

POLITECNICO DI MILANO

Scuola di Ingegneria dell'Informazione



POLO TERRITORIALE DI COMO

Master of Science in Computer Engineering

Android Mobile Application for Dyslexic Children

Supervisor: Prof. Thimoty Barbieri

Master Graduation Thesis by: Shahrzad Andisheh

Student Id. Number: 765521

Academic Year: 2012/13

Abstract:

Learning Disability” is not a specific term; it is a category containing many specific disabilities, all of which cause learning to be difficult.

The term “learning disability” means a disorder in one or more of the basic processes involved in understanding spoken or written language. It may show up as a problem in listening, thinking, speaking, reading, writing and spelling, despite at least average intelligence.

Dyslexia is one of the famous learning disability, which affects the ability to read and spell correctly.

In this project I describe the design development and testing of **Sheryixa** Mobile application for the children in the age group of 6-8 years.

This project is design of the mobile application to help children with reading difficulties specially Dyslexia. The main goal of this project is to implement of interactive mobile application to simplify access to educational game on smartphones. Moreover implementation of this mobile application to improve skills such as reading, listening, writing and spelling in dyslexic children while they have fun. by using this application in addition to above skills ,causes to Improve recognition of words and letters with less confusion, Improve focus and concentration, Stronger Attention to Detail, Improved Confidence in Reading and Renewed Interest in Learning.

Acknowledgment

I would like to express my deepest gratitude to my advisor, Prof. Timothy Barbieri, for his excellent guidance, caring, patience for doing this Thesis.

A very special thanks are due to my friend Milad Ashourpour for his help to complete this Thesis.

Most importantly, none of this would have been possible without the love and patience of my family specially my mother and my father. I really appreciate their understanding and supporting during these years. I would like to express my heart-felt gratitude to my family.

Many friends have helped me stay sane through this Thesis. Their support and care helped me overcome setbacks and stay focused on my graduate study. I greatly value their friendship and I deeply appreciate their belief in me.

Contents

1	Background	1
1.1	Content	1
1.1.1	Dyslexic children: Who are they?	1
1.1.2	Speech modification for dyslexia	2
1.1.3	Human-Computer Interaction and accessibility	2
1.1.4	Dyslexia and auditory processing	2
1.1.5	Treating dyslexia	3
1.2	Technologies	3
1.2.1	Introduction	3
1.2.2	Dyslexia and Speech, Language and Communication Needs (SLCN)	4
1.2.3	Assistive Technologies for Reading, Writing, & Communicating	4
1.2.4	Barriers to Effective Use of Technology for Students with reading disabilities	5
1.2.5	Emergence of Mobile Devices	6
2	Motivation and Goals	7
3	Design and Implementation	7
3.1	Overview of the system	7
3.2	Sheryxia application	7
3.2.1	Introduction	7
3.2.2	Application front-end	7
3.2.3	“Sheryxia “Main interface features	8
3.3	User Interface of a system (UI)	11
3.4	Input Control	11
3.5	Sheryxia back-End	13
3.5.1	Drawable (resource of images)	13
3.5.2	Value	14
3.5.3	The manifest file	14
3.6	Application Fundamental	15
3.6.1	Android API	15
3.6.2	API Level	15
3.6.3	Application component	16
3.6.4	Styles	16
3.6.5	Media playback	17
3.7	Class diagram of the system	18

3.7.1	Use case of the system	18
3.7.2	Class Diagram Model.....	19
3.7.3	Analysis Diagram.....	20
3.7.4	Boundary Objects.....	21
3.7.5	Entity Objects.....	21
3.7.6	Control Objects	21
3.7.7	The Sequence Diagram	22
3.7.8	Method description	24
3.8	Design	29
3.8.1	Sheryxia front-end.....	29
3.8.2	Sheryxia Back-end	35
3.8.3	Sheryxia screen	36
3.9	System usage workflow	49
4	Evaluation	51
5	Conclusions and Future Work.....	57
6	References:.....	58

Table of Tables:

Table 1-control types	12
Table 2-resource directories res/directory	13
Table 3collected during a 14-day period ending on 1st of August 2013	16
Table 4-puzzle class.....	24
Table 5-displaying image and its related resource	24
Table 6-content view class.....	24
Table 7-Resource Identifier.....	24
Table 8-Drag Event Listener	25
Table 9-Shown and chosen letter	25
Table 10-Answering and finishing class	25
Table 11-public class including images and finding random one	25
Table 12-media player class.....	26
Table 13-public Run class.....	26
Table 14- ontouch class	26
Table 15-showing image while drag and drop.....	26
Table 16-random generator.....	26
Table 17-Generate Letters	26
Table 18-Arraylist and shuffle class	27
Table 19-Sorting class	27
Table 20-HashMap.....	27
Table 21-Refreshing page class.....	27
Table 22-score class	27
Table 23-get Base context.....	27
Table 24-assets manager class.....	27
Table 25-package manager	28
Table 26-start activity	28
Table 27-Timer class	28
Table 28-Goal Attainment Scale	53
Table 29- Importance and difficulty scale.....	54
Table 30-The weighting and ASL achieved by two children	55

Table of Figures

Figure 1-DysWebxia Tecnology.....	5
Figure 2-mockup of the main page.....	8
Figure 3-mockup of the first section.....	9
Figure 4-Sheryxia second section mockup.....	10
Figure 5-mockup of Sheryxia third section.....	10
Figure 6-linear layout.....	11
Figure 7-XML file for adding button.....	12
Figure 8-drawable resource image in XML file.....	13
Figure 9-retrieves the image as a Drawable.....	13
Figure 10-value of image View.....	14
Figure 11-Value for table row.....	14
Figure 12-Manifest file.....	15
Figure 13-XML resource.....	17
Figure 14-Media player class.....	18
Figure 15-Usecase of the system.....	19
Figure 16-Class Diagram Model.....	20
Figure 17-Analysis Diagram.....	22
Figure 18-sequence diagram of the system.....	23
Figure 19-Mockup of the main page.....	30
Figure 20-Layout of the main page.....	31
Figure 21- Mockup of the first Icon.....	32
Figure 22-Layout of the first Icon.....	32
Figure 23-Layout for the second Icon.....	33
Figure 24-Mockup of the second Icon.....	34
Figure 25-Layout design for third Icon.....	34
Figure 26-Mockup for the Word Hunter.....	35
Figure 27-menu screenshot.....	36
Figure 28-OBJECT (first page).....	37
Figure 29-selecting the right object (Watch).....	38
Figure 30-dragging more letters.....	39
Figure 31-dragging more letters.....	40
Figure 32-one step to complete the word.....	41
Figure 33Completed Word.....	42
Figure 34-screenshot of the “what’s missing” game.....	43
Figure 35-screenshot of steps of the Second section.....	43
Figure 36-Continuation of playing.....	44
Figure 37-screenshot of the second section.....	44
Figure 38-Game completed with extra shape.....	45
Figure 39-first screenshot of Word Hunter.....	46
Figure 40-Letter G is selected.....	46
Figure 41- it is up to him for selecting the letter.....	47
Figure 42-More letter are selected, score is increasing.....	47
Figure 43-selecting letters.....	48

Figure 44-Word is completed 48
Figure 45-Sheryxia workflow 50

1 Background

1.1 Content

Reading is an important skill that needs to be developed in children. Gaining knowledge about different life aspects and mastering them depends on the reading skill and thus, it is not only a vital skill for academic purposes, but also is it a main determinant of any adult's life. The ability to learn new subjects and find useful information from consumer protection and health problems to academic researches or arts depends on the reading ability.

For many children with reading disabilities, this skill is one of the most difficult and in fact one of the most boring ones that they will ever face in their entire life.

Dyslexia is one of the familiar types of reading difficulties, literally meaning a 'difficulty with words'. [1]

Dyslexia is a brain-based type of learning disability that specifically impairs a person's ability to read. These individuals typically read at levels significantly lower than expected despite having normal intelligence. Although the disorder varies from person to person, common characteristics among people with dyslexia are difficulty with spelling, phonological processing (the manipulation of sounds), and/or rapid visual-verbal responding." [2]

The key Objectives

The key objectives of this study are as follows:

- To carry out research in the area of HCI.
- To consider future uses of mobile applications and areas this could be developed by further research.

The following chapter considers the extensive literature within this domain

1.1.1Dyslexic children: Who are they?

(NINDS) state that Dyslexia is a brain-based type of learning disability that specifically impairs a person's ability to read. These individuals typically read at levels significantly lower than expected despite having normal intelligence. Although the disorder varies from person to person, common characteristics among people with dyslexia are difficulty with spelling, phonological processing (the manipulation of sounds), and/or rapid visual-verbal responding.[3] Dyslexia is not itself a disease, it is a dysfunction of the brain related to language processing. It is a specific impairment in reading accompanied by a normal development in other areas that are not related to the disability. Some authors understand it as a different way of thinking instead of disease [4].

More than 10% of the population in Europe has dyslexia. Dyslexia is a neurologically based learning disability which typically results from a deficit in the phonological component of language. It is characterized by difficulties with accurate word recognition and by poor spelling,

especially with new words, infrequent words, very long words, complex words and phonetically and orthographically similar words [5]

The World Federation of Neurologists [3] explain dyslexia as a disorder in which a child does not develop the skills of reading, writing, and spelling expected according to their age, despite having access to regular schooling[6]

1.1.2Speech modification for dyslexia

There is some evidence in the literature [7, 8] which claims speech modification could aid children with dyslexia. Fast ForWord [8] uses speech modification as intervention for children with language learning impairments. Recent psychoacoustic studies show that a particular style of speech known as clear speech enhances intelligibility for children with dyslexia [28] and more generally for those who have difficulties in hearing [9]. Clear Speech is defined as the style of speech that results when one attempts to make his/her speech more intelligible.

1.1.3Human-Computer Interaction and accessibility

As Preece (2002) states [10], the key to a usable system is one that is easy to learn, effective to use and will provide an enjoyable experience for the user. The first step in developing a usable system, however, is considering the users, domain and activities that will be involved. This has been undertaken during the literature review and these ideas will be drawn upon during this final section to deal with areas such as the presentation of the system, how interaction will occur, flow and dialogue issues. Some researchers into the area of HCI have developed sets of rules (also known as heuristics) that can be used almost as a checklist when designing an interface

Currently, the most prominent organized international effort related to game accessibility is the Game Accessibility Special Interest Group [11] of the International Game Developers Association (IGDA), which was formed in 2003 with the aim “to develop methods of making all game genres universally accessible to all, regardless of disability.”

1.1.4Dyslexia and auditory processing

Dyslexia can be comorbid with language difficulties, writing and mathematics disorders. Though the exact cause of dyslexia is still a matter of debate [12] there is a consensus that a significant proportion of these children have difficulties in auditory perception and these auditory difficulties might be causal to their reading difficulties. The problems in auditory perception include difficulties in backward masking, temporal order judgment, and perceiving amplitude and frequency modulations [13, 14]. This creates difficulty in discriminating speech sounds, for instance the difference between two acoustically close phonemes like /ba/ and /da/ and hence leads to a poor representation of phonemes. Since reading is a grapheme to phoneme correspondence task, this poor representation translates to difficulties in reading.

1.1.5 Treating dyslexia

There is no cure for dyslexia until now, however there is a range of specialist interventions and treatments that can help dyslexic children to improve their reading and writing. Of course the amount and type of treatment will depend on the difficulty of their condition.

Evidence shows that focus on improving phonological skills (the ability to identify and process sounds) are the most effective way of improving reading and writing. These types of educational interventions are often referred to as phonics.

Phonics focuses on six core elements: phonemic awareness, phonics instruction, spelling and writing instruction, fluency instruction, vocabulary instruction and comprehension instruction. [15]

Tijms and Aravena (2007) advocate development of integrated learning system with linguistic associations within a computer game environment as treatment of dyslexia. [16]

Primary Aim of the Project

The primary aim of this project is to create an application specifically designed for the use of dyslexic children (aged 6-8) with reading difficulties to improve their skills with less confusion.

1.2 Technologies

1.2.1 Introduction

Preece (2002) says that before creating an interactive system; first consider who is going to be using the system, where they are going to be using it, and what activities they will be doing when interacting with the system. [18]

The users of the proposed system will be secondary school children with reading difficulties as well as secondary school teachers. The environment will be schools and the activities involved will be both literacy and learning.

It is therefore necessary to look into how a child develops and the differences between a child who reads normally and the special needs of a child with reading difficulties. Additionally, to understand the possible activities being carried out, a review of reading development and literacy will be undertaken.

The main problem in dyslexia is trouble recognizing phonemes (pronounced: fo-neems), which are the basic sounds of speech (the "b" sound in "bat" is a phoneme, for example). Therefore, it's a struggle to make the connection between the sound and the letter symbol for that sound, and to blend sounds into words.

The best type of help teaches awareness of speech sounds in words (called phonemic awareness) and letter-sound correspondences (called phonics). The teacher or tutor should use special learning and practice activities for dyslexia. [19]

1.2.2 Dyslexia and Speech, Language and Communication Needs (SLCN)

Communication can be spoken, written and physical. Communication plays an important role in almost everything we do in our daily lives.

Some people have difficulties that can make communication a special challenge for them. To help people communicate effectively, and participate fully, these people may need some additional support and are therefore said to have communication needs

It is important to define what we mean when we talk about speech, language and communication.

By speech we mean:

- The speech sounds that children use to build up words, saying sounds accurately and in the right places.
- Speaking fluently, without hesitating, prolonging or repeating words or sounds
- Speaking with expression and a clear voice, using pitch, volume to support meaning

By language we mean both talking (expressive language) and understanding of the language:

- Having words to describe actions, objects and properties
- Build up sentences by using these words
- Build up Conversation and narrative by using these words
- Following the rules of grammar, so that things make sense

By communication we mean the way in which language is used to interact with others:

- Using language in different ways; to question, explain and debate
- Using non-verbal rules of communication: listening, looking, and knowing how to take verbal, turns and how to change language use to suit the situation [17]

1.2.3 Assistive Technologies for Reading, Writing, & Communicating

Read&Write Web Apps are a set of mobile apps that provide access to read and write GOLD [2] literacy tools from within a web browser.

Each app provides a toolbar that sits atop most applications. The buttons help users -- especially those with print disabilities -- make reading web content, researching topics, and writing email and text messages easier.

Though accessible on most PC and Mac machines, the Read & Write Web cloud-based applications are optimized for use on mobile devices (e.g. iPad, iPhone, and iPod touch), and work on most browsers, including Chrome, Firefox, Internet Explorer, and Safari.[20]

The most closely related applications are those that target children with learning disabilities such as: Dyslexiclike me, [21]with guidance for children with dyslexia, or DyslexiaQuest, with short games. There are also applications for improving spelling, such as Word Magic.

