Final Year Project Report

VOCAL ODYSSEY

"An AI-Driven Pronunciation Journey for Children"

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Session

2021 - 2025

University of Management and Technology

Iqbal Campus Sialkot Pakistan

DEVOTION

We would grateful to dedicate our project to our loved ones who have imparted valuable lessons and consistently inspired us to believe that we can accomplish anything. They have always supported us during both our challenging and successful times, enhancing our self-confidence to continue our efforts. We are deeply thankful to them for continually motivating us and instilling a sense of belief in our abilities.

FINAL APPROVAL

- **Head of Department**
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  UMT Sialkot

- **Committee Head**
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- **Supervisor**
  Department of KUST.
  UMT Sialkot

- **Co-Supervisor**
  UMT Sialkot

ACKNOWLEDGMENT

We are grateful to Allah Almighty for blessing us with a wonderful life and granting us immense wisdom and knowledge.

Additionally, we extend our heartfelt thanks to all the instructors from the KUST department and UMT who illuminated our path to education and enabled us to undertake this project.

We want to convey my sincere appreciation to our supervisor Sir Haseeb Nasir, whose guidance, support, and encouragement have been incredibly important throughout this study and project journey.

PROJECT INFORMATION

Project Title

"Vocal Odyssey - An AI-Driven Pronunciation Journey for Children"

Objective

- Deliver an AI-based mobile app to improve children's pronunciation and articulation skills.
- Develop real-time feedback systems for phonics words and sentence practice.
- Create an engaging, gamified learning environment to sustain motivation.
- Provide parents and educators with detailed progress tracking and insights.

Undertaken by

- Khizar Ameer (21016065019)
- Abdul Rafay (21016065024)

Supervised by

- Engr. Haseeb Nasir

Starting Date

- 21 October 2024

Completion Date

- 16 June 2025

Tools Used

- Frontend: Flutter
- Backend: Node.js Express
- Database: MongoDB real-time
- AI Speech APIs: TTS Murf AI, SpecchAce for speech evaluation

Operating System

- Windows

PLAGIARISM REPORT

Thesis Similarity Report

Learning Resource Center, UMT, Sialkot

Turnitin Originality Report

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ABSTRACT

In today's digital age, effective communication is a key skill, and learning proper pronunciation at an early stage can significantly enhance a child's language development. Our project name Vocal Odyssey an AI-powered interactive speech models, is designed to help children practice pronunciation in an engaging and structured way.

The mobile application provides a three-tier learning approaches Phonics, Words, and Sentences where children listen to AI-generated prompts, repeat them, and receive real-time feedback on their pronunciation. The system evaluates their speech using advanced speech recognition techniques and encourages them with motivational feedback when needed. To maintain engagement, the app includes gamified elements such as levels and rewards making learning both fun and effective.

Parents and educators can monitor progress through a dashboard, which tracks pronunciation accuracy, learning milestones, and engagement levels. Additionally, admins can manage content dynamically by adding new phonics, words, and sentence exercises to ensure continuous learning opportunities.

Using AI-powered speech analysis and interactive learning, this app creates a fun and personalized experience that helps children improve their pronunciation with confidence. Our goal is to bridge the gap between technology and early language learning, empowering children to communicate more effectively in the future.

REVISION SCHEDULE

Table 1: Revision Chart

Version	Primary Author(s)	Description of Version	Date Completed
Draft 1	Khizar Ameer	Initial draft; we created the first three chapters in rough form.	15/Dec/2024
Draft 2	Abdul Rafay	Second draft incorporating initial review; formatted the first draft and added diagrams to Chapters 4 and 5.	31/Jan/2025
FYP1 Internal	Khizar Ameer	First complete draft; added Chapter 6 to the document for our Capstone 1 requirement.	10/Feb/2025
Revision	Khizar Ameer	Revised draft; updated according to the supervisor's suggestions.	15/Feb/2025
Revision 2	Abdul Rafay	Revised draft; updates table and format them.	19/Feb/2025
Final Version1	Khizar Ameer	Added and review testcases and format them.	25/May/2025
Final Version2	Khizar Ameer	Complete the whole document.	10/June/2025
Final Revision	Abdul Rafay	Proof reading finding mistakes and correct them.	12/June/2025
Document Completed	Khizar Ameer	Proof reading and images adjustments.	16/June/2025

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DEFINITIONS AND ACRONYMS

Table 2: Table of Acronyms and Definition

Acronym	Definition
UMT	University of Management and Technology
TTS	Text-to-Speech
API	Application Programming Interface
AI	Artificial Intelligence
OTP	One Time Password
UC	Use Case
DFD	Data Flow Diagram
FR	Functional Requirement
NFR	Non-Functional Requirement
PID	Prototype ID

Document Conventions

Table 3: Document Convention

Initiative	Font-Style	Font weight and size
Main section Heading 1	Book Antiqua	Bold, 16
Section Heading 2	Book Antiqua	Bold, 14
Sub section Heading 3	Book Antiqua	Bold, 12
Other text body	Times new roman	Normal, 11
Figures and table Caption	Times new roman	Bold, 11

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1. INTRODUCTION

1.1 Motivations

Children of age around 4–8 often face challenges in learning proper pronunciation and speech articulation, which are critical for language development, confidence, and communication. Traditional methods of language learning and speech practice are either not engaging or fail to provide real-time feedback. Existing apps focus on vocabulary and grammar but lack interactive tools for speech improvement tailored for young learners. This project aims to fill this gap by utilizing AI to create a fun, interactive app that makes speech learning engaging and effective for children while empowering parents and educators with progress tracking tools.

1.2 Project Overview

Problems or Overview Statement:

Many children struggle with correct pronunciation, which can affect their confidence and communication skills. Current tools do not provide real-time feedback or engaging solutions for improving phonics and speech articulation.

Customer:

- Primary Users: Children aged around 4–8 learning English as a first or second language.
- Secondary Users: Supervisor (Parents/Guardian and Educators) who wish to monitor and support children's language progress.

Goals:

- Improve children's pronunciation and speech clarity through interactive, AI-powered real-time feedback.
- Motivate children with gamified learning elements like rewards and achievements.
- Empower parents and educators with detailed progress tracking and reporting.

System Functions:

- Provide pronunciation-based exercises for practicing phonics, words, and sentences.
- Offer real-time feedback to correct pronunciation and articulation.
- Gamify learning with levels and rewards to maintain engagement.
- Generate progress reports to monitor improvement.

System Attributes:

- Child-Friendly Design: A visually engaging and easy-to-use interface tailored for young children.
- High Speech Recognition Accuracy: Accurate AI-driven feedback to help children improve pronunciation effectively.
- Real-Time Processing: Immediate responses to ensure seamless interaction and engagement.
- Scalability: Designed to support future enhancements, including multi-language support.
- Performance Optimization: Ensures minimal latency during speech processing and feedback.

1.2.1 Problem Statement

Many young children struggle with saying words correctly, which can impact their communication skills, self-confidence, and overall language development. When children mispronounce words, it can lead to misunderstandings, make them shy, or even cause them to avoid speaking. These early speech difficulties can also affect academic progress, as strong language skills are essential for reading and learning in school.

Traditional language-teaching methods often rely on memorization and repetitive exercises, which aren't always engaging or enjoyable for young kids. This lack of interactivity and personal connection can make it difficult to keep them motivated and interested in practicing their speaking skills. Additionally, parents and teachers often don't have accessible tools to track a child's progress in real time, making it challenging to know when to step in and offer extra support. Addressing these challenges is crucial to helping children improve their pronunciation, gain confidence, and build strong communication skills in a supportive and engaging way.

1.3 Objectives

- Deliver an AI-powered mobile app to improve children's pronunciation and articulation skills.
- Develop real-time feedback modules for phonics words and sentence practice.
- Create an engaging, gamified learning environment to sustain motivation.
- Provide parents and educators with detailed progress tracking and insights.

2. DOMAIN ANALYSIS

2.1 Customer

This project does not have a contracted client. However, the potential customers include:

1. **Parents and Guardian:** Supporting children aged around 4 to 8 in improving pronunciation and language skills at home.
2. **Early Education Institutions:** Preschools and schools integrating interactive tools for language learning.
3. **Speech Therapists and Educators:** Assisting children with speech difficulties through engaging practice.

