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Assesment of Phonological Dyslexia

Bachelor of Science in Computer Science

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CERTIFICATE

We accept the work contained in the report titled "Football Analyzer and Predictor" as a confirmation of the required standard for the partial fulfillment of the degree of BS (CS).

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Abstract

Dyslexia is a neurological learning condition that prevents people from developing functional skills that are suitable for their age and abilities. Dyslexia is characterised by difficulties with various Phonological skills. The early intervention for dyslexic children in Pakistan is restricted by a lack of training in remedial education and dyslexia awareness. Regarding the implementation of remedial assistance and assistive technology, there are obviously clear accessibility and affordance problems. In this study, we created a web-based learning application for devices that tackles the usability needs and developmental progression of dyslexic children with different Phonics challenges. The identification of Phonological Dyslexia in youngsters was our main focus. We created a web-based application with specific modules based on a computational learning model to accomplish this goal. In collaboration with remedial teachers and dyslexic students from a few Pakistani institutions for the study of dyslexia, we evaluated the usefulness and usability of the application that was built. The preliminary evaluation findings showed that the application has validated its function in terms of representation, evaluation, and optimization of young dyslexic Children' Phonological abilities.

Acknowledgments

We would like to express our heartfelt gratitude to our esteemed supervisor, Maam Sumaira Kausar, for her guidance and support throughout the application development process.

Furthermore, we would like to thank respected panel members and Project coordinator Ma'am Maryam Multani for actively communicating with us throughout the academic year in a very efficient manner.

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Acronyms and Abbreviations

AI	Artificial Intelligence
ML	Machine Learning
SVM	Support Vector Machine
XGBoost	eXtreme Gradient Boosting
DT	Decision Tree
C-NN Convolution Neural Network	
k-NN	k-Nearest Neighbor
DSA	Data Structure and Algorithms
OOP	Object Oriented Programming
PF	Programming Fundamentals
SE	Software Engineering
SQL	Structured Query Language
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICODE	Unique, Universal, and Uniform Character enCoding
XML	Extensible Markup Language
POS	Part-of-Speech Tagging
FPR	False Positive Rate
HTML	Hyper Text Markup Language
HTTP	Hyper Text Transfer Protocol
HTTPS	Hyper Text Transfer Protocol Secure
IP	Internet Protocol

Chapter 1

Introduction

1.1 What is Dyslexia?

Dyslexia is a learning impairment in which people have trouble reading because they can't recognize spoken sounds or understand how they relate to letters and words. Dyslexia, commonly known as reading difficulty, affects the parts of the brain that process language.
Dyslexia is a cognitive condition in which people have trouble reading, writing, processing information, and understanding because they have trouble correctly distinguishing speech sounds. A neurological disease that affects how the brain works and how it responds to words.
Students with dyslexia have normal brains and vision. Tutoring or a specialized education programmed can help most dyslexic youngsters succeed in school. Emotional support is also very crucial. Because dyslexia have no cure, it is preferable to get a diagnosis as soon as possible. Dyslexia might go at any time. People with dyslexia typically have normal brains and vision. Tutoring or a specialized education programmed can help most dyslexic youngsters succeed in school. Emotional support is also very crucial. Because dyslexia have no cure, it is preferable to get a diagnosis as soon as possible. Dyslexia can go untreated for years and not be identified until adulthood, but it's never too late to seek treatment.
Dyslexia impairs a person's ability to develop higher-order cognitive skills such as abstract reasoning, planning, organizing, memory, and attention. A different pattern of strengths and limitations in learning and information-processing skills characterizes a specific learning difficulty. Learners may have average or above-average abilities in most areas of thinking, learning, and problem-solving, but unique deficiencies in others.
It is the most common of all specific learning difficulties, affecting 4 percent of the population significantly, with a further 6 percent affected to a lesser degree. Dyslexia tends to run in families. It appears to be linked to genes that alter how the brain interprets reading and language, as well as environmental risk factors. [1]
There are 6 types of Dyslexia described below

- **Phonological Dyslexia:** If you have trouble hearing the sounds that combine to make a word, you may not recognise it when you see it or be able to spell it when it's time to write it down.
- **Surface Dyslexia:** Some people have a specific type of reading difficulties that causes them to take longer to understand language once they've passed the decoding stage. This makes it tough to understand what you're reading and increases the amount of time it takes to comprehend what you're reading.
- **Visual Dyslexia:** Visual processing is implicated in visual Dyslexia, which means the brain does not receive the complete picture of what the eyes are perceiving.
- **Primary Dyslexia:** When dyslexia is caused by a genetically inherited condition, it is referred to as primary dyslexia.
- **Secondary Dyslexia:** Secondary dyslexia is classified as a developmental disorder because it is present from birth and persists throughout one's life.
- **Trauma Dyslexia:** When a person has a brain injury as a result of trauma or disease, they may experience issues with language processing, leading to dyslexia.

Figure 1.1: Sign of Dyslexia

1.2 Project Background/Overview

It is globally estimated that occurrence of dyslexia is about 10 percent in the world which includes about 700 million people who are struggling with learning disability, whereas in Pakistan the rate of Dyslexia is 15 percent to 20 percent which includes 12 million children and adults need help. In order to detect this learning disability, we came up with the solution "Assessment of Phonological Dyslexia.

1.3 Problem Description

People are unaware of Dyslexia disease which is commonly present in one out of ten students. Problem faced by such students is that basically these students face a lot of difficulty while Reading, Writing or Listening so they face a Difficulty. As there is very less awareness of Phonological Dyslexia among people due to which one's don't even know that they are suffering from this disease. The researchers have not yet finalized or assured that exactly what causes dyslexia but based on tests and observations they do know that genes and heredity play an important role and it often runs in families. Scientists have also discovered genes linked to problems with reading and processing languages.

Diagnosis of dyslexia is very costly and time-consuming for example mostly people were used to go to professionals who can assess people for dyslexia or by examining full evaluation of person either at school or in private which also takes days or weeks.[2] Dyslexia is affecting about 10 percent of world population and it is important to identify dyslexic patients or children at an early age to provide them early treatments and learning facilities. In the present scenario, there is no such digital dyslexia diagnostic machine so that is why, we are going to develop an interface that take the data of such students and run different tests based on the provided Data. As there's no single test that can diagnose dyslexia. Several factors are considered such as Child's development, educational issue, and medical history, vision, hearing tests, reading and other academic skills, psychological testing.

Due to a lack of awareness about dyslexia in Pakistan, we must rely on international data, which estimate that 15-20 percent of students in each class have some type of learning difficulty. Based on this ratio, it is predicted that 12 million of Pakistan's 60 million children require assistance and hence there are not many institutions to deal with dyslexic patients and no such systems to diagnose this learning disability in Pakistan. [3]

1.4 Project Objectives

So, in this project, a web application is going to be developed and the concepts of Artificial Intelligence will be used. We are going to restrict our scope to gather the data from different institutions and check if the student is Dyslexic or not.

- To develop a screening device for the detection of dyslexia in youngsters by looking at the functions of Phonics through different machine learning algorithms.
- The assessment of Phonological Dyslexia will be based on the voice input and a set of other Tests based on checking User memory and some simple numeric questions, and the results will be used to determine whether or not a child is dyslexic.

1.5 Project Scope

Almost every challenge we encounter confronts a few hurdles. It is simply the character of any challenging painting and something that desires to be taken in progress. Project scope is a part of the challenge of making plans that includes figuring out and documenting a listing of particular task goals, deliverables, features, functions, tasks, deadlines, and in the end costs. The system will perform analysis through provided data. The analysis will include many features like handwritten test assessments and voice-related assessments. It will predict about the result that the student is suffering from Dyslexia or not. The prediction depends on the Tests Results of the user. The system will be used by students' Parents for their children all around the world. Once completely developed, the system can be used in daily life. We are going to consider developing a web application now. As web applications are user and space-friendly platforms, this will enhance the user experience.[1]

In this chapter, we have covered what is Dyslexia, its type, and how people of different age groups face this problem, especially children and what are the present circumstances of Dyslexia in Pakistan, and the existing rate of Dyslexia internationally. In the following chapter, we are going to talk about Dyslexia Intervention and Diagnosis systems that are currently running in the world and also talk about what is happening in Pakistan regarding Dyslexia.

Chapter 2

Literature Review

2.1 Overview

Dyslexia has been affecting many people over many years and it is observed that this is happening because of a lack of awareness about dyslexia among people and that is why it is growing. In the present situation, the foreign countries have studied dyslexia and developed the systems for assessment of dyslexia and also trained people for diagnosis of dyslexia who help patients with suitable treatments, activities, and educational practices. In this chapter, we are going to highlight the methods through which people with dyslexia got diagnosed. There are basically two methods to diagnose Dyslexia.

2.2 Manual Method

Manual method is one of the old methods which is being followed for many years. In this method, people visit professionals for the diagnosis of dyslexia. The professionals perform different tests on patients to assure that the particular patient is dyslexic or not. If a patient is dyslexic then professionals provide suitable treatments according to the patient's present condition and this method takes a lot of time and sessions.

2.3 Computer Based Test

The second method is to diagnose dyslexia with the help of computer based tests which are available online and this method takes only a few minutes to diagnose the learning disability. In the present era, there are some systems and applications for the assessment of dyslexia having some pros and cons. As dyslexia has many types but we are going to work on the Assessment of Phonological Dyslexia which will be based on a voice input test and a written image test (a pic of the written page will be uploaded).

In the present scenario, technology is performing a great role in the prevention of dyslexia such as through Artificial Intelligence and digital tests that are carried out on Computers and mobile phones over the internet. Individual dyslexics use technology for a variety of reasons, including to promote content area learning and skill practice, as well as to enable users to complete tasks that would otherwise be difficult. Most study Interaction Design and suggests computer-based interventions which offer better results. [3] A frequently investigated field is computer-based programs that help younger people learn to read. Other studies suggest that text-to-speech and speech-to-text technologies, as well as features like spell check and word prediction, are beneficial. Applications for dyslexia are being developed either for its diagnosis, prevention, or both. Some are described below;

2.4 Lexercise

Lexercise is a Web-based application that was developed in 2008 to help dyslexic people. The latest technology is combined with structured literacy. Professional technologists and business people built this platform to diagnose dyslexia in people and help them in improving their learning disabilities. It is a free screener which any person can use, this screening tool first takes a 5 to 10 minutes assessment of a dyslexic person and generates a report based on the evaluation of the test, and provides a treatment plan. This application is using some basic test-based questions or practices through which it identifies a particular person is dyslexic or not.[4]

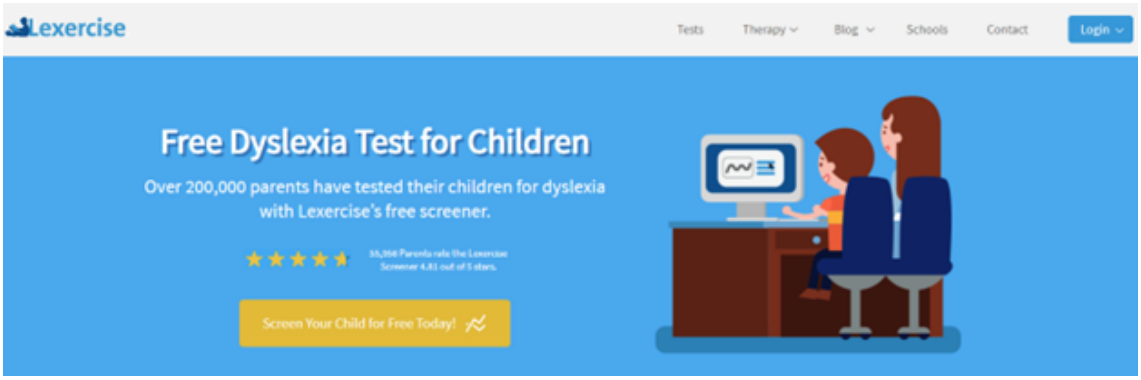

Figure 2.1: Lexercise

2.5 Test dyslexia

Test dyslexia is a web-based application that was developed by Ron Davis. A Reading Research Council was formed based on a set of questions commonly used by children and adults seeking help from the Davis Dyslexia Correction program a set of questions that are widely used with children and adults seeking help from the Davis Dyslexia Correction program. It takes an online assessment and gives the users a profile and also highlights the suitable treatments and practices through which specific problems can be addressed. This application is designed as an educational tool to help

dyslexic people. This application does not require any personal information of the user and in the assessment session, your answers are confidential.
In this application assessments starts by clicking the button “Begin Assessment” and then a list of questionnaires is formed which are meant to be answered. There are total of 5 assessment pages and 41 questions that are necessary to answer, once all the questions are answered a report will generate a report showing graph of disorientation, spelling and reading, attention focus, math and time management, self-esteem and coordination.