As Rello noted in one of the papers she co-authored, dyslexia is a neurological reading disability that is characterized by difficulties with fluent word recognition, as well as poor spelling abilities. It is estimated to affect 10% of the population — and up to 17.5% in the US. [22]

Regardless of the exact figures, there is no doubt that millions of Internet users could benefit from Rello’s PhD work. With DysWebxia, her goal is to measure how content and presentation alter online readability for dyslexics.

Besides its potential impact, one of the most interesting aspects of Rello’s research is that it occurs at the intersection between linguistics and computer science. As such, she based her experiments on tools borrowed from natural language processing (NLP) and human-computer interaction (HCI)[23]. On the one hand, she looked into how algorithms could be used to automatically replace words that are difficult for dyslexics with more common synonyms, and on the other hand, she used eye tracking and facial expression analysis to find out what a dyslexia-friendly Web would look like.



Figure 1-DysWebxia Tecnología

In the case of DysWebxia, two apps are already fulfilling her dream (with several others under work). One of them is Text4all, a Romanian project that helps online users adapt existing Web pages to their needs. The other is the IDEAL Group Reader, the first e-book reader to include settings for dyslexics, which boasts over 11,000 downloads in Google Play. Created in India, it was one of the finalists at Vodafone Foundation Smart Accessibility Awards 2012.

In its current form, Dysegxia is a mobile game with word exercises to support English- and Spanish-speaking kids with dyslexia. It is available for free in the App Store as well as in beta for Android.

1.2.4 Barriers to Effective Use of Technology for Students with reading disabilities

Many technologies previously described are readily available for use by individuals with different types of disabilities and are already providing many students with special needs an opportunity to be educated alongside their nondisabled peers.

However, several barriers inhibit more widespread use of these applications and devices, especially inadequate teacher training and cost. Lack of adequate teacher training has an especially strong impact on students with disabilities because technology is often a critical component in planning and implementing an educational program for these students. In addition, use of technology for multimedia projects, for example, can be very motivating for students with disabilities. But classroom teachers must have a deep understanding of what they are trying to accomplish and how technology can help them achieve their goals [25]. Thus, to meet the needs of students with disabilities within regular classrooms, all teachers, both those in regular education and those in special education programs, need training in how technology can be used, and the technical skills to carry out a plan of action [25]. The cost of the technology needed to help students with disabilities participate in regular classroom settings, especially the computer systems needed for students with more severe disabilities, is also a serious consideration for all schools. Such systems often must be tailor-made for each student and can be quite expensive, costing tens of thousands of dollars.

1.2.5 Emergence of Mobile Devices

There are lots of things on mobile phones that are really useful for people with dyslexia, short term memory difficulties etc. For instance the organizational tools that come supplied with today's smart phones are invaluable for people with dyslexia and organizational problems. A lot of things can be done with Microsoft Outlook and it is a fantastic tool. However, it only works if you turn your computer on. It is therefore easy to miss appointments if the reminders are only on the computer. With a mobile phone it is always on and always with you so that the reminders always work. Research from the University of Southampton has shown that people value their phones and young people especially engage with their phones. Young people do all sorts of things with their phones and so rather than using a separate piece of assistive technology this can be integrated into the phone. Phones are also discrete so you are not flagging up the fact that you have a learning difficulty or a disability. Many of these assistive technologies can be used in a work and an academic context. [26]

2 Motivation and Goals

Overview of the system:

The goal of the project is to create an application specifically designed for the use of dyslexic children (aged 6-8) with reading difficulties

The main objective can be split in the following sub objectives:

Design and implementation of an interactive mobile application to be visualize in format of a game on smartphones and tablets with Android software platform in order to improve children's skills and motivate them for reading while still having some fun.

3 Design and Implementation

3.1 Overview of the system

3.2 Sheryxia application

3.2.1 Introduction

3.2.2 Application front-end

The system consists of a mobile application which is called Sheryxia. The “sheryxia” is a mobile application which is quite user-friendly and enjoys from a unique user interface. When the user goes to the applications page, they just need to find Sheryxia and then they can reach to the main menu. The main menu consists of 4 sections. The first 3 sections provided user with instructions on how to play and the last one is “About Sheryxia” which is a guideline for parents.

After choosing each section they can start the game. Clicking on each section takes user to the other page in order to continue with the game. Each part of the game has been designed for a specific goal.

In the following pages, a description of the application accompanied with the corresponding screen images, system usage work flow and other information would be detailed. Description about each section will be given in the “Sheryxia” front end part. In figure 2, a Mockup of ” Sheryxia” is illustrated.

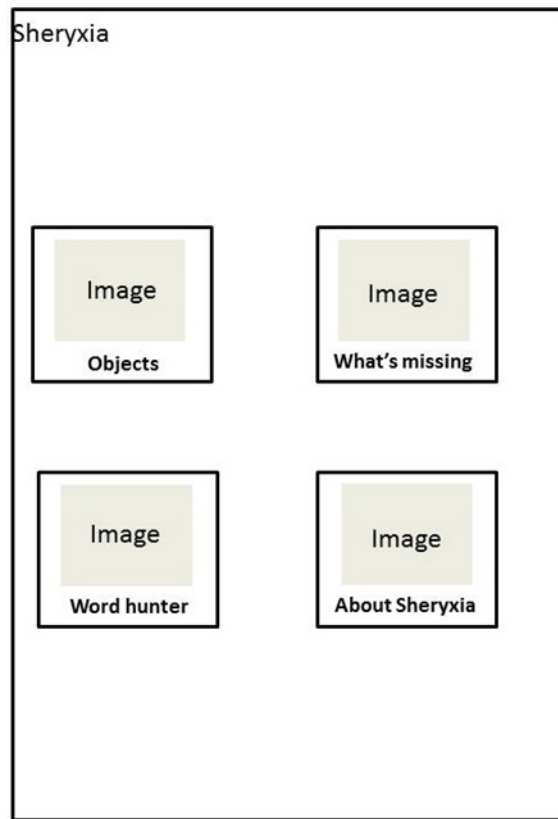


Figure 2-mockup of the main page

3.2.3 “Sheryxia “Main interface features

After choosing Sheryxia, the user faces four different sections. In the first section which is called OBJECTS, the user can play with some objects and letters. After that they are required to find the word that contains the given letters within a specific amount of time. By choosing the correct letter, the background is set to be green and otherwise it is set to red. The interesting part is scoring which increases after each correct answer. In the following figure Mockup of the first window is shown.

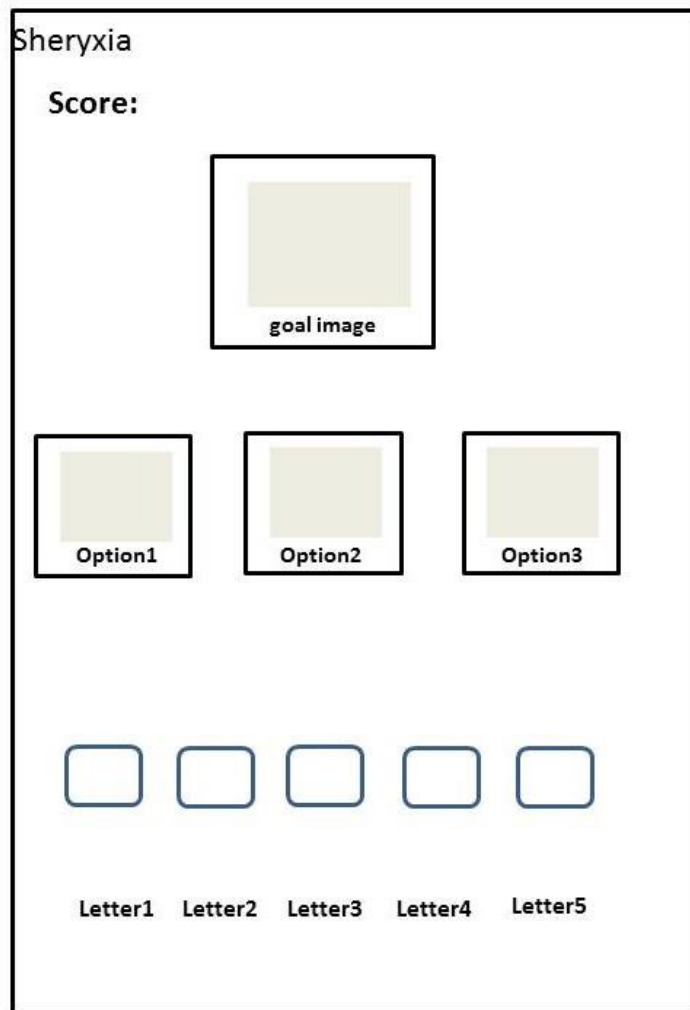


Figure 3-mockup of the first section

The second game is WHAT'S MISSING that is about one particular image at a time. The Goal is to complete the corresponding word (name of the image), and doing this for three consecutive images. These three images have something missing. He should find the complete image from the bottom of the screen, and then drag and drop it to the right side of the image. He gets score each time a missing part is completed and the word is made up. Here is a mock up for this game. Among images on the bottom, there is one wrong image that is a challenge for the user.

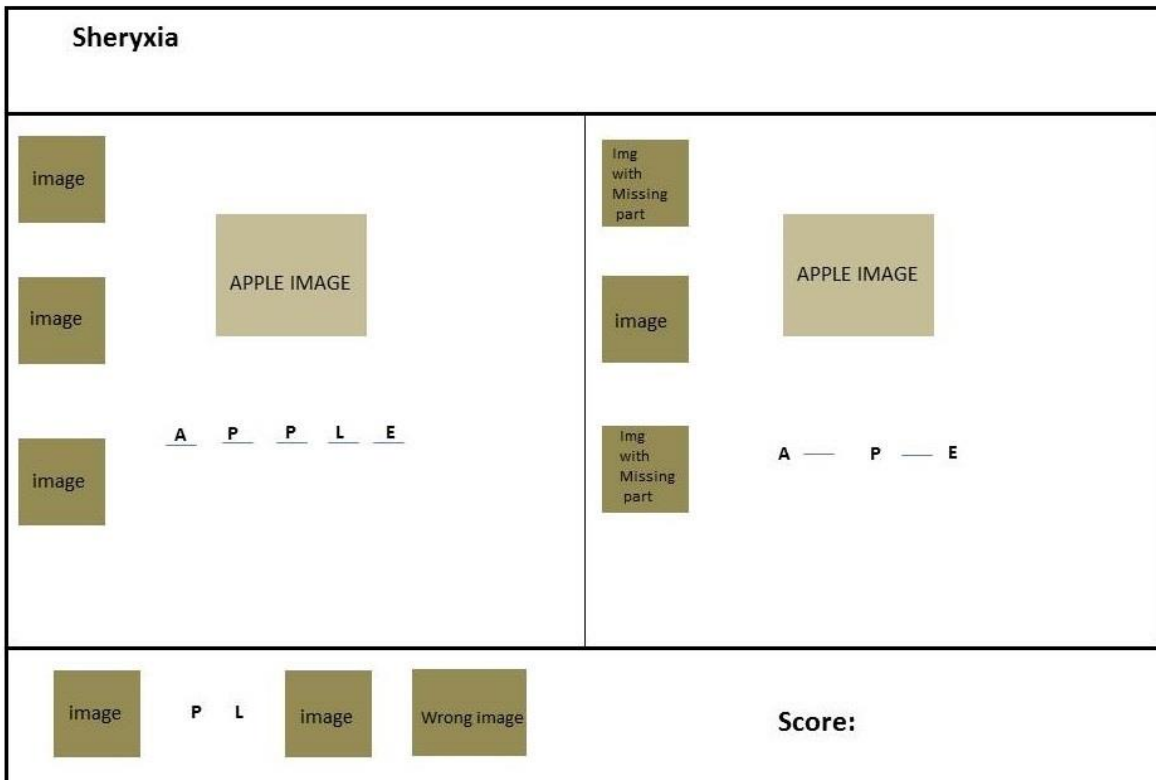


Figure 4-Sheryxia second section mockup

The third section is WORD HUNTING. It is about catching words and putting them in the appropriate place according to the corresponding picture. This is done by dragging and dropping. The user can play and increase his score. Mockup of this page is shown in the next figure. This section consists of one big image which is the Goal of this section. In other words, the user should make a word according to the corresponding picture. In the following page the mockup for this section is shown

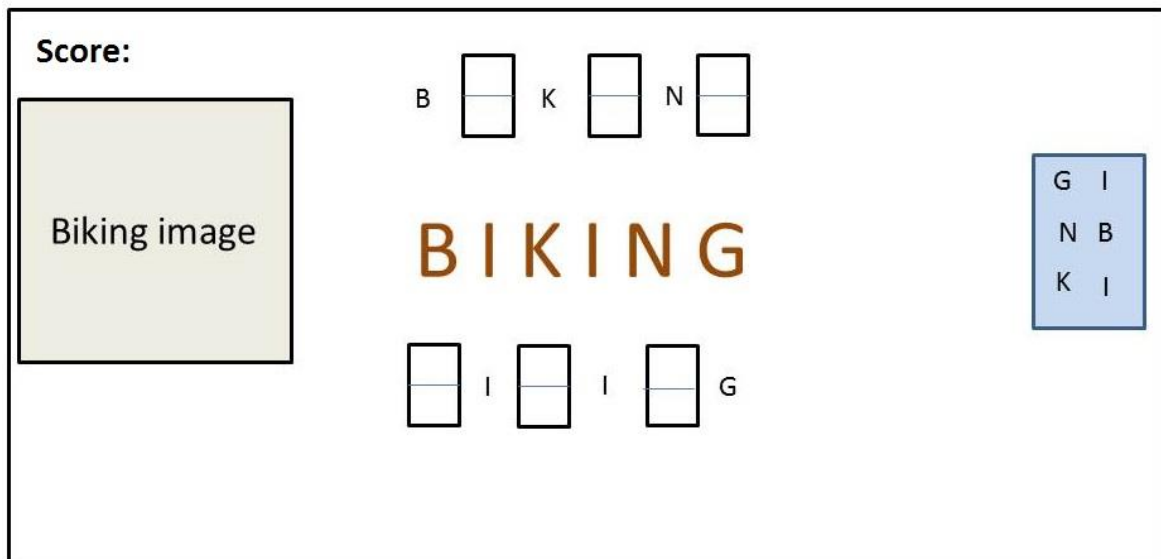


Figure 5-mockup of Sheryxia third section

3.3 User Interface of a system (UI)

During the development of an application it is important to have appropriate Graphical User Interface (GUI). For the development of this application, a simple and intelligible GUI has been considered.

The icons with images help dyslexics understand the content of each game more easily. In other words, App's user interface is everything that user can see and interact with.

A great deal of effort was put into practice to make an accessible and intelligible User Interface in order to help special children with reading problems.