2.2 Stakeholders

Table 4: List of Stakeholders

Stakeholder	Role in System
Children	Primary users of the app, engaging with the AI assistant to practice pronunciation through phonics, words, and sentences.
Supervisors	Supervisor including parents, guardians and educators, that track and manages child progress.
Institutes (Schools/Organizations)	Potential adopters of the app in educational settings, using it as a supplementary tool for teaching pronunciation and speech. They may provide feedback for customization based on institutional needs.
Development Team	Responsible for designing, developing, and maintaining the app. They integrate external speech and text recognition APIs, implement gamified elements, and ensure seamless functionality.
Admins	Responsible for managing user and app level content,
Testers	Ensure the app is bug-free and functions as intended. They evaluate the speech recognition accuracy, gamification features, and overall user experience across various age groups and scenarios.
External API Providers	Provide text-to-speech and speech evaluation technologies that form the core of the app's pronunciation assessment capabilities.

2.3 Groups Affected With Social or Economic Impact

- ***Children***
  The app helps to improve pronunciation skills, fostering better communication and learning abilities.

- ***Parents***
  The parental dashboard allows parents to monitor their child's progress, enabling them to provide targeted support.
- ***Teachers/Educators***
  Teachers can use the app as a supplementary tool to reinforce pronunciation and language skills in a fun, interactive way.
- ***App's Developer***
  Developers will be responsible for maintaining and updating the app, ensuring its functionality and continued user engagement.

2.4 Dependencies/External Systems

- ***Text-to-speech and Speech Evaluation API:***
  The app integrates AI-based Text-to-Speech from Murf.ai [1] and Speech Evaluation from SpeechAce [2] to generate spoken prompts and assess a child's pronunciation accuracy by comparing their speech with correct sounds, words, or sentences.
- ***Flutter-Framework****:*
  Flutter [3] will be used to build the mobile app's frontend for both iOS and Android, enabling cross-platform development.
- ***Express.js (Backend Framework)****:*
  Express.js [4] will be used for server-side development to manage authentication, API communication, progress tracking, and user data.
- ***MongoDB (Database)****:*
  MongoDB [5], a NoSQL database, will store user data such as progress, scores, profiles, and settings, chosen for its flexibility and scalability.

2.5 Reference Documents

2.5.1 Related Projects

Duolingo Kids*:*

- Duolingo offers language learning through games and quizzes but lacks real-time speech feedback for pronunciation practice [6].

Speech Blubs*:*

- A speech therapy app that assists children with delayed speech, focusing on articulation and sounds [7].

Lingo Kids*:*

- An English-learning app for kids that includes vocabulary and phonics, but does not provide real-time pronunciation feedback [8].

2.5.2 Features Comparison

Table 5: Features Comparison with Competitors

Sr No.	Features	Duolingo Kids	Speech Blubs	Lingo Kids	Vocal Odyssey	Remarks
1	Speech Feedback	No	Yes	No	Yes	Real-time AI feedback ensures precise pronunciation correction, missing in others applications.
2	Speech Articulation Focus	No	Yes Primarily for children with speech delays	No	Yes	Our app targets speech articulation with real-time AI, filling a major market gap.
3	Phonics Practice	Yes There is no dedicated phonics section.	Yes Limited focus on articulation	Yes (basic, no feedback)	Yes	Dedicated phonics practice with real-time pronunciation feedback sets our app apart.
4	Pronunciation Correction	No	Yes (basic correction)	No	Yes	AI-driven correction for words and sentences improves learning precision.
5	Sentence Practice	Yes (no feedback)	No	Yes (no articulation focus)	Yes	Full sentence articulation with feedback ensures fluency improvement.
6	Gamification	Yes	Yes	Yes	Yes	Similar to competitors, our app uses gamification, but dynamic difficulty levels based on user progress enhance long-term engagement.
7	Progress Tracking	Yes	Yes	Yes	Yes	Our app provides detailed tracking helps parents monitor progress and focus on improvement areas.

3. REQUIREMENTS ANALYSIS

3.1 Requirements

3.1.1 Functional Requirements

Table 6: Functional requirements

RID	Description	Category	Attribute	Details & Boundary Constraints
R1.1	The system must enable users to securely register into the app.	FR	User Authentication	Users must register using an email address and password or with third-party authentication Google.
R1.2	The system must enable users to log in to their accounts.	FR	User Authentication	Logins must require a valid email and password combination.
R1.3	The system should permit users to log out securely.	FR	User Authentication	Users should be able to log out at any time.
R1.4	The system should support password recovery.	FR	User Authentication	Users can recover account using a secure process, such as a verification code sent via email.
R1.5	The system must provide a module of phonics practice with Alphabets sounds and letter combinations.	FR	Feature Coverage	Include voice interactive alphabets sounds and letter combinations for phonics and real-time pronunciation practice.
R1.6	The system must offer a module for practicing words.	FR	Feature Coverage	Provide a variety of individual words starting from simple to hard words for focused real-time pronunciation practice.
R1.7	The system must include a module for practicing sentences and phrases.	FR	Feature Coverage	Allow multi-word practice with phrases and sentences to improve fluency in real-time.
R1.8	The AI assistant must produce sounds, words, or sentences for imitation.	FR	Interaction Flow	The AI must initiate practice by playing audio and displaying text for the child to imitate.
R1.9	The system must evaluate the child's pronunciation and provide feedback.	FR	Core Functionality	Use external speech recognition APIs to detect accurate and inaccurate pronunciations.
R1.10	The system should allow progression to the next level upon successful pronunciation.	FR	Interaction Flow	Unlock the next sound, word, or sentence once accuracy criteria are met.

R1.11	The system should provide encouragement and allow repeated practice for incorrect pronunciations.	FR	Feedback Mechanism	Include motivational feedback, for instance, “Try again!” and replay the practice item until successful.
R1.12	The system should implement a rewards system to motivate children.	FR	Gamification	Award stars reward for correct pronunciation and achieving milestones.
R1.13	The system must track and display child progress through a parental dashboard.	FR	Reporting	Supervisor can view metrics like accuracy scores, time spent, and earned rewards.
R1.14	The system should allow supervisor to create and manage multiple child profiles under their account.	FR	Child Profile Management	Supervisor can add, edit, or delete profiles for their children to track individual progress and customize learning experiences.
R1.15	The system should allow admin to have access on app and add new features such as new tasks in phonics, words, and sentence practice.	FR	Admin Role Management	Admin can create and manage new content for phonics, words, and sentence practice modules.
R1.16	The system should allow admin to manage all user data.	FR	Admin Role Management	Admin can view and delete user data as necessary for maintenance and support purposes.
R1.17	The system should allow supervisors to edit their own profile information such as name.	FR	Supervisor Profile Management	Supervisors can update their name from the app settings, and changes must be saved securely and reflected system-wide.

3.1.2 Non Functional Requirements

Table 7: Non-Functional Requirements

RID	Description	Category	Attribute	Details & Boundary Constraints
R2.1	The system must ensure timely feedback for pronunciation.	NFR	System Response Time	Feedback must be provided within 3 seconds under optimal network conditions with latency ≤ 100ms.
R2.2	The system must ensure high availability of the app.	NFR	Availability	The app must maintain 99.9% uptime during operational hours.
R2.3	The system must provide a child-friendly and engaging user interface.	NFR	Usability	Use bright visuals, animations, and simple, intuitive navigation for children aged around 4–8 years.
R2.4	The system must support operation on common mobile platforms.	NFR	Compatibility	Must work on iOS 13.0+ and Android 8.0+ platforms without functionality issues.
R2.5	The system should enable smooth, lag-free gamified experiences.	NFR	Performance	Ensure no lag during animations, reward displays, or transitions between levels.

3.1.3 Data Requirements

Table 8: Data Requirements

RID	Description	Category	Attribute	Details & Boundary Constraints
R3.1	The system should store progress data for individual users.	Data Requirement	User Data Storage	Include stars, unlocked levels, and timestamps for tracking progress.
R3.2	The system should collect pronunciation accuracy data for practice items.	Data Requirement	Analytics	Store accuracy percentages for each speech attempt to analyze performance trends.
R3.3	The system must enable parental access to a child's progress data.	Data Requirement	Reporting	Progress data must be retrievable and displayed in the parental dashboard.

R3.4	The system should avoid storing raw voice data.	Data Requirement	Privacy	Store derived metrics for example accuracy scores instead of actual voice recordings.
R3.5	The system must maintain logs of API requests and responses.	Data Requirement	API Integration	Logs must include timestamps, request status, and response accuracy details.

3.1.4 Constraints

Table 9: Constraints in Requirement

RID	Description	Category	Attribute	Details & Boundary Constraints
R4.1	The system must use external speech-to-text and speech evaluation APIs.	Constraint	Technology Limitation	Integrate APIs like Murf AI for speech-to-text and SpeechAce for speech evaluation.
R4.2	The system must operate within budget for API calls.	Constraint	Cost	Optimize API usage to minimize costs while maintaining accuracy and response time.
R4.3	The system must limit storage on local devices.	Constraint	Resource Limitation	Cached data must be managed to remain optimal for device storage.

