AUTONOMOUS DYSLEXIA EVALUATION SYSTEM

Capstone Project Proposal

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TABLE OF CONTENTS

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MENTOR CONSENT FORM

Mentor Consent Form

I hereby agree to be the mentor of the following Capstone Project Team

Project Title:		
Roll No	**Name**	**Signatures**
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NAME of Mentor: Dr. P. S. Rana

SIGNATURE of Mentor:

PROJECT OVERVIEW

Dyslexia is a learning problem where the individual frequently experiences issues perusing and deciphering what they read. It is a Specific Learning Difficulty (SpLD) that influences a singular's capacity to process, store, and recover data. This thus influences the instructive advancement of kids with Dyslexia.

This project aims to track the progress of a child, dealing with Dyslexia through a series of tests. These tests will focus on the following areas – the ability of writing down heard letters and syllables, recognizing whole words, naming objects (letters, words, symbols and images) quickly and automatically and correctly pronouncing displayed words. A track record of the entire test history is maintained and the progress of the child .

The project involves the integration of Audio Classification module, OCR module and web application module and the implementation of deep learning model using Tensor Flow Library. It is an autonomous system, requiring minimal interface, user friendly and is accessible to everyone completely free of cost.

PROBLEM STATEMENT

Dyslexia is a common condition that makes it hard to work with language. Dyslexic subjects have a hard time with reading comprehension, spelling, and writing. The International Dyslexia Foundation states that between 15% and 20% of the population have a language based learning disability, Dyslexia being the most common of these.

How many times have you seen a child struggling in reading simple words? How often have you come across a child unable to differentiate between similar looking alphabets like ‘b’ and ‘d’? How frequently have you seen a child unable to organize letters in the correct order when spelling them? How recurrently have you witnessed a child being unusually slower in processing information than his/her peers?

NEED ANALYSIS

- There are students in almost every class who face difficulties in reading, writing or spelling words. While most parents and teachers struggle with them or completely give up on them, it is important to identify if they are dyslexic.
- Traditional Dyslexia evaluation requires a supervisor who is required to be physically present to conduct the tests and monitor the evaluation.
- Physical evaluation is not always free of cost, thus depriving children from humble homes a fair opportunity to progress and succeed in overcoming this disorder.
- In the traditional evaluation, a skilled doctor is required to conduct this test. The efficiency and accuracy of the doctor, conducting the tests, are vital factors on which the success of the evaluation majorly depends.
- The physical evaluation is a scheduled test which takes place on a particular date, at a particular time and at a specific place. This can be cumbersome for parents to take their children to appointments due to prior commitments or unforeseen issues.
- Analysis of the progress made by the child based on previous tests taken may not be accurate subject to the criteria involved and in some cases the track record of the child may not have been maintained.

LITERATURE REVIEW

Dyslexic is a perusing inability that essentially concerns a specific language base, which influences the capacity to learn words and make words despite the fact that the child has a normal or better than expected knowledge level, adequate persuasive and instructive open doors, ordinary vision and hearing. Developmental Dyslexia is inborn and because of hereditary or genetic elements. Individuals with Dyslexia experience issues not only concerned with perusing, they additionally experience the boundaries to spelling, composing, and some other language perspectives. Notwithstanding, dyslexic kids have typical or even better than expected levels of knowledge. With extraordinary taking care of, the hindrances they experience can be limited. Furthermore, acquired Dyslexia is obtained because of obstruction or changes in the manner the left brain reads [1].

In [2], Raskind et al. tested the hypothesis that handwriting automaticity has a unique path to written composition in individuals with Dyslexia. To rule out the claim that impaired writing in Dyslexia merely reflects a grapho-motor deficit, they tested the hypothesis that the motor problems in Dyslexia involve oral motor planning and oral reading rather than grapho-motor planning in composition. Finally, they tested the hypothesis that, because Dyslexia is the result of impaired automatic temporal integration of verbal codes and orthographic codes, both rapid automatic naming and rapid automatic letter writing load on the same factor. They then examined whether inhibition or verbal fluency was significantly related to rapid automatic letter naming and rapid automatic letter writing.

