenligheds test, den 22/5 - 2012, på Aalborg Universitet.

For at vide hvornår på dagen du kan komme vil vi gerne, at du går ind på denne side (<http://www.doodle.com/d2h6swgbtsdf6z2b>) skriver dit navn og vælger det tidspunkt på dagen du helst vil komme, dette er svar nok for at vi ved du gerne vil komme.

Kommentarer og spørgsmål kan sendes retur til den mail invitationen kom fra.

På forhånd tak,
Android projektet
Software 6. semester
Aalborg Universitet
Selma Lagerlöfs vej 300, 9220 Aalborg



Figure 10.4: Invitation sent to the test persons of the usability test.

Kombinere med mere/mindre sand. Eventuelt kombinere med et lille digitalt ur, til dem der har brug for det, skal kunne slaaes til og fra.

Dags-plan:

ikke saerlig relevant til de helt smaa og ikke saerligt velfungerende boern. Men kunne vaere rigtig godt til de lidt aeldre.

En plan gaar oppefra og ned, og hvis der saa skal specificeres noget ud til aktiviteterne, saa er det fra venstre mod hoejre ud fra det nedadgaaende skema.

Til parrot:

Godt med rigtige billeder af tingene, som paedagogerne selv kan tage, eventuelt ogsaa af aktiviteter, saa pedagogerne kan have billeder af aktiviter som de kan liste efter skeamet.

Der var mange skemaer rundt omkring, og der henviser det sidste billede i raekken til naeste skema, som haenger f.eks. paa badevaerelset eller i garderoben.

10.3 Paper Prototypes

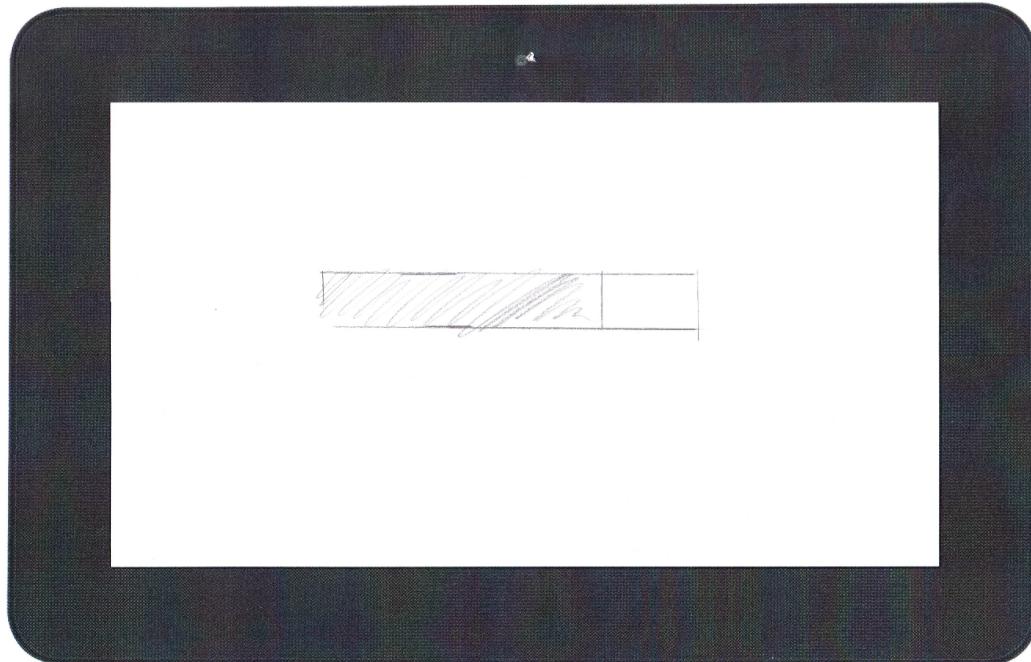


Figure 10.5: Scan of a paper prototype of a single progress bar timer.