3.1.5 External Interface Requirements

Table 10: External Interface Requirements

RID	Description	Category	Attribute	Details & Boundary Constraints
R5.1	The system must interface with text-to-speech and pronunciation analysis APIs.	External Interface Requirement	API Integration	Send audio data to APIs and receive speech analysis results in <3 seconds at good internet.
R5.2	The system must provide a parental dashboard accessible via the mobile app.	External Interface Requirement	User Interface	Dashboard must be accessible through secure login within the mobile app.
R5.3	The system must support third-party authentication for Supervisor to register or login.	External Interface Requirement	Authentication	Allow login using Google, Apple, or email-based authentication options.

3.2 List of Actors

The system boundary defines the interaction between the child, supervisor (parent/educator), admin, and external API with the application. Below are the key actors involved in the system.

Table 11: List of Actors

Actor	Role
Child (User)	Engages with the system by practicing phonics, words, and sentences, earning rewards, and tracking progress.
Supervisor (Parent/Educator)	Monitors child progress, manages child profiles, and accesses reports.
Admin	Manages user data, application content, and system operations.
System (Application)	Provides feedback, evaluates responses, tracks progress, and handles reward distribution.
External API	Manages Text-to-Speech and speech evaluation models.

3.3 List of Use Cases

The list of use cases we derived from our requirements are written below.

3.3.1 User Authentication Usecases

- Register User
- Login User
- Logout User
- Recover Password
- Enter OTP

3.3.2 Supervisor Management Usecases

- Create Child Profile
- Edit Child Profile
- Delete Child Profile
- View Report
- Edit Supervisor Profile

3.3.3 Admin Management Usecases

- Manage User Data
- Manage Level Content
- Add new Phonics
- Add new Words
- Add new Sentences

3.3.4 Child Interaction Usecases

- Practice Phonics.
- Practice Words.
- Practice Sentences.
- Complete task and progress.
- Earn Reward.
- Motivate User to retry.
- Provide Audio Prompts for imitation.
- Evaluate Audio prompts of Child

3.4 System Use Case Diagram

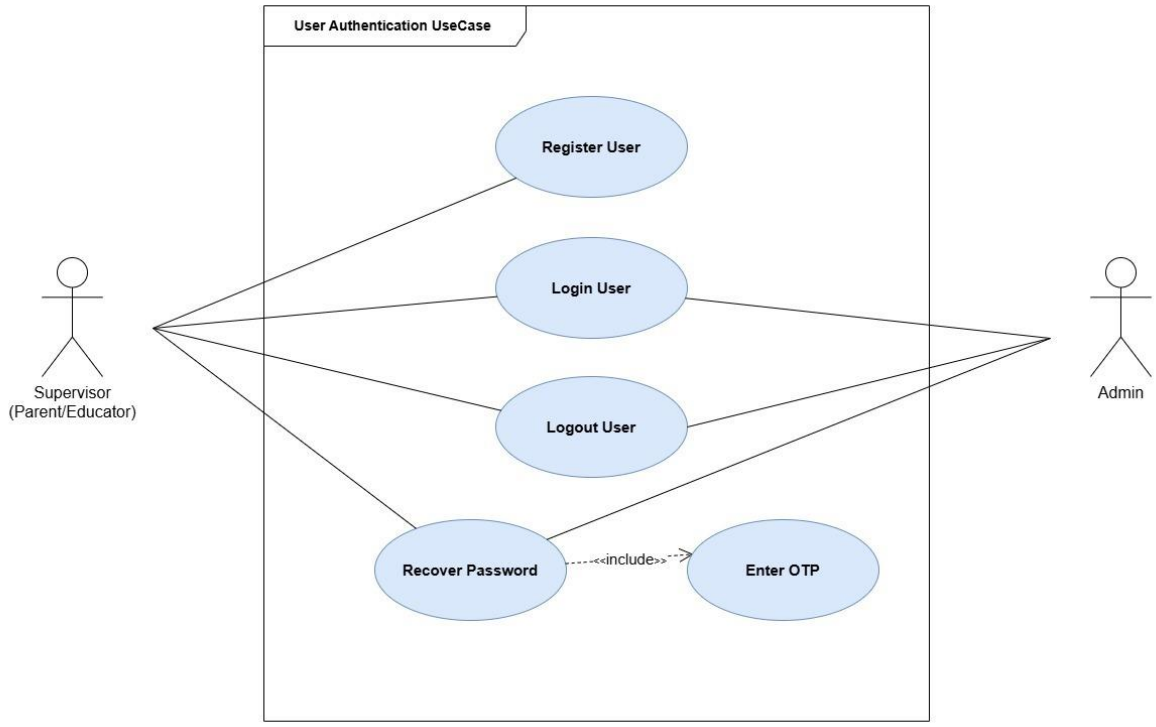

Figure 1: User Authentication UC Diagram

This use case diagram represents the user authentications functionality in figure 1 that how different users register, login and logout into the system. It also represents recovery of password that further include Enter OTP use case.

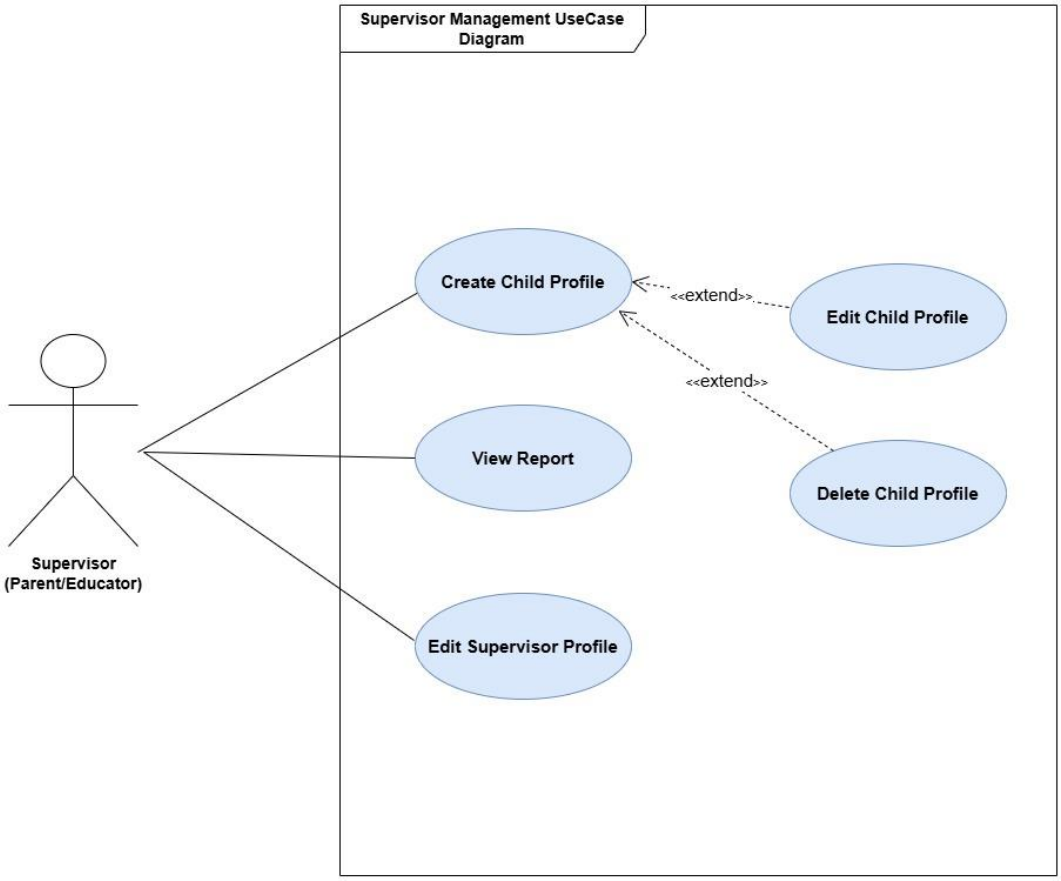

Figure 2: Supervisor Management UC Diagram

The Supervisor Management Use Case Diagram figure 2 express the functionality of supervisor can able to create the profile for the child more on it also able to edit and delete the profile too. Supervisor can also able to view the progress report of his/her child and edit his/her own profile.