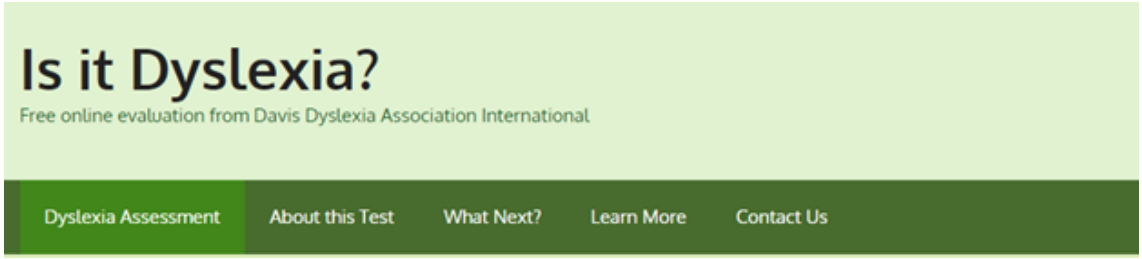

Figure 2.2: Test Dyslexia

2.6 Dyslexia Gold

Dyslexia gold is an online screening program. It is a web application that takes several types of online screening tests. It is quick, easy, and can be used anywhere.[5] At the end of the evaluation, a report will be emailed to the user which will be highlighting the user’s weaknesses and how to overcome them. Dyslexia Gold provides many types of tests which include;

- The Phonological Deficit.
- Eye Tracking.
- Working Memory.
- Audio Discrimination.

Figure 2.3: Dyslexia Gold

2.7 Neurolearning

The Neurolearning Dyslexia Screening Test App evaluates a number of critical brain functions that are underlying reading and spelling abilities and that function differently in people with dyslexia. It

combines these factors with an assessment of present reading skills to determine the chance that the test taker is dealing with dyslexia-related issues in school or at work. Users receive a full and personalized report of their results after the screening.[6]

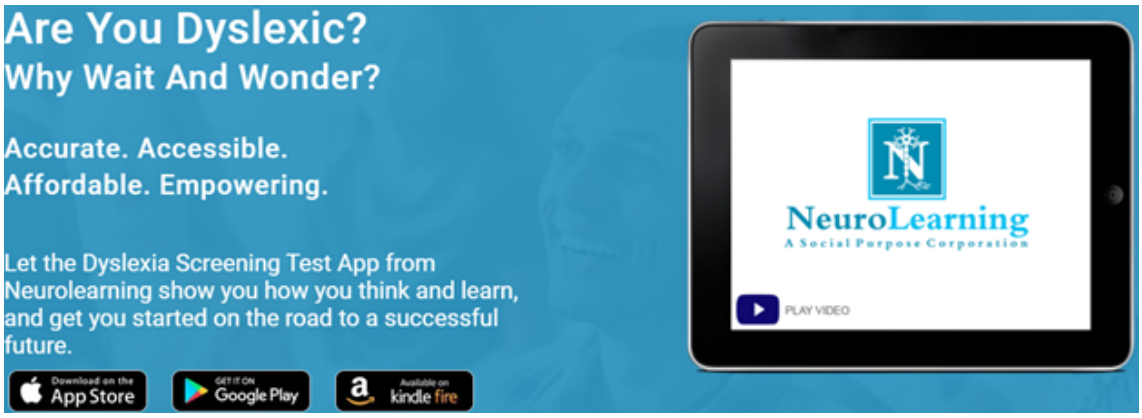

Figure 2.4: Neurolearning

Currently there are many applications for dyslexia but most of them are using basic test methods which include questions that are to be answered and after evaluation, a report is generated based on the answers. In our app "Assessment of Phonological Dyslexia," we are designing an application that will be used for the diagnosis of Phonological dyslexia. There will be primarily two tests to perform the evaluation. Our Primary test will be based on voice input and others will be based on uploading images of the handwriting of Dyslexic Students, unlike questionnaires that are performed on web applications above. We are using AI techniques for the evaluation of dyslexia.[6]

Chapter 3

Requirement Specifications

As there are many platforms already developed and started to work on dyslexia either for its diagnosis or prevention and now technology is also involved. At international level, there are many systems which are evaluating dyslexia in people but most of the systems are using basic question-based tests regarding personal issues, behavior, actions, emotions, and knowledge-based questions.[7]The majority of apps focused on reading followed by multi-sensory experiences, vocabulary development, and auditory experiences. In reality, these focus areas are not mutually exclusive and most apps include more than one area. Some of the developed platforms or existing systems are described below.[4]

3.1 Existing System

Lexercise is a Web-based application that was developed in 2008 to help dyslexic people. It is a free screener which any person can use, this screening tool first takes a 5 to 10 minutes assessment of a dyslexic person and generates a report based on the evaluation of the test, and provides a treatment plan. This application is using some basic test-based questions or practices through which it identifies whether a particular person is dyslexic or not. This system follows a set of methods for the treatment.[3]

- **Structured Literacy Methodology:** It is a method proven to work with the way a dyslexic brain learns. It is suitable for anyone facing difficulties in reading and writing.
- **Customized Daily Practice:** In this method, the system provides expert therapists to deal with dyslexic children or adults and perform practices. This method helps parents in measuring the improvement in their children.

Figure 3.1: Lexercise

Dyslexia Gold is an online screening program. It is a web application that takes several types of online screening tests. It is quick, easy, and can be used anywhere. At the end of the evaluation, a report will be emailed to the user which will highlight the user's weaknesses and how to overcome them. This system provides a different set of methods for the evaluation of dyslexia.[7]

- Engaging eyes (reading and spelling)
- Spelling tutor
- Dyslexia Screening Test

These are some of the existing systems that are being used online.

3.2 Proposed System

In our proposed system we are going to diagnose Phonological Dyslexia through voice inputs and hand-written documents/images. This system consists of two test methods for better and more precise evaluation. The two test methods are Voice Input and hand-written Image document. In our system, the analysis will be done in run-time and the test will be dynamic, there will be no questionnaire's-based test like in other systems. The system will filter the provided data and perform an analysis. The analysis will include many features like handwritten test assessments and voice-related assessments. It will predict about the result that the student is suffering from Dyslexia or not. The prediction and report generation depends on the Tests Results of the user. The system will be used by students' Parents for their children all around the world. Once completely developed, the system can be used in daily life.

3.3 Requirement Specifications

3.3.1 Functional Requirements:

FR-01. User Should Get Registered.

FR-02. Profile of Users to be Maintained.

FR-03. Test Methods to be Explained Correctly.

FR-04. Analysis must be accomplished Successfully.

FR-05. Statistics must be Properly mentioned in Report and Report should be Concise.

3.3.2 Non-Functional Requirements:

NFR-01. Security for Users must be Maintained.

NFR-02. Response Time and Net Processing Time Should be within 5 seconds.

NFR-03. Capacity, Growth And Scalability.

NFR-04. Development Standard to be maintained.

NFR-05. Reliability.

NFR-06. Test Module's to be Explained in Detail.

NFR-07. Website should be supportable on multiple Devices.

NFR-08. Data of users should be Maintained.

NFR-09. System Should Explain Information about Phonological Dyslexia.

3.4 Use Cases

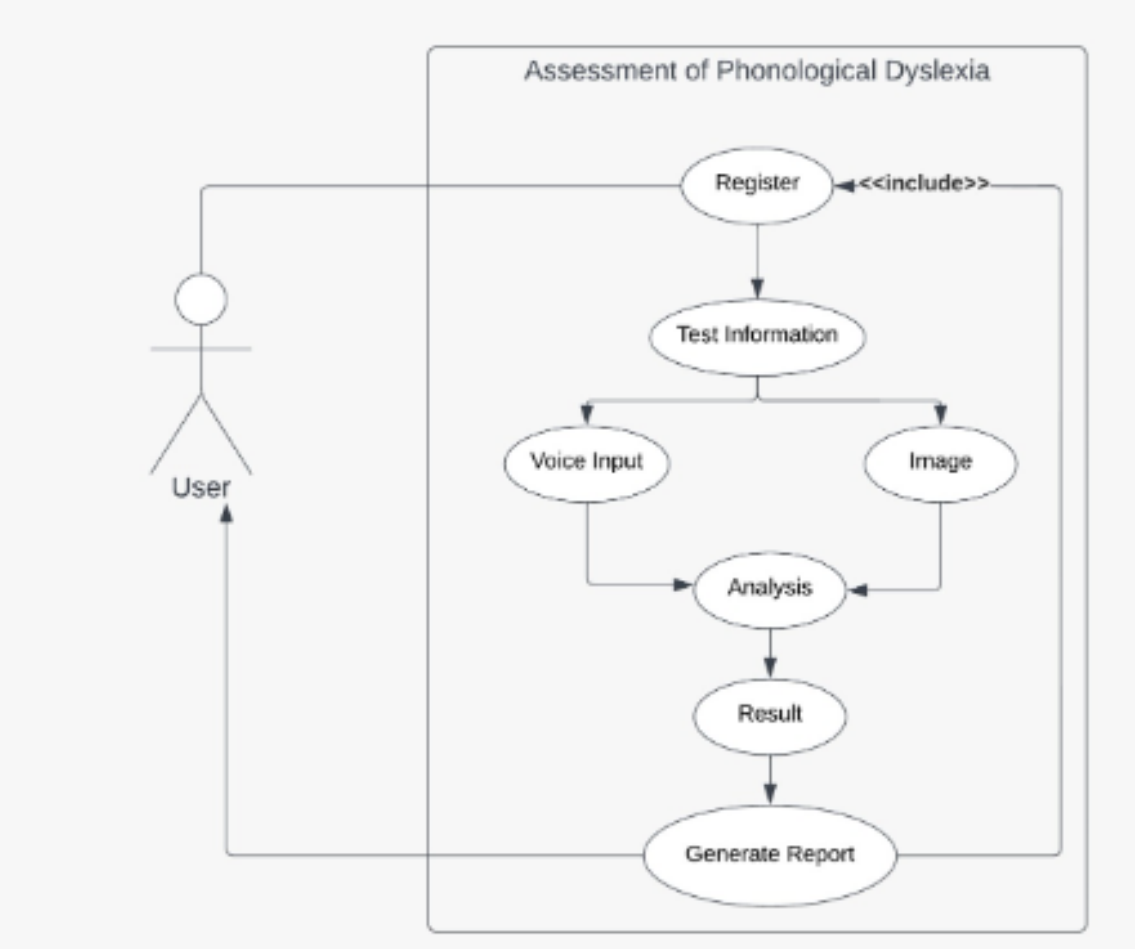

Figure 3.2: Use Case

Use Case ID	001
Use Case Name	Assessment of Phonological Dyslexia
Description	This use case allows the user to register and access functions of this system according to user's need. This use case provides the user to perform simple test methods for the diagnosis of dyslexia. Once the result comes then user can also generate report so, he or she can save it for later use. User can perform various functions such as registration, system details, test information, perform tests and generate report.
Primary Actor	User
Secondary Actor	None
Pre-conditions	1. Internet Connection 2. Compatible device
Post condition	1. Generate report 2. Responsive
Main flows	1. Registration 2. Test Information 3. Test types 4. Test-1 5. Test-2 6. Analysis 7. Test Result 8. Generate report 9. Show generated report to user
Alternative flows	1. If user do not register, then user cannot perform test. 2. User can perform a single test or both for more precise evaluation. 3. User can manually generate the report after test result.

