A Simulated Environment for Wayfinding to Address Visual Attention Issues in Dyslexic Children

By

Muhammad Imran Bin Abukri

Dissertation submitted in partial fulfillment of
the requirements for the
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CERTIFICATION OF APPROVAL

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Approved by,

_____

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UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
September 2012

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 reference and acknowledgements, and that the original work contained herein has not been undertaken or done by unspecified sources or persons.

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(MUHAMMAD IMRAN BIN ABUKRI)

ABSTRACT

Dyslexia is known as developmental disorder which might affect a person's ability to comprehend either oral or written language which also known as language-related learning disorder. This disorder might leads dyslexics to encounter a major problem with language skills such as words articulation, spelling and writing. As reading and writing are two main components inside the primary education curricular, again it is important for the dyslexic children to empower these skills. Furthermore, according to statistic in Malaysia, the percentage of dyslexic children that cannot read well is 80%.

Hence, this project is developed in order to address the visual attention behavior among dyslexic children at the early stage before they are going for reading and writing lessons during primary school. The ability of the dyslexia children to interpret the visual information in the wayfinding environment is very important as it could be a benchmark of performance later on. Moreover, the latest research has proven that the dyslexic children have no difficulty in reading skill if and only if they were able to identify the visual information such as colours, shapes, images, and signs at early stage. The best time suggested period would be during preschool term.

Thus, the aim of this project is to help these dyslexic children to categorize them for extra attention from their educators based on ability, in order for helping them to strive for excellent in school and life as well as unleash the utmost talent beneath themselves.

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Last but not least; the writer would also like to express his acknowledgement, especially to the final year students under Dr. Suziah Binti Sulaiman supervision for their ideas, feedbacks and kind cooperation and participants whose involved in the testing phase which have helped the author a lot in developing, improving and implementation of the system prototype.

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ABBREVIATIONS AND NOMENCLATURES

RAD	Rapid Application Development
JAAPOS	Journal of the American Academic of Pediatric Ophthalmology
DAM	Dyslexia Association of Malaysia

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND OF STUDY

Nowadays, people are really aware with the needs of dyslexic people especially those who are affected at early age. The medical site proved that dyslexia is a learning disorder that is language based and they will tend to have difficulty in reading [2]. In other word, dyslexia is known as developmental disorder which might affect a person's ability to comprehend either oral or written language also known as language-related learning disorder [3].

In addition, they might encounter a major problem with language skills such as pronouncing words (words articulation), spelling and writing. And the most crucial thing is this learning disorder might lead to complexity to speak in the future. In Malaysia, as said by the Dyslexia Association of Malaysia (DAM) president Sariah Amirin, 80% of children with dyslexia cannot read well[4].

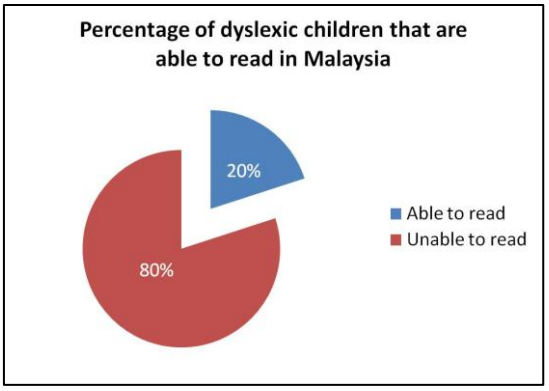


Figure 1.1.1: Percentage of dyslexic children that are able to read in Malaysia

Medical research has been done and indicated that dyslexia is not a vital disease but only a malfunction in the brain which cause learning disorders. In fact, dyslexia is not the only learning disorders exist in this world; there are dyscalculia and dysgraphia [3].

Furthermore, the dyslexia people have to bear with this disorder for the rest of their life but at different stage it is possible to change [2]. The changes happen depends on how the approach taken towards these special people.

Despite all the worst part of dyslexia, there is several hidden talent that rarely public notice in dyslexic people. Among of them, there are few prominent figures whose stand as world-known personalities such as Leonardo da Vinci, Walt Disney, Keanu Reeves, Muhammad Ali Albert Einstein, Tom Cruise and more to be listed. There are now at least two Nobel laureates whose are Niels Bohr and Baruch Benacerref as well as numerous other distinguishes physicians and scientist who are dyslexic [21]. These are people that have amazing skills in art, design, drama, music and sport which require no strong language skills [4]. Sometimes, public might assume that these special people are gifted with dyslexia, indeed they are. James Hinshelwood, a Scottish ophthalmologist who elaborated the disorder in children noted that these children were often exceptionally smart except for their inability to read and proposed special education programs as treatment [21]. So, the dyslexic children should have no fear to face the world as these dyslexic leaders in business, science, architecture, acting and arts have proved that there is nothing a dyslexic person cannot do even with learning disability [5]

Referring to the percentage of children with dyslexia in Dyslexia Association of Malaysia (DAM) webpage, the studies show that approximately 10% of a school-age children experience dyslexic-type difficulties and about 4% have problems that are severe enough to be a real handicap to their learning in a traditional classroom [6].

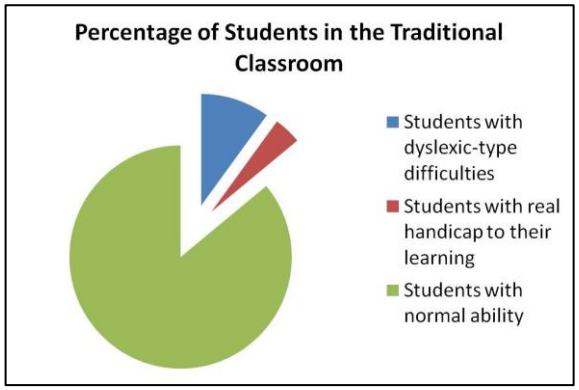


Figure 1.1.2: Percentage of students in the traditional classroom with ability

The difference way of learning in the traditional classroom might give pressure to these special kids as they will be unable to fit in, and sometimes these dyslexic children are wrongly categorized as lazy, stupid and slow students [5]. Based on an article in The Star Online webpage, according to Education Ministry, there are about 314,000 school-going children in Malaysia having dyslexia and this figure shows that more children are dyslexic rather than asthmatic [4]. Additionally, Sariah Amirin has added that the Dyslexia Association of Malaysia (DAM) is now in process of educating kindergarten teachers to identify kids who may have dyslexia, for early intervention. This step needs to be done in order to get the kids ready for primary school because in Year One, there are no more reading lessons she claimed [4].

Thus, here comes "A Simulated Environment for Wayfinding to Address the Visual-Attention Issue in Dyslexic Children" which is a simulation project that is designed specifically for dyslexic children in the preschool level. The main purpose of this project is to address these special children's dyslexic symptom at the early stage before they are going for reading and writing later on during their primary school. The ability of the dyslexia children to interpret the visual information provided along the wayfinding environment is very important as it could be as reading and writing indicator in the future. Moreover, the latest research has proven that the dyslexic children have no difficulty in reading skill if and only if they were able to identify the visual information such as colours, shape and etc. at early stage (mostly recommended during preschool term). Even though, the result of the research is bounded by the type of dyslexia suffered by the children, of course here the subject matter would be dedicated to developmental dyslexia children. These types of dyslexia will be further discussed in the next chapter.

In a conclusion, as dyslexia is not a disease which there is exist cure, only proper approach and remedial education which involves a multisensory programme utilizing hearing, vision and touch will be the key success of these special people [4]. These dyslexic children really require special attention in order for helping them to achieve in school and life and unleash the utmost talent beneath themselves. According to Shaywitz, there is no doubt that, could be many more if otherwise bright and able

dyslexic men and women were provided with accommodations necessary to access their strengths on tests that serve as gate-keepers [21].

1.2 PROBLEM STATEMENT

In supporting the best education development for the dyslexic children, hereby there is need for any organization or individual out there to help out these children and give the best support in their learning.

Thus, the best way to help them is by determining the symptom in the children as early as possible which the best term is during preschool. Besides, early detection and treatment is the key to help these dyslexic children to excel in their life [4.]This could help the teacher to address them a lot during the preschool term before they are pursuing their studies in primary school. The problem occurrence is related to the children's visual attention towards interpreting the visual information at the young age. As reading and writing are main components inside the education curricular in the primary school, again it is important for the children to empower their skills in reading and writing specifically. If not they will left behind and need a special assist during the class conduct.

Hence, on regards to this project one hypothesis has been identified which is: If the dyslexic children have problems in interpreting visual information before learning to read, it is hypothesized that they will have difficulties in reading during primary school.

