Dyslexia Spelling System Using Machine Learning

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ABSTRACT

Dyslexia is a cognitive difficulty caused by a neurological problem. It's marked by problems with accurate and/or efficient language comprehension, as well as poor handwriting and word recognition. These challenges are usually caused by a phonological aspect of linguistic impairment, which is often overlooked in connection to other cognitive talents and successful classroom work. Although dyslexic youngsters generally display high intellect, the cognitive condition presents a unique obstacle to traditional classroom learning methods. As a result, early detection of the illness is critical in guaranteeing that parents and teachers give adequate support. The needs of the dyslexic children are different and need to be fulfilled to help them overcome this disability. The dyslexic kids do not lack intelligence on the contrary most of these kids are actually inherently more intelligent. Therefore, there is need to develop an effective tool to allow for the dyslexic children to be able to learn and memorize spellings easily. For this purpose, this research outlines an effective and useful mechanism for the purpose of teaching dyslexic students spelling 4 letter words and improving their linguistic ability.

Keyword : *Dyslexic Student Spelling System, Teaching Aid, Interactive System for Learning Disabilities.*

1.INTRODUCTION

Children with dyslexia frequently struggle with handwriting. Reading is thought to be a crucial feature of writing in certain cognitive theories of literacy development, thus this is not unexpected. Dyslexic kids' writing challenges can be ascribed in addition to their reading struggles and express in a variety of different ways in their writings, including misspellings, readability, absence of diversified lexicon, poor conceptual design, and/or lack of organization.

Dyslexia and writing problems are linked for two main reasons. For starters, reading and comprehension are dependent on similar fundamental mechanisms. Dyslexia, for example, causes problems interpreting phonetic knowledge required for understanding the text, but writing necessitates storing phonological knowledge. Considering dyslexia affects the fundamental mechanism in both the reading and comprehension systems, it's not

surprising that students with dyslexia have writing problems. Secondly, reading is a necessary ability for the process of writing.

Writers must often study reference material prior to actually composing their own text, as well as study and review their respective work to detect text issues such as language and grammatical faults, as well as disorganization. Reading challenges make this activity more challenging, particularly if children have weak handwriting abilities, which makes reading their own work much more challenging.

Proofreading is a critical skill for children's learning and development in primary school because it helps them to improve their concentration and awareness, both of which are necessary for comprehending and remembering. Furthermore, reading encourages thought and conversation in attempt to become critical thinkers competent of forming their own ideas as well as comprehending any subject, including arithmetic, disciplines such as sociology, and biological sciences.

Lately, primary schools have developed accessible programs to help students with learning disabilities including such dyslexia, dyspraxia, and developmental disabilities. This research is relevant to the exploration of dyslexia, which is a specialized name for a collection of characteristics in the text comprehension that comes within the broad spectrum of unique learning disabilities in reading. Dyslexia can cause problems with fundamental word recognition, comprehension skills, and written expression, and dyslexia frequently impacts all three elements. Someone with particular training can provide dyslexia remediation using a hierarchically structured, multimodal methodology to reading instruction.

In principle, a dyslexic kid exhibits many reading difficulties, necessitating the usage of additional educational materials that are simple to use and master in order to improve reading comprehension. The word dyslexia has indeed been defined in a variety of ways, including as distinct from or comparable with a number of other designations that refer to reading issues. This encompasses specialized reading challenges, reading disabilities, reading disabilities, learning disabilities, unforeseen learning challenges, and reading comprehension complexities. Nevertheless, an early childhood educator puts in a lot of time and dedication to create a teaching strategies and numerous modifications of educational materials in addition to teaching writing to a kid with dyslexia.

1.1 PROBLEM DEFINATION

To provide assistance to the children suffering with dyslexia to achieve improved spelling an character recognition through the use of an interactive word puzzle devised using character shuffling on Swings Framework using java programming language

2.LITERATURE SURVEY

M. A. Rahman et al. published a new, language-independent bulk screening mobile health architecture that employs auto-grading algorithms to offer dyslexia categorization to participants [1]. Data about dyslexia diagnosis may be shared safely with mobile medical practitioners throughout the world. The authors use Blockchain to make test results unchangeable and safe to communicate with a range of parties. For the first time, in 20 minutes, the ability to mass screen pupils while concurrently gathering test results in a big data warehouse. The exam consists of four parts: a reading test, a writing test, a clock drawing test, and a cognitive test involving sketching family members, all of which are complemented by the eye-tracking modality. The framework integrates eye-tracking and voice capture during development. Several clinically validated test modules have been devised and assessed by medical practitioners who treat dyslexic people.

