DEVELOPMENT OF A MOBILE AUDIO-BASED EDUTAINMENT APPLICATION FOR THE VISUALLY-IMPAIRED

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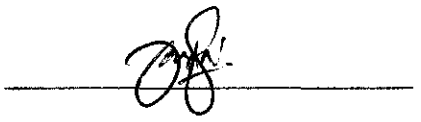
CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



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CERTIFICATION OF APPROVAL

Development of a Mobile Audio-based Edutainment Application for the Visually-impaired (AudioVenture)

by

Wan Mohd NorHafizi Helmi bin Wan Md Nor

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Abstract

This project is designed for visually impaired persons where the users can experience computer games same as normal person do but using different methods in term of output and input devices that will be used in the system. The approaches that will be used are the system will make the most uses of the audio output because visual output is irrelevant for this project and a touchscreen will be used as the input device to enable the users interact with the system by tapping on the screen.

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CHAPTER 1
INTRODUCTION

1.1 Background

An *audio game* is an electronic game played on a device such as a personal computer. It is similar to a video game save that the only feedback device is audible rather than visual. Audio games originally started out as 'blind accessible'-games and were developed mostly by amateurs and blind programmers. But more and more people are showing interest in audio games, ranging from sound artists, game accessibility researchers, mobile game developers and mainstream video gamers. Most audio games run on a personal computer platform, although there are a few audio games for handhelds and video game consoles. Audio games feature the same variety of genres as video games, such as adventure games, racing games, etc. [1].

This project can benefits the visually impaired persons to enjoy play games like the normal persons do. Although they may be experience different methods when using the games, it is still much more the same as normal games currently in the market. Furthermore audio games market is still scarce for the visually impaired people. This may limited their entertainment preferences unlike normal people do.

This research focuses on the contents, input and output that are suitable to visually impaired person. The content of the game may consists of different genres such as role playing (RPG), action, racing, sports and many more. The input also plays an important role so the research may focus on the input interfaces required so the user may find it is easy to use.

1.2 Problem Statement

Touchscreen nowadays has become common gadget in consumer electronics industry. From mobile phones, tablet PCs, electronic book, MP3 players and many more. Although it has become common to them, many researchers find that the touchscreen not feasible for visually impaired persons.

Unlike the controls on a standard gaming device, mobile phone or handheld device that can be easily felt through touch, touchscreen technologies do not provide any tactile interfaces between controls and display space. While a visually impaired person can learn the locations and functions of tactile control panels on current mobile and gaming devices, attempting to do the same with touchscreen based devices is much harder, due to the lack of tactile interfaces between virtual buttons and surrounding surfaces. This affects the degree of independence that a visually impaired person can enjoy when trying to use a touchscreen based device [2].

This lack of accessibility may also cause the recent legislative programs such as the American Disability Act that require devices to be accessible to people with visual impairments. From this journal, the researchers argued in this paper that although visually impaired people find touchscreens to be inaccessible, the increasing use of touchscreen technology presents a significant opportunity to improve several aspects of assistive technology, allowing good accessibility to be incorporated into the same devices, and on an equal footing, to interaction for sighted users. They argue this through the results of a questionnaire based study on the use of everyday technology by visually impaired people, before carrying out a motivated study comparing possible interaction techniques on two touchscreen based MP3 players [2] [3].

The issues that must be faced are the costs and the feature access of the device [2]. Regarding the cost, a dedicated device designed for visual impairments does not come in cheap because of lacks of demand. When designing a new device that similar to current devices that marketed to general users, some of their futures and function such as control buttons must be simplified. Even some needs to be removed in order to meet the specification that is compatible with the visual impairments. Two main problems when visual impairments try to interact with conventional video games:

- **Interaction problems**: problems in information perception from the game, problems in transmitting commands to the game [15].
- **Level problems**: game difficulty level too high, problems to understand the game play, game speed [15].

With visual impairments, interaction problems are prominent because the handicap prevents the player from using the natural interface of computer game: the graphical display. Nevertheless, a way to solve interaction problems is to develop multi modal communication layers. Multimodality consists on providing several game representations based on various modalities (graphical, audio: speech synthesis, haptic: force feedback, tactile: braille terminal) and several game controllers also based on different modalities (joypad, joystick, speech recognition, breath). So, according to its abilities, he (or she) could choose which modality to use. The audio modality is currently the main solution to give visually impaired players the access to computer games. Moreover, this modality has an important potential even if this modality is underused by the video games industry. They only focus on audio tracks to increase the immersion phenomenon and not as a way to represent a game. Examples like "AudioQuake" 4 underline the feasibility of introduce audio representation of mainstream games [16]. Then, more and more players are looking for new game

experiences with new interfaces: see the success of "Nintendo Wii" console, haptic controllers (Sensable Phantom or Falcon Novint) or audio games. With audio games, more and more players (visually impaired or not) are interested in this new kind of games: as a example, the success of the website "AudioGames", which proposes more than one hundred audio games, a forum, an on-line magazine (Audyssey), etc. More than the research of a new entertainment experience, the low financial investment necessary to play these games, also explains their success as well as the improvement of vocal synthesis and sounds spatialization techniques.

Level problems are more difficult to take into account because the limit between difficulty linked with the handicap and difficulty linked with the game is very thin. Indeed, even if tricky levels can prevent the user from playing the game, it is also one of the interest of numerical entertainment. This limit is well represented by the definition of the state of "Flow" introduced by the psychologist Csikszentmihalyi and extended to games by Chen Jenova in [17]. "Flow" is "the mental state of operation in which the person is fully immersed in what he (or she) is doing, characterized by a feeling of energized focus, full involvement, and success in the process of the activity". So, player has to aim this mental state to have fun [18].

1.3 Objectives

The objectives of this project are:

- To develop an audio based edutainment application for the visually-impaired.
- To propose an interface design layout for a mobile audio-based game.
- To evaluate user's perception on the developed application and interface design.

1.4 Scope of Study

This research covers on the human blindness, human computer interactions and the visual impairments. The project also focuses on determining the right and suitable way to use the input device when playing the game. Critical review of related works on visual impairments and the touchscreen technology will be conducted to develop the end product.

This research also focuses on how the visual impairments interact with electronics devices such as mobile phones, MP3 player, and game controllers. Furthermore, I try to make a research on existing technologies that have been used to make specific device for the visual impairments and try to improve it so that I can design a game that simple but fun to the users.

The target users for this application are kids with visual impairment between ages 5 to 10 years old. The research also focuses on the Android platform.

CHAPTER 2
LITERATURE REVIEW

1. The Audio Games

Philip Mendels and Joep Frens state in their research that the possibilities of sound for computer games are largely under-investigated as most games and game research focus on visuals. However, audio is an important interactive element of games, and frameworks about game audio are gradually emerging [4] [5] [6] [7]. Although audio is commonly used to complement visuals in games, they feel that the unique aspects of audio are best experienced when visuals are omitted. One reason for this is that the lack of visual information enables the player to use his imagination to visualize the audio world, like a book requires the reader to imagine the textual world. Imagination plays an important role in the feeling of presence of the user [8].

They also added that they are interested in audiogames, computer games that only use audio. They come in all genres, ranging from puzzle games to first-person shooters. A description of audiogames is given by Friberg an Gärdenfors [9] and the interested reader can find an overview of audiogames on the audiogames.net website [10]. The majority of the audio games are made for visually impaired players and are adaptations of visual games that do not exploit the full potential of audio only gaming. In line with Röber and Masuch [11] they think that new opportunities will arise when audio games leave the realm of the pc and if they are not developed for visually impaired players exclusively. To maximally exploit these new opportunities, interfaces need to be designed specifically for audio games. Additionally, audio games can be enjoyed in different settings if the interfaces are made portable.