Table 3.1: Use-Case of Dyslexia

Chapter 4

Design

In this chapter we are going to define about system architecture through diagrams, design constraints and design methodology to help in understanding the proposed system. Further we are going to explain high and low-level designs to satisfy the requirements.

4.1 System Architecture

The system architecture design explains the presentation layer the interface and the logical or server layer. It actually explains how these layers are divided into segments and how these layers work with each other when user interacts with the system.

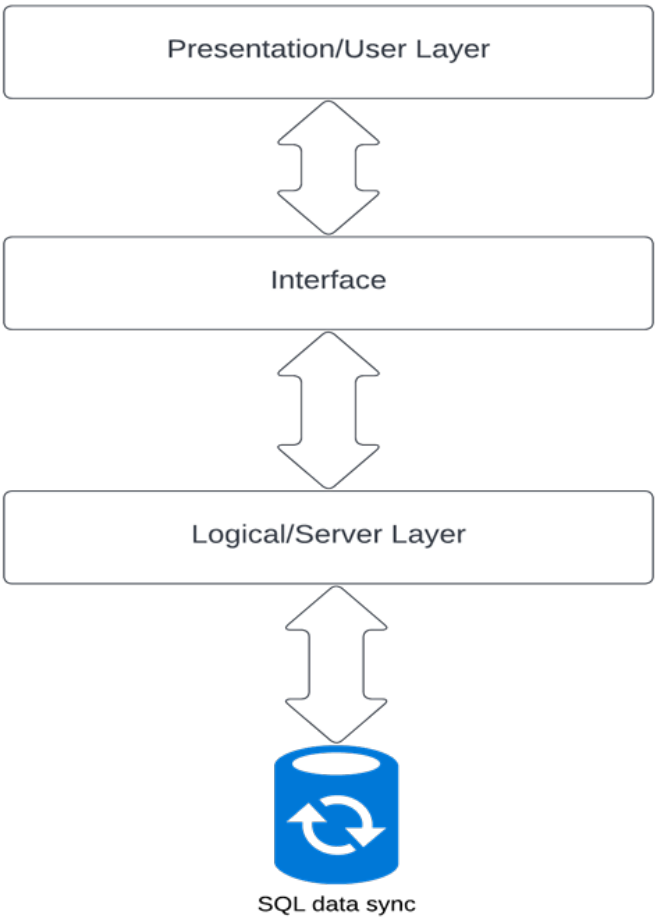

Figure 4.1: System Architecture

Presentation is also known as user layer which actually defines user interaction. Interface is the UI linking between Logical/Server layer and presentation/user Layer.

4.2 Design Constraints

Design constraints are obstacles on a design. There are some sorts of Design Constraints we can face while designing. Some of them are listed below;

- Compliance Applicable laws, regulations and standards. Data privacy rules
- Functional Requirements Functional necessities inclusive of specs of capabilities for a website
- Styling Constraints Stylistic constraints are rooted in aesthetic characteristics and are usually shared in logo fashion guides, factor libraries, or different files used for layout decisions.
- Integration A layout that desires to paintings with different matters including products, services, systems, processes, controls, companions and information.

This application was developed on the Web platform following industry standards and guidelines to provide cost-effective technical learning solutions for dyslexic children. However, in order to achieve this, it has abandoned a large user population that currently operates mobile technology based on other platforms. One of the major enhancements worthy of research is the addition of 2- and 3-letter sight word spelling assessment to the application to address dyslexia issues related to spelling concepts.

4.3 Design Methodology

As a developing country, Pakistan faces several challenges in dealing with dyslexia. Government assist is not enough to combat dyslexia nationwide. Moreover, the introduction of professional learning aids is still in its infancy. The research field of assistive technology for dyslexia has not made a significant contribution so far. In order to improve the dyslexia situation in Pakistan, we are working on the design and implementation of an interactive Technology Learning Aid specifically for dyslexic children who have handwriting difficulties. It also addresses the notable issues of awareness, affordability, and accessibility in relation to corrective action educational support and the adoption of assistive technology. [4] Considering this application is customized to the needs of dyslexic schoolchildren, the software engineering methodology used in the study is the Usability Engineering Process Model. Which back the usability considerations of the target group throughout development and create interaction designs through iterative cycles

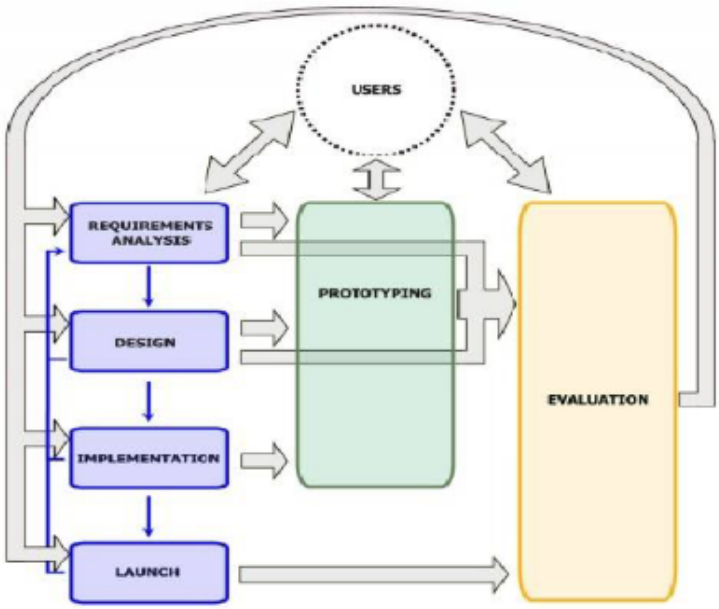

Figure 4.2: Design Methodology

- **Analysis:** Gather and structure user requirements using literature research and interviews.
- **Design:** Conceptually design the application architecture model, technical framework, and proposed learning algorithms.

- **Implementation:** use software to transform the specification into an executable application.
- **Evaluation:** Evaluate applications developed within a learning environment to determine their effectiveness in learning speaking, writing skills. An iterative analysis, design, and evaluation cycle greatly helped advance the various elements of the application during the implementation process.

4.4 High Level Design

4.4.1 Prototype demonstration

The application manages multiple user profiles, so each user account has a unique login ID and password. This allows devices to be securely shared among many users while maintaining separate records of individual learning performance data. shows screenshots of representations related to various modules of the developed application. This section describes in further detail elements discussed in the Architecture. High-level designs are most effective if they attempt to model groups of system elements from several different views. Typical viewpoints are:

1. **Activity Diagram** It describes the dynamic aspects of the system. This diagram is representing the flow of one activity to another activity. An activity can be defined as operation or function of the system.

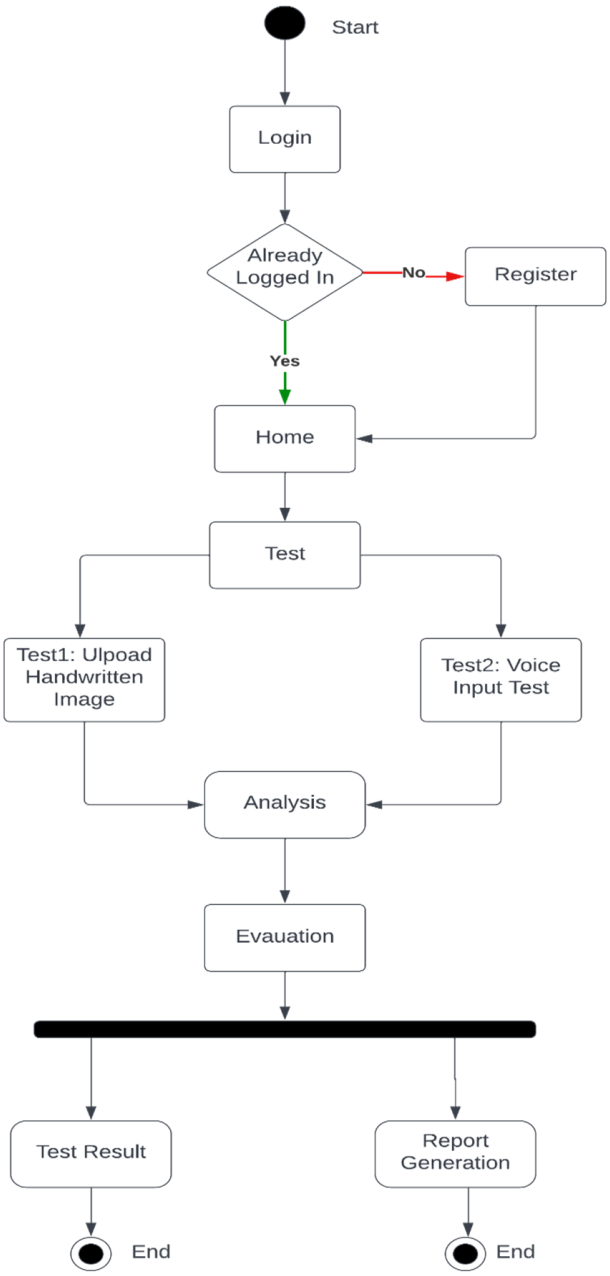

Figure 4.3: Activity Diagram

2. **Sequence Diagram** This diagram is describing/illustrating the sequence of messages between the objects in an interaction. It consists of group of objects such as (register, login, test information, begin test, test evaluation, test results, report). Each object can be defined as function or operation of the system.

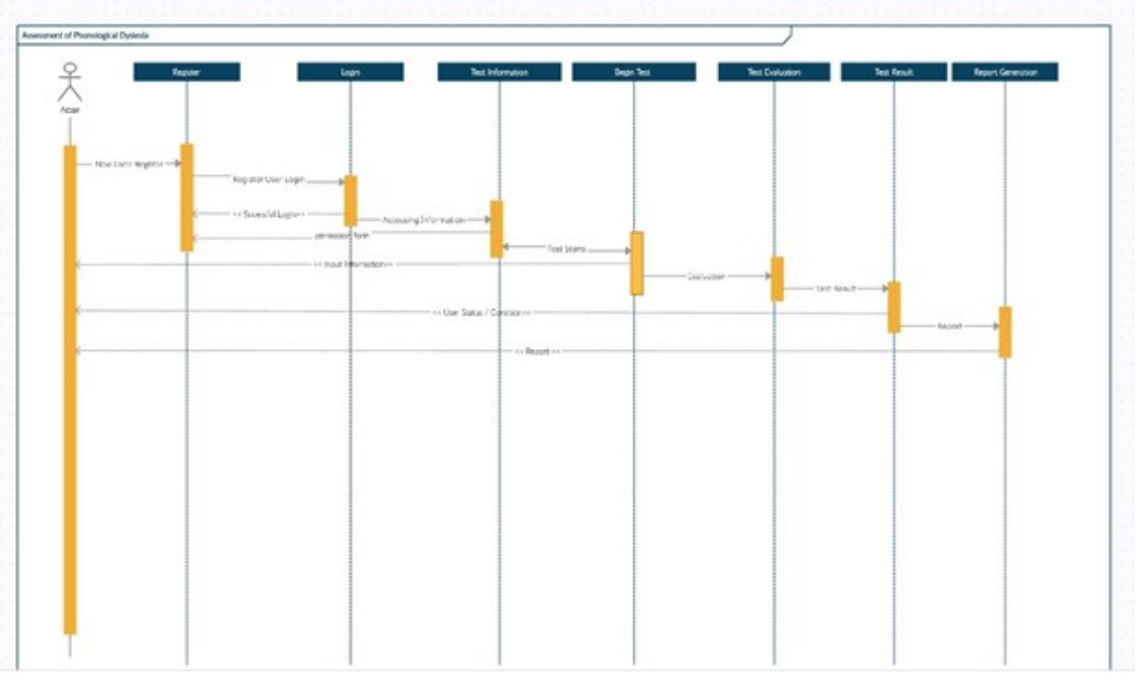

Figure 4.4: Sequence Diagram

3. **Data Flow Diagram** This diagram defines the standardized set of symbols and notations to describe the operations of system through data. In this diagram the flow and linking of activities are defined to help in understanding the flow of data.

