Learning Disability Evaluation Kit For Preschool Children

Project Proposal

Project ID: 14-076

Bachelor of Science Special (Honors) Degree in Information Technology

Sri Lanka Institute of Information Technology

Learning Disability Evaluation Kit
For
Preschool Children

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Declaration

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Abstract

Every child is not perfect in their learning. Many children facing difficult in learning and many of them are having hidden disorder called Learning disabilities. Most developing countries are not aware of this situation and these children's simply are being rejected. Identifying this issue in early stages is far better for the child. This proposing system is capable of providing indications to the parent about child's condition. This system is mainly focused on preschool level children. Proposed learning disability evaluation kit will check symptoms of four major learning disabilities in child using simple games. The document will describe what the learning disabilities, impacts, symptoms are, necessary steps have been taken for them, strengths and weaknesses of those steps or methods. Further, it will illustrate the main research objective, proposed methodology and expected final outcome along with the benefits to the users.

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1. Introduction

Childhood problems are the most affective things in human lives. If a person failed to learn or failed to face the society as a child that will affect through their whole life. Learning disabilities is a very common and most undiscovered lifelong issue in some children, and most parents in under developed countries are unaware of this condition. Learning disabilities is more than a different or difficulty, its neurological disorder that affects the brain's ability to receive, process, store and respond to information. There are four main type of learning disabilities identified as Dyslexia, Dysgraphia, Dyscalculia and Dyspraxia.

Learning disabilities are not same as intellectual disabilities (Mental impedance), Vision or hearing impairments or autism related disorder. People with learning disabilities are of average or above-average intelligence but still struggle to acquire skills that impact their performance in school, at home, in the community and in the workplace. Learning disabilities are lifelong, and the sooner they are recognized and identified, the sooner steps can be taken to circumvent or overcome the challenges they face. Learning disabilities affect every person differently and they present differently at various stages of development. Learning disabilities can range from mild to severe and it is not uncommon for people to have more than one learning disability [1].

The most common types of learning disabilities involve problems with reading, writing, math, reasoning, listening, and speaking. Common learning disabilities,

- Dyslexia – a language-based disability in which a person has trouble in processing language. It may also be referred to as reading disability or reading disorder.
- Dyscalculia – a mathematical disability in which a person finds a difficult in time solving arithmetic problems and grasping math concepts.
- Dysgraphia – a writing disability in which a person finds it hard to form letters or write within a defined space.
- Dyspraxia - a disorder that affects motor skill development. People with dyspraxia have trouble planning and completing fine motor tasks [1].

Children with these disabilities are mostly face difficulties in school work and school might become a nightmare for them. And they may face difficult situations with their friends such as bullying and it can give stress for their mind.

As we know LD is lifelong issue which cannot be cured by medicine. We can only give treatments. With the right support and intervention, however, children with learning disabilities can succeed in school and go on to successful, often distinguished careers later in life. As we know children with these disabilities have creative minds. So, if they did not get any special attention, maybe we will lose a good creator too.

1.1 Solutions Have Been Made

In modern countries most parents, kindergarten teachers, primary grade teachers are aware of this medical condition since the technology improvement. There are many resources in internet to follow up about children medical situations in learning. And also there are many institutions for these children to do tests and get treatments. Some of them are British institute of Learning Disability (UK) [2], Learning Difficulties Australia (Australia) [3], National Center for Learning Disabilities (USA) [4]. These institutions have done many researches about these learning disabilities and have been developed good awareness in parents through campaigns, internet, public media, social media sites and conferences.

Normally learning disorder is diagnosed through a clinical review of the individual's developmental, medical, educational, and family history, reports of test scores and teacher observations, and response to academic interventions. The diagnosis requires persistent difficulties in reading, writing, arithmetic, or mathematical reasoning skills during formal years of schooling. Symptoms may include inaccurate or slow and effortful reading, poor written expression that lacks clarity, difficulties remembering number facts, or inaccurate mathematical reasoning [5]. Clinically this issue can diagnose most of the time very accurately. But the problem is parents do not identify this medical condition and they do not take their child to a doctor because they don't know this as a medical condition.

There are several applications designed to test this issue, but most of them are based on questionnaires to be followed by parents, guardian or child. And to do so they must be very keen in computer literacy and also in English because most of applications are in English. Although this applications give results based on answers provide to questions, not by the interactions of user or by observing the actions of user. And these applications are basically address to more adult children (above 6 year old).

1.2 Computer Based Existing Screening Applications

- Dore dyslexia symptom check [6] – Questionnaire based testing application. Child or parent can answer the questions and take the test results. User must have good computer literacy in order to perform this test. This is a free test, but to have the results user have to give an email and results will be sending to that email.
  This application test only one category of only.