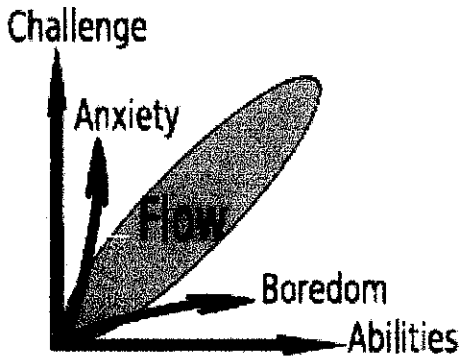


Figure 1: State of "flow" by Chen Jenova

According to Chen Jenova, in games, the "flow" state represents a compromise between game level difficulty and player abilities. Indeed, if game is too simple, it is getting boring whereas if game is too difficult, it is stressful for the player. Finally, to create a computer game accessible for everyone, whatever its physical or mental abilities, and interesting for everyone, we have to design an auto adaptive game AI to manage game level difficulty according to player's behavior. Several methods deal with such an adaptive AI [19][20].

2. Game Design

When designing an audio adventure game experience for a relaxed and casual setting three aspects play an important role: an interactive audio world, an interactive narrative and a physical interface [4].

A problem with many existing audio games is that navigating the audio-only world is not a trivial task. The first person shooter Terraformers [10] offers a three-dimensional world in which the player can move around freely. Several in-game navigation interfaces (spoken GPS, sonar beep, compass beep) are available, but even with these interfaces navigation remains rather difficult. Although they fit in the narrative setting of this particular game, we think that they are not suitable for all narratives. We also think that these audio interfaces can conflict with the sounds of the audio world and possibly annoy the player.

Chillingham [11] is an audio adventure game that requires the player to use the arrow keys to make combinations of verbs, world elements and inventory items. (e.g. look at – statue) The advantage of this interface is that it is impossible for the player to get lost. A disadvantage is that the interface is very present: Looping through narrated verbs, hotspots and items can become tedious and the feeling of traveling the audio world in an analogue way is missing. Moreover, the element of exploration (searching for places and items) is lost. These examples show that a balance is needed between freedom of exploration and ease of navigation. Especially for games that draw heavily on narrative, navigation should not demand the entire player's attention. In this paper we show how the structure of the audio world can be changed to achieve such a balance [4].

According to Johnny Friberg and Dan Gardenfors' research journal, the development of game audio has, however, opened up possibilities for people with visual impairment to play computer games, provided that the games are developed with regard

to their abilities. There is a growing scene for soundbased games that convey all necessary information through auditory interfaces. Among the more popular titles are the games Shades of Doom [12] and Terraformers [13]. New, increasingly advanced audio games appear regularly and, as the visually impaired gaming community expands and grows more established, the content and game interfaces of the mature [10]. One effect of this is that new audio games can start building upon older titles and become more advanced. Yet, the complexity of today's audio games is still far behind that of mainstream games [14].

By providing auditory interfaces, and treating sound with a concern equal to what normally is exclusive for the graphics, we believe that it is possible to develop not only functional games, but also aesthetic gaming experiences. This is an important design principle, in particular since toys for children with special needs today often has a focus on therapeutic aspects. We want to show that computer games for visually impaired children do not need to be simplified to such an extent that they resemble the games sighted children played 10-15 years ago [14].

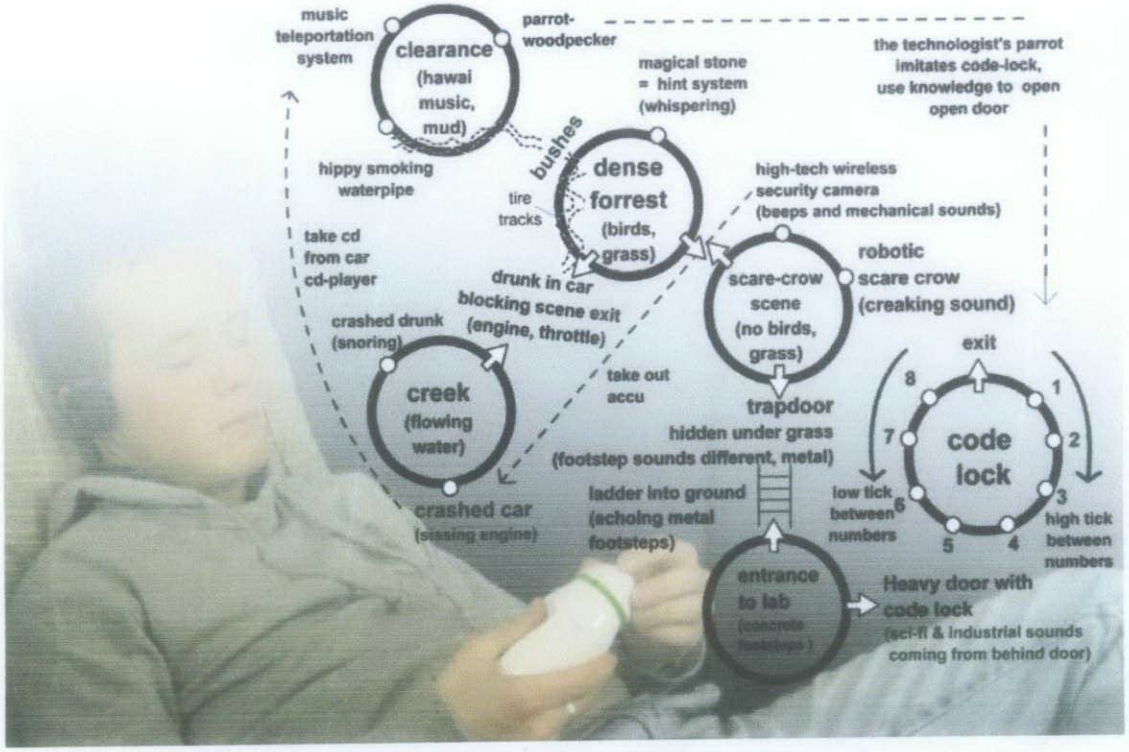


Figure 2: A schematic representation of a part of one of the constructed audio worlds [4]

Based on the figure above, to make navigation easier, we restricted the audio world to a network of paths, rather than a collection of open spaces that can be explored freely. A network of paths can still become quite complex: The player needs to know when he is at an intersection, and how to move the player-character into a side-path. To give the audio world a clear structure, we constructed it out of scenes with each a matching ambient sound and/or music, and assigned a single path to each scene [4].

When the sound of an adjacent scene is heard, the player can select to exit the current scene and automatically move the player-character to the adjacent scene. A path can be discontinuous (open-ended) or continuous (closed). We initially chose for continuous paths because of their inherent spatiality (the path encloses the space of a scene), and because they can be mapped easily to a rotational controller, which is discussed in the next chapter. A continuous path can be abstractly modeled as a circle,

although it can have any closed shape in the imagination of the player. When the player-character walks audio footsteps are played, matching the terrain of the scene and the speed of movement. Each path contains hotspots that can be places, objects, characters or scene-exits [4].

When the player selects a scene-exit the player-character automatically moves to the adjacent scene and the ambient sounds of the current scene and the adjacent scene are cross-faded. Sometimes hotspots are triggered automatically (e.g. the player-character slips over something), but in most cases the player has to select them. We found out that it is already possible to create engaging simple adventure games by offering the possibility to explore and select hotspots. New ideas for interaction evolved, for example that the controller can represent an in-game object (the codelock in figure 2) [4].

CHAPTER 3
METHODOLOGY

The project adopts a Rapid Application Development life cycle and is segmented into four main phases. Phase 1 mainly involves research work. Phase 2, 3 and 4 make up the main development stage. A Gantt chart on the project schedule is crafted (see Appendix 1-1).

The project's methodology is based on rapid prototyping which enable the developer to program faster but at the same make it easier to modify certain code in the development process. This stage covers feasibility study, planning, analysis, design and implementation. The developed modules from the iterations will be evaluated, inspected and further enhancements will be made, if needed. The rapid methods could align the development of the proposed optimization technique with academic standards.

