

# PODDANTA PULUWAN: Educational Game for Toddlers Based on Leap Motion Technology

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**Abstract-** Addict on to new technologies lead the children away from educational activities. The main problem is that will mainly affect to child's future because of the early childhood does not developed on correct way. Considering about this problem project development team implemented an educational base gaming application based on how to use technologies toward to better future by navigate children to educational activities and reducing time wasting for useless things through the modern technologies. Poddanta Puluwan is a windows tablet computer gaming application for children of 6-8 age category. The system was developed prototype methodology to implementation. There are many educational base gaming applications were developed using English language. The developed gaming application based on Sinhala language and includes many features. Application developed to improve child's cognitive skills in mathematical, language, decision making, and reading areas. Different game categories used to develop child's different kind of skills and each category included different levels. The variation of gaming categories will be motivating child to do different sides. Most of the children showing negative feedback about educational applications. To avoid that, application uses leap motion technology to detect inputs and this will make the child, feeling interesting about application. When considering about parents, within the busy life style some parents have not time to check child's skills improvements. As a solution, developed application calculates brain development. Application will navigate children to other activities to stop addicting.

**Index Terms-** Toddlers, Educational base gaming applications, Cognitive skills, Leap motion technology

## I. INTRODUCTION

In the modern world, children are practiced to use smart devices with the development of the technology. Most of the children are using their parent's electronic devices like smart phones, tablets as a habit. Because of that, children are addicted to these devices. Those children use these devices to waste their time instead of taking advantages from them for educational purposes. This will directly affect to child's knowledge and their skills. As a solution for this problem this educational base gaming application is developed based on Sinhala language. Application will provide a game that preferable for age 6 to 8 children. It includes different educational areas to improve children's mathematical skills, reading skills, decision making skills, memorization skills etc. Application detects the improvements that had happen to child through the game by keep tracking of child's activities. Application provides several levels with different areas which increase the knowledge of the child

step by step. To make easier to play this game project team developed it using leap motion technology. This technology will attract children to this game application. Application provides instructions/ advices to child to reduce game addiction and motivate to do other activities. This application will be helpful for children to use smart device towards educational purposes.

Most of the researches carried out in the children's game development field are focused only on the game and entertainment. There are less number of game applications to keep track of child's improvement rate or mind growth rate along with gaming and entertainment. And there are no such educational gaming applications in motion detection area.

Objectives of this research project are,

- To identify the gaming characteristics that effect on a child's education.
- To identify the features to be added to a gaming application to improve a child's knowledge that entertainment purpose.
- To define rules to control game addiction.
- To develop an educational game based on Leap motion technology to attract toddlers.
- To identify cognitive skills can be improved via a gaming application.
- To develop an algorithm to measure the performance of a toddler.

The rest of the paper is organized as follows. Section 2 has provided the background through the Literature Review. Section 3 describes the methodology of this system. The discussion of the developed system has described in Section 4. Section 5 contains results of this research. Finally, the conclusion is discussed in section 6.

## II. BACKGROUND AND RELATED WORK

### A. Children Educational Applications

Sinhala language is one of a most difficult language to pronounce and write. In this position, technology is the most effective way to teach Sinhala alphabet to Children. There are only few modern technological solutions for enhancing the learning experience of Sinhala Language. A Mobile Application with Augmented Reality to Enhance Sinhala Learning Experience for Children, was a solution is focused on teaching Sinhala alphabetical letters to children and improve their language fundamental knowledge using augmented reality. The android application implemented by prototype methodology and application provides AR 3D Sinhala letters with animations, pronunciation. The problem of

this research is there is no such away to predict child's improvement [1].

Currently considerable numbers of mobile applications are available to accomplish educational purposes, but not improving child's cognitive skills. Considering about this OntoCog: developed for improve Cognitive skills and English knowledge of preschool children. Mainly this includes classification and relatedness in addition with memory skills related activities. Children must categorize the images according to understanding the relationship with the random question that they got. As a disadvantage child will not feel a variety, because of same type of game activities [2].