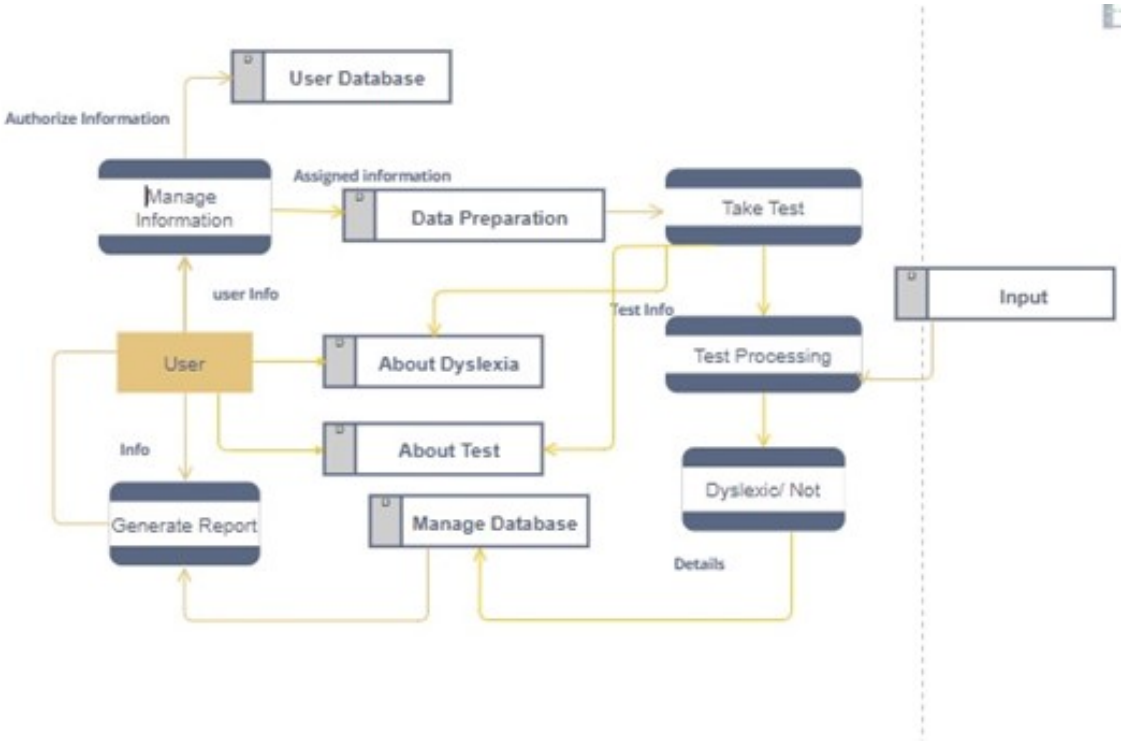

Figure 4.5: Data Flow Diagram

4. **System Flow Diagram** This diagram is representing how the data flows in a system and how decisions are being made to control the flow of data or operations of system. In this diagram the structure of the system is defined to help the viewer understand system.

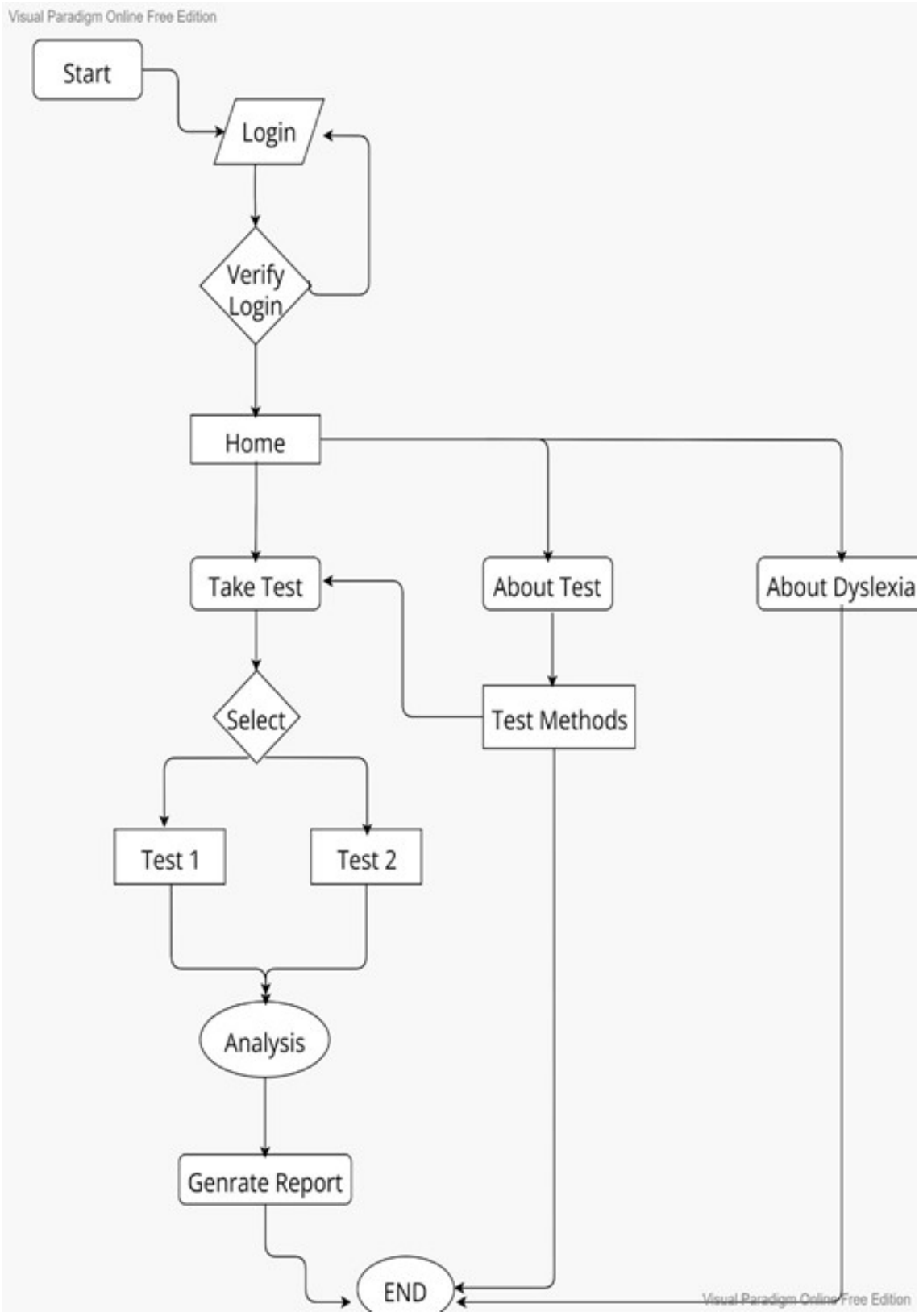

Figure 4.6: System Flow Diagram

5. **Use Case Diagram** This diagram allows the user to register and access functions of this system according to user's need. This use case provides the user to perform simple test methods for the diagnosis of dyslexia. Once the result comes then user can also generate report so, he or she can save it for later use. User can perform various functions such as registration, system details, test information, perform tests and generate report.

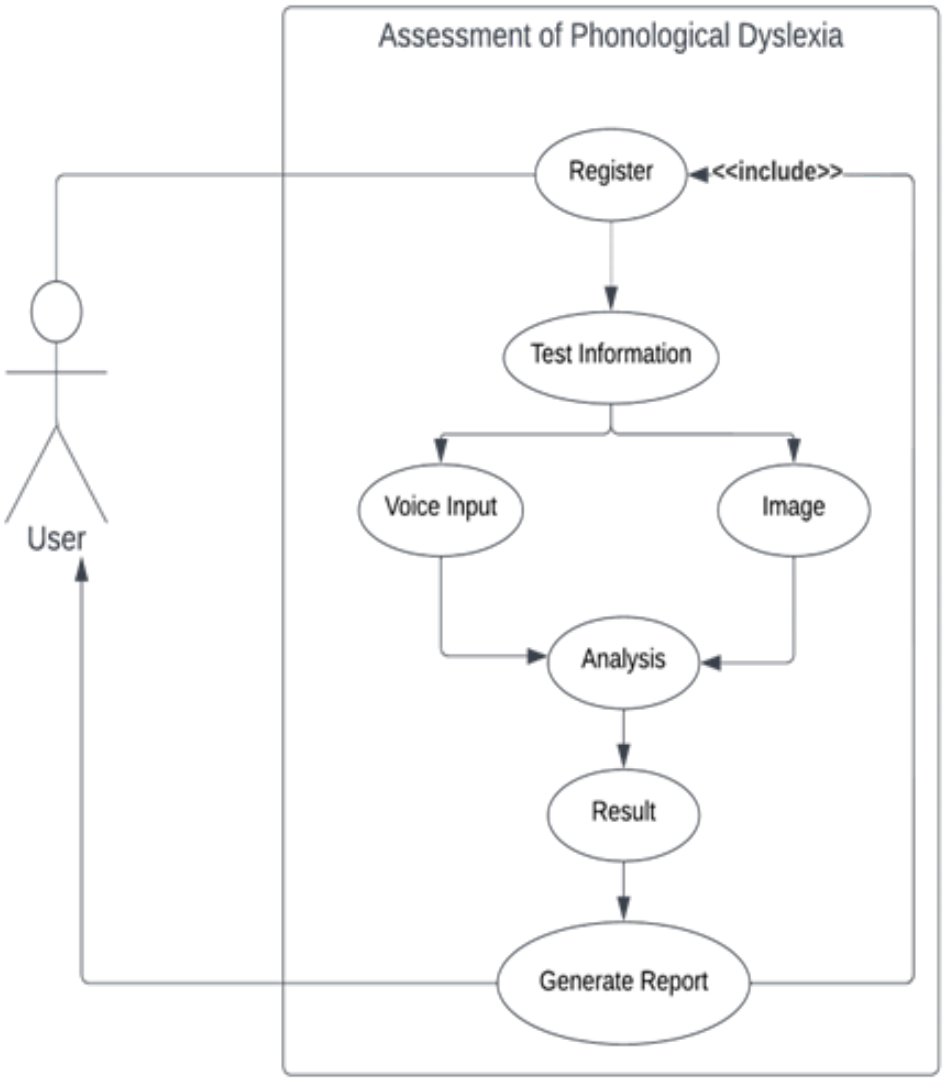

Figure 4.7: Use Case Diagram

4.5 Low Level Design

A low-level design is a detailed description of each software module. In our low-level design, we will have two modules. In first module we will use natural language processing for taking the voice as an input and convert it into text (speech to text). The other module will be based on machine

learning algorithms in which the model will assess on the basis of the input by the user that the person is dyslexic or not.

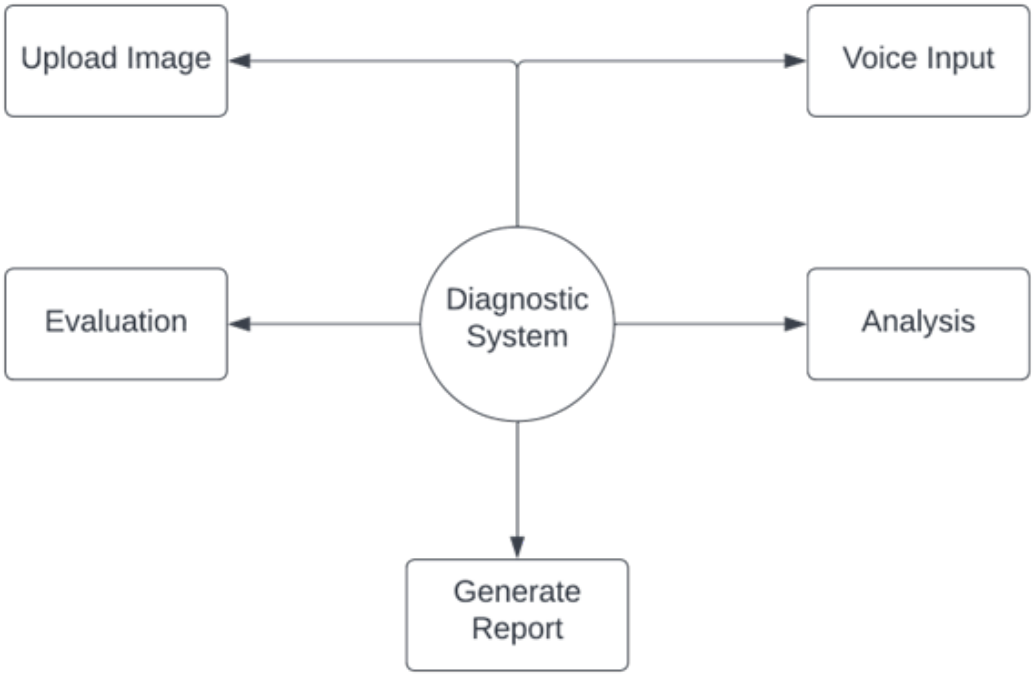

Figure 4.8: Block Diagram

4.6 Database Design

Database design is the organization of information consistent with a database model. Designer determines what information have to be saved and the way the information factors interrelate. With this information, we could start to in shape the information to the database model.