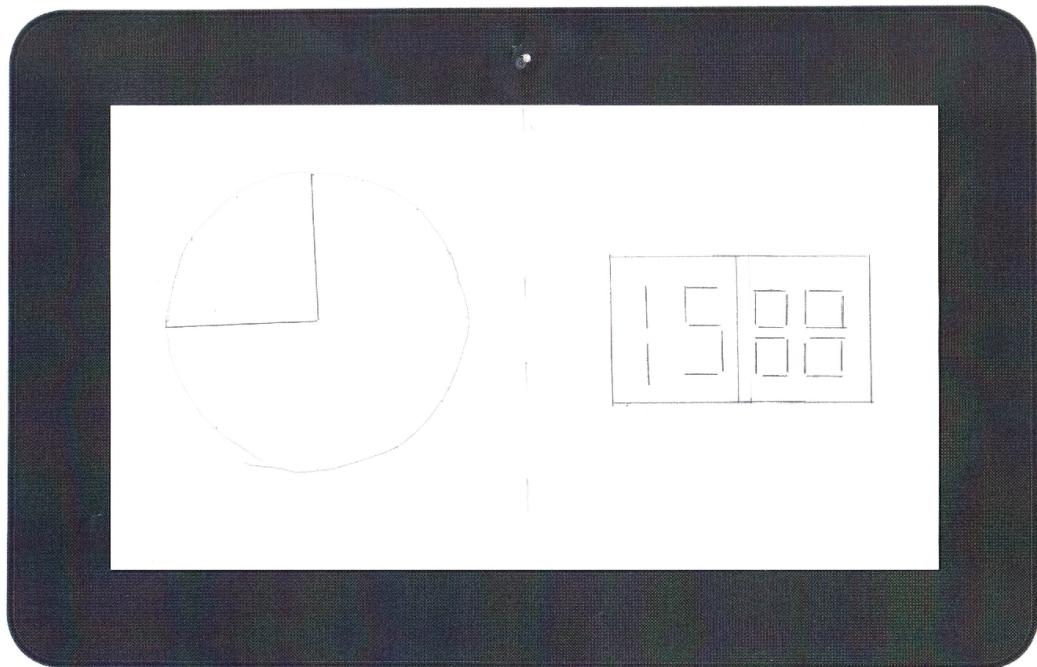


Figure 10.6: Scan of a paper prototype of a double timer.

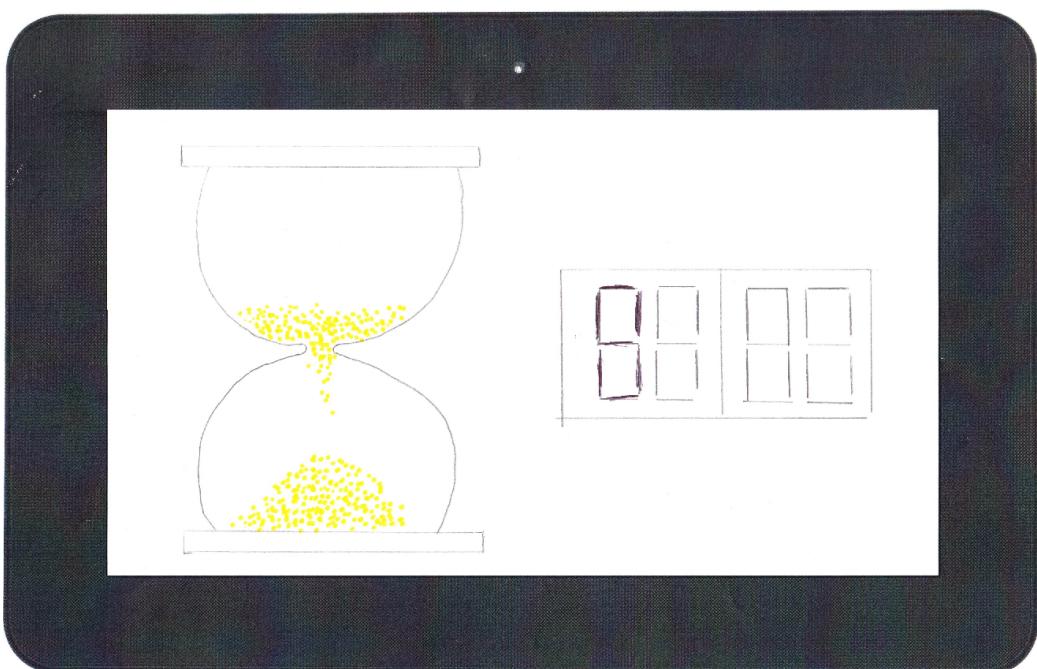


Figure 10.7: Scan of a paper prototype of another double timer.

