MAD-MULTISENSORY APPLICATION FOR DYSLEXICS

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Abstract: *Dyslexia affects 10-15 % of children, many of whom remain undiagnosed. In Greek "Dys" means a difficulty with and "lexia" means with language. According to IDA (International Dyslexia Association), "Dyslexia is a specific learning disability that is neurobiological in origin". These children suffer from difficulties like alphabet recognition, reading words and writing in mirror patterns. The existing system has taken efforts to handle interaction, letter recognition, phonological processing and visuo - spatial attention. The proposed system "MAD- Multisensory Application for Dyslexic" aims at developing a learning aid that helps the children also to overcome the Dyslexia via three sensory modalities (visual, auditory, and tactile). Dysgraphia, a part of dyslexia is a condition that causes trouble with writing expression. The proposed application mainly aims in aiding the teachers to efficiently train dyslexic children who need special attention in reading (vision and auditory) and writing (vision and graphical trait) thereby resolving the problem of "one child- one tutor".*

Keywords: *Dyslexia, Learning disability, neurological, letter recognition, Dysgraphia, teachers, one child-one tutor.*

1. INTRODUCTION:

Dyslexia is a language-based learning disability. It is a developmental disorder originating in childhood. It is a neurological condition and one which needs an educational prescription [1]. It is not a disease and can't be completely eradicated but we can mitigate the effects. If not suppressed, invalidated or destroyed by parents or the educational process, the children will have two characteristics: higher than normal intelligence, and extraordinary creative abilities [2]. Some of the renowned dyslexic people include Albert Einstein, Pierre Curie, Michael Faraday, Henry Ford, Leonardo da Vinci and so on.

Dyslexia can vary from mild to moderate or severe. No two children would have similar difficulties. In any degree of severity, these children need support from teachers, resource room teachers and remedial teachers along with classroom accommodations and examination provisions [1].

ICT (Information and Communications Technologies) is an umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems and so on as well as the various services and applications [3].

2. RELATED WORK:

A. 'Dyslexia Baca' Mobile App- The Learning Ecosystem for Dyslexic Children [4]

This system mainly addresses the issue related to assisting the alphabet recognition. With that the students are motivated to learn and recall the information in a fun and multisensory approach. The system is developed in Malay language using multisensory approach in Android platform.
Drawbacks:
- It doesn't consider the phonological processing and visuo-spatial attention training to the dyslexic children.
- User only has to find one alphabet in level 2 of this app, which is too simple and it is not standardized from the other level.

B. Multimedia Application for Dyslexia and Reading Improvement Gamifying Learning Experience (MADRIGALE) [5]

This system mainly addresses to design and implement an educational action game oriented to promote, through forms of engaging and motivating interaction, phonological training and visuo-spatial attention in dyslexic students aged between 7 and 9.

Drawbacks:
1. It doesn't support the feature of monitoring the under-performed students by a professional tutor. Therefore this application can't be used in dyslexic schools.

3. PROPOSED SYSTEM:

The proposed system aims at developing an application that will reduce letter recognition, phonological processing and backward and mirror writing problems in dyslexic children. It helps the tutors to view the performance profile of dyslexic student thereby overcoming the drawbacks of existing system.

"One child-One tutor" paradigm is necessary for effective training of dyslexics but it is nearly impossible to implement this strategy in this hustle world. To make this paradigm adaptive to the resources available we have designed "Many children- One tutor" paradigm that makes it possible for a tutor to handle a set of children and monitor their progress by using ICT devices. Although this concept can be implemented in several ways, MAD is designed as an android application, an ICT device since it is proven that the children of age between 4 to 7 years old learn from apps. And moreover in a study, for 5 to 7 old kids gained more than 20% from pre- to post-test on the vocabulary test [4].

Figure 1. Functional diagram explaining the various processs involved in student's corner.

MAD is an integrated system running on android platform consisting of two exclusive working components, one for tutor and another for dyslexic children.

Students: This component enables the dyslexic students to listen to lectures and take tests. The application allows a student to move to the next level only if the student has acquired a predefined a score limit. MAD repeats the lectures and tests until the student performance is satisfactory. It also uses multisensory application in order to promote letter recognition, phonological processing and visuo-spatial attention.