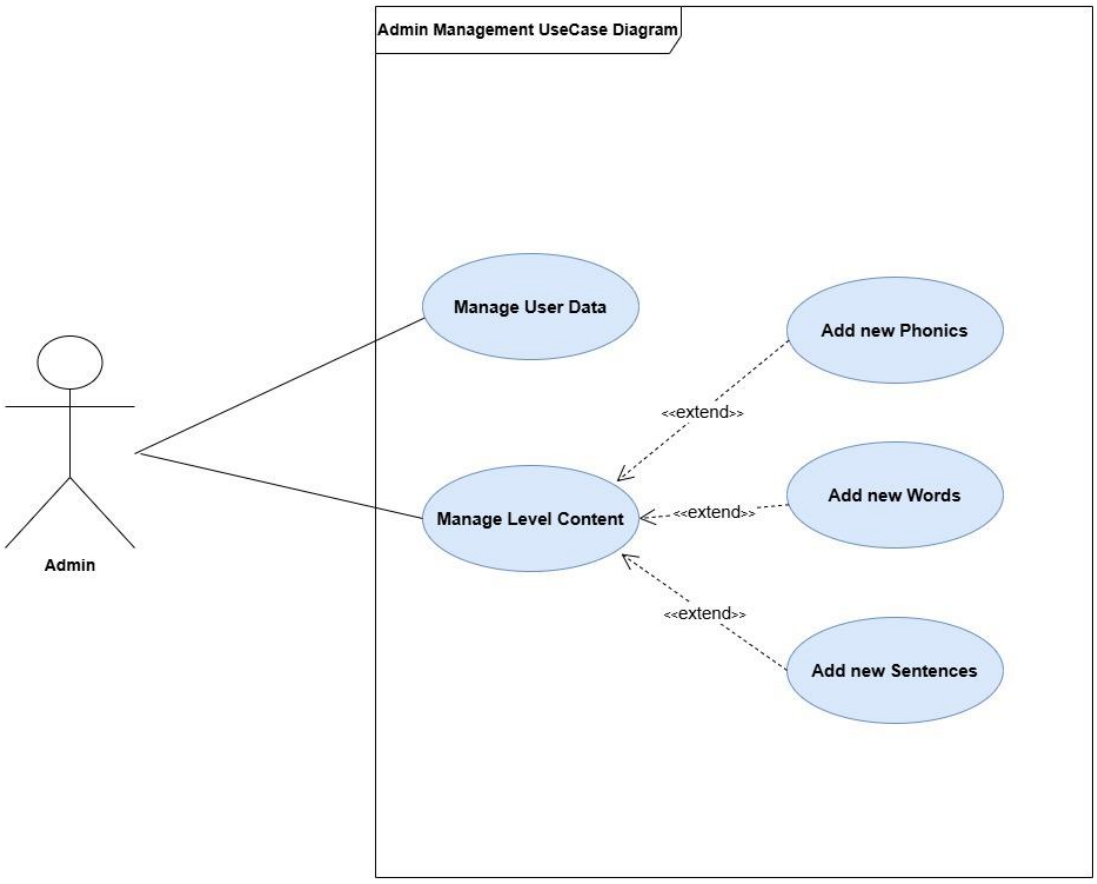

Figure 3: Admin Management UC Diagram

The figure 3 represents admin role in use case diagram that admin can able to manage and track the user data it also able to manage the app content like adding new modules in the system such as phonics, words and sentences.

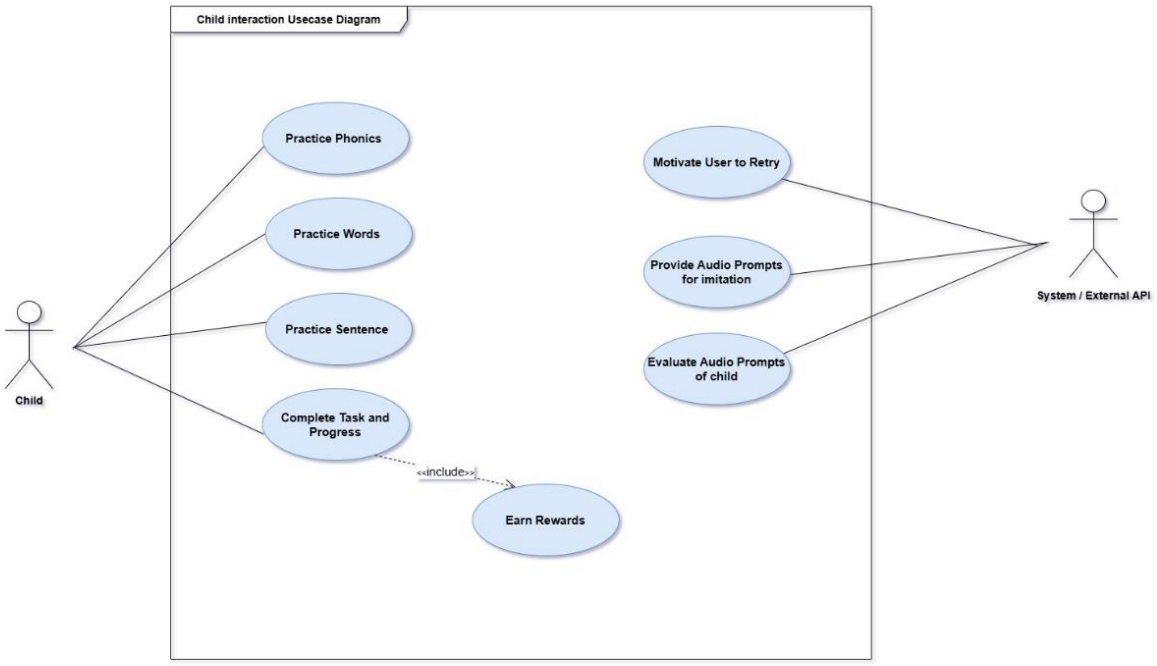

Figure 4: Child Interaction UC Diagram

In figure 4 use case diagram, the primary user child interacts with the system practice different modules complete tasks and earn rewards whereas system evaluates the child audio prompts motivate and engage user if failed.

3.5 Extended Use Cases

3.5.1 User Authentication Usecase Description UC1

Table 12: Register User UC Description

UseCase_ID	UC_1.1
UseCase_Name	Register User
Authored By	Khizar Ameer
Modified By	Abdul Rafay
Creation Date	21/Jan/2025
Last Modified Date	17/Feb/2025
Actors	Supervisor (Parent/Educator)
Trigger	The user initiates the registration process by clicking the "Register" button or link on the platform.
Description	• This use case describes the process by which a new user registers an account in the application. • The user provides required details, and the application verifies and stores them.
Preconditions	• The user is not already registered. • The application is available and accessible.
Postconditions	• The user's account is created, and a confirmation message is displayed. • User can log in with the registered credentials.
Normal Flow	• The user navigates to the registration page. • The user enters required details like name, email, password. • The system moves to child create screen if the email is not registered already.
Alternative Flows	If the email is already registered: • The application shows an error message. • The user is prompted to log in or recover their password.
Exceptions	If the application is unavailable during registration: • The application shows an error message. • The user is asked to register again later.
Includes	None
Frequency of Use	On User Demand
Special Requirements	• The application must validate user-provided email and password format. • The application must process the registration within 5 seconds.
Assumptions	• The user has a valid email address and internet connection.
Notes and Issues	None

Table 13: Login User UC Description

UseCase_ID	UC_1.2
UseCase_Name	Login User
Authored By	Khizar Ameer
Modified By	Khizar Ameer
Creation Date	21/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Supervisor (Parent/Educator) • Admin
Trigger	The user starts the login procedure by selecting the "Login" button or link on the platform.
Description	• The use case outlines how a registered user accesses the application by entering valid login details.
Preconditions	• The user must already have an account. • The application should be available and operational.
Postconditions	• User is successfully logged in to the application. • Application displays the user homepage.
Normal Flow	• The user goes to the login page. • The user enters email and password. • The system validates the credentials. • If the credentials are valid, the application logs the user in. • The application redirects the user to their homepage.
Alternative Flows	If the application is unavailable during login: • The system shows an error message. • The user is asked to try again later.
Exceptions	If the application is unavailable during login: • The application shows an error message and asked to try again.
Includes	None
Frequency of Use	Multiple times daily
Special Requirements	• The application must validate credentials within 2 seconds. • The application must prevent brute force login attempts.
Assumptions	• The user remembers their login credentials. • The user should have internet access.
Notes and Issues	• None

Table 14: Logout User UC Description

UseCase_ID	UC_1.3
UseCase_Name	Logout User
Authored By	Khizar Ameer
Modified By	Khizar Ameer
Creation Date	21/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Supervisor (Parent/Educator) • Admin
Trigger	The user starts the logout process by selecting the "Logout" button or link within the application.
Description	• The use case describes how a logged-in user logs out of the application, guaranteeing a secure session termination.
Preconditions	• The user must log into the application.
Postconditions	• The user successfully logs out, and the application navigates to the login page or homepage.
Normal Flow	• User clicks on the "Logout" button. • The application redirects the user to the login page.
Alternative Flows	• User cancels the logout and remains logged in to the system.
Exceptions	If the application encounters an error during logout: • The application displays an error message. • The application retries the logout process or advises the user to refresh the page.
Includes	None
Frequency of Use	Multiple times daily, depending on the user
Special Requirements	• The logout should happen within 2 seconds of clicking the "Logout" button.
Assumptions	• The user wants to log out securely. • The user can utilize the logout feature.
Notes and Issues	• Ensure logout functionality is consistent across all device platforms.