The study of [3] presents five boys, aged 7.5–10.7 years, with a syndrome of extreme Dyslexia and color-naming difficulty, without comparable object or picture naming difficulty, without partial blindness, and without obvious "delicate" neurological signs. Their color-naming defect deformity was contrasted with an assortment of shading

anomias detailed in grown-ups with obtained sores and it was reasoned that these young men most intently look like the "aphasic", as opposed to the "disconnexion" type. The astounding seriousness and virtue of their Dyslexia, combined with the color naming deformity, proposes that an exceptionally explicit separation of capacity exists inside the cerebral language regions and discrete breakdown can represent explicit subtypes of Dyslexia.

The picture and word naming performance of developmental dyslexics was compared to the picture and word naming performance of non-dyslexic poor readers, reading age, and chronological age-matched controls. An object name recognition test assessed each subject's vocabulary knowledge of those names which they were unable to spontaneously label in the picture naming task. Findings indicated that the dyslexic and the poor readers exhibited a picture naming deficit relative to both chronological and reading age-matched controls. The dyslexic children also recognized significantly more unnamed target words than all comparison groups, suggesting a particular difficulty in retrieving he phonological codes of known picture names rather than a vocabulary deficit [4].

[5] Describes a technique to apply speech recognition using knowledge of suitable Artificial Intelligence methods. Feature extraction from an audio file is done using Mel-frequency cepstral coefficients which have 39 features some of which are related to amplitude and frequencies of that audio. These MFCC’s can be standardized and then can be trained for classification using RNN’s with LSTM’s. Sigmoid Activation Function/SoftMax Activation Function can be used to test the correctness of the spoken word. A value closer to 1 indicates the more correctness of the spoken word and value nearer to 0 indicates incorrect pronunciation of that word.

Jaro-Winkler Distance is a very popular metric which is used to compare similarity b/w two strings. This will be used in Rapid Color Naming Evaluation for comparing two strings out of which one is solution string and other one is the string spoken by the candidate (considering first letter of each color spoken). The measurement scale is 0.0

to 1.0, where 0.0 is the least likely and 1.0 is a positive match. [6]

All the literature findings from various research papers have been listed below:-

S.No	Paper Title	Tools/Technology	Findings	Citation
`	Speech, Writing Disorder and Therapy of Dyslexic Patient [1]	Word Pronunciation Test and its Evaluation	Individuals with Dyslexia experience issues not only concerned with perusing, they additionally experience the boundaries to spelling, composing, and some other language perspectives	Gustianingsih1, Elmeida Effendi and Ali
2	Writing Problems in Developmental Dyslexia: Under-Recognized and Under-Treated [2]	Writing Test and its Evaluation	Handwriting automaticity has a unique path to written composition in individuals with Dyslexia.	Virginia W. Beninger, Kathleen H. Nielsen, Robert D. Abbott, Ellen Wijsman and Wendy Raskind
3	Color-Naming Defects in Dyslexic Boys [3]	Rapid Color Naming Test and its Evaluation	A highly specific differentiation of function exists within the cerebral language areas and discrete malfunction can	Martha Bridge Denkla

			account for specific subtypes of Dyslexia.	
4	Picture Naming Deficits in Developmental Dyslexia: The Phonological Representations Hypothesis [4]	Object Detection Test and its Evaluation	The dyslexics' picture naming errors are particularly marked on polysyllabic and/or low frequency words, indicating a possible phonological basis to the picture naming deficit of the dyslexic children.	Denise Swan and Usha Goswami
5	Speech Recognition using Feature Extraction techniques – MFCC & PLP [5]	MFCC, RNN, LSTM's, Neural Networks	A technique to apply speech recognition using knowledge of suitable Artificial Intelligence methods.	Hiroshi Shimodaira , Steve Renals
6	Jaro-Winkler Distance [6]	Jaro Similarity, Pattern Matching Algorithms	A metric to find similarity b/w two strings.	Matthew A. Jaro
7	Speech Recognition using MFCC [7]	MFCC's calculation using Audio processing	Technique to find MFCC's of audio	Chadawan Ittichaichareon, Siwat Suksri and Thaweesak Yingthawornsuk

OBJECTIVES

- The main objective our project is to automate the process of a dyslexic child's evaluation and track the progress of the dyslexic child.
- To maintain a track record of the patient which helps to monitor the progress of patient and these track records can be also presented to a doctor for proper treatment.
- To test a patient for Dyslexia using an autonomous system which eliminates the requirement of a doctor.
- To increase the efficiency of dyslexic evaluation process and optimize the overall cost.
- To provide a personalized remote based solution which helps to evaluate Dyslexia at any time and at any place free of cost.

