Neuroscreen: Dyslexia& Dysgraphia Detector

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Agenda

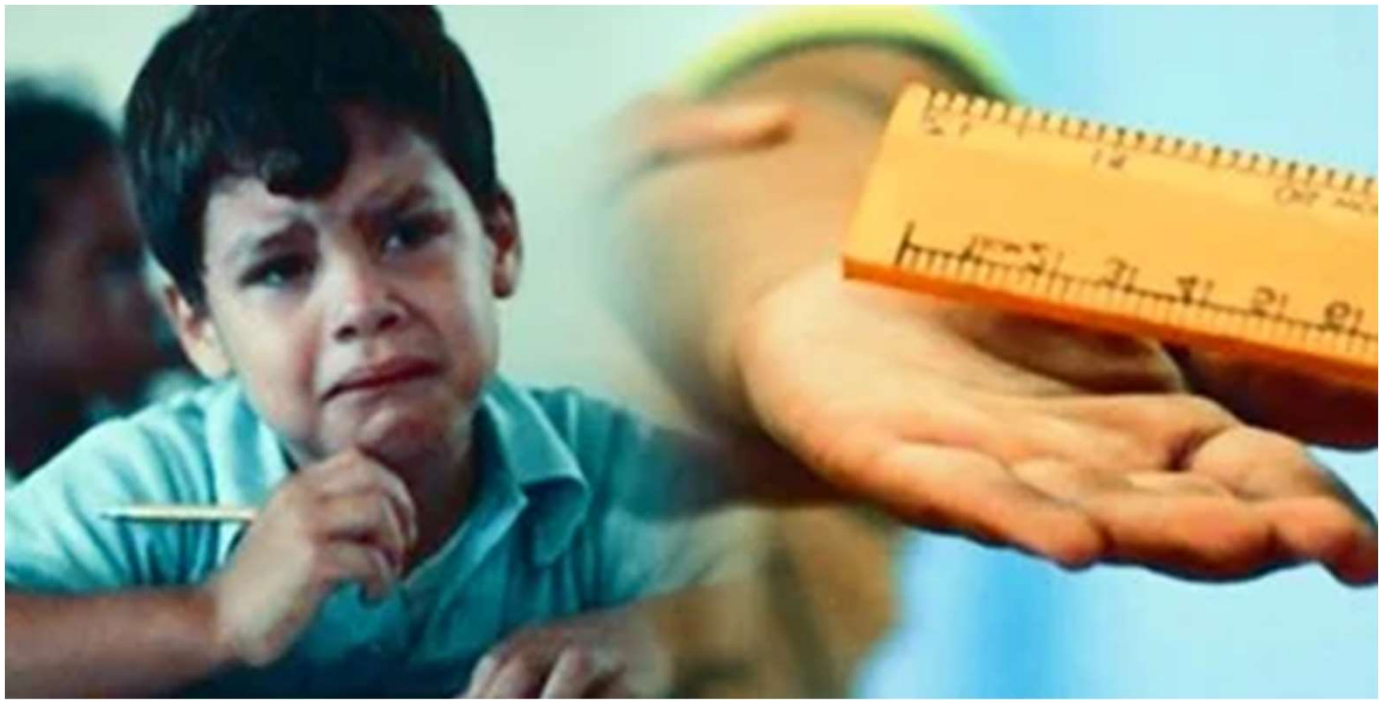
1. Motivation
2. Introduction
3. Problem
4. Solution
5. Gathering Requirements
6. Challenges
7. System analysis and design
8. Implementation Tools
9. Conclusion


Motivation

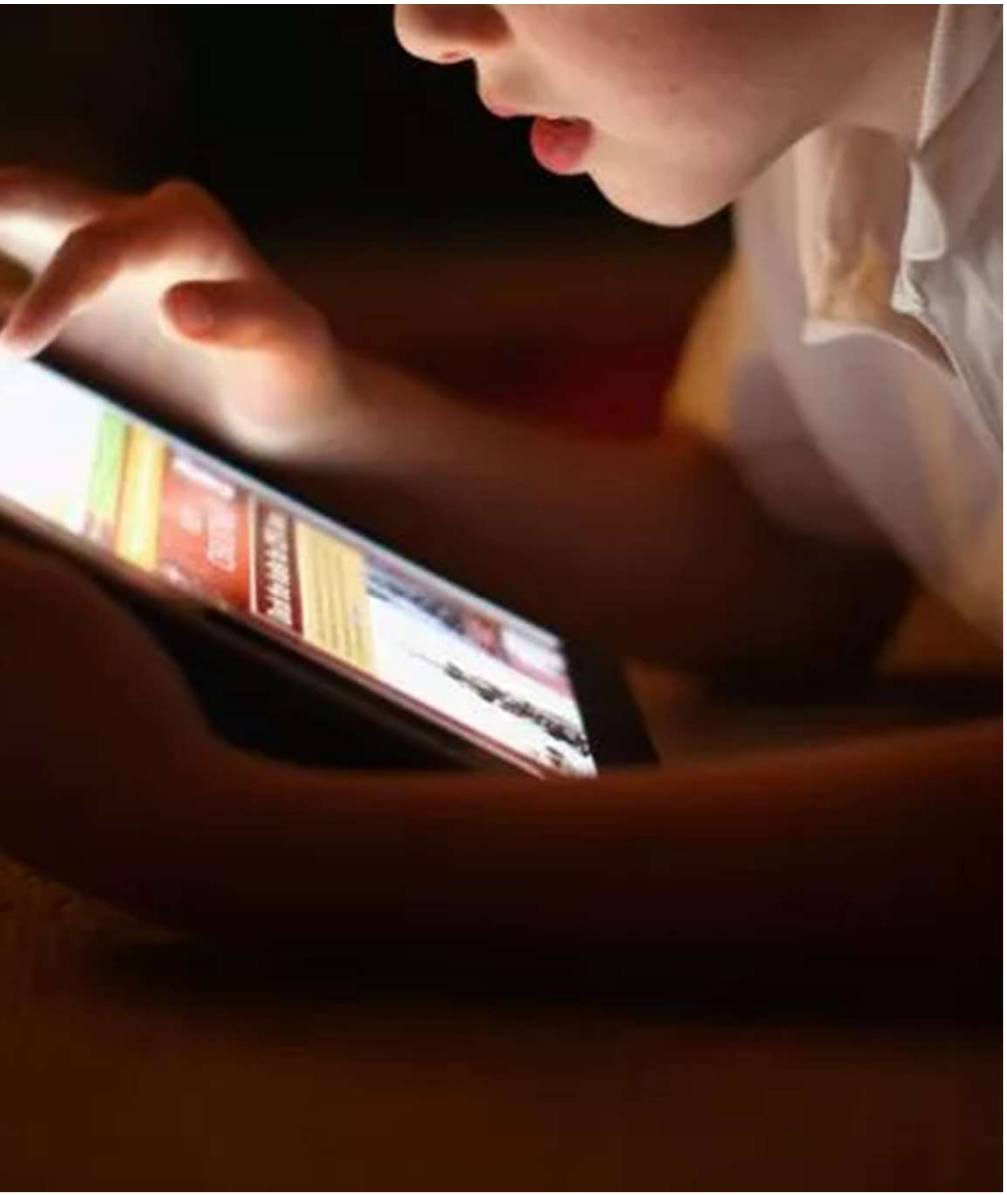
1. Global Disability Support:

All words now supports individuals with disabilities through laws and initiatives.