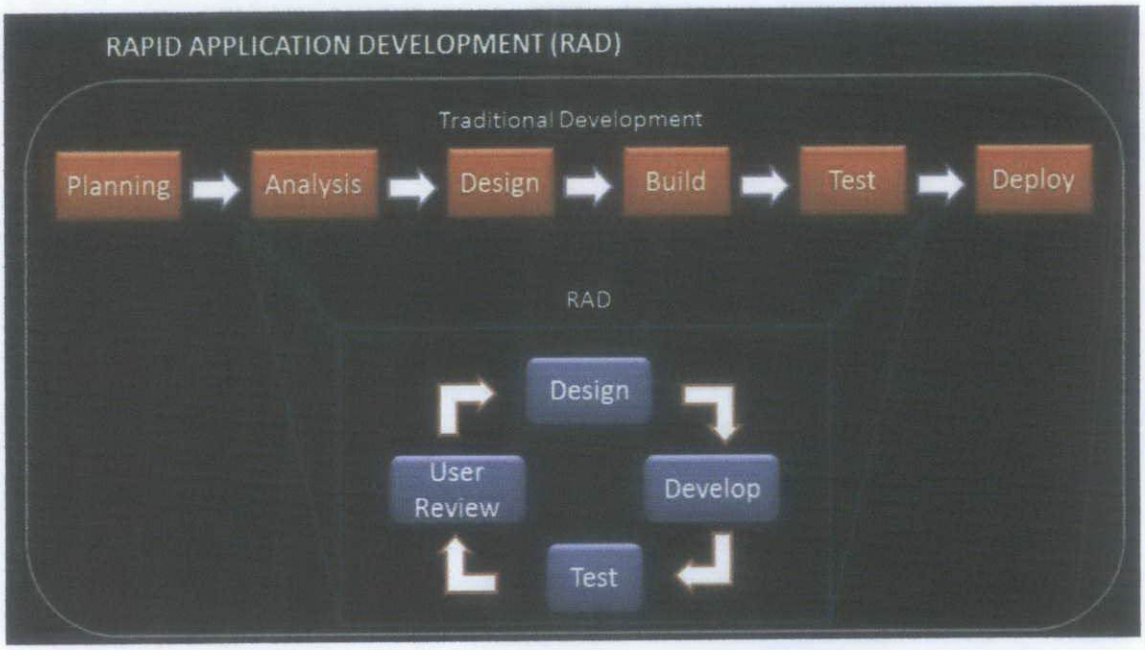


Figure 3: Rapid Application Development Methodology

3.1 Phase 1: Research and Literature review

The project is initiated with a detailed background study on the human computer interaction and blindness. Related works on the visual impairments interaction is also examined to identify the problems that related to the research. This will done by reading through some journals, website or any reliable sources that related to the project. I have found some Audio Games that is available in the market:

Real Sound: Kaze no Regret (1997)

Developer: WARP Inc.

Publisher: Sega

Platform: Sega Saturn & Dreamcast Console

Designer: Kenji Eno

Gameplay:-

Figure 4: Real Sound game CDs

- Player spends the majority of the time listening as the story unfolds.
- At critical forks in the plot line, a set of chimes will ring, alerting the player that it is now his job to choose the course the plot will take.
- The choice that is selected is confirmed with the controller and the plot resumes.

iReading – Stories Collection I

Developer: Dam Chen

Platform: Apple iOS

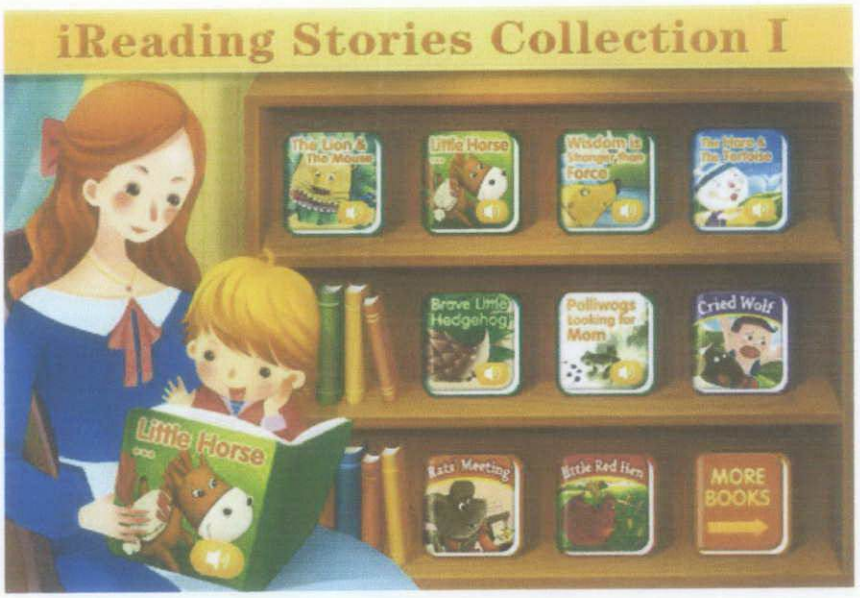


Figure 5: Users can choose variety of stories to read.

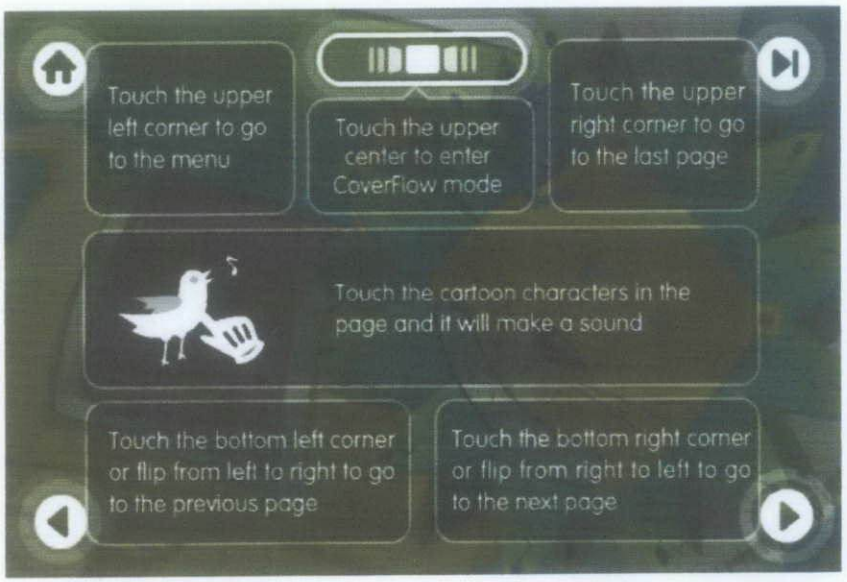


Figure 6: This screenshot shows to users how to navigate.

Figure 7: Story progress

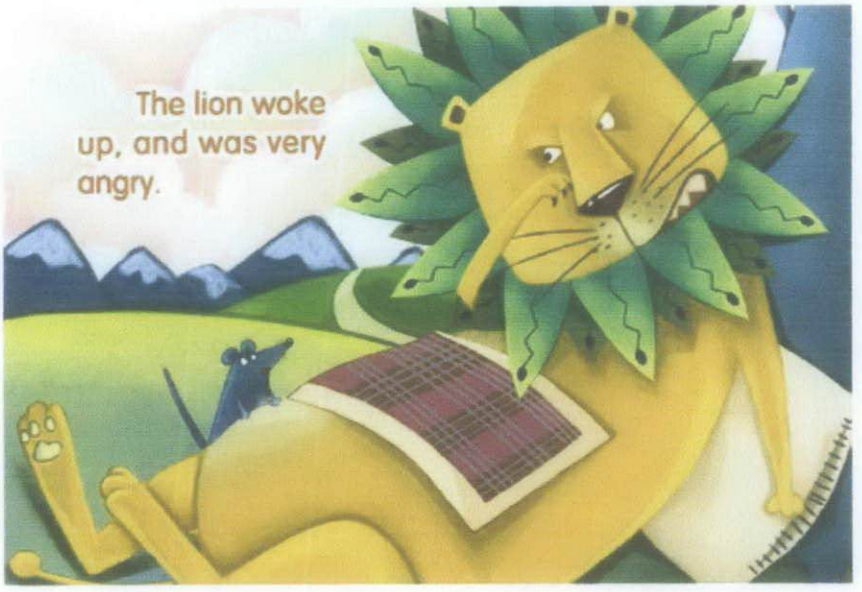


Figure 8: Users can choose whether to read by themselves or hear the audio.