METHODOLOGY

Our project is based on 4 tests including Pronunciation Evaluation, Rapid Color Naming, Handwriting Evaluation and Object Classification. The method deployed to implement each test is enlisted below:-

- **Pronunciation Evaluation** – It involves data collection, Data/Audio Preprocessing wherein audio is converted to monotonic type from stereo type and is stored in the form of Mel-Frequency Cepstral Coefficients and implementation of a deep learning model using Tensor Flow Library.

- **Rapid Color Naming** – It involves conversion of audio into text using speech recognition libraries. A string is created from the converted text using first word of each color. This string is matched with the answer string and score is generated based on similarity of the two strings. The similarity b/w two strings is calculated using the **Jaro–Winkler distance** metric.

- **Handwriting Evaluation –** It involves designing specific set of problems which includes spellings/wordings for a particular object designed in such a manner that it will be difficult for the dyslexic child to write. The source of the Spellings/Wordings will be an experienced psychiatrist or a recognized research paper.

- **Object Classification** – It involves the implementation of a basic module of our web application developed using MERN stack. The design consists of specific set of problems which includes images for a particular object. Each problem will also contain a set of similar looking options, which will make it difficult for the dyslexic child to distinguish from the right choice.

PROJECT OUTCOMES

- **Evaluation of Dyslexia** –Automate the process of dyslexic subject's evaluation through various tests specially designed for them.
- **Track record -** A track record of the entire test history of the taker will be maintained. This record will help analyze the progress of the child after each test.
- **Accessible** – The evaluation system will be accessible at any place and at any time. The child will have the freedom to take the test at his/her leisure.
- **Inexpensive** – The system will require a stable internet connection and no additional cost will be incurred. We promise to deliver an evaluation system with no financial constraints.
- **No supervision** – The tests will not require supervision by an adult. Each test will be designed in such a way that child will easily understand how to proceed and will not face any trouble while taking it.
- **Minimal interface –** The evaluation system will be designed while acknowledging the targeted age group. Hence, it will have minimal interface and will be child friendly.

WORK PLAN

Sr No.	Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1	Identification formulation and Planning of Project											
2	Study of Evaluation Parameters of Dyslexic Patient											
3	Development of Modules for each Evaluation Parameter											
4	Analysis of Report produced by our System											
5	Design Optimization											
6	Performing Modifications											
7	Results Evaluation											
8	Final Report											

INDIVIDUAL ROLES

- Kashish :- Backend of Web Application, Rapid Color Naming Module, Documentation
- Paras Bakshi :- Handwriting Recognition Module, Pronunciation Evaluation Module, Documentation
- Sanidhiya :- Handwriting Recognition Module, Pronunciation Evaluation Module, Documentation
- Shreya Somani :- Front end of Web Application, Object Classification Module, Documentation

COURSE SUBJECTS

The following is the list of the course subjects that will be used during the successful execution of our capstone project:-

- Artificial Intelligence
- Deep Learning
- Data Science
- Machine Learning
- Web Development
- Software Engineering
- Predictive Analysis Using Statistics

REFERENCES

[1] G. M.Hum and E. Effendy, "Speech, Writing Disorder and Therapy of Dyslexic Patient," *Speech, Writing Disorder and Therapy of Dyslexic Patient,* p. 8, 2019.

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[4] D. Swan and U. Goswami, "Picture Naming Deficits in Developmental Dyslexia: The Phonological Representations Hypothesis," *Picture Naming Deficits in Developmental Dyslexia: The Phonological Representations Hypothesis,* p. 24, 1997.

[5] J. Hui, "Speech Recognition — Feature Extraction MFCC & PLP," *Speech Recognition — Feature Extraction MFCC & PLP,* p. 15, 2019.

[6] M. A. Jaro, "Jaro–Winkler distance," *Jaro–Winkler distance,* p. 3, 1989.

[7] C. Ittichaichareon, S. Suksri and T. Yingthawornsuk, "Speech Recognition using MFCC," *Speech Recognition using MFCC ,* p. 4, 2012.