For several reasons, students with dyslexia struggle with reading and writing. Hebert Met al. used a writing sample from a dyslexic student (Jordan) to demonstrate the writing challenges these kids have, as well as studies on the underlying links. Following that, the authors discussed different strategies for resolving writing issues and/or assisting students in compensating for skill deficiencies [2]. Although they try to present a list of recommended tactics that target abilities that dyslexic kids may struggle with, this list is far from exhaustive. Over the last 15 years, meta-analytic investigations have uncovered a plethora of successful ways for boosting students' writing abilities. The authors recommend teachers utilize a variety of treatments to accommodate their dyslexic pupils' writing demands.

S. Abbasi Baharanchi et al. set out to build and install a tactile stimulation device to improve auditory discrimination in children with developmental dyslexia who acquire auditory discrimination at a slower rate than the general population [3]. When comparing the TACTUATOR with the Tactile Arm Wrap, it's clear that there are two major concepts for tactual voice transmission. For constructing vibrational routes, the first uses a few actuators with diverse stimulations, while the second uses several actuators with identical stimulations. The second technique was utilized by the authors, and all kinds of Persian minimum pair words were investigated. The word list for the test had a GUI developed for evaluating the baseline of auditory discrimination, whereas the word list for practice had a GUI suited for using the device in therapy sessions.

Sabisch B et al. used ERPs to examine auditory sentence comprehension in 9- to 12-year-old children with developmental dyslexia with controls who were age, gender, and nonverbal intelligence matched. The N400 suggested that semantic processes were quite comparable in both groups. Syntactic mechanisms seemed to be distinct for the early anterior negative but comparable for the P600 component. The P600 results point to comparable controlled procedures of syntactic reanalysis. Automatic processes of syntactic structure generation, as shown by the early left anterior negativity (ELAN), and prosodic structure formation, as represented by the RAN, were detected in the control children [4]. In comparison to their age-matched controls, the dyslexic youngsters had delayed anterior negativity (300–600 msec). Because dyslexic children were able to notice the syntactic violation in the behavioral test and performed well, it might be concluded that the left anterior negativity serves as a precursor for the ELAN.

The previous 20 to 30 years of research on children with dyslexia have developed an extraordinarily convergent and powerful theoretic knowledge of the nature of their reading difficulties and the underlying cognitive or language deficiencies that underlie them, according to Schatschneider C et al [5]. These youngsters struggle to acquire the alphabetic principle early on, which leads to both incorrect and dysfluent text reading abilities. The major hindrance to reading comprehension in children with dyslexia is the inability to interpret text words properly and fluently. The benefit of frequent progress observation in the establishment of phonemic awareness, letter knowledge, and eventually phonemic decoding abilities is that prediction accuracy enhances as children age. If schools have a system in place that measures student performance several times a year, predictive accuracy will be constantly updated, and at-risk pupils who may have been missed in an earlier assessment will be discovered as soon as their difficulties manifest.

In a behavioral study, A. Facoetti et al. [6] assessed reaction times to visual and auditory stimuli in cued-detection activities to assess exogenous spatial awareness in dyslexic children and matched controls. When compared to controls of the same chronological age and reading skills, as well as dyslexics with delayed but accurate verbal material decoding, dyslexics with poor verbal material decoding accuracy showed a shorter time course of visual and auditory spatial attention. Individual changes in the time course of multisensory spatial attention contributed to 31% of the unique diversity in the total dyslexic population's nonword reading performance after correcting for age, IQ, and phonological ability. According to the findings, multimodal "sluggish attention shifting," which is linked to temporoparietal dysfunction, selectively impairs the ability to learn.