Top Speed

Developer: Playing in the Dark

Platform: Windows 98 and above

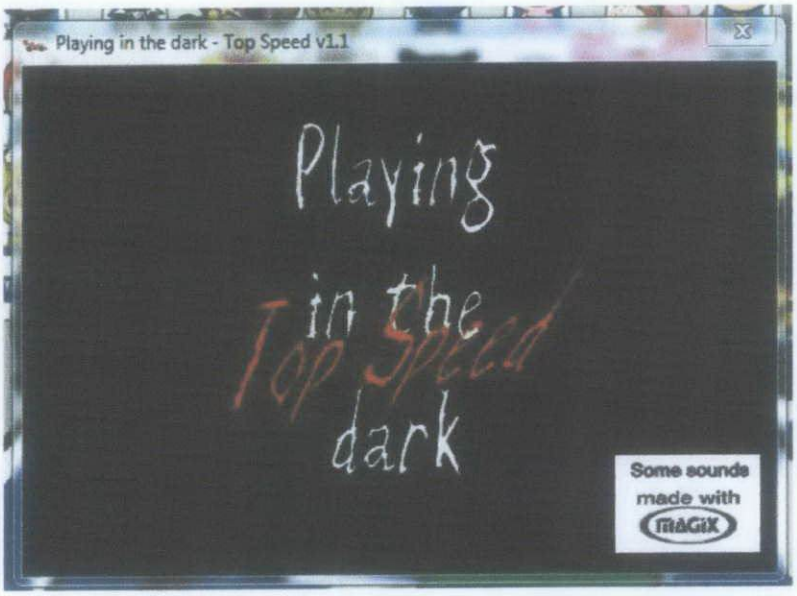


Figure 9: Top Speed main layout

It is a racing game based on sound. The goal is to reach the finish line as fast as possible without crashing. The game contains following features:

- choose between two racecars or two motorcycles
- choose between 8 racetracks or select one of the 4 street adventures containing different road surfaces, sounds and weather effects
- choose between automatic or manual transmission
- maintain track records and compare them with others
- input device: Keyboard

Sound Match

Developer: spokko

Platform: Apple iOS

Sound Match is a twist of the classic memory game. Remember the sounds and put them in pairs. Packed with sounds and animations, Sound Match gives users a chance not only to test their memory skills, but also to compete with others.

Sound Match includes:

- Multiplayer Versus mode - challenges other players
- Achievements - try to get them all!
- 25 unique sounds
- 3 Difficulty settings - Each making the stage bigger with more sounds to discover.
- Global and local high scores - compare your skill with others from around the world

Figure 10: Loading page

Figure 11: Main menu

Figure 12: The game

3.2 Phase 2: Planning and Design

Preparation for audio game includes identifying and planning on the feasibility and procurement of tools and parts to design the game and input device. Installation of the Android software development kit (SDK) is required to do programming and run the simulations. As both of the games mentioned above are on console and Windows platform. I would to design this game to run on Android mobile platform. The gameplay will be much more the same with Real Sound but I will simplify it to meet the time constrain and resource available. The user will interact while playing the game by using only 5 buttons on the mobile device's touchscreen. The users will recognize the buttons by using their touch sense. To minimize the hardware cost, I prefer Samsung Galaxy S with capacitive touchscreen. I think this device is suitable for prototype. Along with the touchscreen device, a punched cardboard resembled arrows shape will be used. Here are the specifications of the hardware that I will be using for development.

Hardware

- **Samsung Galaxy S**
    - Samsung Hummingbird S5PC110 (ARM Cortex A8) 1 GHz
    - 800×480 px, 4.0 in (10 cm) at 233 ppi WVGA Super AMOLED (0.37 megapixels)
    - 512 MB RAM

3.3 Phase 3: System Development

In this phase after acquiring identified devices and software needed, the development can be start. First, using the touchscreen we need to identify the areas on the screen for input locations: up, down, center, left and right. The coding will mainly in JAVA and XML involve the five inputs mentioned before. The mobile device is running on Android 2.3 platform, so to be able to develop program for this OS, I will be using Eclipse as IDE for programming. Here is list of software that I will use:

- Android SDK
    - Eclipse IDE
    - JAVA & XML
- Goldwave
    - Record & Edit audio clips
- Adobe Photoshop
    - Designing buttons and others graphics interface if required

Project Key Milestones

1. FYP II Progress Report (Done) – 7th November 2011
2. Pre-EDX poster presentation (Done) – 30th November 2011
3. Final Draft Technical Report (Done) – 7th December 2011
4. Viva presentation – 21st December 2011
5. Final Dissertation – 28th December 2011

The Game & Storyboard

After considering the time and resources limitation, a decision has been made regarding the content of the game. I have decided to develop a kid's edutainment application combined with some learning and game elements. When the application is launched, users can choose which 3 types of contents; Learn Sounds, Stories, and Memory Match Game using the assigned buttons. In memory match game, the right or wrong answer will be accompanied with the device's vibrations. Basically there are 3 basic layouts for this application which are main page, story, and quiz. Each of these layouts will have same inputs (buttons) with each buttons will be assigned to certain functions. This is the initial first draft of the layout.