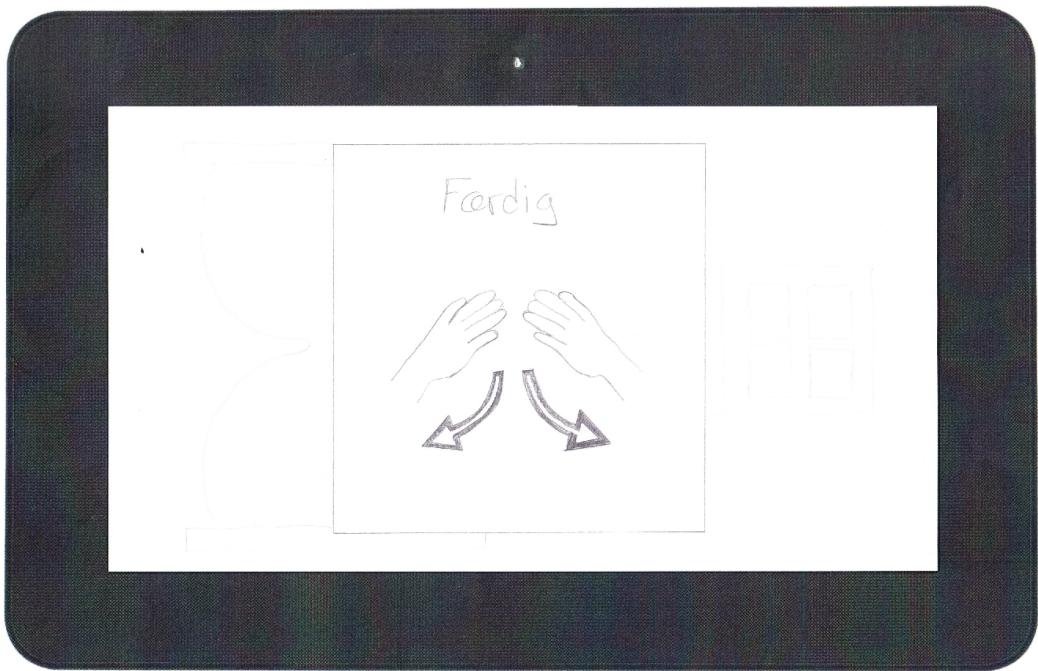
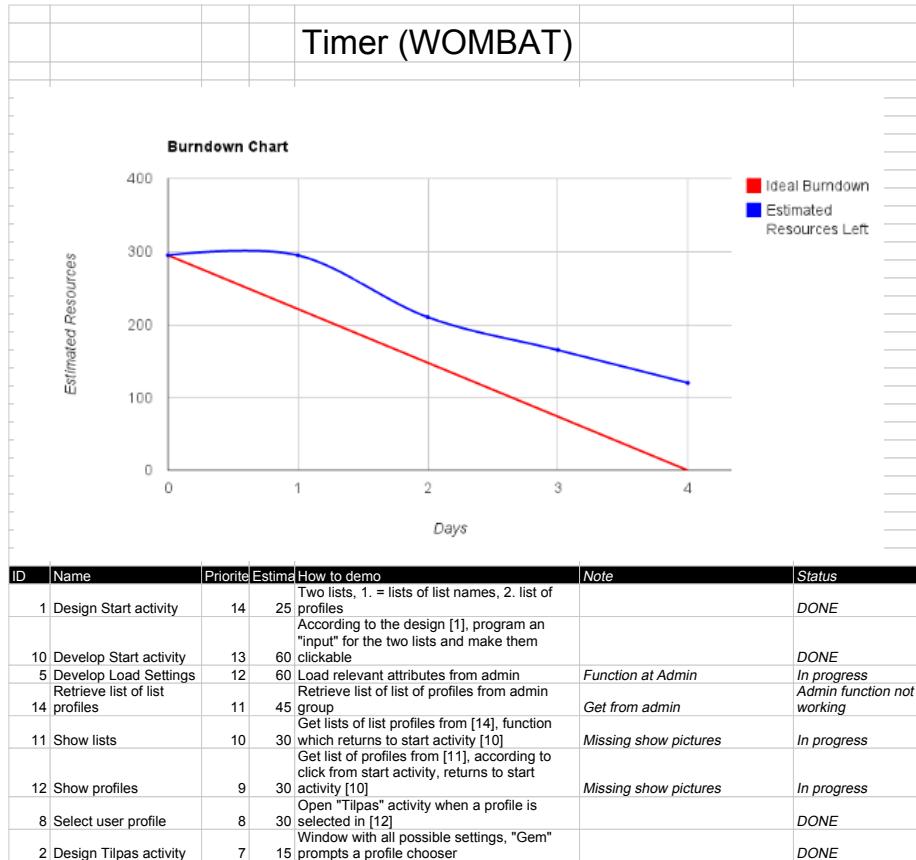
