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DYSLEXIA ASSISTIVE APPLICATION USING TTS AND TEXT CLASSIFICATION USING FEED FORWARD NEURAL NETWORKS

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Abstract - *Dyslexia can be explained as a developmental learning disorder that affects reading, word decoding, comprehension, short-term memory, writing, pronunciation, and speech problems. Those who are diagnosed with dyslexia appear to exhibit symptoms of poor self-esteem and anxiety because they cannot communicate with society in the manner that their peers do. Many applications on the market in this domain facilitates them by correcting their problems by enjoying games and reading some hard-coded texts or pdf books. This correcting method takes time and dyslexics become helpless managing their daily activities. This project focuses on creating a dyslexic friendly application for students. which helps the dyslexic users to deal with them reading difficulties in real life successfully, while they are receiving proper treatments. This project can identify the texts in a PDF and read it loudly so that user can understand and will be allowed to customize the chunking and formatting of words according to their disability levels. By integrating dictionary support with the phonic and morphological structure of the word, the user will then be ready to comprehend difficult and sophisticated words easily. In addition, the project also uses machine learning approach to make complex words simpler. For this project we have used specialized python libraries, MYSQL database, Text to speech technology, and machine learning technique to make the reading life of a dyslexia student better.*

***Key Words*: Machine Learning, Python, MYSQL, Text To speech, Dyslexia.**

1.INTRODUCTION

Dyslexia is a learning inability that impacts our capacity to read, spell, write, and converse. Children who have it are astute and dedicated; however, they have difficulties relating the letters they see to the sounds those letters produce. About 5% to 10% of Americans have a number of signs of dyslexia, like drowsy perusing, trouble in spelling, or blending up words. grown-ups can have this learning disability; Others do not get it they have dyslexia until they get diagnosed. According to WHO almost 15% of the worldwide populace is enduring one or other sort of learning inabilities like, dyscalculia, dysgraphia, dyslexia, and autism. Children with dyslexia moreover have an ordinary vision and are as brilliant as their peers. In any case, they come up short more in school since they take longer to study. Issues with word handling can moreover make it troublesome to spell, write, and talk clearly. It is caused by chromosomes, which is why the cluster continuously runs in families. On the off chance that a person's parents, kin, or other family members have dyslexia, he or she is more likely to have it as well. The disability is caused by variations within the parts of the brain that interpret language. Imaging scans of individuals with dyslexia uncover that parts of the brain that ought to be involved while reading doesn't work appropriately. The brain of a child with dyslexia has trouble matching letters to the sounds they deliver and after that mixing those sounds into words. As a result, for somebody with dyslexia, the word "cat" can show up as "tac." Reading can be a drowsy and complicated handle as a result of these errors. Everyone's dyslexia are one of a kind. A few individuals have a gentle form of the illness that they continuously learn to treat. Others have a bit more trouble getting over it. Indeed, in the event that children don't totally outgrow dyslexia, they will go to college and exceed expectations in life. Python's design empowers useful programming within the Lisp convention. It incorporates filter, outline, and diminish highlights, as well as list comprehensions, text-to-speech, content extraction, lexicons, sets, and generator expressions. These libraries can be utilized to chunk PDF records and read the substance to dyslexic students. MySQL could be a relational database administration framework that's free and open-source (RDBMS). Its name could be a combination of "My," co-founder Michael Wideness's daughter's title, and "SQL," the abbreviation for Structured Query Language. A relational database organizes data into one or more data tables in which data sorts may be connected to one another; these connections help in the data structure. Machine learning (ML) is the study of computer calculations that improve themselves consequently through training and use of data. It is regarded as a component of artificial intelligence. A complex words classification could be a strategy for recognizing complex words in a text and giving definitions by mapping such words to a word reference database to help dyslexia. Finally, the scope is to develop an application for dyslexia students, for text extraction and text to speech conversion of PDF documents and by using Machine learning techniques, find an accurate classification of complex words and provide dictionary support accordingly.