GUI for “Sheryxia” application is made of simple images that user can interact with in order to play. Furthermore, dragging and dropping interaction feature would make the experience even more interesting.

For the UI menu, Sorting of images is modeled. From the Layout point of view, a Linear Layout (Vertical Layout) was chosen for this project. It comprises different components (Images), XML files and corresponding API based on the application which was required. These will be explained in the following sections.

A Linear Layout is a view of the group that aligns all children in a single direction, vertically or horizontally. The layout direction android: orientation attributes.



Figure 6-linear layout

3.4 Input Control

Input controls are the interactive components in the application UI. In this application, buttons and texts have been the mostly used ones. Adding input control to the UI is simple and easy. For this purpose, the components are required to be added to the XML file. Here is a sample of adding Button to xml file and common controls which were used in “Sheryxia”.

```

<TextView
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:text="score:"
    android:id="@+id/scoreText" android:layout_gravity="left|center_vertical" android:textColor="@color/black"/>

```

Figure 7-XML file for adding button

Table 1-control types

Control type	Description	Related class
Text field	An editable field	Text View
Button	A push button that can be touched and click.	Button

3.5 Sheryxia back-End

3.5.1 Drawable (resource of images)

A drawable resource is a general concept for a graphic that can be drawn to the screen and that is retrievable with APIs such as `getDrawable(int)` or could be applied to another XML resource with attributes such as `android:drawable`. There are different types of drawable. In this project images are located in `res/drawable` and they are used in all part of Sheryxia. Android supports bitmap files in a three formats: `.png`, `.jpg` and `.gif`. The format which was used for this project is the `.png` format.

With an image saved at `res/drawable/img_q_1`, the layout XML applies the image to the view.

```
<ImageView
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:id="@+id/imageView1" android:layout_gravity="center"
    android:src="@drawable/img_q_1"/>
```

Figure 8-drawable resource image in XML file

The following application code retrieves the image as a Drawable:

```
String quPic = thing.getBlack Image();
int id = getResources().getIdentifier(quPic, "drawable", getPackageName());
((ImageView) findViewById(R.id.imageView1)).setImageResource(id);
```

Figure 9-retrieves the image as a Drawable

Table 2-resource directories res/directory

Directory	Resource Type
Color/	XML file that define a state list of colors
Drawable/	Bitmap files(<code>.png</code> , <code>.jpg</code> , <code>.gif</code>) or XML files that are complies into the Bitmap this Project as a <code>.png</code> resource.
Layout/	XML files that define a UI layout.
Raw/	Arbitrary files to save in their raw form. With aresourceID, which is <code>R.raw.filename</code>

Value	<p>XML file that contain simple value,such as string,integer and colors. Some filename conventions for resource in directory:</p> <ul style="list-style-type: none"> • Arrays.xml for resource arrays • Colors.xml for color values • Strings.xml for string value
-------	---

3.5.2 Value

Here there is an example corresponding to each page of the application related to its value:

```

<ImageView
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:id="@+id/imageView3" android:layout_column="1"
    android:src="@drawable/left_pic_1_2"
    android:layout_gravity="center"/>

```

Figure 10-value of image View

This code is showing a value of a table Row that is “fill_parent” which is shown in the XML file.

```

<TableRow
    android:layout_width="fill_parent"
    android:layout_height="fill_parent">
</TableRow>

```

Figure 11-Value for table row

3.5.3 The manifest file

Without AndroidManifest.xml file (the “Manifest” file), the system cannot start application component. In the other words, the system must know that the component exists by reading the application’s AndroidManifest.xml file. The application must declare all its components seen in this file. Thus, they must be at the root of the application directory.

```

<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.ut7"
    android:versionCode="1"
    android:versionName="1.0">
    <uses-sdk android:minSdkVersion="16"/>
    <application android:label="@string/app_name" android:icon="@drawable/sheryxia"
        android:debuggable="true">
        <activity android:name=".MyActivity"
            android:label="@string/app_name">
            <intent-filter>
                <action android:name="android.intent.action.MAIN"/>
                <category android:name="android.intent.category.LAUNCHER"/>
            </intent-filter>
        </activity>
        <activity
            android:name=".Page"
            android:label="@string/salam">
        </activity>
        <activity
            android:name=".Puzzle"
            android:label="@string/salam">
        </activity>
        <activity

```

Figure 12-Manifest file

3.6 Application Fundamental

3.6.1 Android API

Android applications are written in java programming language. The Android SDK tools compile the code along with any data and resource file into an Android package. All the codes in a single .apk file would be considered to be one application. The file would then install the application in the Android device.

3.6.2 API Level

An integer value that uniquely identifies the framework API revision offered by a version of the Android platform is called API Level.

A framework API that application can use to interact with the underlying Android system is provided by Android platform. The framework API consists of:

A set of XML elements and attributes for declaring a manifest file and resource also for declaring and accessing the resources.

- A core set of package and classes
- A set of intents

For Sheryxia minimum SDK set to 4.1 on SDK 1.7 starting from android 4.1.2 Jelly bean (API Level16).

Table 3collected during a 14-day period ending on 1st of August 2013

Version	Codename	API	Distribution
1.6	Donut	4	0.1%
2.1	Éclair	7	1.2%
2.2	Froyo	8	2.5%
2.3-2.32	Gingerbread	9	0.1%
2.3.3-2.3.7	Gingerbread	9	33.0%
3.2	Honeycomb	13	0.1%
4.0.3-4.0.4	Ice Cream sandwich	15	22.5%
4.1.x	Jelly Beans	16	34.0%

*Any version with less than 0.1% distribution is not shown

3.6.3 Application component

Application components are the essential building blocks of an android application. Each component is a different point through which the system can enter the application. Not all components are actual entry points for the user and some depend on each other.

There are four types of application components such as activities, services, content provider and broadcast receiver. In this project, the activity components which have been represented by a single screen UI have been implemented.

3.6.4 Styles

A collection of properties that specify the appearance and format for a View or window is called a Style. A style can determine properties such as padding, height, font color; background color and font size. It is defined in an XML resource that is separate from XML which determined the layout.


```
<TextView
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:text="Score: "
    android:id="@+id/scoreText" android:layout_column="0"
    android:textColor="@color/black"/>
```

Figure 13-XML resource

By saving an XML directory of the project, a set of styles are creatable. But it must use the .xml extension and be saved in the res/value folder.

3.6.5 Media playback

The Android multimedia framework includes support for playing a variety of common media types which can easily integrate audio, video and images into the applications. It is easy to play and video from the media file stored in application's resource (raw resources) by using MediaPlayer APIs.

The following class is used for the application to play sounds:

MediaPlayer: This class is primary API for playing sound.

Here is an example of how to play an audio in the application which is available as a local raw resource (saved in my application's res/raw/directory):

```

final Handler handler = new Handler();

Timer t = new Timer();

t.schedule(new TimerTask(){

    public void run() {

        handler.post(new Runnable() {

            public void run() {

                //DO SOME ACTIONS HERE , THIS ACTIONS WILL WILL EXECUTE AFTER 5 SECONDS...

                String voice = "what_is_missing_here";

                int id = getResources().getIdentifier(voice, "raw", getPackageName());

                MediaPlayer startVoice = MediaPlayer.create(Puzzle2.this, id);

                startVoice.start();

            }

        });

    }

}, 500);

```

Figure 14-Media player class

3.7 Class diagram of the system

3.7.1 Use case of the system

The use case diagram is used to show how a user interacts with the system. This is a technique for capturing the functional requirements of the system. Use cases work by describing the typical interactions between the users of the system and the system itself, and providing a narrative of how a system is used. For this application, the user is defined as a dyslexic child.

In the figure 15 use case of the system is shown.

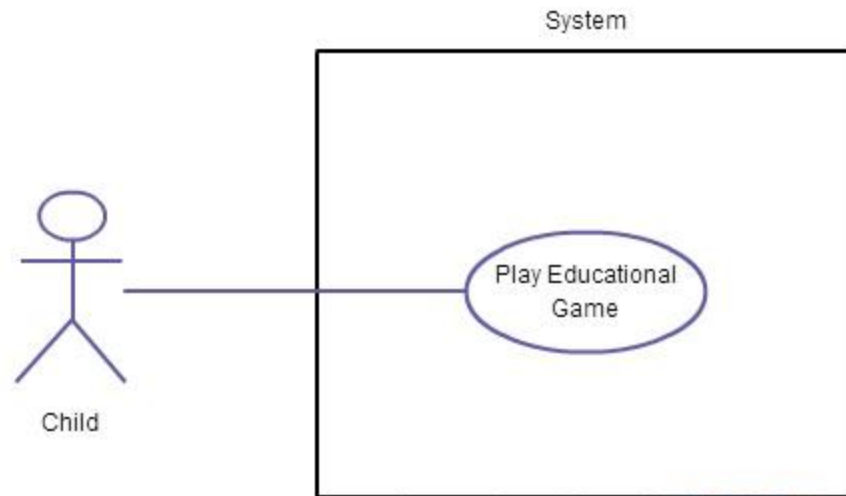


Figure 15-Usecase of the system

As you can see the user is the child that uses the system by playing an educational game. Once he opens the game, he'll see the menu with four options, he can decide to play one of the options .after each part, he will get a point, by playing correctly his score increasing also, and by dragging each letter ,system will response as a voice, in other words, the user can hear a voice after dragging. The general idea of a system is to play game to improve the user's skills.

3.7.2 Class Diagram Model

Class Diagram model is a visual specification of the user interface and it discussed on both static and dynamic aspects of the system. Class Diagram covers user interface elements and their navigation. The main concern of Class Diagram model is how to present system data to the user. This Model is defined by its two elements. The first element is the screen which is a list of screens making up the user interface. The screens are related to each other with associations which identify navigation paths. In this application screens are Main Page, Object, Missing letters and Word Hunter. The second element is the Navigation Map, which is conveying the structure of the user experience model. A screen may contain multiple input forms, each of which contains user input fields. Screen and input form have class stereotypes of <<screen>> and <<input form>>, respectively. In Sheryxia Class Diagram Model <<Input form >> are Letter Answer, Put Letters, Drag Pictures and Drag Letters

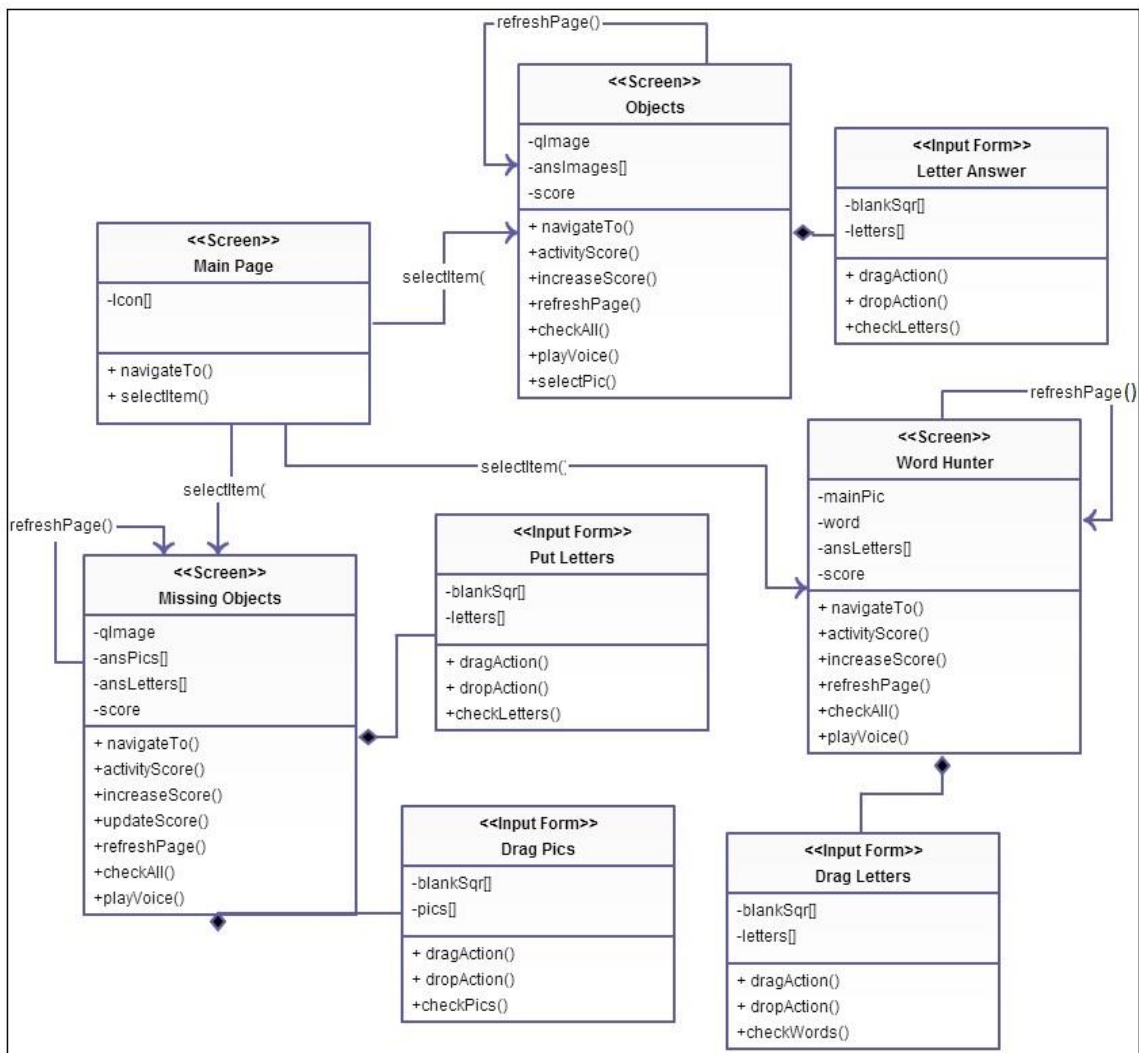


Figure 16-Class Diagram Model

As it is shown in the Model above for the first screen which is the Main Page, “SelectItem” is available which means that the action for the user in beginning of the application. It selects one item on the screen that can be one of the three options. In the Object Screen there is “qimage” that is an image which is the game target and the “ansImage” that shows an answer image. After selecting answer image the actions that would happen here are as follows: “increasing score()” “playing voice()” and “refreshing page()” after “check all ()” the answers. The <<Input Form>> for this screen is “Letter Answer” which composed of “Blanksqr[]” and “Letters[]”. the actions that user faced with them in the “Letter Answer” are “Dragaction()”, “DropAction()” and “checkLetter()”. The UX Model is checked for all the possibility actions in the application.

3.7.3 Analysis Diagram

Analysis diagram provides an analysis narrative text of each use case and identifies a first-guess set of objects that participate in the Use Cases, and then classifies them as one of three types of objects:

- Boundary Objects – which actors use in communicating with the system
- Entity Objects – which are usually objects from the domain model
- Control Objects – which serve as the glue between boundary objects and control objects.