Therefore, without an improper approach to help the children, years from now, they might have difficulties in reading and writing, and worst case scenario, they might as well have problem with speaking.

1.3 OBJECTIVES

Generally, the project will focus on four areas which are visual attention, simulated environment, wayfinding approach and last but not least, the dyslexic children behaviour. As the project is proposed towards these special children, they will become the main subject matter during testing and also along the project development. These are the objectives for this project:

- To investigate the visual attention among dyslexic children
- To develop a suitable for wayfinding environment in order to address the visual attention issues in the dyslexic children. Intended for practitioners and teachers.
- To test the environment towards the targeted audiences.

According to an article written by Bernama (2012), Women, Family and Community Development Minister of Malaysia , Datuk Seri Shahrizat Abdul Jalil claimed that the ministry was working with the Dyslexia Association of Malaysia (DAM) to prepare a module on the method of early detection among children. Besides, she also added that Welfare Department of the ministry had identified that the dyslexic children is the group that needed immediate attention at the early stage [7]. Not just that, she really looking forward into this module as dyslexia is one of the areas of disabilities that parent are always be seen as the major short-coming in assisting children in the category and early detection could help realize the dyslexic children potential abilities [7].

The statement above supports the aim of the project which is to investigate the visual attention among dyslexic children as the early detection in order to address the reading and writing ability in the future. The statement made by Women, Family and Community Development Minister of Malaysia, Datuk Seri Shahrizat Abdul Jalil suggested that to prepare a module on the method of early detection among dyslexic children. This shows how serious the early detection is in order to make sure the dyslexic children have no difficulties in learning during their schooling period.

The project is relevant to Information and Communication Technology academic syllabus of Universiti Teknologi PETRONAS (UTP). It includes simulation and

modeling development which fall under category of subject major: Software Engineering. Furthermore, the project also touches on humanities subject especially communications. At the beginning of the first semester, the project will focus on methodology implementation and design conceptualization. The second semester will focus on detail design and development of simulation environment. Based on the given timeframe, the objective of this project is considered achievable.

The second semester will focus on development, testing and evaluation. Works executed during the second semester will be based on the design conceptualization completed during the first semester. Development, testing and evaluation of the application are achievable by referring to the given the timeframe of the second semester.

CHAPTER 2
LITERATURE REVIEW.

2.1 WHAT IS VISUAL ATTENTION ISSUES/BEHAVIOURS?

The real meaning of visual attention as derived from Cognitiveatlas Website is:

"two-stage process in which attention is distributed uniformly over the external visual scene and processing of information is performed in parallel, attention is then concentrated to a specific area of the visual scene and processing is performed in a serial fashion" BGregory (2011)

Based on paperwork done by two brilliant women, Blankfied S. and Williams S. from Edge Hill College of Higher Education, UK which working on software named "Inspiration" that is able to help the Dyslexic/Specific Learning Difficulties (SpLD) students to develop the academic writing skills through visual thinking [14]. This approach with aids of colour and shape are invaluable cognitive organizing tools that assist the students to customize their planning text. This software requirement is relevant to each individual student's course of study and for that reason, regardless the medium is software or hardware, from the paperwork itself, it is shown that the visual thinking is really important for the dyslexic student in order to develop a good academic essay [14].

Moreover , in one of article written by Rasicot J. (11 April 2012), new research has been published in the journal of Current Biology , there was a visual attention study conducted by an assistant professor in Italy's University of Padua, Facoetti A. towards dyslexic children in pre-school. The experiment resulted in finding of 60 percent of the tested kids who had trouble in interpreting visual information before learn to read also had trouble in reading later on during primary school [13]. The result of the experiment really against the widely acceptance fact by the public which is the reading disorders

arise from a spoken language, while the result actually demonstrate the critical role played by visual attention in learning to read as written in an article by Conley M. (5 April 2012)[13]. Therefore, the study claimed that the children at risk for dyslexia could be treated for visual attention problems before learning to read. This finding met the objective that has been set up by the researchers at upfront which is: signs of the developmental reading disorder may appear before the children could start to read, making it possible to diagnose and treat dyslexia much earlier before it becomes worse [15].

Article by Vidyasagar, T. R. and Pammer, K. (2010) that published in the journal trends in Cognitive Sciences has shown a good write up regarding dyslexia. The synopsis said:

"It is widely assumed that phonological deficits, that is, deficits in how words are sounded out, cause the reading difficulties in dyslexia. However, there is emerging evidence that phonological problems and the reading impairment both arise from *poor visual* (i.e. orthographic) coding . . . . controlled by the dorsal visual stream help in serial scanning of letters and any deficits in this process will cause a cascade of effects, including impairments in visual processing of graphemes . . . . This view of dyslexia localizes the core deficit within the visual system and paves the way for new strategies for early diagnosis and treatment" [19]

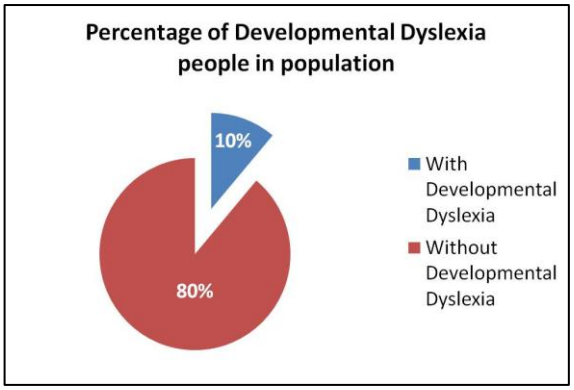


Figure 2.1.1: Percentage of people with Developmental Dyslexia in population

Shaywitzes claimed that people with dyslexia are always consult their physicians about unconventional remediation of reading difficulties [21], which has nothing to do with

these treatments: optometric visual training, medication for vestibular dysfunction, chiropcratic manipulation and dietary supplementation [20]. For that reason, Shaywitzes argument has been modeled as following:

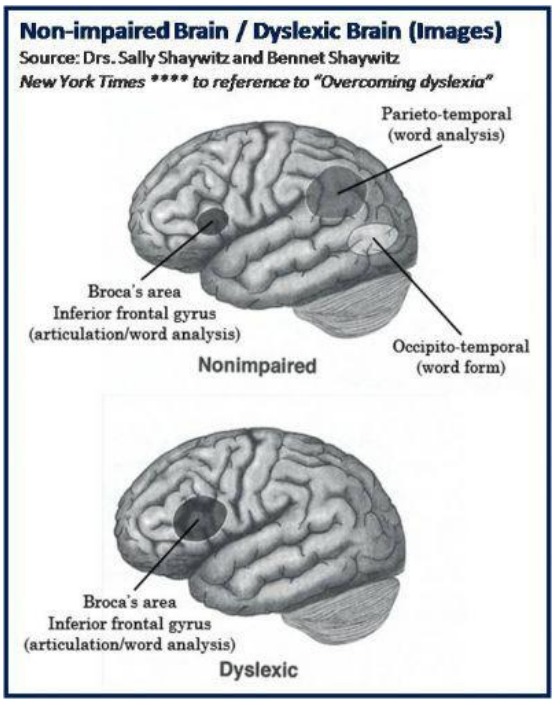


Figure 2.1.2: Comparison of brain structures between Dyslexic brain and Non-impaired brain

The Shaywitzes are trying to convey that the occipito-temporal system appears to predominate when a reader has become skilled, and binds together the orthographic, phonological and semantic features of the word [20]. In the Journal of the American Academic of Pediatric Ophthalmology (JAAPOS) article said the anterior sites, which are critical in articulation may help the dyslexic children develop and awareness of the sound structure of the word by subvocalizing, thus allowing the children to read, albeit more slowly and less efficiently than if the fast occipito-temporal word identification system were functioning [21].

Subvocalizing here means by forming the word with the lips, tongue and vocal apparatus [21]. Therefore, based on the comparative studies between the brain structures, the vision therapy is only unconventional if one does not grasp the significance of being able to boost the performance of the visual brain through vision therapy [20]. The studies suggested that educators and physicians have to stop paying lip service to helping children with visual dyslexia and *visual attention problems* through the phonology bypass [20]. On the other hand, they need to help the dyslexics by encouraging assessments and interventions that boost the visual parts of the brain [20].

Back to this project relevancy, as the targeted audiences in this simulation are dyslexic children in preschool so, this will be an assessment that might enhance the quality of learning of these people and help to improve their visual parts in the brain.

2.2 SIMULATED ENVIRONMENT: IN WHAT SENSE IT DOES HELP TOWARDS THIS PEOPLE?

This project is concern on involvement of dyslexic children that age may range from 4 to 6 years old. Due to safety reason to conduct this activity in the real environment which could danger the children, simulation of the real environment is the best way towards these special kids. By having this, the children have no need to expose themselves to the real outside and can be supervised by their teachers during the activity conduct.

