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Interim report

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Open Crowdsourcing

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Summary

Dyslexia is a learning disability that affects the brain in processing words and graphics [1]. Children with dyslexia have difficulties in learning languages in school. In Hong Kong, 9.4% to 12.6% of children were identified as dyslexic and suffering from symptoms of dyslexia [2]. They ought to receive proper supports in order to learn the languages more efficiently.

The interim report provides details on the current progress and future tasks of the final year project. A mobile application, DyslexHero, will be developed by Unity. It aims to evaluate the cognitive abilities of children and provide training to them. Research shows that the earlier intervention the dyslexic children receive, the better the improvement to be achieved [3]. Therefore, the project targeted at preschool to kindergarten children because they learn the most effective in their early stage of education.

As the dyslexic children are generally weaker in phonological awareness, processing speed, orthographic awareness, working memory and memory span [4], several game exercises are designed for testing and improving their abilities in above areas before they attend the primary school. The games exercises serve as training to improve children reading and writing abilities. Through the concept of open crowdsourcing, the weaknesses of dyslexic children will be analyzed from the game results.

The current status is that it has passed through the Inception phase and undergoing the Elaboration phase. We have planned the development of the project outline. The game exercise of the mobile application has been designed. The database and the server have been developed to process the request from application and stores the game results in the database. Moreover, the data analytic dashboard has been implemented to visualize the children's performance. One of the five games has been implemented in the mobile application. The games are also pending for adjustment of the difficulties and optimization on the UI interface to attract the children to play DyslexHero.

Acknowledgement

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List of Abbreviations

I/O	Input/Output
LTS	Long Term Support
SEN	Special Educational Needs
SpLDs	Specific Learning Difficulties
TTS	Text To Speech
UI	User Interface
VPS	Virtual Private Server

1. Background

In traditional Chinese thought, the children who learn, write and read slowly are always being branded as “lazy”. However, there are many possibilities that could lead to troubles with learning. One of the common possibilities is dyslexia. Dyslexia is one of the Specific Learning Difficulties (SpLDs). Children with dyslexia not only have difficulties in reading and writing, but also have difficulties in pronouncing multisyllabic words and distinguishing words with similar sounds [4]. Most of the people are unfamiliar with dyslexia, or they neglect the importance of intervention. They might not consider bringing their children to have a formal screening test. Even they wanted to, the screening test may cost several thousand Hong Kong dollars which are not affordable to lower-income families. Therefore, a simple, free-of-charge, easy-to-use application is necessary for testing their children and alert the parents for signs and symptoms of dyslexia in advance.

According to research by Foorman, Francis, Shaywitz, Shaywitz, and Fletcher (1997), for the children with SpLDs and receive intervention in lower primary school, the success rate is 82%. For third grade to fifth grade children, the success rate is 46% but for the higher grade student, the success rate drops to 10%-15% [3]. The research concludes that it is better to notice children’s learning difficulties and receive intervention as early as possible. However, one of the biggest problems is that it is difficult for the parents to observe the learning problem of their preschool to kindergarten children because they are not required to spell and write very often. As they do not have much homework, they are more likely to learn during school rather than at home. Also, class teachers may not be able to identify the student with specific learning difficulties among a large group of students.

In this project, a new set of training games will be designed for preschool to kindergarten children. It will be a user-friendly application for children and parents. The application can evaluate the children’s performance in different abilities. The difficulty of the training games depends on their educational level. Improvement will be shown if the dyslexic children complete the game sessions regularly. Even though the children may not know how to read and write, there are certain methods to test their abilities. For example, although preschool children have not learned alphabetic letters yet, their orthographic awareness could still be assessed by treating the letters such as “p” and “q” as an image or giving them the actual pictures. There will be no pass-fail line or specific standard to diagnosing dyslexia in children. However, with the crowdsourcing features, it should be able to analyze their level by comparing a large group of children in same age. They could easily find out their strengths and weaknesses in different abilities. The best result of the application will be that the children can achieve significant improvement by playing the games continuously and can study normally without consulting the therapy. However, parent can still decide to bring their children to a formal assessment if their performance is generally weaker than same-age children.

The web analytics dashboard is part of this project. It provides interactive charts on gender, education level distribution and the average score on individual game. It makes the analysis of the game exercises and children's performance easier and more efficient.

For the long term, after collecting sufficient data, it should be able to discover the weakest abilities of the dyslexic children in Hong Kong and find the most effective training method to help them. The collected data could also help researchers to design a better assessment method by analyzing the incorrect answers from the children.

The following paragraphs provide the details of the project, which includes the objectives, previous works evaluation, system design, game application content, deliverables, work accomplished, difficulties/limitation encountered, and future tasks.

2. Objective

The main objective of this project is to create a mobile application to improve the cognitive abilities of dyslexic children, helping them to adapt to learning in school. The application will provide games to determine the severity of dyslexia on every child. Through playing the games continuously, the children gradually develop their cognitive abilities. The rate of improvement for the games are recorded and the difficulties of games will be adjusted according to the rate of improvement. It will also help investigating the symptoms of dyslexia and raising the awareness of dyslexia to Hong Kong people. Also, a web analytics dashboard is created to visualize the game data and present the founding from the game results.

To investigate the symptoms of dyslexia, a large sample size of research materials is required. The materials for investigation are the incorrect answers given by the children in training exercises. From the large variety of game results collected, it is possible to discover the common mistakes made by children and understand the weakness of dyslexic children. By understanding the viewpoint of dyslexic children, it will be easier to develop learning tools for them and a better assessment method for dyslexia. Dyslexic children have difficulties in phonological awareness, processing speed, orthographic awareness, working memory and memory span. Analyzing the results of the exercise allows researchers to understand which abilities dyslexic children perform the worst and understanding which ability dominates the symptoms of dyslexia. The research facilities an improved strategy in dyslexia training. Dyslexic children can improve their abilities using suitable time on each area to maximize the efficiency of training.