Tutor: A Tutor can view the student performance profile of each student which reflects student's knowledge in every aspect. A tutor can also report on the student's status. In case of adverse performance, the tutor can pay special attention to the concerned students. This paradigm will have huge impact in training of students in dyslexic schools.
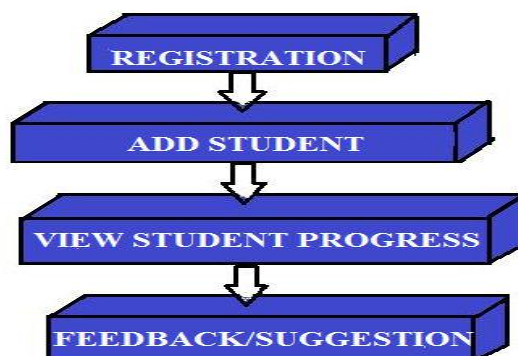

Figure 2. Functional diagram explaining the various processs involved in tutor's corner.

4. LEARNING PARADIGM:

Chang and Gutl [6] had developed the learning ecosystem (LES) model based on this biological metaphor, which "consists of the stakeholders incorporating the whole chain of the collaborative learning processes, the learning utilities and the learning environment, within specific boundaries, called environmental borders". Thus the learning ecosystem can be defined as a community that comprises of tutors and dyslexic students [4].

The ecosystem consists of Pedagogy, Technology and Content. Technology is the application of scientific knowledge for practical purposes. In our paradigm, Technology comprises Mobile and Learning Environment.

Pedagogy is the approach of teaching and learning that must suit to the learners, and what more to those learning disabled children. Mobile is the actual hardware on which the entire environment is hosted. The Learning Environment is powered by Android platform with its Interactive User Interface and Cost effectiveness.

Apps are one of the technologies that can be used to ease reading difficulties [4]. The content refers to the data related to the application and it comprises the Learning Repository and Student Portfolio. Learning Repository comprises the learning material that is designed to adapt to the learning requirements of dyslexics. Student Portfolio comprises profile and performance details of dyslexic students who have installed the application.   The paradigm design comprises Capture and Analytics within pedagogy. Capture refers to the process of tracking the Linguistic skills of dyslexic children. Analytics refers to the process of projecting the captured data by pictorial representation for easy interpretation.
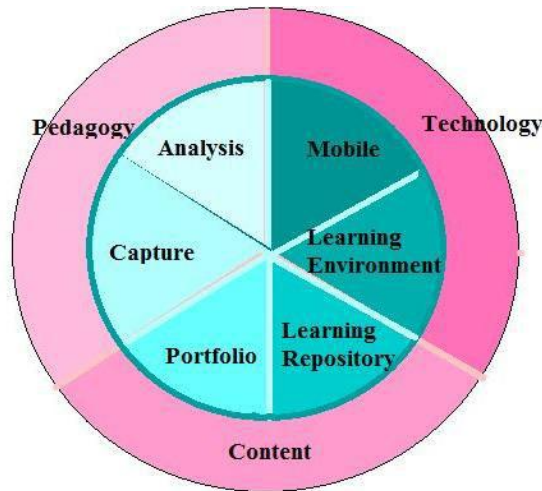

Figure 3. Learning paradigm to be used in proposed work

4. SYSTEM ARCHITECTURE:

The architecture consists of implementing the tutor's and student's corner individually by considering the requirements of dyslexic students. The modules with their purpose can be explained as below.

A. Multisensory Repetition: Each Component is taught to the students and the process repeats until the child recognizes the letter/word correctly.

B. Knowledge Analysis: Tests are conducted and the status such as test score, time taken to complete the test updated in the profile.

C. Reader's Profile: The application allows the parents/ tutors to login and view/reset the profile of a child. This feature also enables them to identify whether the children need special care or not.
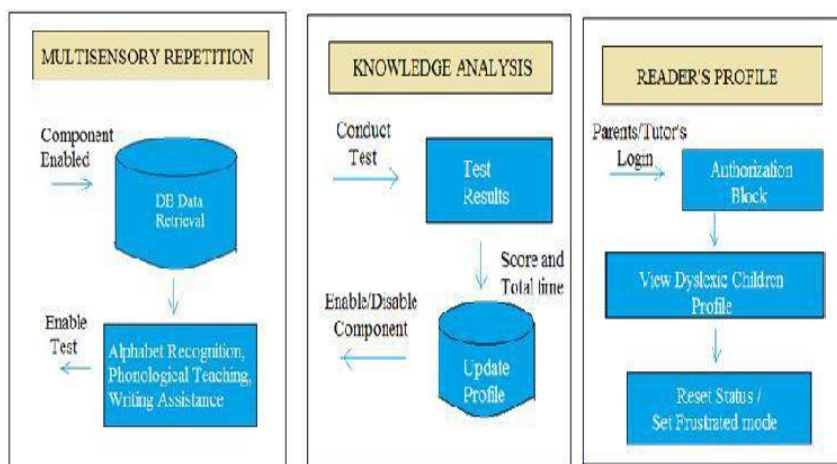

