



CSIS0801 Final Year Project 2013 – 2014

FYP13002 - Educational Software with Interactive Robot Platform

Group Final Report

Supervisor: Dr. Vincent Lau

Second Examiner: Dr. Chim T W

Group members:

Chan Chun Pong 2011567883

Cheung Chan Teng 2011574331

Fung Ying Wa 2011531286

Szeto Wing Yan 2011569556

Change History

Version	Change Date	Author	Description
0.1	2014/04/01	2011569556	Draft
0.2	2014/04/10	2011531286	Revision on draft
0.3	2014/04/11	2011567883	Revision on draft
0.4	2014/04/12	2011574331	Revision on draft
1.0	2014/04/15	2011569556	Initial version

Abstract

Technologies on gadgets are becoming more and more useful in nowadays life. It does not only provide us a platform of entertainment and communication, but also a platform to learn. Nowadays, the most commonly used high-tech gadgets include smartphone and tablet.

In this project, our team is integrating tablets with a robot to assist children in learning. We have developed an Android application – EduBuddy, and this document summarizes everything about our project.

Our project aims to provide children, especially children with special needs, an interactive robot platform for educational purpose. New technologies such as augmented reality are implemented in our project as well. With the aid of a robot, we hope that children's interests in learning can be aroused. Besides, the project is expected to provide a communication and monitoring platform for parents. We believe this system can help children to learn efficiently.

Table of Contents

CHANGE HISTORY.....	II
ABSTRACT	II
CHAPTER 1 PREFACE.....	1
1.1 PURPOSE.....	1
1.2 SCOPE.....	1
1.3 ABOUT THE TEAM AND STAKEHOLDER	2
1.4 CREDIT	2
CHAPTER 2 PROJECT OVERVIEW.....	3
2.1 BACKGROUND.....	3
2.2 SMART PHONE APPLICATION ANALYSIS	4
2.3 SPECIAL EDUCATION NEEDS.....	5
2.4 ROLE OF ROBOT	7
2.5 PROJECT OBJECTIVE	8
2.6 AMENDMENT OF PROJECT SCOPE FROM PROJECT PLAN	9
2.7 PROJECT DELIVERABLES	11
2.8 MAJOR WORK PRODUCTS	12
2.9 PROJECT RESPONSIBILITY	13
2.10 MAJOR MILESTONES.....	14
CHAPTER 3 PRODUCT DESIGN	15
3.1 ITEMS OF THE PRODUCT FUNCTION.....	15
3.2 MAJOR PRODUCT FUNCTION DESCRIPTIONS.....	16
3.3 HARDWARE REQUIREMENT	18
3.4 SYSTEM ARCHITECTURE	18
3.4.1 System Structure	18
3.4.2 Database design.....	19
3.5 SOFTWARE PROCESS MODEL	20
3.6 MONITORING AND CONTROLLING MECHANISM.....	21
3.7 TESTING	23
CHAPTER 4 IMPLEMENTATION AND PROJECT DELIVERABLES SUMMARY	24
4.1 PROJECT DELIVERABLE.....	24
4.2 THE APPLICATION	24
4.2.1 Development Toolkit	24

4.2.2	<i>User Interface</i>	26
4.2.3	<i>Summary of technical skills used in functions</i>	36
4.3	DIFFICULTIES AND POSSIBLE SOLUTIONS	37
4.3.1	<i>Robotic Car Control</i>	37
4.3.2	<i>Customize Question</i>	38
4.3.3	<i>Augmented Reality</i>	38
4.4	FUTURE DEVELOPMENT	38
4.4.1	<i>Voice Recognition</i>	38
4.4.2	<i>Stroke Recognition</i>	39
4.4.3	<i>iOS development</i>	39
4.4.4	<i>Multi-lingual</i>	39
CHAPTER 5	SCHEDULE	40
CHAPTER 6	BALANCE SHEET AND RESOURCE ALLOCATION	41
REFERENCES	42
APPENDICES	44
APPENDIX I:	MAIN FLOW OF THE APPLICATION	44
APPENDIX II:	FLOW CHART OF "ROBOTIC CAR CONTROL"	45
APPENDIX III:	FLOW CHART OF "CHATROOM"	46
APPENDIX IV:	FLOW CHART OF "SHOP"	47
APPENDIX V:	FLOW CHART OF "MATHS & LOGIC"	48
APPENDIX VI:	FLOW CHART OF "READ & SPEAK"	49
APPENDIX VII:	FLOW CHART OF "VOCABULARY"	50
APPENDIX VIII:	FLOW CHART OF "WRITING"	51
APPENDIX IX:	FLOW CHART OF "CUSTOMIZE QUESTION"	52
APPENDIX X:	FLOW CHART OF "REVIEW REPORT"	53
APPENDIX XI:	FLOW CHART OF "SETTING"	54
APPENDIX XII:	TEST PLAN	55

Chapter 1 Preface

1.1 Purpose

This document is to describe the finalized situation of the Educational Software with Interactive Robot Platform Project, Final Year Project for Department of Computer Science, The University of Hong Kong in 2013-2014. The following includes background and overview of the project, system design, deliverables, difficulties and limitations of the project as well as ideas for future development.

1.2 Scope

Educational Software with Interactive Robot Platform Project is a Final Year Project for Department of Computer Science, The University of Hong Kong in 2013-2014. It aims to integrate the use of robotic car with software application. The software application is for educational use and therefore its target audience is set to be children. Besides, some advanced features are added to make it more user-friendly for some of the disabled. New technology, such as augmented reality, is also applied in this project to make it more interesting.

The project team believes that through this project, technology can be integrated with learning in an interactive way.

1.3 About the Team and Stakeholder

Four Computer Science students of The University of Hong Kong participated in this project. The team is shown in Table 1.1 below.

Team Members	Chan Chun Pong (Steve) Cheung Chan Teng (Kaka) Fung Ying Wa (Eva) (Contact person) Szeto Wing Yan (Catherine)
School	The University of Hong Kong
Supervisor	Dr. Vincent Lau
Second Examiner	Dr. Chim T W
Project Name	Educational Software with Interactive Robot Platform
Project Web Page	http://www.cs.hku.hk/~c0801/~fyp13002
Contact Mail	ywfung@cs.hku.hk

Table 1.1 The Team

1.4 Credit

Android and Google Play are trademarks of Google Inc.

Unity® is a trademark of Unity Technologies, protected by applicable trademark, copyright and other intellectual property laws.

Chapter 2 Project Overview

2.1 Background

In this century, children can gain knowledge from school as well as self-learning at home with the assistance from their parents or tools. Traditional tools include story books, word cards, puzzles, and so on. Yet, children are now learning with traditional tools together with modern high-tech tools such as tablet to improve the effectiveness of learning.

Nowadays, many parents focus on their work in an attempt to earn more money so that their children can enjoy a better living environment. They are too busy and tired of reading story books with children after a whole day of work. Besides, they usually hire a maid to take care of their children and send them to various classes like play group and abacus class. Most parents would like to teach their children to read and write outside classes. Some children may even have chance to learn such areas of knowledge since they were toddlers.

Therefore, a platform will be introduced in this project for children to learn and for parents to monitor and communicate with their children. We propose using robots to draw children's attention in the first place and then keep interacting with these little learners during the learning process. This is believed to be more interesting to keep children focused. In the light of numerous choices of learning tools existing in the market, we hope our product could stand out by providing a platform that allows parents to monitor and thus better understand their children's learning process.

Things ranging from watching television to talking to friends, which are intuitive tasks for normal people, could be quite difficult for the hearing impaired. Thus, we did take this into consideration when building the system.

With the aid of robot and tablet, we hope that children can improve their reading and writing skills as well as gaining knowledge in mathematics. We also hope parents can have a closer connection with their children through the monitoring and communication functions even if parents and their children are geographically distant.

Currently, there do exist smartphone applications that help children to learn and guide the deaf and blind to use smartphones or tablets. The applications with learning purposes are usually games like crossword puzzle and music games. For applications designed for the deaf and blind, they are usually a speech-to-text converter and media player specifically designed for the needy. Therefore, we would like to develop our software with new ideas that do not exist in today's market.

2.2 Smart Phone Application Analysis

Worldwide Smartphone OS Market Share

Period	Android	iOS	Windows Phone	BlackBerry OS	Others
Q4 2010	33.2%	15.9%	1.5%	14.3%	35.1%
Q4 2011	52.8%	23.0%	1.3%	8.1%	14.7%
Q4 2012	70.4%	20.9%	2.6%	3.2%	3.9%
Q4 2013	78.1%	17.6%	3.0%	0.6%	0.7%

Table 2.1 Smartphone OS analysis, source: IDC (Q4 2013)

From the above table, Android operating system has obviously dominated the smartphone market. With the support of major hardware and software developers, such as Samsung and HTC, the market share of Android operating system has increased dramatically from 2010 to 2013 and this trend is likely to be continued.

Therefore, we have decided to develop our project on Android application with future possible development for iOS devices.

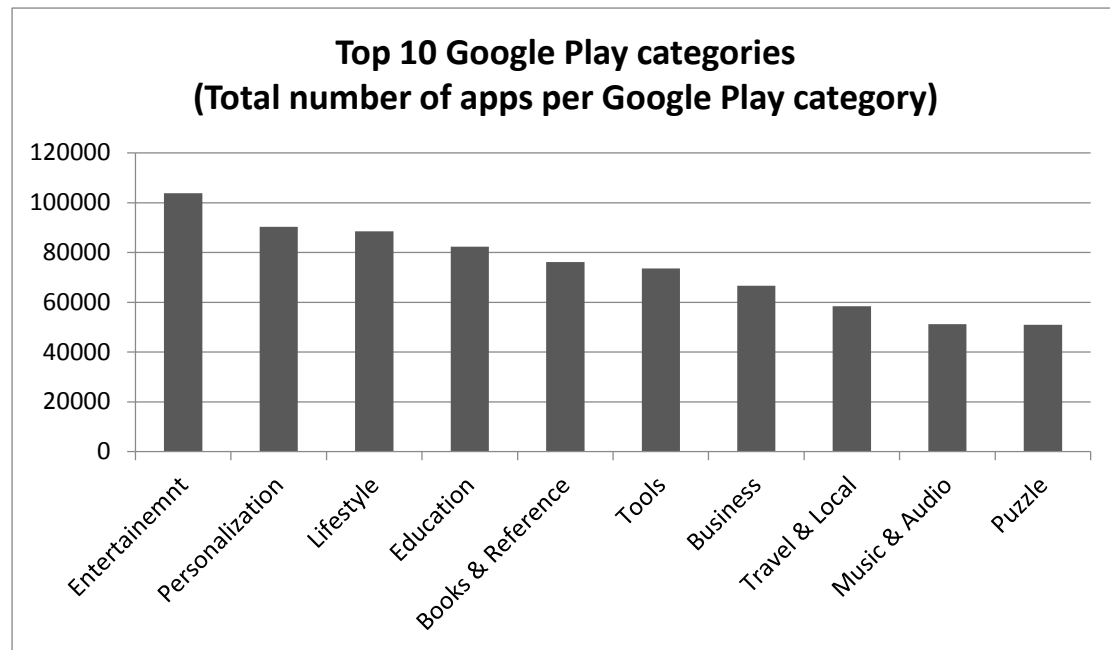


Figure 2.1 Google Play categories analysis, source: AppBrain (April 2014)

The analysis above has shown the top 10 categories in Google Play, which is a digital distribution platform for application for the Android operating system. Among all the apps in Google Play, education apps shares about 7% and 25% of them are low quality apps.

Education apps include not only apps for children's learning, but also foreign language learning, drawing, virtual musical instrument, guidelines for sports and so on. Thus, the number of apps for children's learning is actually very limited. Apps serving this purpose mainly focus on one learning area – either vocabulary or mathematics, but not both. Hence, we aim to develop a quality app with multiple learning areas in this project.

2.3 Special Education Needs

There are several types of special education, such as hearing impaired and mental disorder. In this project, our target is children without mental disturbance as their intelligences are same as normal children. We would like to provide them with the equal opportunity to learn with little assistance.

Hearing impaired implies partial inability to hear, which can be divided into several levels – mild, moderate, moderately severe, severe and profound. Hearing impaired is found to be more sensitive to high pitch as well.

For hearing impaired children, their progress in learning is generally slower than normal hearing children. In classrooms, teachers will usually pair up hearing impaired students with normal hearing students which allow them to ask normal hearing students questions about the concept they do not understand. Teacher will also maintain visual focus on them in classroom.

Furthermore, hearing impaired children are found to be weaker in reading and mathematics. They may encounter difficulties in learning these aspects. Thus, they need to pay more efforts to learn in order to have improvements.

Apart from the hearing impaired, we also aim at providing a better visual image for the color blind. Red-green color blindness, which is known as the most common type of blindness, actually divides into different subtypes. And one of its sub-types, called deutan color vision deficiencies (Deuteranopia), is the most well-known form of color blindness.

In specific, patients with this color blindness are considered as “green weak”. They are weak in discriminating small differences in hues from red, orange, yellow, green region in the light spectrum. Below are the pictures showing the color chart of normal people and deuteranopia people.

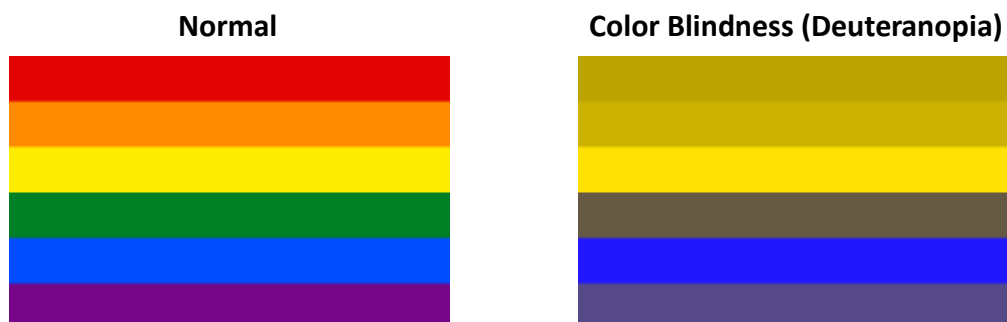


Figure 2.2 Comparison

Therefore, we aim to provide a platform which can be used by the hearing impaired and children with color blindness. We have developed sounds features to help hearing impaired. Besides, we aim to help children with color blindness to distinguish green and red color – the “yes” and “no” color. Green and red colors are commonly used to distinguish two opposite meaning, for example, “go” and “stop” in the traffic light.

2.4 Role of Robot

Robot plays an important role in this project. Not only can it arouse children's interests, it can also keep their attention, especially for younger children.

With the plentiful sound and visual effects, together with interactive robot, children's learning can be more interesting and comprehensive.

Robotic car is used in this project. We believe that our system can be extended to other robot types with more features in the future, such as robot with movable hands to enhance the learning experiences.



Figure 2.3 Robotic car

2.5 Project Objective

There are four major objectives that we strive to achieve by producing desirable software in this project:

2.5.1 To provide children with a tool for interactive learning

The very first goal of the team is to create educational software with interactive robotic feature that facilitates the learning of children aged from three to eight.

2.5.2 To design for the hearing impaired and color blind people

The hearing impaired and color blind children should also be taken care of by the software through its special sound effects and visual projections respectively.

2.5.3 To enhance children-parents bond

Via the communication and monitoring features of the software, we wish to strengthen the connection between children and their parents, especially working parents, and to tighten their bonding gradually.

2.5.4 To support multiple platforms

The above would not be meaningful enough if the final software cannot reach the mass market. Therefore, it is essential for it to support and run smoothly on multiple platforms, such as iOS and Android, which are commonly used by our target users.