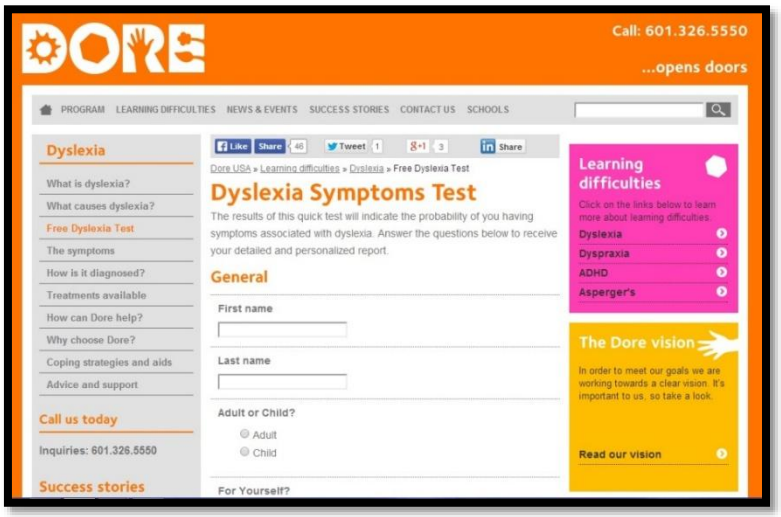

Figure 1.2.1 – dore dyslexia symptom check

- Adult Self-Assessment Tool by IDA [7] – Questionnaire based testing method, only for adults. Adult can answer the question given in test and according to answers user given scores. Site says if user have high score, user have high possibility of LDs. User have to have good computer literacy. Child cannot interact with this application.

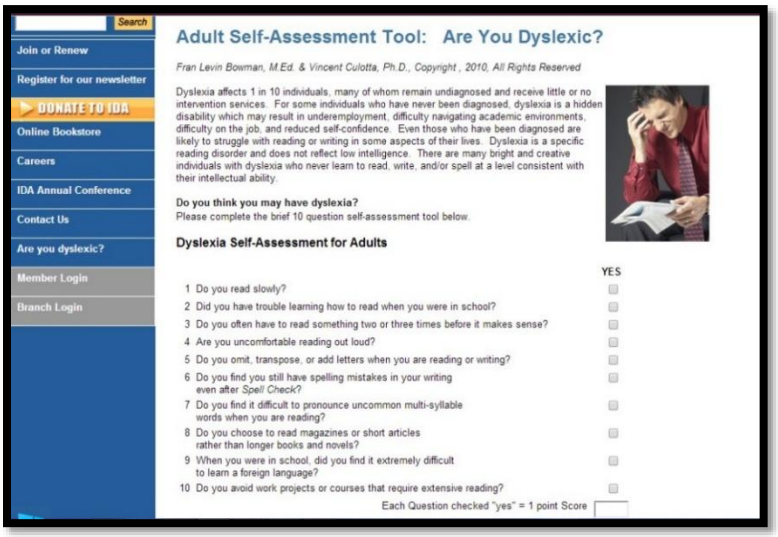

Figure 1.2.2 – adult self-assessment tool

- Lexion [8] – Complex system used to test only Dyslexia. At least child should be 6 years old to be interacting with this system. And this system contains applications for train dyslexic students.

Figure 1.2.3 – lexion

- Dyslexia Screener [9] – Age must be above 6 to do testing using this system and it's costly. This site contains different type of screening applications, but parents have to buy them to test each disability.

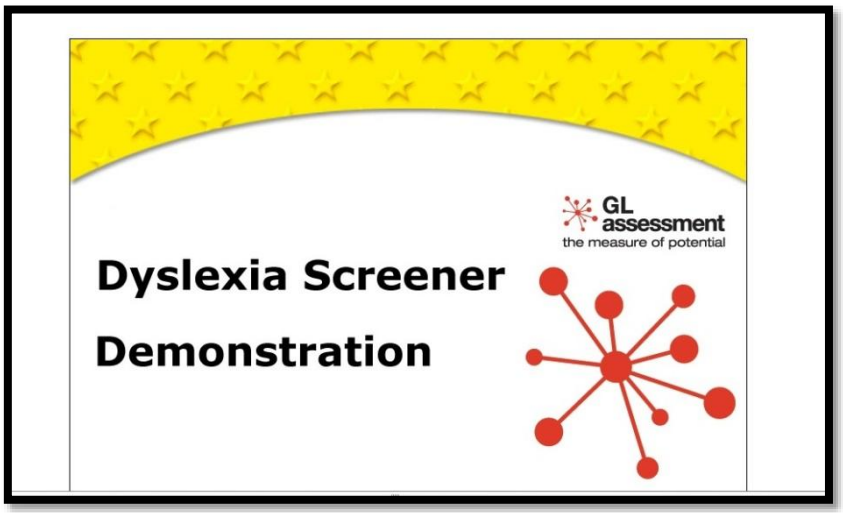

Figure 1.2.4 – dyslexia screener

- Lexercise [10] – Complex dyslexia screening application. Child must have a good computer literacy to test with this application.