Table 15: Recover Password UC Description

UseCase_ID	UC_1.4
UseCase_Name	Recover Password
Authored By	Khizar Ameer
Modified By	Khizar Ameer
Creation Date	21/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Supervisor (Parent/Educator) • Admin
Trigger	The user initiates the password recovery process by selecting "Forgot Password" on the login page.
Description	• This use case enables a user to reset their password by confirming their identity with an OTP (One-Time Password) sent to their email, allowing them to set a new password.
Preconditions	• The user must have a registered account with a valid email.
Postconditions	• The user successfully sets a new password and can log in using it.
Normal Flow	• User clicks "Forgot Password" and enters their registered email or phone number. • User first enters the register email and click on “Request OTP” • OTP is received on email with validity of 10 minutes. • User then enters OTP and set new password and click on “Save” Button. • The system checks ff the OTP is valid and correct then reset the password successfully.
Alternative Flows	**User provides an unregistered email:** • The application shows an error notification. **User enters an incorrect OTP:** • The user asked to re-enters the email and requests a new OTP.
Exceptions	• If the application fails to send the OTP application send error to retry.
Includes	• Enter OTP Use Case (UC_1.4.1)
Frequency of Use	Whenever a user forgets their password.
Special Requirements	• OTP must expire within 10 minutes.
Assumptions	• The user has access to the registered email.
Notes and Issues	None for now.

Table 16: Enter OTP UC Description

UseCase_ID	UC_1.4.1
UseCase_Name	Enter OTP
Authored By	Khizar Ameer
Modified By	Khizar Ameer
Creation Date	21/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Supervisor (Parent/Educator)
Trigger	The user enter the register email and OTP send to email.
Description	• This sub-use case handles the process of the user entering the OTP received on their registered email for identity verification during password recovery.
Preconditions	• The OTP must have been sent to the registered email.
Postconditions	• The OTP process is secure, and no unauthorized access occurs. • The user successfully verifies their identity.
Normal Flow	• The user Request OTP on his/her registered email • The user enters the correct OTP and set new password and click on save. • The system checks if the OTP is not expired and correct then reset the password.
Alternative Flows	If the user enters an incorrect OTP: • The application displays an error message. • The user re-enters the email and request a new OTP.
Exceptions	If the OTP has expired: • The application displays an error and prompts the user to request a new OTP.
Includes	None
Frequency of Use	During password recovery
Special Requirements	• The OTP should be numeric and valid for only 10 minutes.
Assumptions	• The user has received the OTP. • The user has access to the device where the OTP was sent.
Notes and Issues	None for now.

3.5.2 Supervisor Use Case Description UC_2

Table 17: Create Child Profile UC Description

UseCase_ID	UC_2.1
UseCase_Name	Create Child Profile
Authored By	Khizar Ameer
Modified By	Khizar Ameer
Creation Date	21/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Supervisor (Parent/Educator)
Trigger	The supervisor initiates the process by selecting the "Create Child Profile" option in the application.
Description	• A supervisor creates a child profile in the app to track individual progress and customize learning experiences.
Preconditions	• The user must log into the application.
Postconditions	• The child profile is successfully created and saved, with all entered information stored.
Normal Flow	• The supervisor clicks on the "Create Child Profile" button. • The supervisor fills in required information like name, age, and gender. • The supervisor clicks "Save" to create the profile. • The application confirms the profile creation and displays the new profile.
Alternative Flows	• If the supervisor does not fill out all required fields, the system prompts them to complete the missing information before proceeding.
Exceptions	• If the application encounters an error while saving the profile: – The system shows an error message. – The supervisor can retry creating the profile after the error is resolved.
Includes	• Edit Child Profile (UC_2.1.1) • Delete Child Profile (UC_2.1.2)
Frequency of Use	Typically, once per child, though repeated if any profile details need to be updated.
Special Requirements	• The child profile should be created and saved in the application database immediately after the supervisor clicks "Save".
Assumptions	• The supervisor wants to create a new profile for a child. • The supervisor is authorized to create profiles.
Notes and Issues	• Ensure the profile creation process is straightforward with clear instructions.

Table 18: Edit Child Profile UC Description

UseCase_ID	UC_2.1.1
UseCase_Name	Edit Child Profile
Authored By	Khizar Ameer
Modified By	Khizar Ameer
Creation Date	21/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Supervisor (Parent/Educator)
Trigger	The supervisor selects the "Edit" button next to the child's profile in the app.
Description	• This allows the supervisor to edit an existing child profile, updating details as necessary like name, age, learning progress.
Preconditions	• The supervisor must already log into the application. • The child profile must already exist.
Postconditions	• The changes are successfully saved and reflected in the profile.
Normal Flow	• The supervisor selects the "Edit" button for a specific child profile. • The supervisor updates the necessary fields. • The supervisor clicks "Save" to apply changes. • The application saves and displays the updated profile.
Alternative Flows	• If the supervisor inputs invalid data (e.g., incorrect format), the system requests a correction.
Exceptions	• If an error occurs while saving the profile: – The system shows an error message. – The supervisor is asked to retry the update.
Includes	• None
Frequency of Use	Multiple times, depending on the need to update a child's profile.
Special Requirements	• Changes should be reflected immediately within 3 seconds after the "Save" button is pressed.
Assumptions	• The supervisor has the correct permissions to edit the profile.
Notes and Issues	• Ensure there is a confirmation before saving to prevent accidental edits.

Table 19: Delete Child Profile UC Description

UseCase_ID	UC_2.1.2
UseCase_Name	Delete Child Profile
Authored By	Khizar Ameer
Modified By	Khizar Ameer
Creation Date	21/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Supervisor (Parent/Educator)
Trigger	The supervisor selects the "Delete" button next to the child's profile in the app.
Description	• This use case allows the supervisor to delete a child's profile from the system when no longer needed.
Preconditions	• The child profile must exist in the system.
Postconditions	• The child profile is deleted permanently from the system.
Normal Flow	• The supervisor selects the "Delete" button for a specific child profile. • The system asks for confirmation to delete the profile. • The supervisor confirms the deletion. • The system permanently deletes the profile and confirms the deletion.
Alternative Flows	• If the supervisor cancels the deletion, the profile remains unchanged.
Exceptions	• If there is an error during deletion: – The system shows an error message and provides an option to retry.
Includes	• None
Frequency of Use	Rare, typically used when the child is no longer part of the learning system or account.
Special Requirements	• The profile should be deleted from the database.
Assumptions	• Deletion is irreversible after confirmation.
Notes and Issues	• Ensure there is a proper confirmation step to avoid accidental deletion.

Table 20: View Progress Report UC Description

UseCase_ID	UC_2.2
UseCase_Name	View Progress Report
Authored By	Khizar Ameer
Modified By	Khizar Ameer
Creation Date	21/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Supervisor (Parent/Educator)
Trigger	The supervisor selects the "View Progress Report" option from the parental dashboard in the app.
Description	• This use case allows the supervisor (parent or educator) to view detailed reports on their child's learning progress, including pronunciation accuracy, time spent on each activity, and any rewards earned.
Preconditions	• The supervisor must be logged into the app. • The supervisor must have at least one child profile with completed practice data.
Postconditions	• The progress report displays accurate information about the child's activities, achievements, and areas for improvement.
Normal Flow	• The supervisor clicks on the Progress Report button. • The supervisor selects the child profile. • The application generates and displays a detailed progress report showing metrics like accuracy scores, time spent on each activity, and earned rewards.
Alternative Flows	• If no data is available for the selected child or date range, the system notifies the supervisor that there is no data to display.
Exceptions	• If the application encounters an error while generating the report: – The system shows an error message. – The supervisor can attempt to view the report again or reach out to support for assistance.
Includes	• None
Frequency of Use	Periodically, depending on how often the supervisor wants to monitor their child's progress.
Special Requirements	• The report should be generated in real-time and provide up-to-date information on progress. • The system should allow filtering of data by date range and specific activities.
Assumptions	• The supervisor is interested in reviewing the child's progress.
Notes and Issues	• Ensure the progress report is visually clear and easy to understand, with accessible graphs or charts.