Dyslexia and dysgraphia are misunderstood, leading to stigma and delayed diagnosis.



2. Lack of Awareness:



3. Impact on Education and Development:

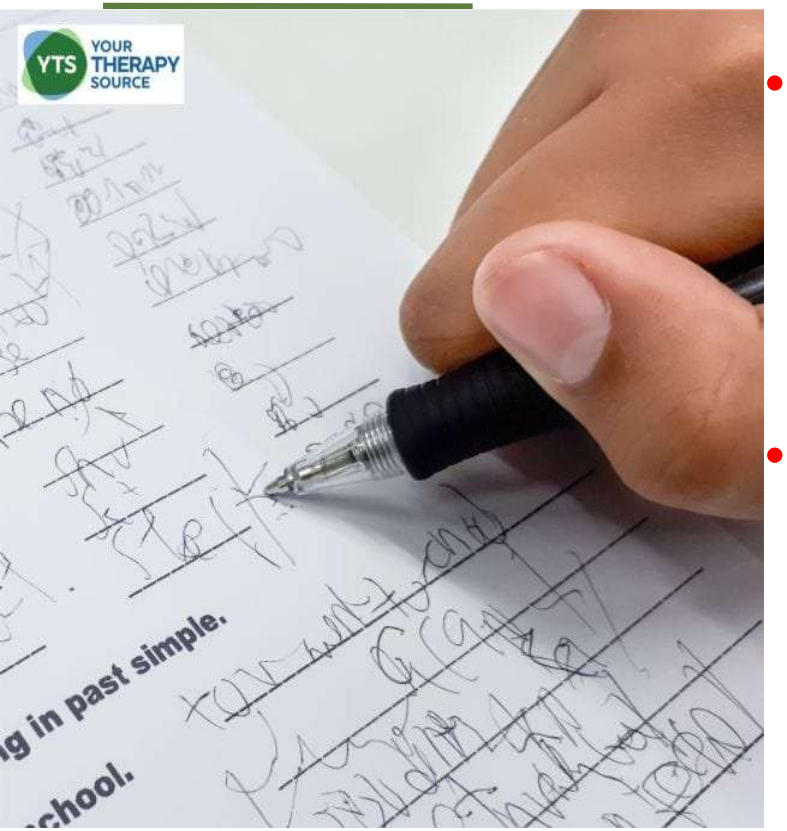
Early detection prevents struggles and helps children reach their potential.


INTRODUCTION

What is Dyslexia

- Dyslexia is a learning disorder affecting reading, spelling, and word comprehension.
- It stems from difficulties in processing language sounds but does not impact intelligence.
- Approximately 10% of people have dyslexia, facing greater challenges in languages with complex spelling like English.

What is Dysgraphia



- Dysgraphia affects handwriting and written expression, making it hard to write clearly, form letters, and spell.
- Often co-occurs with dyslexia or ADHD and can impact organizing thoughts in writing.

Problem

The Problem

1. Limited Awareness: Symptoms often mistaken for lack of effort.
2. Accessibility Issues: Current detection methods are costly and inaccessible in many areas.
3. Delayed Diagnosis: Late diagnosis leads to significant academic setbacks.


PROBLEM
SOLUTION

Our Solution

1. AI-Driven Platform: Combines gamified tests and handwriting analysis for precise screening.
2. Accessible and Scalable: Multilingual, cost-effective, and community-serving.
3. Support for Parents and Educators: Offers feedback, resources, and early intervention tools.

Gathering Requirements

Gathering Requirements

1. Understanding the Problem Thorough research and consultations with specialists, educators, and parents helped identify key challenges in diagnosing dyslexia and dysgraphia.

2. Target Audience Focused on young children, their parents, and educators globally, designing a user-friendly and accessible platform with minimal technical requirements

3. Technical Requirements Created gamified tests for accurate assessments, added handwriting analysis for dysgraphia, and used Flutter and Django for a scalable, efficient system

Challenges

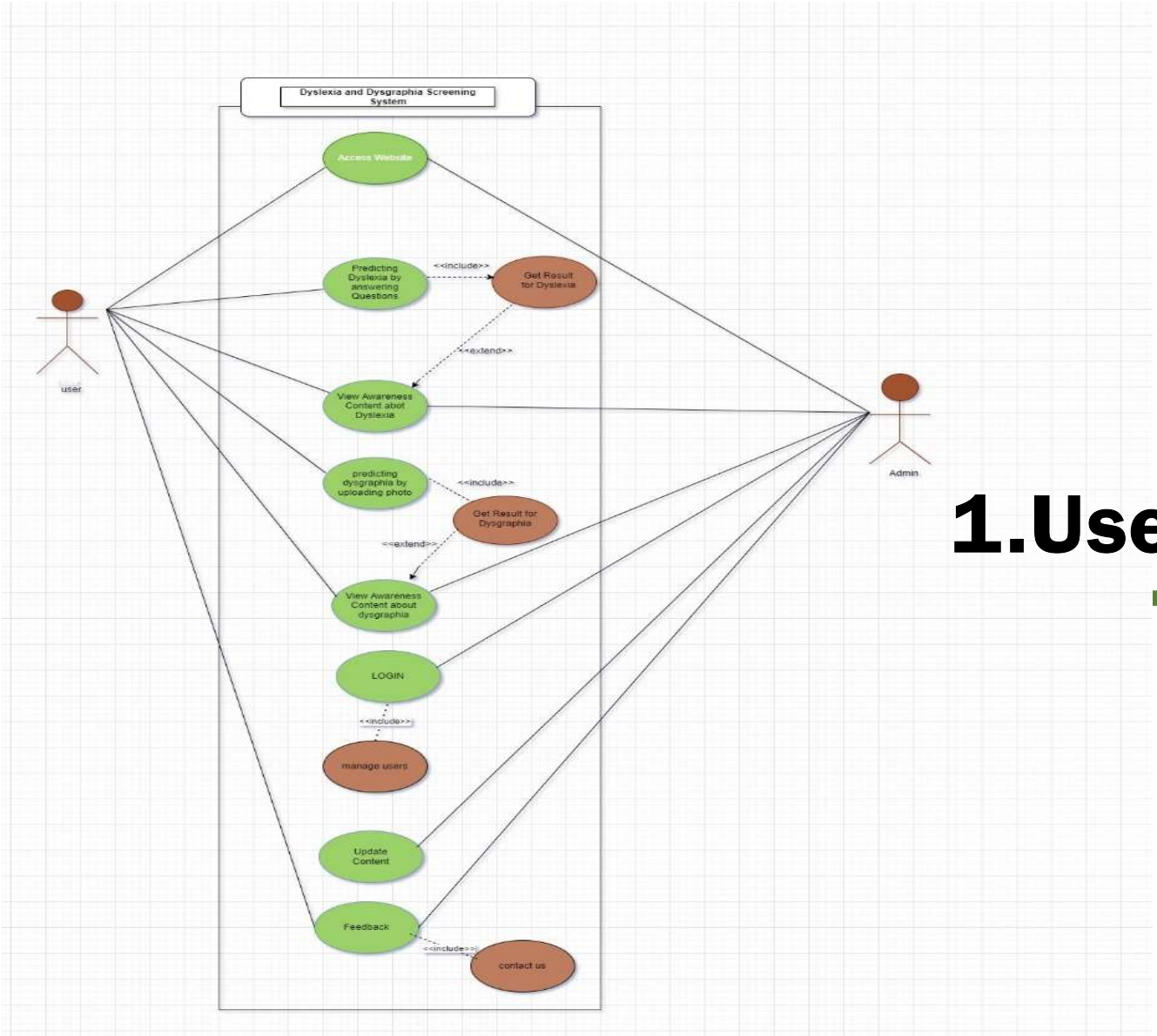
Challenges

1. Dataset Challenges: Limited datasets supplemented with synthetic data for diversity.
2. Website Localization: Currently supports English, with plans to add Arabic and more.
3. Algorithm Optimization: Improved accuracy for varied handwriting and reading styles.
4. User Engagement: Gamification ensures engagement while maintaining accuracy.