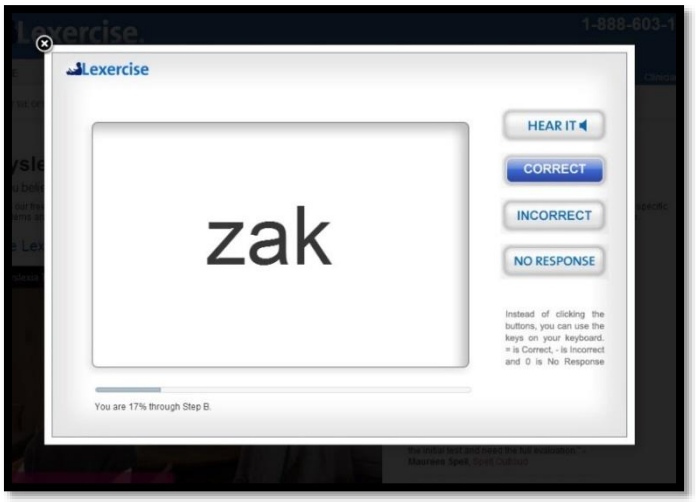

Figure 1.2.5 – lexercise

Problem with all these systems are they mainly focused on one kind of learning disability, but most of the time there is two or more learning disability in children. And these all online or desktop mode applications can be played by a person who has more computer literacy only.

Application	Language	Age	Test on	Disability	Cost	Interaction	Interactive
Lexercise	English	6+	Online	Dyslexia	Free	Parent checks	No
Dore	English	Adult	Online	Dyslexia	Free	Parent or Child	No
IDA	English	Adult	Online	Dyslexia	Free	Parent	No
Screener	English	6 -14+	Stand alone	Dyscalculia	Costly	Child	No
Checklist	English	Adult	Online	Dyspraxia	Free	Parent or Child	No
I Move To Learn	English & Chinese	6+	Stand alone	Dyspraxia	Free	Child	Yes
Proposed System	**English & Sinhala**	**4 - 6**	**Online**	**All LDs**	**Free**	**Child & Parents**	**Yes**

Table 1.2.1 – summery of existing systems

In 3rd world countries like Sri Lanka, This situation is very different. Teachers are given information, details about these medical conditions about children in their teacher's trainings, but with amount of children in class, they do not get the chance to evaluate each child performance and children who shows difficult in learning simply labeled as weak student. Many of these children are not weak as they show. They might be having learning disability and if they got chance they can improve themselves. But unfortunately that chance is very low in Sri Lanka.

And above systems also less helpful for Sri Lanka since they all are in English medium. Therefore we planned to develop a series of attractive games can used to identify symptoms of above mentioned four types of learning disabilities. Some of games will develop to play on android tab devices and some of them to play using Kinect device. And there is to be Sinhala and English versions of these games, therefore this system might help to reduce unawareness of these disabilities. We are planning to develop these games for children who are in age 3 to 5 range, So if child identified to be positive for some kind disability, they got chance to improve them self's. Those games have to be played under supervision of parent or guardian. And we hope to give instructions for parents about what steps has be taken if child is indicate as positive from our system.

2. Objectives

The main objective of the project is to build an interactive learning disability evaluation kit for children in age group 4 to 6, which focuses to identify main four categories of learning disabilities. This application is going to develop based on game series which can get attention and interaction of children. For this purpose we thoroughly investigate about the current existing IT solutions and the diagnosis mechanisms that available. This kit is not only going to be a learning disability identification tool it also give knowledge this untouched area in Sri Lanka. There for this application will be localized. The application develops to identify dyslexia, dysgraphia and dyscalculia using mobile application and dyspraxia identification by Kinect based PC application. Those two game series are connected through a website which provides final evaluation of the user.

- This application not only to identify the disability by processing user interactions, those games is designed to change according to the user for more accurate result.
- To reduce the hardware interaction and improve the interactivity - The system is developed with less hardware equipment which will only use a computer with Kinect and a tablet PC. The interaction with the keyboard and the mouse will be very less. Voice commands will be used to navigate throughout the application.
- To develop the system for internationals and especially localize for Sri Lanka - Since learning disability is not a known area among Sri Lankans we develop the system in Sinhala medium.
- To promote the new technologies into the Medical area - This system is going to build with the most attractive and popular technologies such as Kinect technology, image processing, computer graphics, Mobile games and modeling.
- To create attractive and efficient environment which is able to identify disability within home or at the kindergarten - This learning disability evaluation kit is comes in a website, which is provide full information about the disability to understand it and ability to download the mobile game application & Kinect game application from the website.
- To provide an accurate evaluation - For that we have to overcome limitations of technology such as we cannot get user interaction of child with shoe laces, ties and buttoning. Therefore we introduced question based evaluation tool for parents or a guardian.