Table 21: Edit Supervisor Profile UC Description

UseCase_ID	UC_2.3
UseCase_Name	Edit Supervisor Profile
Authored By	Khizar Ameer
Modified By	Abdul Rafay
Creation Date	21/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Supervisor (Parent/Educator)
Trigger	The supervisor selects the settings option in the app.
Description	• This use case allows the supervisor (parent or educator) to modify or edit his/her own profile information
Preconditions	• The supervisor must be logged into the app.
Postconditions	• The supervisor's name changes and renders on the app screen
Normal Flow	• The supervisor clicks on the setting button. • The supervisor clicks on the name field. • The supervisor edits his/her name and click on save.
Alternative Flows	• if no data passes system asks to enter the name and minimum three words for name
Exceptions	• If the application encounters an error while editing the name: – The system shows an error message. – The supervisor can attempt to edit the name again or reach out to support for assistance.
Includes	• None
Frequency of Use	Depends on supervisor.
Special Requirements	• None
Assumptions	• The supervisor is changes the name.
Notes and Issues	• Ensure the name write successfully.

3.5.3 Admin Management Usecase Description UC_3

Table 22: Manage User Data UC Description

UseCase_ID	UC_3.1
UseCase_Name	Manage User Data
Authored By	Abdul Rafay
Modified By	Abdul Rafay
Creation Date	25/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Admin
Description	• The admin will manage user data in the application, including viewing and deleting user profiles.
Trigger	The admin selects the "Manage User Data" option from the admin panel.
Preconditions	• The admin must be logged into the app.
Postconditions	• The admin successfully views and deletes user data as per the operation requested.
Normal Flow	• The admin logs into the application and accesses the admin panel. • The admin clicks on the "Manage User Data" option. • The system presents a list of all registered users. • The admin selects a user and chooses an action like view and delete.
Alternative Flows	• If there are no users registered, the system notifies the admin and displays an empty user list.
Exceptions	• If the system encounters an error while processing the request: – The system shows an error message. – The admin can attempt the action again or reach out to technical support for assistance.
Includes	• None
Frequency of Use	• Occasionally, depending on the need for data updates or maintenance.
Special Requirements	• All operations must comply with relevant data privacy regulations.
Assumptions	• The admin has the authority and permissions to manage user data.
Notes and Issues	• Ensure data integrity during deletions.

Table 23: Manage App Content UC Description

UseCase_ID	UC_3.2
UseCase_Name	Manage Level Content
Authored By	Abdul Rafay
Modified By	Abdul Rafay
Creation Date	25/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Admin
Description	• This use case allows the admin to manage learning content by adding new phonics, words, or sentences for practice.
Trigger	The admin selects the "Manage Levels" option from the admin panel.
Preconditions	• The admin must already be logged into the app.
Postconditions	• The app content is updated and made accessible to users.
Normal Flow	• Admin selects "Manage Levels" from the admin panel. • Admin chooses to add phonics, words, or sentences. • Admin inputs the new content details. • System saves the input and updates the database.
Alternative Flows	• If input is invalid, the system prompts the admin to correct it.
Exceptions	• If content fails to save: – The system shows an error message. – The admin is prompted to retry.
Includes	• None
Frequency of Use	• Depends on content updates
Special Requirements	• New content should align with the app's structure and user levels.
Assumptions	• The admin has verified the quality and relevance of the added content.
Notes and Issues	• Validate all input before saving to ensure quality and consistency.

Table 24: Add new Phonics UC Description

UseCase_ID	UC_3.2.1
UseCase_Name	Add New Phonics
Authored By	Abdul Rafay
Modified By	Abdul Rafay
Creation Date	25/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Admin
Description	• Enables the admin to add new phonics sounds or letter combinations.
Trigger	Admin clicks on "Create New Level" from the content management menu.
Preconditions	• Admin must be logged into the app.
Postconditions	• The new phonics content is successfully saved and visible to app users.
Normal Flow	• Admin clicks " Create New Level " • Inputs phonics details like name, description, ideal score and content • Selects the phonics content type • Saves the content.
Alternative Flows	• If the input is invalid, the system prompts the admin to correct it.
Exceptions	• If content fails to save: – The system shows an error message. – The admin is advised to retry.
Includes	• None
Frequency of Use	• Depends on content updates
Special Requirements	• Content must align with the app structure and appropriate user levels.
Assumptions	• The admin has validated the accuracy and quality of the new phonics.
Notes and Issues	• Input validation is critical before saving to ensure proper functionality.

Table 25: Add new Words UC Description

UseCase_ID	UC_3.2.2
UseCase_Name	Add New Words
Authored By	Khizar Ameer
Modified By	Khizar Ameer
Creation Date	25/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Admin
Description	• Enables the admin to add new words for practice purposes.
Trigger	Admin clicks on "Create New Level" from the content management menu.
Preconditions	• Admin must be logged into the app.
Postconditions	• New words are successfully saved and become accessible to app users.
Normal Flow	• Admin clicks " Create New Level " • Inputs word details like name, description, ideal score and content • Selects the words content type • Saves the content.
Alternative Flows	• If input is invalid, the system prompts the admin to correct it.
Exceptions	• If the system fails to save the content: – An error message is shown. – The admin is advised to retry.
Includes	• None
Frequency of Use	• Depends on content update frequency
Special Requirements	• New content must align with app structure and appropriate user levels.
Assumptions	• The admin ensures that the added content is of high quality.
Notes and Issues	• All input must be validated before saving to maintain app integrity.

Table 26: Add new Sentences UC Description

UseCase_ID	UC_3.2.3
UseCase_Name	Add New Sentences
Authored By	Khizar Ameer
Modified By	Khizar Ameer
Creation Date	25/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Admin
Description	• Allows the admin to add new sentences for learning and practice purposes.
Trigger	Admin clicks on "Create New Level" from the content management menu.
Preconditions	• Admin must be logged into the app.
Postconditions	• New sentences are successfully saved and become accessible to app users.
Normal Flow	Admin clicks " Create New Level " • Inputs sentence details like name, description, ideal score and content • Selects the Sentence content type • Saves the content.
Alternative Flows	• If input is invalid, the system prompts the admin to correct it.
Exceptions	• If the system fails to save the content: – An error message is displayed. – The admin is prompted to retry.
Includes	• None
Frequency of Use	• Depends on content update needs
Special Requirements	• Sentences must match the app structure and be appropriate to the intended user level.
Assumptions	• The admin reviews the content for quality and suitability before saving.
Notes and Issues	• All inputs must be validated before saving to maintain content integrity.

3.5.4 Child Interaction Use Case Description UC_4

Table 27: Practice Phonics UC Description

UseCase_ID	UC_4.1
UseCase_Name	Practice Phonics
Authored By	Abdul Rafay
Modified By	Abdul Rafay
Creation Date	28/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Child
Description	• Enables the child to practice phonics by listening to and repeating sounds or letter combinations.
Trigger	The child selects the **"Practice Phonics"** option in the app.
Preconditions	• The child is logged into the app. • Phonics content is available.
Postconditions	• The child completes the phonics task successfully or retries as needed. • Progress is saved.
Normal Flow	1. The child selects a phonics task. 2. The system plays the corresponding sound or letter combination. 3. The child repeats the sound. 4. The system evaluates the response. 5. Upon success, progress is recorded.
Alternative Flows	• If the attempt is not successful, the system allows multiple retries. • Feedback and motivation are provided to encourage the child.
Exceptions	• If the system cannot process the child's input, it notifies the child and encourages retrying.
Includes	• None
Frequency of Use	• Frequently during a learning session, depending on the child's pace.
Special Requirements	• Interface must be intuitive and visually engaging. • Audio quality should be clear and child-appropriate.
Assumptions	• The child is familiar with app navigation and follows verbal or visual cues.
Notes and Issues	• The system should maintain engagement by balancing encouragement and challenge. • Avoid frustration due to repeated failures—include positive reinforcement and hints.

Table 28: Practice Words UC Description

UseCase_ID	UC_4.2
UseCase_Name	Practice Words
Authored By	Khizar Ameer
Modified By	Khizar Ameer
Creation Date	28/Jan/2025
Last Modified Date	17/Feb/2025
Actors	• Child
Description	• The child engages with the word practice module by listening to words and repeating them to enhance pronunciation skills.
Trigger	The child selects the **"Practice Words"** option in the app.
Preconditions	• The child is logged into the app. • Word practice content is available.
Postconditions	• The child successfully completes word practice tasks or retries as needed. • Progress is recorded.
Normal Flow	1. The child selects a word practice task. 2. The system plays the word audio. 3. The child repeats the word. 4. The system evaluates the repetition. 5. Upon successful pronunciation, progress is saved.
Alternative Flows	• If pronunciation is incorrect, the system allows retries. • The child receives motivational prompts after unsuccessful attempts.
Exceptions	• If the input cannot be processed, the system prompts the child to try again.
Includes	• None
Frequency of Use	• Frequently during a learning session, based on the child's pace and curriculum.
Special Requirements	• The interface must be child-friendly. • Pronunciations should be clear, slow, and age-appropriate.
Assumptions	• The child is willing to practice and can follow verbal instructions.
Notes and Issues	• Ensure the word list is age-appropriate and engaging to sustain the child's interest.