The parent panel facilitates more parent-children interactions and monitors the results of the children. It is important in following up children's performance. From collecting the scores of each game played, an average score will be calculated. It serves as a normal standard for children's abilities. Parents can compare the results of their children with the normal standard to check whether their children having symptoms of dyslexia. Therefore, parents can keep track on game result and understand their children's situation. The result will be kept secret since this project hopes to help dyslexic children to build confidence in learning and will not be discouraging dyslexic children by showing the game results.

The web analytics dashboard first helps the developers to understand the children's performance by plotting the improvement rate of each game. The difficulty of the training exercises was originally designed to suit the educational level. And the developers will adjust the difficulty of the games after analyzing the effectiveness of the game exercise on the specific educational level. Moreover, researchers that study on dyslexia can also access to the web system to understand the characteristics of dyslexia, like the common mistakes and their features.

3. Previous Works Evaluation

In the mobile application market, there are some previous works that help children with Special Educational Needs (SEN) to train their cognitive abilities to facilitate better learning process. Some are listed as follows:

- Galaxy Maze (Android) [6]

The mobile application helps the children with SEN to improve their memory and concentration through visual perception. The parents are able to interact with children by providing missions for children and adjusting the starting point in the game. However, the interface is monotone and only one game mode can be selected to pair identical objects. Users suffer from duplicate game experience and reduce the interest in playing the game after some time.

- Dyslexia Quest (iOS) [7]

The mobile application is specially made for dyslexic people which provides six different games for testing memory and learning skills. The interface is attractive and the game flow is smooth. The game analysis is clearly explained in terms of different abilities. However, the game targets people whose native language is English. People who have other native languages are difficult in playing some of the games. The overall idea and game design are nice. However, the application is not general enough and not designed for preschool and kindergarten children.

- Dyslexia Therapy (Android) [8]

The games are suitable for children to play since they are simple and instructive enough. However, it is bound with another software Adobe Air in order to start the game which is not independent and convenient. And the games are not smooth and attractive.

From the previous works, developers implement different ideas in games to assist the students with SEN to improve their learning ability. The general disadvantages experienced from previous works are the unattractive interface, insufficient game modes and repeated game content. This project should avoid making the same mistakes and take advantages of the good features of previous works.

Features like parent panel and the games which training different cognitive abilities are worth as reference and to be implemented in this project. Performance analysis is another good feature that should be implemented in this project. The children's abilities can be clearly shown and parents can compare children's performance easily. Finally, since the project targets preschool to kindergarten, the interface must be interesting and colorful to attract them for continuous training.

4. System Design

In this session, it explains the system design including system architecture, methodology and approach used in this project.

4.1. System Architecture

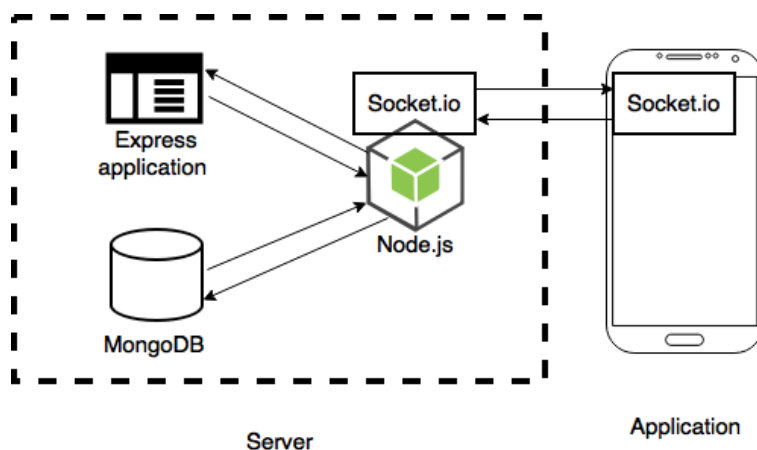


FIGURE 1 - SYSTEM ARCHITECTURE

In this project, it has a client-server architecture (Figure 1). It mainly constructed by four components:

I. Node.js

It is an open-source JavaScript runtime environment. It is used to build the server in this project for handling requests from the application, storing and receiving data from MongoDB.

II. Socket.io

It is a JavaScript library that enables bidirectional event-based communication. One part of Socket.io is used as a server-side library for Node.js server. Another part is for the client-side application.

III. MongoDB

It is an open-source, document-oriented database program. It is used to store all the data in this project including user registration information, players' scores and game questions.

IV. Express Application

It is a flexible and minimal web application framework based on Node.js. It is used to invoke series of middleware functions and to visualize the game statistics.

Why Node.js and MongoDB?

Node.js is not the only way to implement the client-server architecture. Another common method is using PHP with MySQL. PHP is widely used and easy to learn. Node.js is a low-level technology, so it is complicated than PHP. However, Node.js is using an event-driven and non-blocking I/O architecture which is able to handle concurrent requests. If the application requires a lot of I/O requests, Node.js will be faster. To test the performance of Node.js and PHP, the response times for handling 200 HTTP requests were recorded (Figure 2) [9]. Node.js took 175.535 seconds to respond all the requests and PHP took 711.790 seconds. Node.js was four times faster than PHP when handling many concurrent requests. Since this project requires to implement the crowdsourcing process, a high performance approach is needed for data collection and analysis. Therefore, Node.js is more suitable for this project.