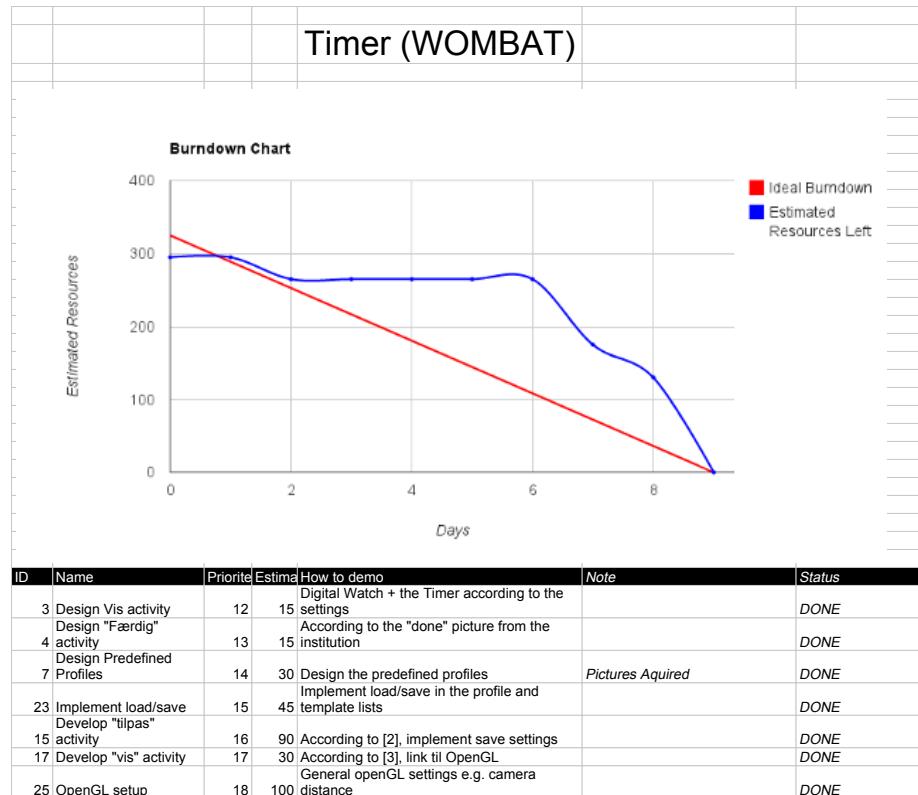
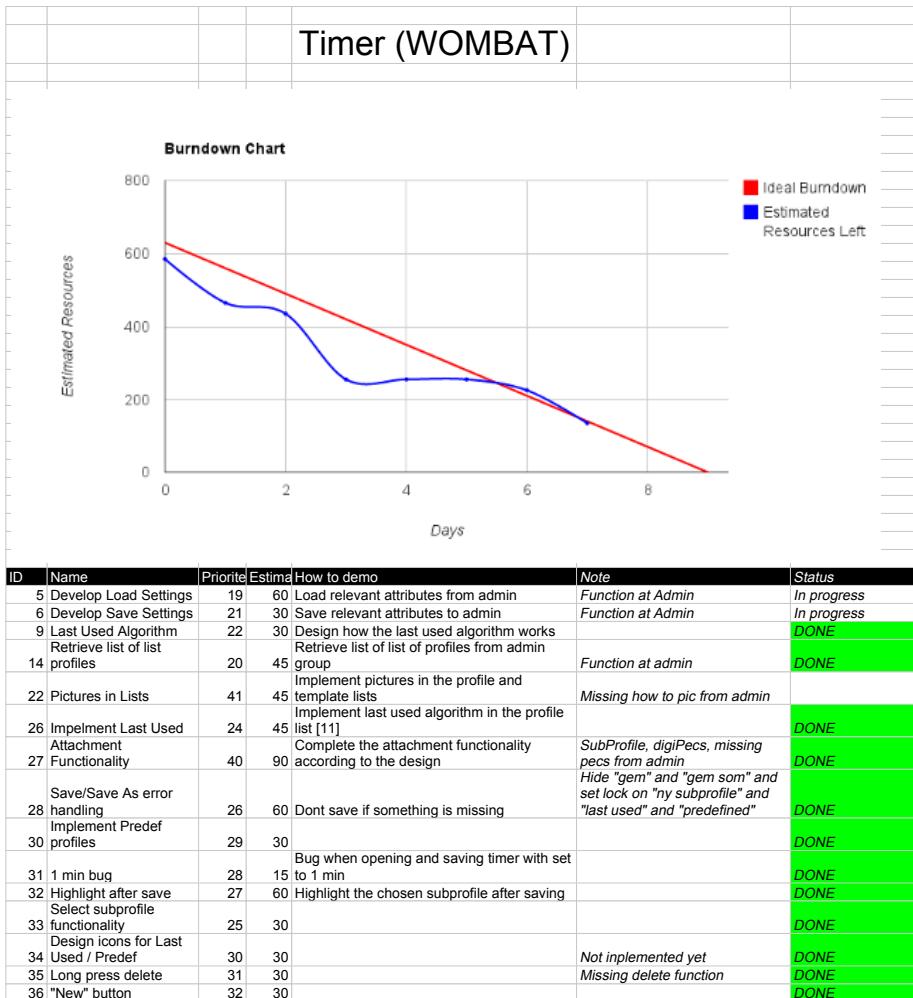