Table 29: Practice Sentence UC Description

UseCase_ID	UC_4.3
UseCase_Name	Practice Sentence
Authored By	Abdul Rafay
Modified By	Abdul Rafay
Creation Date	28/Jan/2025
Last Modified Date	19/Feb/2025
Actors	• Child
Description	• The child interacts with the sentence practice module by listening to sentences and repeating them to improve fluency and pronunciation.
Trigger	The child selects the **"Practice Sentences"** option in the app.
Preconditions	• The application must be logged in. • Sentence practice content must be available.
Postconditions	• The child successfully completes the sentence tasks or retries as needed. • Progress is saved and reflected in the user's learning record.
Normal Flow	1. The child selects a sentence task. 2. The system plays the sentence audio. 3. The child listens and repeats the sentence. 4. The system evaluates the pronunciation and fluency. 5. Upon success, progress is recorded.
Alternative Flows	• If pronunciation or fluency is not satisfactory, the system allows retries. • The system offers encouraging feedback to motivate the child.
Exceptions	• If the system fails to evaluate input or save progress, an error is displayed and the child is prompted to try again.
Includes	• None
Frequency of Use	• Multiple times during a session, depending on the child's pace and content availability.
Special Requirements	• Sentences must be short, simple, age-appropriate, and engaging. • Clear and slow audio playback is essential.
Assumptions	• The child understands instructions and is willing to practice.
Notes and Issues	• Ensure sentence content includes a variety of vocabulary and keeps the child engaged.

Table 30: Complete Task and Progress UC Description

UseCase_ID	UC_4.4
UseCase_Name	Complete Task and Progress
Authored By	Khizar Ameer
Modified By	Khizar Ameer
Creation Date	28/Jan/2025
Last Modified Date	19/Feb/2025
Actors	• Child
Description	• The child completes a task in the phonics, words, or sentences module. Upon successful completion, their progress is updated, and they earn rewards.
Trigger	The child successfully completes the assigned task.
Preconditions	• The application must be logged in •A task must be available in the selected module.
Postconditions	• The child's progress is updated, and rewards are allocated.
Normal Flow	• The child completes a task in the selected module. •Progress is marked as complete for that task. •The system includes the "Earn Rewards" use case to grant rewards for successful completion.
Alternative Flows	• The child is unable to complete the task and is prompted to retry until successful.
Exceptions	• If the child fails to imitate correctly, the system motivates them to retry.
Includes	• Earn Reward (UC_4.4.1) Usecase
Frequency of Use	• Multiple times during a session, depending on the child's learning pace.
Special Requirements	• The progress should be visually displayed.
Assumptions	• The child is motivated to complete tasks and improve their progress.
Notes and Issues	• Ensure that rewards are engaging and appropriately scaled to the difficulty of tasks.

Table 31: Earn Reward UC Description

UseCase_ID	UC_4.4.1
UseCase_Name	Earn Rewards
Authored By	Abdul Rafay
Modified By	Khizar Ameer
Creation Date	28/Jan/2025
Last Modified Date	19/Feb/2025
Actors	• Child
Description	• The child earns rewards, such as stars upon successfully completing a task in the phonics, words, or sentences module.
Trigger	The successful completion of a task.
Preconditions	• The child must successfully complete a task.
Postconditions	• The stars are granted and visually displayed to the child.
Normal Flow	• The child completes a task successfully. •The earned reward is displayed, and the child's reward tally is updated.
Alternative Flows	• If the task is incomplete or failed, no reward is granted, and the child is prompted to retry.
Exceptions	• None
Includes	• None
Frequency of Use	• Multiple times during a session, depending on the number of tasks completed successfully.
Special Requirements	• Rewards should be visually engaging and instantly displayed to motivate the child.
Assumptions	• The reward system encourages consistent engagement and progress.
Notes and Issues	• Ensure reward thresholds and scaling are balanced for varying difficulty levels.

Table 32: Motivate User to Retry UC Description

UseCase_ID	UC_4.5
UseCase_Name	Motivate User to Retry
Authored By	Khizar Ameer
Modified By	Abdul Rafay
Creation Date	28/Jan/2025
Last Modified Date	19/Feb/2025
Actors	• System/External API
Description	• The system motivates the child to retry when their pronunciation does not meet the required accuracy. Encouraging feedback and prompts are provided to improve their performance.
Trigger	The system detects that the child's pronunciation does not match the required accuracy threshold.
Preconditions	• The child has attempted the pronunciation but did not meet the accuracy criteria.
Postconditions	• Encouragement is displayed, and the audio prompt is repeated to enable another attempt.
Normal Flow	• The system identifies inaccurate pronunciation. •The system provides motivational feedback, such as “Try again!” or “Almost there!” •The system replays the audio prompt for imitation.
Alternative Flows	• If the child fails multiple times, the system continues to encourage but may suggest taking a break or revisiting the task later.
Exceptions	• None
Includes	• None
Frequency of Use	• As needed, whenever the child’s pronunciation does not meet the required accuracy.
Special Requirements	• Feedback should be engaging and positive to maintain motivation.
Assumptions	• The child is willing to retry the task based on the encouragement provided.
Notes and Issues	• Ensure feedback is culturally appropriate and encouraging for the target age group.

Table 33: Provide Audio for imitation UC Description

UseCase_ID	UC_4.6
UseCase_Name	Provide Audio Prompts for Imitation
Authored By	Abdul Rafay
Modified By	Khizar Ameer
Creation Date	28/Jan/2025
Last Modified Date	19/Feb/2025
Actors	• System/External API
Description	• The system plays audio prompts to guide the child in practicing sounds, words, or sentences.
Trigger	The child starts a practice activity or requests a replay of the audio prompt.
Preconditions	•The child has initiated a practice session (phonics, words, or sentences). •Application is connected to the internet.
Postconditions	• The system provides clear audio for the child to imitate.
Normal Flow	• The child selects an item to practice (sound, word, or sentence). • The system retrieves the appropriate audio file. • The system plays the audio prompt clearly for the child.
Alternative Flows	• The child requests a repeat of the audio prompt, and the system replays it.
Exceptions	• If the audio file cannot be retrieved, the system displays an error message and suggests trying again.
Includes	• None
Frequency of Use	• Multiple times per session as required.
Special Requirements	• Audio quality must be clear and suitable for the child's age group.
Assumptions	• The child is ready to listen and imitate the provided audio.
Notes and Issues	• Ensure audio prompts are engaging and aligned with the content's difficulty level.

Table 34: Evaluate Audio of child UC Description

UseCase_ID	UC_4.7
UseCase_Name	Evaluate Audio Prompt of Child
Authored By	Khizar Ameer
Modified By	Khizar Ameer
Creation Date	28/Jan/2025
Last Modified Date	19/Feb/2025
Actors	System/External API
Description	• The system analyzes the child's audio input to assess pronunciation accuracy and provide feedback.
Trigger	The child records their imitation of a sound, word, or sentence.
Preconditions	• The child has completed recording their audio prompt.
Postconditions	• The system provides an accuracy score and feedback based on the analysis of the child's input.
Normal Flow	• The child records their response to a given prompt. • The system sends the audio input to the external API for analysis. • The system receives the evaluation results, including accuracy and areas for improvement. • The system displays feedback and a score to the child.
Alternative Flows	• If the child's audio is not clear or incomplete, they can re-record the prompt.
Exceptions	• If the audio analysis fails, the system prompts the child to re-record or shows an error message.
Frequency of Use	• Multiple times during a single practice session.
Special Requirements	• The external API should return results within 2-3 seconds to maintain engagement.
Assumptions	• The child is using a device with functional microphone input.
Notes and Issues	• Ensure the feedback is child-friendly and encouraging, regardless of performance level.