New technological educational applications were developing day by day for many different subjects. Yang et.al have implemented Map-Puzzle Application for the Evaluation of Children's Spatial Knowledge. This android application is mainly focused on geographical education. In previous jigsaw-puzzle games, predicting the result by calculating total time that child spent to finish the task. But the mentioned application calculate result by consider about total time that taken to finish the task and total movements that made. This gives more accurate result than the previous [3].

A game-based platform which is designed for teaching English to preschool children in many nations. Application mainly designed for iPad tablets and pcs and it provides two platforms for children to learning and playing as a game to practice the learnings. Application contains more than 150 interactive lessons and teacher tools, with a focus on listening to, speaking, writing and reading English. Game will give rewards to child to motivate child to complete new tasks [4].

### *B. Skill Development Applications*

In the abundance of mobile application in the market, there is less availability of educational games particularly for toddlers and pre-schoolers [5]. Rojo et.al have implemented mobile application that would cater the toddlers and pre-schoolers in terms of reading, spelling and mathematics. In this gaming application, the user chooses the category what user wants to play and there are five categories of the game specifically alphabets, body parts, colours, shapes and numbers. Each game has its time limits and the score is dependent to the strategy and deepness of each game. Once the player loses the game the application will give and show the score. The problem of this research method is costlier than using the manual and computer process [5].

Previous studies demonstrated the value of serious games for learning, not sufficient efforts were made to apply serious games to reduce children illiteracy. As a Solution team designed a serious game an interactive virtual learning environment, introducing concepts of Mathematics and English. The gaming application implemented a tablet serious game as virtual learning environment of 2D technology using the Unity3D game engine. This game improves memory enhancement and mathematical development of kids using problem solving [6].

One of difficulties in learning mathematics counting can be overcome by providing a relaxed and fun learning for pre-schoolers. Games can be used as an alternative solution. This has been the research basis in improving cognitive abilities, especially for preschool children numeracy skills through the game [7]. The method conducted in this study was a modified linear sequential model. The problem in this research is that, it focuses on only the mathematical content.

The research paper explains about an Android-based application which is designed to teach and help the preschool children, to achieve literacy skills, is presented [8]. The key benefit is that it improves the literacy skills of children while familiarizing them with the technology. Progress and the performance of the child is stored in database using the server. Parents will be tracking the child's performance using the other android application via a mobile device. This research application only focuses on languages. So, the child will not feel any variations.

### *C. Leap Motion Technology / Sensor Technology Applications*

Using new technologies like leap motion and sensor technology is one of the additional ways for the effective learning. The kids are more attracted towards new technologies and considering this problem in 2016 Game Based Learning with the leap motion controller application was developed. The research was carried out with a small group of kids at an elementary school and they covered the area of using innovative input devices in school education. A small 3D infrared camera will track the user's hand and finger movements in the 3D space and allow the user to play the game [9].

A Gestural Interface for Practicing Children's Spatial Skills is a research carried out in 2016. This research will help the children to practice and learn spatial reasoning skills. In this game the player requires to create several 3D objects by moving, rotating and assembling smaller pieces in correct paths through a gestural interface. The gestures were designed by having a congruent mapping between hand gestures and spatial operations and discussed about the development of a theoretical frame work for designing gestural interfaces for educational games [10].

Utilizing Motion Sensing Technology in Storytelling for Young Children: Puppet Narrator, is about how children's narrative ability can be trained and how to develop the competencies of cognition and motor coordination of children using gestures by utilizing depth motion sensing technology as the human computer interaction method. The system allows them to use hand gestures to play with the virtual puppet and manipulate it to interact with virtual items in virtual environment to assist narration [11].

Leap Mania is a research which has discussed about gesture control technologies in game based learning. This application generates an interesting learning environment for the kids to learn different colors, different shapes and numbers using a leap motion controller which will overcome the problem of short attention spans of the children. The research has focused on

building an enthusiastic and pleasurable learning environment to enhance the self-learning skills and knowledge of kids [12].