2.6 Amendment of Project Scope from Project Plan

After reviewing the project in these few months, some features were modified and added:

- “Customize Question”: This feature is added as an important feature in our application. It allows parents to add questions in different learning areas according to their own needs.
- “Robotic car control”: To utilize the use of robotic car, a separate feature is added to let children have fun with the robotic car during their study.
- “Vocabulary” learning area: Augmented reality (AR) is used in this learning area. Originally, there will be buttons on story cards to allow children to control actions of images via AR and camera. However, due to time constraint and the difficulties of implementation of AR, this feature is amended. Besides, instead of story, single words are used.
- “Maths & Logic” learning area: After reviewing, we have made use of robotic car in the questions to make it more interesting and interactive.
- Disability friendly features for children with color blindness: Apart from the hearing impaired friendly features, we have added one more disabilities feature – color blindness friendly features.
- Left and right hand features: During the implementation of “Writing” learning area, we found that it is better to position the writing panel and animation panel differently for left hander and right hander.
- Parent’s account: Parent’s account is added as there are new features, such as “Customize Question”. Parents can have access to the result report and chatroom. Besides, they can customize questions and change the setting for their children in this account, such as changing the handedness for their children.
- Database implementation: Database is implemented for storage of user information and related data. It is used to facilitate some of the other features and functions in the application.

On the other hand, a few features were removed:

- “Read & Speak” learning area: The original idea was to provide passages for children to read and speak. Besides, technology of voice recognition will be used to determine the correctness of the pronunciation. However, recognition of voice is complicated and difficult, especially for children. Therefore, this feature is amended and will be part of the future development.
- “Writing” learning area: The original idea was to provide animation to show stroke order and recognize the stroke written by children on the screen. However, recognition of writing is complicated. Thus, the recognition is eliminated due to time limitation and will be a part for future development.

2.7 Project Deliverables

The project is divided into three phases. In each phase, there are different deliverables. Our team has achieved the targets of the project at each stage.

Phase & Period	Deliverables
Phase One - Inception (23 September 2013)	<p>Detailed project plan: It describes the background, project overview and timeline in detail.</p> <p>Project web page: It provides a platform for public to know the project news and updates.</p>
Phase Two - Elaboration (26 January 2014)	<p>Preliminary implementation: Basic functions of the application were implemented. The user interfaces are initially implemented. In addition, the four learning areas, chatroom and parent's account are initially implemented as well.</p> <p>Detailed interim report: It describes the status, processes and implementations of the project at that stage.</p>
Phase Three - Construction (20 April 2014)	<p>Finalized tested implantation: The project is tested internally and externally after and during implementation. A finalized version is released.</p> <p>Final report: The report, that is this report, included detailed description of the final product, implementations, challenges and improvements.</p>

Table 2.2 Project deliverables

2.8 Major Work Products

In this project, there are two major work products – an Android application and a project web page.

The Android application runs on Android 2.3.1 to Android 4.2. It is compatible with all devices with suitable Android operating system; however, this application works best in Samsung Galaxy Tablet 10.1. To enable the communication of the robotic car, MagicPad is required.

The web page contains all information and news about this project, including all the documentations.

2.9 Project Responsibility

Major project function	Person responsible
Application features: “Robotic car control”	Kaka
Application features: “Shop” & Coins system	Steve
Application features: “Chatroom” for parents and children	Catherine
Application features: Learning area - “Maths & Logic”	Steve
Application features: Learning area - “Read & Speak”	Eva
Application features: Learning area - “Vocabulary”	Kaka
Application features: Learning area - “Writing”	Catherine
Application features: Parent’s account - “Customize Question”	Eva
Application features: Parent’s account - “Review Report”	Catherine
Application features: Parent’s account - “Setting”	Eva
Basic system implementation	Eva
Contact person and person in charge	Eva
Database: Client to server API	Kaka
Database: Local database	Kaka
Database: Online database	Kaka
Database: Server to online database API	Kaka
Documentation: Minutes	Steve
Documentation: UML diagram	Catherine
Graphics and publication	Eva
Points system	Steve
Project management and related task	Eva
Project web page	Steve
Robotic car integration	Kaka
Sounds and voices	Catherine
Testing and quality control	Catherine
Tutorial session in all learning areas	Steve
User interface	Eva
Version control	Kaka

Table 2.3 Project responsibility

2.10 Major Milestones

This project is divided into three phases and there are two major milestones.

The first major milestone is the initial implementation of the Android application. It was released in January 2014. The user interfaces are initially implemented. In addition, the four learning areas, chatroom and parent's account were included.

The second major milestone is the finalized tested implementation. The features are described in this document in detail.

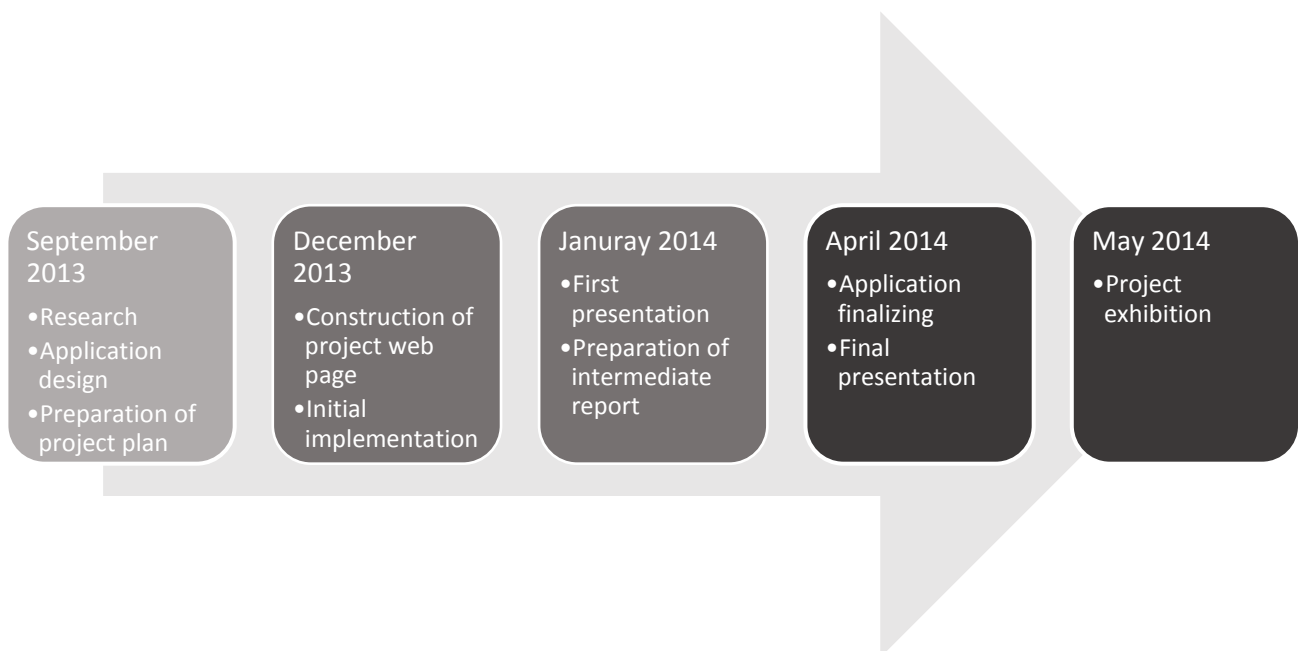


Figure 2.4 Project process

Chapter 3 Product Design

3.1 Items of the Product Function

Major project function	Objective
Application features: "Robotic car control"	Allow user to control the robotic car
Application features: "Shop" & Coins system	Store coins gained and coins can be used to purchase items
Application features: "Chatroom" for parents and children	Provide a communication platform for users
Application features: Learning area - "Maths & Logic"	Learn basic mathematical operations and logical concept
Application features: Learning area - "Read & Speak"	Provide illustrated story
Application features: Learning area - "Vocabulary"	Provide AR image with vocabulary
Application features: Learning area - "Writing"	Provide writing panel and animation
Application features: Parent's account - "Customize Question"	Allow user to customize own questions
Application features: Parent's account - "Review Report"	Display result
Application features: Parent's account - "Setting"	Customize setting for different children
Basic system implementation	Provide fundamental structure of the app
Database: Client to server API	Obtain and send data from and to server
Database: Local database	Store user information
Database: Online database	Store messages of chatroom
Database: Server to online database API	Serve PHP process
Points system	Generate the result for each question set
Robotic car integration	Provide interactive feedback
Sounds and voices	Enable voice and sound effects
Tutorial session in all learning areas	Provide guideline for each learning area
User interface	Provide a strategic user interface for user

Table 3.1 Functions introduction

3.2 Major Product Function Descriptions

This part describes the major product function in this application. The main flow of this application can be found in Appendix I.

3.2.1 Application features: “Robotic car control”

In “Robotic car control”, user is allowed to control and communicate with the robotic car alone. The flow of this feature can be found in Appendix II.

3.2.2 Application features: “Shop” & Coins system

After completion of each question set, children can gain a certain number of coins according to their performance. Coins can be used to purchase items in “Shop”, which allow users to customize the user interface. The flow of “Shop” can be found in Appendix III.

3.2.3 Application features: “Chatroom” for parents and children

There are two “Chatroom” features in a single application – one for parents and one for children. Communication can be done between them or between devices. The flow of this feature can be found in Appendix IV.

3.2.4 Application features: Learning area - “Maths & Logic”

There are questions sets with different levels in “Maths & Logic”. Children can learn basic operations and logical concepts in this learning area with the aid of robotic car. Multiple choices questions are used here. The flow of this feature can be found in Appendix V.

3.2.5 Application features: Learning area - “Read & Speak”

Similar to other learning areas, there are question sets with different levels in “Read & Speak”. In each questions set, a story with pictures and voices is included. Children can learn the pronunciation and follow it to speak. Voices of children can be recorded for parents to review in this area. The flow of this feature can be found in Appendix VI.

3.2.6 Application features: Learning area - “Vocabulary”

Vocabulary Book is needed in this learning area and there are also question sets with different levels. There are pictures of vocabularies inside the book. Children are required to find out the correct picture in the book according to the word shown on screen. Augmented reality image will be shown on screen and sound of the vocabulary will be provided. The flow of this feature can be found in Appendix VII.

3.2.7 Application features: Learning area - “Writing”

In “Writing”, twenty-six alphabet letters, including small letters and capital letters are divided into different levels. Animation on writing of the letter is provided in each question. Children are required to follow the correct stroke order to write it in the writing panel. The flow of this feature can be found in Appendix VIII.

3.2.8 Application features: Parent’s account - “Customize Question”

Parents can access this feature after logging in the parent’s account. They can customize questions according to their children’s needs by providing photos, texts, voices and answers. The flow of this feature can be found in Appendix IV.

3.2.9 Application features: Parent’s account - “Review Report”

In parent’s account, there is a feature called “Review Report”. It allows parents to view the result of each question sets of all the four learning areas. Besides, recorded soundtracks from “Read & Speak” are provided for parents to review. The flow of this feature can be found in Appendix X.

3.2.10 Application features: Parent’s account - “Setting”

In “Setting”, there are four options – enablement of hearing impaired friendly features, enablement of color blindness friendly features, selection of left or right-hander, and change password for parent’s account. The flow of this feature can be found in Appendix XI.

3.2.11 Database

There are two databases, including local and online. Besides, there are client to server and server to online database API. These databases are used to store information related to the devices and user information such as coins gained.

3.2.12 Points system

Point, which is score of that question set, will be calculated after the submission of each question set. Moreover, medals will also be used to represent the performance together with actual points for children, and points will only be kept for parents.

3.2.13 Robotic car integration

To increase the degree of attractiveness, robotic car is used throughout the whole application. There are feedbacks from the robotic car after completion of questions.

3.2.14 Tutorial session in all learning areas

Tutorial sessions are provided in all the four learning areas. Guidelines and instructions on the use of particular learning area are provided in the tutorial session. We encourage first time users, including parents and children, to go through it once.

3.3 Hardware Requirement

In this project, there are some hardware requirements:

1. Device with network access is a must for transmission of data and messages.
2. Device with a camera is required for the use of technology of augmented reality.

In addition, to communicate with robotic car, there are additional hardware requirements:

1. MagicPad (model A280) is required.
2. Enough batteries should be installed inside the robotic car.

3.4 System Architecture

3.4.1 System Structure

Our application is development in Unity using Model View ViewModel structure. The Model View ViewModel (MVVM) is an architectural pattern used in software engineering.

There are three layers in a MVVM structure. View is on the top of the hierarchy,

followed by View Model and Model. Each level can only access the level below but not above.

View refers to all elements displayed by the graphic user interface such as buttons, labels, and other controls. It controls the UI changes, like assign words that shown on the screen or remove a sprite from screen. View Model is an abstraction of the view that also serves in mediating between the view and the model. It is responsible for calculation and backend logic for the program. Model refers to a domain model which represents the real state content and the data access layer that represents the corresponding content. In our project, we use Model for linkage to data access object, accessing database and storing data.

MVVM enables true separation between “View” and “Model”, which gives a proper layering of the coding. Data is not stored in the view, and the view is just for presentation of the data. It allows us to make changes to “Model” without the need to change the “View” and vice versa. It can also minimize the interaction between the “coding” and the user interface.

3.4.2 Database design

We have designed several tables to store the data of the application, such as user_data and user_answer, to store submitted results, user information and relevant information. When a View is created as mentioned in Chapter 3.4.1, the application will access databases and obtain required data to perform their functions.