2. LITRATURE REVIEW

S. S. Abdul Hamid et al., [1] (2015) states in the paper “A study of a computer-based learning model for students with

dyslexia," and L. Rello et al.,[2] (2012) in "Layout guidelines for web text and a web service to improve accessibility for dyslexics," discussed guidelines that are dyslexic friendly and he found relatively modest reading speed effects from font choice as well as some effects of other formatting preferences. R. Baeza-yates et al.,[3] (2013) states in the paper "Frequent Words Improve Readability and Short Words Improve Understandability for People with Dyslexia," has discussed about the metrics for dyslexic font choices.

H. Saggion et al.,[4] (2012) states in the paper "Graphical Schemes May Improve Readability but Not Understandability for People with Dyslexia" found significant improvements from the amount of text presented and font size on certain types of dyslexia.

We could find no research investigating effects of reader interface on the use of key accessibility features. However, research on text-to-speech should also be taken into account having reported significant gains from the earliest days by authors N. A. Bartolom et al.,[5] (2012) states in the paper "Dyslexia diagnosis in reading stage though the use of games at school," and T. Cuschieri et al.,[6] (2014) states in the paper "The iLearnRW Game: Support for Students with Dyslexia in Class and at Home," that most dyslexic students suffer with pronunciation.

S. Mascheretti et al.,[7] (2017) states in the paper "Neurogenetics of developmental dyslexia: From genes to behavior through brain neuroimaging and cognitive and sensorial mechanisms,". This paper presents the results of simulations of a brand-new category of artificial neural network models of reading. not like previous models, they're not restricted to mono-syllabic words, need no difficult input-output representations like Wickelfeatures and, though supported the NETtalk system of Sejnowski and Rosenberg (1987), need no pre-processing to align the letters and phonemes within the coaching information. the most effective cases square measure able to succeed 100 percent performance on the Seidenberg and McClelland (1989) coaching corpus, in more than ninetieth on rolling nonwords and on harm exhibit symptoms just like nonheritable surface learning disorder.

As they have trouble in processing information by looking at a word, connecting the sound made by a specific letter or deciphering the sounds of all the letters together that form a word in the paper "'Dyslexia baca' mobile app - The learning ecosystem for dyslexic children," by S. M. Daud and H. Abas [8] (2013) the conventional teaching approaches are not suitable for them. Thus, the application is based on advanced technologies such as touchscreens, accelerometers, gyroscopes and voice recognition. Visual, auditory and kinesthetic approaches are said to be appropriate and suitable for teaching dyslexic children. Hence the app has adopted a multisensory approach to making it more worthwhile

M. Kast et al.,[9] (2017) states in the paper "Computer-based multisensory learning in children with developmental dyslexia.," and V. F. Martins et al.,[10] (2017) the paper "Mobile application to support dyslexia diagnostic and reading practice," gives statistics recorded a total of 4096 downloads of the application among various countries with USA, UK, and Malaysia having higher percentages. Therefore, this app can be considered as a practically proven potential path for such children to learn how to read, as reading is based on repetition of recognizing and memorizing letters of the alphabet.

D. Lukes [11] (2016) states in the paper "Dyslexia friendly reader: Prototype, designs, and exploratory study," by discusses the guidance mode consisted of lexical support with dictionary integration to learn unfamiliar complex words and instructional support the practice of reading activities and their associated skills such as skimming and scanning and Ultimately the study concludes by stating that a simple interface focused on immediate results through text-to-speech has proved very popular and the customization of text display increases the easiness to access to the text.

The most commonly employed aspect of gamification is the use of an achievement system, often in the form of badges or rewards is discussed in the paper by D.Gooch et al.,[12] (2016) "Exploring the use of a Gamification Platform to Support Students with Dyslexia," The platform Classdojo being a gamification system that uses real-time feedback, it allows the teacher to create badges of rewards as they see fit.

In the paper "Dyslexia Adaptive eLearning System Based on Multi-Layer Architecture," by A. Alsobhi et al.,[13] (2015) discusses the newly designed app was identified with new features that supported adaptivity so that the learning content can be customized according to the preference of the user proving that it was, in fact, more useful to the dyslexic community.