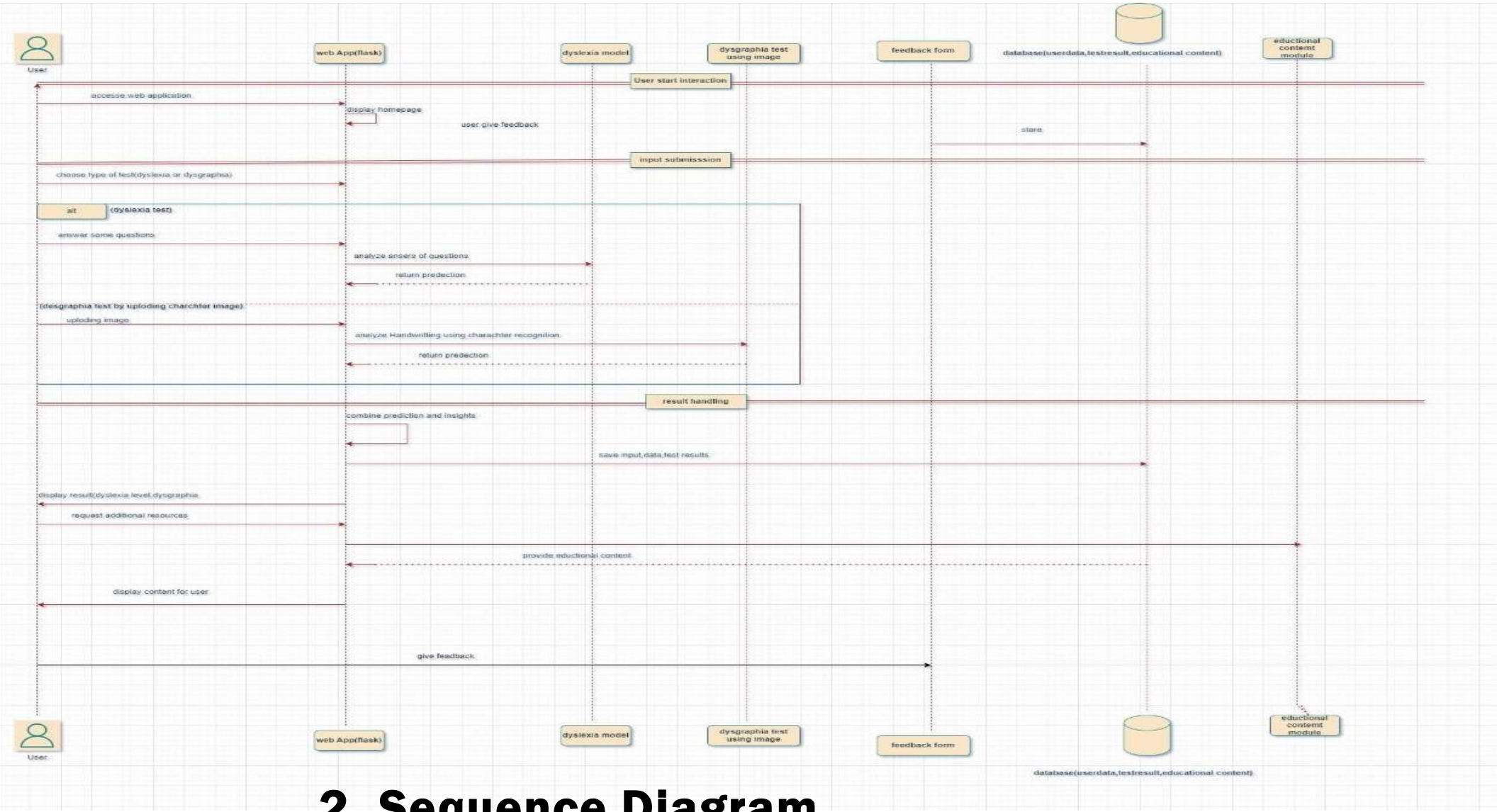

System
Analysis
&Design

Diagrams

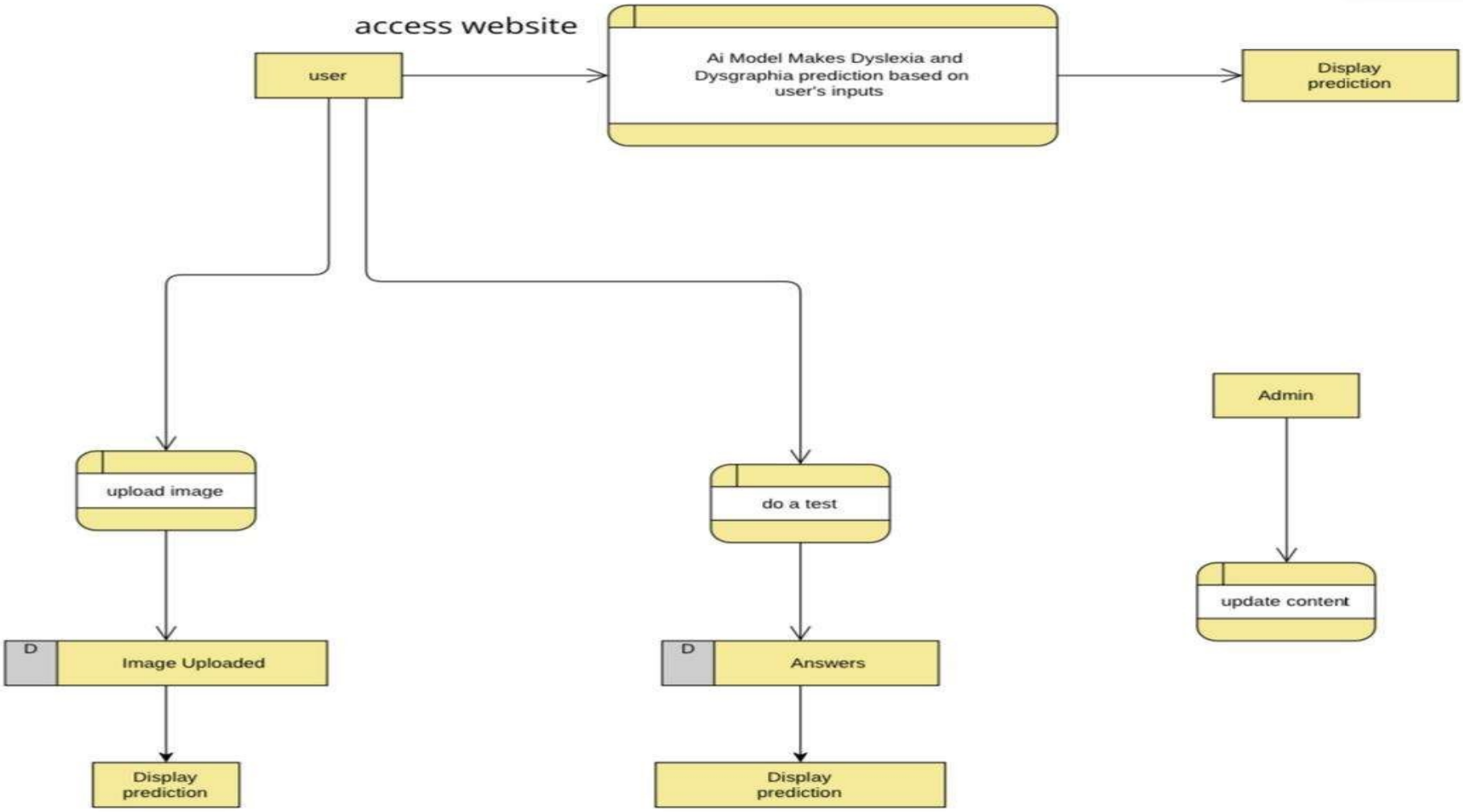
1.Use-Case Diagram	3.3 Level 2
2. Sequence Diagram	4.Class Diagram
3.Data Flow Diagram (DFD)	5.Entity Relationship Diagram (ERD)
3.1 Level 0	6.Activity Diagram
3.2 Level 1	7.Scheme Diagram