Figure 4: Overall System Architecture

5. WORKING:

The basic concept on which the whole application revolves is of training student, conducting tests, analyzing the captured score and updating the student profile. On the other hand, the tutor can view the student profile. And in case of extremely affected student, excessive care must be taken by the tutors.

Once the application is downloaded and installed, it will go to the registration page where the user can store their personal information and a ID value is generated. Then the students are allowed to learn the first tutorial. Since the dyslexic people finds difficulty in identifying alphabets including b, d, p, q, m, and w, these letters are

concentrated more in the tutorial. As stated earlier, that the level of dyslexia severity varies with student each level is taught number of times until the student get it right. At the end of each level, a test is being conducted to evaluate the performance of the student and the students are congratulated for their performance with "Thunder claps". This will encourage them and motivate them to perform better. On receiving the predefined mark, the students are allowed to view/learn the next level and their marks, performance are updated in the student profile. This type of teaching approach mitigates the problems raised such as letter recognition, phonological processing and writing difficulties. The difficulty increases with each level in terms of the following [5].

- *Number of letters:* The number of letters popping out in the screen increases with the level. The earlier level of the application may bring fewer letters than the higher levels.

- *Type of letters:* It is easy for dyslexic student to identify letter L than letter b. Since these students often get confused with some letters, this application concentrates more on the letters p, q, m, w, b, and d.

- *Semantics:* The dyslexic people find difficult to recognize and spell "Dysgraphia" than "dog". The meaning of the word need to be considered for each level.

- *Word Length:* The difficulty level increases with the number of letters in the word popping out in the screen.

On the other hand, once the application is downloaded and installed by the tutor, they can add the children as their students using the student ID and can follow their progress in each level, such as student's marks, the number of times the student attempted to clear the level, the difficult words/letters for each student. The tutor can then write comments and suggestions on the student's progress. If the student performance is extremely bad, then the tutor can take individual care on them.
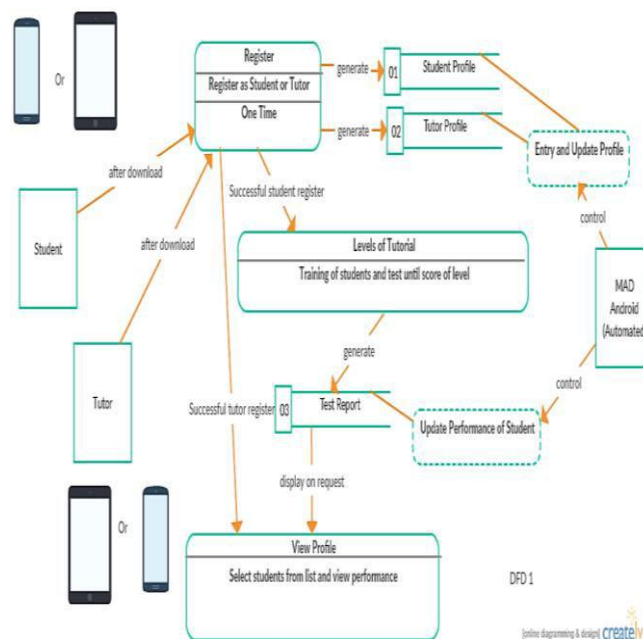

Figure 5. Data flow diagram for MAD explaining the different process from training to tutor suggestion.

7. COMMERCIAL VIABILITY:

This type of application has not implemented so far. This can be effective if used in dyslexic schools, which are quoting that the teachers are not sufficient to train the students [7]. This application can be commercialized and sold to those schools. This can also be used by the parents of the dyslexic children for the remote monitoring of the student by a tutor.

8. CONCLUSIONS:

Technology is a light that cuts through darkness and promotes lives on earth. The development of reading/writing aid is a noteworthy step in promoting a dyslexic student's view to the entire world. It helps them to work independent of others help in their day-to-day activities. Since the application reduces the student's reading difficulties, it helps them to concentrate on other interests. This approach bundled with the low cost android software is fairly a simple logic, but, it has a great potential.

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