- **System Flow Diagram:** This diagram is representing how the data flows in a system and how decisions are being made to control the flow of data or operations of system. In this diagram the structure of the system is defined to help the viewer understand system.

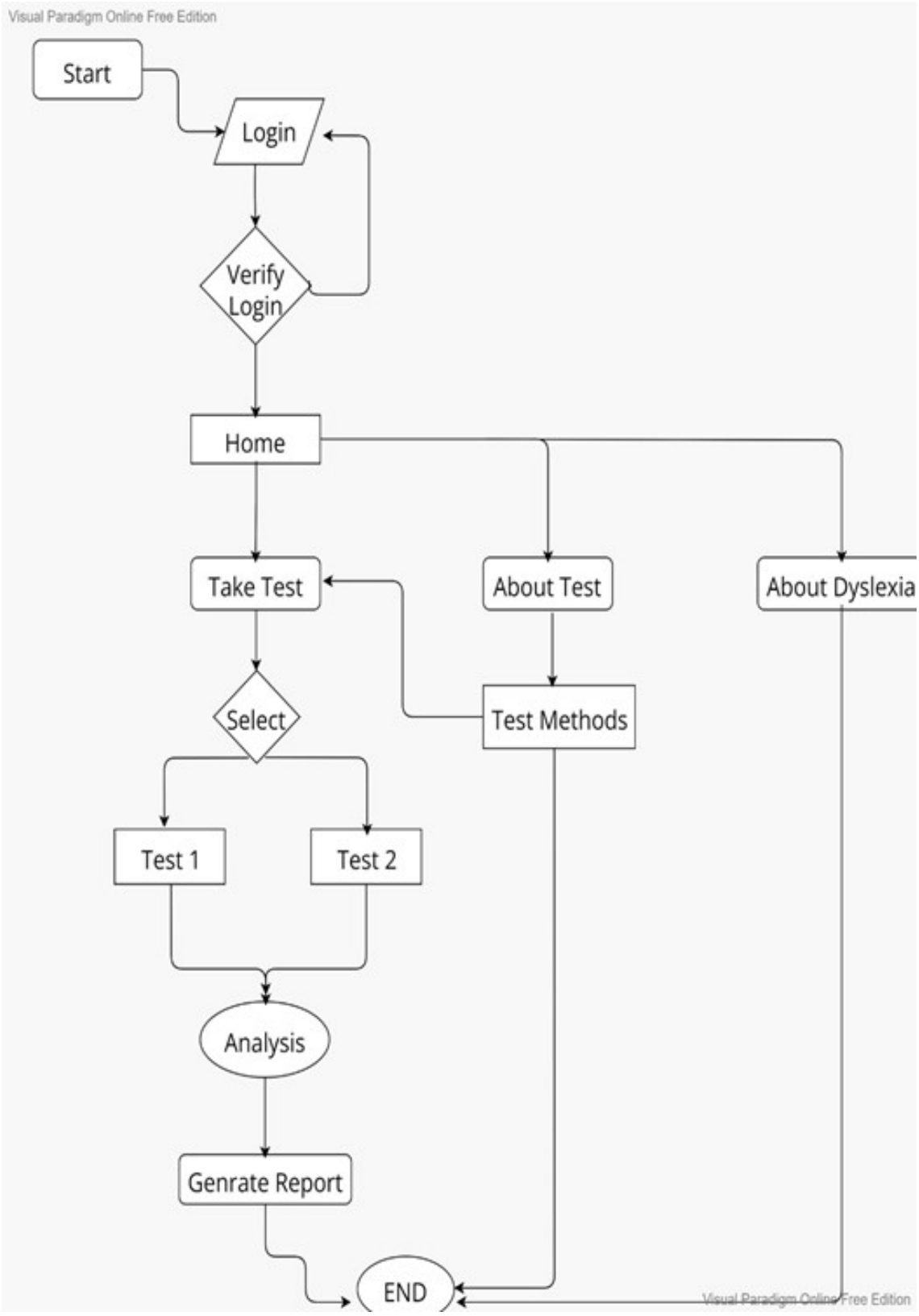

Figure 4.9: System flow Diagram

- **Low Level Design** A low-level design is a detailed description of each software module. In our low-level design, we will have two modules. In first module we will use natural language processing for taking the voice as an input and convert it into text (speech to text). The other module will be based on machine learning algorithms in which the model will assess on the basis of the input by the user that the person is dyslexic or not.

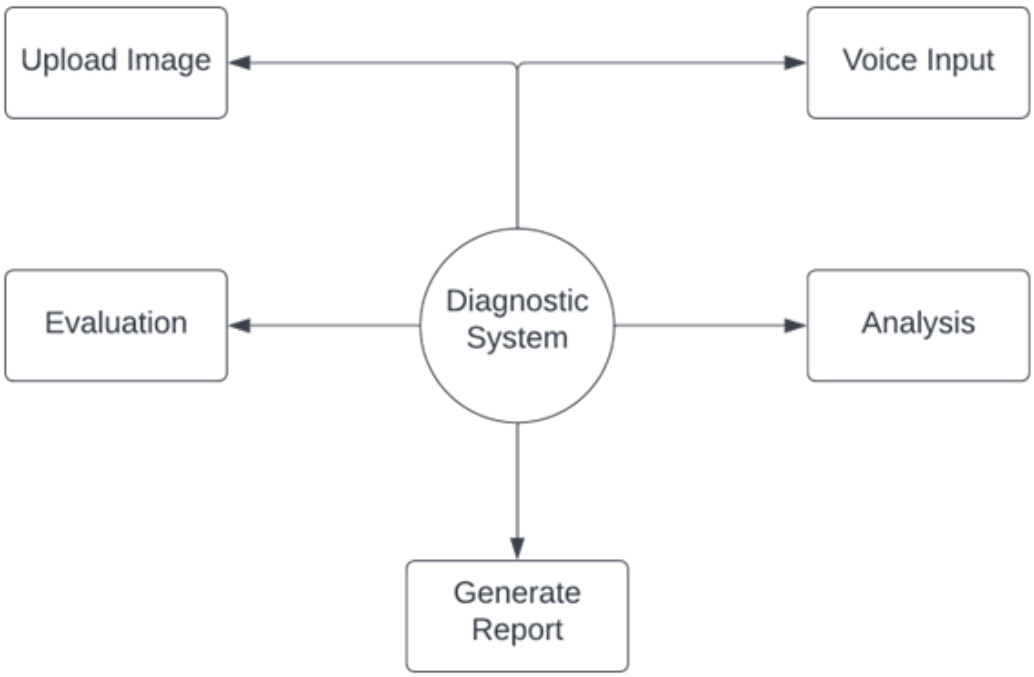

Figure 4.10: Low level Diagram

4.7 GUI Design

Graphical user interface is the high-level interface design through which the user interacts with the system. A graphical user interface makes it easy for the user to understand and use the system efficiently. In our proposed system the interface is designed in such a way that the users will first register themselves to build a profile. The user then can access the test information to know about the test. The user can begin test at anytime and the test is based on voice input of the user or person performing the test. After test evaluations the user can have either test result or full report in which other information of the user will be provided along with the test result.

In this chapter all the high-level and low-level designs of the system are discussed in which it is explained that how the user will interact with the system and how the system works. In the following chapter the system implementation and its architecture will be discussed and explained and in the sixth chapter system testing and its evaluation will be provided and, in the end, brief conclusion will be given.

Chapter 5

System Implementation

In this chapter a brief discussion is about the implementation techniques that are being used in-order-to make this application. The development phase of the project starts after the design. During this phase a design in the form of shapes, images, text, and voice data is converted into working model. The model is developed in such a way so that it detects the risk of phonological dyslexia and satisfies it requirements and specification. The implementation phase of any system is concerned with the tools used in the development work.

5.1 System Architecture

In our designed system there are sets of test series based on different modules which are implemented using different techniques and algorithms on which data sets are provided and trained in order to achieve desired results and make system efficient. The mentioned test series are the core feature of our system. In test series there will be some basic memory-based questions and some questions are based on voice input in which speech to text module is implemented based on some libraries and algorithms, this would evaluate the reading, speaking of person performing test. Further tests will be based on the recognition of geometrical shapes. In shape recognition module we have implemented and used libraries, models, and algorithms to make the system work efficiently.