1.Use-Case Diagram

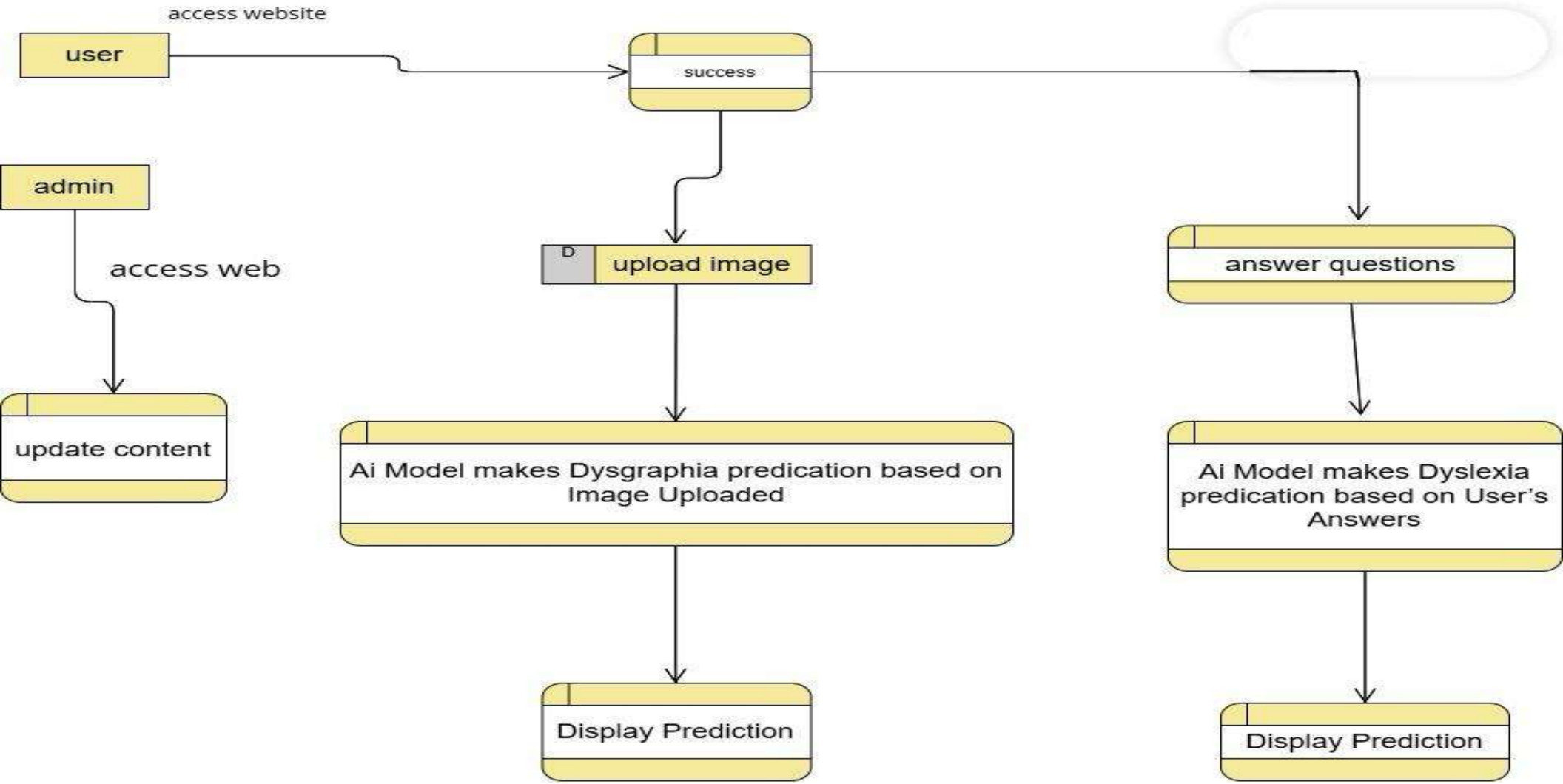


2. Sequence Diagram



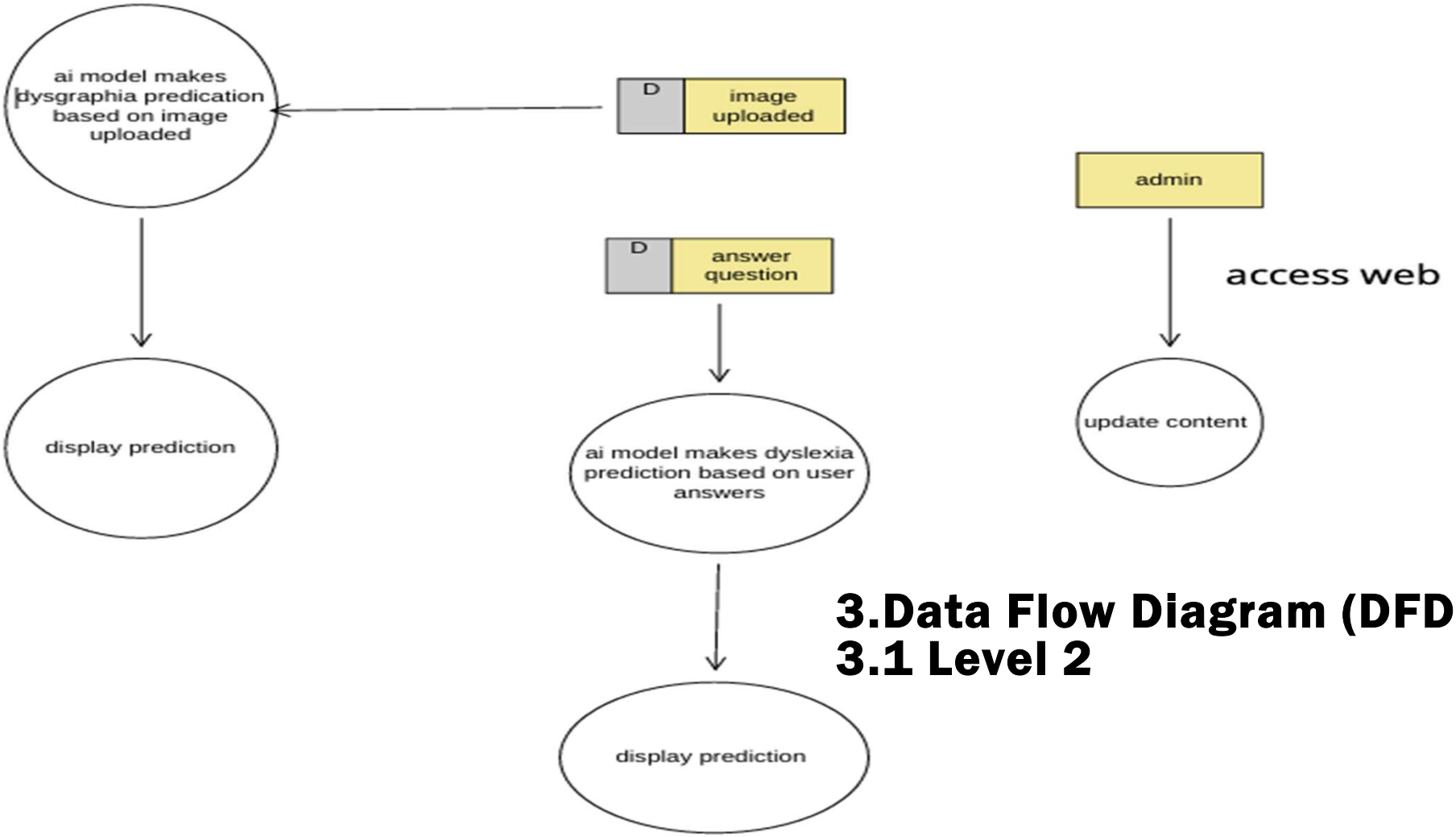
3.Data Flow Diagram (DFD)