Analysis modeling is critical link between the what (use cases) and the how (interaction diagrams)

3.7.4 Boundary Objects

Objects in the new system with which the actors (users) will be interacting.

- Usually screens, windows, dialogs, and menus.

These should take the form of Control Objects associated with the Boundary Objects.

Some boundary objects are needed in addressing alternate courses of actions within use cases, such as warnings or error dialog boxes that might appear separate from entry window.

In the following figure the design of an Analysis diagram for the application is described. The name of a<<Boundary>> is educational application which is Sheryxia and the child only interacts with the boundary classes. The boundary classes in the application interact with a control class that is explained in following paragraph.

3.7.5 Entity Objects

An entity object is usually a map to database tables and files that outline the use case execution and it is the basis for the logical design of the database. The database included all the images and voice in located in res/Drawable and res/raw folder.

.

3.7.6 Control Objects

Control objects serve as placeholders to ensure you don't miss any functionality and system behaviour required by the user cases.

Control class in the Sheryxia is the application manager which Includes Some operations such as (Create“MainPage()”,retrievepics(),retrieveVoice(),retrieve Letters(),refreshingpage() and upadatin score()).

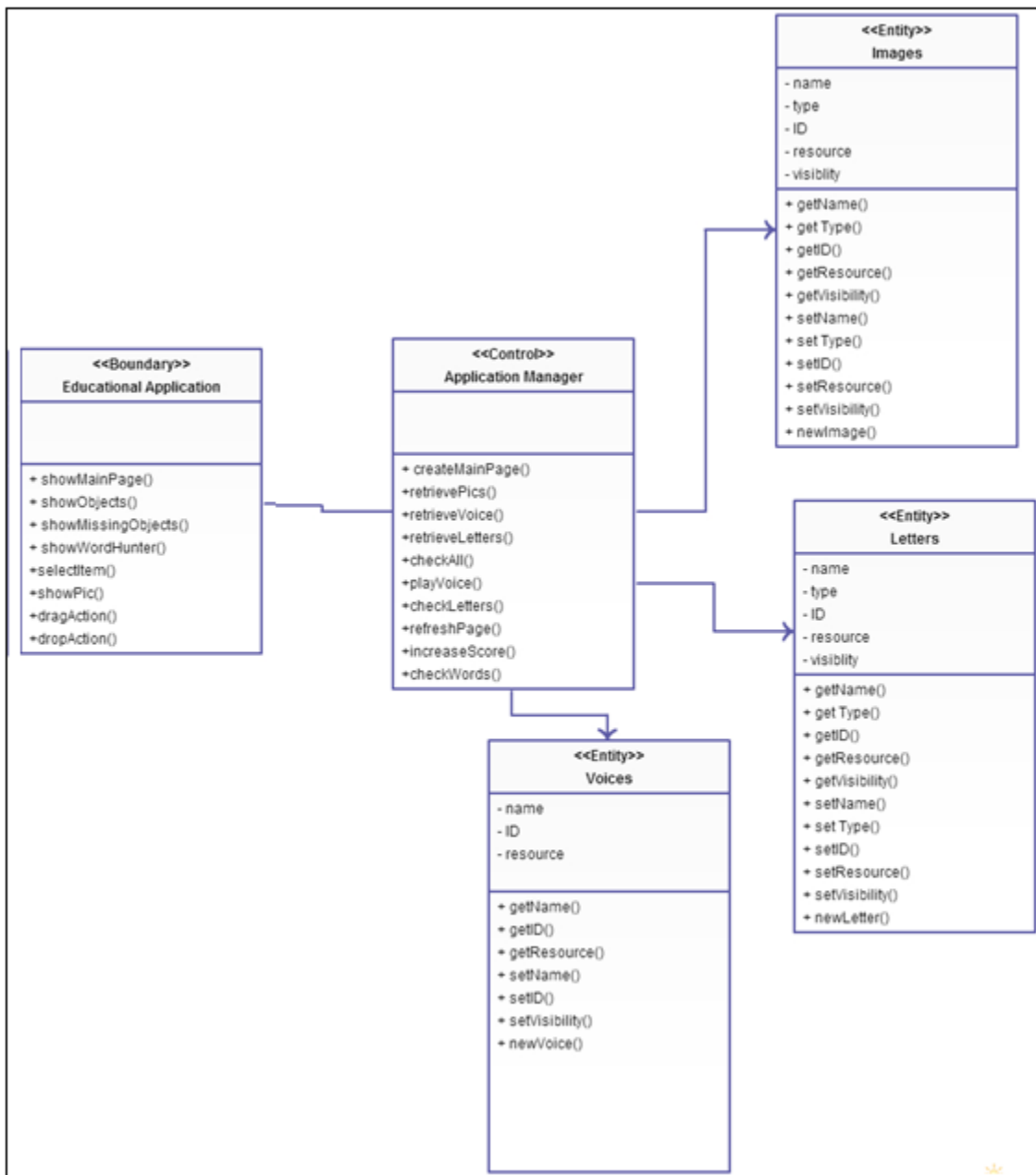


Figure 17-Analysis Diagram

3.7.7 The Sequence Diagram

Interaction diagrams describe how groups of objects collaborate in the overall behavior.

Typically, a sequence diagram captures the behavior of a single scenario. The diagram shows a number of example objects and the messages that are passed between these objects within the use case. Sequence diagram emphasizes the time sequence of messages and collaboration diagram emphasizes the structural organization of the objects that send and receive messages.

In the figure 18 I design sequence diagram for my application for the “Object” game.

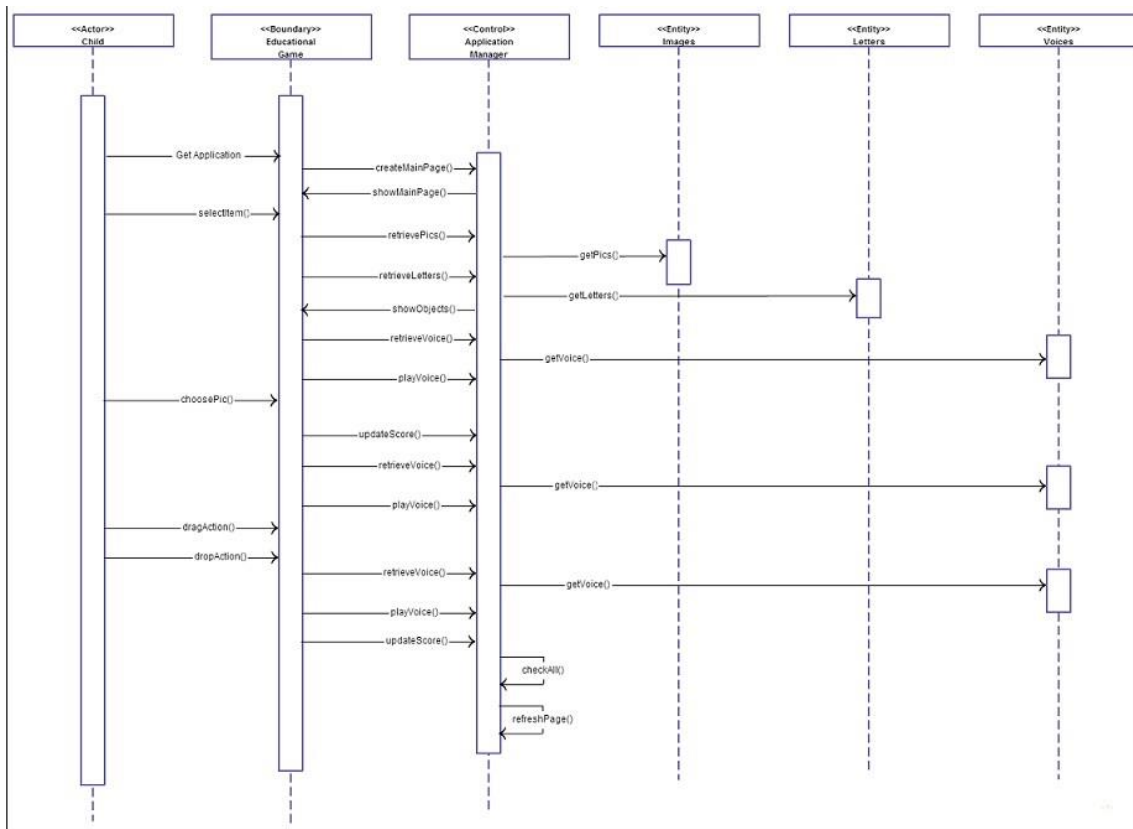


Figure 18-sequence diagram of the system

In this figure all the operations are illustrated. From the beginning the user chooses the application from the device and gets the menu of the game, then he selects “Object” game and the game screen appears with all the images. In the next step he should find the right object among three images, after selecting right object, a guide voice begins to play. Now it is a time for choosing letters to make the appropriate word and in the last part he’ll hear the word sound again. The last operation is refreshing the page that happen after checking all the answers.

3.7.8 Method description

Public class Puzzle

Table 4-puzzle class

public class Puzzle	Create app component to provide screen with which users interact in order to do something
public void onCreate (Bundle savedInstanceState)	Displaying image and Drawable resource
super.onCreate(savedInstanceState)	Activity can save state information with a collection of key-value pairs. The default implementation of this method saves information about the state of the activity's view hierarchy
getResource()	Return resources instance for your application's package

Displaying image and Drawable resource

Table 5-displaying image and its related resource

public class ImageView extends View	Displays an arbitrary image, such as an icon. The Image View can load images from various sources (such as resources or content providers)
public class ImageButton extends ImageView()	Displays a button with an image (instead of text) that can be pressed or clicked by the user.
public void setImageResource(int resId)	Sets a drawable as the content of this ImageView

Set content view class

Table 6-content view class

setContentview(R.layout.puzzle2)	Set the activity content to an explicit view. To use layout parameters of puzzle2
----------------------------------	---

Resource identifier

Table 7-Resource Identifier

getResources().getIdentifier(String name, String defType, String defPackage)	Return a resource identifier for the given resource name and Finds a view that was identified by the id attribute from the XML
findViewById(R.id.my_image)	Finds a view (Imageview1) that was identified by the id attribute from the XML

Drag Event Listener

Table 8-Drag Event Listener

setOnDragListener()	To set the listener for a View object
class DaDragListener implements View.OnDragListene	A View receives drag events with either a drag event listener
public boolean onDrag(View v, DragEvent event)	Called when a drag event is dispatched to a view
DragEvent.ACTION_DRAG_STARTED	Action constant returned by getAction(): Signals the start of a drag and drop operation.
ACTION_DRAG_ENTERED	Action constant returned by getAction(): Signals to a View that the drag point has entered the bounding box of the View.
ACTION_DRAG_EXITED	Action constant returned by getAction(): Signals that the user has moved the drag shadow outside the bounding box of the View.
DragEvent.ACTION_DROP	Action constant returned by getAction (): Signals to a View that the user has released c,
ACTION_DRAG_ENDED	Action constant returned by <u>getAction()</u> : Signals to a View that the drag and drop operation has Concluded.
ACTION_DOWN	Constant for getActionMasked () A pressed gesture has started; the motion contains the initial starting location.
ACTION_DROP	Signal to a view that user has released the drag shadow and the drag point is within the bounding box.

Letters

Table 9-Shown and chosen letter

private List<Integer> letters	Our shown letters
private List<String> answers	Our words to be chosen

Answer and finish game method

Table 10-Answering and finishing class

public void isAnswered()	when one answer is correct
public boolean isFinished()	Asking if the game is finished

Public class Thing

Table 11-public class including images and finding random one

public class Thing()	Include String name,blackImage,sImage,bImageint id, in place and answer ,create next image
private Thing createNextImage(int[] lastObjects, lastPlace)	Create next image randomly corresponding to random place.

Media Player Method

Table 12-media player class

Public static MediaPlayer create(Context context,int resid)	play audio that's available as a local raw resource
---	---

Specifying the code to run on a Thread

Table 13-public Run class

public void run()	In the class, the Runnable.run() method contains the code that's executed
public final boolean post(Runnable r)	Returns true if the Runnable was successfully placed in to the message queue. Returns false on failure, usually because the lopper processing the message queue is exiting.

Public abstract Boolean onTouch

Table 14- ontouch class

public boolean onTouch(View view,MotionEvent motionEvent)	Called when event is dispatched to a view.this allows listener get chance to respond before the target view
---	---

Displaying image during Drag and drop

Table 15-showing image while drag and drop

View.DragShadowBuilder shadowBuilder = new View.DragShadowBuilder(view);	Creates an image that the system displays during the drag and drop operation. This is called a "drag shadow". The default implementation for a DragShadowBuilder based on a View returns an image that has exactly the same appearance as the given View
--	--

Public Random ()

Table 16-random generator

Random generator()	Construct a random generator with the given seed as the initial states.Equivalent to Random r=new Random();r.setseed(seed)
--------------------	--

Generate Letters

Table 17-Generate Letters

private char[] generateLetters()	Generate letters in String
----------------------------------	----------------------------

List Class

Table 18-Arraylist and shuffle class

<code>ArrayList<Character> chars = new ArrayList<Character>(nome.length());</code>	Array List is an implementation od List, backed by an array. All optional operations including adding, removing and replacing elements are supported
<code>public static void shuffle(List<?> list)</code>	Moves every element of the list to a random new position in the list

Sorting class

Table 19-Sorting class

<code>public static void sort(int[] array)</code>	The { @code int } array to be sorted.
---	---------------------------------------

HashMap:

Table 20-HashMap

<code>private HashMap<ImageView,String> im2str</code>	Is an implementation of Map. All optional operations are supported
---	--

Refresh page Class

Table 21-Refreshing page class

<code>private void refreshPage()</code>	Refreshing page after finishing actions
---	---

Update score class

Table 22-score class

<code>protected void updateScore()</code>	Keeping score update
<code>protected void increaseScore()</code>	To decrease or increase score

Base context class

Table 23-get Base context

<code>public Context getBaseContext()</code>	allows access to application-specific resources and classes
--	---

Assets manager class

Table 24-assets manager class

<code>public AssetManager getAssets()</code>	Presents a lower-level API that allows you to open and read raw files that have been bundled with the application as Simple stream of bytes.
--	--

Retrieving various kinds of information related to the application packages

Table 25-package manager

Public PackageManager.getPackageManager()	This exception is thrown when a given package, application, or component name cannot be Found.
---	--

Start Activity method

Table 26-start activity

public void startActivity(Intent intent)	this method is used to start a new activity, which will be Placed at the top of the activity stack.it takes a single argument, n Intent, which describes the activity to be Executed.
--	---

Timer class

Table 27-Timer class

public class Timer()	Timers schedule one-shot or recurring for execution.
----------------------	--

3.8 Design

3.8.1 Sheryxia front-end

3.8.1.1 Menu Screen Features and Layout

The Main Navigation in the application is “Menu “screen. User needs to reach Menu screen in order to start application and it’s the only way to choose game options.