Educational patterns are preconized by J. Muoz-Arteaga et al. [7] as a best practice in terms of educational applications, taking into account both technological and pedagogical factors. They can be utilized by teachers to enhance reading skills for dyslexic primary school students. A technique for obtaining educational patterns, in which a multidisciplinary team specifies pedagogical and technical solutions to reduce dyslexia problems, is the second contribution of this research. To validate a feasible educational pattern, the interdisciplinary team might collaborate with the teacher's pupils. Using the proposed technique, seventeen instructional patterns were produced. The categorization of educational patterns into four primary grammatical reading levels, such as pre-syllabic, syllabic, pre-alphabetical, and alphabetical, is the key contribution.

R. Kariyawasam et al. created "Pubudu," one of the first deep learning and machine learning oriented smartphone applications, for the assessment and treatment of dyslexia, dysgraphia, and dyscalculia in local languages. Clinical screening and diagnostic approaches approved by health experts for screening and intervention have been followed in "Pubudu." Deep neural networks were used to test for dyslexia, letter dysgraphia, and numeric dysgraphia, while machine learning techniques were used to screen for dyscalculia. Gamified environments are used to deploy intervention strategies [8]. The system was tested with 50 children who were differently-abled and 50 children who were not. With the first dataset, neural networks achieve 88 percent, 58 percent, and 99 percent screening accuracies for letter dysgraphia, dyslexia, and numeric dysgraphia screening, respectively.

Isa et al. achieved the first goal, which was to design an automated handwriting identification system employing image processing techniques and pattern recognition. One form of character recognition is pattern recognition utilizing the optical recognition approach. An image processing approach and pattern recognition were used to create an automated handwriting recognition system that produced considerable results [9]. The OCR technique is a suitable way to employ for identifying solid letters, such as words on a signboard. The second goal was also accomplished by the authors, which was to classify the levels of dyslexia symptoms depending on their accuracy. The classification accuracy performance is instantaneous as a result of the outcome. This is because ANNs require a large number of samples to achieve high accuracy and require more character traits. This investigation was able to get the dysgraphia and dyscalculia symptoms using data from the Association of Dyslexia Malaysia (ADM).

The research by N. J. Ahuja et al. [10] focused on Dyscalculia and Non-Dyscalculia students. Dyscalculia learners have distinct learning demands and assistance requirements than non-dyscalculia students. For this project, a well-designed education model, tutor agent, and learning companion in an ITS were developed. The goal of this research was to see how pedagogical agents and a well-designed instructional model affected learners with and without dyscalculia's intrinsic, external, and relevant cognitive burden. The research will look at these students' learning experiences in contexts with and without pedagogical agents.

3.SCOPE OF THE PROJECT

3.1 Dyslexia Quest

Dyslexia Quest is one of the best dyslexia apps for kids to get a good start with their reading journey. This app is especially designed for individuals with dyslexia and other learning disabilities, giving them the tools they need to succeed. Dyslexia Quest is a game-based quest designed to help assess your child's memory and listening skills. It helps point parents in the right direction since it serves as a basic skills screener to identify strengths and weaknesses. It uses games to assess a child's strengths and weakness in the following areas: working memory, phonological awareness, processing speed, visual sequential order, auditory sequential memory, and visual memory.

Dyslexia Quest has 6 different games that develop different cognitive skills. The gameplay involves the player touching, dragging, and swiping – this creates a multisensory learning experience. This app can be used as an ongoing progress-monitoring tool to assess areas of improvement in reading skills. In addition to the ability levels, a brief description of each ability level and the uses for each skill level is included. The student also has the option of a reader-friendly description of dyslexia and personal dyslexia quiz.

3.2 Dyslexia Gold

Dyslexia Gold is a popular app for kids with dyslexia. This dyslexia app improves reading fluency, speed and comprehension of children with learning disabilities. It increases reading age by over 12 months. Their fun, effective & unique programs help children learn to read and write:

- Improve Reading with Engaging Eyes and Fluency Builder
- Master Spelling and Times Tables

Dyslexia Gold addresses underlying problems that cause reading difficulties. We address vision problems to stop your child from skipping lines and words. And auditory problems so your child can hear that goat is made up of 3 sounds g - oa – t. The program is suitable for children aged 6-15. You can choose US or UK spelling and works on any PC or laptop with sound - Windows or Mac. Dyslexia Gold is used in over 250 schools and by thousands of parents. Dyslexia Gold also helps adults, as the program addresses the underlying difficulties causing reading problems.