3.1 Level 0

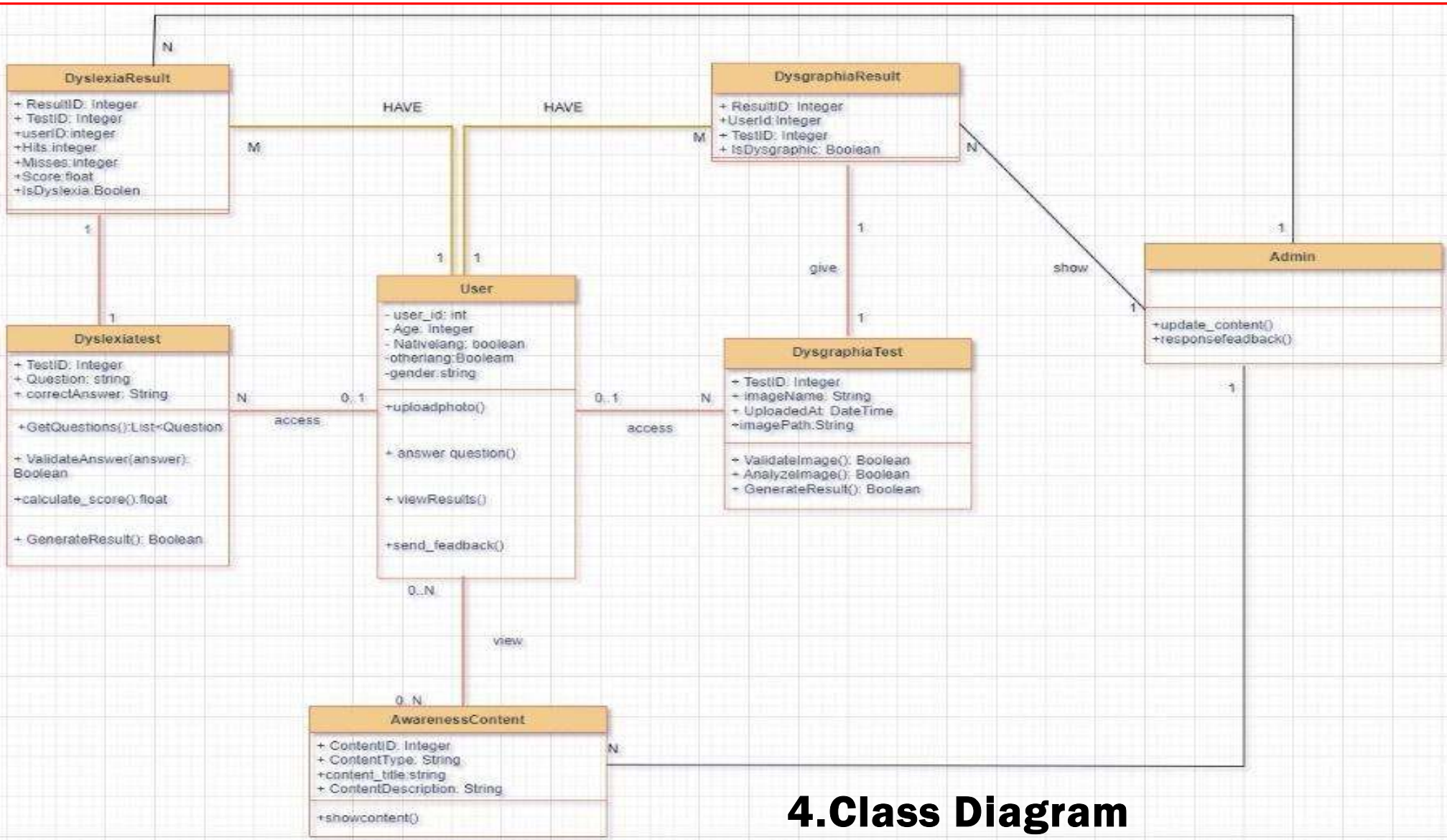


3.Data Flow Diagram (DFD)