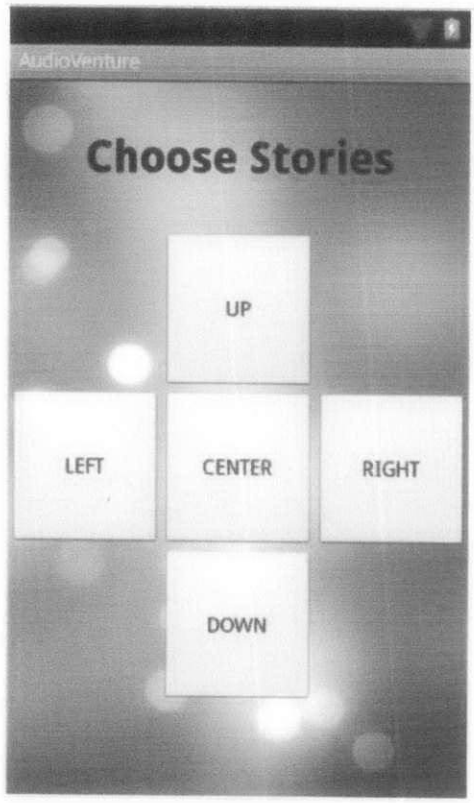


Figure 13: Story menu

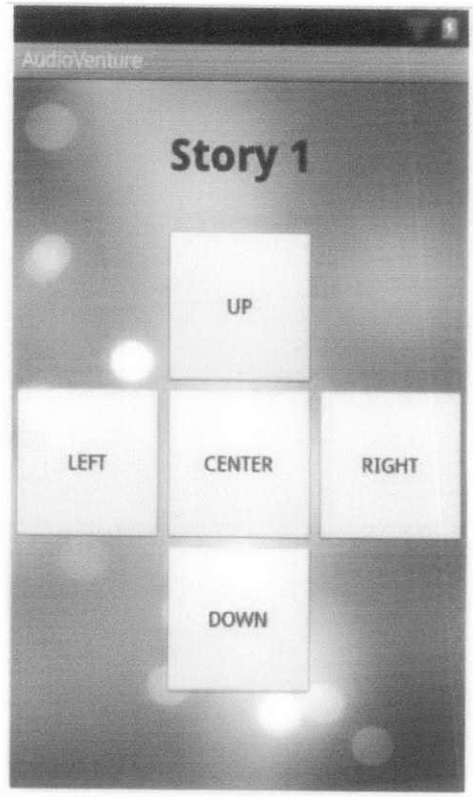


Figure 14: Story 1

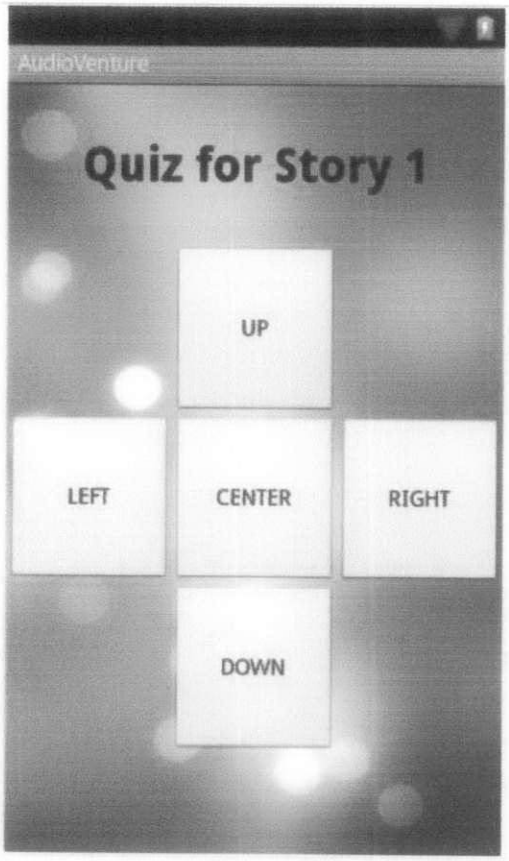


Figure 15: Quiz

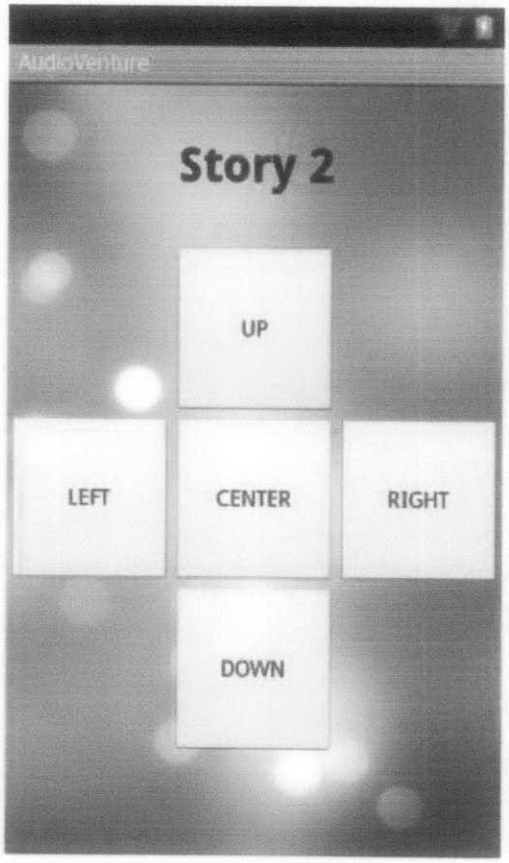


Figure 16: Story 2

Flow Chart

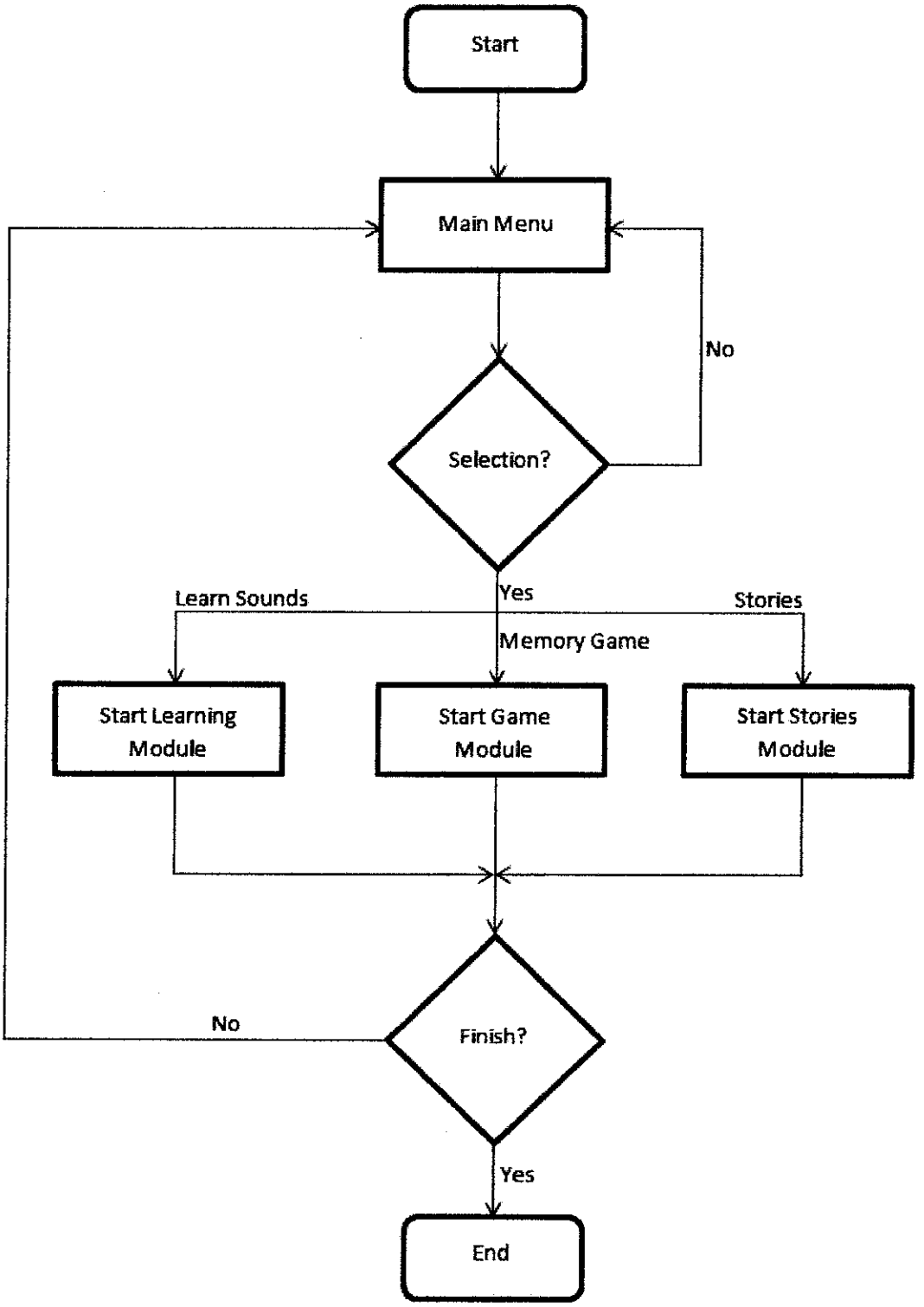


Figure 17: System's flow chart

Problems

During the development process, there is only one problem which is how to make the device's screen to become tactile so that users who have visual disability able to use their touch sense to recognize which buttons that they need to choose and press because capacitive touchscreen is very sensitive to touches. I have overcome this problem so that users will fully experience the game.

3.4 Phase 4: Evaluation, Testing, and Further Enhancements

After the final product is finished, a test will be conducted to specified users to obtain their feedbacks regarding their interactions with the game. After getting their feedbacks, we may try to improve it based on what they have specified. What I have planned for future enhancements are:-

- Create a suitable background images
- Replace buttons with suitable size
- Include sound effects
- Improve tactile features of the system

CHAPTER 4
RESULTS AND DISCUSSIONS

DATA GATHERING AND ANALYSIS

Prototype Testing

A usability test of the application has been conducted. The test users are consisted of my colleagues because we cannot try to reach the target users (blind kids) because of the time constraint. The test users were blindfolded been given the android smartphone and launched the application. The test users will use the application's features and each of them gave their comments on how to improve it.