3. Methodology

3.1 Product Design

Our proposed system is consisting with three main components. Android game series using Android Tab-PC, Kinect based game series using PC and main web application to view results.

Android game series

Android game series can be played in android tab devices. It will identify Dyslexia, Dysgraphia and Dyscalculia. These games will play by children in age group 3 to 5.We plan to develop 6 different android games based on stories known to children. Child needs to listen to instruction in games and follow the tasks in game by selecting, writing on tab and speaking.

Kinect and desktop based game series

Kinect and desktop based game series will be used to identify Dyspraxia. These games will play by children in age group 3 to 5. Child has to move hand, body according to interact with game and each motion will be identified using Kinect device. There will be minimum two games in different stories as shown in figure 3.1.1.

Each of this game will be have more than 15 different tasks to do and each of them will examine a symptom in LDs. And all game will be attractive, colorful and easily to understand. Each user will be given separate login so we will ensure that child is not playing these games with previous practice. It might lead to false indications.

Main web application

Main web application will be used to connect android and Kinect games results. Final result will be given to parent or guardian. And also it's impossible to 100% correctly say whether child is having or not these disabilities, what we can do is give indications to parents, so that they can meet up with a specialist and confirm the situation. And for more accurate results we hope to include some questionnaires to fill by parents about child and child background. And take those details in our final conclusion.