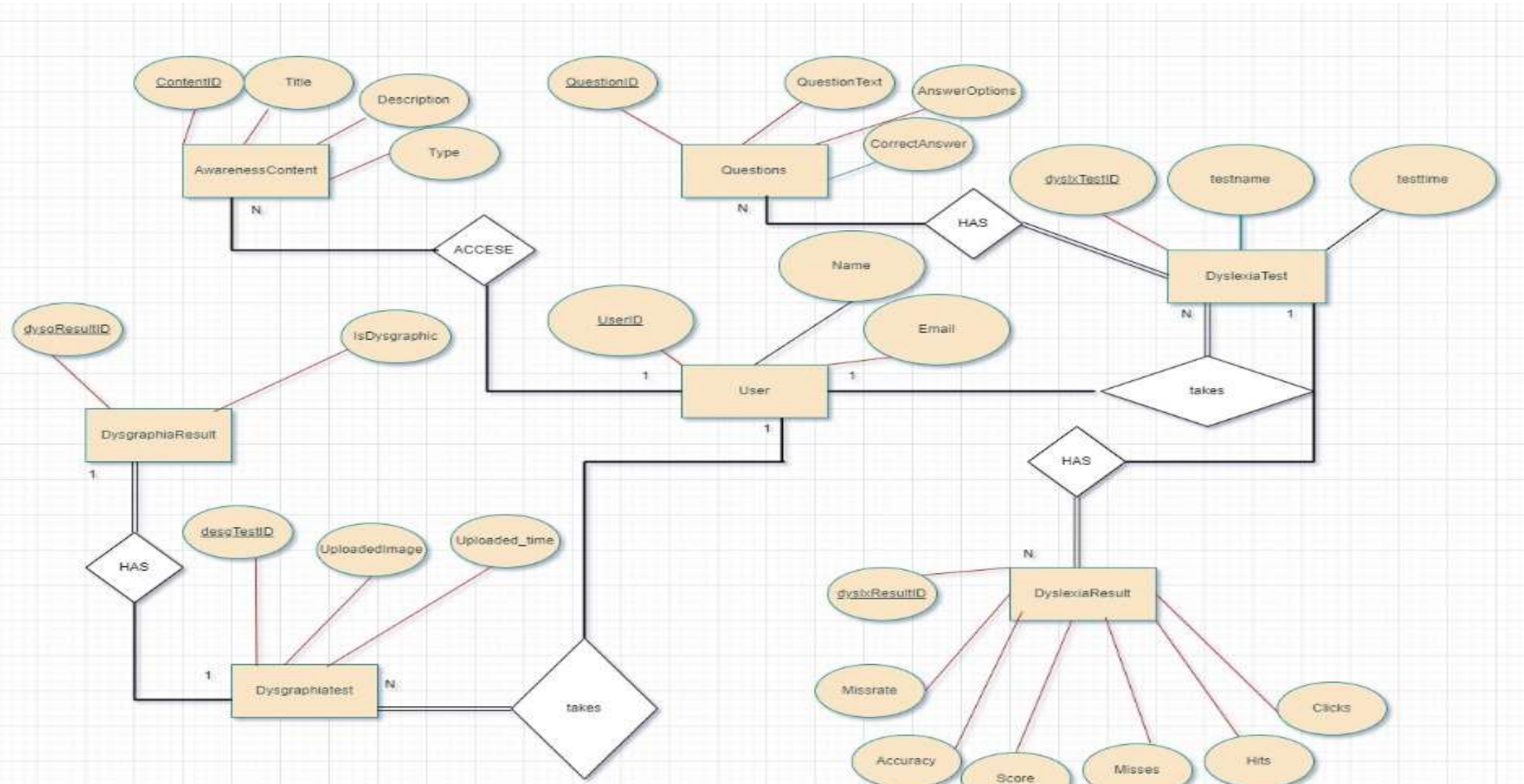
3.1 Level 1



3.Data Flow Diagram (DFD)
3.1 Level 2

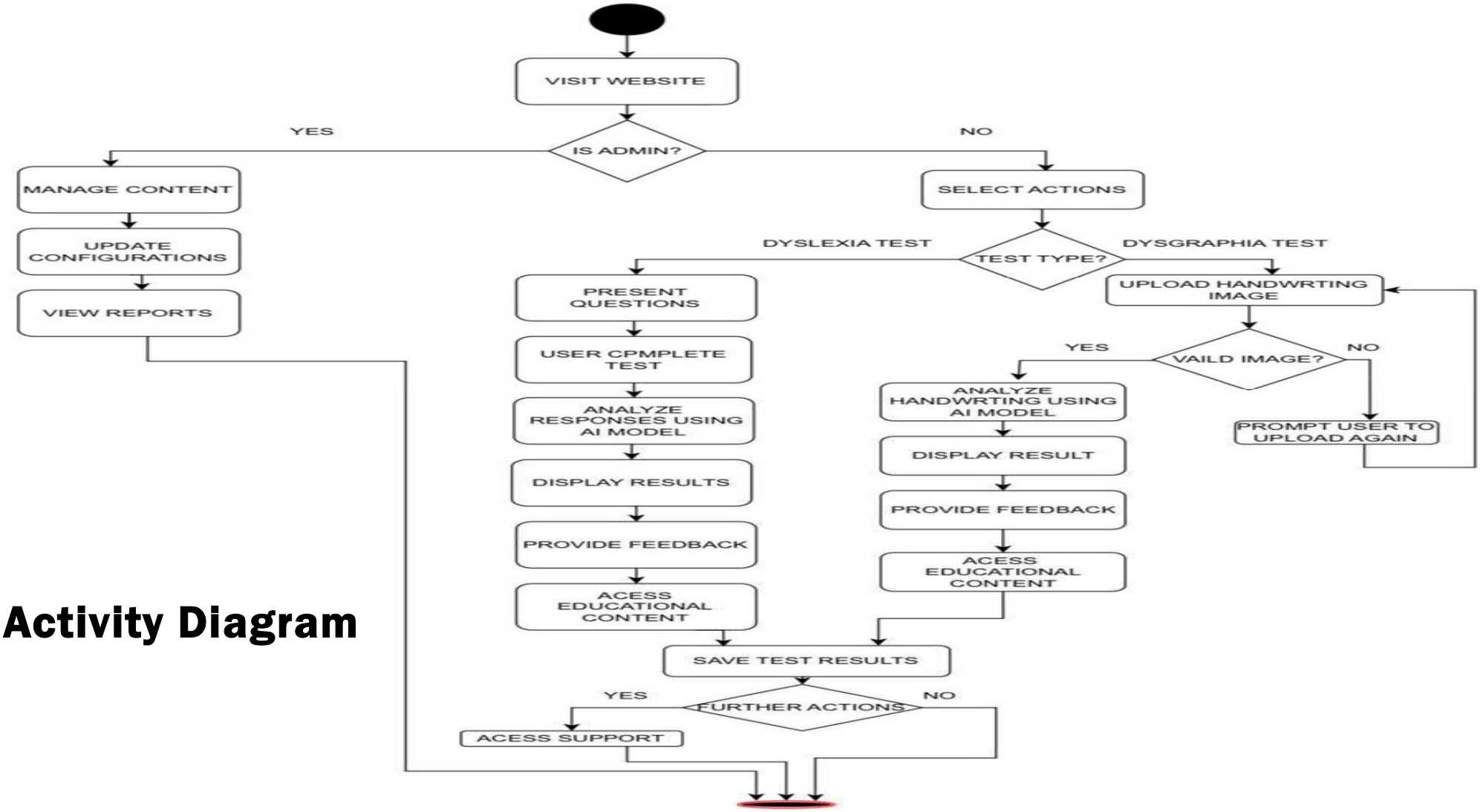