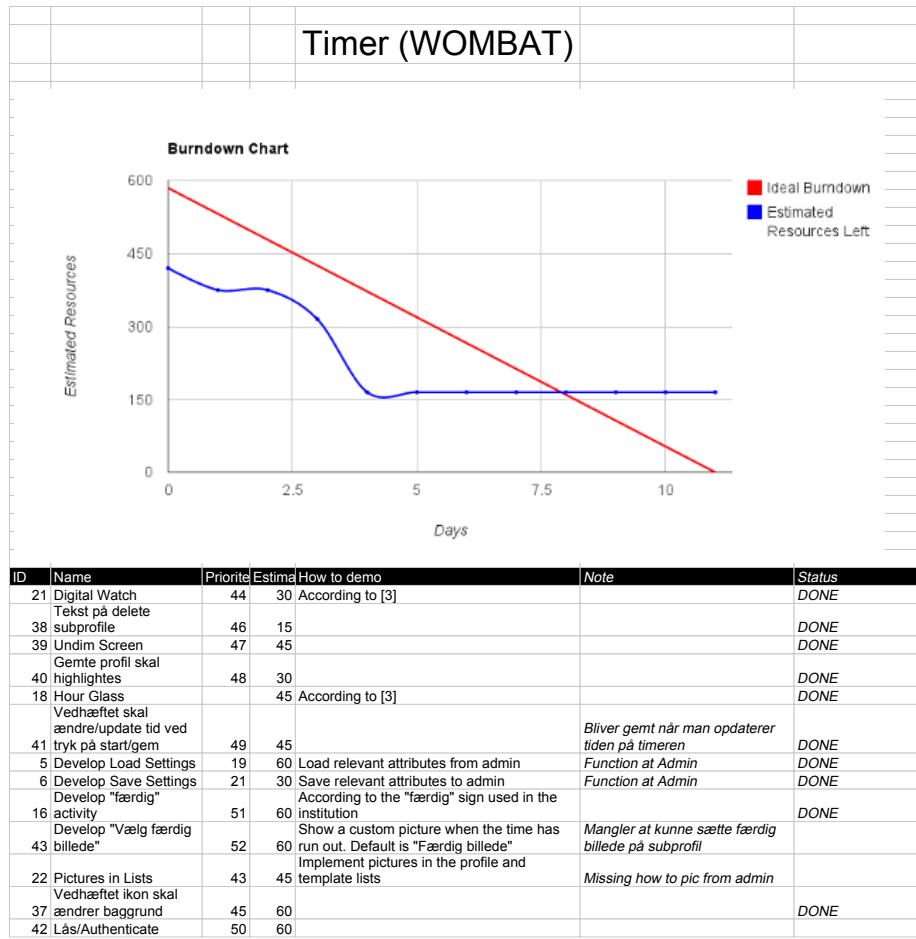
Figure 10.8: Scan of a paper prototype of the "Done" screen shown when the time has run out.