3.5 Software Process Model

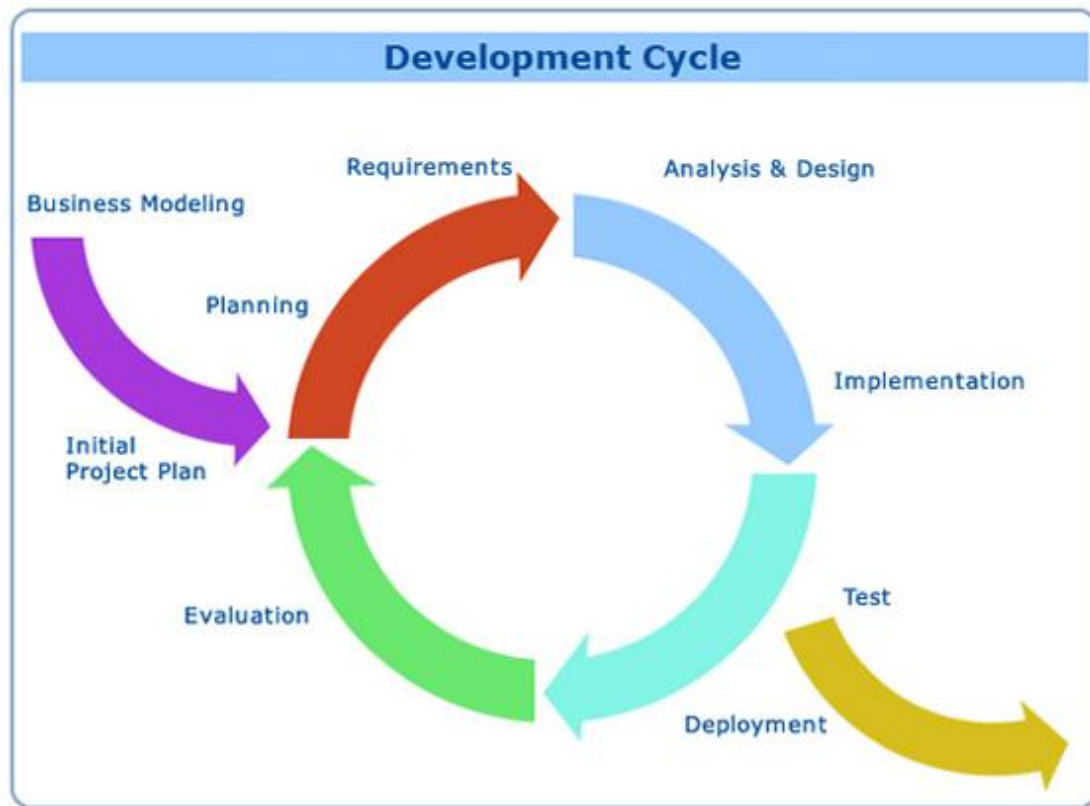


Figure 3.1 An iterative development model

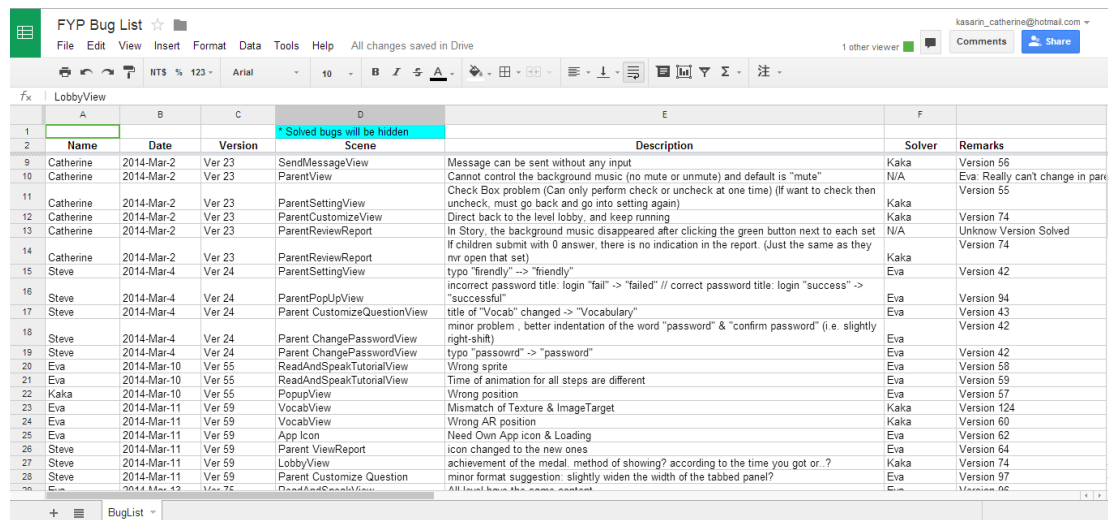
In an iterative model, a system is developed through repeated cycles. This model does not require a full specification of requirements at the beginning. Further requirements are identified during the development.

At the initial planning stage, a proposal was released. There are different phases in the cycle as shown in Figure 3.1. In each cycle, requirements are gathered and analyzed followed by implementation and testing of the product. At the end of each cycle, the current products and requirements are reviewed, and there may be changes to the proposed requirement.

At the end of this project, the finalized product is released together with this report.

3.6 Monitoring and Controlling Mechanism

For documentation storage, there are several free cloud servers available now, including SkyDrive, Dropbox and Google Drive. In this project, Dropbox is used to store the documents, graphics and materials that need to be used among all members. In addition, an online document, the bug list, is created in Google Drive. With the use of them, materials and files can be shared efficiently and conveniently.



	A	B	C	D	E	F	G
	Name	Date	Version	Scene	Description	Solver	Remarks
9	Catherine	2014-Mar-2	Ver 23	SendMessageView	Message can be sent without any input	Kaka	Version 56
10	Catherine	2014-Mar-2	Ver 23	ParentView	Cannot control the background music (no mute or unmute) and default is "mute"	N/A	Eva: Really can't change in parent
11	Catherine	2014-Mar-2	Ver 23	ParentSettingView	Check Box problem (Can only perform check or uncheck at one time) (If want to check then uncheck, must go back and go into setting again)	Kaka	Version 55
12	Catherine	2014-Mar-2	Ver 23	ParentCustomizeView	Direct back to the level lobby, and keep running	Kaka	Version 74
13	Catherine	2014-Mar-2	Ver 23	ParentReviewReport	In Story, the background music disappeared after clicking the green button next to each set. If children submit with 0 answer, there is no indication in the report. (Just the same as they nvr open that set)	N/A	Unknown Version Solved
14	Catherine	2014-Mar-2	Ver 23	ParentReviewReport	type "friendly" -> "friendly"	Kaka	Version 74
15	Steve	2014-Mar-4	Ver 24	ParentSettingView	incorrect password title: login "fail" -> "failed" // correct password title: login "success" -> "successful"	Eva	Version 42
16	Steve	2014-Mar-4	Ver 24	ParentPopUpView	title of "Vocab" changed -> "Vocabulary"	Eva	Version 94
17	Steve	2014-Mar-4	Ver 24	ParentCustomizeQuestionView	minor problem, better indentation of the word "password" & "confirm password" (i.e. slightly right-shift)	Eva	Version 43
18	Steve	2014-Mar-4	Ver 24	ParentChangePasswordView	type "password" -> "password"	Eva	Version 42
19	Steve	2014-Mar-4	Ver 24	ParentChangePasswordView	Wrong position	Eva	Version 58
20	Eva	2014-Mar-10	Ver 55	ReadAndSpeakTutorialView	Time of animation for all steps are different	Eva	Version 59
21	Eva	2014-Mar-10	Ver 55	ReadAndSpeakTutorialView	Wrong position	Eva	Version 57
22	Kaka	2014-Mar-10	Ver 55	PopupView	Mismatch of Texture & ImageTarget	Kaka	Version 124
23	Eva	2014-Mar-11	Ver 59	VocabView	Wrong AR position	Kaka	Version 60
24	Eva	2014-Mar-11	Ver 59	AppIcon	Need Own App icon & Loading	Eva	Version 62
25	Eva	2014-Mar-11	Ver 59	AppIcon	icon changed to the new ones	Eva	Version 64
26	Steve	2014-Mar-11	Ver 59	ParentViewReport	achievement of the medal. method of showing? according to the time you got or..?	Kaka	Version 74
27	Steve	2014-Mar-11	Ver 59	LobbyView	minor format suggestion: slightly widen the width of the tabbed panel?	Eva	Version 97
28	Steve	2014-Mar-11	Ver 59	ParentCustomizeQuestionView	All icons have the same color	Eva	Version 98

Figure 3.2 Bug list

For version control of our application, we have considered the use of Dropbox, Github and TortoiseSVN at first. Dropbox cause conflict of files easily and the setup of GitHub is not simple, therefore, we decided to use TortoiseSVN.

TortoiseSVN allows us to perform version control easily by merging files and resolving conflicts of files. If there is anything wrong in the latest version, we can always reverse it back to the previous version. Besides, it is a free and stable software.

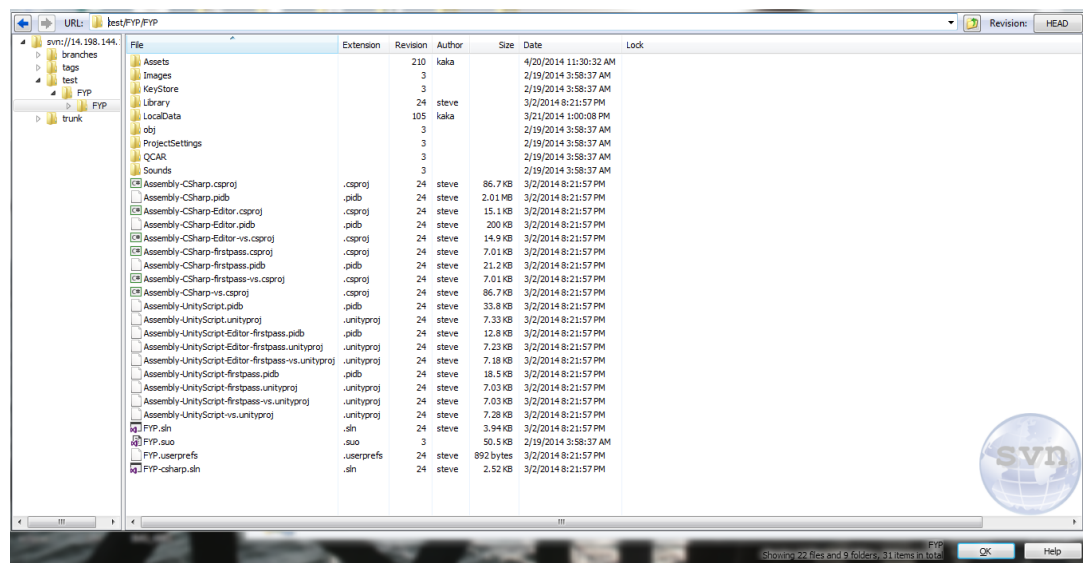


Figure 3.3 TortoiseSVN

3.7 Testing

At the end of each phase, there were system acceptance testing. Samsung phone and tablet, including Samsung Galaxy Tab 10.1, were used for testing in system acceptance testing. Black-box testing was involved in system acceptance testing. We have tested the application with test cases. Besides, some other criteria are observed as well during testing, such as the loading time and transition time.

User acceptance testing was used at the stage of the implementation. Users of Android devices were invited to test the application and give feedback about the application. Sometimes, developers missed some parts that are important for user. Therefore, user acceptance testing helped us to find out some bugs that we were not expected and helped us to improve the application to be more user-friendly. In user acceptance testing, a test plan is provided for user to familiar with the testing purposes and procedures. The test plan can be found in Appendix XII.

Chapter 4 Implementation and Project

Deliverables Summary

4.1 Project Deliverable

In the last stage of this project, which is the construction phase, there are two deliverables including this final report and the final tested implementation. The detail description of the final tested implementation can be found in this document. In this chapter 4, technical details will be elaborated and individual reports of each group member are suggested to be viewed for more details in different functions.

4.2 The Application

4.2.1 Development Toolkit

In this project, we have selected Unity as our development platform and a few plug-in to add some specific features to the application.

As we would like to build an Android application with future development to application used in other platform, we have selected Unity as our development tool. Unity is a cross-platform engine with a built-in IDE, supporting development for Android, Windows, iOS, Blackberry 10, OS X, Linux, etc. It is also designed for the development of application for mobile devices.

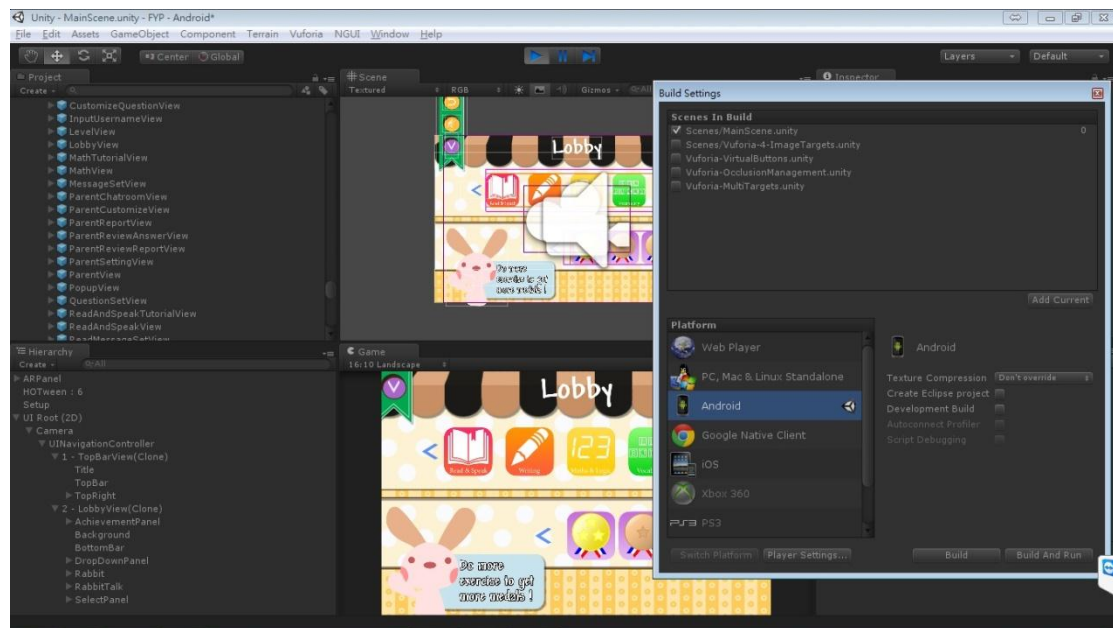


Figure 4.1 Unity development platform

It supports C# and JavaScript programming languages, and the use of Vuforia. Unity is easy to use and suitable for our application implementation as it is designed for 3D development.

Plug-in is a software component to allow user to add some other features to an existing application. The major plug-in that we used included Next-Gen UI kit, HOTween and Vuforia. There are other plug-in that we used, including but not limit to Android plug-in.

Next-Gen UI kit (NGUI) is a powerful user interface system and event notification framework for Unity. It facilitates the design and development of our user interface. For example, we can drag and drop pre-set buttons and panels easily. It also provides font maker, atlas maker, etc, which can be used to create and modify atlases directly.

HOTween is an object-oriented tween engine for Unity. In our project, we make use of this engine to enhance the visual and audio experience. It is easy to use and provide high flexibility.

Vuforia is a software platform that enables augmented realities (AR) app experience. Augmented reality is a live view of a physical, real-world environment whose elements are augmented by computer-generated sensory input. Vuforia is the most popular and award winning SDK in the market. It also supports features such as virtual button and video playback, which can be used in our application.

4.2.2 User Interface

4.2.2.1 Design Strategy and Benefits

There are numbers of factors that we have considered for the design of the user interface:

1. Simple layout for children to understand and use easier
2. Sharp colors are used instead of dull colors to make the application more suitable for children
3. Buttons are designed to be bigger than normal for children to press easily
4. Toolbar and navigation should be provided for easy transition between pages in the application
5. Features are categorized well with different image buttons to make the application convenient to use
6. Text input is only allowed for parents
7. Loading pages are added in certain pages to indicate the application is loading
8. Parent's account is created to avoid children from accessing features designed for parents

4.2.2.2 Starting screen

A loading page is shown when the application launched. The application will ask the user to input user name if the user is a first time user.