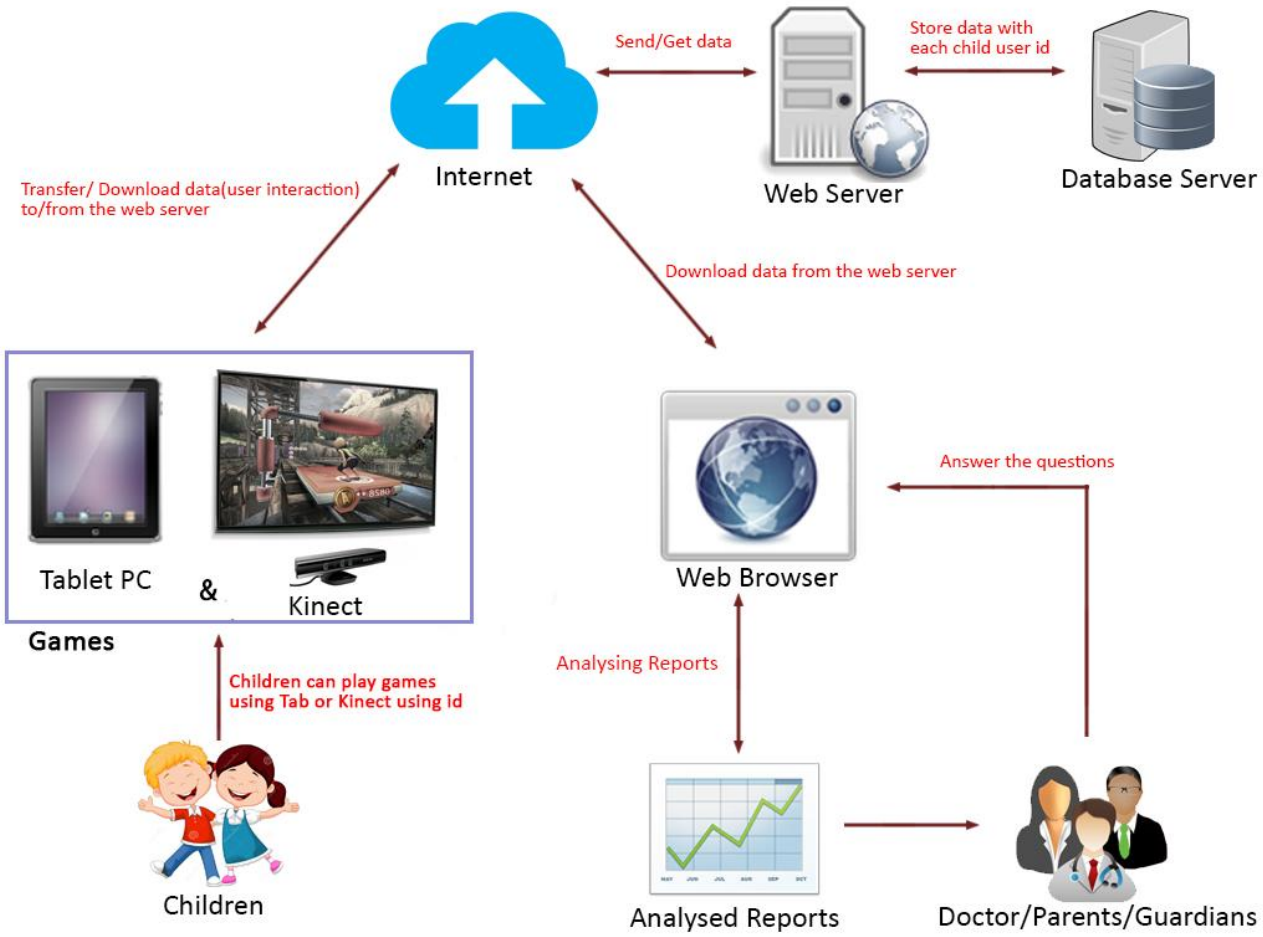

Figure 3.1.1 – high level architecture diagram

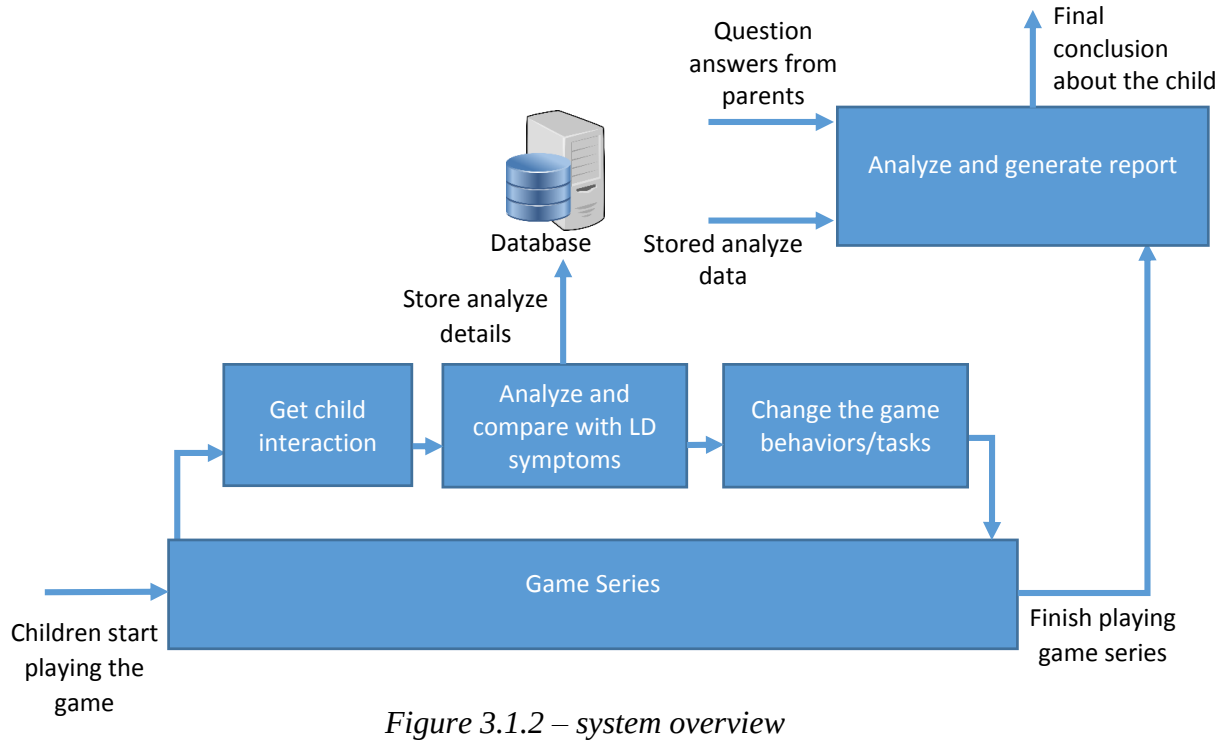

Figure 3.1.2 – system overview

Mainly there are two types of games, one is based on motion detection using Kinect and it is design to identify symptoms of Dyspraxia. The other game is Android Tab-PC game design to identify dyslexia, dysgraphia and dyscalculia as shown in the figure 3.1.1. It includes six types of story based games and those games can identify more than fifteen symptoms. Each and every game has three levels, one level runs approximately ten minutes and check at least five symptoms using tasks (one game level has 5 tasks). Each task has three thing to do and if child do them wrong the number of things to do is change to five.

For each game, user interactions will be saved in a cloud database server, after child play one level, they won't be able to play it again until they finishes the whole game series. Final conclusion is analyzed based on all details and send to the parents.

3.2 Project Development Process

We have decided to use prototyping model to carry out our project, as it enables to understand customer requirements at an early stage of development. It helps to get valuable feedback from the customer and helps software designers and developers understand about what exactly is expected from the product under development to give more accurate application.