3. EXISTING SYSTEM

Dyslexia Baca (DB) is a mobile application created in Malay, giving a learning tool for children affected by dyslexia. DB is designed and executed by tending to the problems of troubles confronted by dyslexic children in recognizing and memorizing the alphabet. Its primary objective was to propel such children to read by recognizing the alphabet and practicing recalling learned information. It is said to be a user-friendly and supportive learning tool, which gives visual illustrations for befuddling letters (such as p, q, b, d, m, and w) nearby with an arrangement of games to play. Aiding to distinguish the dissimilarities between the letters was the most point of this application.

As they have trouble in processing information by looking at a word, connecting the sound made by a specific letter or deciphering the sounds of all the letters together that form a word, [14] the conventional teaching approaches are not suitable for them. Thus, the application is based on advanced technologies such as touchscreens, accelerometers, gyroscopes and voice recognition. Visual, auditory and kinesthetic approaches are said to be appropriate and suitable for teaching dyslexic children. Hence the app has

adopted a multisensory approach to making it more worthwhile[15].

As the existing traditional apps merely presented the disabled students only with direct instructions, and as it was not effective and the systems lack necessary interactivity those were not suitable enough to serve the purpose of aiding the patients properly. The newly designed app was identified with new features that supported adaptivity so that the learning content can be customized according to the preference of the user proving that it was, in fact, more useful to the dyslexic community than the existing e-learning based apps.

Moving on to other applications that already exist by conducting researches regarding this aspect, 'Dyslexia Friendly Reader'application and the exploratory study can be identified as another prominent approach. It is mainly focused on overcoming the limitations of existing reading apps and presenting a prototype with more significant features [15].

4. PROPOSED SYSTEM

Moving to the Dyslexia assistive application that was proposed, it has primarily proposed three modes, specifically listening, chunking, and dictionary support. The listening mode has the ability to get content through the document uploaded by means of text-to-speech functionality. Furthermore, the audio is coordinated with dyslexia-friendly speed for superior understanding of the content after which the content will be shown on the display box. Additionally, the second mode chunking gives the capacity to control the amount of text displayed on the screen at once, and scrolling may well be done by syncing with the audio feed. Finally, the dictionary mode consisted of the lexical support with dictionary integration to learn unfamiliar complex words, this can be divided into two, one being the google dictionary support and another being self-training after doing the Text classification using feed forward neural network and collecting the complex words and updating it in MySQL database.

The proposed system consists of five modules, which are listed as follows,

4.1 Creation and setting the path for pdf reader

The very first step is to get the root directory from the user from where the file system needs to be read. Any event which occurs within that directory can be analyzed and proper data with no redundant files or directories can be maintained. The above step also involves selecting the languages which need to be monitored in that file system. The python language with corresponding execution paths is to be chosen as there can be multiple python installed of various versions. The PDF will be monitored from the time the system is on and till the system gets off. Making sure all events are gathered to know the files and sub-directories of the root directory created from user inputs.

4.2 Text reading to PDF

Optical Character Recognition is a text recognition method that allows the written text or pdf copies of the text to be rendered into editable soft copies or pdf files. Pdfreader is used for the scanning of text from the images and converting that image into the editable text file. pypdf2 is a python library used for cropping, managing and merging the pages in the pdf document. Pdfminer is the tool used for text extraction from the pdf document. Word chunking facility is provided to the user to segment the document into chunks of 60 to 70 characters at a time.Text formatting techniques such as size change, fontstyle change, and color change along with background formatting are provided according to the british Dyslexia Association. Finally, the fully manipulated text output will be displayed on a separate screen.

4.3 Text to speech

The reach of this module starts with the completion of the preceding text Recognition module. The module is in charge of converting the transformed text to audible form. Pyttsx3 is the library used for text-to-speech conversion, and we used the rate, volume, and voice commands to create dyslexic-friendly audio. The Python TTS engine library can aid in text reading.

4.4 Training keywords

Text from the pdf will be extracted and will be separated into key words. The understandable keyword is then read by the engine. If not understandable, python will check with mysql database and it will read the text voice from MySQL db. This component is added to aid the users to help in understanding complex words they come across. It is implemented in both ways where the user can type a word and find the meaning or the complex words from the document are identified and displayed on the screen along with the meanings. The training of the keywords is then done manually by the system administrator by getting the list of words after the classification of the text using feed forward neural network.