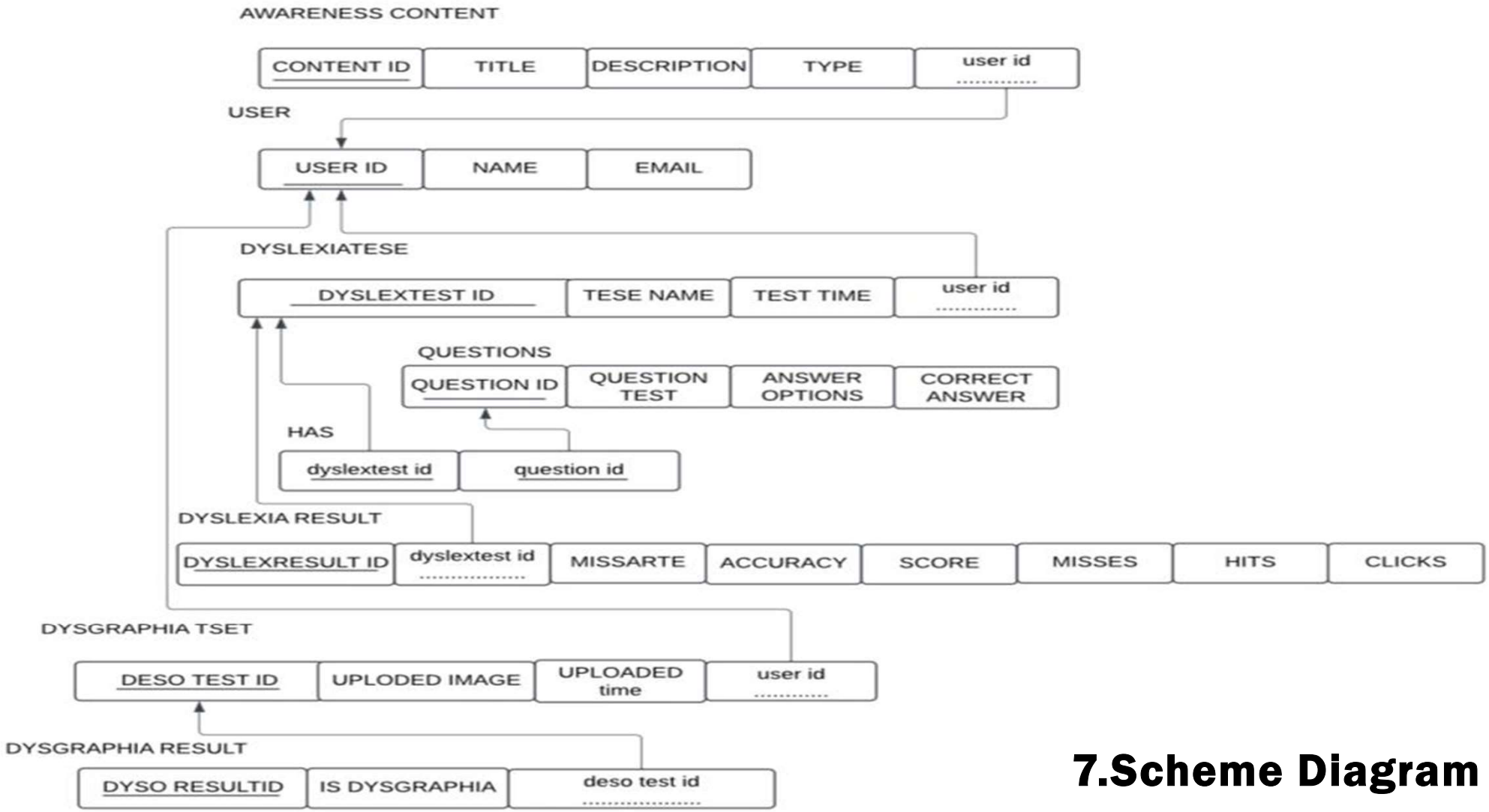
4.Class Diagram



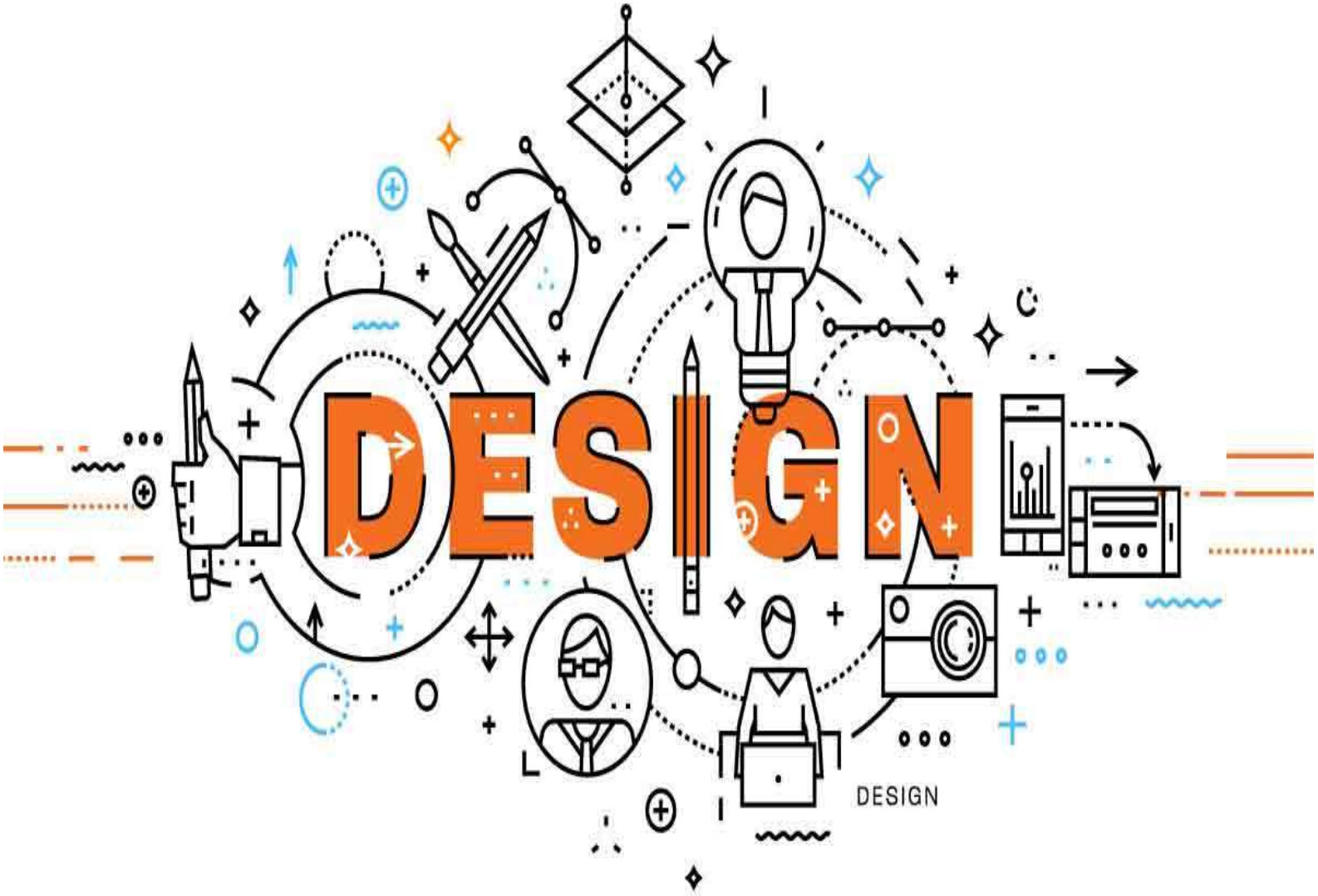
5.Entity Relationship Diagram (ERD)