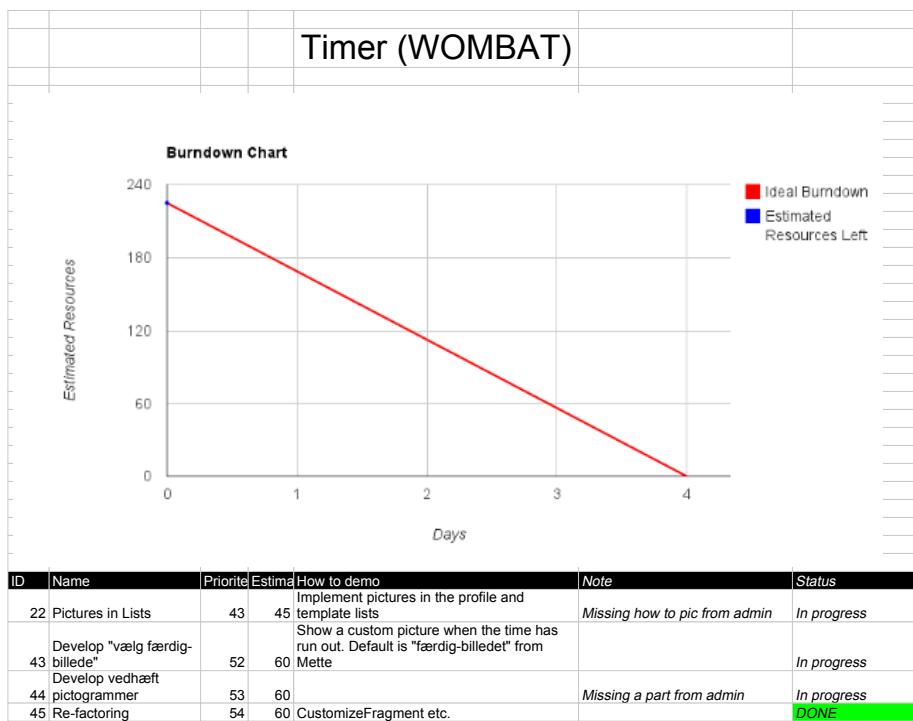
10.4 Sprint Burndown Charts and Backlogs