4.5 Classification of words

The model is implemented using Anaconda and the language used is python. The data is first preprocessed to fill in any values that are lost. The preprocessed data is then separated into training and testing data to train the algorithm. The model has single hidden layer and a "bag of words" approach to organize the training data which belongs to two classes, easy and hard. The classification is based on the following parameters, length of the words, count of vowels, mirror letters and frequency of the words.

The dataset is fitted to the model and the model is trained with 50 epochs. The model that is trained and saved is loaded. A Neural network model is created containing all our synaptic weights for the training data and it can be improved by adding words, identified by the user while using the application. The words are then updated in the database Then the Output will be displayed.

4.5 System Architecture

The below figure 1 explains how this architecture works. The user after login enters the application and uploads the required document. Text extraction is then done from the document using OCR. Then Text from the document is converted into speech after which the document is then divided into many segments, each segment having 60 to 70 characters. This process is called chucking.

Finally, the complex words are identified from the text then the user can search for the meaning of the word and at the end the complex words are displayed in the display screen with their synonyms. Text classification of the sentences takes place using feed forward neural network after classifying the sentences into hard and easy, the acquired list is then updated in the database manually or imported.

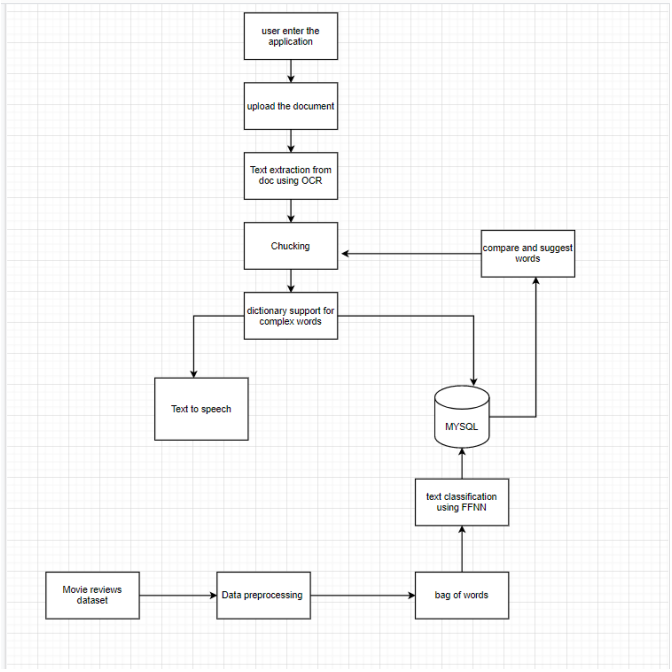

Fig -1: System Architecture

5. RESULTS

This work presented an effective assistive application for dyslexia students.

- Comparison between the existing methods and the proposed method is carried out.
- The final output is presented in the form of a desktop application and the accuracy of the classification model is 86.000001
- These results indicate that the proposed method is accurate and can be used by the dyslexia community.
- The model's accuracy and loss during each epoch is included for better interpretation. The model is also fed with words for classification of them into easy and hard classes.
- Figure 2 represents the segmentation of the paragraphs in the document.
- Figure 3 represents the keyword insertion for training and Figure 6.5 represents the pop message after the successful updating in database.
- Figure 4 represents the bag of words model after data preprocessing.
- Figure 5 represents the accuracy metric after the training and testing.