A layout of the “Main “screen contains the following elements: a LinearLayout ,TableLayout ,TableRow and ListView.

LinearLayout is view group that aligns all children in a single direction, vertically or horizontally. In this application the orientation of the LinearLayout is vertical and it covers the whole screen. The vertical orientation of the LinearLayout means that all other elements or children added to this layout are placed in vertical order, one after another, from top to bottom.

TableLayout is a ViewGroup that displays child View elements in rows and columns. TableLayout positions its children into rows and columns. In this case for Layout properties for layout width and height ‘Wrap_content’ is used as well. For Layout gravity [right,center_vertical] is considered.Layout gravity is a pre-child layout information associated with ViewLinearLayout.

In this peorject the “Menu”consists of four Imageview buttons which stand on TableRow.

TableRow objects are the child of a TableLayout(each TabkeRowdefines a single row in the Table).Each rows has zero or more cells,each of which is defined by any kind of other view.in this case the cells of row are ImageView objects.

The Menu screen Mockup and Layout for that is shown on figures 19 and 20.

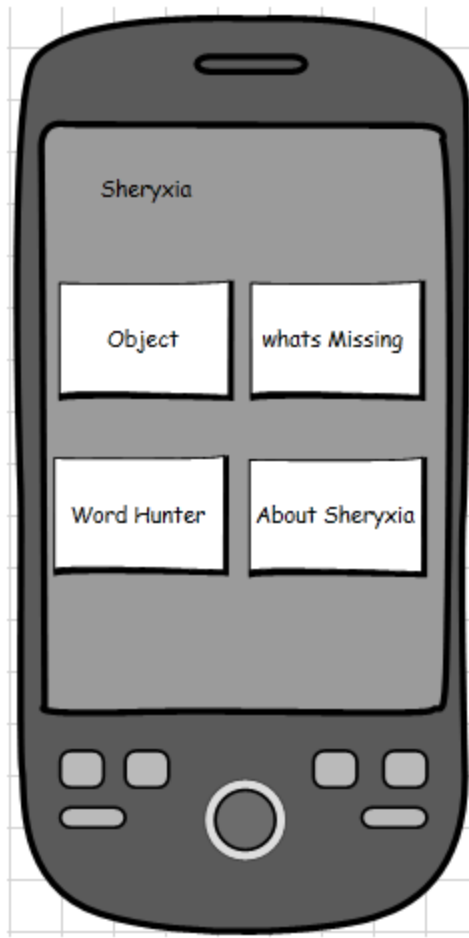


Figure 19-Mockup of the main page

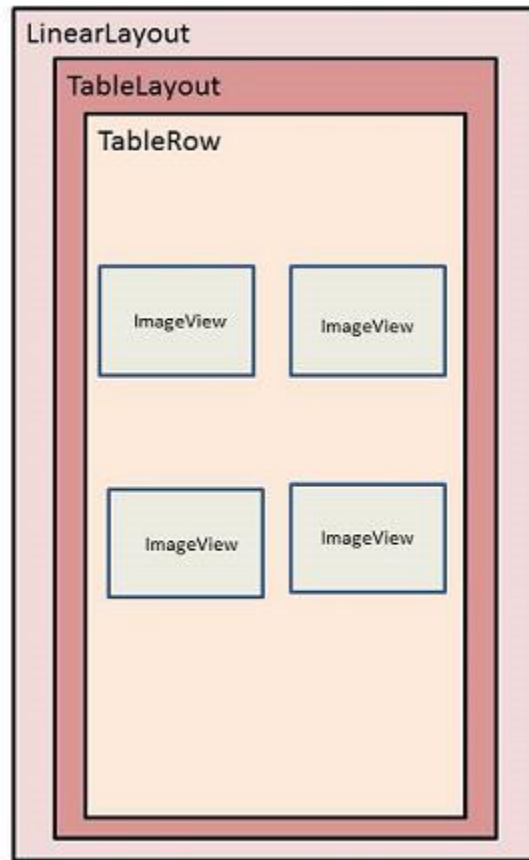


Figure 20-Layout of the main page

3.8.1.2 Main feature and layout for Menu Icon

Icon1: OBJECTS

Menu Icon1 is one of the most important screen in this application which displays a first menu option that is “OBJECTS “and contains sort of images that user can play. By clicking on the correct object user can find the answer and then he should move to the bottom of page in order to find an exact letters to complete the word which is related to the previous image. When the user clicks on one of the three images View, he can find a correct answer and then try to complete the word and put them together to the ‘dash’ part in order to get complete word which corresponds to the correct chosen answer. The first TextView on the top is shows a Score of this Game

Figure21 shows a mockup screen of this “Icon”, Moreover Layout of the “OBJECT Icon” is shown.

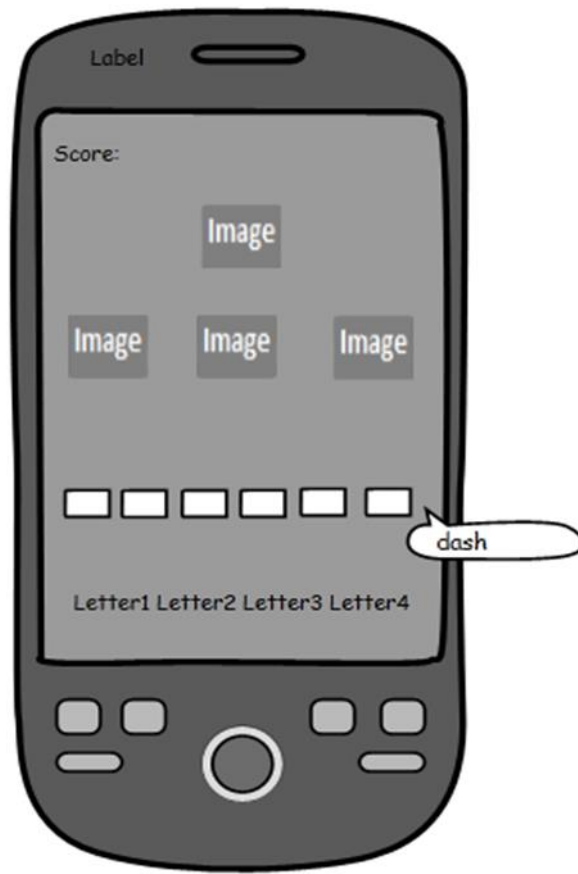


Figure 21- Mockup of the first Icon

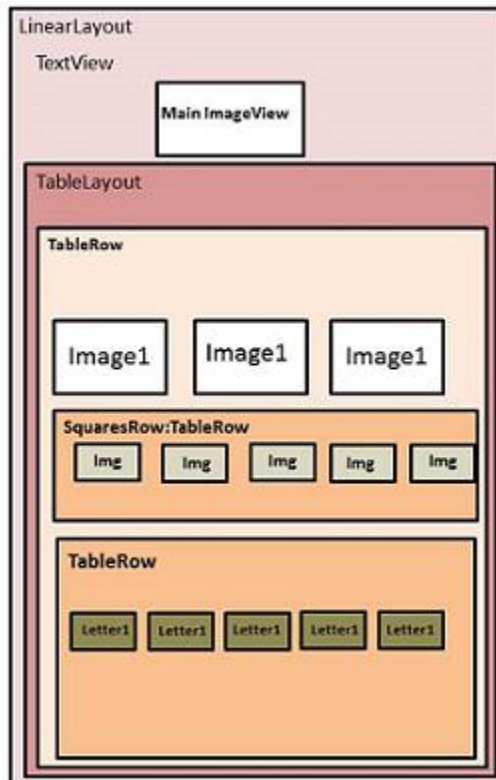


Figure 22-Layout of the first Icon

Icon2: What's Missing

The second screen of this application is named “What’s Missing” that is related to finding a missing point while comparing two images including the image and the letters to complete a correct word.

The Layout of this section consists of LinearLayout, TableLayout and Table Row. The screen is divided into two parts. The most of the images are applied into TableRow that is composed of one image on the left side of the screen and a complete Picture on the right side of the screen. There are 3 images on the left side. These images should be similar to the main image on the left side of screen but with some differences. In addition to those pictures there is one Main picture in the middle and some space for completing a word. In addition to the first TableRow, there is the other TableRow on the bottom of the screen which occupies by missing objects. In addition to them there is TextViw on the top-left corner.

The important fact of this part is Landscape view, in order to reach this part he should rotate a device to access all functionality of this part. . I prefer to design as landscape because of some issue related to dyslexic children; first of all Landscape view give him better visualization. Second, having a wide screen cause to more concentration. Lastly he feels more comfortable the important fact of this part is Landscape view, in order to reach this part he should rotate a device to access all functionality of this part. . I prefer to design as landscape because of some issue related to dyslexic children; first of all Landscape view give him better visualization. Second, having a wide screen cause to more concentration. Lastly, he feels more comfortable.

In the figure 23 designs for this section is shown, moreover there is a mockup for second Icon.

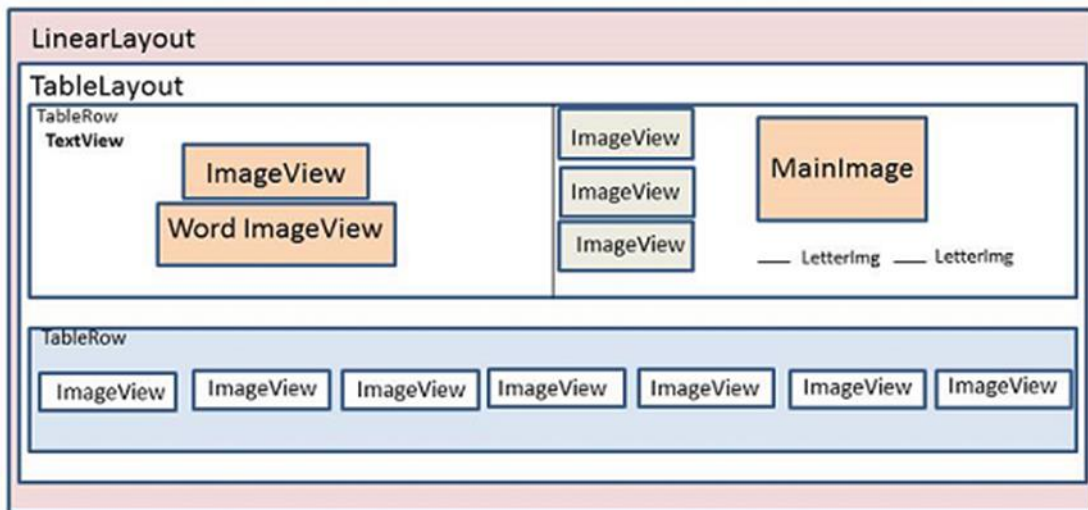


Figure 23-Layout for the second Icon

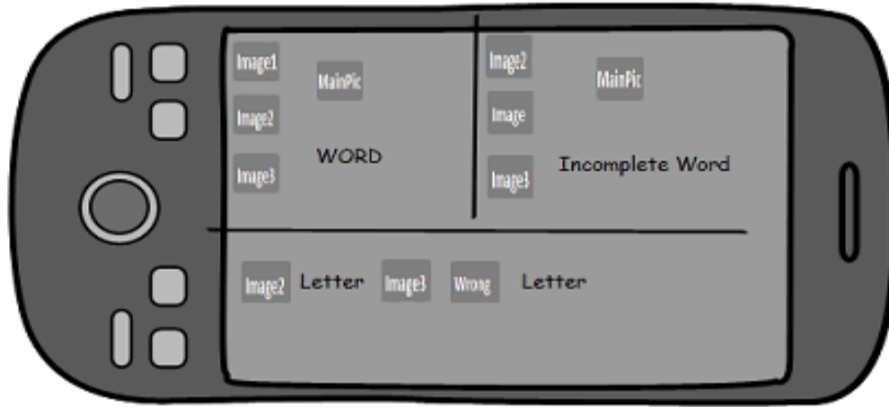


Figure 24-Mockup of the second Icon

Icon 3: Word Hunter

This part is about hunting words. It means that user should find appropriate letters and put them together in a space up and down a Word.

“Word Hunter” screen layout contains the following elements:

Linear Layout, Table Layout, 2main Table Row, one Text View, one Image View on the left side of screen, one Image View in the middle and one pic o the right side. There is also Image view on the top and bottom of screen.

Main actions happen in a second TableRow. In this part the important navigation in among right ImageView and sort of ImageView on top and down. In the other words, he should move ImageView from right side of screen and put them in the correct place on the top and down.

In a figure25 a layout design and Mockup for “Word Hunter “is shown.

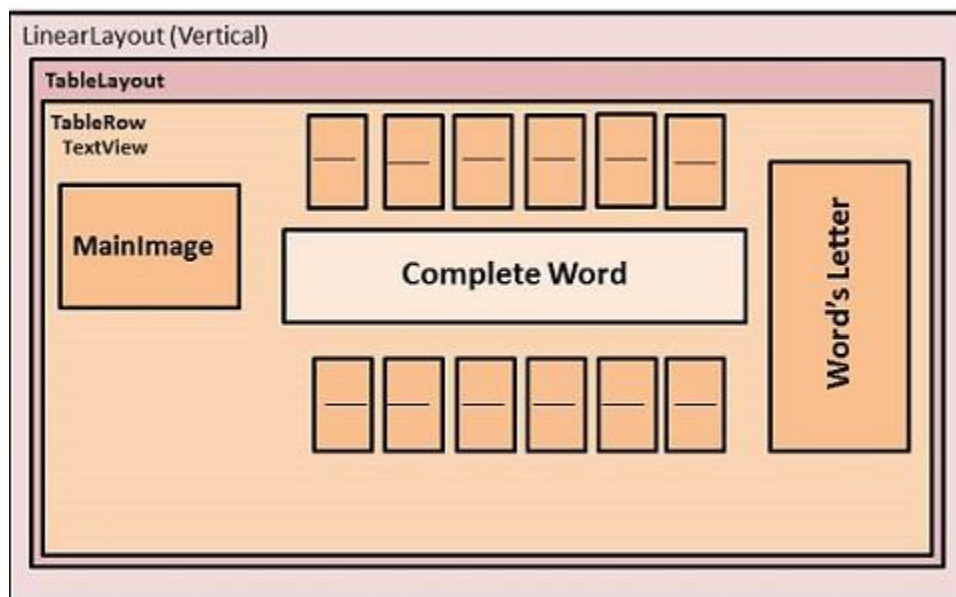


Figure 25-Layout design for third Icon

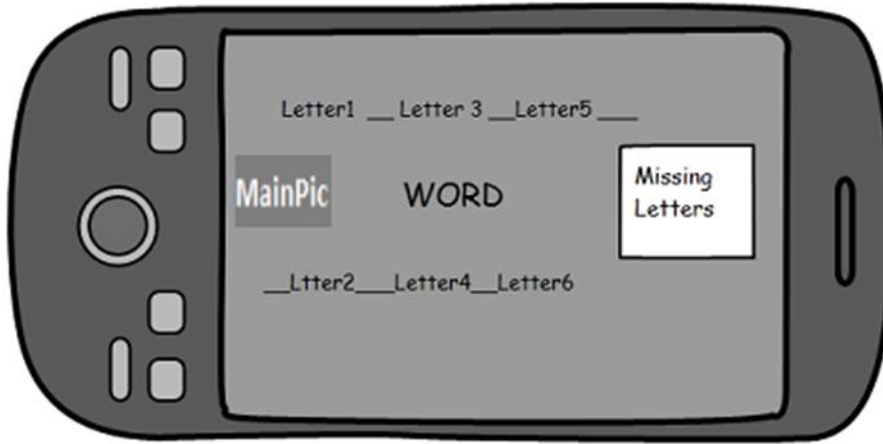


Figure 26-Mockup for the Word Hunter

3.8.2 Sheryxia Back-end

3.8.2.1 Activity workflow

The Application component that makes a screen with which user can interact in order to do some actions (such as Clicking a Menu button and move to the other activity) is called an Activity.