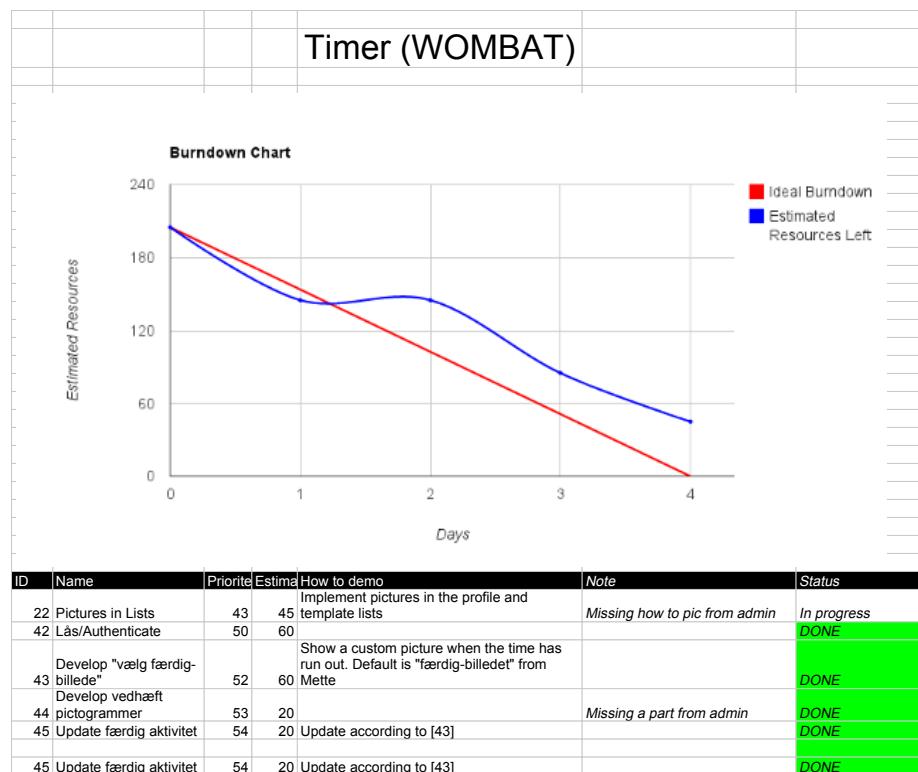












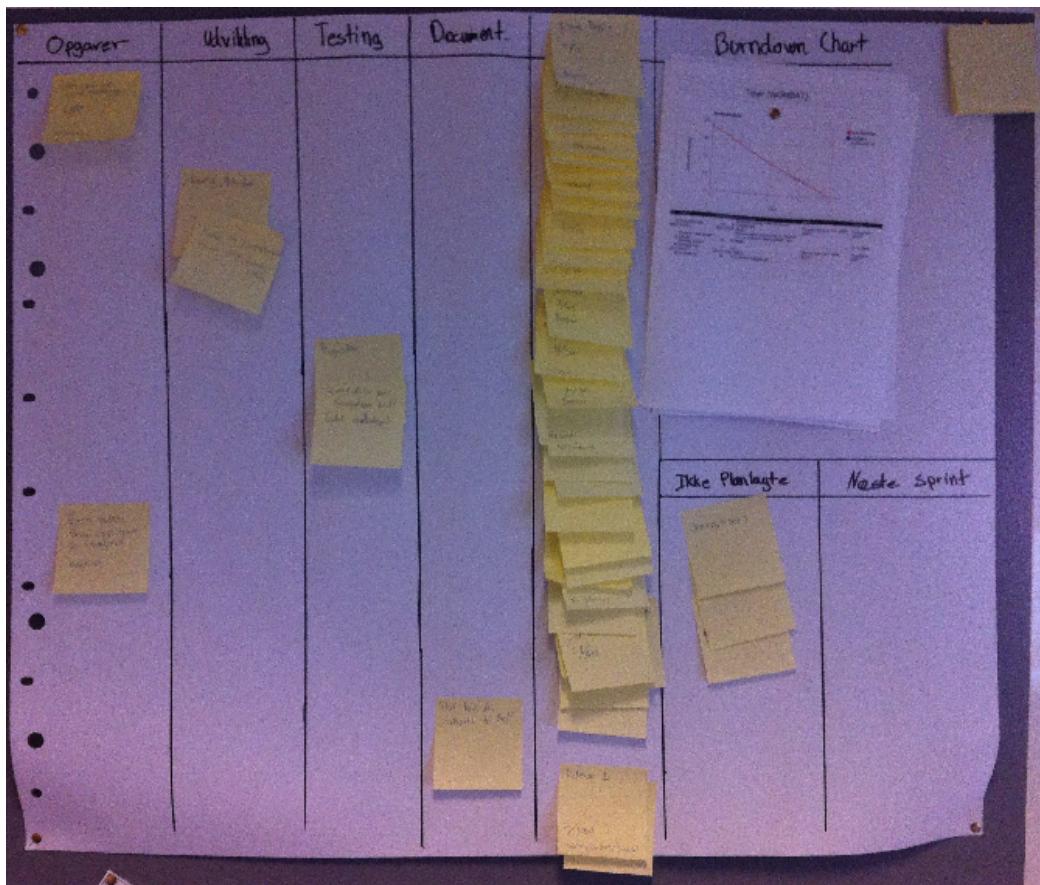


Figure 10.9: Picture of our burndownchart and list of assignments. Used to manage the total project backlog.

10.5 Acceptance Test Diary

Dato: 16/5 - 12

	Virkede godt	Virkede knapt så godt/slet ikke
Mads	Vas klært genkendelig for barnet (Sandur)	slutbilledet var for hurtigt vek. Måske kunne det blive indtil jeg bestemmer andet.

Dato: 18/5 · 12

Virkede godt	Virkede knapt så godt/slet ikke
<p>Drugne forstod straks hvad hensigten var.</p> <p>De gik til skema da tiden var valget.</p> <p>Sandur Lukas: Emil Lukas</p> <p>digetal</p> <p>Var mere op>taget af tallene end aktiviteterne</p> <p>ellers virkede det efterhensigten.</p>	"SAMSUNG" (visuel støj)



Figure 10.10: Scan of a paper prototype of the "Done" screen shown when the time has run out.

10.6 WOMBAT Setup for Eclipse

To fetch the released code from SVN, make a checkout to <https://sw6-2012.googlecode.com/svn/tags/wombat/>, previous versions of the project, reports, and the wiki can be found by making a checkout to <https://sw6-2012.googlecode.com/svn/>. The folders on SVN contains the following:

- *trunk* - contains iteration releases of the code.
- *branches* - contains code under development.
- *tags* - contains the newest final release of the code.
- *common_report* - contains the common part of the report.
- *Reports* - contains all group reports.
- *wiki* - contains summaries from all group- and supervisor meetings, and guides/agreements.

When SVN checkout has finished downloading content from the SVN, import Wombat, AmbilWarna (the color picker), and wheel projects from svn to Eclipse, figure 10.11.

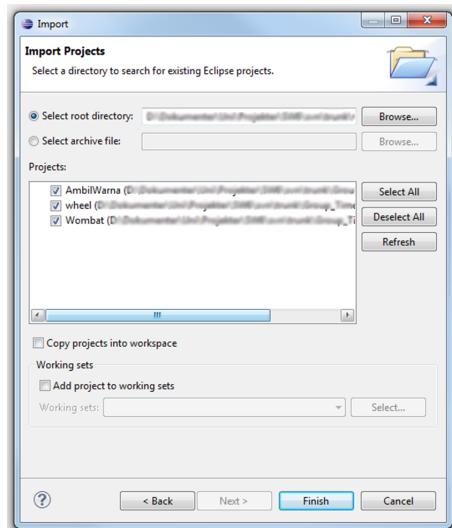


Figure 10.11: Import Wombat, AmbilWarna, and wheel.

Right click the Wombat project in Eclipse and click "Properties". Under the "Android" pane, ensure that AmbilWarna and wheel are added as project libraries, figure 10.12.