"The learning will become more fun to the kids because of the variety of sounds that they can learn"

Ahmad Farid Sainuri, BIS Student

"The game is interesting. It would be great if more you put more sounds in it"

Syazwan Abu Bakar, ICT Student

"The tactile hardware is very useful when using the smartphone touchscreen because if people who cannot see can sense using their touch to navigate the application"

Izzat Aziz, ICT Student

EXPERIMENTATION AND MODELLING

After developing the system, tests were carried out to check whether the system works on different hardwares and how it affects the system performance. There will be also survey to check on the system interface to see if there the effectiveness of the system and improvement need to be carried on.

The first test is to determine whether the system works well in different type of phone that is using Android operating system. This test is basically focusing on the performances of the system.

Phone Model	Android Platform	Remarks
HTC Desire HD	Android 2.3.3	Installation successful and application is similar to emulator.
Samsung Galaxy S	Android 2.2.3	Installation successful and application is similar to emulator.

Table 1: Performance Testing for Different Android Platforms

The second test is obtaining the user satisfaction that includes system interfaces, systems problems and defects.

Elements	Rating	Remarks
Application installation	5	The installation to the devices is easy.
Interfaces	4	The interfaces can be improved in future works.
Functionality	4	Other new functionalities could be added to the system in the future.
Time to run	5	The application does not take long time to run.
Choices of color	-	No need to because it is for blind users.
Icons used	-	No need to because it is for blind users.

Table 2: Usability Testing

Marks:

1 = Very dissatisfied

2 = Somewhat dissatisfied

3 = Neither satisfied nor dissatisfied

4 = Somewhat satisfied

5 = Very satisfied

Prototype - Interface

After getting the feedback from the test users, some modifications on user interfaces have been made to improve the user's experience. Two standardized navigation buttons will be put into each layout except in Game module; INFO and BACK. The INFO button will play the audio and explain to the users what each buttons do and where the users currently are and BACK button will link the users to the previous menu. Below are the final design layouts of the interface.

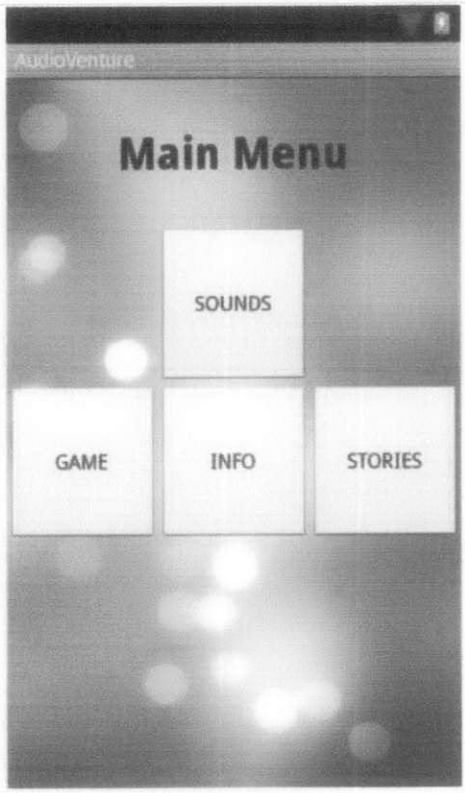


Figure 18: Main menu. To navigate, users can touch the center button. An audio will be played explaining how to use the application.

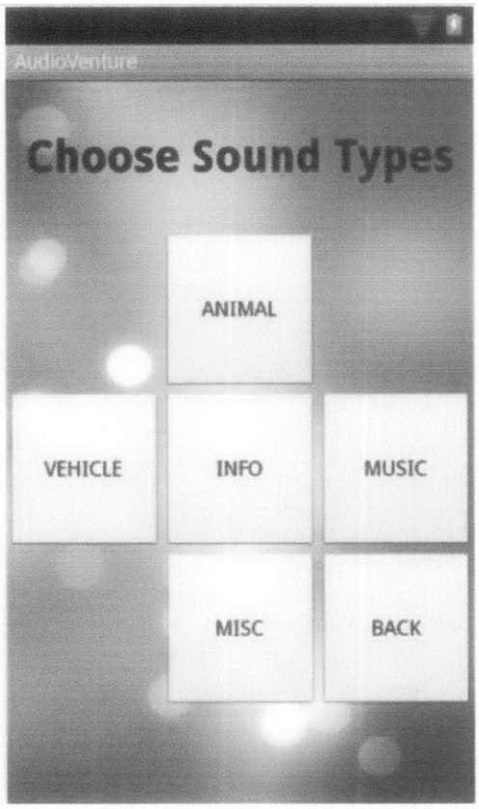


Figure 19: Learn Sound module. Each button has been assigned to certain type of sound.

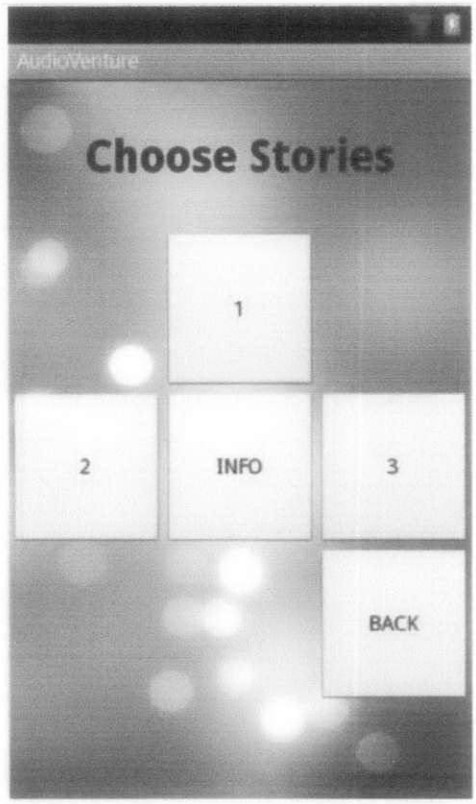


Figure 20: Stories module. There are 3 stories available to users. Users can start by touch any of the 3 buttons assigned to each stories.

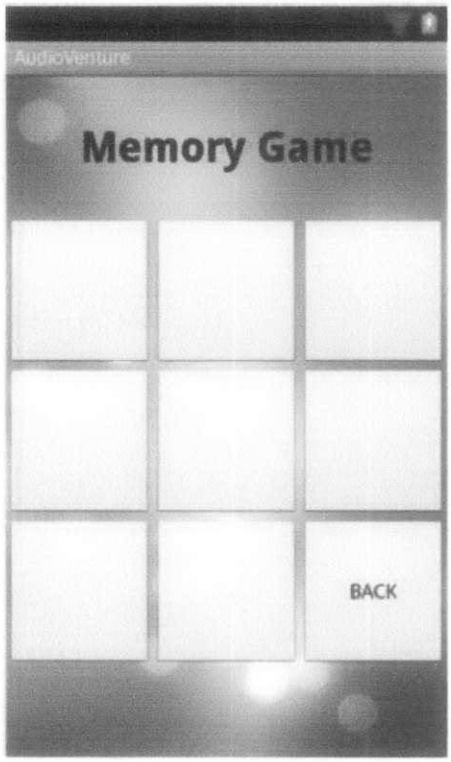


Figure 21: Game module. This module contains the sound match game. The game is similar to Sound Match on iOS mentioned in the previous section.