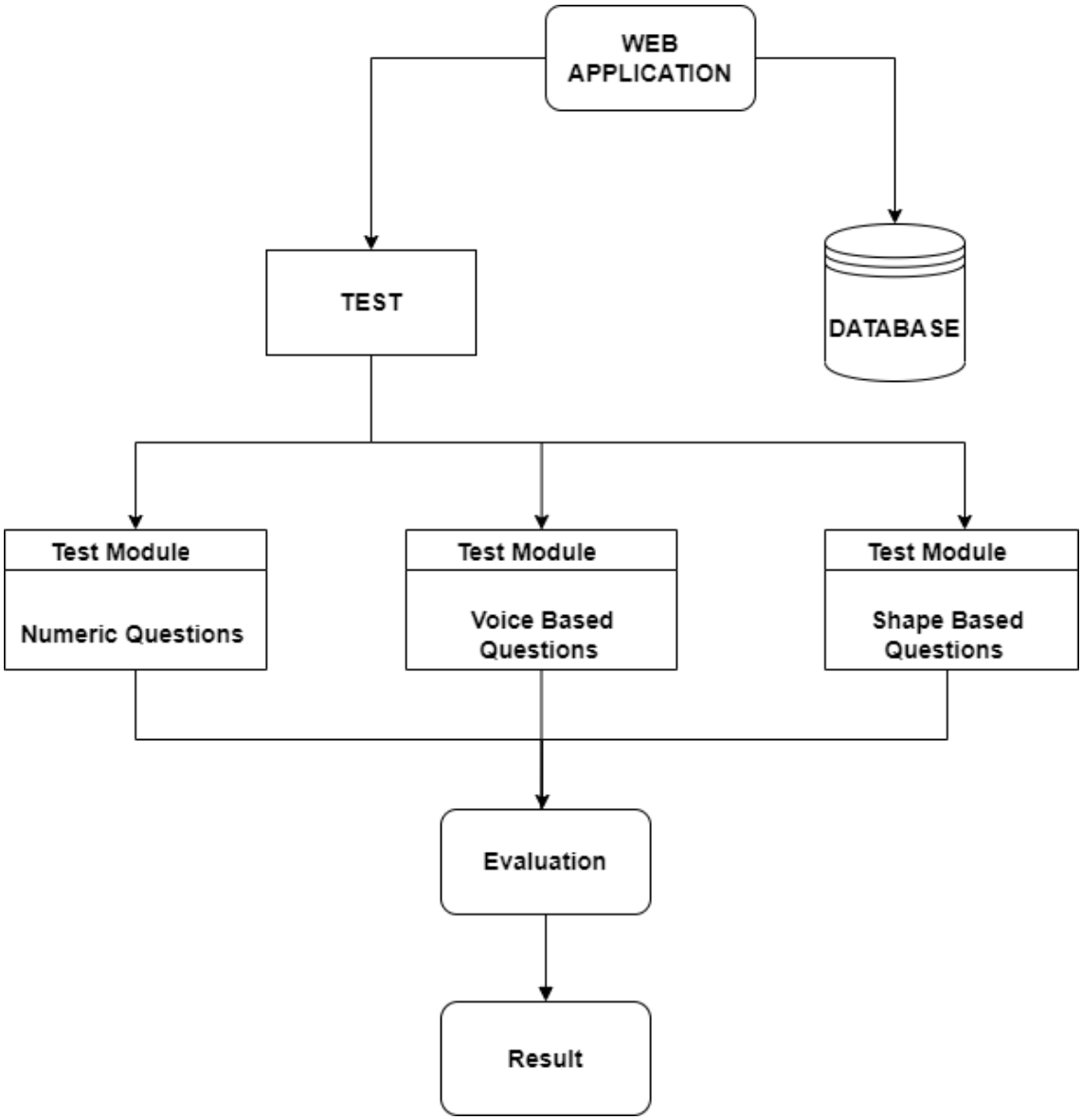

Figure 5.1: System Architecture Diagram

5.2 Test Modules:

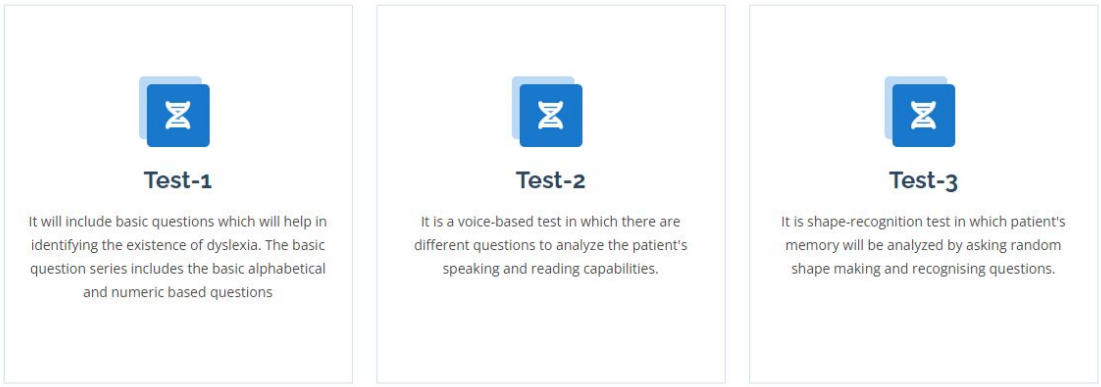

Figure 5.2: Test Modules Diagram

5.2.1 Test Module-1

It will include basic questions which will help in identifying the existence of dyslexia. The basic question series includes the basic alphabetical and numeric based questions.
In this test there are some alphabets of letter B where some are reversed and some are actual letters of B and they will be shown to user and the user will have to select the actual B. This test is basically to check the user, Memory.

5.2.2 Test Module-2

In this module we are providing voice-based tests in the form of speech to text conversion. In this module the system will match user input (voice based) with system's generated word. If the user input and system word match the score will count as +1 otherwise if not, then score will be -1. We have implemented this model using Vosk library. Vosk is an offline speech recognition toolkit. The model we are using is memory efficient (light weighted) and easy to embed. It runs in background thread. We have used such methods that helps in eliminating common false outputs.

Additionally, it also has unique lifelong learning component for the training. In our test some words will be shown to the user and user will be asked to pronounce that word and that pronounced word will be matched. This is used to check if the user can clearly pronounce the actual word or not. We used and compiled acoustic, language, and phonetic dictionary models to build voice recognition model. The Acoustic model is the model of sounds of language. The language model is model of word sequences, with the help of language model the sequence of words in text became an easy task and was required in speech recognition and we build our language model according to our domain requirement.

5.2.2.1 Data-Set

The initial step in constructing a language model is gathering data. The quantity of data needed is contingent upon the domain and vocabulary - typically, a good model requires a significant amount of texts, or at least 100Mb of text. This text can be acquired by transcribing existing recordings, collecting data from the web, or generating it synthetically with scripts. In any case, real-life data is the most valuable. As we collect texts or create them, keep in mind that we are attempting to maintain the target distribution in your model; thus, the word frequencies in the model should mirror the distribution. For example, if we are aiming to recognize songs, you should repeat songs or singer names in accordance to their popularity, not just list them.

5.2.2.2 Text Clean-Up

Once data has been gathered, it needs to be cleansed - punctuation taken out, sentences divided into lines, and numbers expressed as words. This can be accomplished with scripting languages such as Python.

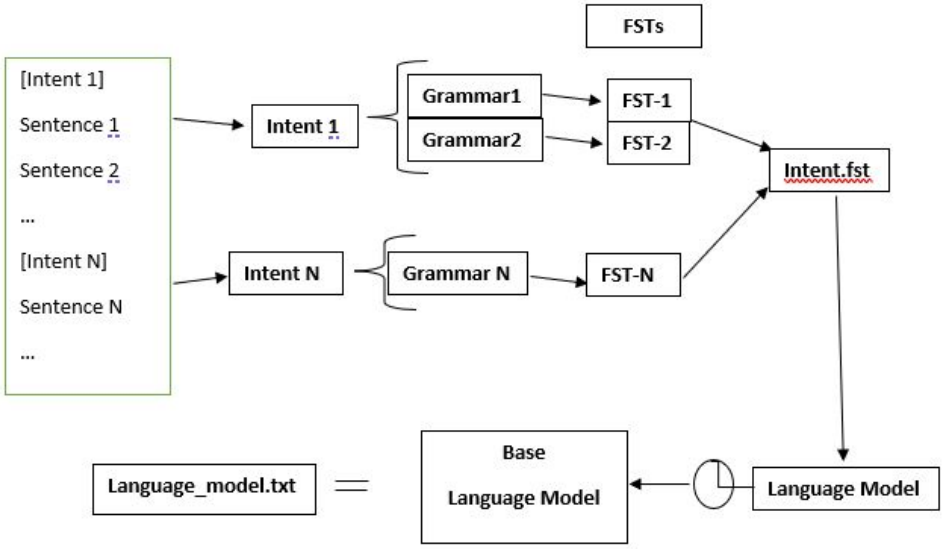

Figure 5.3: Language Model Diagram

Phonetic model deals with the decomposition on words to sounds. The phonetic dictionary model provides mapping of vocabulary. We used a simple textual data and saved it as text file to use in this model to train our model such as;

```
the TH IH
the TH AH
```

Figure 5.4: Phonetic Model file

```
hello H EH L OW
world W ER L D
how H AW
```

Figure 5.5: Phonetic Model file

For model training we have used special machine learning library called g2p which works as grapheme to phoneme which means pronunciation of words based on textual data provided for training. In model training and model testing we used different data sets. As our data set was in small size such that in textual form, so model pruning did not required in our data.

5.2.2.3 Block Diagram

In this diagram whole process how voice input is taken and then what steps it go through are explained;

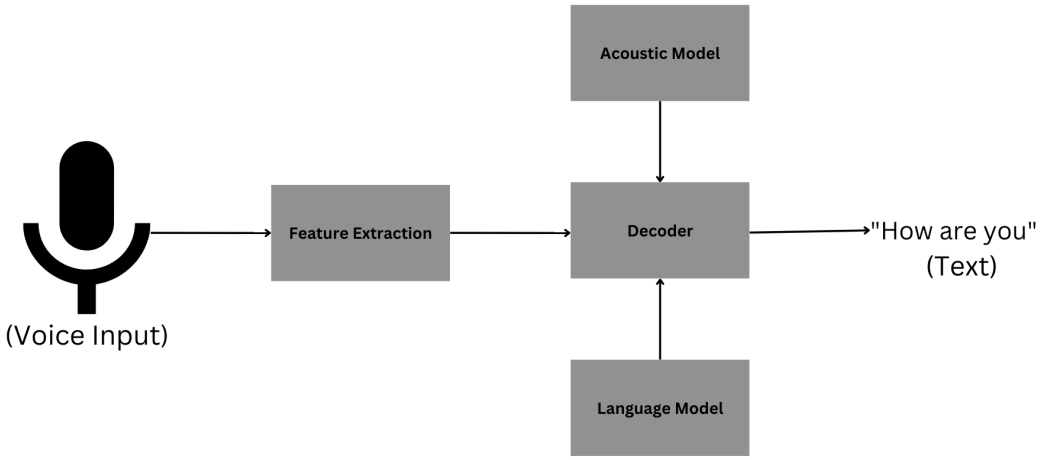

Figure 5.6: Block Diagram

5.2.3 Test Module-3

It is shape-recognition test in which User's memory will be analyzed by asking them to draw a random shape this test is basically done to see the user ability of recognising questions.
In this Module we have Train a CNN Model on Some Simple shapes Pictures that can be Circle, Square, Star or Triangle.
CNN was created primarily to process input images. Therefore, their architecture is more detailed and is made up of two primary building blocks. This sort of neural network's uniqueness is made by the first block since it serves as a feature extractor. The first layer applies numerous convolution kernel filters to the picture and outputs "feature maps." Neural networks are utilised in the second block to do classification.

5.2.3.1 Data-Set

This data-set contains 16000 images of four shapes; Circle the square star and triangle. Each image is 200x200 pixels. Data was collected using a Garmin Virb 1080p action camera. The shapes were cut out of card stock and then painted green. I held each shape in the cameras eye for two minutes. We moved the shape and rotated it while the camera recorded the shape. All four videos were processed using OpenCV in Python. A 60x60 pixel shape is cropped from the image using color space. The data is organized in four folders; Circles Triangles and Stars. Images are labeled 0.png 1.jpg etc...