#### *D. Analyzing Applications*

In the current world, medical and healthcare is one of an area that highly use new technologies. Autism spectrum disorder is a cognitive and neurobiological disease which shows deficits in social and communicative skills. Some parents cannot identify this disease. As a solution for that Elizabeth et.al have developed a gaming platform to analyze child's neural and body based reactions and mainly focuses on human social and emotional cognition. Application analyze child's behavior through the game and predict child has autism or not by analyzing the time taken to complete a task, behaviors, gaming style, selection of gaming patterns, responsiveness, heart rate using sensor technology and used different kind of biological terms that connected with autism. Less user friendliness and less attraction of the children are the problems of this research [13].

### III. METHODOLOGY

The prototype methodology is used to achieve the goals of the project. In prototype methodology the three phases analysis, design, and implementation are performed concurrently, and they repeat until the entire system get completed. First prototype was built with minimal number of features and the rest of the features were added to each prototype produced.

#### *A. Planning*

Planning and controlling of the system handled in this phase. The research problem was identified, and scope of the project was discussed among the team members and the stake holders. Business value was identified which will show why the system should be built. Finally, the project charter was created including a brief description of the proposed system to get the approval for the project. Once the need for the system and its basic functionality has been clearly identified a feasibility analysis was carried out to determine whether the project is technically, economically and organizationally feasible.

#### *B. Analysis and Requirement Gathering*

First the current systems and the weaknesses and the strengths of the current system were identified.

After analyzing the current system, the next step was to gather the requirements. Questionnaires were prepared for the preschool kids to get more information about them. A psychiatrist was interviewed to get the knowledge of the psychological characteristics of the kids. Parents and teachers were interviewed and collected more information about behavioral and educational patterns of the kids. Finally, the information that was gathered during the analysis and information gathering phase were organized and documented.

This research paper is discussed about developing children's acquisition of emotional knowledge of skills like recognition, appreciating and understanding emotions and their expressions and problem-solving abilities. when considering about this paper Koivula.et.al have come up with this application's humorous features, creative opportunities, and possibilities to make progress while playing motivate the child to learn. By practicing through the game and in peer group interactions simultaneously the application becomes an effective learning environment [14].

This application is developed specially for the kids who are suffering from Development Dyslexia (DD). This game helps the children to obtain an early identification of DD during preschool years which consist of serious games which predict the risk of DD in preschoolers and potentially training specific skills impaired in this learning disability [15].

Based on the statistical analysis results it can conclude as mobile games can affect to child's brain development. Gender does not affect to this and however if there is a good family background for the child the brain development level can be maximized.

Research team created all the user interfaces in blue and pink related colors because most of the responded selected blue when comes to the user interfaces. Research team used red, green, yellow and orange colors. Research team used frozen characters and Mickey Mouse cartoon characters in game because most of the respondent voted for that particular character. Research team used different characters according to the game background and the situations. Lot of children like background music when play games. More than 50% of the respondents like to play games with Sinhala language. They are addicted to mobile games and other games. So it is a high possibility to think that nowadays students are less interest to do studies. Majority of the respondents stated that they use tablets more than mobile phone. This application developed in windows platform.

#### *C. Design*

The logical diagrams that were designed during the analysis phase converted to physical diagrams which defines how the operations are done and how the final system will work including the technology used and kids and parents' interactions with the system. The user interfaces were developed more appealing to the kids and suitable to the research project. The databases were created using SQLite database and data stored in database. The whole system designed as very user friendly. The high-level architecture diagram is given in figure 1.

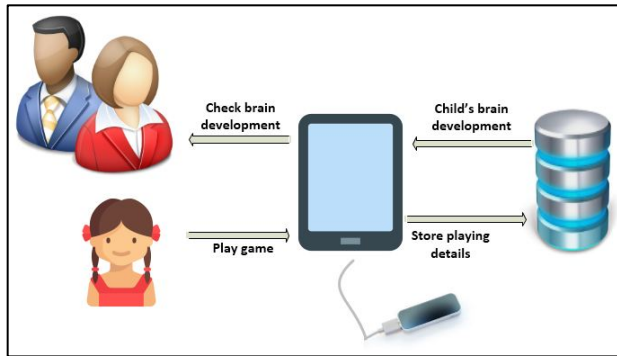


Figure 1: High level Architecture Diagram

There are two main users as parent and child. Child can play the game and all the playing details will store in database. Application calculates the brain development rate by accessing the data from database. Parent can check child's brain development rate through the application.