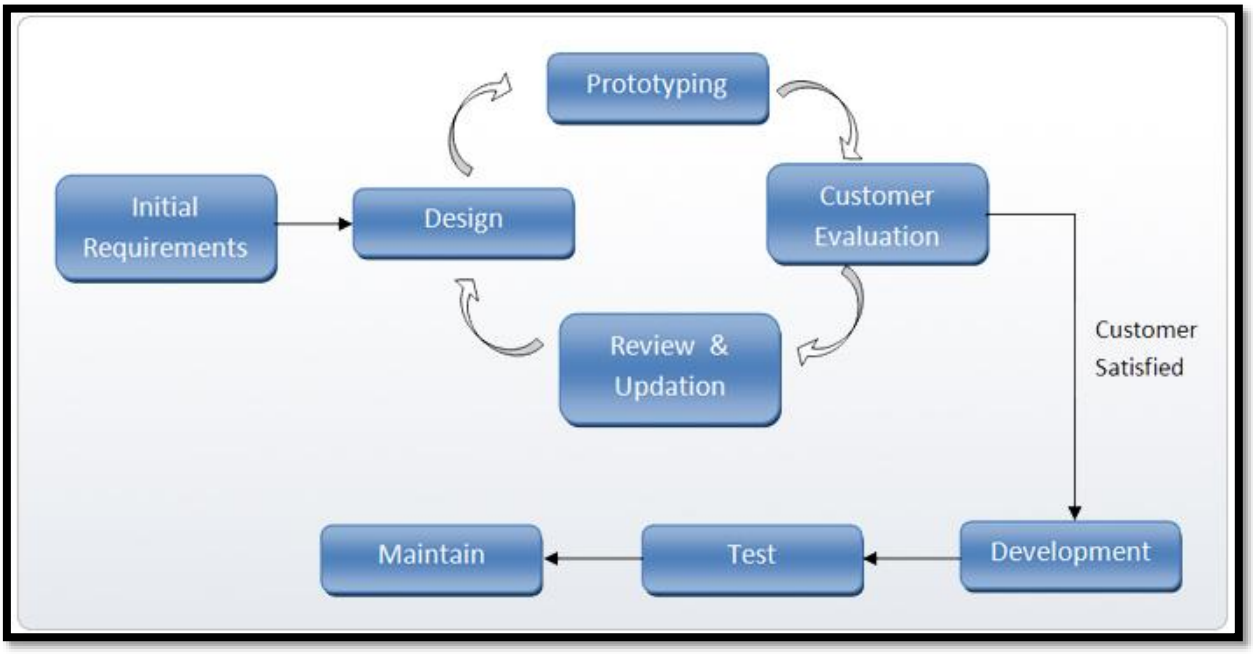

Figure 3.2.1 – system architecture "Prototyping Model"

The mobile gaming part is going to be develop in android and the Kinect games are going to develop in C# language with help of other necessary techniques and methodologies. The interfaces will be developed in a high interactive way with more user-friendliness. Microsoft visual studio 2013, Eclipse 4.3.1, SQLite, Android SDK and .NET framework are the some development tools that going to be used. We plan to develop our evaluation kit in prototyping model. When we consider about the software development life cycle we decided that prototyping model is matched very well to our system. Because after developing a part of the system we have to analyze again whether the application is match for a child and whether it can achieve the expected goal of the project.

3.3 Research Components

Our learning disability evaluation kit is divided into four modules to achieve the goal in development. All four modules cannot be developed as isolated projects because even though the modules are divided there is a huge interconnection between these modules. Every module is closely attached to another module to in many ways. The Proposed modules in the system are:

1. Design game algorithms that will use to identify each disability.
2. Design disability analyzing algorithms
3. Change the game behavior while playing.
4. Identify hand gestures and body movements using Kinect game

These modules are collectively help to build a best application to achieve our main objective which is the identify learning disabilities of a child.

3.4 Information Collecting

To carry out this project successfully and accurate we need many information in many ways,

- **Information to check the feasibility of this project**

  For check the feasibility of this project we had to meet with supervisors and describe our idea to them. And ask about their opinion and feasibility of this project to finish up in given time to given goal. We have given more ideas from our lectures and we have done a literature survey on internet about this related system and according to those details we analyze the feasibility of our system.

- **Information about Learning Disabilities and testing methods.**

  There are many resources in internet about these disabilities. Since we hope to develop this system for Sri Lankan students we need details from specialist doctor in this area. Therefore we met with director of Lady Ridgway children hospital Borella, and through him we got chance to meet child psychiatric specialist Prof.Hemamali Perera. Having brain storming sessions with her we have collected details about how they identify this issue in our children and methods they use for it. And further she has explained some more ideas to include in our proposing system.

- **Behavior of children in age 3 to 6**

  We need the information about preschool children. To what extent they fluent in alphabet, their normal vocabulary, their knowledge in mathematics, how fast they have mood swing and etc. To collect these data we plan to visit some preschools and interview teachers and get above information.

- **Accuracy of proposed game series**

  We planning to draw sketches of games first and show them to our supervisor and then show them to Prof.Hemamali perera. She will check them thoroughly and give some changes to do. And finally we will copy those sketches as a book and give to children who have been identified as children with LD. By observing the way they are playing it we will identify issues to be correct. To do so, Prof Hemamali has given chance to work with children in 19^{th} ward (Psychiatrist ward) in Lady Ridgway children hospital.