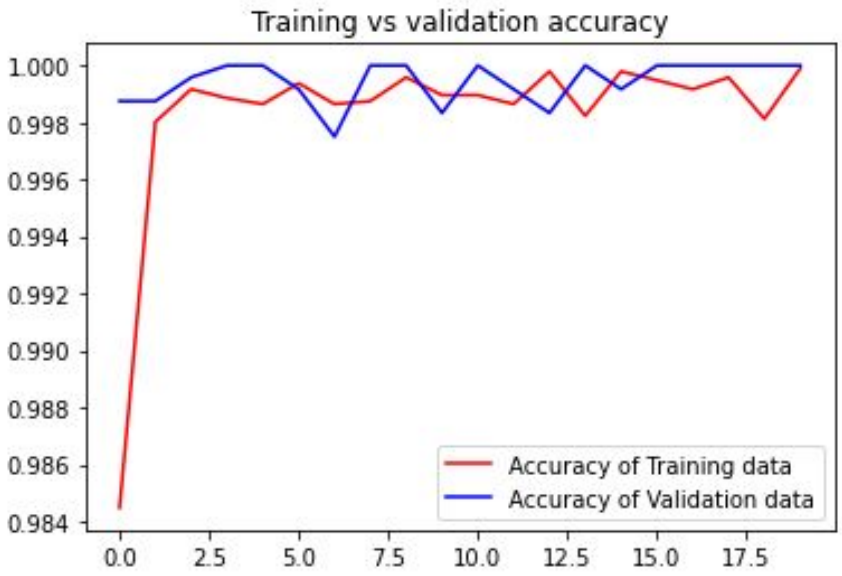

Figure 5.7: Training Vs Validation Accuracy

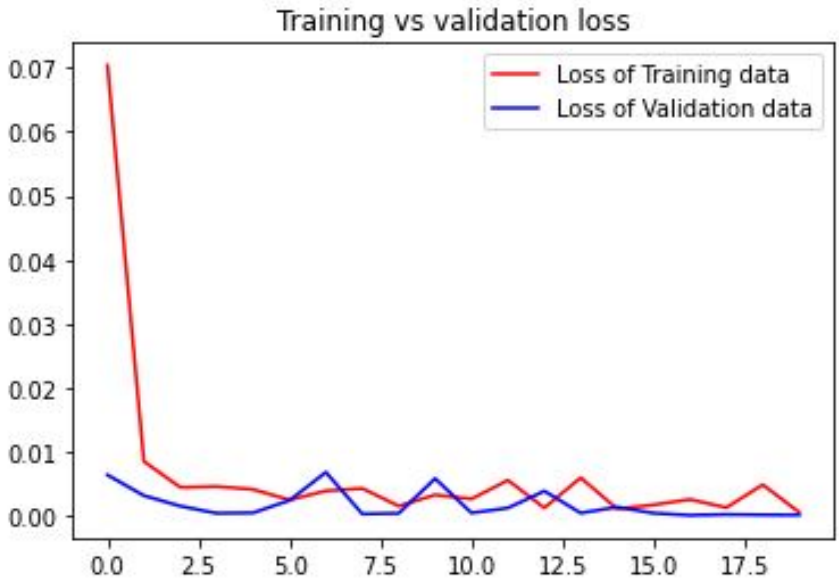

Figure 5.8: Training Vs Validation Loss

5.2.3.2 Architecture Diagram

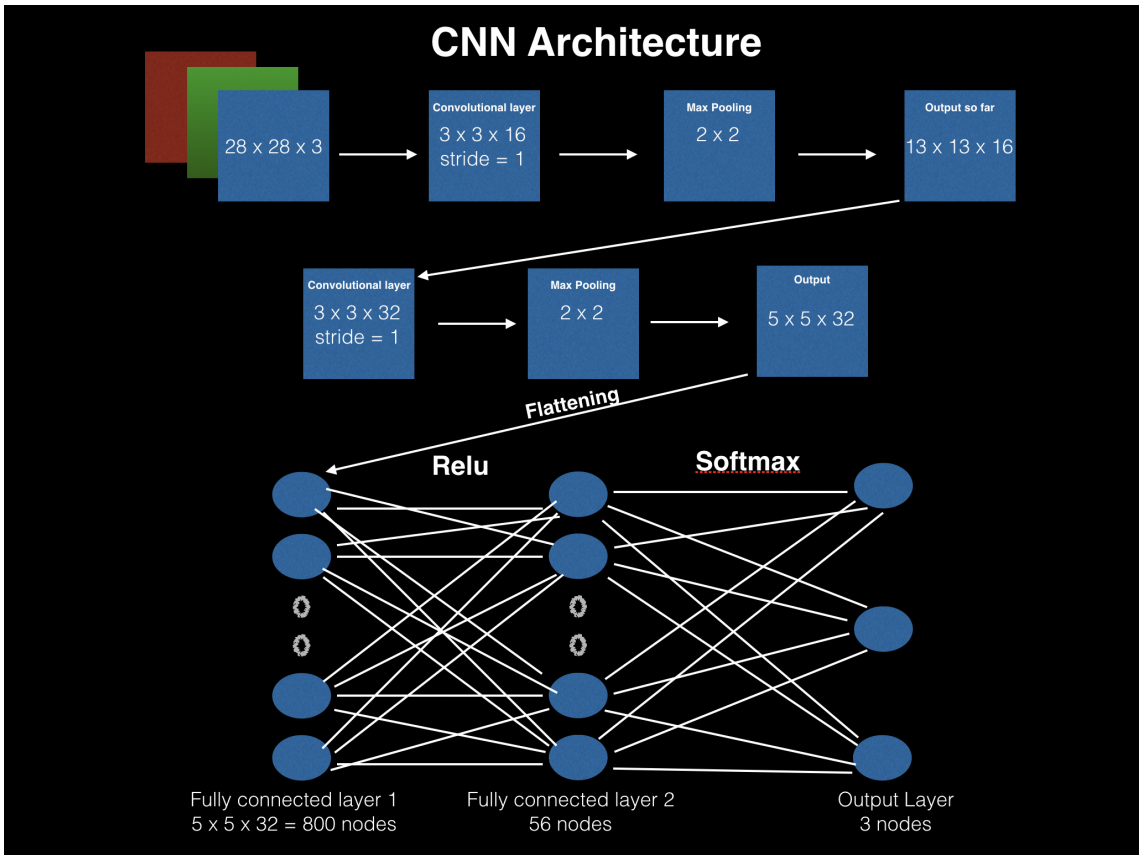

Figure 5.9: CNN Architecture Diagram

We have use Tensor Flow for training this model. Tensor Flow is a free and open-source software library for artificial intelligence and machine learning. It can be used for a variety of applications, but focuses particularly on deep neural network training and inference. We have divide the data-set into a test set for model validation and a train set for model training. We have use 80 Percent of the data-set to create the train set, and the remaining 20 Percent to create the test set.

5.2.3.3 Block Diagram

In this diagram whole process how image input is taken and then what steps it go through are explained;

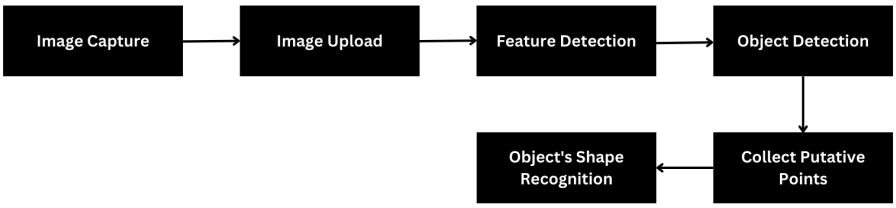

Figure 5.10: Block Diagram

5.3 Implementation Strategy

This project's implementation strategy was entirely incremental. To get to the finished product, a number of milestones were set, and by the time the application was finished being developed, all of the milestones had been met. The following were the project's major milestones:

1. Design aesthetic GUI.
2. Develop a Sign-Up/ Register page.
3. Develop a Database.
4. Storing of credentials on Database.
5. Integration of pages with database.
6. Develop a Test page.
7. Integrate Test-Models into the system.
8. Storing of User Attempted questions in Database.
9. Develop a user page.
10. Testing all the pages.

All the milestones were achieved successfully.

5.4 Tools and Technology

5.4.1 HTML:

With the use of HTML, which is a markup language, web information may be organised and given meaning by specifying paragraphs, headings, and data tables as well as by including images and videos on the page.

5.4.2 CSS:

In order to style HTML content, CSS is a language of style rules that may be used to determine background colours and fonts as well as arrange text in multiple columns.

5.4.3 JavaScript

With the help of the scripting language JavaScript, you can pretty much do anything—create dynamically updated material, manage multimedia, animate graphics, etc.

5.4.4 Mongo Db

MongoDB is an open source non-relational database management system(DBMS). Use flexible documents instead of tables and rows to process and store different types of data. As a NoSQL solution, MongoDB does not require a relational database management system. Therefore, it provides a flexible data storage model that allows users to easily store and query multivariate data types. This not only simplifies database management for developers, but also creates a highly scalable environment for cross-platform applications and services.

5.5 Application Access Security

Due to the fact that the application manages several user profiles, each user account has a different login ID and password. This enables the safe sharing of a single device by numerous users while maintaining individual records of each user's learning performance data.

Chapter 6

System Testing and Evaluation

Software and hardware systems are tested as a whole, integrated system to see whether they adhere to the requirements that have been set forth. It is insufficient to create a system and describe its architecture and operation in writing. It is essential that you assess your work both in isolation and in relation to other approaches, tools, and technologies already in use. This involves both quantitative and qualitative evaluation, including expressibility, usability, and many other factors. The following testing types should be taken into account when conducting system testing:

- Graphical user interface testing
- Usability testing
- Software performance testing
- Compatibility testing
- Exception handling
- Load testing
- Security testing
- Installation testing

6.1 Testing Techniques

In order to determine if the planned functional or non-functional requirements are operating well or not, testing approaches subject your intended programme to a number of test processes. This helps to identify any system flaws prior to the system's publication. The system was put through a few testing procedures, which you can read about in the following headings.

6.2 Graphical User Interface Testing

Graphical user interface testing is the process of evaluating how simple it is for a user to engage with a Web application utilising the interface. A user who is inexperienced with mobile applications can rapidly learn how to use them by reading the text or pictures on the buttons if the graphical user interface is user-friendly. We have tested the user interface to make sure that every feature is working and that the tasks are being carried out correctly. The user interface must to be easy to comprehend. The layouts, controls, graphics, and text are all simple to understand. The layout's colour scheme is uniform, and the responsiveness of the entire interface is guaranteed.

No of Steps	Tasks	Expected Result	Status
1.	Proper Functioning GUI	Will perform it's functioning rightly	Pass
2.	Eye soothing aesthetics	The GUI will have good aesthetics	Pass
3.	The buttons to work up to the mark	The buttons in the GUI is expected to work according to it's assigned task	Pass
4.	Accurate Pixels	The GUI is expected to have accurate pixels.	Pass

Table 6.1: User Interface Table

6.3 Usability Testing

Usability testing is advantageous since it enables designers and developers to identify issues before to beginning any code. This enables the team to spot issues before they are coded and released, addressing them in time to prevent problems and defects from developing later. It is determined through testing whether team members are actually able to complete their jobs. Additionally, it allows the team to test the system in a real-world setting to see how well it functions. During usability testing, the team often evaluates and designs the measures to see how user-friendly the system is.

6.4 Test Case Login

Test Case id	TC_ID2
Description of the Test Case	User will Sign In to the Application
Testing Functionality	Signing In to the application.
Testing Setup	• Availability of internet • Server responding • Fulfilling all credentials
Testing Evaluation	• Enter User Email • Enter Password • Press the button 'Sign In'
Expected Result	User Signed In Successfully.
Actual Result	User Signed In Successfully.
Status	Pass

Table 6.2: Test Case Login

6.5 Load Testing

The response time of a Web Application is the focus of load testing. During load testing, we check the application under a variety of loads to determine the application's speed and capacity. We tested the app on three to four different smartphones at the same time, and the layout controls and functionality worked perfectly on all of them.

6.6 Integration Testing

Testing of integrated modules to check the combined functionality of different modules after integration. Each module is first tested individually to check its complete working and analyzing whether it fulfills the requirement then integrated each module and all system functionalities to obtain the exact requirement from one system and tested the integrated module to analyze its effectiveness. Integration testing is an important step of every project which leads its developer team to the exact state of the system and after complete testing all the functionalities should be working peoperly. We integrated our python based back-end with Django (html, css, javascript) interface and for data manage and store we used PostG-Sql and integrated these modules to make our system complete and work properly.

No of Steps	Tasks	Expected Result	Status
1.	Login into system	Successfully log into the main page	Pass
2.	About Dyslexia	Successfully Display all Information Relating Dyslexia	Pass
3.	Test Module-1 GUI	Should perform it's functioning rightly	Pass
4.	Test Module-2	Should perform it's functioning rightly	Pass
5.	Test Module-3	Should perform it's functioning rightly	Fail
6.	Report	Should Show Every Test	Pass

Table 6.3: Integration Testing

6.7 Security Testing

In our system user credentials has been maintained and are secured such that no other person can see this data. Every user can see their own data. All security measure have been taken to save that data from unauthorized person. Basic security testing has been done to ensure the security features and proper steps have been taken to save our system from external threats.
Although our system do not contain or asks any sensitive information from user but still we know that privacy matters. Every single has only access to their own credentials and report which will be generated by the system after proper test evaluations.

6.8 Exception Handling

Exception handling has been done for different scenarios. In our system we are providing test series which includes three sections and while performing test if any unexpected error occurs by the system then there will be a message shown to the user related to the error.

Chapter 7

Conclusions

By utilizing the modern mobile technology features, we have developed an application addressing the diverse needs of dyslexic children with learning differences focused on detecting the occurrence of Dyslexia in Children. It was designed and evaluated on basis of the Psychological test use by Psychologists for detecting dyslexia in children also to inform their parents and remedial teachers having hands on experience in field of dyslexia, to ease the learning difficulties of dyslexic children as well as to measure progress in their Speaking and writing skills. The preliminary results of application evaluation showed the promising effectiveness of developed application in the Detection of Dyslexia. This is basically to improve the overall learning performance of dyslexic children which otherwise was hard to observe.

The initial evaluation yielded that both the user interface design and learning content structure of application fulfills the elicited requirements of dyslexic children aged 5 and under. Examining the impact of developed application on the detection of children with such Speaking, Memory differences highlighted. Within the whole research scope was improving learning performance of dyslexic children, motivating them to enhance the learning growth over period of practice and eliminating the consequences in future.

Thus the design of Application was basically on measuring Detection the learning progress of children with learning differences is believed to be a great addition to the existing literature as there still is a lack of reliable and valid performance measurement tool to accomplish this job. Since the application implements a great deal of tests based on Psychological aspects, therefore it expected to prove as an efficient and cost-effective technology-based educational resource solving the issues of educational technology awareness, affordability and accessibility in Pakistan.