*D. Implementation*

In this phase research team focused on implementing the proposed system and used Unity as the developing framework, SQLite as the database and C# as the developing language. Occasional meetings were held for the better coordination of the

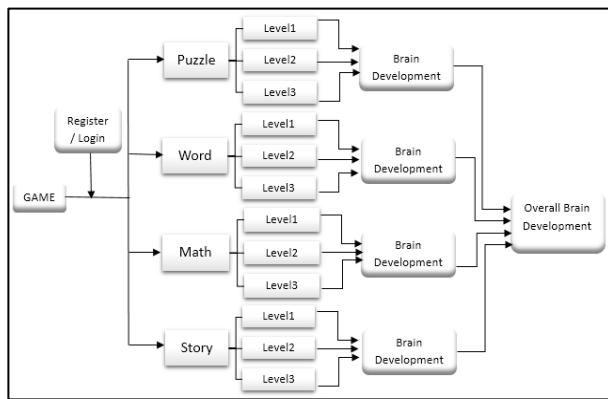


Figure 2: structure of the game

project.

*E. TESTING*

After completing each function to validate that unit testing will be done for identify individual units of source code are working properly. Integration testing will be done after completing and combine all the functions. System test will be performed to verify that the system meets requirements and its usability, security and performance under a great workload. Documentation testing will be performed by checking all the documents for correctness.

**IV. RESULTS AND DISCUSSION**

*A. RESULTS*

Figure 3 illustrates the login and register page. At the very first time of application opens it direct to registration page. Parents can register to the system by providing parent's username, email and password. All the inputs will be validated, and wrong inputs will be result in an error message. After the registration, parent can log into the system using user name and password. Wrong inputs will be result in an error message and the user cannot logged in to the system.

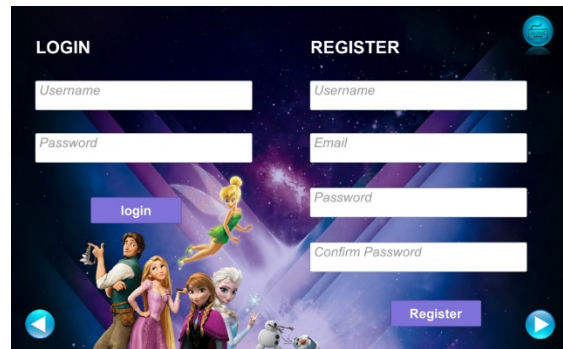
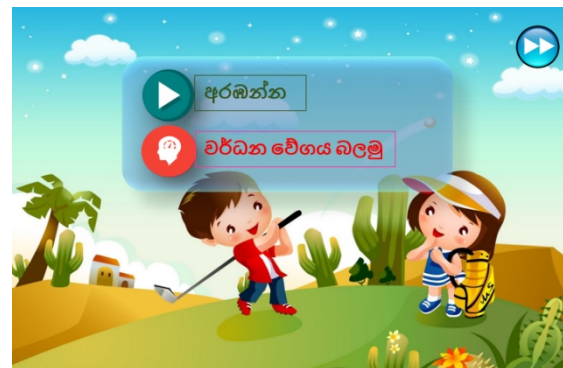


Figure3: Register and Login Window

Figure 4 illustrates the menu window. A logged user can play the game by clicking "play" button and check the child's development by clicking "check development" button.



Furthermore, the user can exit from the game by clicking the exit button.

Figure 4: Menu Window

Figure 5 illustrates the game category window. This window will appear after user click "play button" in "menu window". User can select any game category and play each category's game levels.