According to Shannon (1975), simulation is the process of designing a model of real system and conducting experiments with this model for the purpose either of understanding the behavior of the system or of evaluating various strategies (within the limits imposed by a criterion or set of criteria) for the operation of the system [23]. Simulated environment must earn its way by providing a value-added contribution to solving real world problem [22]. Besides, simulation technology is making a difference in many fields such as health care, emergency response, airport security, and manufacturing and now towards education [22]. Here, in the development of the simulated environment for dyslexic children could be one of the efforts to bring up the

value of simulation - not so much as a technology but as means to solve problems. In addition, simulation could be a tool that is available to help with analysis and decision making [22].

As the project itself, the simulated environment will be the medium in order for the educators/ teachers to analyze any of their dyslexic students that have difficulties in translating the visual information. The result from the analysis could be a good reference in the future in order to keep track the performance of the students in their primary term.

2.3 DOES WAYFINDING APPROACH IS THE BEST TO HANDLE DYSLEXIC CHILDREN?

The wayfinding is always being discussed in gaming topic, mostly related closely to the strategy and mapping skill focus. Referring to the exact meaning of wayfinding itself from a journal prepared by Blades M. entitled "Wayfinding Theory and Research: The New Approach" [1]:

"Wayfinding is the ability to learn a route through environment" Piaget, Inhelder and Szeminska, (1960); Siegel and White, (1975) [1]

In this journal, the author simplified the meaning of wayfinding by defining it as the ability to learn and remember a route through the environment. In addition, the route knowledge and wayfinding in familiar environment will depend on a person's overall understanding (in this project, the "person" is referring to the dyslexic children) of the area, and the person's plans and intentions when deciding how to travel between several different places [1].

Based on a transcript reported by Roy E. (2005) in The World Today program, there was research regarding to dyslexic people, published in New Scientist Magazine whereby average 30% of dyslexics react longer to traffic signals and signs [11]. This research conducted at the Norwegian University of Science and Technology, Trondheim Norway.

According to Sigmundsson, H. (2005) the reason for doing the experiment is to explore the prediction that dyslexics would be likely to have particular problems compared to control group, on response time task when 'driving' a car simulator. As this is in relation to this project, thus it might help the author to understand the reason of delay in time happened in dyslexics during the activity conduct. Plus, the reason for doing so stems from the fact that there is considerable body of research on visual processing difficulties manifested by dyslexics [16].

In the experiments, there were 17 volunteers and six of them were dyslexic. The reaction time of the dyslexic people recorded along the simulated country road at 50 to 80 kilometers an hour about 0.13 seconds longer during the rural drive and 0.19 seconds slower in the city, where of course the simulated environment was more complex. This let the research concluded that dyslexia may affect the way the brain processes information [11]. By referring to the same experiment, reported by an article from Future Pundit webpage, the level of delay is worse than what happens as result of moderate drinking [12].

Therefore, the wayfinding approach is chose simply because it could give more interactive and fun learning environment towards the dyslexic children. Besides, this also could make the children to improve their brain utilization in navigating and remembering the route.

2.4 WHAT EXACTLY NEED TO BE DONE FOR EARLY DETECTION IN DYSLEXIC CHILDREN?

"Dyslexia is a reading difficulty in a child or adult who otherwise has good intelligence, strong motivation and adequate schooling……Dyslexia reflects a problem within the language system in the brain" (Shaywitz, 2003) [6]

Regarding to an article prepared by medical authors namely Dr. Perlstein. D : currently working as Medical Director of St. Barnabas Hospital, and Dr. Stoppler. C. M : a

specialist consultant in the breast oncology research program at the University of California, San Francisco School of Medicine, have classified that the causes of dyslexia may vary and there are also several types of dyslexia that public have to aware of.

First and foremost is called *"Trauma dyslexia"* which is claimed as rare case nowadays. This kind of dyslexia is due to affect of brain trauma or injury at area that controls reading and writing [9]. Secondly, the type of *"Primary dyslexia"* is concerns on dysfunction of the left side brain (cerebral cortex) and this will permanently affects the children along their age [9]. Interestingly, this "Primary dyslexia" will be inherited through their genes (family lines) and the boys are major affected group compared to girl. The third type of dyslexia is *"Developmental/Secondary dyslexia"* which referred to be caused by hormonal development during the early stages of fetal development [9]. The article also included that this type of dyslexia will reduce as the child grows and also more common in boys rather than girls.

There are several tests that suggested to be done by health care provider in order to determine the disorder in people. Few to be mentioned, they will perform a complete medical exam, including a neurological exam towards the children. Next, they will ask questions about the children's developmental, social and school performance, and ask if anyone else in the family has had dyslexia [8]. Besides of these steps, psychoeducational testing and psychological assessment will be conducted towards the children [8]. Once it is confirmed that the children have dyslexia, several approaches could be taken which are extra learning assistance (remedial education), private or individual tutoring and special day classes. Although these approaches are available but still, positive reinforcement is important as many children with learning disabilities have poor self-esteem [8]. Here, psychological counseling comes to play role in order to make sure these special children do not feel isolated.

As dyslexic children, they are tending to think as "big picture" rather than words. This is because it is hard for them to read by breaking words down into component sounds. According to Davis R. (1980), the founder of The Davis Dyslexia Correction program

which is the most widely used dyslexia correction program in the world; believes that dyslexia is a result of an inherent mental gift or talent [10]. These people are creative, imaginative and solve the problem by looking at the whole picture, rather than working step-by-step [10]. This explanation shows the beauty of dyslexia, which no one else has except the dyslexia people. The good thing about the program is, it is really working fine based on the statistic provided in the Rock Point Academy webpage [10]. Referring to the statistic prepared by Marshal A., Smith L., Smith Jr. & B. (2009), the reading progress is measured within one week and after one week.

The reading level at the beginning and end of the basic five –day program was measured using the Ekwall- Shanker Reading Inventory (ESRI) during oral and silent passage reading [10]. Here, Ekwall- Shanker Reading Inventory (ESRI) is a set of test instruments designed for the assessment or diagnosis of individual students' reading abilities.

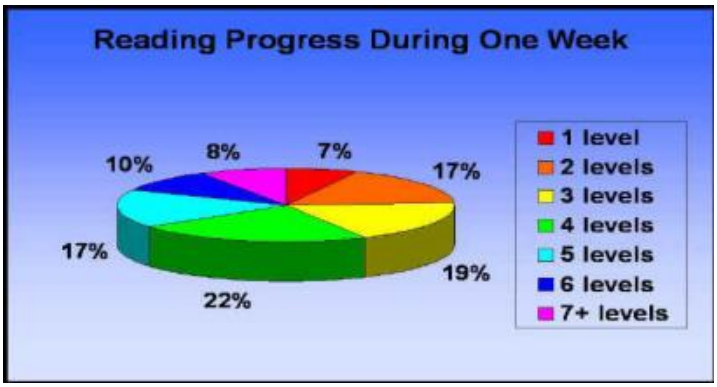


Figure 2.4.1: Reading progress during one week based on The Davis Dyslexia Correction program

The Smith's data shows the level of improvement is correlated to the age of the student, a clear pattern of steadily rising results emerges. Children age 8 to 12 had average gains of slightly above 3 grade levels. Teenagers, age 13 to 18, averaged almost 5 grade levels of improvement during the one week program. Meanwhile, adults ranging in age from 19 through 57, experienced an average improvement in ability of 6 grade levels (Marshal A., Smith L., Smith Jr. & B. 2009) [10]

Figure 2.4.2: Reading improvement after one week based on The Davis Dyslexia Correction program

So, by looking to the third type of dyslexia, this project is aiming to address these children at early stage before it becomes severe in order to help them interpret the information by major aid of visual, audio as well as sensory. Thus, the worksheet provided later during the testing phase can be used to identify the effectiveness of the children to interpret the visual information in the simulated environment. From the Shaywitz point of view, it is the obligation of each physician to ensure that diagnosis and management of children and adults with dyslexia are based on science [21].