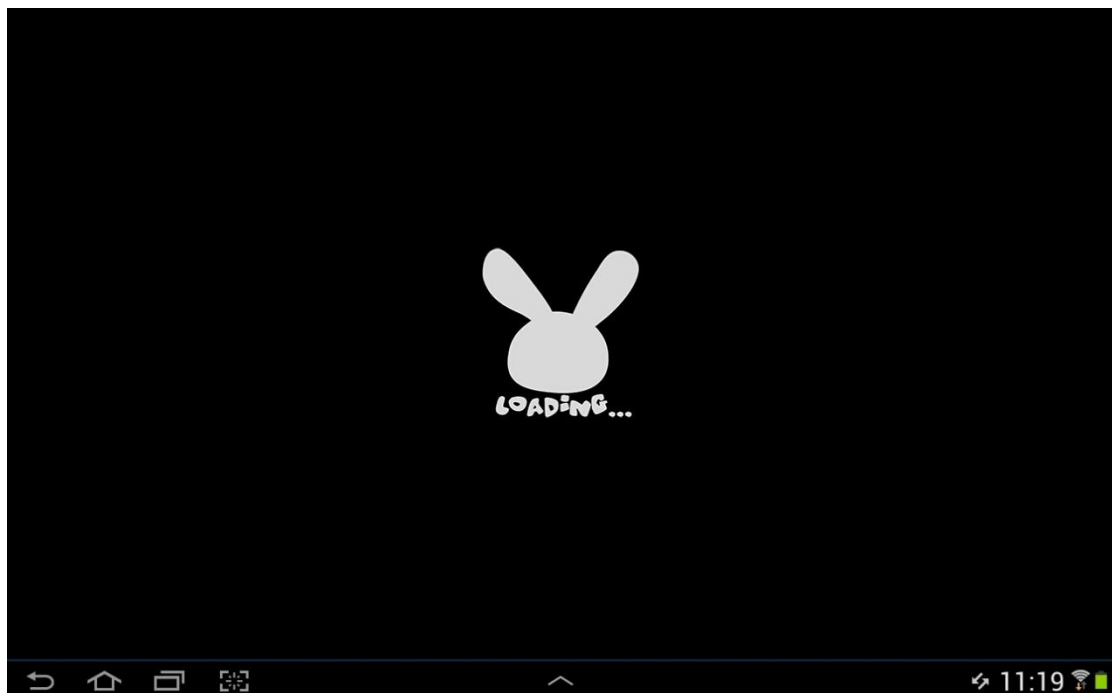


Figure 4.2 Loading page

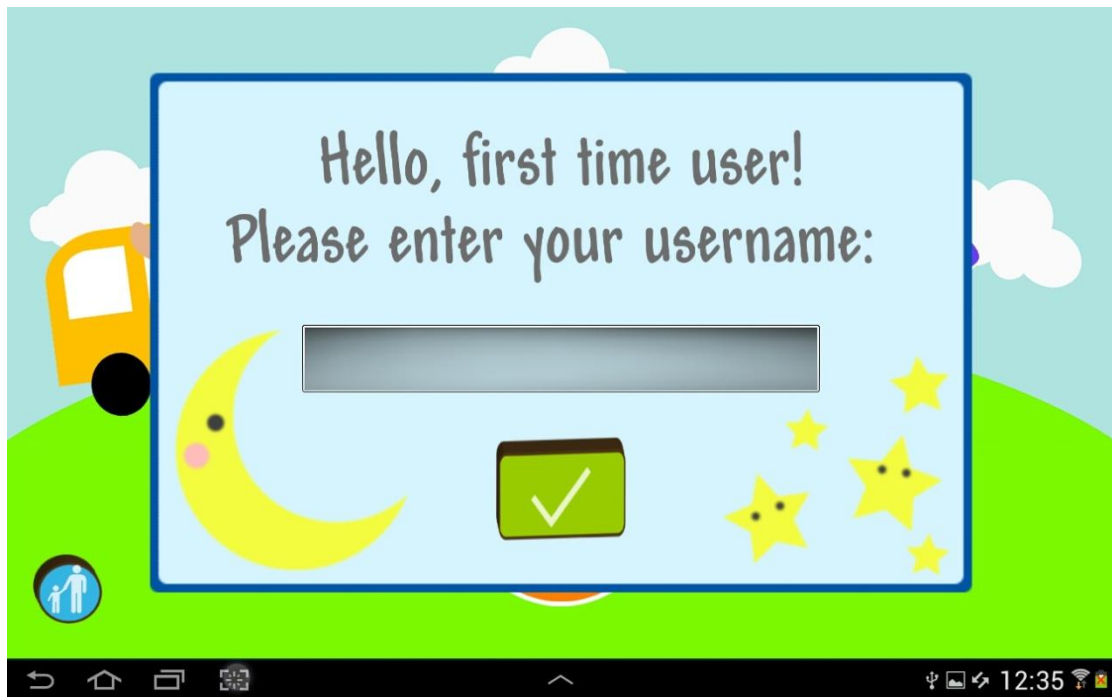


Figure 4.3 User name input



Figure 4.4 Start page

4.2.2.3 Main lobby

In the main lobby, a toolbar and navigation bar is available on the top left corner. Besides, the number of unread message is shown as a badge on the icon of "Chatroom" as well.



Figure 4.5 Main lobby

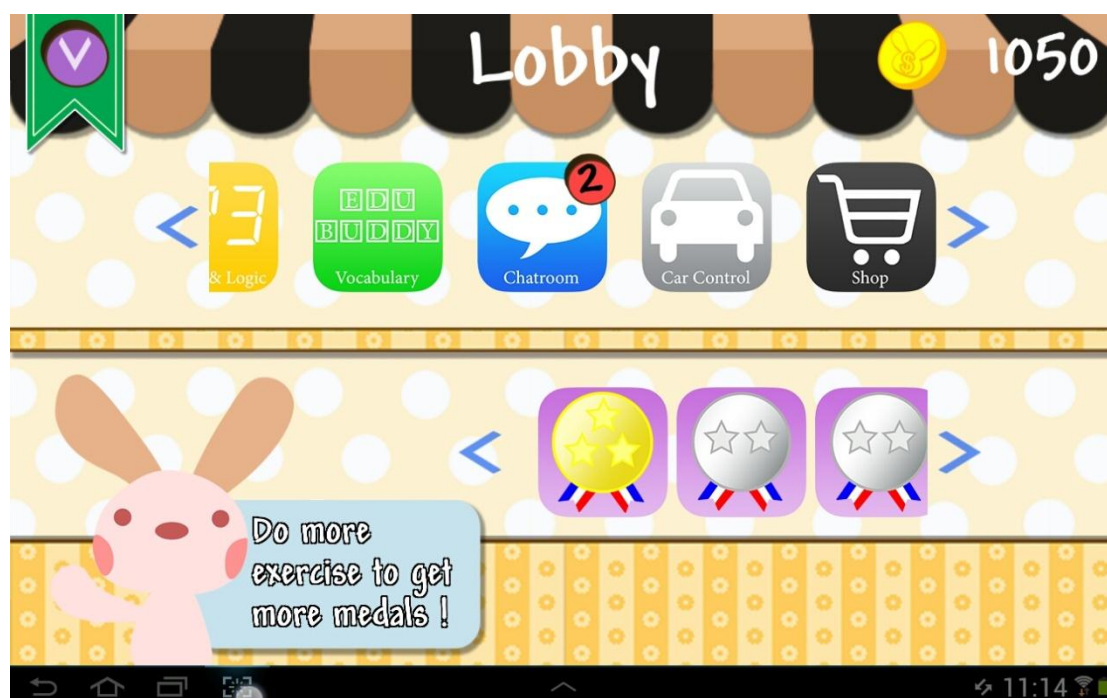


Figure 4.6 Main lobby with unread message in "Chatroom"

4.2.2.4 Four learning areas

There are four learning areas – “Maths & Logic”, “Read & Speak”, “Vocabulary” and “Writing”. In each of the learning area, there is a page for selection of question sets.



Figure 4.7 Selection of level page



Figure 4.8 Content in each learning area

4.2.2.5 Chatroom

There are two options in “Chatroom”, including send message and read message.



Figure 4.9 Chatroom

4.2.2.6 Robotic car control

A panel is provided to control the robotic car to move forward, backward, left and right.

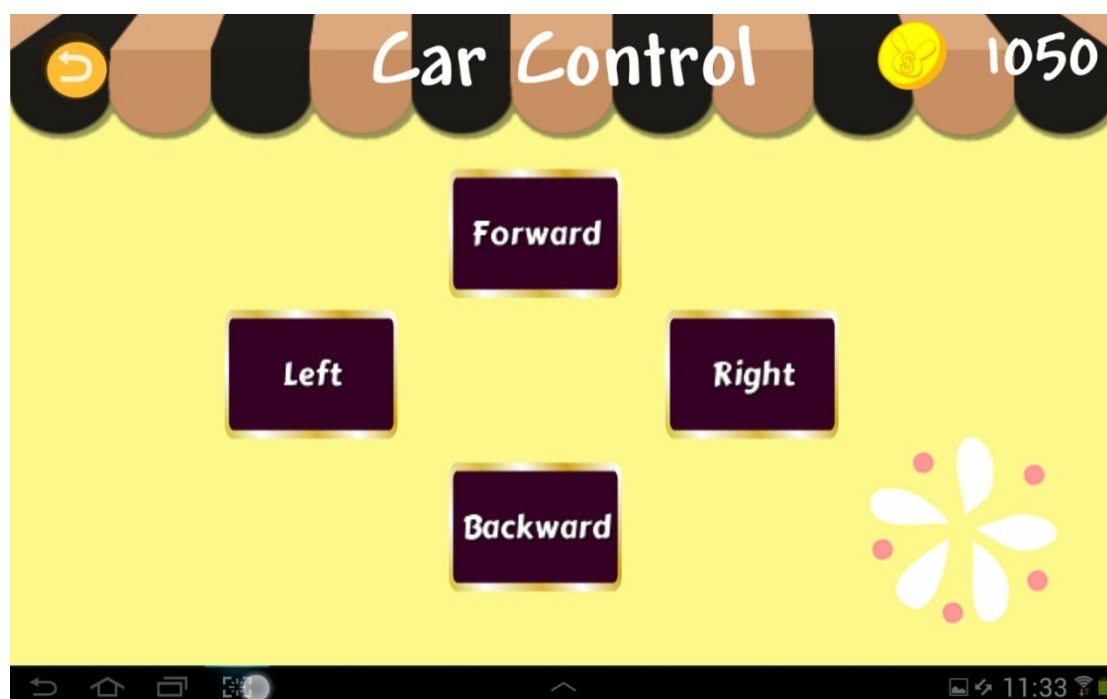


Figure 4.10 Robotic car control

4.2.2.7 Shop

User can purchase item to customize their user interface in “Shop”.

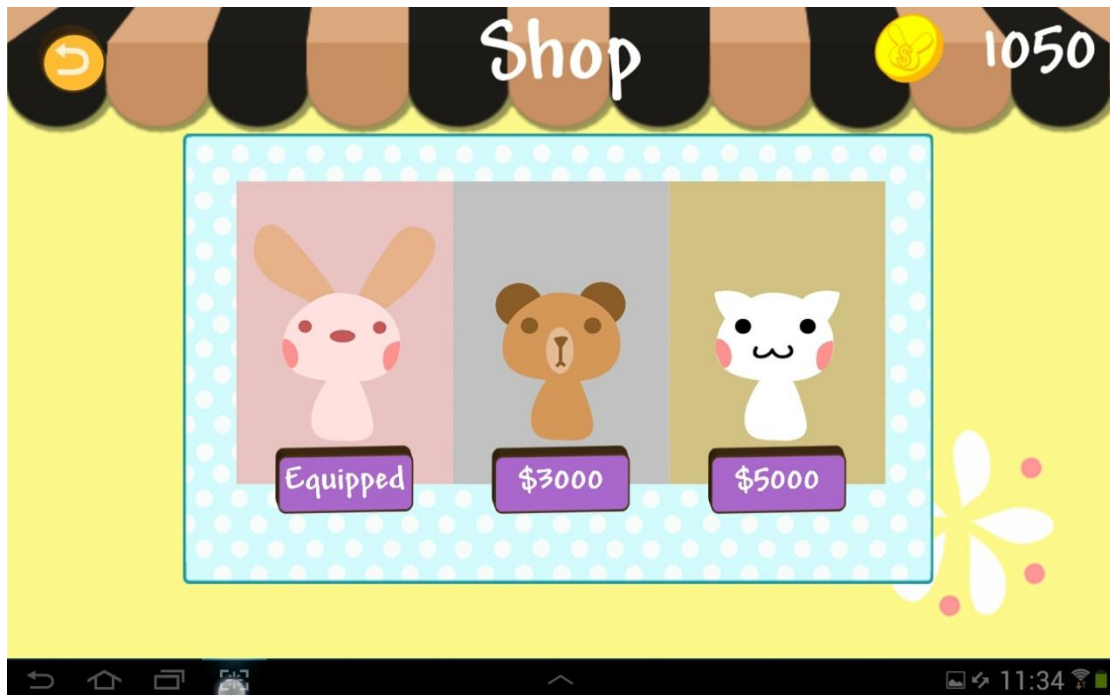


Figure 4.11 Shop

4.2.2.8 Parent's account

There is an icon on the bottom left corner in the start page for parent's account. To access the parent's account, password is required. Chatroom in parent's account is the same as the previous one. Besides, “Report Review”, “Customize Question” and “Setting” features are provided.