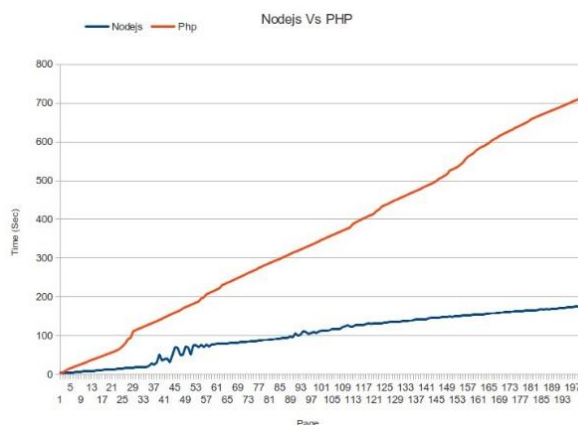


FIGURE 2 - NODE.JS VS PHP PERFORMANCE

Besides the server scripting language, the choice of database system can also affect the performance. Node.js and PHP are usually connected with different database systems. MySQL is the most popular relational database used with PHP. On the other hand, Node.js is natural with NoSQL databases such

as MongoDB. Therefore, MySQL was also compared with MongoDB. The performances of MySQL and MongoDB were tested by handling multiple INSERT and SELECT queries, which are the most common queries that will be used in this project. The response times for handling 10000 INSERT queries are shown in figure 3 [10]. The response time of MySQL was 440 seconds and MongoDB was 0.29 seconds. For testing the performance of SELECT query, 10000 users and 5000 discussion topics were previously inserted. There were two SELECT queries tested, the first one is to select all discussion a user attended, and the second one is to select all users and the number of discussion started by each user [10]. The result is shown in figure 4 [10]. For the first query, the computation was simple and the response times were nearly the same. For the second query, the computation was much more complicated than the first query. The response time of MySQL was 0.6478 seconds and MongoDB was 0.0052. Therefore, no matter handling INSERT or SELECT queries, MongoDB had a better performance than MySQL.

MySQL and MongoDB are usually used in different situations. MySQL is better than MongoDB when the application involves complex transactions, such as bank account transfer and reservation system. MongoDB is better than MySQL when it involves rich data model and dynamic schema. As it has a higher flexibility and scalability, it is suitable for handling data analysis.

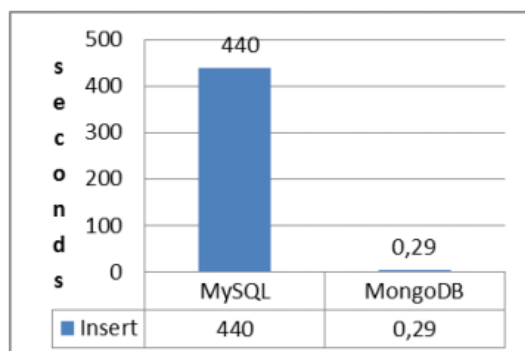


FIGURE 3 - MYSQL VS MONGODB INSERT

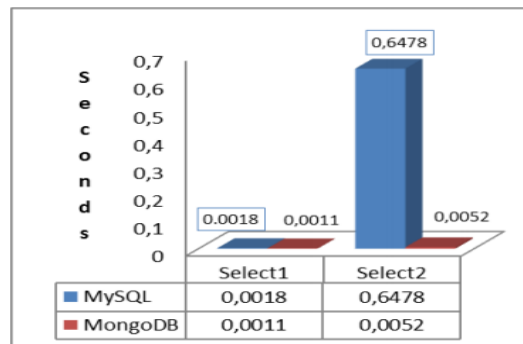


FIGURE 4 - MYSQL VS MONGODB SELECT

After comparing PHP with Node.js and MySQL with MongoDB, it is decided to use Node.js with MongoDB as the server model in this project for the following reasons:

- I. Higher flexibility
- II. Higher scalability
- III. Higher performance when processing big data

4.2. Methodology

4.2.1. Handwriting Recognition

The handwriting recognition function will be implemented by a computational model of artificial neural network. Artificial neural network is organized into three layers, which are input layer, hidden layer, and output layer (Figure 5) [11]. The model is inspired by biological neural networks. The nodes in each layer could be considered as neurons. The set of nodes in the input layer would be the pixel of the handwritten image. The neurons in the input layer will send signal to the neurons in the hidden layer. The neurons in the input layer will be activated if it detects the colour in that pixel. The strength of the signal depends on how many neurons are activated and the weight of the connection. The hidden layer, after summing up all the signals received from the input layer, will apply the activation functions. The resulting signal will be sent to the neurons in the output layer, which represent the letters/digits.

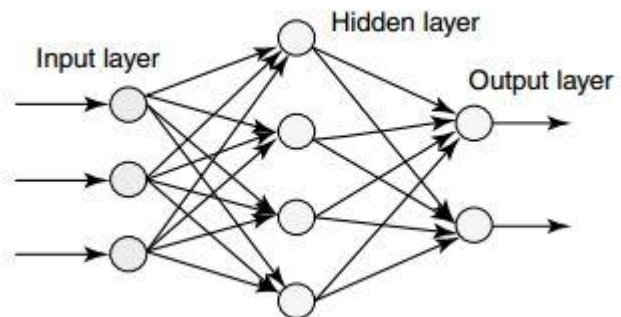


FIGURE 5 - MULTI-LAYER ARTIFICIAL NEURAL NETWORK



FIGURE 6 - EXAMPLE OF NORMALIZED DIGITS FROM THE TESTING SET

The model is just like a newborn baby and it needs to learn to recognize the letters and digits. Therefore, the model needs to learn from examples (Figure 6) [12]. For example, it learns by giving it a digit and letting it guess what digit it is. Then, it compares the correct answer with its guess. The weight of the connection will be adjusted after each time of training. In order to train the model, it requires a large amount of example. There are several datasets available online. MNIST database contains more than 60000 images of digit (0-9) [13] and NIST Special Database 19 has over 810000 of letters images (a-z, A-Z) [14]. These two datasets will be used in training the model in this project. The children's handwriting will also be collected for improving the accuracy of the system.

4.2.2. Question Generation

Dyslexic children have difficulties in processing words and graphics. When they read, they see at a different viewpoint than the others, causing them difficult to recognize and remember words [15]. For example, they get confused with “p” and “d”, “mood” and “doom” [16]. For example, in the writing game, children write the characters as the requirement of the game. Those wrongly written characters are good example of wrong recognition of dyslexia and will be reused in reading games. In the reading game, user is needed to choose a correct answer among several incorrect answers. The wrong answers come from the writing game. Figure 7 shows examples of words generated from the grouping of characters. Thus, more questions can be



FIGURE 7 - TEN VARIATIONS OF WORD "TEAPOT" AS WRITTEN BY DYSLEXICS

automatically generated. In theory, infinite number of questions can be generated if more and more children play the first game. This makes the game contents flexible and interesting because players will experience new questions every time they played.