CHAPTER 3
METHODOLOGY

3.1 RESEARCH METHODOLOGY

In completing this project, the main methodology to be used is the Rapid Application Development (RAD) method. This methodology is designed for faster development and higher-quality results than those achieved with the traditional lifecycle. It is designed to take the maximum advantage of powerful development that has evolved recently (Martin J., *n.a*)

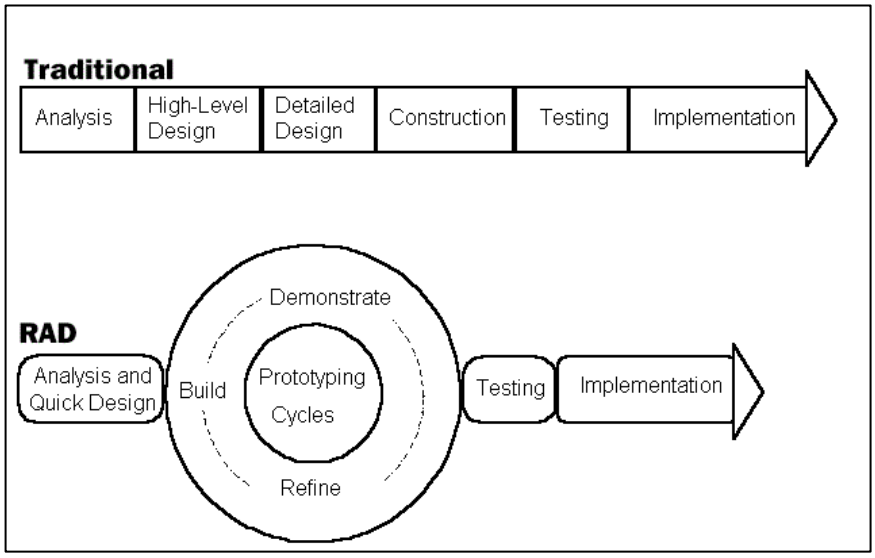


Figure 3.1.1: Rapid Application Development Cycle (RAD)

Rapid Application Development (RAD) method takes an approach whereby minimal planning is required and focuses more towards rapid prototyping. The reason on why this methodology is chosen is due to the constraint of the time provided to finish this project, which in total is less than 10 months. In addition, there might be possibilities of functionality and performance compromising along the development process. This allows flexibility towards any changes to be made during the development phase if there is needed to be reviewed and rechecked at any phase. Thus, in short, the Rapid

Application Development (RAD) method enables quality project to be developed faster and saving valuable resources rather than traditional approach.

3.2 PROJECT ACTIVITIES

This methodology provides four main phases in order to ensure the project progress meets the milestones that have been set in front. The phases with the project activities are subcomponents inside Key Milestones of this project. The tasks involved are shown in the table below:

Key Milestones/Project Activities	
Analysis and Quick Design	• Storyboard • Design the User-Interface • Literature review on the subject matters (dyslexia, visual attention, simulated environment, wayfinding approach) • Prepare the Gantt Chart for the task accomplishment and progress. • Prepare SUS Questionnaire for Usability testing, Visual Attention Scale and Visual Measurement Scale for Visual Attention Testing as well as several interviews for data gathering.
Prototyping Cycles	
-Build	• Develop the user interface in the prototype • Create scenes in the Adobe Professional Flash CS5.5 according to the storyboard prepared. • Write code in ActionScript 2 to link the button from one scene to another
-Demonstrate	• Run simple test to show the workability of the prototype • Ensure all the components in the prototype interrelated

	and working fine (audio and visual)
-Refine	• Redo the prototype's coding for button • Reconstruct the scenes of the prototype according to the storyboard prepared.
Testing	• Evaluate the program functionality and usability • Check the specification of the prototype is aligned with the requirement
Implementation	• The prototype is ready to be used when its passed all the testing phase • Further recommendations on the prototype will be further discussed in next section

Table 3.2.1: Key Milestones and Project Activities

3.3 TASK SCHEDULE

All the main tasks in developing the project have been scheduled inside Gantt Chart for better view. This timeline-based graphical approach is useful to visualize the current progress of the project and any chances of delay, defect or prototype's failure. For that reason, below is the task schedule with respect to the time frame given by the coordinator of Final Year Project of Computer Information Sciences (CIS).

First Term : Final Year Project I															
No	**Tasks**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Analysis and Quick Design															
1	Storyboard and design the User Interface														
2	Prepare the Gantt Chart for the project														
3	Literature review on subject matters (dyslexia, visual attention, wayfinding approach,simulated environment)														
4	Conduct interviews, questionnaire and interviews. (qualitative and quantitative method)														
Final Term: Final Year Project II															
No	**Tasks**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
Prototyping Cycles															
-Build															
5	Develop the User Interface														
8	Create scenes in the Adobe Professional Flash CS5.5 according to the storyboard														
9	Write code in ActionScript 2 to link the button from one scene to another														
-Demonstrate															

10	Run simple test to show the workability of the prototype														
11	Ensure all the components in the prototype interrelated and working fine (audio, visual and scenes)														
-Refine															
12	Redo the prototype's coding for button														
13	Reconstruct the scenes of the prototype according to the storyboard prepared.														
Testing															
14	Evaluate the program functionality and usability														
15	Check the specification of the prototype is aligned with the requirement														
Implementation															
16	The prototype is ready to be used when its passed all the testing phase														
17	Further recommendations on the prototype will be further discussed in next section														

Table 3.3.1: Task Schedule

3.4 STORYBOARD

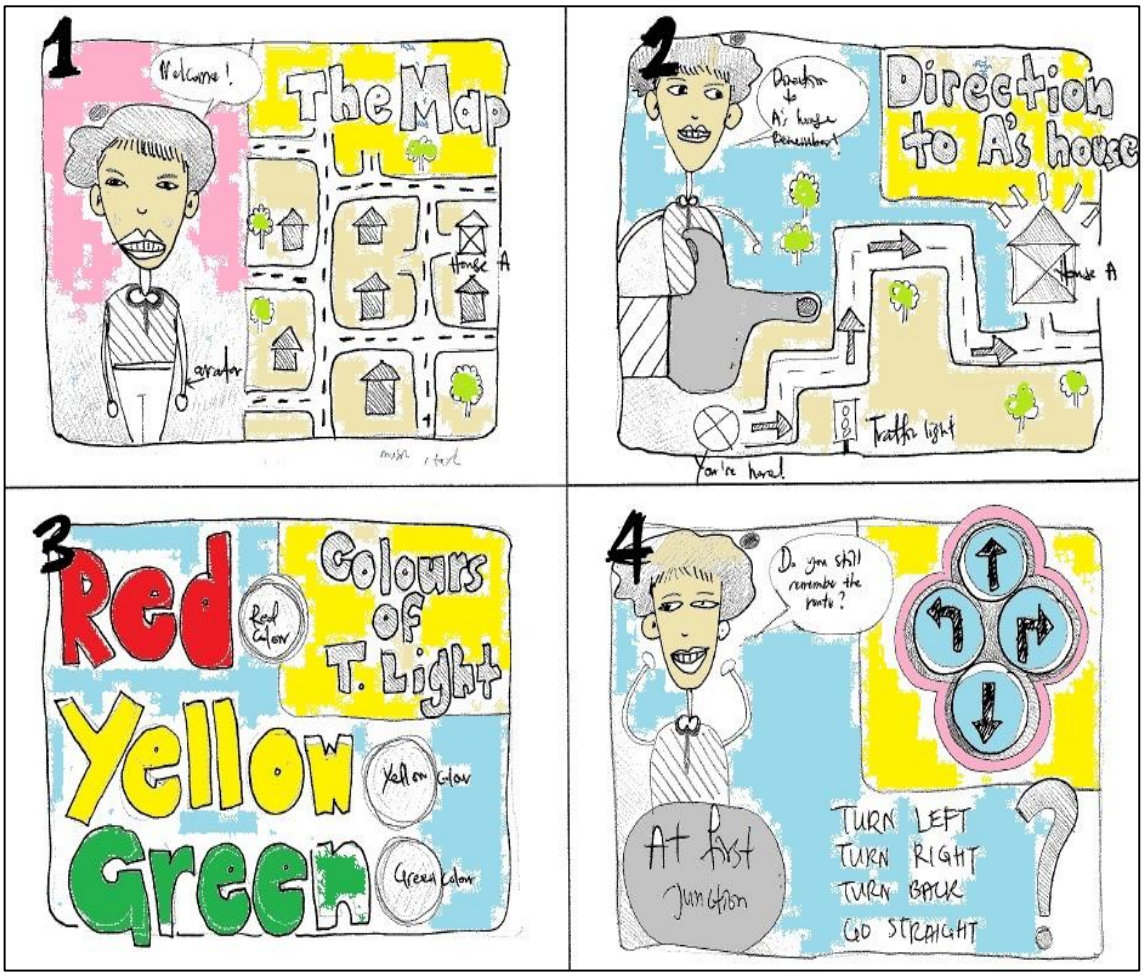


Figure 3.4.1: Storyboard

Consequently, from the research, the author managed to come out with storyboard that will be guideline for the simulation development. The sketch of the storyboard illustrated on A4 paper and scanned using scanner for project development. These four frames of simulation showed the system-flow of the prototype and several visual attention testing towards the dyslexic children.