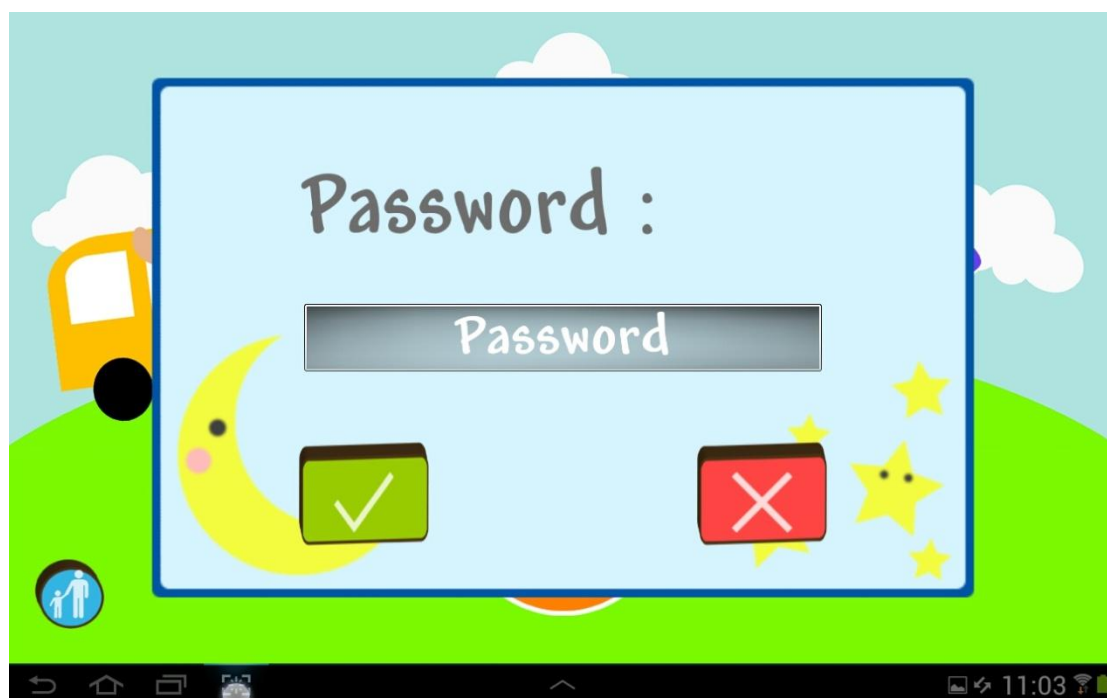


Figure 4.12 Parent's account login page

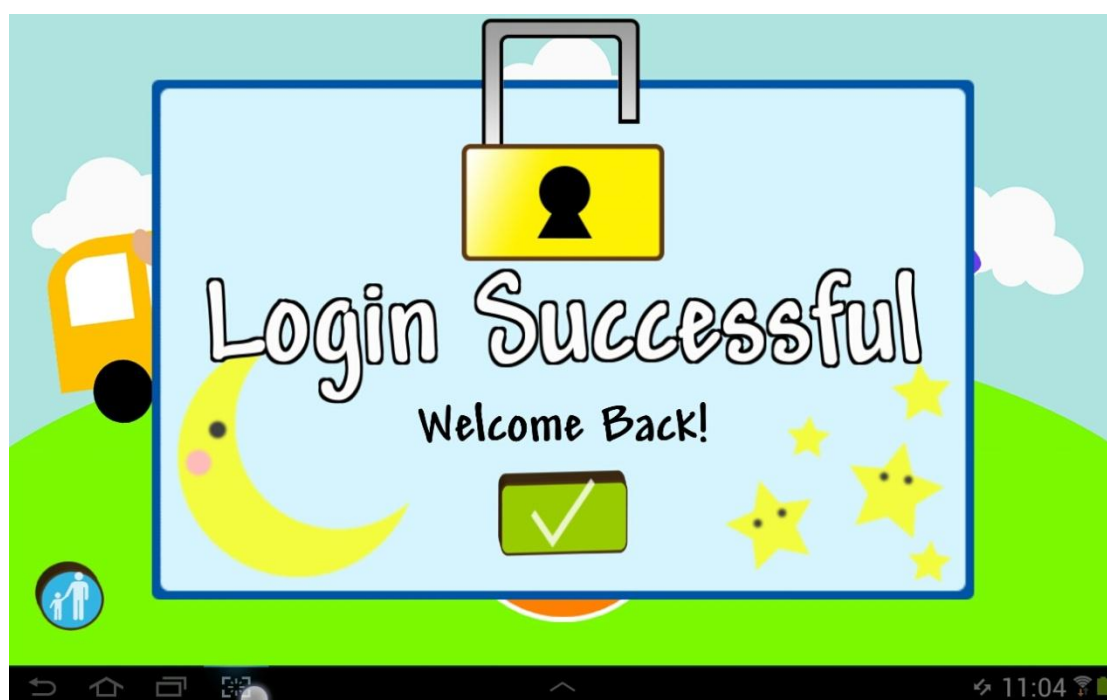


Figure 4.13 Login success page

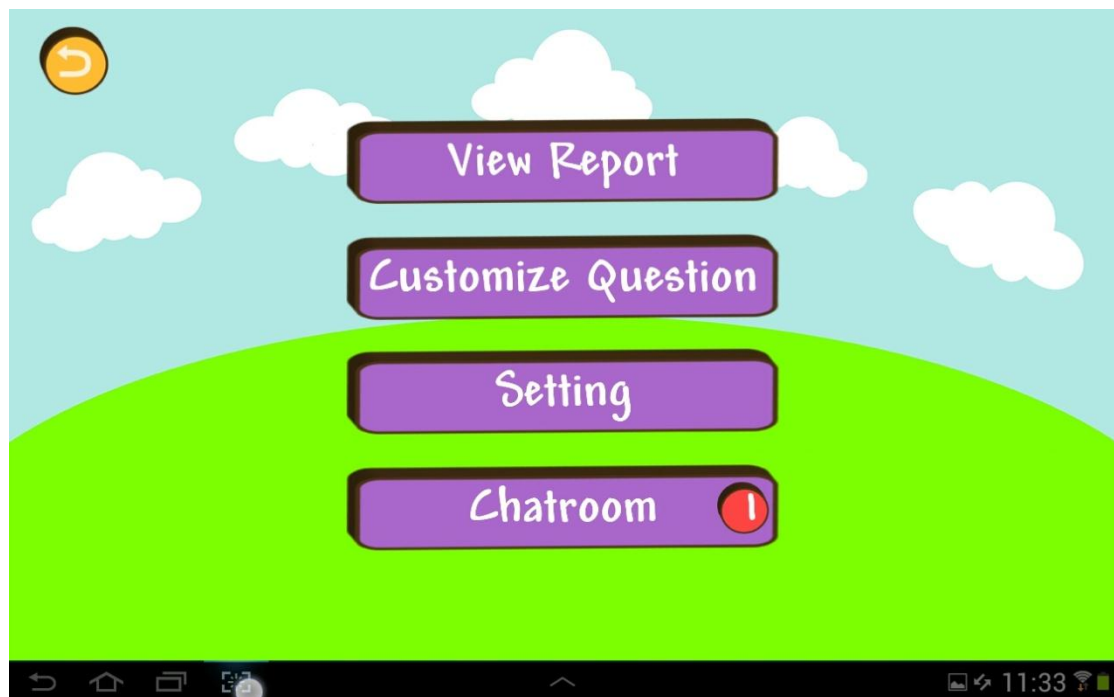


Figure 4.14 Parent's account with unread message

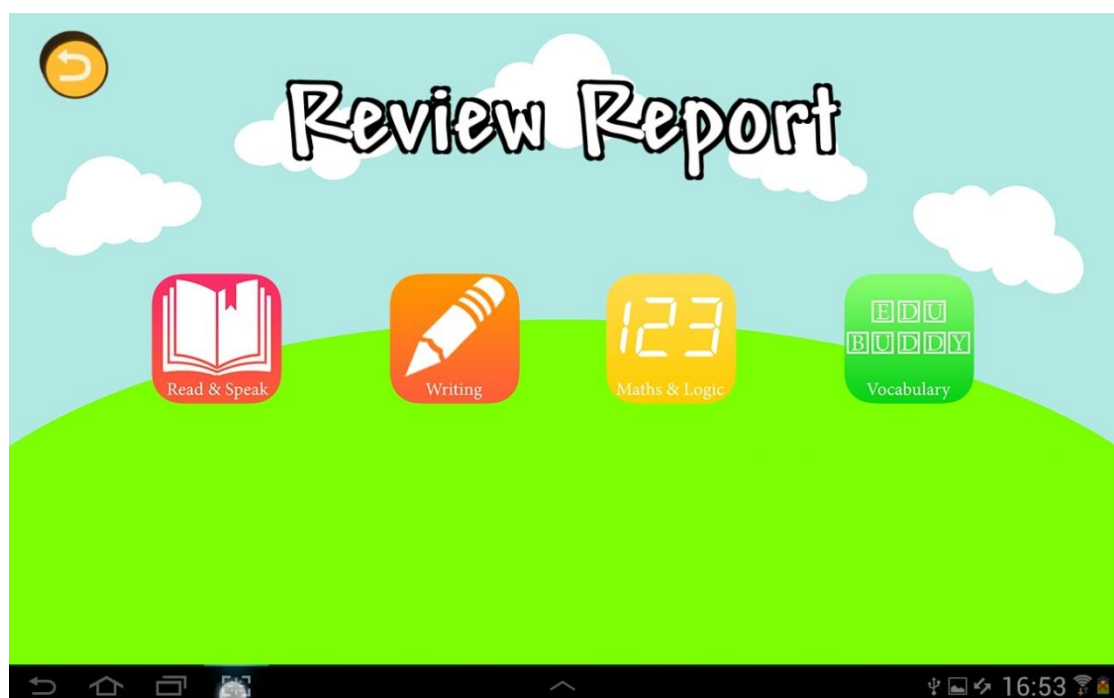


Figure 4.15 Selection page in "Review Report"



Figure 4.16 "Review Report" of "Maths & Logic"

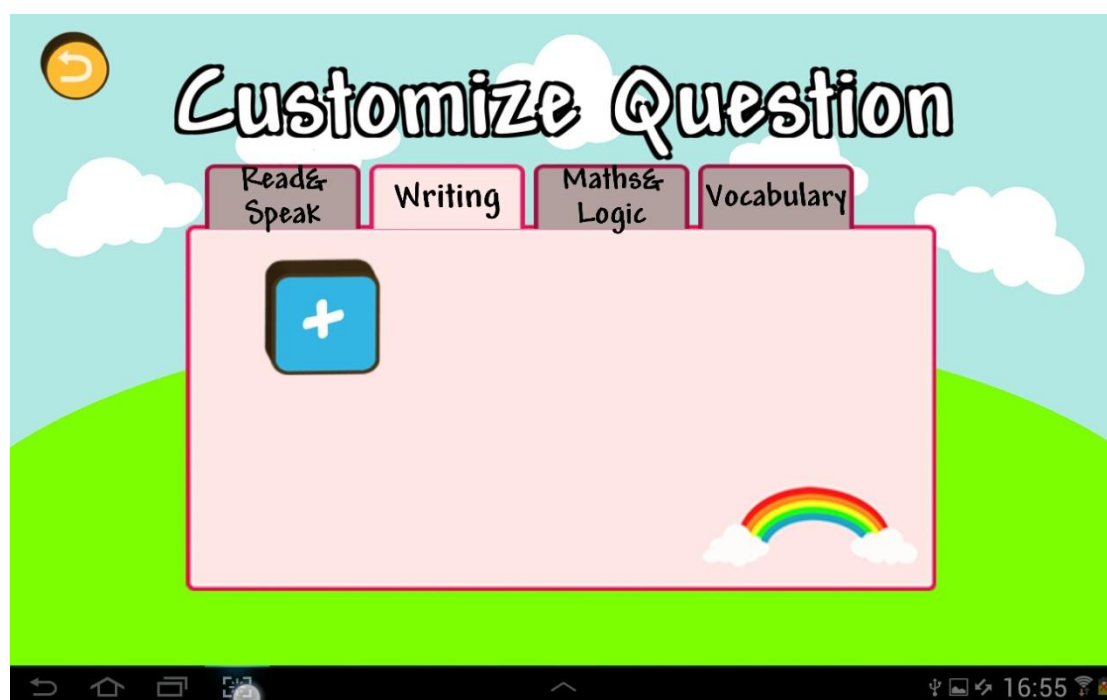


Figure 4.17 Selection page of "Customize Question"

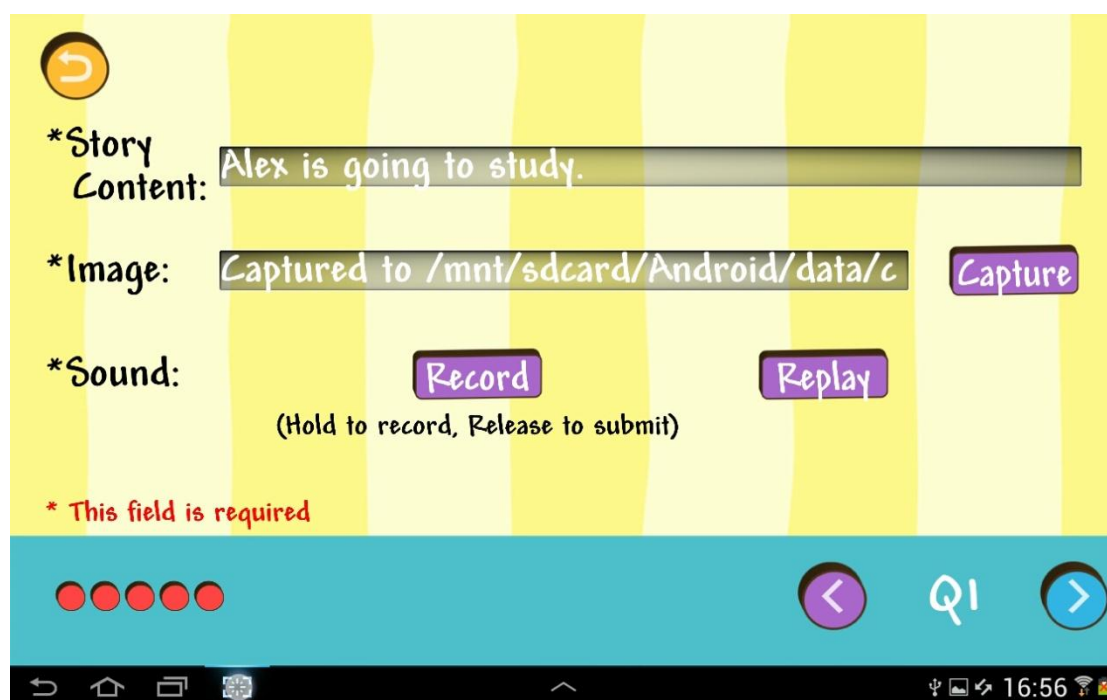


Figure 4.18 "Customize Question" of "Read & Speak"

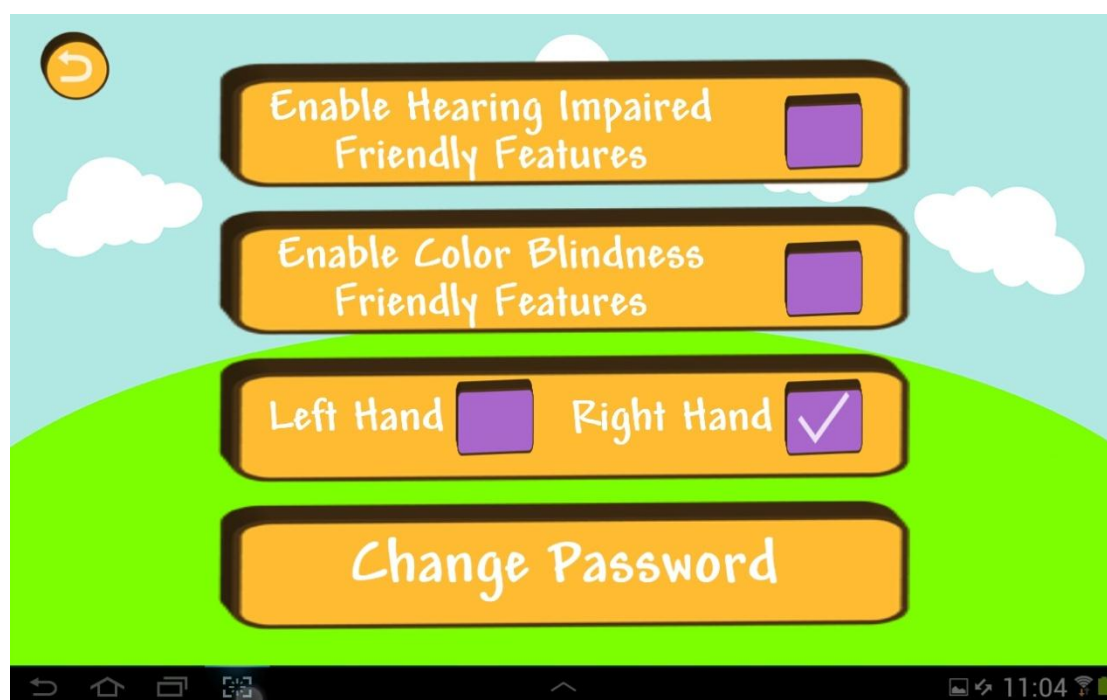


Figure 4.19 "Setting"

4.2.3 Summary of technical skills used in functions

4.2.3.1 Application features: “Robotic car control”

Application can be used to communicate with robotic car using Java Native Interface (JNI).

4.2.3.2 Application features: “Shop” & Coins system

Number of coins gained is stored in database and coins can be used to purchase items in “Shop”. Currently, “Shop” provides two characters other than rabbit for user to purchase and use to customize their user interface of the application.

4.2.3.3 Application features: “Chatroom” for parents and children

Messages can be sent and received within devices and between devices through the use of online server.

4.2.3.4 Application features: Learning area - “Maths & Logic”

Car control function is used in this learning area.

4.2.3.5 Application features: Learning area - “Read & Speak”

In this learning area, there are buttons for playing sound and recording voice.

4.2.3.6 Application features: Learning area - “Vocabulary”

AR function is used together with sound features in this learning area.

4.2.3.7 Application features: Learning area - “Writing”

Animation panel and writing panel is developed to show the animation of writing and get the coordinate of the touch on screen respectively.

4.2.3.8 Application features: Parent's account - “Customize Question”

Inputs of text, voice and image are allowed. Questions are stored inside local database.

4.2.3.9 Application features: Parent's account - “Review Report”

Results stored in local database are retrieved here.

4.2.3.10 Application features: Parent's account - “Setting”

Setting is stored in local database and is retrieved to customize the setting of the

application when the app initialize. Colors of some icons changed for color blindness friendly mode. Besides, sounds and voices in the application other than the background music are adjusted to higher pitch in hearing impaired friendly mode. Left or right-hander feature controls the panels in “Writing”. Furthermore,

4.2.3.11 Database

There are two databases, including online and local database. Besides, application programming interfaces are created to communicate with databases and allow editing of databases, such as client to server and server to online database API.

4.2.3.12 Points system

Point is calculated and medal is used to represent the result for children in each set of question. Besides, points are stored in local database for “Review report”.

4.2.3.13 Robotic car integration

Car control function is used to give feedback.

4.2.3.14 Tutorial session in all learning areas

Graphics and labels are added for explanation and indication.