4.2.3. Data Visualization

Data Visualization is implemented on the web analytics dashboard. D3.js is the main tool used for render graphical objects on a web page. It is a JavaScript library that applies data-driven transformations to the document. Those documents are fetched from MongoDB. Crossfilter and dc.js are also acted as the key libraries for making the interactive charts. Crossfilter provides an extremely fast way to manipulate data. Dc.js supports different types of charts such as bar chart, line chart and pie charts. With the combination of these three libraries, the web analytics dashboard can provide fast, efficient, and user-friendly data analysis.

4.3. Development Platform

The Node.js server, database and web application are hosted in a Virtual Private Server (VPS) provided by DigitalOcean. The operating system of the VPS is Ubuntu LTS 14.04. Express framework is used for developing the web analytics dashboard.

Unity is the main development platform used in the game application. It supports cross-platform game development for Android, iOS, Windows, Linux, etc. It also supports C# and JavaScript programming languages. Unity Community provides a lot of assets and tutorials which are a good reference for the project. Testing platforms of the application is an iPad mini with iOS 8.

5. Game Application Content

The main functions of the application are the game exercises and parent panel. Initially, the application requires users to complete a first-time registration. They need to enter the children's name, gender, age and education level before the application is functional.

5.1. Game Design

The difficulties of the games exercise will be determined based on their education level and it will be divided into three stages: Beginner(preschool), Intermediate(K1-K2) and Advanced(K3). It includes 5 game exercise and each game corresponds to one specific category of weak abilities. All the questions in each category are randomly generated. The children will be required to play all the games once before they can freely play the game exercise. As the target users are young, they may not be able to fully understand the written instructions of the games. Therefore, the games will involve verbal instructions. A text-to-speech (TTS) extension will be used for generating voice dialogue. The details of the game exercise are as follow (Table 1):

TABLE 1 - GAME CONTENT

Category	Meaning	Game Content		
		Beginner(preschool)	Intermediate (K1-K2)	Advanced (K3)
Phonological awareness	the ability to manipulate meaningful sounds in human languages	Word Discrimination: identify whether two words are the same or different	Rhyme Recognition: identify whether two words end the same or rhyme	Word Discrimination and Rhyme Recognition: identify whether two words are same, different or rhyme
Processing speed	the ability to solve problems or tasks quickly	Visual Scanning Task: showing three type of objects with different color, ask the user to drag the specific objects on the screen and drop it to specific area as quick as he/she can	Visual Scanning Task: showing four type of objects with different color, ask the user drag the specific objects on the screen and drop it to specific area as quick as he/she can	Visual Scanning Task: showing five type of objects with different color, ask the user to drag the specific objects on the screen and drop it to specific area as quick as he/she can

Orthographic awareness	the ability to form, store and recall words	Writing the Alphabets and Recognizing Letters: ask the user to write the letters of the alphabet in order, showing letters with similar appearance and ask the user to pick the correct one	Writing the Alphabet and Recognizing Simple Words: ask the user to write the letters of the alphabet in order, showing simple words with similar appearance and ask the user to pick the correct one	Writing the Alphabet and Recognizing Longer Words: ask the user to write the letters of the alphabet in order, showing words with similar appearance and ask the user to pick the correct one
Working memory	the ability to remember and transform the information at the same time	Message Transformation: three to five digits will be presented in sequence and ask the user to recall them in reverse order	Message Transformation: three to six digits will be presented in sequence and ask the user to recall them in reverse order	Message Transformation: three to seven digits will be presented in sequence and ask the user to recall them in reverse order
Memory span	the ability to receive the verbal information and repeat it in sequence	Span Task: present three to four tasks verbally and ask the user to do the tasks in sequence	Span Task: present three to five tasks verbally and ask the user to do the tasks in sequence	Span Task: present three to six tasks verbally and ask the user to do the tasks in sequence

5.2. Parent Panel

The parent panel is specially made for the parents to view their children's performance in the game exercise. After completing the game exercise, the application would find out the strengths and weaknesses of the children and shown in the parent panel. Also, the results will be uploaded to the database for calculating the average score among the students with same educational level. Parents can compare their children's result with the average score in a radar chart easily (figure 8). If the score is significantly below average, the parent may consider taking further actions.

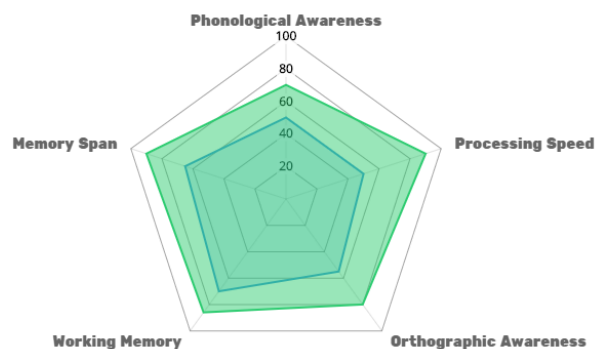


FIGURE 8 - A RADAR CHART SHOWING A CHILD'S ABILITIES

6. Deliverable

The deliverables of this project are shown below.

TABLE 2 - DELIVERABLE

Date	Deliverable	Description
2 October 2016	Phase 1 (Inception) - Detailed project plan - Project web page	Detailed project plan: It provides the project background, objectives and methodology in detail. Project web page: It provides the update of the project progress.
22 January 2017	Phase 2 (Elaboration) - Preliminary implementation - Detailed interim report	Preliminary implementation: The server, database setup, web analytics dashboard and basic functions of the game application are implemented. Detailed interim report: It reports the progress and implementation in detail.
16 April 2017	Deliverables of Phase 3 (Construction) - Finalized tested implementation - Final report	Finalized tested implementation: The application and the web system are tested and optimized. The implementation will be released and finalized. Final report: It includes all the details about the final project.