For the development process, this sketch helped the author to develop basic design on the stage, before advancing it into better simulation. On regards to the time allocated, the author succeeded to come out with SEVEN pages including main page.

3.5 TOOLS

Figure 3.5.1: The logo of proposed tools to develop the simulated environment

Tools that have been opted for this project are Adobe Flash Professional CS5.5 and Adobe Photoshop CS4. At the design phase, the development of the simulated environment is suggested to interrelate with game strategy, thus the collaboration with gaming platform is considered. But as progressing, the simulated environment is avail for its function as tool to address the visual attention issue among dyslexic children not as vision therapy.

Thus, few changes had been made as objective to align with testing environment provided by a visual attention website. The layout of the environment has to be simple for better eye navigation and eye gazing. This website became a main reference for the scenes development in the simulated environment .For audio part, Audacity was used to record all the nursery rhymes and narrator voices before importing them in the Adobe Flash Professional library.

There was an attempt to use Blender software as a tool to develop the simulated environment, but due to time constraint and knowledge barrier the development had to be stopped.

CHAPTER 4
RESULTS AND DISCUSSION

This chapter is a core component of the whole report whereby result and justification were discussed here. All the results gained during project testing are tabulated and analyzed in this section. It also included the findings of the project in visual attention behaviours testing among dyslexics, system usability testing and system-flow diagram.

4.1 VISUAL ATTENTION BEHAVIOURS TESTING

This information merely retrieved from attention test [24] documentation done by Timothy C. Papadopoulus, J.P. DAS**, H. M. Nelly Kodero and Veronica Solomon. Referring to the test conducted, they found that the good visual attention children performed better than low attention children. The visual attention here is concluded in form of speedy processing of information and complex tasks [24]. From the perspective of the project efficiency, the author has determined to reutilize the checklist in order to measure the project effectiveness during testing phase. This attention checklist is intended to be used as screening tool for teachers in order to do classroom setting [24]. Included herewith, is the result of the checklist that has been applied in this project.

Based on offline survey (through email and social media) done towards special education teachers specialized in educating dyslexic children, found that 40% of their students having problem in reading still, even though had been exposed with the dyslexia-type of practices. This survey was done by sending out the Attention Checklist Scale softcopy to the teachers. Plus, in the class population 70% of the children are boys. As to be mentioned, the schools involved in the offline survey were Sekolah Kebangsaan Tunku Azizah, Sekolah Kebangsaan Bandar Baru Sri Damansara, Sekolah Kebangsaan Klang and Sekolah Kebangsaan Jalan Enam. Generally, in special education classroom, there are average 15 students per class. Thus, in a figure form, the

sample population would be out of 15 children there are SIX children that having problem with dyslexic-difficulties.

Early Signs Of Dyslexia	
Eye-Tracking Skills	1. Delay in speech 2. Recalling names or familiar words 3. Difficulty in hearing and producing sounds 4. Trouble in learning the alphabet and sequence information.
Vision Perception Skills	5. Confused with left and right 6. Poor handwriting

Table 4.1.1: Implementation of dyslexia early signs and visual attention testing

Importance Of The Chosen Visual Attention Skills	
Eye-Tracking Skills	**Information:** The children have to read and pronounce each word on the line accordingly. If the children cannot control their eye movements, they are expected to have problem in comprehension. *(Comprehension Difficulties)*
Vision Perception Skills	**Information:** The children need to understand, analyze, interpret and memorize the signs. This skill will help to increase the learning ability of the children. If the children have problem in this activity, it may lead towards disability in remember things visually and give or get directions. *(Retention Difficulties)*

Table 4.1.2: Importance of the Chosen Visual Attention Skills

Additionally, the author had responded with the moderator of the ePKhas USM which is an online source for e-education and multimedia interaction for special education. From the respond, a list of early detection in dyslexia can be identified as mentioned in **Table 4.1.1** and **Table 4.1.1.**

Meanwhile, for the objective measurement is measured based on Objective Measurement Scale set at the beginning of the project. Due to several obstacles during getting permission to run a testing in one of primary school near Batu Gajah, the author decided to test the simulated environment towards a number of dyslexics range age of 20 to 25. These adults responded towards the simulated environment as it intended for and did all the visual attention testing without knowing they were actually on evaluation. Based on the observation towards the physical behaviours of the participants during testing conducted, they were showing some physical gestures.

Physical Gestures Of The Dyslexics During The Testing	
Eye-Tracking Skills	**Movement:** -Obvious eyes-blinking during reading and pronouncing the words. -Moved the finger along the line while tracking the object meanwhile some of them were able to track without moved along the finger.
Vision Perception Skills	**Movement:** -Looked closer to the screen during memorization of the signs. -Shut eyes after the signs disappeared from the screen meanwhile some candidates came with facial expression. -Good in drawing back the signs on the paper and some of the candidates not remember the signs.

Table 4.1.3: Physical gestures during testing

Based on the time taken for the participants to complete the testing was vary depending on the attention given by the candidates towards the simulated environment. The figure below shows the performance of the participants:

Visual Attention Test	Time Interval (sec)	Candidates				
		1	2	3	4	5
Eye-Tracking Skill						
1. Line Tracking (complex/time)	-	70 sec	90 sec	100 sec	120 sec	90 sec
2. Reading Saccade- Number 1 (complex/time)	2	✓ .	✓ .	✓ .	✓ .	✓ .
3. Reading Saccade-Word 2 (complex/time)	3	✓ .	✓ .	✓ .	✓ .	✓ .
Vision Perception Skill						
1. Memory Test (complex/correct)	30	✓ .	✓ .	✓ .	X	X

Table 4.1.4: The result of the testing conducted

There were some participants that are talkative and speak well with good articulation though they were dyslexics. Overall on the testing day, all the FIVE candidates had shown the best in them to cooperate well in this testing. Due to lack of correspondents, it was not enough to compare between the high attenders and low attenders. Some of them had commented few matters regarding the prototype:

Participants' Feedback After Doing The Testing	
Participant	***Comment***
1	Colour distraction in the prototype has become a challenge to read the number on the screen. Besides, the phase to the next frame is too fast and more to be improved as diagnosis tool.
2	The colour schemes were good and the button placement should be consistent at all scenes in the prototype.
3	It should be direct communication between the children with the simulated environment. Can be improved by involving activities that needed the children to click the object in the computer.
4	The simulation was too fast. Obviously at the part whereby had to memorize all the signs and drew them back on a piece of paper.
5	No comment

Table 4.1.5: Participants' Feedback

Objective measurement has brought to the clear feedback from the testing participants as shown in the table above. In the near future, the prototype will be tested with the targeted dyslexic children in the preschool term. This future work is expected to be conducted in early of December after approval from Ministry of Education Malaysia and receiving permission from the respected school.

4.2 SYSTEM USABILITY SCALE TESTING

This "quick and dirty" scale is technology independent and can be tested in vast products. It is copyrighted to be used as tool for measuring perceptions of usability. The reasons of choosing SUS Questionnaire are due to its reliability, validity and ability to measure learnability in users. Therefore, the author decided to use this questionnaire in order to evaluate this prototype. There were 20 respondents consist of dyslexics and non-dyslexic. The bar graph below shows the score of each question:

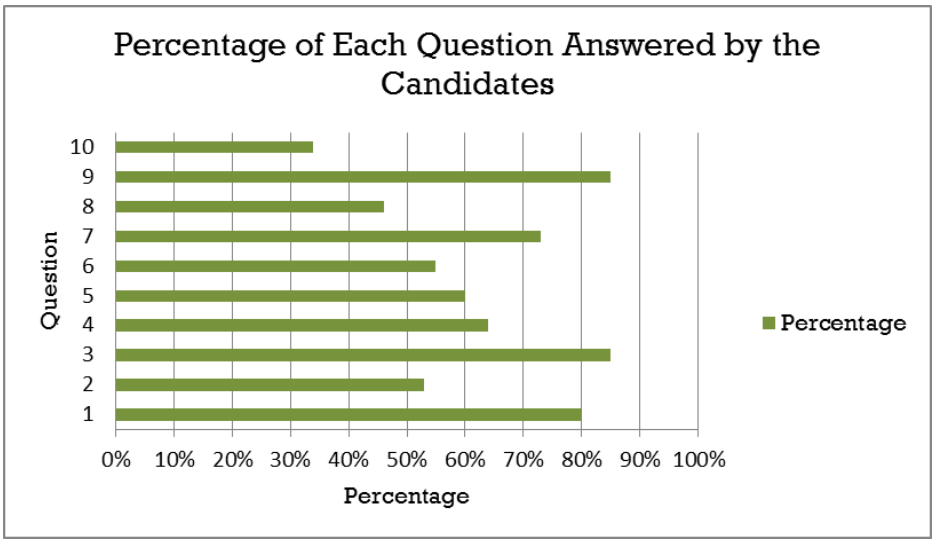


Figure 4.2.1: Percentage of each question answered by the respondents

The questions and analysis are as followed:

Question number 1 is referring to the user experience during testing the prototype. The total score for this single question is 80/100. This can be concluded that most of the respondents are agree to use the system frequently in the future.