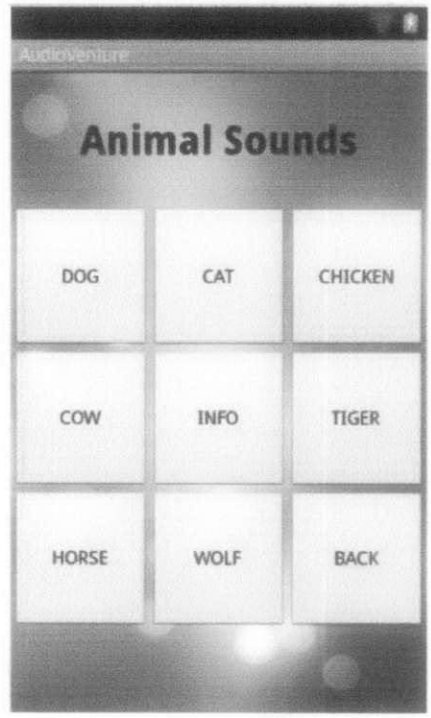


Figure 22: Learn Sound sub module: Animal. Press each button and it will play the sounds.

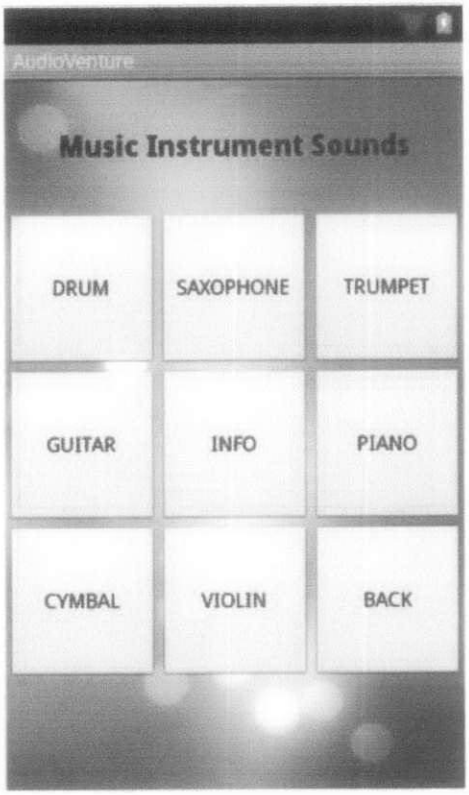


Figure 23: Learn Sound sub module: Musical Instruments. Press each button and it will play the sounds.

Figure 24: Learn Sound sub module: Other sounds. Press each button and it will play the sounds.

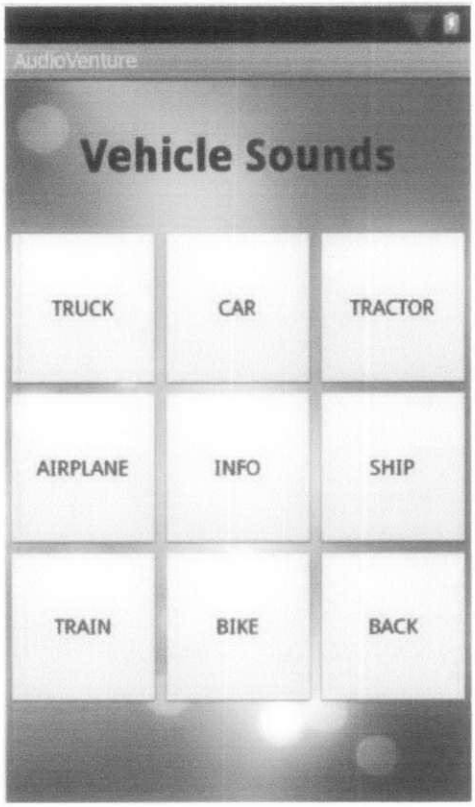
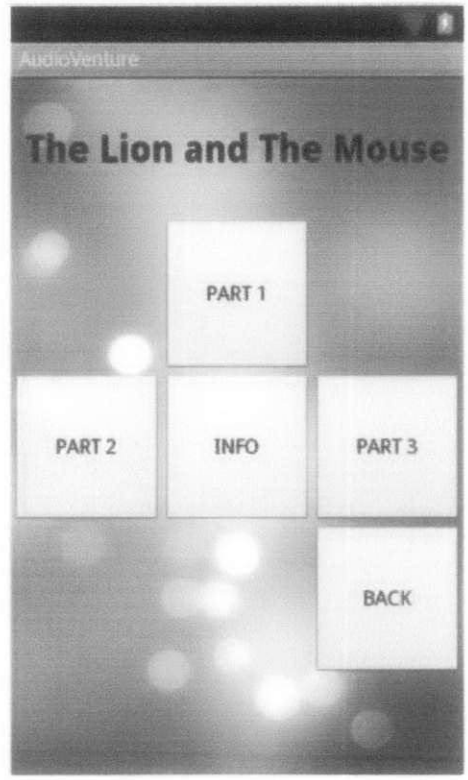


Figure 25: Learn Sound sub module: Vehicles. Press each button and it will play the sounds.

Figure 26: Story sub module: The Lion and the Mouse. Press each button and it will play each's story part.



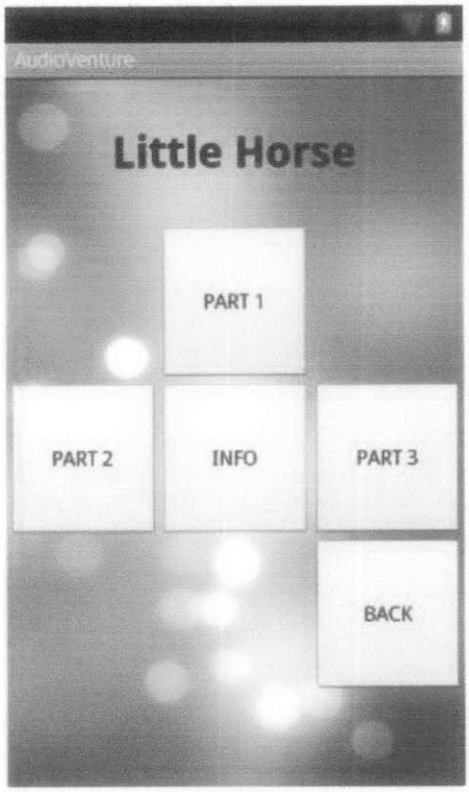


Figure 27: Story sub module: Little Horse. Press each button and it will play each's story part.

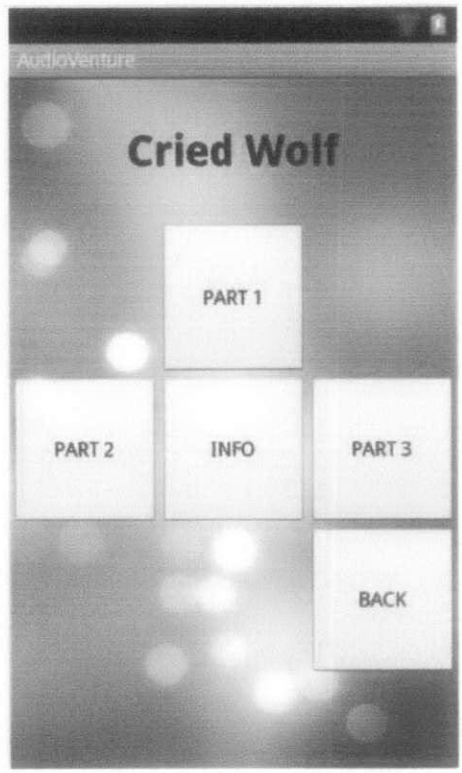


Figure 28: Story sub module: Cried Wolf. Press each button and it will play each's story part.

Tactile Device

To improve the tactile features of the application, a special hardware must be designed and develop so that the users can use their touch sense to touch the buttons in the application. A case made of mounting board with 9 holes on it has been made. Below is the design of the case. This case will put on the touchscreen after the application is launched.

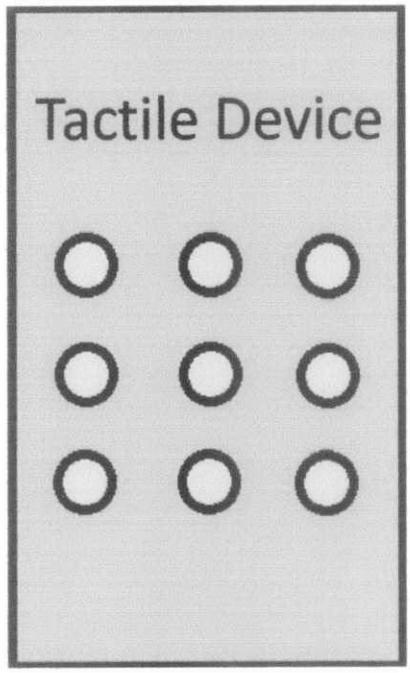


Figure 29: The case design.