Fig -2: chucking of Text

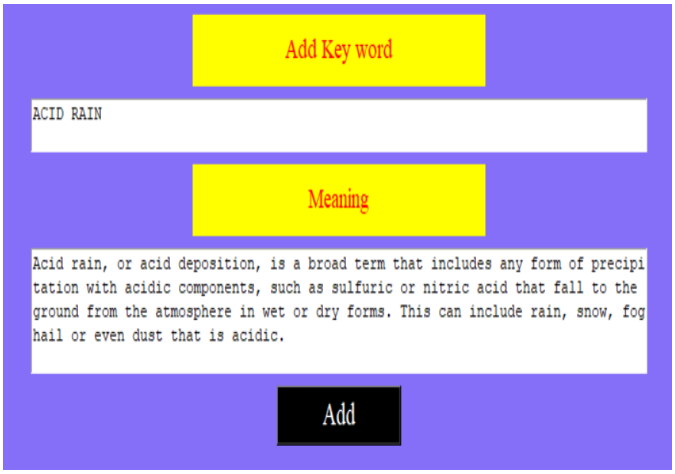

Fig-3 : Training of keywords

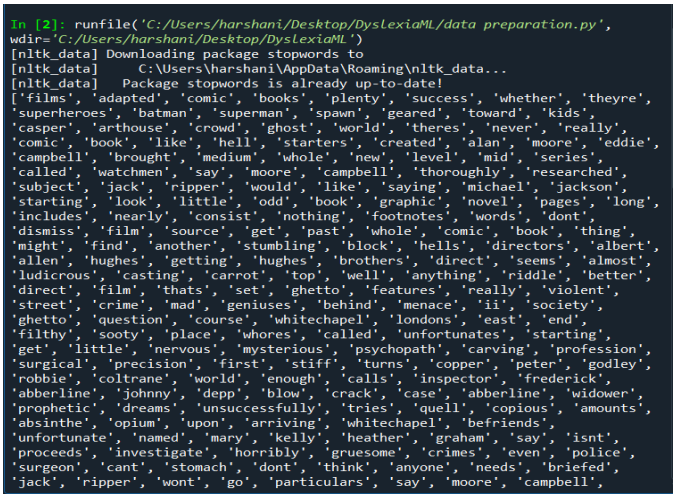

Fig-4 : Bag of words model

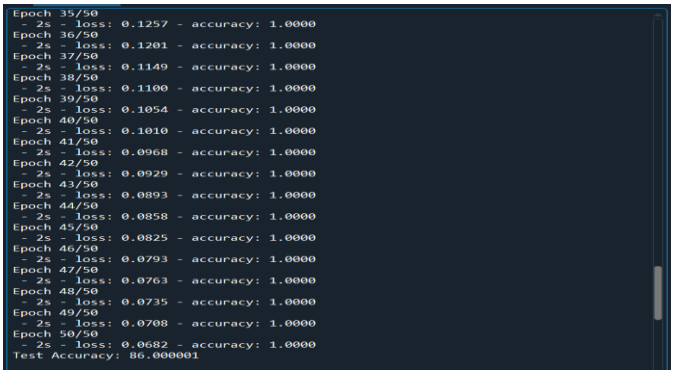

Fig -5: Accuracy metric

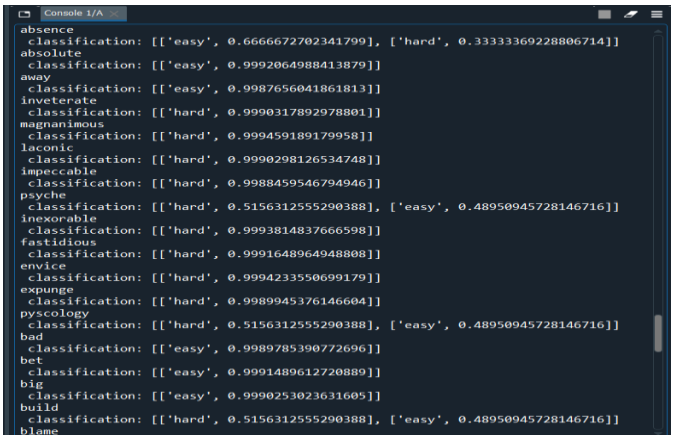

Fig-6: classification of words

- Figure 6 represents the classification of words after training the model.

6. CONCLUSIONS

In spite of a surge in number of accessible reader apps, none of them offer assistance to people suffering from one or other reading disabilities. In specific, a basic interface centered on quick results through text-to-speech has demonstrated exceptionally well known with young struggling readers. In light of this, the need for text-to-speech. Students moreover acknowledged the capacity to customize the way the text is shown. The model preparatory testing affirmed that the investigation was effective. In spite of the fact that there are numerous reader applications, the features displayed to the dyslexics by this model were yielding results already. Having features that can be customized according to their inability, let dyslexics who are typically reluctant to read texts, engage with their environment effectively and more excitedly. There is still research to be done to develop a full-fledged application that can cater to all the needs of the user.

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