“Sheryxia” application is composed of 2 activities for each button Menu. Overall there are six actions from Menu which are accessible except the Info page.

Each activity has a specific user interface for a special goal: Menu Activity represents the main Menu screen; “Objects “Activity is shows a main page of Respective game. What’s Missing Activity screen represents another screen for a game and the last activity is related to “Word Hunter” Activity which is show the Primary screen of respective game. In addition, the last Activity is “About –Sheryxia” that is reachable from Menu Activity screen.

As you can see each activity is a separate application that is presented to the user when he starts for the first time. As is shown in workflow activity the Main Activity is considered to be a start point of this application. It means anytime he decides to play, should start from Menu activity screen. From Main activity user can go to the three mentioned options.

The previous activity stops when a new Activity starts but the system saves a score and user can continue with a new game but with the previous score. The score task uses the basic “last in, first out stack mechanism, so when the user is done with current activity and clicks on the back button it is came out from the stack and the previous score resumes. However for the new Activity previous score is kept.

3.8.3 Sheryxia screen

In following figure screenshots of “Sheryxia” are shown. Each page is explained separately in following pages.

In Figure27 the first screen appears to the User when he wants to start the application. In this screen he should choose one of the three icons. The fourth one in the bottom right side of the screen is some information about Sheryxia.



Figure 27-menu screenshot

Icon1 (OBJECT):

As it was explained in previous pages, Sheryxia has three different kinds of game. Object is the first option to play. By clicking on this icon the user can find 2 parts on the screen. First he can hear the voice that says ‘Find right objects’ so he has time to find right objects among three. After choosing the correct one he should put the letters in an appropriate place which is shown by small squares. He could first make an exact word and then switch to find a correct object. In addition, there is always at least one extra letter among letters. The aim of this part is to help and improve Image recognition and spelling, writing and increasing power of word making for dyslexic children according to their reading disabilities.

In following figures screenshot of Icon1 is shown step by step:



Figure 28-OBJECT (first page)

In this part as it shown there are 2 set of images.one images in black and white which is target of this part, on the bottom of the screen there are some letters which correspond to the target image. After running the page, the user hears the voice that tells him what to do. He should choose the right object, which is placed in middle in this screenshot. The following figure is showing the chosen image.



Figure 29-selecting the right object (Watch)

The watch is chosen which the correct answer is. The score is increasing after choosing right answer. For each correct answer he can get one point. After that, it is the time for making the word. He can drag and drop the letters one by one and put them in the correct place which is provided by Small Square. If he chose a wrong letter, its background would set to red color. During play the user can hear voices; first time is when he chose correct object, second, when he drags each letter, can hear the voice of each letter. Last time is after completing the word, so it causes to repeat for him so he can memorize the word better. Figure below is showing this procedure step by step.



Figure 30-dragging more letters



Figure 31-dragging more letters

In these two figures as it is seen, the user drag letters “W”, “A”, “T”, just C, H and O are left but “O” is an extra letter so if the user drag and dropped it, it would set the background with red color. In the following step the user drops the rest of letters and when he’s done with that, he can hear the name of the object.



Figure 32-one step to complete the word



Figure 33 Completed Word

This part is finished and the score increases to 6. After finishing this part, page automatically goes to another page and the same game is started. In each part of the game if he chose a wrong object or letter, he would lose score.

Icon2 : What's Missing

In this section the screen is divided into two parts. On the right side of the screen there is a complete image with one image in middle and three different shapes on the left. Main image is related to the word that should be completed. On the right side is the same image as on the middle with those three shapes but with some missing features. In addition to completing the missing part, he should complete the blank with the letters. All missing features and letters are embedded on the down side of the screen.

In this activity the child completes the images and the word. When a child "figures something out" all by himself his mind is excited and new connections are formed. This simple activity is much more likely to help a Dyslexic child to learn the spelling of the word than practice and memorization- because of the "discovery factor".

The following screenshots shows the process of this part.

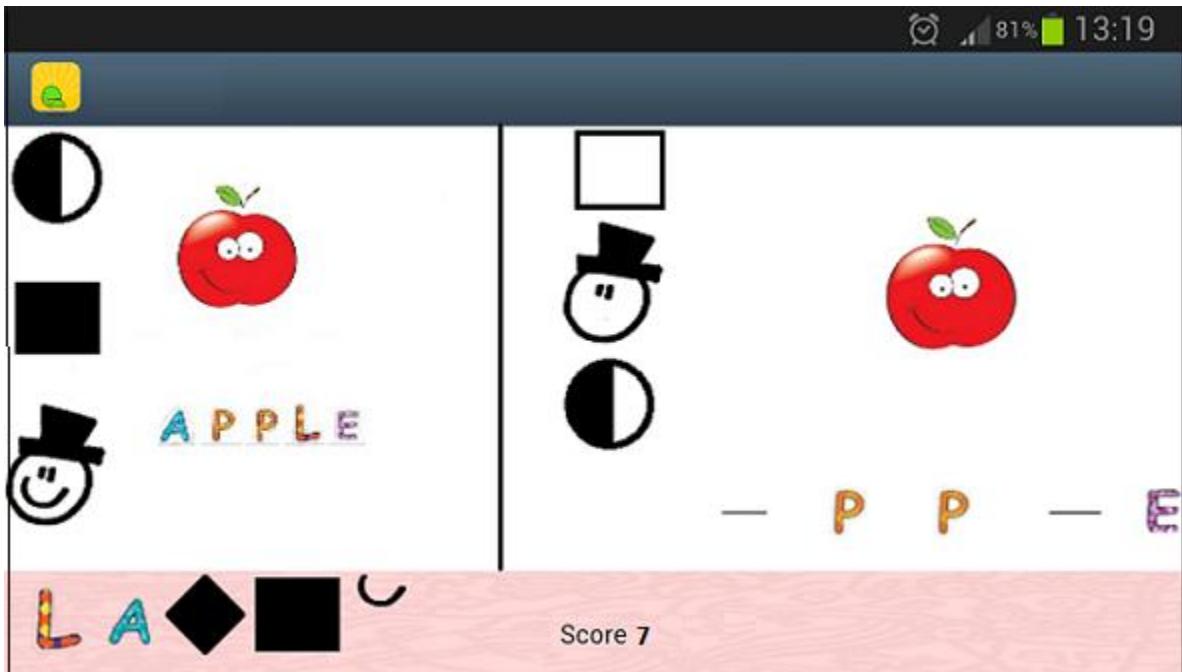


Figure 34-screenshot of the "what's missing" game

Screenshot of the second Icon is shown in figure 1. As it was explained in the above section, the screen is divided into two parts. The left image is complete but the right one has something missing. In the following screenshot the goal of this part of the game would become more explicit.

In a below screenshot the user chose the square which is the first difference between left and right image. So in this part, 1 score is awarded to him. In the following figures more screenshot are shown.