7.1 Limitation and Future Enhancement

To address the dyslexia challenges connected to spelling concepts, one of the crucial expansions of study would be to incorporate the writing assessment of two and three lettered sight words in

the application. Furthermore Over the course of six to twelve months, we plan to conduct the summative review of the application, offering adequate data on its efficiency in teaching and/or enhancing handwriting ability. To achieve more reliable outcomes, accept dyslexic pupils enrolled in other remedial education programmes. We want to distribute the programme via the online Android marketplace after making adjustments to it in light of assessment results. Android users will be able to acquire the app for personal incentive, such as from parents who want to get it for their dyslexic child to use outside of the classroom, or for collective incentive, such as from remedial educators and dyslexia educational institutions to use inside of mainstream classrooms.

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Appendix A

User Manual

User manual includes the following series of using the website.

A.1 Login:

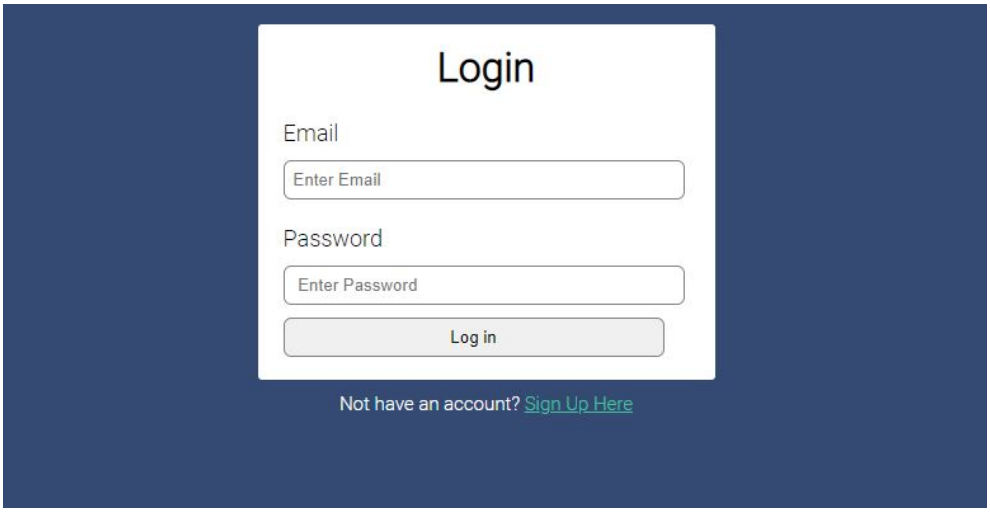

Figure A.1: Login Page

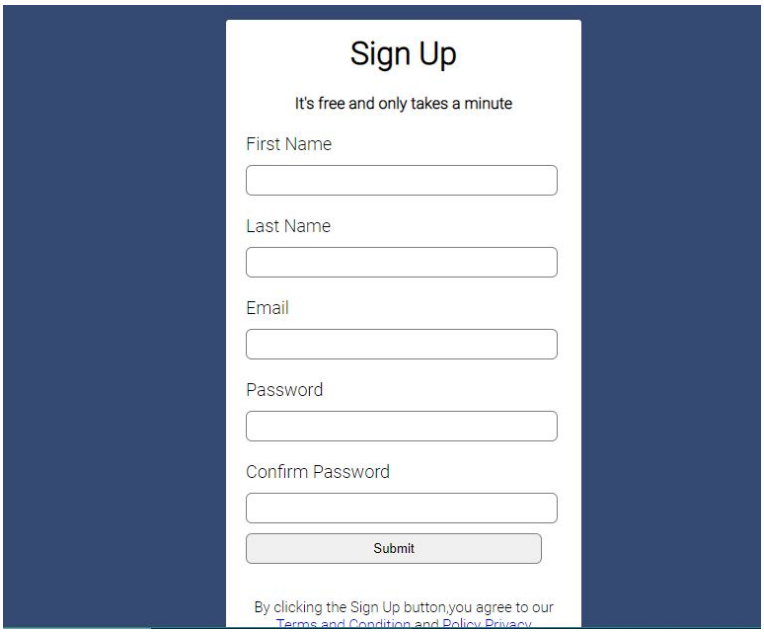

Figure A.2: Sign-Up Page

A.2 Home:

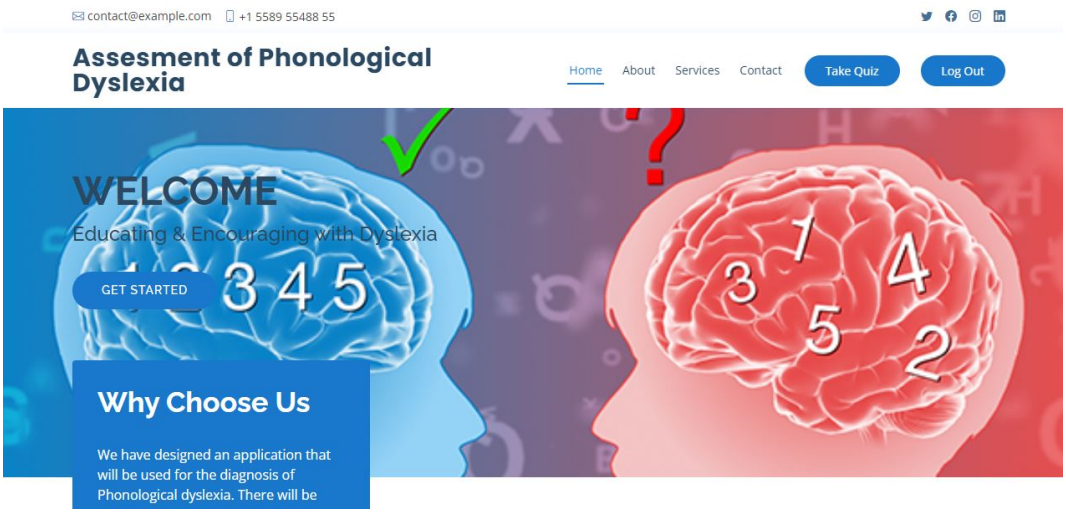

Figure A.3: Home Page

A.3 Test 1:

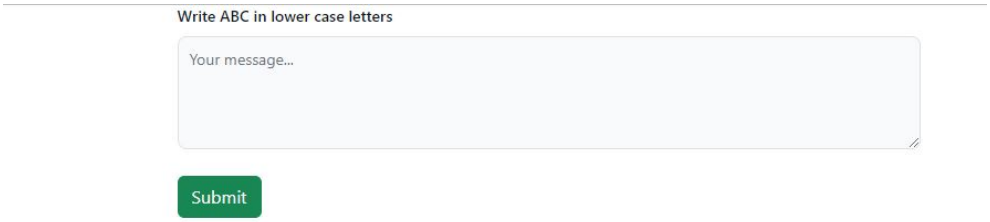

Figure A.4: Test1 Page
+

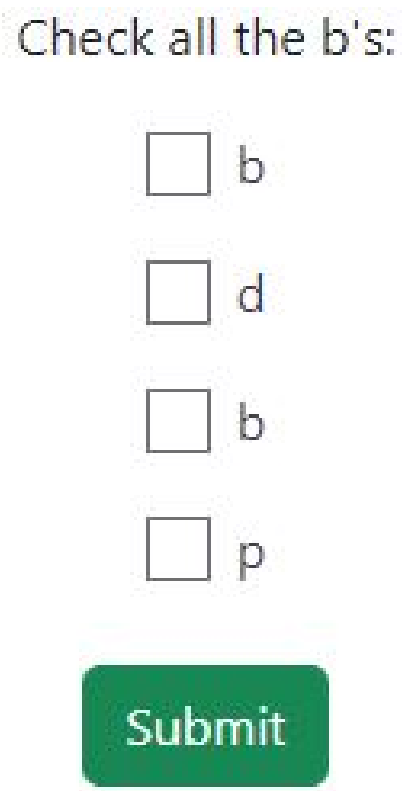

Figure A.5: Test1 Page

A.4 Test 2:

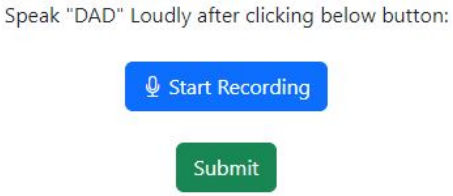

Figure A.6: Test 2 Page

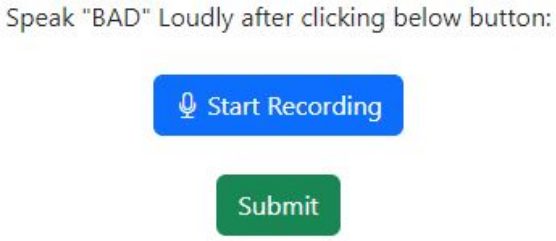

Figure A.7: Test 2 Page

A.5 Image Classification:

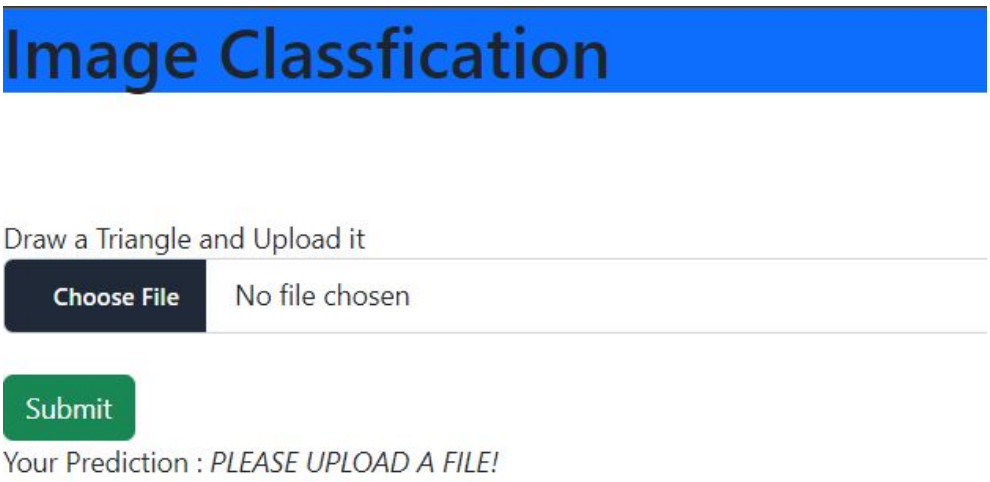

Figure A.8: Image Classification

A.6 Report:

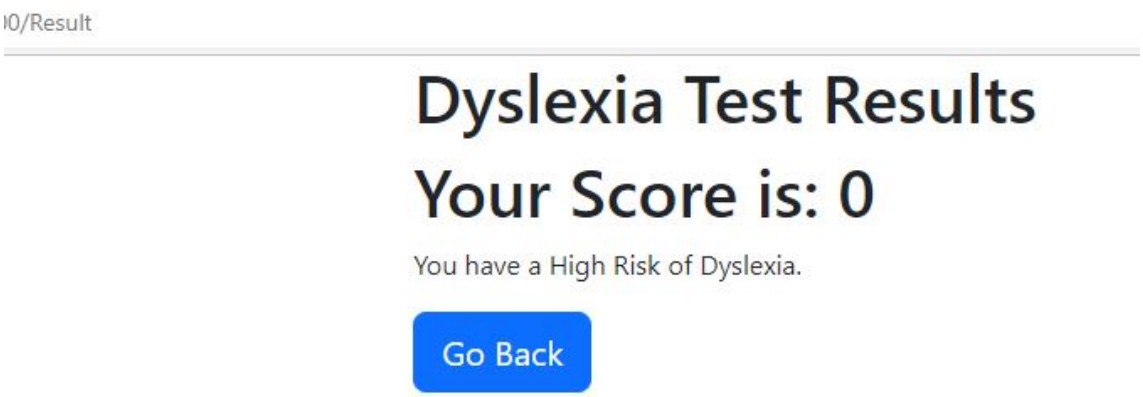

Figure A.9: Report

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