6.Activity Diagram

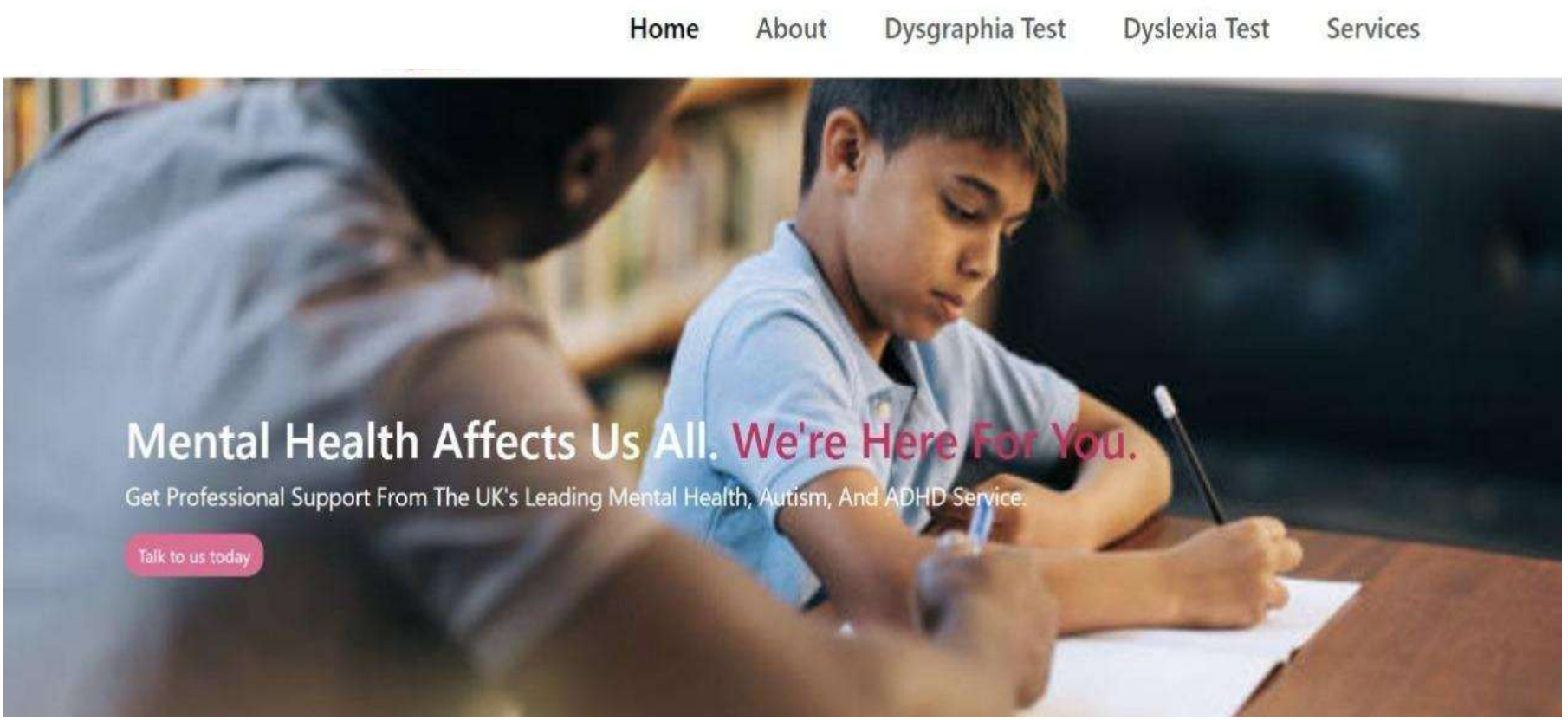




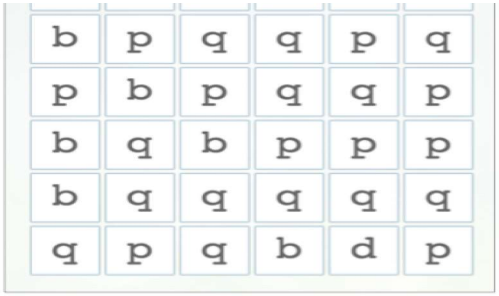
7.Scheme Diagram

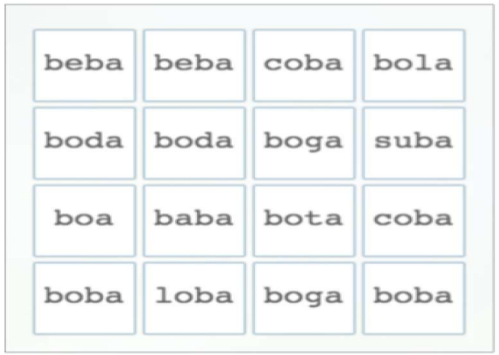

DESIGN
DESIGN

website view



Dyslexia test





Desgraphia test by uploading picture

Choose File No File Chosen

Models Used

model	Use case	why	how
CNNs	Handwriting analysis for dysgraphia detection.	CNNs are highly effective in image recognition and pattern analysis, making them suitable for detecting irregularities in handwriting.	Analyze uploaded handwriting images to identify fine motor skill issues associated with dysgraphia.
SVM	Classification tasks for dyslexia and dysgraphia prediction.	SVMs perform well on binary classification problems, helping distinguish between affected and non-affected individuals.	Train on labeled datasets to predict conditions based on test results.
Random Forest	Feature importance and classification.	This algorithm handles complex datasets and provides insights into which features (e.g., test responses or handwriting metrics) are most important for predictions.	Use decision trees to classify and rank features.

Models Used

model	Use case	why	how
Logistic Regression	Establishing a simple, interpretable baseline for dyslexia prediction.	Easy to implement, interpretable results, and effective for binary classification.	Features such as scores, clicks, and demographic data are used. A weighted logistic regression model is trained with class_weight='balanced' to address class imbalance. Predictions are output as probabilities and converted into binary label
XGBoost	Predicting dyslexia based on structured/tabular data like scores, hits, and accuracy.	Efficient with structured data, handles class imbalance using scale_pos_weight, and excels in binary classification tasks.	Preprocessed data is fed into the model with tuned parameters (max_depth, learning_rate, etc.). Predictions are generated as probabilities, with thresholds optimized for maximum F1 score.
MLPClassifier	Capturing complex, non-linear relationships in test data.	Neural networks can model intricate patterns and relationships in the data.	Neural networks can model intricate patterns and relationships in the data.

Models Used

model	Use case	why	how
SMOTE	Balancing datasets with underrepresented classes (e.g., dyslexia-positive cases).	Addresses class imbalance by creating synthetic samples, improving minority class recall.	Applies oversampling to training data by generating synthetic samples for the minority class. Balanced data is then used to train models like XGBoost, Random Forest, or MLPClassifier.
Stacking Ensemble	Combining predictions from multiple models for improved classification.	Combining predictions from multiple models for improved classification.	Predictions from base models are aggregated using a meta-classifier (e.g., Logistic Regression). This meta-model learns from the predictions of the base models to make the final decision

Other AI models have limitations that make them less suitable for our project:

1. k-Nearest Neighbors (k-NN): Effective for smal datasets but struggles with large or high-dimensional data.

2. Naive Bayes: Fast but assumes feature independence, limiting its use for correlated features.

3. Decision Trees: Easy to interpret but prone to overfitting and lacks robustness for handwriting analysis.

So OUR MODELS, LIKE CNNS AND XGBOOST, ARE BETTER SUITED FOR COMPLEX DATA, IMAGE ANALYSIS, AND IMBALANCED DATASETS.


Implementation

Implementation Tools

- Frontend: HTML, CSS, JavaScript, Bootstrap, Angular.
- Backend: Laravel and Flask for server-side processing and AI integration.
- Database: SQL for managing user data, test results, and predictions.

Conclusion

- The Neuro Screen Project provides AI-powered early detection for dyslexia and dysgraphia.
- Combining gamified assessments, handwriting analysis, and multilingual support, it bridges accessibility gaps.
- By delivering accurate screenings and resources, Neuro Screen empowers educators, parents, and children globally.

Thank you