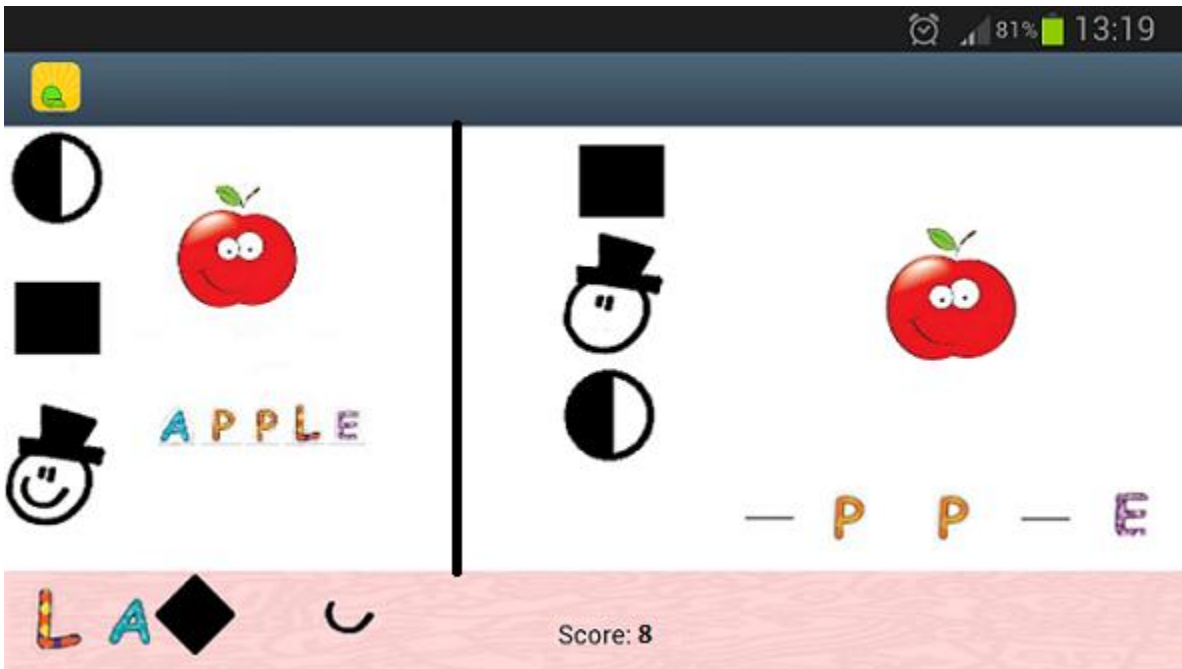


Figure 35-screenshot of steps of the Second section

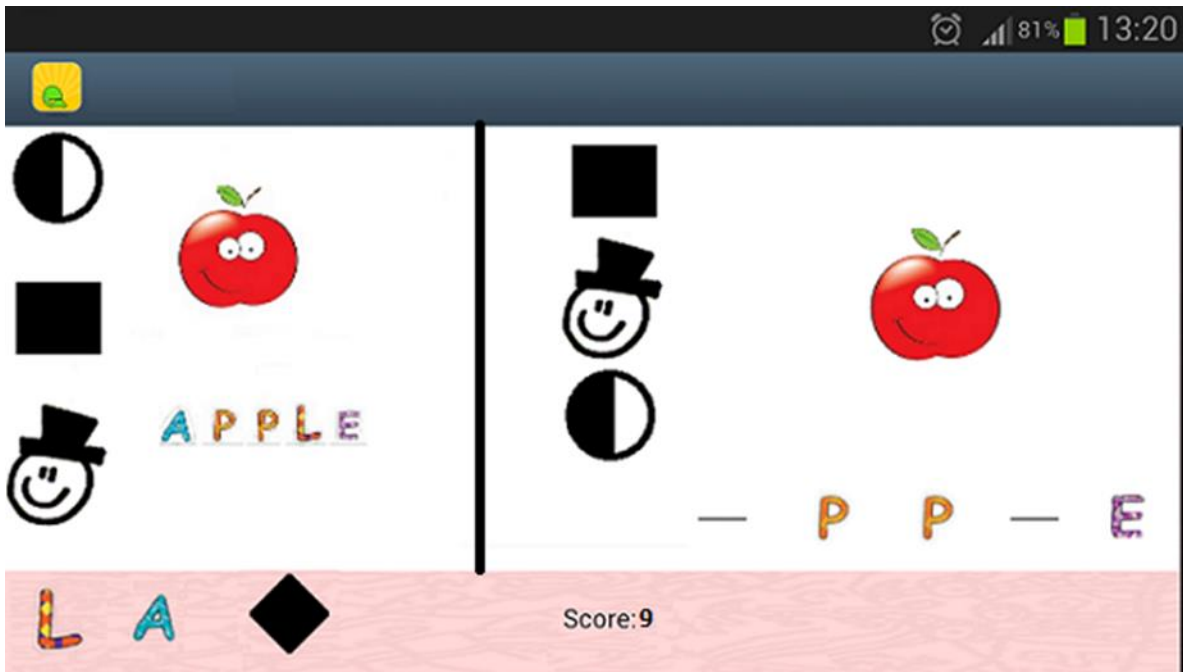


Figure 36-Continuation of playing

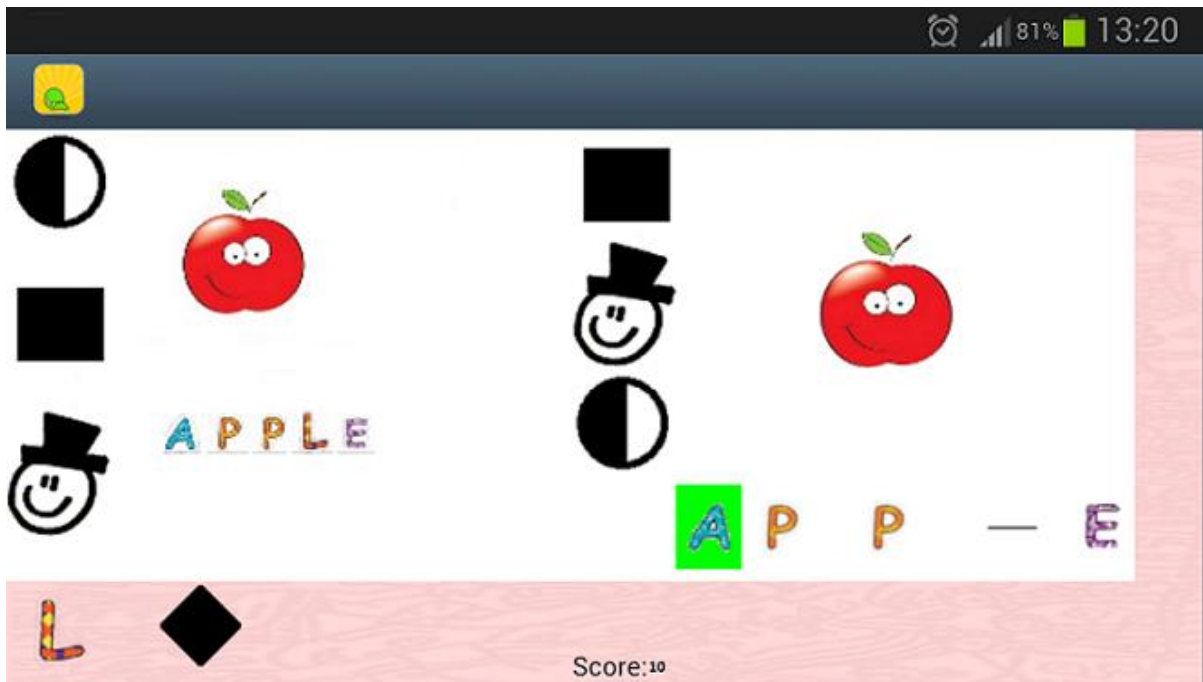


Figure 37-screenshot of the second section

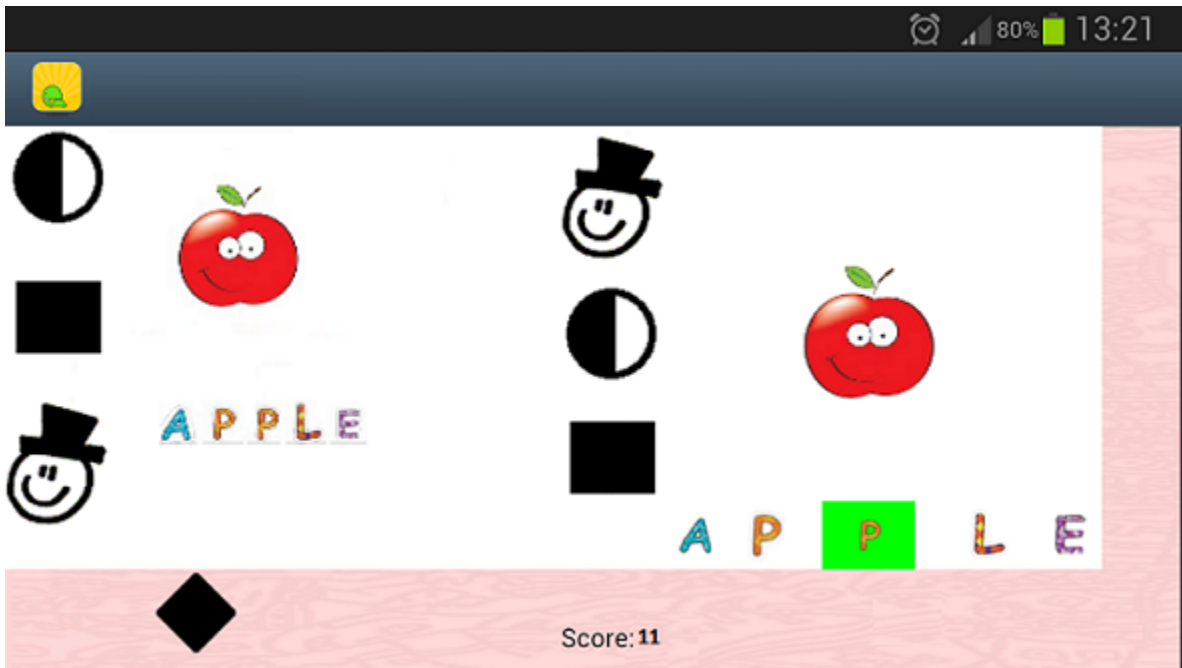


Figure 38-Game completed with extra shape

As it is shown the game is done in this step and he could increase his score. After this part voice is playing and says “Apple”.

Icon3: Word Hunter

Dyslexics have trouble with phonics [29]. This is a unique way of presenting a spelling word that activates the visual mind. This gives the child a chance to sound out the word based on the picture and letter clues. Missing letters are available, dyslexic can drag and drop them in particular place which means Hunting in this part. After completing each word, dyslexic can hear a related voice.

The important fact is the implementation of a method that gives her/him chance to repeat after that. The aim of this part is improving spelling, reading and writing.

I'd like to explain about the game instruction, after selecting a WORD Hunter from the menu ,the user face with the first page of the game which is shown in the following pages.in the first page he'll see the main page which is picture that is showing the verb with –ing clauses ,one complete word in the middle,2 incomplete word with some blank on top and bottom and some letters in order to fill the blanks on the right.by drag and drop he can complete the word and get score. After finish one word the page automatically refresh to another page.

Each page has a briefly explanation.



Figure 39-first screenshot of Word Hunter



Figure 40-Letter G is selected.

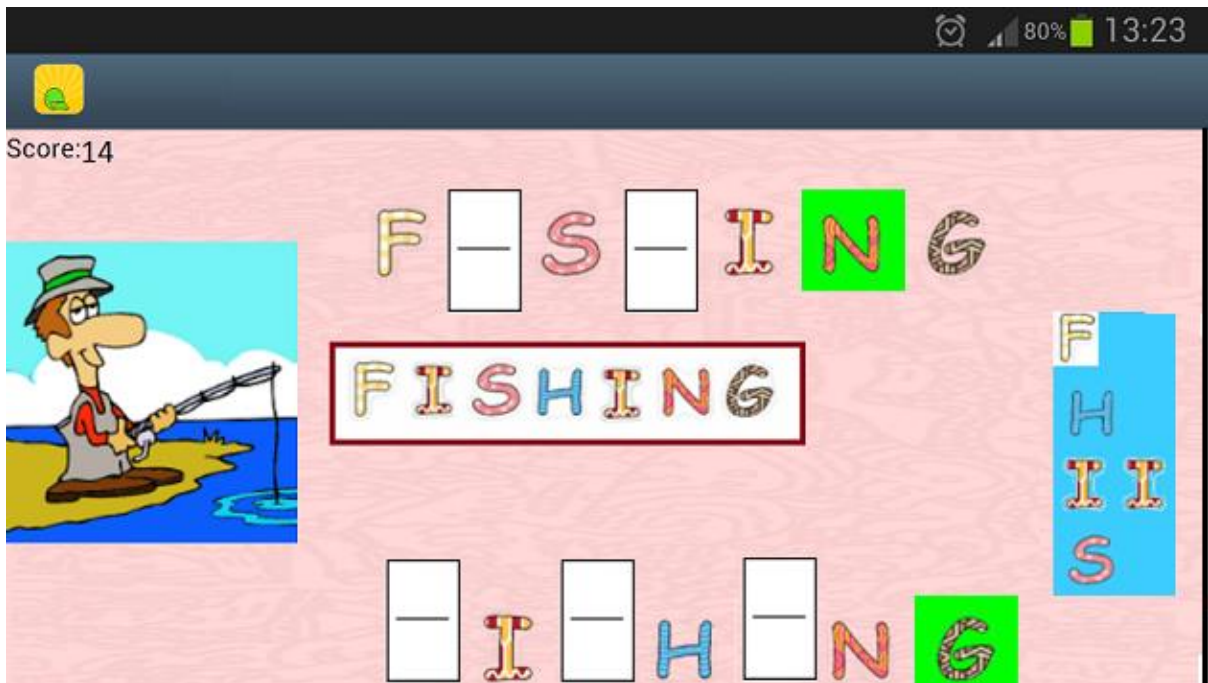


Figure 41- it is up to him for selecting the letter



Figure 42-More letter are selected, score is increasing



Figure 43-selecting letters

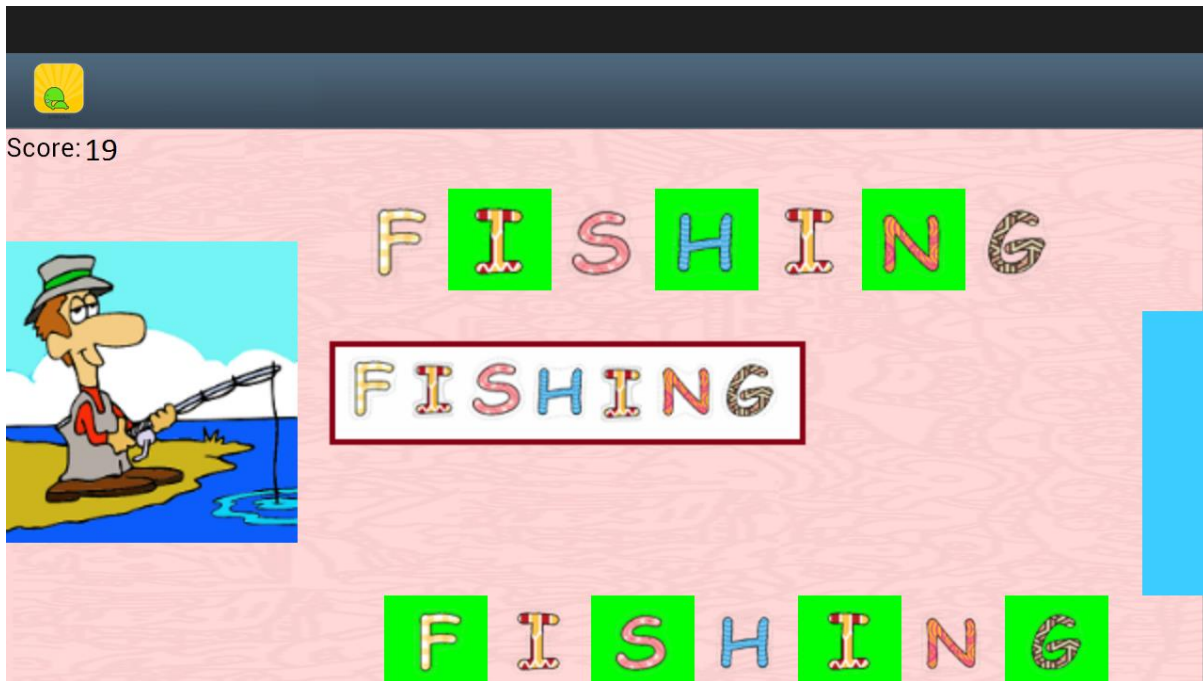


Figure 44-Word is completed

He would be done with this word and he'll hear the voice after that. Now it is a time for refreshing page which happens automatically.

All the game parts from beginning to the end are defied. The only part is a section about the game, which explains information about the game and programmer's details.

3.9 System usage workflow

As I mentioned before the system is designed for the android mobile application called “Sheryxia” on the figure below the system usage workflow is shown for the application.

In the first activity that represents “Sheryxia” after running application, the user can go three ways depending on his choice. Having chosen the first item which is Object, he should find the right object, by choosing a correct answer the image background is set to green color, score is increased, he can do the next step which is complete the word. After all this action the page is turned automatically, on the other hand, considers he does not do it correctly, in this case the image background is set to red, the score is reduced and he should try it again. He can choose to continue or leave the game. If he wants to play more he could go back to the menu and then choose among Items.

The second choice is what’s missing game. If he found missing items and completed the word he would get score, hear the voice and then would be taken to the next page. Here he has the option to either continue the game or exit the game.

This item can be reached after choosing to exit from the previous item or from the beginning. In the Word hunter he should put the letters in an appropriate place and make a word, voice is playing after completing and page is automatically turned. Like the other Items he gets the score and can choose either to play or Not. For all items in a case of wrong choice he loses the score.

The “Sheryxia” usage workflow is shown in figure below.

.

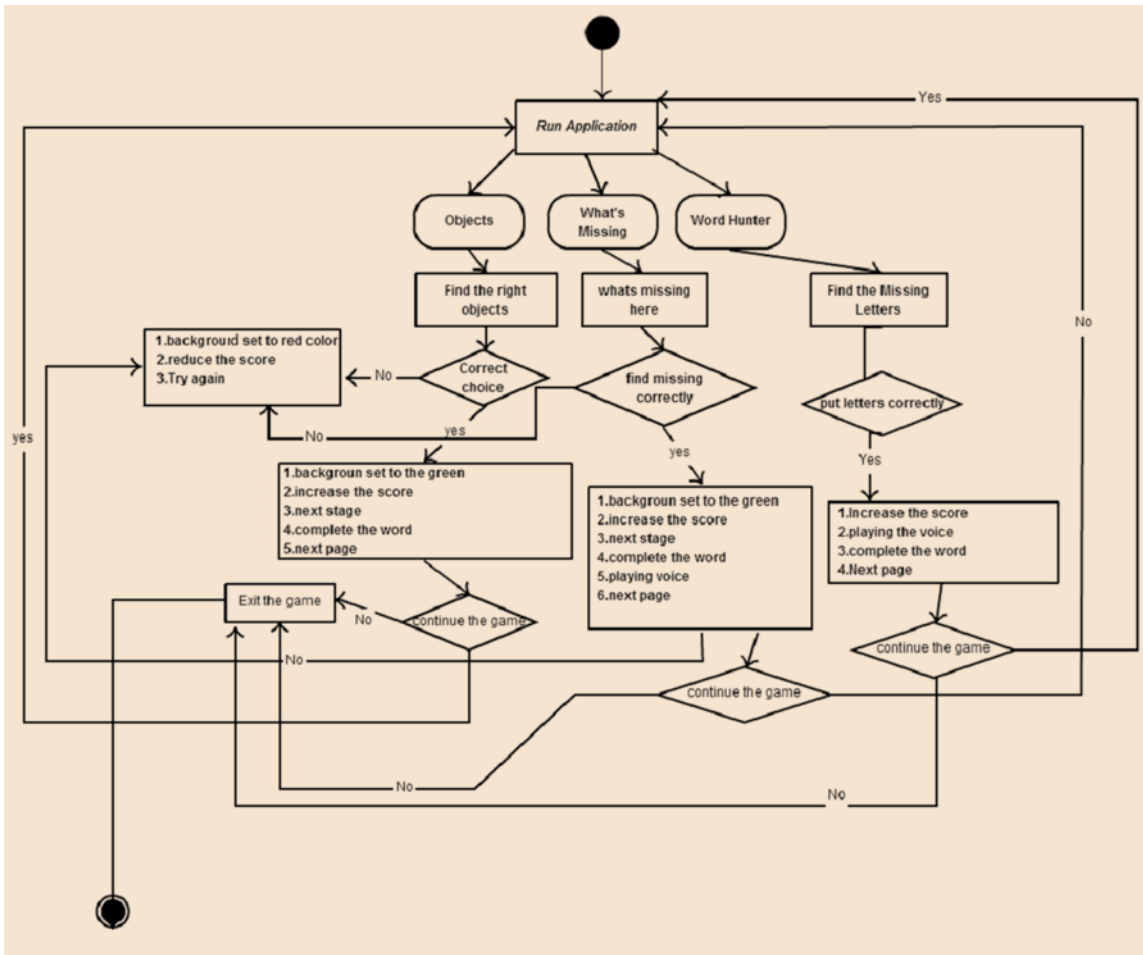


Figure 45-Sheryxia workflow

4 Evaluation

The Goal Attainment Scale (GAS) Method is adopted in order to evaluate the users' satisfaction. I'm going to explain about GAS evaluation, how to calculate and testing conditions for the "Sheryxia mobile application" which is installed on Galaxy SIII device and I tested on 2 girls at the age of 6 and 7.