7. Work Accomplished

Currently, the project is running on schedule. The overall work accomplished is shown in the table below (table 3). The research on dyslexia, previous works and feasibility have been done and the project website has been set up. The prototype of the application has been finished. The server and database setup has been done. For the application, the first-time registration, interactive menu and one the five games have been implemented and tested. For the web analytics dashboard, the interface charts based on the data on mongoDB have been done.

TABLE 3 - WORK ACCOMPLISHED

Date	Work Accomplished		Assigned to
October 2016	Research on dyslexia, previous works and feasibility		All
	Project Website		All
November 2016	Prototype		All
	Server and Database Setup		David Chan
December 2016	Game Application	First-time registration	David Chan
		Interactive Menu	Enid Lam
		Processing Speed	Enid Lam
	Web Analytics Dashboard	Data Visualization	All

7.1. Server and Database Setup

The server of this project is Ubuntu LTS 14.04 server which has been installed in the virtual machine provided by DigitalOcean. The Node.js v6.9.2 environment and socket.io v1.7.2 have been installed in the server. The database system, MongoDB 3.0.14, has been installed. Mongoose is used as an object modeling package for Node.js.

The schemas of the data are defined as follow:

```
gameSchema = new mongoose.Schema({
  nthPlayed: {type:Number, min:0},
  date: {type:String},
  score: {type:Number, min:0},
  numOfCorrectTask: {type:Number, min:0}
});
```

```
var userSchema = new mongoose.Schema({
  uid: {type:String, trim:true},
  name: {type:String, trim:true},
  gender: {type:Number, min:0},
  eduLv: {type:Number, min:0},
  dateCreated: {type:String},
  proSpd: [gameSchema],
  phono: [gameSchema],
  ortho: [gameSchema],
  workMem: [gameSchema],
  memSpan: [gameSchema]
});
```

```
var letterSchema = new mongoose.Schema({
  png: { data: Buffer, contentType: String},
  noOfPlay: {type:Number, min:0},
  noOfChosen: {type:Number, min:0},
  status: {type:Number, min:0},
  dateCreated: {type:String}
});
```

```
var orthoSchema = new mongoose.Schema({  
  letter: {type:String},  
  image: [letterSchema],  
  correctWrite: {type:Number, min:0},  
  totalWrite: {type:Number, min:0},  
});
```

```
var phonoSchema = new mongoose.Schema({  
  rhymeWords: {type:Array},  
});
```

```
var dictionarySchema = new mongoose.Schema({  
  words: {type:String}  
});
```

The gameSchema represents each of the game records. The userSchema represents each of the users, which included multiple game records of different type of games. The letterSchema represents each handwritten image of the letter. The orthoSchema represents 26 letters, which included multiple handwritten images of each letter. The phonoSchema represents a list of rhyme words. The dictionarySchema represents each word from the dictionary.

7.2. Game Application

7.2.1. Starting Screen

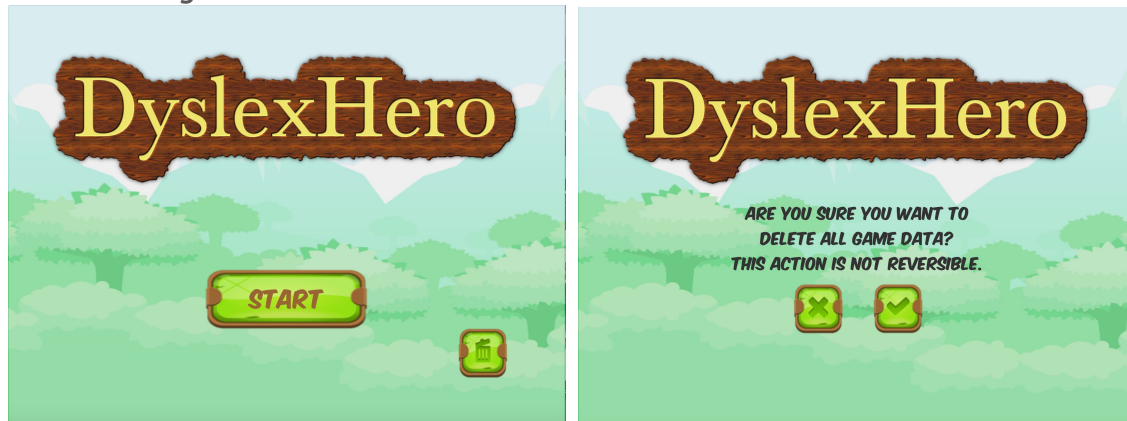


FIGURE 9 - STARTING SCREEN INTERFACE

The figures above show the starting screen interface. On the screen of the left figure, there are two buttons showing “START” and a garbage bin icon. When the user presses the “START” button, the system will check whether the mobile devices has created a record or not. If no record is found, it will proceed to 7.2.2.first-time registration. If a record is found, the application will be forwarded to 7.2.3.interactive menu. Otherwise, pressing the trash bin icon on the starting screen interface will pop up a message which is shown on the right figure. The system will need the user’s confirmation to delete the original game data stored in the mobile devices.