1. **I think that I would like to use this system frequently?**

Question number 2 is regarding the simplicity of navigating the prototype. Based on the responds from the correspondents, the score for this single question is 53/100. This showed that the complexity of the prototype was just at the right composition.

2. **I found the system unnecessarily complex?**

Question number 3 is inquiring about the experience of easiness during using the prototype. The score for this single question is 85/100. Above than half, this means that the respondents thought the system is easy to use.

3. **I thought the system was easy to use**

Question number 4 is asking about the users' need of technical assistant during using the prototype. The result for this single question is 64/100. This can be determined that not many of the respondents need an assistant during using the system but in case there still will be few of the respondents asked for explanations.

4. **I think that I would need the support of a technical person to be able to use this system?**

Question number 5 is about the view of the users regarding the functionality in the prototype. The score for this single question is 60/100.This can be concluded that the system still has not reached well integrated stage but in average the prototype suited its purposes.

5. **I found the various functions in this system were well integrated?**

Question number 6 is asking about the opinion of the users on regards to inconsistency in the prototype such as the colour schemes, button placement or font size. The score for this single question is 55/100. The average reflected that the prototype needs to be improved in term of human computer interaction specifically in consistency.

6. **I thought there was too much inconsistency in this system?**

Question number 7 is asking about the judgment of the users about the learnability of novice user that will use the system in the future. The score for this single question is 73/100. This result expressed most of the respondents agree that the next users will have no difficulties in learning this system.

7. **I would imagine that most people would learn to use this system very quickly?**

Question number 8 is asking about the weakness of the prototype that really troublesome the users experience during using the system. The score for this single question is 46/100. The result indicated that the respondents disagree about the system brought troublesome during experiencing the system navigation.

8. **I found the system very cumbersome to use?**

Question number 9 is asking about the confident of the users to use the prototype. The result for this single question is 85/100. The score reflected the confident of the respondents during using the prototype almost to the maximum.

9. **I felt very confident using this system?**

Question number 10 is asking about the knowledge expectation of the users before using the prototype. The result for this single question is 34/100. This illustrated that the users can use the system even without knowing a single thing about the nature of the system at the first place. This score showed the respondents could get going with the system easily without preparing a lot of thing.

10. **I needed to learn a lot of things before I could get going with this system?**

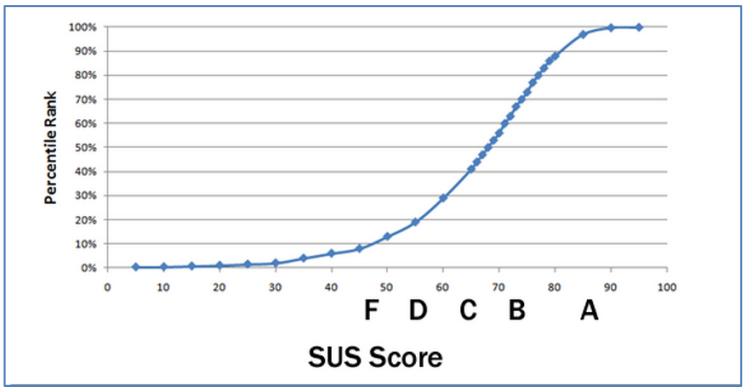


Figure 4.2.2: SUS Score Reference

Based on the graph provided above, the SUS score were examined by doing data normalization. The average score was 68, 11 of them were scored 68 and above, meanwhile the rest scored 65 and below. Thus, from the result tabulated, the author can conclude that 55% of the respondents have experience the usability of the prototype above the average level and the rest is below average. For better view, below is the tabulated SUS Score based on the conducted survey:

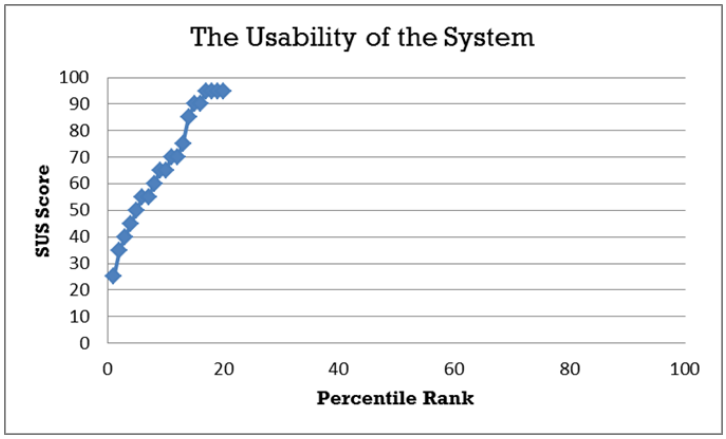


Figure 4.2.3: SUS Score

4.3 SYSTEM FLOW DIAGRAM

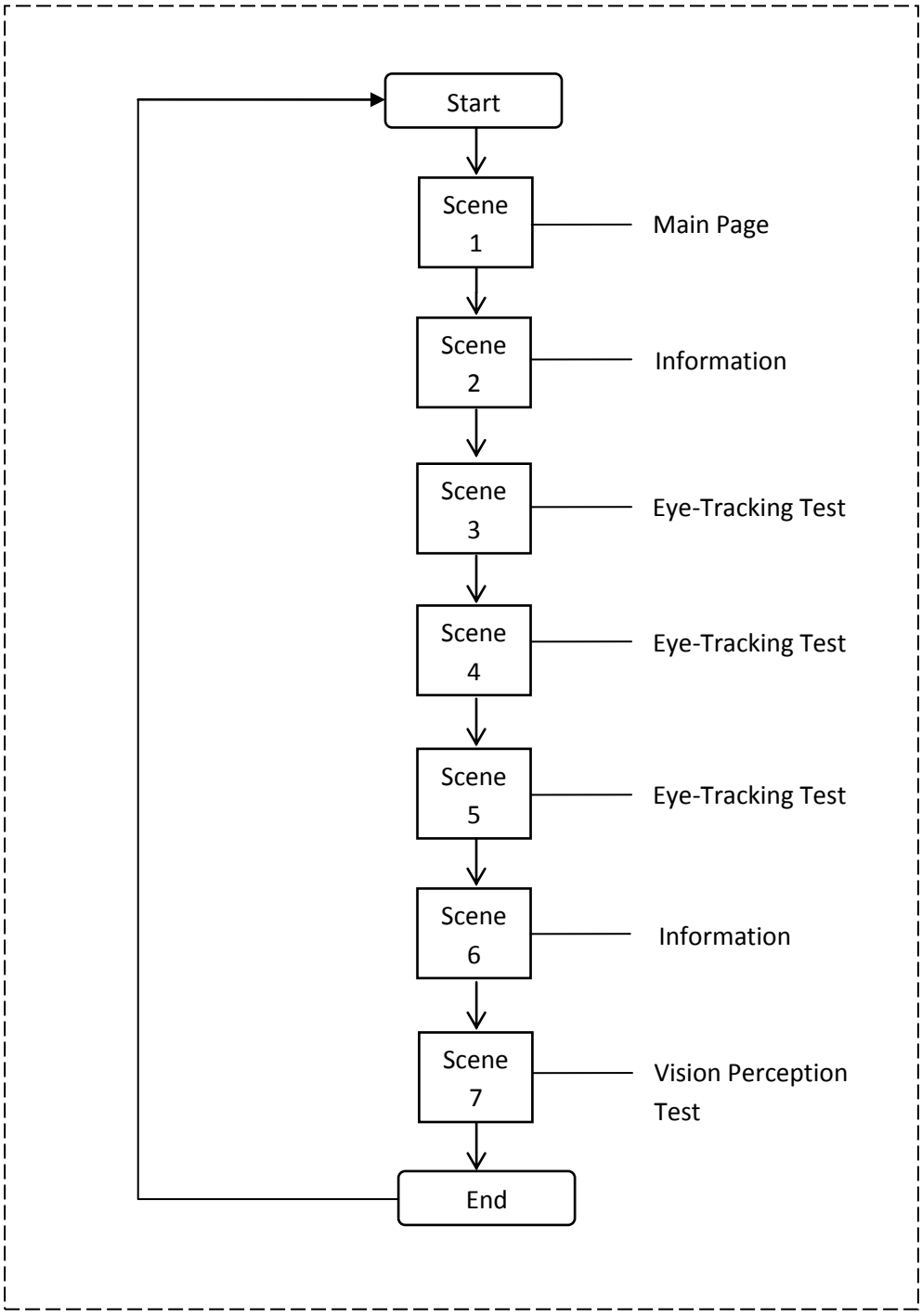


Figure 4.3.1: System Flow Diagram

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSION

This document is intended to provide sufficient information regarding to the project completion and all components involved during the project development. It consists of Project Introduction, Literature Reviews, Methodology, Result and Discussion, and Conclusion and Recommendations. In short from the perspective of the project planning, the author has successfully finished the project within the time frame given. The project entitled "A Simulated Environment for Wayfinding to Address the Visual Attention Issues among Dyslexic Children" has finished in development and tested with few dyslexics during testing phase. This is because reading and writing are two main components inside the primary education curricular, again it is important for the dyslexic children to empower these skills.

The author believed that more reading has to be done in order for this project to expanded and meet the standard as diagnostic tool. Besides, the author also has succeeded to meet the requirements that have been gathered through offline surveys, questionnaire and interviews. This qualitative and quantitative method really helped a lot in doing data gathering in special education for dyslexic children. Not just that, the helps from the supervisor especially in term of visual attention issues really benefits the author about understanding of the issues itself.

As a conclusion, the author really hopes that the project could be expand further in term of technology used and also can be realize as one of diagnostic tool for visual attention issues among dyslexic children. Lastly, hopefully this project could open more opportunity towards all organizations and individual to get involved in helping these special children to survive in the future.

5.2 RECOMMENDATIONS

This simulated environment for wayfinding to address visual attention issues in dyslexic children is developed as a result from the research of the project; therefore this prototype can be improved in many aspects especially in terms of its performance and features. As this project is merely about the theoretical knowledge based so it is suggested in the future to be in form of practical activity towards the targeted audiences. Based on the project, the practical groups are the pre-school dyslexic children with age range from 4 to 6 years old meanwhile the other group would be the practitioners and the teachers.

Furthermore, the simulation could be expanded to be a Multilanguage application inside android or IOS platform. This could cater the area of mobility and increase the user utility. This difference in language used could be a variable to test the linguistic acquisition of the targeted audiences. The prototype can be enhanced into final product that is recognized by government to be implemented officially in education for challenged students.

Due to several limitations that have been recognized during project development, currently, this prototype's first limitation is the visual attention testing involved only two skills which are Eye-Tracking Skills and Vision Perception Skills. In near future, it is suggested to widen the testing by also introducing the Eye-Teaming and Eye-Focusing Skills. It is also recommended for the project expansion in addressing visual attention issues among dyslexic children in 3-Dimensional environment. This new environment could give different view and make even more interesting diagnostic tool.

REFERENCES

[1] Wayfinding Theory and Research: The New Approach: Blades M. Department of Psychology, University of Sheffield, Shefield S10 2TN United Kingdom

[2] (n.a.) The Power of Dyslexia; Dyslexia in Children retrieved 24 June 2012 from http://www.thepowerofdyslexia.com/

[3] (n.a.) Discovery Fit & Health; What exactly is Dyslexia retrieved 20th June 2012 from http://health.howstuffworks.com/mental-health/neurological-conditions/question666.htm

[4] Li Za, W. (2009), The Star Online; Hope for Dyslexics retrieved 21st June 2012 from:http://thestar.com.my/lifestyle/story.asp?file=/2009/3/16/lifefocus/3336348&sec=lifefocus

[5] Famous Dyslexics retrieved on 21st June 2012 from http://www.famousdyslexicpeople.com/

[6] Persatuan Disleksia Malaysia; What is Dyslexia retrieved on 22nd June 2012 from http://www.dyslexiamalaysia.org.my/What+is+Dyslexia%3F_23_1.htm

[7] Bernama (2012) The Star Online; Shahrizat: Early dyslexia detection programmes in all nurseries retrieved 23rd June 2012 from http://thestar.com.my/news/story.asp?file=/2012/2/14/nation/10732847&sec=nation

[8] (n.a.)(2010) PubMed Health; Developmental reading Disorder. In A.D.A.M Medical Encyclopedia, retrieved 23rd June 2012 from http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0002379/

[9] Perstein, D., Stoppler, M.C, (n.a) MedicineNet.com; Dyslexia retrieved 19th June 2012 from http://www.medicinenet.com/dyslexia/article.htm

[10] Marshall, A., Smith, L., & Borger-Smith, S. (2009). Davis Program Average Reading Gains. Retrieved June 24, 2012 from Dyslexia, the Gift from http://www.dyslexia.com/science/results.htm

[11] Roy, E (2005) The World Today; Study shows dyslexia slows driver's reactions retrieved 24th June 2012 from http://www.abc.net.au/worldtoday/content/2005/s1296300.htm

[12] (n.a.) (2005) Future Pundit; Dyslexics react TO Road Events More Slowly When Driving retrieved 23rd June 2012 from http://www.futurepundit.com/archives/002610.html

[16] Sigmundsson, H. (2005) Brain and Cognition, Vol 58(2), July 2005, 213-216

[17] Piaget's theory of cognitive and affective development: Foundations of constructivism (5th ed.).Wadsworth, Barry J.White Plains, NY, England: Longman Publishing

[18] Atherton J S (2011) Learning and Teaching; Piaget's developmental theory [On-line: UK] retrieved 24 June 2012 from http://www.learningandteaching.info/learning/piaget.htm

[13] Conley, M. (2012) ABC News; Signs of Dyslexia Start Before reading, Study Finds retrieved 18th June 2012 from http://abcnews.go.com/Health/visual-attention-lead-dyslexia children/story?id=16078380#.T96qCxcthRk.

[14] Blankfield, S., Williams, S. (2003) “Dyslexia, Inspiration and Academic Writing”, In Proceeding ICSC 2003 2nd International Conference on Spatial Cognition Scientific Research and Application retrieved 22nd June 2012 from http://w3.uniroma1.it/icsc/2003/Proceedings.htm#6.

[15] Rasicot, J. (2012) Education Work; Study Links Dyslexia to Visual Attention Problems in Preschool retrieved 25th June 2012 from http://blogs.edweek.org/edweek/early_years/2012/04/study_suggests_dyslexia_not_just_a_language_problem.html

[19] Vidyasagar, T. R. , Pammer, K. , (2010) “Dyslexia: a deficit in visuo-spatial attention, not in phonological processing”.

[20] Leonard J. Press (2010) The Vision Help Blog; Understanding the Visual nature of Dyslexia and Reading/Attention Problems retrieved 24th June 2012 from http://visionhelp.wordpress.com/2010/11/11/understanding-the-visual-nature-of-dyslexia-and-readingattention-problems/

[21] Sally E. Shaywitz, Bennet A. Shaywitz () The Science of Reading and Dyslexia, Journal of AAPOS Volume 7 Number 3 June 2003

[22] Beaverstock, M, A. Greenwood, E. Lavery, and W. Nordgren. 2011. Applied Simulation, Modeling and Analysis using Flexsim. 1st ed. Oren, Utah: Flexsim Software Products, Inc.

[23] Ingalls, R. G. (2011) “Introduction to Simulation” In Proceedings of the 2011 Winter Simulation Conference, edited by S. Jain, R.R. Creasey, J. Himmelspach, K.P. White, and M. Fu, eds.

[24] Eur. J. of Special Needs Education, Vol. 17, No. 1 (2002), pp. 15–32

[25] Gordon W. Blood, Ingrid M. Blood, Kristy Maloney, Andrea V. Weaver and Bethany Shaffer (2007) “Exploratory Study of Children Who Stutter and Those Who Do Not Stutter on a Visual Attention Test” Communication Disorders Quarterly 28: 145

[26] Pneuman M. S. (2009) “Defining the early indicators of dyslexia: providing the signposts to intervention”.