GAS is a method of scoring the extent to which patient's individual goals are achieved in the course of intervention. In effect, each patient has their own outcome measure but this is scored in a standardized way as to allow statistical analysis. Traditional standardized measures include a standard set of tasks (items) each rated on a standard level. In GAS, tasks are individually identified to suit the patient, and the levels are individually set around their current and expected levels of performance.

How is GAS rated?

An important feature of GAS is the "a priori" establishment of criteria for a "successful" outcome in that individual, which is agreed with the patient and family before intervention starts so that everyone has a realistic expectation of what is likely to be achieved, and agrees that this would be worth striving for. Each goal is rated on a 5-point scale [27], with the degree of

Attainment captured for each goal area:

- If the patient achieves the expected level, this is scored at 0.
- If they achieve a better than expected outcome this is scored at:

+1 (somewhat better)

+2 (much better)

- If they achieve a worse than expected outcome this is scored at: -1 (somewhat worse) or -2 (much worse)

Normally 3-4 goals are identified, which are incorporated into the single GAS score. Goals may be weighted to take account of the relative importance of the goal to the individual, and/or the anticipated difficulty of achieving it.

Overall Goal Attainment Scores are calculated by applying a formula:

$$GAS = 50 + \frac{10 \sum w_i x_i}{\sqrt{(1 - \rho) \sum w_i^2 + \rho (\sum w_i)^2}}$$

w_i-the weight assigned to the *i*th goal (if equal weights $w_i=1$)

x_i-the numerical value achieved (between -2 and +2)

P-the expected correlation of the goal scales.

For practical purposes, according to Kirusek and Sherman, ρ most commonly approximates to 0.3, so the equation simplifies to:

$$GAS = 50 + \frac{10 \sum(w_i x_i)}{\sqrt{0,7 \sum w_i^2 + 0,3(\sum w_i)^2}}$$

In effect, therefore the composite GAS (the sum of the attainment levels x the relative weights for each goal) is transformed into a standardized measure or T score with a mean of 50 and standard deviation of 10. If goals are set in an unbiased fashion to that results exceed and fall short of expectations in roughly equal proportions, over a sufficiently large number of patients, one would expect a normal distribution of scores and the GAS thus performs at interval level.[28]

Two children took a GAS test evaluation with following characteristic: intelligent 6years old girl who studied in Bilingual Primary School and 7years old with reading disability (dyslexia) and also difficulties in writing and concentration problems with primary knowledge of English.

“Sheryxia mobile application “is given to each children separately and then time was given to them in order to found and play with Application. After a while they interviewed to check results. The attainment score levels and the goals were provided in the following table:

Table 28-Goal Attainment Scale

Goals: Attainment score levels:		Most unfavorable treatment outcome thought likely (-2)	Less than expected success (-1)	Expected level of success (0)	More than expected success (1)	Best anticipated success (2)
1	A child could Navigate through the application	A child doesn't understand how to use the app and how to navigate within it	A child partly understands what app is needed for and how to navigate it	A child understands the app and knows how to use it	A child fully understands the app and knows how to use it	A child understands the complete structure of the app and knows where to go to get what he needs
2	A child is able to choose an appropriate Icon and launch it	A child is not able to choose an appropriate icon and launch it	A child is not able to choose an icon and play it without any help	A child is able to choose an icon and play with some assistance	A child is able to select an icon himself and play little bit	A child is able to choose icon himself and play without any help
3	A child could understand the instruction of each part of the game	A child couldn't understand the instruction of the game	A child could understand some instruction but doesn't know how play properly	A child is able to play some part of game with a few assistance	A child is Able to play game without any assistance	A child is interested in playing game
4	A child is able to turn back the menu page with a back button	A child is unable to go to the menu by using back button	A child cannot go to the first page without the help	A child is able to navigate from one game to another mode	A child is able to turn to the first page without help	A child Is totally understand when the game is finish and she could come back to the menu
5	A child is able To Click on Images and put them in appropriate place in order to complete word	A child is unable to click on images and put them in appropriate place in order to complete word	A child cannot decide to play which Part Choosing Image or completing the word	A child Could Play really slowly beside asking for a help	A child Could play without asking for a help	A child is Totally Understand the first game

6	A child is able to switch between three games and choose to play	A child doesn't know how to switch among games	A child switch to one of the game but she wasn't interested on it	A child understand how to switch among game with some help	A child is able to switch Between games without any help	A child is able To choose her favorite game and switch easily between them
7	A child is able to follow the words while being spoken	A child is notable to follow the words	It is hard for child to follow the words	A child is able to follow the words but sometimes she lost her concentration or got confused	A child can follow the words and seems very concentrated	A child follow the word easily and she is very interested in a game

In the first column of the table the goals are stated, the rest columns show attainment score levels achieved by the children. The expected level of success with the value equals to 0 is considered to be an expected outcome of the application usage.

A weight was assigned to each goal using the table below. Weight is the product of importance and difficulty. Importance and difficulty is rated on a 4 point scale:

Table 29- Importance and difficulty scale

Importance	Difficulty
0-not at all (important)	0 - not at all (difficult)
1 - a little (important)	1 - a little (difficult)
2 - moderately (important)	2 - moderately (difficult)
3 - very (important)	3 - very (difficult)

In effect though, if the goal is “not at all” important it will not be selected, and if not at all “difficult” it has presumably already been achieved, so that in effect these resolve to 3-point scales. If a weighting system is not used, a value of „1“ is simply applied to weight in the formula. The calculated weight and attainment score for two children is shown in table below.

Table 30-The weighting and ASL achieved by two children

Goals:	Importance	Difficulty	Weight	Attainment score levels	
				I child	II child
1	3	3	9	2	2
2	2	1	2	1	1
3	2	2	4	0	-1
4	2	1	2	2	2
5	3	2	6	1	0
6	2	1	2	2	2
7	3	1	3	1	0

Child I Overall Goal Attainment score

$$GAS = 50 + \frac{10 \sum(w_i x_i)}{\sqrt{0,7 \sum w_i^2 + 0,3(\sum w_i)^2}}$$

$$\begin{aligned}
 GAS &= 50 + \frac{10 \sum(w_i x_i)}{\sqrt{0,7 \sum w_i^2 + 0,3(\sum w_i)^2}} \\
 &= 50 + \frac{10(18 + 2 + 0 + 4 + 6 + 4 + 3)}{\sqrt{0,7(81 + 4 + 16 + 4 + 36 + 4 + 9) + 0,3 \cdot 784}} \\
 &= 51.07
 \end{aligned}$$

Child II Overall Goal Attainment score:

$$\begin{aligned}
 GAS &= 50 + \frac{10 \sum(w_i x_i)}{\sqrt{0,7 \sum w_i^2 + 0,3(\sum w_i)^2}} \\
 &= 50 + \frac{10(18 + 2 - 4 + 4 + 0 + 4 + 0)}{\sqrt{0,7(81 + 4 + 16 + 4 + 36 + 4 + 9) + 0,3 \cdot 784}} \\
 &= 50.70
 \end{aligned}$$

The overall data can be considered positive because two children reached the maximum GAL (+2) for three goals and the positive goal attainment levels (0, +1, +2) for 6 of 7 goals. The overall GAL for the first and the second child are 51.07 and 50.70 respectively.

The range of GAS scores calculated using the expected correlation of the goal scales (ρ) approximated to 0.3 goes from 18.54 to 81.46. The low bound is calculated assuming that for all the goals a child scores the most unfavorable goal attainment levels (-2). The upper bound is calculated assuming that for all the goals a child scores the most fortunate goal attainment levels (+2). When the attainment score levels for all goals are assumed to be zero we get the expected results equals 50. Thereby for these two children, GAS confirms better than expected result.

As I saw from feedback, I found out that those children who are not familiar to the mobile device and mutually mobile game are not interest or maybe don't have a confidence to play.

The second reason that I found out is about English knowledge, children with poor knowledge of English are not interest in the English application.

The last reason was the today's children are interested on Action Game and they do not have that much interest in educational application with lowest excited options.

5 Conclusions and Future Work

Necessity of mobile applications especially in a field of education has greatly changed in recent years. As ordinary people need to use mobile application to have better life, people with some disabilities as well as the other need to use technologies. In this project I designed mobile application for dyslexic children who have problem with reading disabilities to in order to achieve their potential.

In this project the system is provided for improving their visualization, concentration, reading, writing and listening skills.

As a result the following objectives have been achieved

- Design and implementation of interactive mobile application to simplify access to educational game on smartphone.
- Design and implementation of mobile application in order to improve skills in dyslexic children.

The characteristics of "Sheryxia" are as follow:

- Navigate between different options to play
- Allows to the user to choose between selecting the images and writing a corresponding words.
- Allows drag and drop in order to complete images and words
- Pronounce Words aloud after complete each word.
- Allows increasing the score and keeping it update from each different part of the game.
- Allows user to hear and repeat after dragging each letter
- Highlight the true dragging to the green, otherwise to red

Of course any system has some defects and short comings. This system is not an exception To resolve this issue, some of the future ideas and works would be mentioned in the following.

One of essential extensions worth of research would be improving the wording and helping users improve the writing. The idea is that the user can write on their own. In the other word, the user can write by his finger on the touch screen instead of changing the font and color of writing. This idea helps them overcome concentration problem and letter reversals.

Next important functionality is making picture sentences instead of making words. This helps users overcome reading confusion.

Another important issue is to make a game in action genres. Because as it was earlier mentioned, today's children like to play action game. For this reason, making action game for dyslexic in an educational framework could prove to be more effective.

6 References:

1. Dyslexia Information Page, National Institute of Neurological Disorders and Stroke. Available at <http://www.ninds.nih.gov/disorders/dyslexia/dyslexia.htm>
2. Dyslexia Information Page, National Institute of Neurological Disorders and Stroke. Available at <http://www.ninds.nih.gov/disorders/dyslexia/dyslexia.htm>.
3. Dyslexia Information Page, National Institute of Neurological Disorders and Stroke. Available at <http://www.ninds.nih.gov/disorders/dyslexia/dyslexia.htm>.
4. Narain, C. (2006) Childhood developmental disorders. *Nature Neuroscience*, 9, 1209. DOI:10.1038/nn1006-1209.
5. JF. Cuetos and F. Valle. Modelos de lectura y dislexias (Reading models and dyslexias). *Infancia y Aprendizaje*, 44:3-19, 1988.
6. World Federation of Neurology (1968) Report of research group on developmental dyslexia and world illiteracy. *Bulletin of the Orton Society*, 18, 21-22, 1968.
7. 28. A. Bradlow, N. Kraus, and E. Hayes. Speaking clearly for children with learning disabilities: sentence perception in noise. *Journal of Speech, Language, and Hearing Research*, 6:80-97, 2003.
8. 29. S. S. Nagarajan and et al. Speech modifications algorithms used for training language learning impaired children. *IEEE Transactions on rehabilitation engineering*, 6:257-268, 1998.
9. M. A. Picheny, N. I. Durlach, and L. D. Braida. Speaking clearly for the hard of hearing I : Intelligibility differences between clear and conversational speech. *Journal of Speech and Hearing Research*, 28:96-103, 1985.
10. . Rogers, Y., Sharp, H. and Preece, J. (2002) *Interaction Design: Beyond Human Computer Interaction* Wiley & Son.
11.] GRAMMENOS, D., SAVIDIS, A., GEORGALIS, Y., AND STEPHANIDIS, C. 2006. Access Invaders: Developing a universally accessible action game. In *Computers Helping People with Special Needs, Proceedings of the 10th International Conference (ICHP 2006)*, Springer, Berlin, 388–395
12. <http://www.sciencedaily.com/releases/2012/11/121112095945.html>
13. P. Tallal. Auditory temporal perception, phonics, and reading disabilities in children. *Brain and Language*, 9:182-198, 1980.
14. C. Witton, J. Talcott, and et al. Sensitivity to dynamic auditory and visual stimuli predicts nonword reading ability in both dyslexic and normal readers. *Current Biology*, 8:791-797, 1998
15. <http://www.nhs.uk/Conditions/Dyslexia/Pages/Treatment.aspx>
16. Tijms J. and Aravena S. (2007), *Treatment for Reading and Spelling Problems of Individuals with Dyslexia: Evaluation of Clinical Effects and New Directions*, IWAL-Institute for Dyslexia, Amsterdam, and EPOS, Department of Psychology, University of Amsterdam, The International Development in Europe Committee (IDEC), Retrieved April 10, 2009, from http://www.literacyeurope.org/IDEC/index.php?option=com_content&task=view&id=81&Itemid=5

17. http://www.thecommunicationtrust.org.uk/media/13565/managers_pack_final_final_8th_may.pdf
18. **Interaction Design: Beyond Human-Computer Interaction** PREECE, J., ROGERS, Y. & SHARP, H. (2002) Interaction Design: Beyond Human-Computer Interaction. John Wiley & Sons, Inc
19. <http://kidztalk.co.nz/services/childrensstages4/dyslexia/>
20. <http://www.texthelp.com/>
21. <http://itunes.apple.com>
22. RELLO, LUZ; RICARDO BAEZA-YATES, HORACIO SAGGION, CLARA BAYARRI & SIMONE D. J. BARBOSA. 2013. The 15th International ACM SIGACCESS Conference of Computers and *Accessibility*, Bellevue, Washington USA, 22-24 October.
23. <http://thenextweb.com>
24. White, B.Y., and Fredrickson, J.R. Inquiry, modeling, and metacognition: Making science accessible to all students. *Cognition and Instruction*, 1998
25. Mack, C.G., Koenig, A.J., and Ashcroft, S.C. Microcomputers and access technology in programs for teachers of visually impaired students. *Journal of Visual Impairments and Blindness*, 1990 Impairment. London: Whurr; 1999.
26. <http://www.dystalk.com>
27. *Goal Attainment Scaling (GAS) in Rehabilitation: A practical guide* **Clinical Rehabilitation** 2009; 23(4): 362-70.
28. Ashford S, Turner-Stokes L. *Evaluation of goal attainment in management of spasticity with botulinum toxin: Use of Goal Attainment Scaling to demonstrate functional gains* **Physiotherapy Research International** 2006
29. <http://www.tes.co.uk/article.aspx?storycode=6002967>