7.2.2. First-time Registration

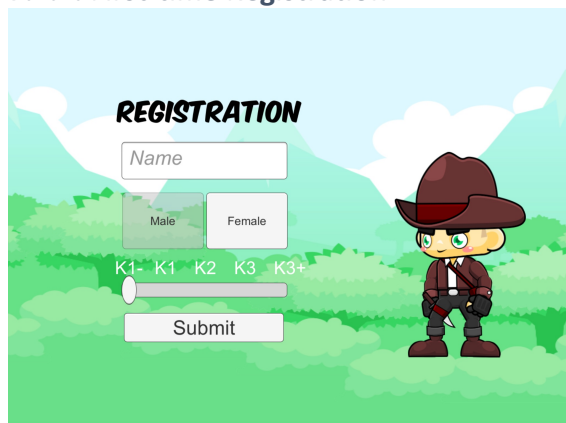


FIGURE 10 - FIRST-TIME REGISTRATION INTERFACE

The figure above shows the first-time registration interface. It is designed with a simple, user-friendly and colorful layout. The name field requires the user to input the name by an on-screen

keyboard. The education field requires the user to drag the indicator on the slider. The gender can be chosen by clicking the “Male” or “Female” button and the selected button will become transparent. After inputted all the required information, the user needs to click on the submit button. When the arrow button is clicked, the network connection will be checked. If the application successfully connected to the server, the user information will be passed to the server and stored in the database. Otherwise, the user is not allowed to proceed.

7.2.3. Interactive Menu

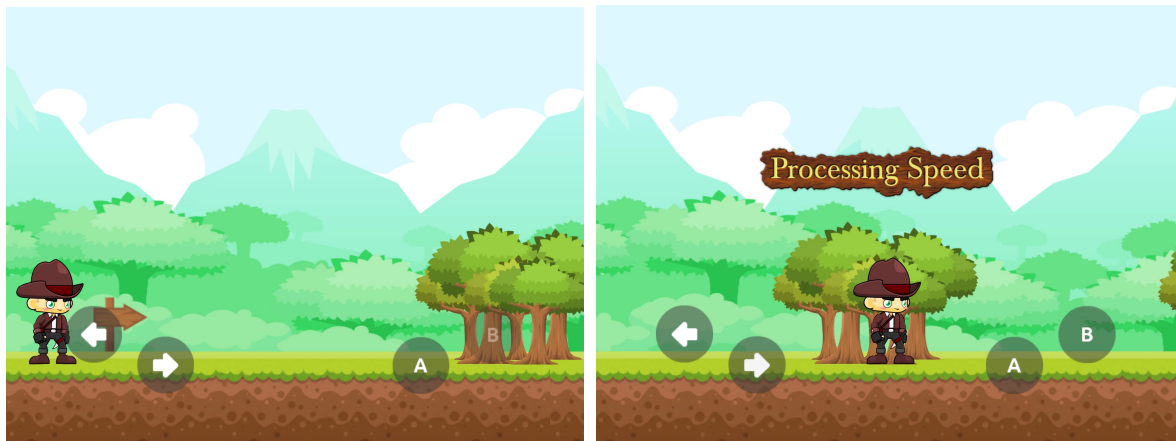


FIGURE 11 - INTERACTIVE MENU INTERFACE

In order to make the game more attractive and interesting, the game selection menu is designed to be interactive. The user can walk around by pressing the left and right arrow, or even jump by pressing the A button. The B button is used for entering the game or changing scene. When the character arrived the game selection point, the B button will become active.

7.2.4. Processing Speed



FIGURE 12 - PROCESSING SPEED GAME INTERFACE

The figure above shows the beginner level of the interface of the processing speed game. It tests the users by giving them visual scanning task. The objects on the screen have similar shapes or colours. The game requires the user complete the task within certain time. On the top-right corner, it displays a countdown timer. The game will end when the time is up. The task is showing on the board on the bottom-right corner. The full score of the game is 100. Each correct answer worth 5 scores. The final score will be the basic score multiplies by accuracy.

7.3. Web Analytics Dashboard

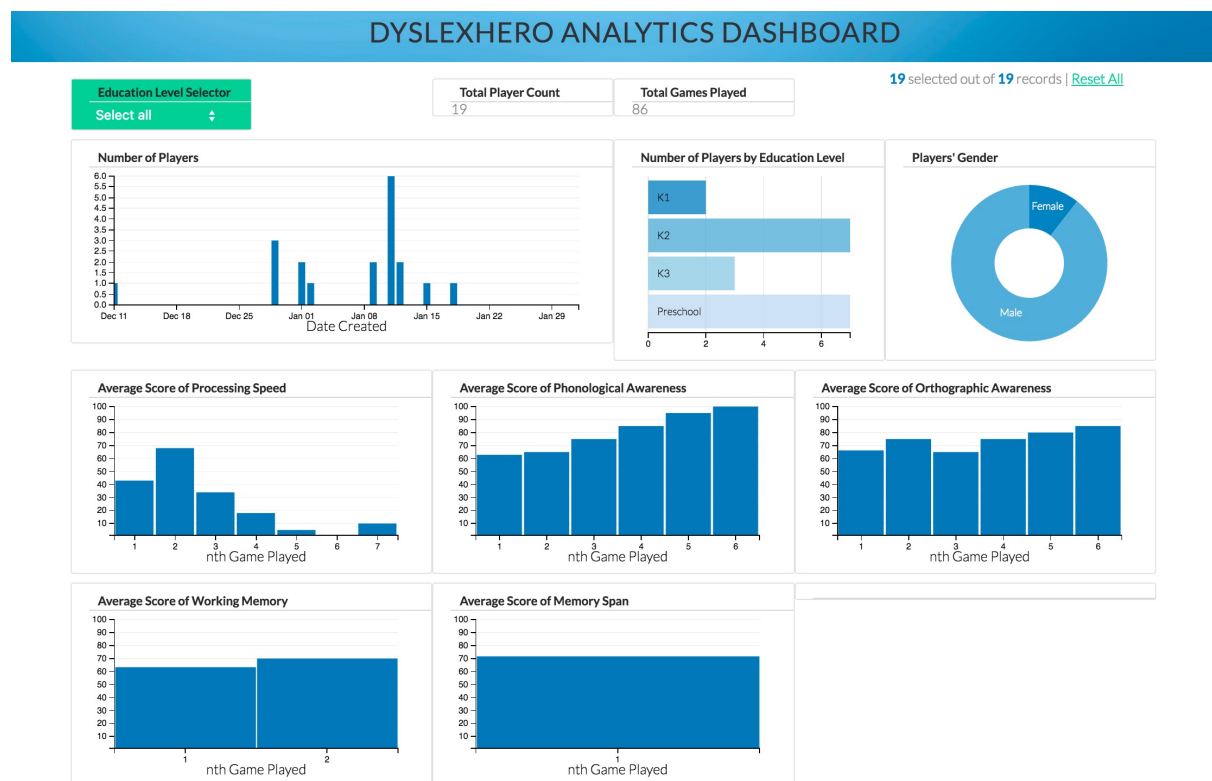


FIGURE 13 - WEB ANALYTICS DASHBOARD INTERFACE

The web analytics dashboard has two main functions:

1. Analyze game records and statistics (Data Visualization)
2. Show common mistakes from users

Currently, the first function has been done. The interface of the data visualization is shown above (Figure 13). The whole interface contains 8 charts:

1. Number of Players by Date Created (line chart)
2. Number of Players by Education Level (row chart)
3. Players' gender distribution (pie chart)
4. Average score of Processing Speed by nth Game Played (bar chart)
5. Average score of Phonological Awareness by nth Game Played (bar chart)
6. Average score of Orthographic Awareness by nth Game Played (bar chart)
7. Average score of Working Memory by nth Game Played (bar chart)

8. Average score of Memory Span by nth Game Played (bar chart)

Users of the dashboard can select one or more target groups for analysis by clicking on the regions on the charts. For example, if the user want to analyze the performance of K2 boys, then they can select “K2” on chart 2 and select “male” on chart 3. The result is shown in Figure n+1.

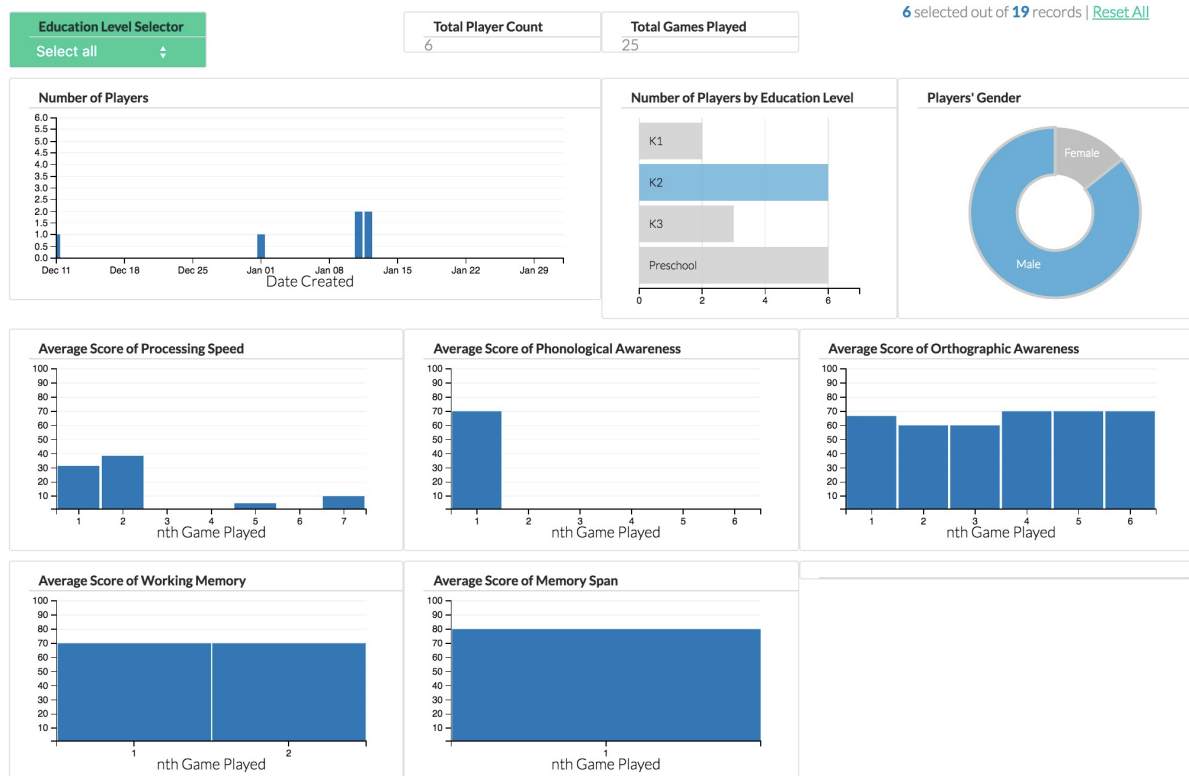


FIGURE 14 - RESULT OF SELECTING "K2" AND "MALE"

The non-selected regions will be changed into grey colour. The data on the other charts will change instantly which match with the selected groups. From the above example, it shows that there are total 6 players in the selected groups with total 25 games played by them. The improvement on Orthographic Awareness (Chart 6) is not significant. The expected result would be the more they play the higher the average score they get.

8. Difficulties/limitation Encountered

The difficulties/limitation encountered in this project are shown below.

TABLE 4 - DIFFICULTIES/LIMITATION ENCOUNTERED

Difficulties/limitation	Impact	Solutions
Insufficient data from the formal dyslexia screening test materials in Hong Kong for reference	Low	As the formal assessment tool in Hong Kong could only be used by registered educational psychologist and clinical psychologist, the team cannot access the assessment materials directly. Therefore, the game design will be based on the reference books in foreign countries.
Unfamiliar with the development tool	Medium	More time was spent on learning the development tool and estimating the feasibility of the project.
Difficult in considering the number of games involved in the mobile application. If the team decides to develop too many games, the team may not be able to finish it within the period of final year project	Low	Five mini games were decided because each game tests each of the five weak abilities of dyslexic children. They cannot be joined together because it affects the result of assessment or training. In order to ensure the progress of the game exercise, each game exercise would be in form of mini games to reduce the time of development.
Inconvenient in cooperating with a Unity project between members	Low	After discovering the problem, the team found that there is a latest beta version of Unity Collaborate. It allows small team to save, share, and sync the Unity project. Therefore, the team has joined the open beta to obtain this feature.