- **Analyzing methods of disabilities**

  By using observations of children interactions with the games, we do statistics about each symptoms and find critical points to taken for analyze these disabilities. We will discuss analyzing methods of our games with Prof Hemamali and with her advices we well design our analyzing algorithms. And also discussions with our supervisor and co supervisor we will polish our analyzing algorithms to be more accurate.

- **Product accuracy**

  We plan to test our final system using two kinds of children. First we plan to test final application with children who are positive to these issues and check whether system is working properly. And secondly we will test it with normal students to test whether its give the expected result.

3.5 Main Tasks and Sub Tasks

- Do background research and identify research problem

  Team had to do thorough research on this area and clearly identify the problems to address and plan how to address them.

- Gather information

  Team has to meet up with specialist doctor and gather details about learning disabilities; standard methods used to identify them, symptoms of learning disabilities and etc. And also has to meet with primary school teachers to gain knowledge in children normal learning abilities in age group 3 to 5.

- Design game algorithms that will use to identify each disability.

  According to symptoms of learning disabilities game should be designed. And child shouldn't be getting any confusing situations. Therefore these games should be designed in a way that cover symptoms of learning disabilities and very interactive way for children to get interested in game and play it without any mood changes or getting dormant.

- Check accuracy of games

  Team has to make sketches in designed games as books. And give those books to children and observe their interaction with game and identify thins to be correct and improve in design before develop.

- Develop games in android environment.

  Designed games have to be developed using android game engines. Android games basically identify three learning disabilities which are Dyslexia, Dysgraphia, and Dyscalculia. Android games will check child ability in reading, writing and mathematics.

- Design disability analyzing algorithms

  These disabilities have unique symptoms. By the way of playing, system must be able to give the condition of user. Whether user positive or negative for these disabilities. For this analyzing part, have to develop sequence of algorithms.

- Change the game behavior while playing

  By analyzing the way of playing system gives indications to game. According to these indications game changes its behavior. Ex - While playing if child shows some symptom like trouble recognizing printed numbers, game will change to confirm it.

- Identify hand gestures and body movements using Kinect game

  Dyspraxia is based on coordination problems. Therefore using Microsoft Kinect, motion detection games will be developed to identify motor skills in children.

3.6 Hardware and Software

❖ Tablet PC

A tablet computer, or simply tablet, is a mobile computer with display, circuitry and battery in a single unit. Tablets are equipped with sensors, including cameras, microphone, accelerometer and touchscreen, with finger or stylus gestures replacing computer mouse and keyboard. The fore to work with a tablet a person does not need a high computer literacy. For our project we will be using android tablets which will runs Android OS.

❖ Kinect Device

Kinect is a line of motion sensing input devices by Microsoft for Xbox 360 and Xbox One video game consoles and Windows PCs. Based around a webcam-style add-on peripheral, it enables users to control and interact with their console/computer without the need for a game controller, through a natural user interface using gestures and spoken commands. Children can interact with this device without difficulties.

❖ Graphic Software

Since we are developing games, we need much graphical software. We will be using Adobe Photoshop CS6, Adobe Illustrator CS5 and Microsoft Blend software for designing and animation.

❖ Developing platforms

Android games develop on eclipse IDE using Android game engine tools and Kinect games will be developing using Microsoft visual studio 2013 and Kinect Developer Toolkit vesion 1.8.0.

❖ Web Server

Main web application is hosted in a Linux based web server which support PHP 5.3+ and MySQL 5.5 and SQLite 3.8.3.

3.7 Anticipated Conclusion

The Learning Disability Evaluation Kit is going to be first evaluation kit for all four learning disabilities that based games. This evaluation kit is target for kids in age 4 to 6, especially pre-school kids to ensure that kids suffering or not these disabilities. This evaluation kit consists of set of story type games, these games play using android Tab-PC and PC, PC games are use Kinect. The games are design including attractive colors, game instructions are voice based and very understandable. Because of the difference of these games kids get more attention about this. The games have lot of levels and tasks therefore the evaluation report become very accurate.

3.8 Milestones and Gantt Chart

We have to have a good time plane to accomplish this research project. So we have to allocate time frames to all tasks and sub tasks of the project. When achieving our goal we have to pass several milestones. We need to have a work breakdown structure to achieve the final goal.