3.3 OgStar Reading Explore

Ogstar Reading is an unique, multisensory reading app follows the Science of Reading. OgStar lessons progress in a very systematic and structured way yet include gamified elements to motivate your kids. Their Orton-Gillingham approach offers a home or school-based full structured literacy curriculum for dyslexics or struggling students from ages 4 - 13. This is a free version of their complete app, designed to give parents and teachers a sample view of the program. The complete version exposes students to a wide variety of skills up to a 5th grade reading level.

Kids practice both reading and writing all sounds in isolation, in words, and in sentences. Ogstar Reading is a free app for kids that develop skills such as phonological awareness, reading fluency and basic handwriting.

3.4 Omoguru: Dyslexia Friendly Reader

Dyslexic students (and adults) use Omoguru to make the text more readable and decode words with ease. Omoguru Reader is a reading tool for dyslexics that improves reading skills in an enjoyable way. For people with dyslexia, the ability to read and understand text can be affected by the way in which text has been written and produced. Omoguru improves readability and better visual impact for all readers, but especially those with dyslexia.

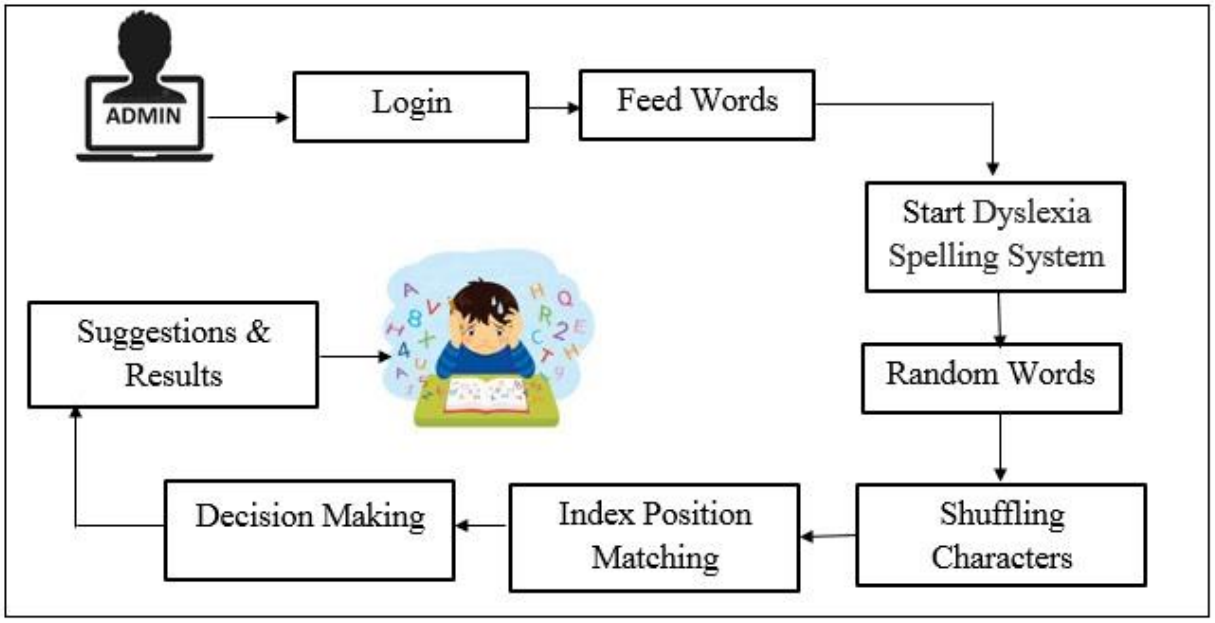
This app is fantastic and easy to use allowing you to find the most appropriate appearance that suits the individual user. Importantly, Omoguru offers a serious amount of feature change options as each person with dyslexia are affected in different ways.

3.5 Easy Dyslexia Aid - Dysgraphia Spelling & Literacy Helper

Easy Dyslexia Aid is a simple and intuitive app and a must for all classrooms that have children with dyslexia or dysgraphia. Easy Dyslexia Aid helps with spelling and literacy with the aid of the 'OpenDyslexic' font and colour overlays.