APPENDICES

Attention Measurement Scale

(Intended for teachers and practitioners)

Visual Attention Test

1. *Vision Perception Skill*

    a. Memory Test (simple/correct) — Number of finding

2. *Eye Tracking Skill*

    a. Reading Saccade (simple/time) — Number of finding

    b. Line Tracking (simple/time) — Number of finding

Attention Checklist Scale

(Intended for teachers and practitioners)

---

1. **Does child have short attention span?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

2. **Does child daydreaming in class?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

3. **Does child have trouble concentrating?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

4. **Does child stay with one activity long enough to complete it?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

5. **Does child work independently?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

6. **Does child easily distracted?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

7. **Is the child able to concentrate on a task until completed?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

8. **Does the child listen attentively?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

9. **Does child become easily engrossed in an activity?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

Thank You

SUS Questionnaire

(Intended for evaluating the system's usability)

---

1. **I think that I would like to use this system frequently?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

2. **I found the system unnecessarily complex?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

3. **I thought the system was easy to use?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

4. **I think that I would need the support of a technical person to be able to use this system?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

5. **I found the various functions in this system were well integrated?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

6. **I thought there was too much inconsistency in this system?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

7. **I would imagine that most people would learn to use this system very quickly?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

8. **I found the system very cumbersome to use?**

Strongly Disagree	1	2	3	4	5	Strongly Agree

9. **I felt very confident using this system?**

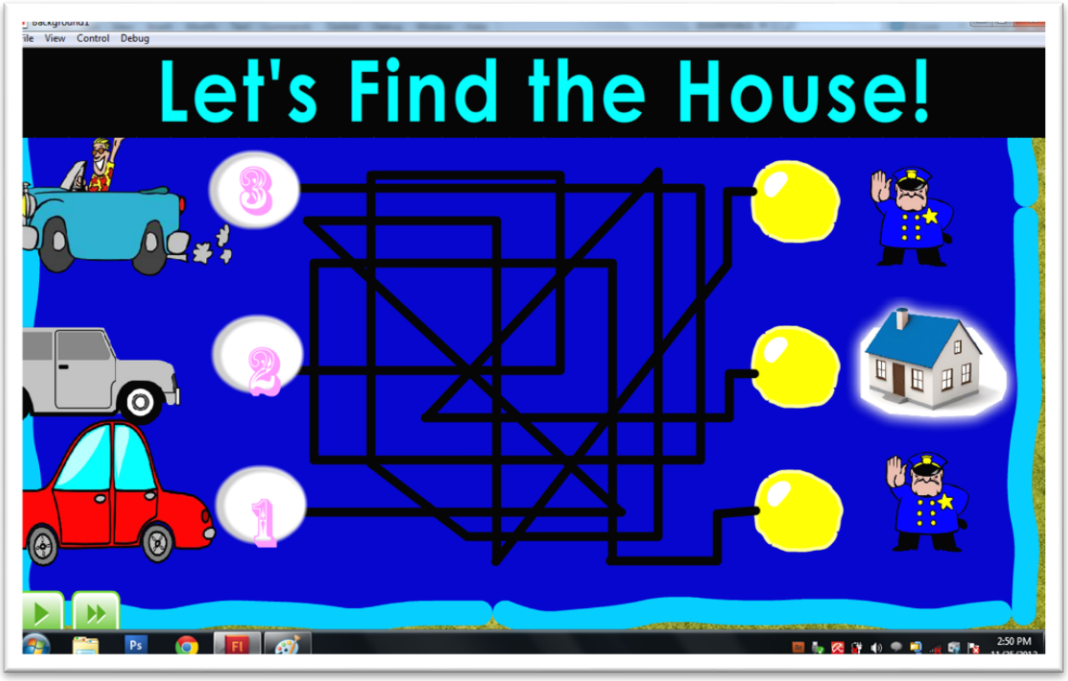
Strongly Disagree	1	2	3	4	5	Strongly Agree

10. **I needed to learn a lot of things before I could get going with this system?**

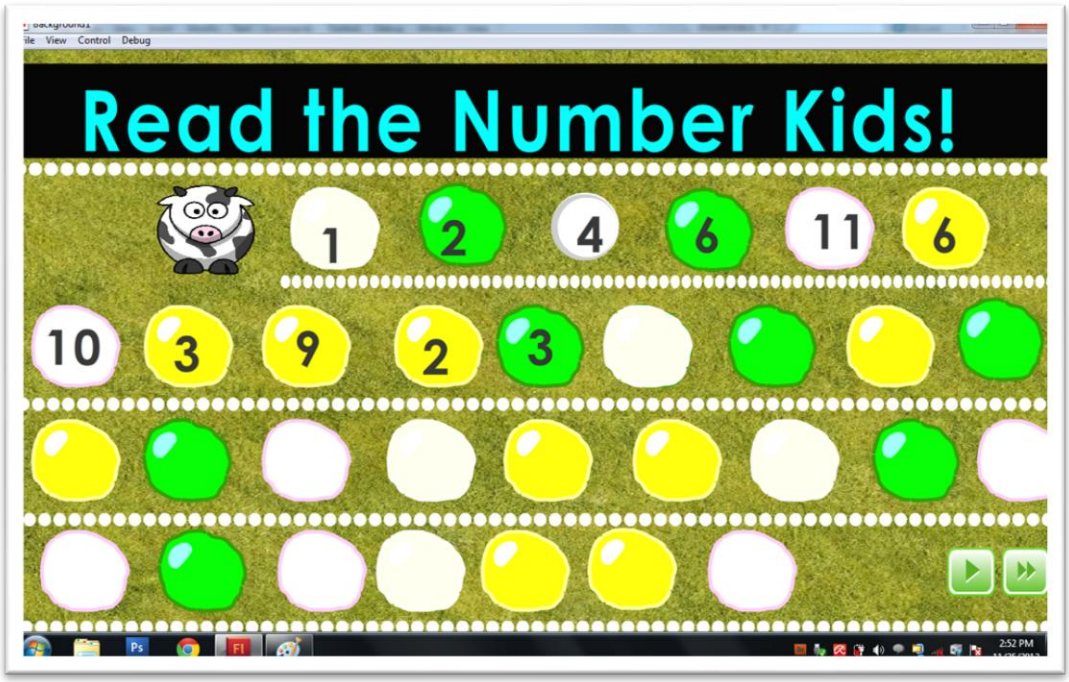
Strongly Disagree	1	2	3	4	5	Strongly Agree

Scene 1

Scene 2

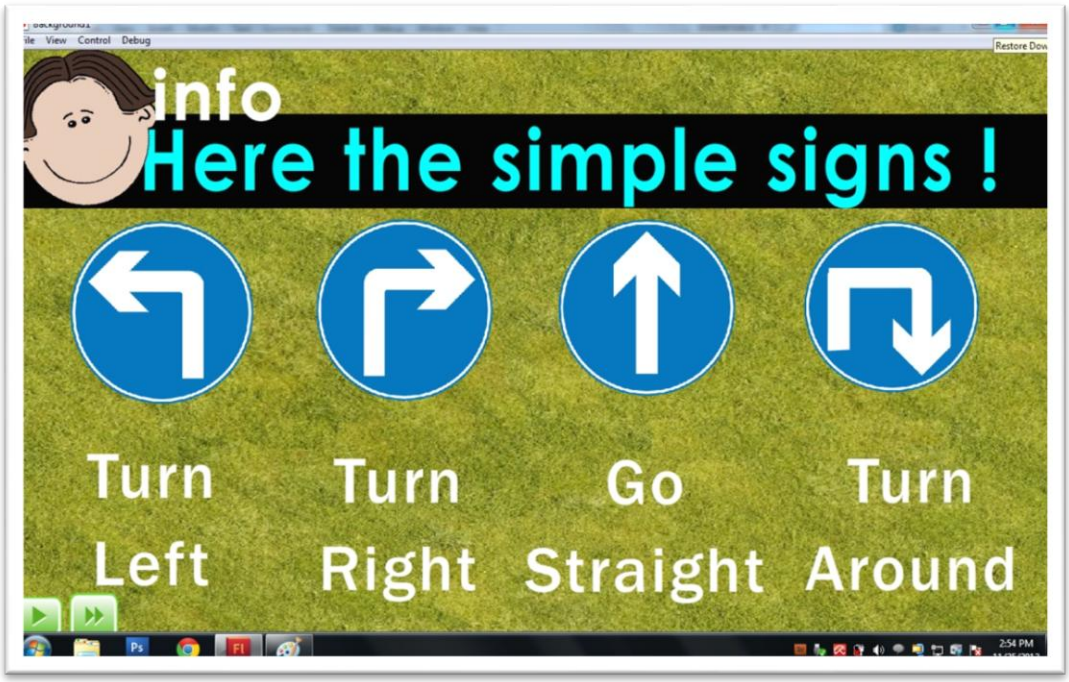


Scene 3



Scene 4

Scene 5



Scene 6

Scene 7