- Project proposal
- SRS documentation
- Prototype
- Mid Review
- Final & Viva

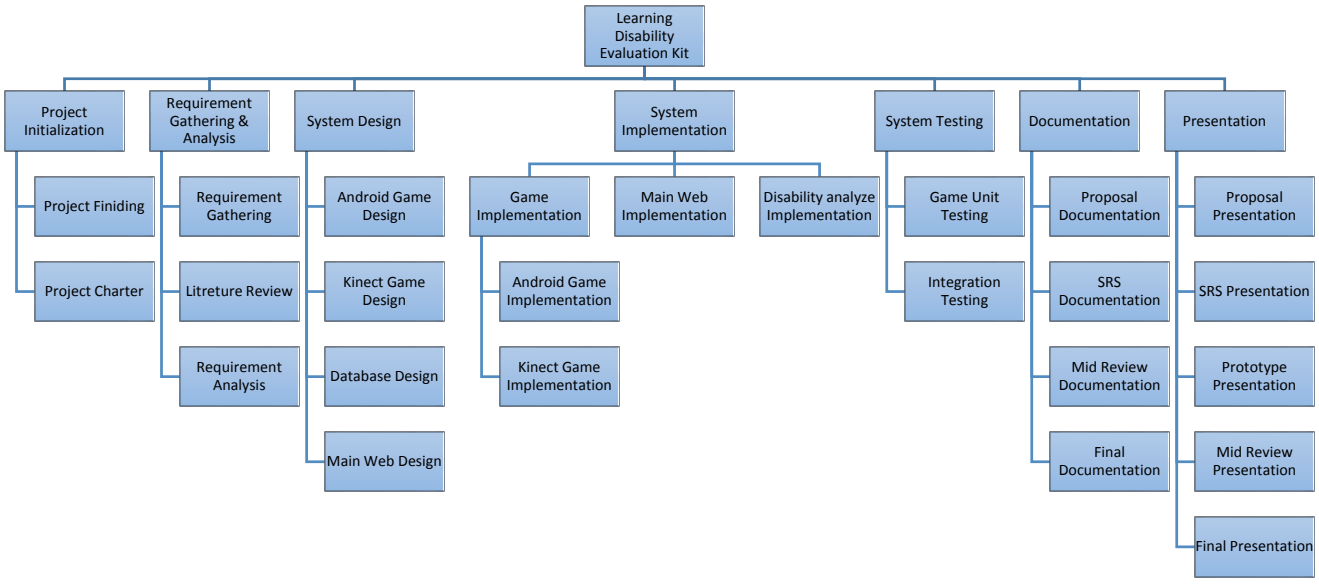

Figure 3.8.1 – Work Breakdown Structure

4. Description of Personal and Facilities

In order to achieve a successfully developed system, team collaboration is essential. Each and every member of the group should contribute equally and they are mutually accountable for successfully complete whatever task they have individually assigned and thereby achieving their common objectives. Team is a mix of different people with different skills in the different areas. Therefore it is a joint effort. Team members should pay their attention to each other, share their knowledge, and respect each and everyone's individual talents and capabilities. Within a team there are personal roles responsibilities. Different fields and areas have to be followed in order to come up with the final project. Therefore each field has to be studied to get the idea. Basically all members in a project team have to involve in all the activities in the project and they should be getting together and work for achieving common understanding and common vision. Therefore all members have the overall understanding of the project activities.

Student ID and Name	Special areas & Responsibilities	Recourses
T.C.P Kularathna IT11169086	• Team lead • Database Designer & Developer • Programmer • Researcher Research Component - Change the game behavior according to the user interaction while playing.	• Eclipse • Android SDK • SQL

L.C Kuruppuarachchi
IT11170044
	• Technical lead
	• Structural Designer
	  ○ High Level design
	  ○ Low level design
	• Software Developer
	
	Research Component – Design and implement game algorithms that will use to identify each disability.
		• Eclipse
		• Android SDK

W.M.S.S Wijekoon IT11176398	• Main UI Designer • Technical Support • Software Developer • Graphic Designer Research Component - Identify hand gestures and body movements using Kinect game	• Visual Studio 2013 & .Net • Photoshop CS6 • Kinect Technology
W.A.M Kulamini IT11186434	• Architectural Designer • Android UI Developer • Mobile Application Developer Research Component - Design and implement disability analyzing algorithms	• Eclipse and Android SDK

Table 4.1 – special areas & responsibilities

Other than specific areas mentioned above for each member, researching and documentation will be done by the whole team. The testing and bug fixing for each area will be handled by the person responsible for that module. The final system developed will be tested and evaluated by the whole team.

External professional assistance

Prof. Hemamali Perera. MBBS, MD (Psych), FRCPsych

She is Professor in Psychiatry division in University of Colombo medical faculty. Also she currently provides her service as a Consultant Child Psychiatrist in Lady Ridgeway Hospital Borella. She helps us with her knowledge in Learning disabilities and providing test objectives to test our applications.

5. Budget and Budget Justification

Expense	Amount (Rs.)
Mobile and Hard ware accessories Microsoft Kinect	 25,000.00
Travelling Charges Lady Ridgway Hospital (for all 4 members, to visit hospital 10 times, Rs. 90.00 per one member) Pre-school Visit (for all 4 members, to visit preschool 8 times, Rs. 60.00 per one member)	 3,600.00 1,920.00
Miscellaneous	5,000.00
Total	**35,520.00**

Table 5.1 – budget

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