Figure 5: Category Window

Figure 6 illustrates the Puzzle game window. This window will appear when user select the “puzzle” category from the “category” window. Puzzle category contains these kinds of multiple puzzle levels and child can select the puzzle level he or she want to play. Each puzzle level contains different kind of puzzle games with different kind of random questions. Child can drag and drop each letter until each letter drop to the correct place. When child drag and drop a wrong letter, letter will be return back to the previous place with a beep noise. By clicking home button, user can return to the “menu window”.



Figure 1: Puzzle Level 1 Window

Figure 7 illustrates the Maths game window. This window will appear when user select the “maths” category from the “category” window. maths category contains this kind of multiple maths levels and child can select the maths level he or she want to play. Each maths level contains different kind of mathematical games with different kind of random questions. Child can type the answer in the given text field. The correct answer will be display when move to the next question. This level contains 6 questions.



Figure 2: Maths Level 1 Window

Figure 8 illustrates the word game window. This window will appear when user select the “word” category from the “category” window. word category contains this kind of multiple word levels. Each word level contains different kind of word games with different kind of random questions. Child can select the answer within the given answers. If child select a wrong answer it will make a beep sound.



Figure 3: Word Level 1 Window

Figure 9 illustrates the story game window. This window will appear when user select the “story” category from the “category” window. story category contains this kind of multiple story levels. Each story level contains different kind of story games with different kind of random questions. At the first, story will be displayed and then questions will be display which are related to the story. If child select a wrong answer, application will mark it as wrong.



Figure 4: Story Level 1 Window

Figure 10 illustrates the brain development window. This window will appear when user click the “check brain development” button in the “menu window”. Parents can view child’s overall brain development using this window. Child’s development calculating by considering the marks, number of movements and the time taken to complete each level. This overall development displays all the developments through all four game categories. By clicking “home” icon, user can return to “menu window”.

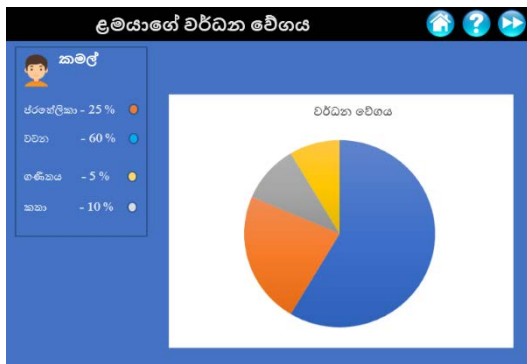


Figure 5: Brain Development Window

### B. Discussion

Poddanta Puluwan contains functioning components improve child's cognitive skills and Sinhala knowledge, measure the brain development and mechanism to stop game addiction through windows tablet application.

The reliability of the system is that the system provides smooth and simple operations. Using leap motion sensor will improve the game experience for user. The system will provide proper error messages and alerts if incorrect operations performed. Proper advices are provided to stop game addiction. System reliability is 70% and accuracy rate is 95 %. Research team tested the application 50 times application and 45 times it worked properly. 5 times the system was frozen due to some tablet issues and database connection issues. There are some technical limitations of this application, such as, to process with leap motion sensor tablet need some processing power and if the game played continuously windows device get heat. There should be a high processor. The accuracy of the brain development calculations varies according to the amount of data in the database. The accuracy of calculation may increase based on playing attempts.

### V. CONCLUSION

"PODDANTA PULUWAN" the mobile game application that work as a children's brain development application. The possible functionalities that research team developed in this game application is measure the brain development and improve child's knowledge and cognitive skills. This project covering several levels with different areas which increase the knowledge of the child step by step. Application is measure improvements of child that by keep tracking what are the marks that child has got.

### VI. FUTURE WORK

As the research was limited to a specific time period the research group was able to focus only on a limited number of components. This game application can be implemented as a 3D game for many different languages in the future by adding more features.

Moreover, there can be featuring to sending notifications to parent if child spent more time on application and child's brain development as an email or a SMS. Also, a data mining algorithm can be used to predict the child's week points of a subject.

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