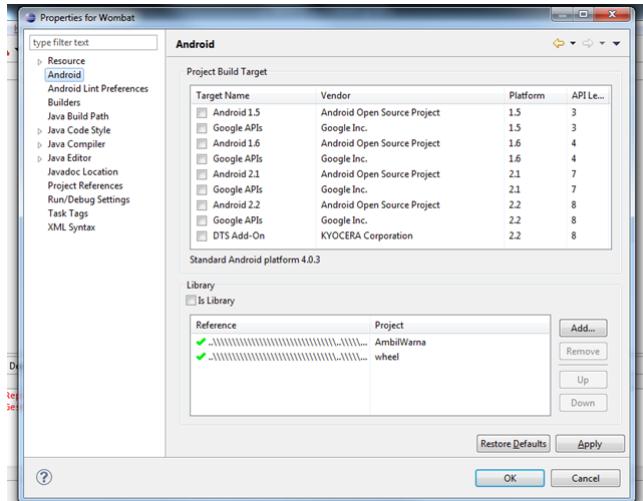


Figure 10.12: Add AmbilWarna and wheel as project libraries.

In case Eclipse fails to recognize the libraries in the libs folder, manually add the three JAR files in Wombat/libs on svn as external JARs, in Wombat - Properties, figure 10.13.

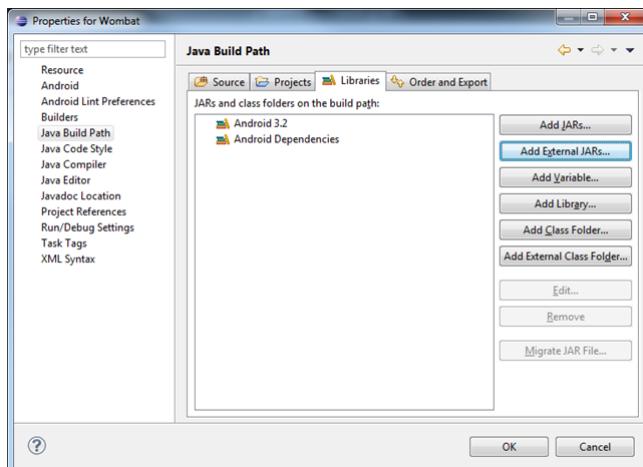


Figure 10.13: Add Oasis, TimerLib, and DrawLib as external JARs if Eclipse cant recognize them in the libs folder.

Extras

To edit the TimerLib and DrawLib the two projects has to be imported to the workspace in Eclipse, figure 10.14.

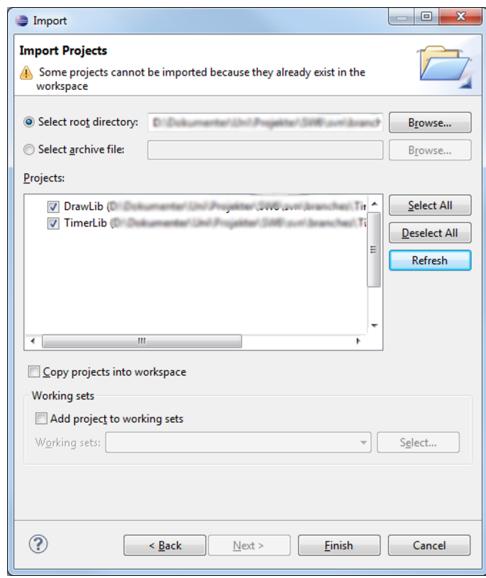


Figure 10.14: Import TimerLib and DrawLib to the workspace.

To debug the TimerLib and DrawLib in WOMBAT the projects has to be added as libraries in the Wombat properties, with AmbilWarna and wheel, figure 10.15. Then the TimerLib and DrawLib JARs has to be deleted from the libs folder or the Java Build Path library, to avoid a compile error.

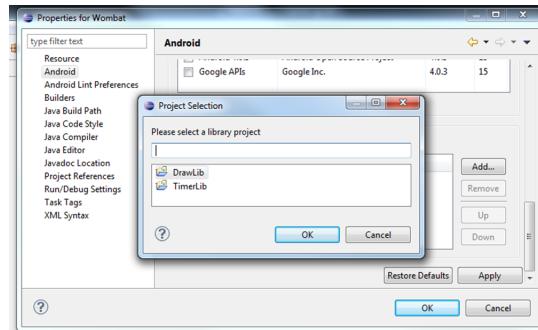


Figure 10.15: Add TimerLib and DrawLib as project libraries.

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