System Architecture

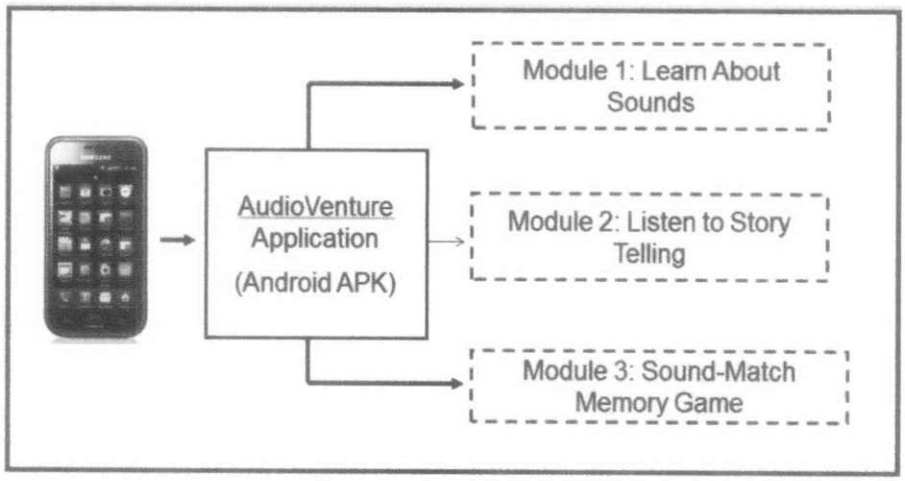


Figure 30: System Architecture.

Recommendations

The inspiration of making this application is to encourage the amateur and professional developers to develop software for all people including those who have some disability. This application is very basic but developers can get the idea from it to make it better in the future.

By having this application, it will create more excitements for the blind kids in learning and playing. They will be not left behind with the mobile OS platforms keep expanding and more developers are now creating a lot of applications. So there is no reason why we cannot create applications for them.

Several things can be done to improve such as:-

- Add more variety of games ranging from adventure, puzzle and so on instead of only memory game
- More types of learning modules for kids
- Add more sound effects
- Improve the hardware so it becomes more tactile to users
- Study more on human blindness and how they interact with the surroundings
- Focus more on what are they really need in this application

Suggested Further Works

No.	Title	Duration	Week
1	PROTOTYPE TESTING: - Identification of potential user - Check whether it meets the requirements - Prototype testing by the user (internal and external)	2 weeks	8th and 9th
2	ANALYSING: - Compile all data from testing - Rectification / modification	2 weeks	9th and 10th
3	DESIGN: - Modify (if possible)	2 weeks	11th and 12th
4	Present the application to the users (if the application can complete earlier than the estimated time)	1 week	12th
5	DELIVER	-	13th

Table 3: Further Works.

*All the activities included in the above table are subject to changes according to time constraints and availability.

References

[1] *Audio game - Wikipedia, the free encyclopedia*, 2011. Retrieved on March, 2011 <http://en.wikipedia.org/wiki/Audio_game>

[2] McGookin D., Brewster S., Jiang W. W., 2008, *Investigating Touchscreen Accessibility for People with Visual Impairments,* Department of Computing Science, University of Glasgow.

[3] U.S. Department of Justice. Ada home page - ada. Gov - information and technical assistance on the Americans with disabilities act. 2008 [cited 2008 18th April]; Available from: http://www.ada.gov/.

[4] Mendel P., Frens J., 2008, *The Audio Adventurer: Design of a Portable AudioAdventure Game*, Designing Quality in Interaction group, Department of Industrial Design, Eindhoven University of Technology.

[5] Grimshaw, M., Schott, G., 2007, *Situating Gaming as a Sonic Experience: The Acoustic Ecology of First-Person Shooters.* In: Situated Play, Proceedings of DIGRA, Digital Games Research Association, University of Tokyo, Tokyo, Japan

[6] Huiberts, S., van Tol, R. 2008, *IEZA: A framework for Game Audio*, http:// www.gamasutra.com/view/feature/3509/ieza_a_framework_for_game_audio.php

[7] Stockburger, A., 2003, *The game environment from an auditive perspective.* In: Level Up, Proceedings of DIGRA, Digital Games Research Association, Utrecht University, Utrecht, The Netherlands

[8] Jacobson, D., 2001, *Presence revisited: imagination, competence, and activity in text-based virtual worlds.* CyberPsychology & Behavior 4, 653–673

[9] Friberg, J., Gärdenfors, D., 2004, *Audio games: New perspectives on game audio.* In: Advances in Computer Entertainment Technology 2004, Singapore

[10] van Tol, R., Huiberts, S.: Audiogames Website, http://www.audiogames.net

[11] Rober, N., Masuch, M., 2005, *Leaving the Screen: New Perspectives in Audio-Only Gaming.* In: 11th International Conference on Auditory Display (ICAD), Limerick, Ireland

[12] GMA., 2004, Gma games. http://www.gmagames.com/sod.html

[13] Pin., 2004, Pin interactive. http://www.terraformers.nu/eng/

[14] Friberg J., Gardenfors D., 2004, *Audio Games: New perspectives on game audio,* Stockholm International Toy Research Centre, KTH, Royal Institute of Technology

[15] Sepchat A., Descarpentries S., Monmarch´e N., and Slimane M., 2008, *MP3 Players and Audio Games: An Alternative to Portable Video Games Console for Visually Impaired Players.* Laboratoire d'informatique de l'Universit´e Francois Rabelais de Tours, France

[16] Atkinson, M.T., Gucukoglu, S., Machin, C.H.C., Lawrence, A.E.: *Making the mainstream accessible: What's in a game?* In: Miesenberger, K., Klaus, J., Zagler, W., Karshmer, A.I. (eds.) ICCHP 2006. LNCS, vol. 4061, pp. 380–387. Springer, Heidelberg (2006)

[17] Jenova, C.: *Flow in games.* PhD thesis, MFA Thesis, University of Southern California (2001)

[18] Archambault, D., Ossmann, R., Gaudy, T., Miesenberger, K.: *Computer games and visually impaired people.* UPGRADE 8(2), 43–53 (2007)

[19] Spronck, P.: *Adaptive Games AI.* PhD thesis, Maastricht University (2005)

[20] Sepchat, A., Clair, R., Monmarch´e, N., Slimane, M.: *Artificial ants and dynamical adaptation of accessible game level.* In: Miesenberger, K., Klaus, J., Zagler, W., Karshmer, A. (eds.) ICCHP 2008. LNCS, vol. 5105, pp. 593–600. Springer, Heidelberg (2008)

Appendices

ID	Task Name	Deliverables	Duration	April	May	June	July	August	September	October	November	December
	Adventure Audio Games for Visually Impaired Kids/Adolescents											
	Phase 1 : Research and Literature Review											
1	Do research based on the project topic	Documentation										
2	Gain input from supervisor regarding project	Discussion										
	Phase 2 : Planning and Design											
3	Design the input interface of touchscreen	Documentation & Discussion										
4	Interface for the input button											
5	Design and develop game											
6	Record audio story clips											
7	Insert Musics											
8	Record sound effects											
	Phase 3 : System Development											
9	Identify Programming and coding methods											
10	Conduct test on touch screen device											
	Phase 4 : Evaluation, Testing, and Further Enhancements											
11	Test the system											
12	Get user's feedback											
13	Enhance and improve											
14	**Submission of the working prototype**	Presentation										

Appendices

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11	Test the system											
12	Get user's feedback											
13	Enhance and Improve											
14	**Submission of the working prototype**	Presentation										