Easy Dyslexia Aid is a welcome addition to the assistive technology market for dyslexia. This app can help dyslexic learners with specific cognitive difficulties making it easier to process particular kinds of information.

4.WORKING AND PROCESSES



The presented approach for the Dyslexia Spelling system has been elaborated diagrammatically in the system overview provided in the figure 13 above. The approach has been detailed in a step by step manner in the section given below.

Step 1: Data Collection – The proposed methodology has been achieved through the use of the swings framework based on the java programming language. The Graphical User Interface is being used by the Admin to register on

the standalone system to get the login credentials. These credentials can now be used to log into the system by the admin. Once the admin has been logged into the system, the words for the spelling system can now be fed into the system.

The system for the spelling utilizes 4 letter words which are provided by the admin in the form of an excel sheet. This excel sheet is provided to the system by browsing and selecting an excel sheet consisting of 100 different 4 letter words. The excel sheet is being interfaced with the java code through the use of the JXL library which enables the reading of the worksheet from which the words are extracted and stored in an ArrayList for further processing.

Step 2: Random Word Selection and Shuffling – The ArrayList created in the previous step is being utilized as an input in this step of the methodology. This ArrayList consists of the words that have been extracted from the excel sheet given as an input by the Admin. These words are to be used for the spelling system being constructed. A random word from the list is extracted and will be processed to use it for the purpose of spelling system. The individual letters of the 4 letter word are extracted and stored separately in a list. This list is then shuffled to shuffle the words using the inbuilt function. This results in two different set of words, one word is the original word and the other is the shuffled word. The original word is utilized for the purpose of displaying it to the dyslexic kids, whereas the shuffled word is set into the buttons for the kids to tap on sequentially to successfully spell the word correctly. The process is shown in the below algorithm 1.

Algorithm 1 Random Word Selection and Shuffling

```
//Input: Word List WL
 //Output: Random Shuffled List RSL
getRandomShuffledWord(WL)
 1: Start
2: RSL = Ø
3: for i=0 to size of WL
4: OWRD = WL[i]
5: TL[] = OWRD[j++] [TL = Temporary List]
6: STL[] = Shuffle(TL[]) [STL = Shuffled List]
7: SWRD = P(STL[] )
8: TMPL[0] = OWRD
9: TMPL[1] = SWRD
10: RSL = RSL + TMPL
11: end for
12: return RSL
13: Stop
```

Step 3: Decision making through Index Position Matching – The interactive user interface is being used for the purpose of displaying the dyslexic kid the original word and the shuffled word in the form of buttons. The kid will look at the original word and sequentially spell it using the shuffled words. When a word is being displayed to the kid an index is initialized with the value as -1.

This index value is incremented whenever the kid taps on any of the buttons. As the kid selects the first shuffled letter, the index is incremented and is now at 0. At this stage the selected shuffled letter is taken and the index value is being used for the purpose locating the letter on the specified index on the original word. These two letters are extracted and compared, if the letters match, the letter is turned green, and the kid can enter the next letter in the spelling. If any of the letters from the letter in the selected button does not match with the letter on the index of the original word, the system will identify it as a wrong spelling and give a suitable alert. Once the alert is provided to the kid, another random word is selected and displayed to the kid and the counter is reset to -1. This way the dyslexic kid can practice the spellings to increase their vocabulary effectively.

5. CONCLUSIONS

The presented approach for the realization of the Dyslexia spelling system has been elaborated in this research article. Dyslexia is a neurological disorder that causes cognitive difficulties. It is characterised by difficulties with precise and/or effective language understanding, along with poor writing and word identification. These difficulties

are commonly accompanied by a phonetic element of language disability, which is sometimes neglected in the context of other cognitive abilities and effective teaching performance. The main problem with dyxlexic children is the fact that they need a lot more practice and getting familiar with words. This requires extensive teaching and the valuable time of the teacher which becomes difficult. Therefore, to strengthen the kids vocabulary, this Dyslexia Spelling system allows for a much better practice for the kid. This approach has been desinged to display 4 letter words which are shuffled to the kid who has to enter the letters in the proper order by tapping them. This improves the kids vocabulary and allows for a much better practice improving the dyslexia symptoms. The proposed approach recieves minimal amount of error as shown in the resutls section above.

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