4.3 Difficulties and Possible Solutions

4.3.1 Robotic Car Control

In phase one, which is the planning and design phase, we have think of different ways to integrate the use of robotic car into our application. Unfortunately, due to unknown specification of the robotic car at that time, communication method provided by the vendor is not capable to use in our project developed in Unity.

Therefore, when we got the robotic car at a later stage, we have put efforts to resolve this issue. Currently, an Android service, which is called in Unity, is used to communicate with the robotic car. The Android service is written in Java and Java Native Interface library is packed inside.

4.3.2 Customize Question

At the beginning, we have difficulties in getting the path of images and sounds. After investigation and several trials, we discovered that it was an error caused by incorrect path format. We successfully solved it by changing the path format.

Besides, there were difficulties in implementation of “Customize Question” for “Writing” and “Vocabulary” learning areas. As augmented reality was involved in “Vocabulary” learning area, we cannot find a way for parents to enable this feature, which was a limitation. Besides, in “Writing”, as there was an animation panel, it was hard and complex to capture the animation provided by parents.

Another difficulty in “Customize Question” was the image issue. The CaptureScreenshot API did not allow us to save the image file in specific file path. Therefore, we could not perform the function solely based on the API, modification is required.

4.3.3 Augmented Reality

In “Vocabulary” learning area, augmented reality is used. At the early stage of implementation, we have experienced some issues. We were not able to show the progress bar or labels together with the AR camera. After investigation and several trials, it was found to be the layering issue. Therefore, instead of resizing and repositioning the AR camera, we arranged the layer of the AR camera to the bottom to resolve the problem.

We have tried to limit the detection of the image to a specific one. However, there were unknown issues that cannot be solved until the end. When we disabled other target images, we were not able to detect them again even we enabled it.

4.4 Future Development

4.4.1 Voice Recognition

Voice recognition can be performed using some free library online. However, due to the limitation of Unity, the libraries that we found are not suitable to use in Unity. We suggested putting more efforts to find a suitable library for this purpose in the future.

Another possible solution of voice recognition is to compare the speed and similarly

of the recordings with a computer generated voices. There are a few well-known algorithms for voice recognition. This method requires time and efforts to perform deep research on this topic, which may be a separate project.

4.4.2 Stroke Recognition

We have researched on stroke recognition and we have found several ways to perform stroke recognition. One of the possible solutions is to use a genetic algorithm for offline handwriting recognition proposed by computer scientists of Soft Computing and Expert System Laboratory.

As suggested from them, mathematical methods can be used to perform stroke recognition. However, large amount of time is needed to implement this idea and there is high uncertainty on the accuracy of this stroke recognition method.

4.4.3 iOS development

Development of an iOS version of the application is possible as Unity support the development of multi-platform application, including iOS and Android application.

Before building an iOS application, an Apple Developer account is required. Unity can be used to build iOS application. An XCode project will be generated from Unity for compilation and distribution.

4.4.4 Multi-lingual

Multi-lingual of the application can be developed in the future, for example, Chinese. Although dynamic fonts can be used to implement the Chinese version, dynamic fonts are currently supported on Desktop platforms only.

A possible way is to use images for labels, instead of strings. However, there are a few disadvantages for this method:

1. It is not an effective and suitable method for massive amounts of texts.
2. It is not an effective and suitable method to support large number of languages.

Therefore, this method requires loads of time for implementation.

Chapter 5 Schedule

1 st – 21 nd Sept 2013	Initial planning
22 nd – 25 th Sept 2013	Preparation of project plan and web page
29 th Sept 2013	Project first deliverables: Detailed project plan and project web page
1 st Oct 2013 – 10 th Jan 2014	Preliminary implementation
10 th Dec 2013 – 24 th Jan 2014	Preparation of first presentation and interim report
14 th Jan 2014	First presentation
26 th Jan 2014	Project second deliverables: Preliminary implementation and detailed interim report
27 th Jan 2014 – 10 th Apr 2014	Further implementation and testing
1 st – 22 nd Apr 2014	Preparation of final report and presentation
20 th Apr 2014	Project third deliverables: Finalized tested implementation and final report
24 th Apr 2014	Final presentation
15 th – 25 th Apr 2014	Preparation of project exhibition
5 th May 2014	Project exhibition

Table 5.1 Schedule

Chapter 6 Balance Sheet and Resource

Allocation

A maximum of HKD4000, financed the project by the Department of Computer Science, The University of Hong Kong as budget, was spent as below:

<u>Item</u>	<u>Amount (HK\$)</u>
Printed Materials for AR	550
	<u>550</u>

Table 6.1 Table of balance sheet

References

- AppBrain Stats. (n.d.). Most popular Google Play categories. Retrieved October 12, 2013 from <http://www.appbrain.com/stats/android-market-app-categories>
- Augmented reality, Retrieved September 16, 2013 from http://en.wikipedia.org/wiki/Augmented_reality
- Brinkley, D. (2011). *Supporting deaf children and young people : strategies for intervention, inclusion and improvement*. London: Continuum International Publishing Group.
- Deafness (2011). Retrieved September 20, 2013 from http://en.wikipedia.org/wiki/Hearing_impairment
- Dingle (n.d.). Cycle development. Retrieved April 10, 2014 from <http://idingle.com/developing-games/cycle-development>
- Easterbrooks, S. R., & Baker, S. K. (2002). *Language learning in children who are deaf and hard of hearing : multiple pathways*, US: Pearson Education.
- Hudson, B. (n.d.). How does voice recognition work?, Retrieved September 9, 2013 from http://www.ehow.com/how-does_4895460_voice-recognition-work.html
- International Data Corporation (n.d.). Smartphone OS Market Share, Q4 2013. Retrieved October 15, 2013 from <http://www.idc.com/prodserv/smartphone-os-market-share.jsp>
- Kala, R., Vazirani, H., Shukla, A., & Tiwari, R. (2010). Offline handwriting recognition using genetic algorithm, *IJCSI International Journal of Computer Science Issues*, 7(2), 16-25. Retrieved from <http://arxiv.org/ftp/arxiv/papers/1004/1004.3257.pdf>
- Marschark, M. & Hauser, P. C. (2011). *How deaf children learn: what parents and teachers need to know*. Oxford: Oxford University Press.
- Ness, C. (n.d.). *Free stories and eBooks for the beginning reader*. Retrieved November

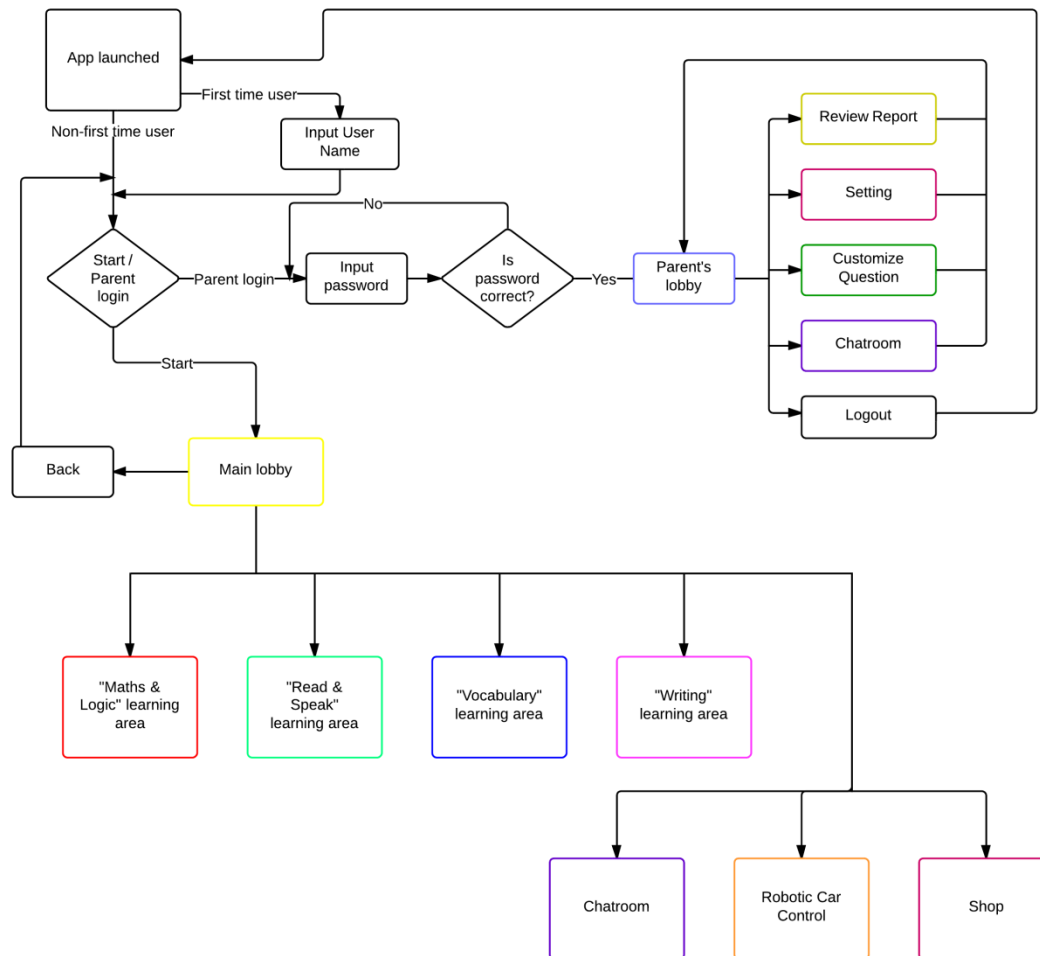
20, 2013 from <http://www.clarkness.com>

Stewart, D. A. & Kluwin, T. N. (2001). *Teaching deaf and hard of hearing students: content, strategies, and curriculum*. Cambridge: Cambridge University Press.

Appendices

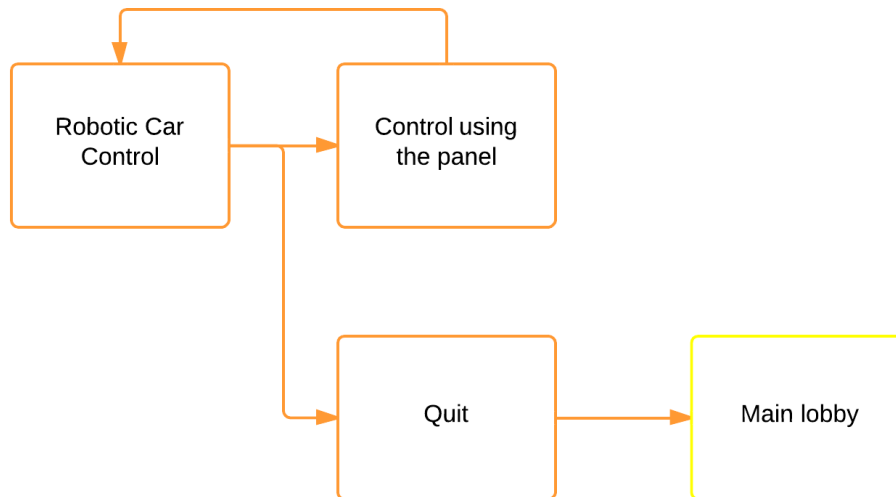
Appendix I: Main flow of the application

Main flow chart:



Appendix II: Flow chart of “Robotic car control”

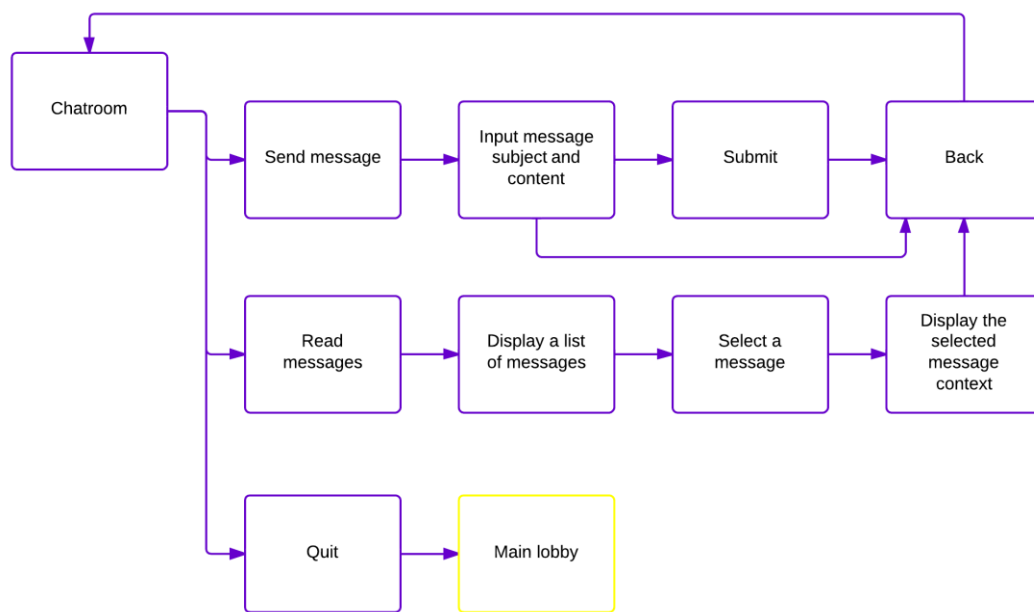
Flow chart of “Robotic car control”:



Appendix III: Flow chart of “Chatroom”

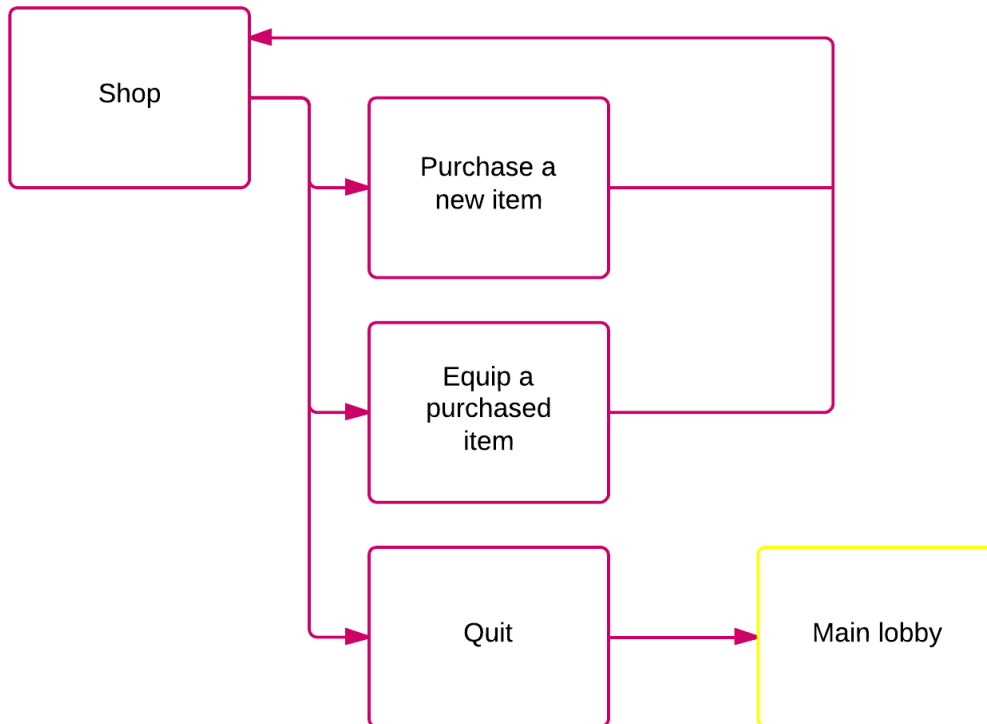
Flow chart of “Chatroom” for both parents and children:

(Flow chart of Chatroom under parent’s account is the same as “Chatroom”):