9. Future tasks

The future tasks of this project are shown below.

TABLE 5 - FUTURE TASKS

Date	Future Tasks		Status	Assigned to
January 2017	Game Application	Phonological Awareness	In progress	Enid Lam
		Orthographic Awareness	In progress	David Chan
		Parent Panel	In progress	David Chan
February 2017		Memory Span	TBD	Enid Lam
		Working Memory	TBD	David Chan
		Background music and sound effect	TBD	ALL
	Web Analytics Dashboard	Login System	TBD	Enid Lam
		Common mistakes analysis	TBD	David Chan
March 2017	UI Optimization		TBD	All
	Testing		TBD	All
April 2017	Poster design		TBD	All
	Finalization of implementation		TBD	All

10. Conclusion

By developing interactive and interesting application, dyslexic children can learn and improve their cognitive abilities through game exercise. It is hoped that with the free assessment, more parents can understand what dyslexia is and utilize the assessment features to spot the sign of dyslexia on their children. Parent-child interaction consolidates the relationship between them. The project aims to give help to the dyslexic children.

Besides, the web analytics dashboard act as a key tool for analyzing children's performance and evaluate the effectiveness of the games. With the feature of data visualization, the analysis process becomes easier and more efficient. Its facilitates the research of improving the efficiency of training by giving suitable training exercise.

Currently, the prototype of the application has been finished. The database and server has been set up on a VPS. The first-time registration function and one of the five games have been implemented and tested. The communication between the application and server can work normally and the message containing game result is successfully sent. For the web analytics dashboard, the charts can be successfully rendered.

Summarizing the report, although several functions have not been implemented, the project is progressing on schedule. Most of the difficulties encountered have been solved by the effort of the team. Future tasks will focus on developing rest of the games. More considerations on the game interface design and audio effects are needed to provide better game experience.

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Appendices

Appendix I: Flow chart of the game application

Flow chart of the application:

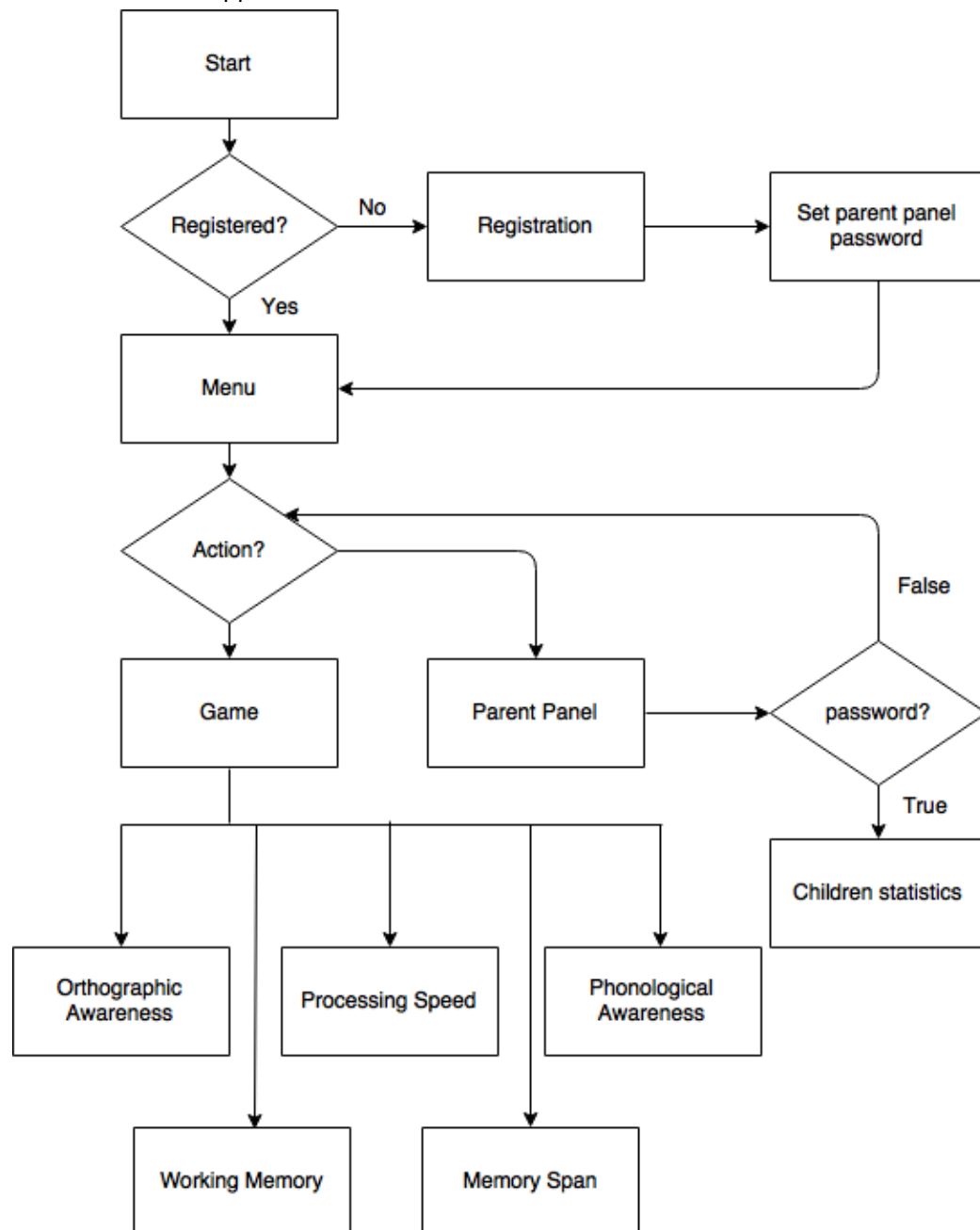


FIGURE 15 - FLOW CHART OF THE GAME APPLICATION