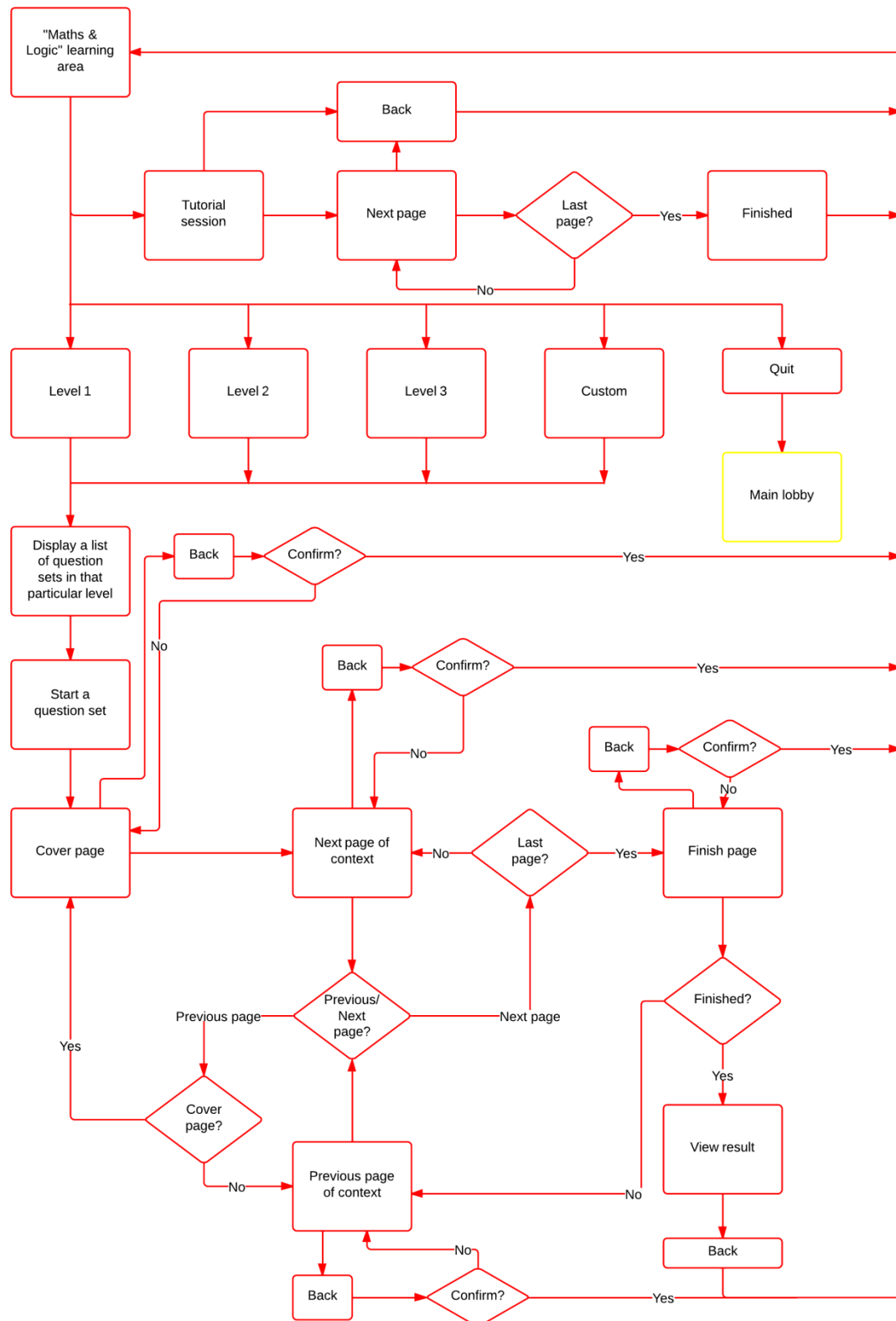
Appendix IV: Flow chart of “Shop”

Flow chart of “Shop”:



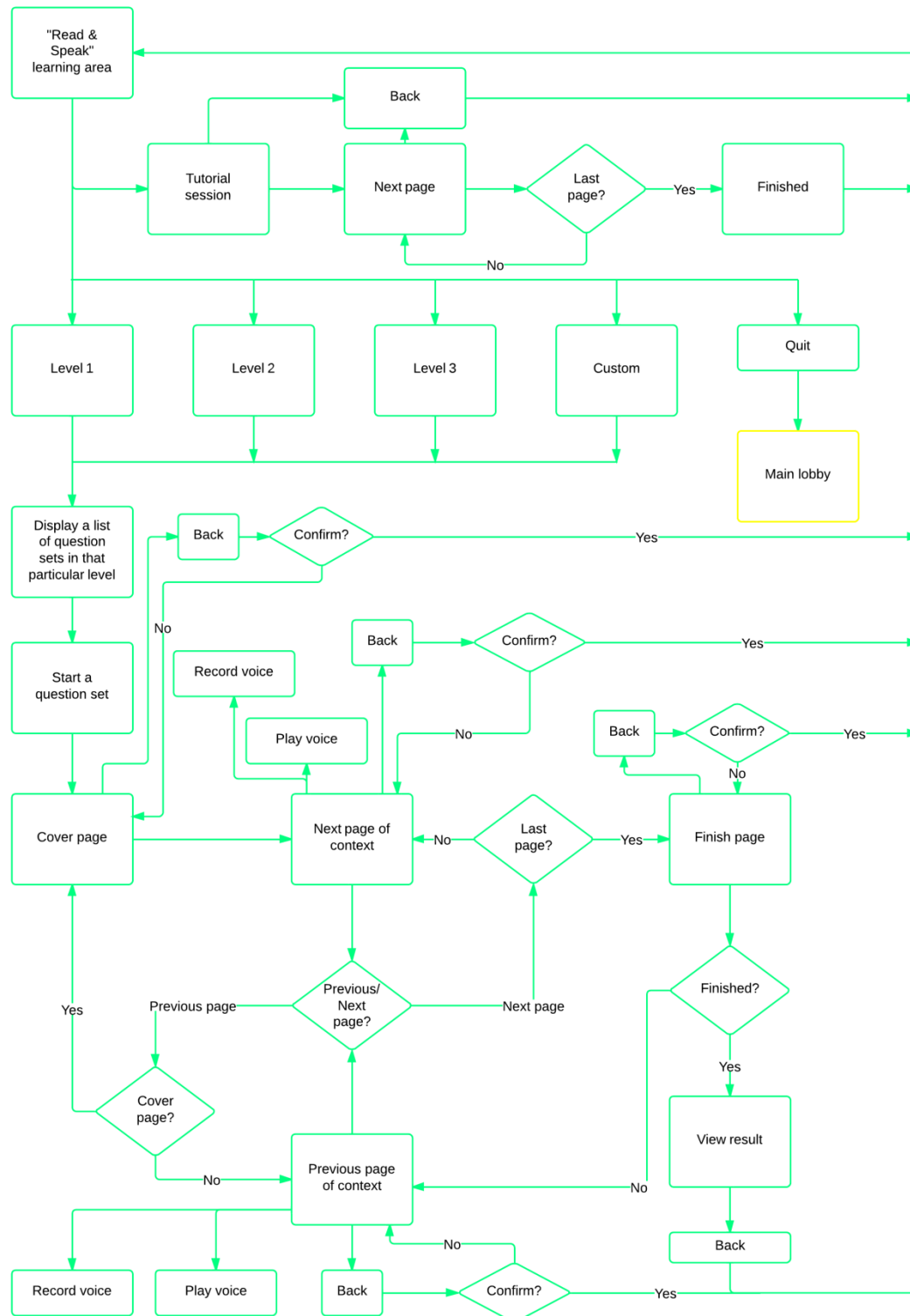
Appendix V: Flow chart of “Maths & Logic”

Flow chart of “Maths & Logic” learning area:



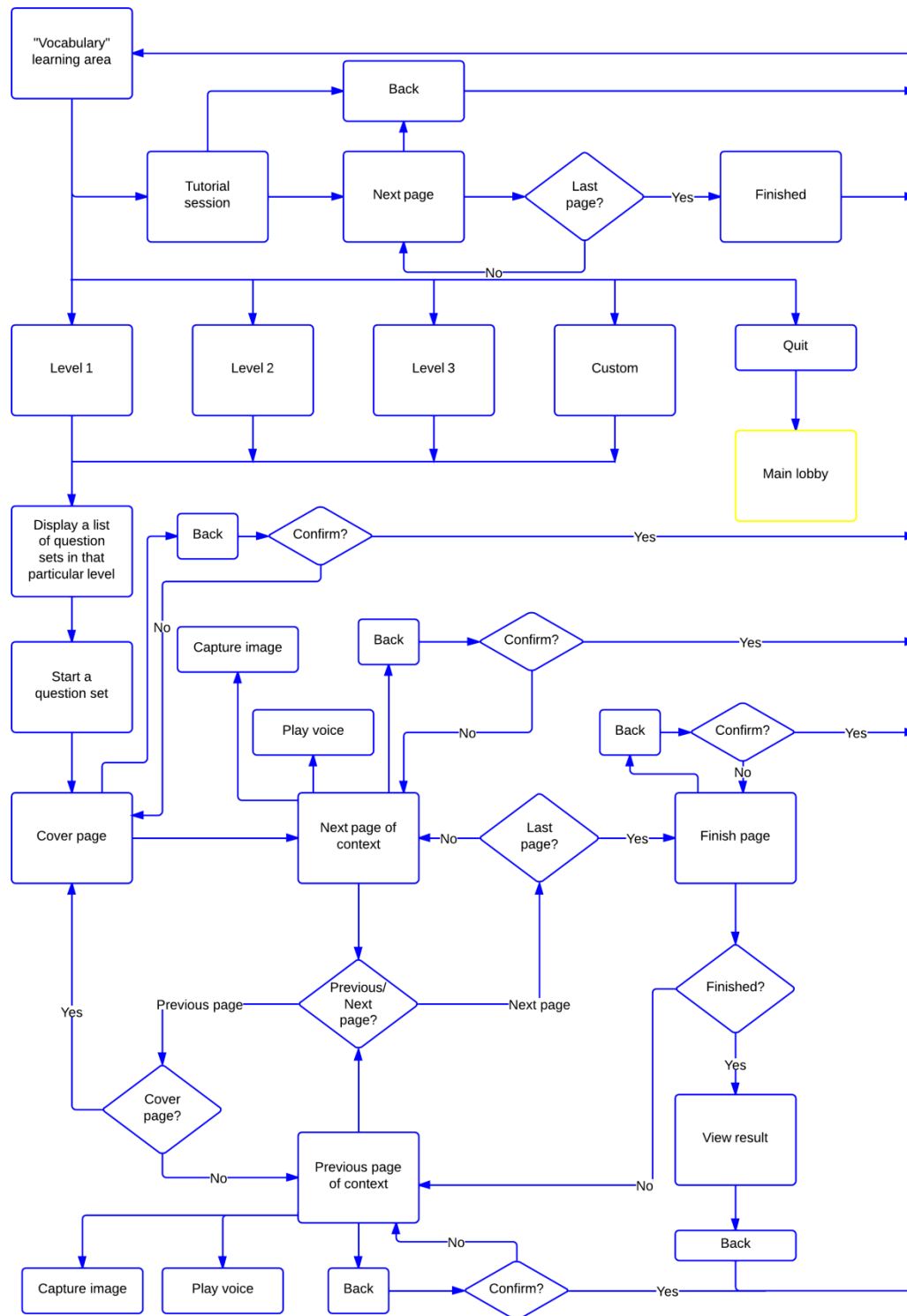
Appendix VI: Flow chart of “Read & Speak”

Flow chart of “Read & Speak” learning area:



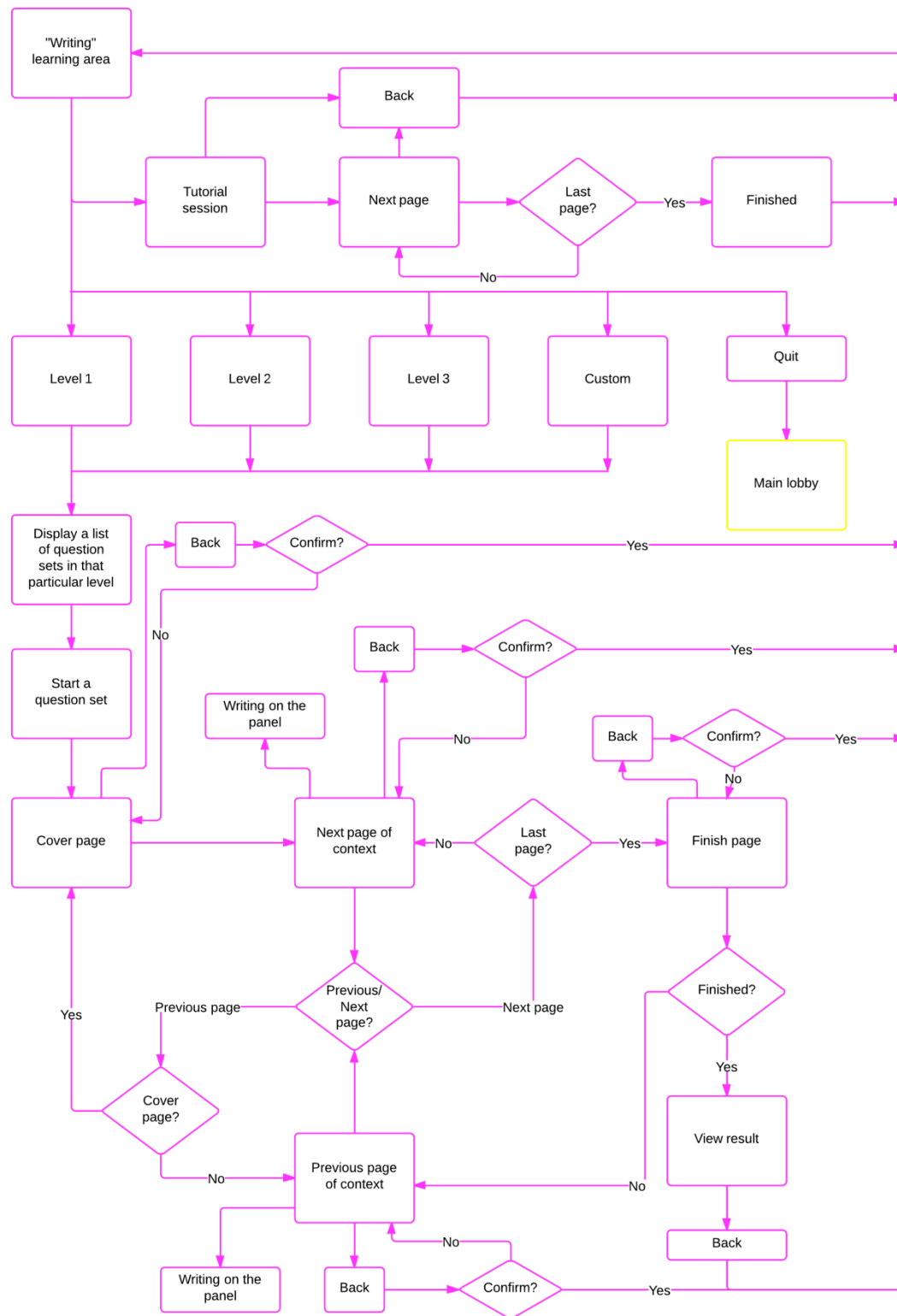
Appendix VII: Flow chart of “Vocabulary”

Flow chart of “Vocabulary” learning area:



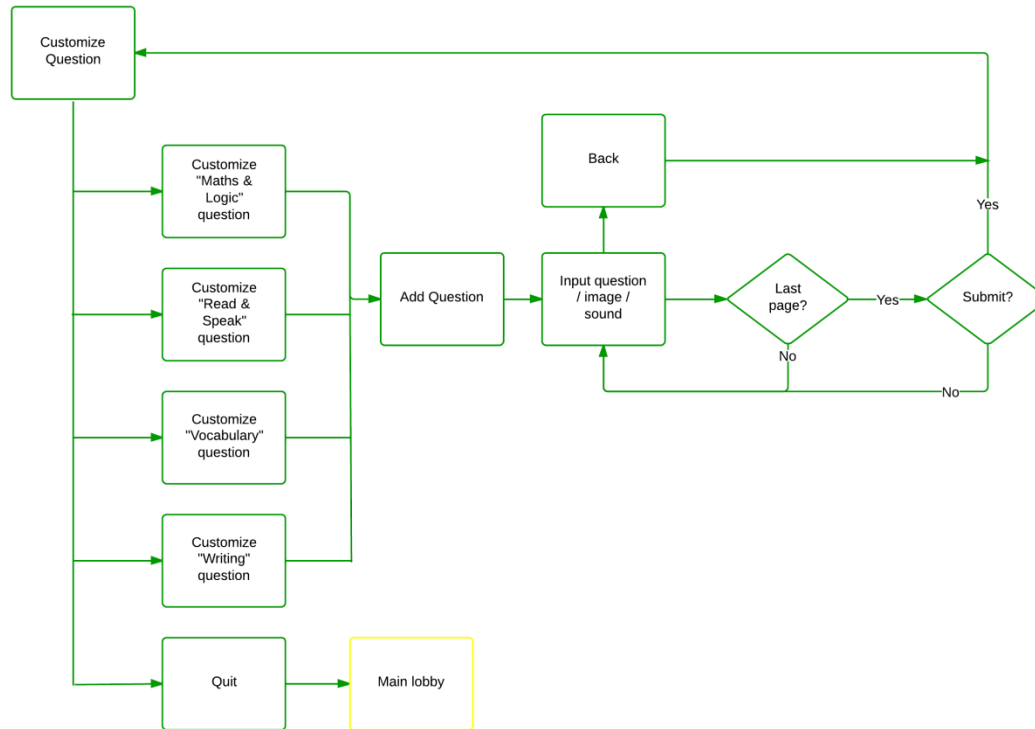
Appendix VIII: Flow chart of “Writing”

Flow chart of “Writing” learning area:



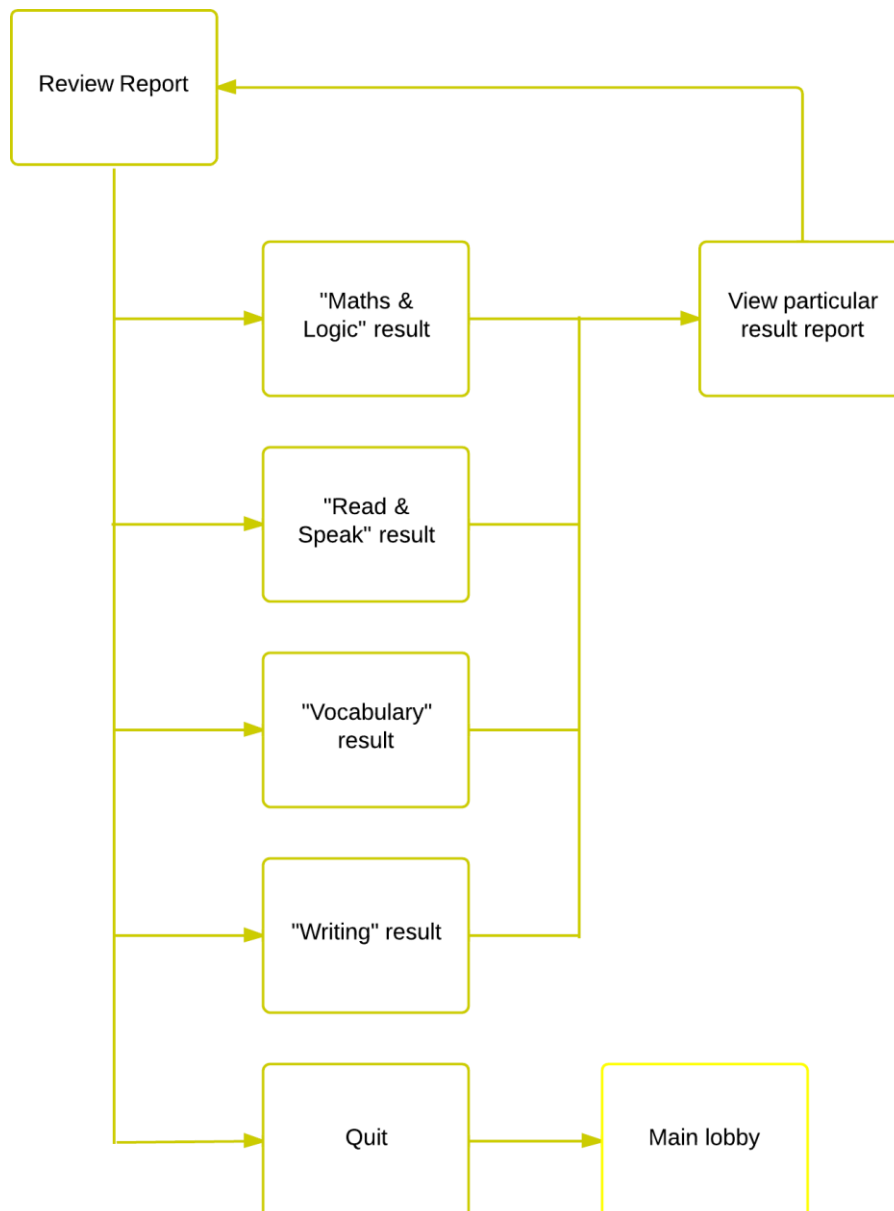
Appendix IX: Flow chart of “Customize Question”

Flow chart of “Customize Question” under parent’s account:



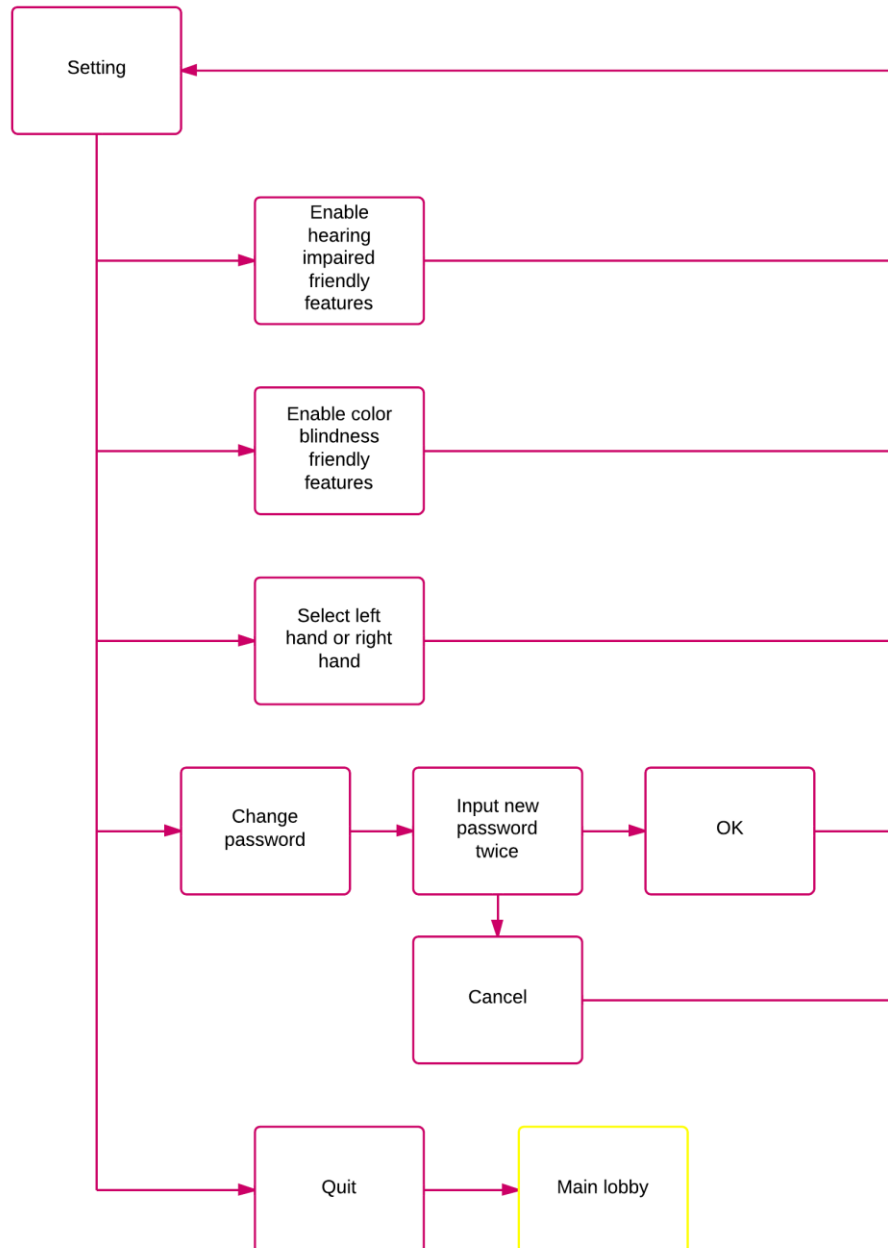
Appendix X: Flow chart of “Review Report”

Flow chart of “Review Report” under parent’s account:



Appendix XI: Flow chart of “Setting”

Flow chart of “Setting” under parent’s account:



Appendix XII: Test plan

This test plan for user acceptance testing is distributed to the testers.

Change History

Version	Change Date	Author	Description
1.0	2014/04/01	2011569556	Initial version

1 Introduction

This document describes the testing procedures for the application, EduBuddy, on Android devices with Android 2.3.1 to Android 4.2.

1.1 Scope

This document is to outline the testing procedures for the testing of EduBuddy, which is a product from Educational Software with Interactive Robot Platform Project, Final Year Project for Department of Computer Science, The University of Hong Kong in 2013-2014.

“EduBuddy.apk” is provided for testing. It can be installed in any Android devices, including tablet and smartphone. However, in this project, we only focus on Android tablet.

The purpose of the testing is to test whether the application returns any unexpected results in different situation. Therefore, test cases are included to assist in this testing.

1.2 Reference

Section 12 extract, IEEE Standard 829-2008

2 Detail

In this section, detail descriptions of testing steps are provided.

2.1 General description of testing procedure

Before and after executing the test cases, tester should perform the following steps to install the product, perform testing and record the result:

2.1.1 Connect device to user-preferred computer.

2.1.2 Load “EduBuddy.apk” into the device.

2.1.3 Find and tap “EduBuddy.apk” in the device for installation.

2.1.4 Tap the icon of EduBuddy to start the application.

2.1.5 If launched successfully, run the test cases in session 2.2 one by one and record the result – either success or failed.

2.1.5.1 If failed to launch, take a screen shot.

2.1.5.2 If the application has no response in any test case, record the issue in the result table and take a screen shot.

2.1.6 Record all the result of the test cases in the result table provided in session 3 in a separate document.

2.1.7 Send the result to szetowy@connect.hku.hk.

2.2 Test cases

2.2.1 “Maths & Logic” learning area

Steps:

1. Click “Start” from the start page to enter the main lobby
2. Click the icon of “Maths & Logic”
3. Click the tutorial tab and enter the tutorial session
4. Follow the instruction and complete the tutorial session
5. Click any one of the question set in any level
6. At the finishing page of the question set, click “No” to go back to the question set and modify the answer
7. Complete the question set

2.2.2 “Read & Speak” learning area

Steps:

1. Click “Start” from the start page to enter the main lobby
2. Click the icon of “Read & Speak”
3. Click the tutorial tab and enter the tutorial session
4. Follow the instruction and complete the tutorial session
5. Click any one of the question set in any level
6. At the finishing page of the question set, click “No” to go back to the question set and modify the answer
7. Complete the question set

2.2.3 “Writing” learning area

Steps:

1. Click “Start” from the start page to enter the main lobby
2. Click the icon of “Writing”
3. Click the tutorial tab and enter the tutorial session

4. Follow the instruction and complete the tutorial session
5. Click any one of the question set in any level
5. Complete three questions in this question set
6. Click the back icon from the top left corner without completion of the question set

2.2.4 “Vocabulary” learning area

Steps:

1. Click “Start” from the start page to enter the main lobby
2. Click the icon of “Vocabulary”
3. Click the tutorial tab and enter the tutorial session
4. Follow the instruction and complete the tutorial session
5. Click any one of the question set in any level
6. Place the device steadily to allow camera to recognize the images provided (Either images on screen or printed images is acceptable)
7. Click the back icon from the top left corner without completion of the question set

2.2.5 “Chatroom”

Steps:

1. Click “Start” from the start page to enter the main lobby
2. Click the icon of “Chatroom”
3. Click “Send message”
4. Fill in the form and send it to your user name + “parent” (For example, if your user name is “Chris”, send to “Chris parent”)
5. Click the green button

2.2.6 “Shop”

Steps:

1. Click “Start” from the start page to enter the main lobby
2. Click the icon of “Shop”
3. Try to click any of the price tag, you should be unable to purchase any item as the amount of coins is not enough

2.2.7 Parent’s account – “Setting”

Steps:

1. Click the icon of parent’s account on the bottom left corner

from the start page

2. Input the password "12345"
3. Click "Setting"
4. Change all the settings inside (Enable the hearing impaired friendly features, enable color blindness features, change to left hand and change the password to one that you preferred)
5. Go back to the start page
6. Click "Start" from the start page to enter the main lobby
7. Click the icon of "Writing"
8. Click any one of the question set in any level
9. The writing panel and animation panel should be switched
10. Click the back icon from the top left corner without completion of the question set
11. Click the back icon from the top left corner
12. Click the icon of "Read & Speak"
13. Click any one of the question set in any level
14. Complete the question set, and notice that the recordings should be changed to a higher pitch and the color of progress bar should be changed to blue and yellow

2.2.8 Parent's account - "Chatroom"

Steps:

1. Click the icon of parent's account on the bottom left corner from the start page
2. Input your password
3. Click "Chatroom"
4. Check if there is any message inside

2.2.9 Parent's account - "Customize Question"

Steps:

1. Click the icon of parent's account on the bottom left corner from the start page
2. Input your password
3. Click "Customize Question"
4. Click "Maths & Logic"
5. Fill in the questions, images and answers one by one
6. Go back to the start page

7. Click “Start” from the start page to enter the main lobby
8. Click the icon of “Maths & Logic”
9. Click the customize tab and enter the question set
10. Check if the question set is the one you input previously

2.2.9 Parent’s account - “Review Report”

Steps:

1. Click the icon of parent’s account on the bottom left corner from the start page
2. Input your password
3. Click “Review Report”
4. Click “Maths & Logic”
5. Check if there is any result inside

2.2.9 User interface test

Use and test the application as you preferred, and check for any unexpected user interface behavior.

2.2.10 Load test

Repeat any of the test cases 2.2.1 – 2.2.6 for at three times.

3 Result table

The table below is used for recording of testing result:

	Success/Fail	Comment/Reason of failure
Launching (Record the launching time in second in comment box)		
“Maths & Logic” learning area (State the level and question set selected in comment box)		
“Read & Speak” learning area (State the level and question set selected in comment box)		
“Writing” learning area (State the level and question set selected in comment box)		
“Vocabulary” learning area (State the level and question set selected in comment box)		
“Chatroom”		

"Shop"		
Parent's account – "Setting"		
Parent's account – "Chatroom"		
Parent's account – "Customize Question"		
Parent's account – "Review Report"		
Load test (State the test case used in comment box)		
Other opinion / suggestion / bug report		