3.6 User Interfaces (Mock Screens)

3.6.1 Welcome and Authentication Screens

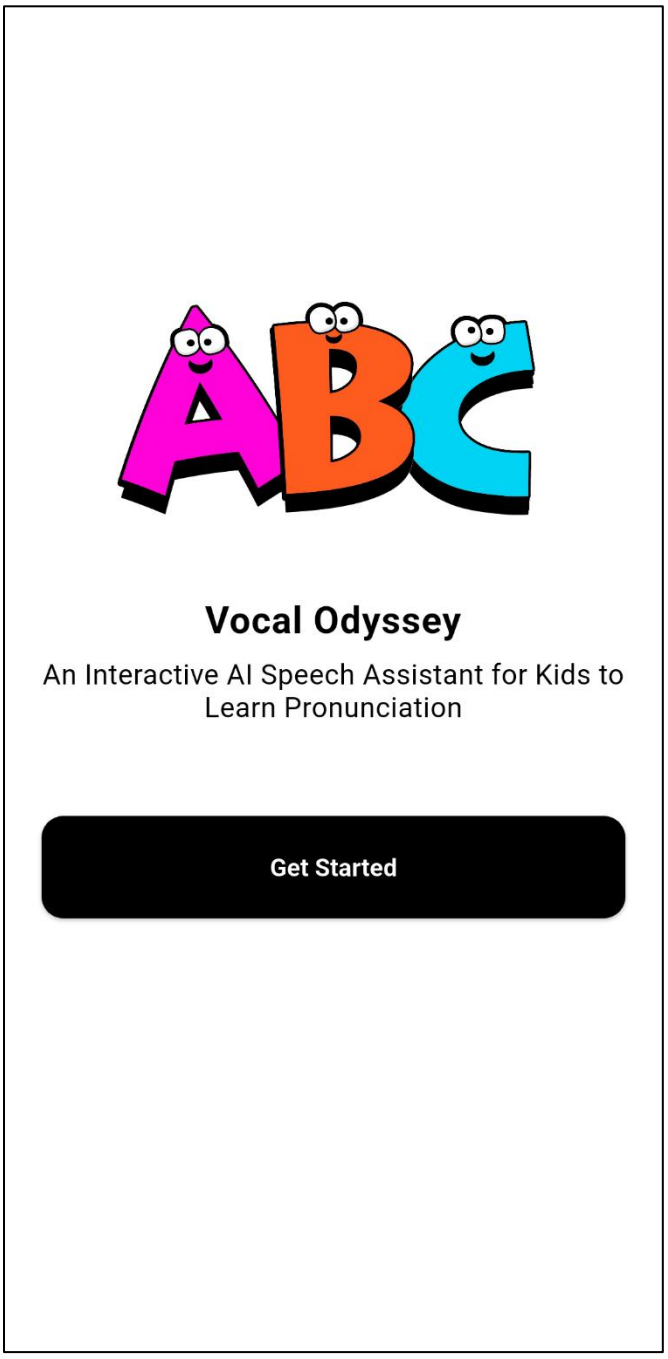

Figure 5: Welcome Screen

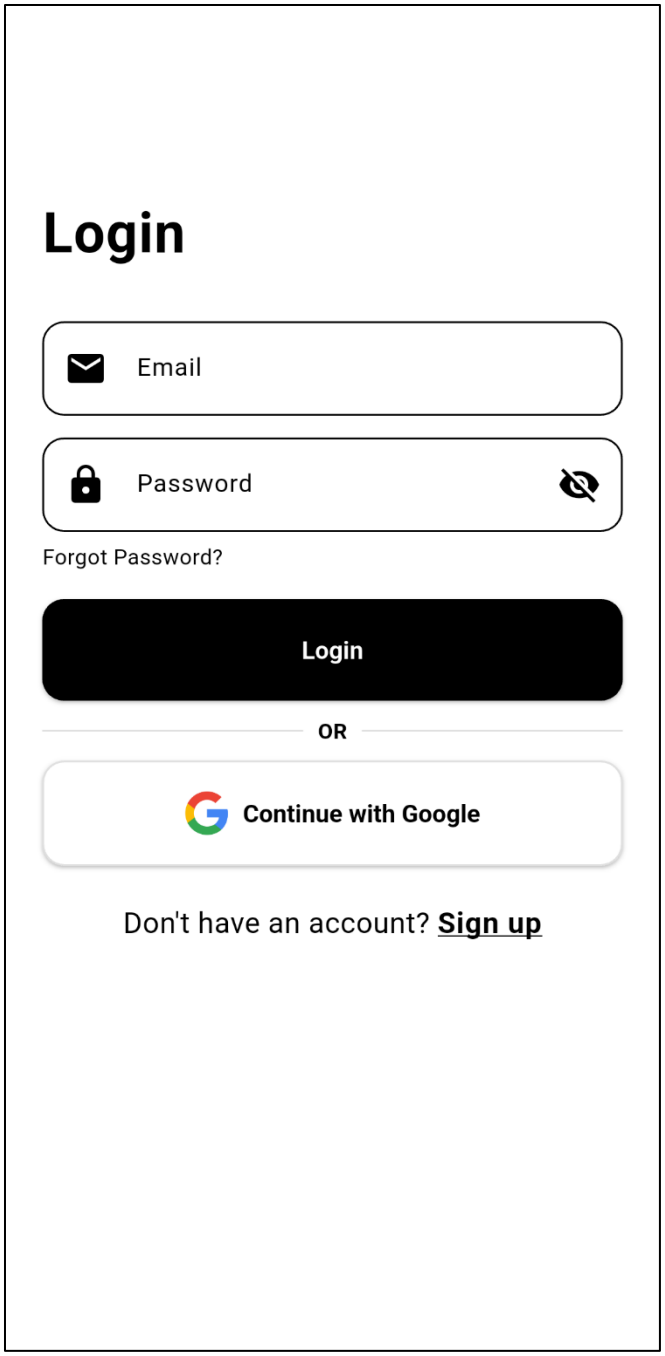

Figure 6: PID_1 Login Screen

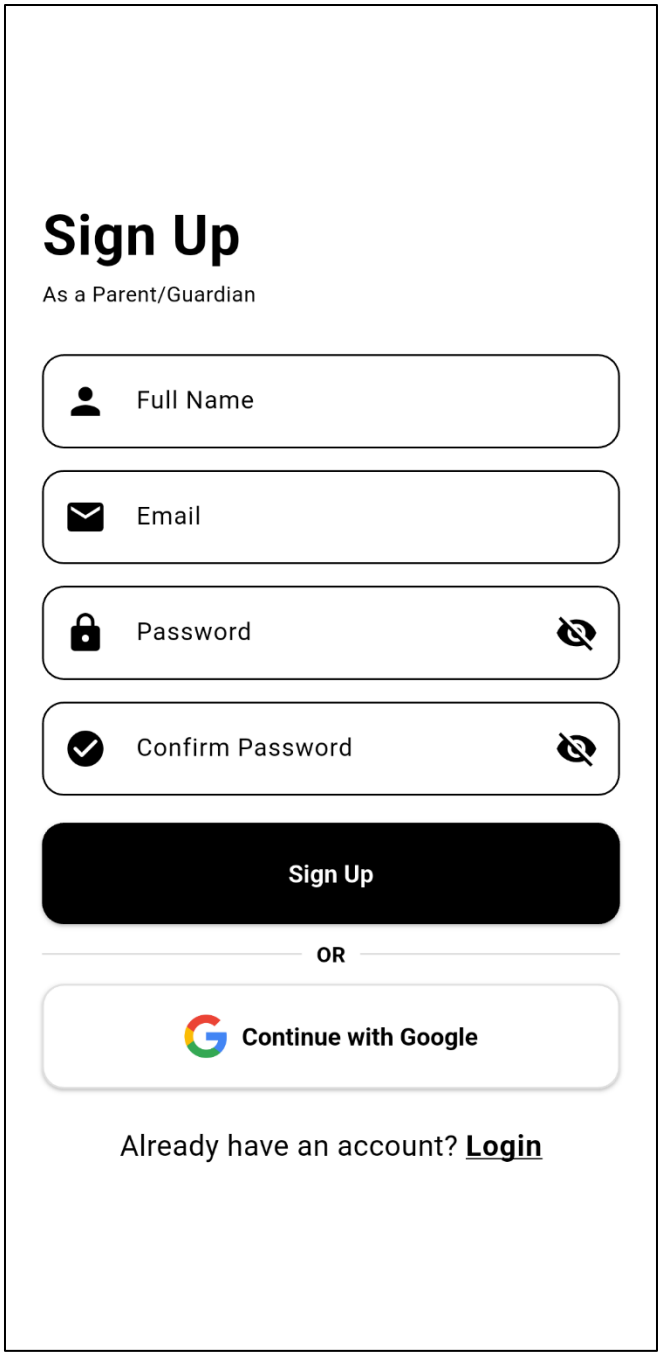

Figure 7: PID_2 Sign up Screen

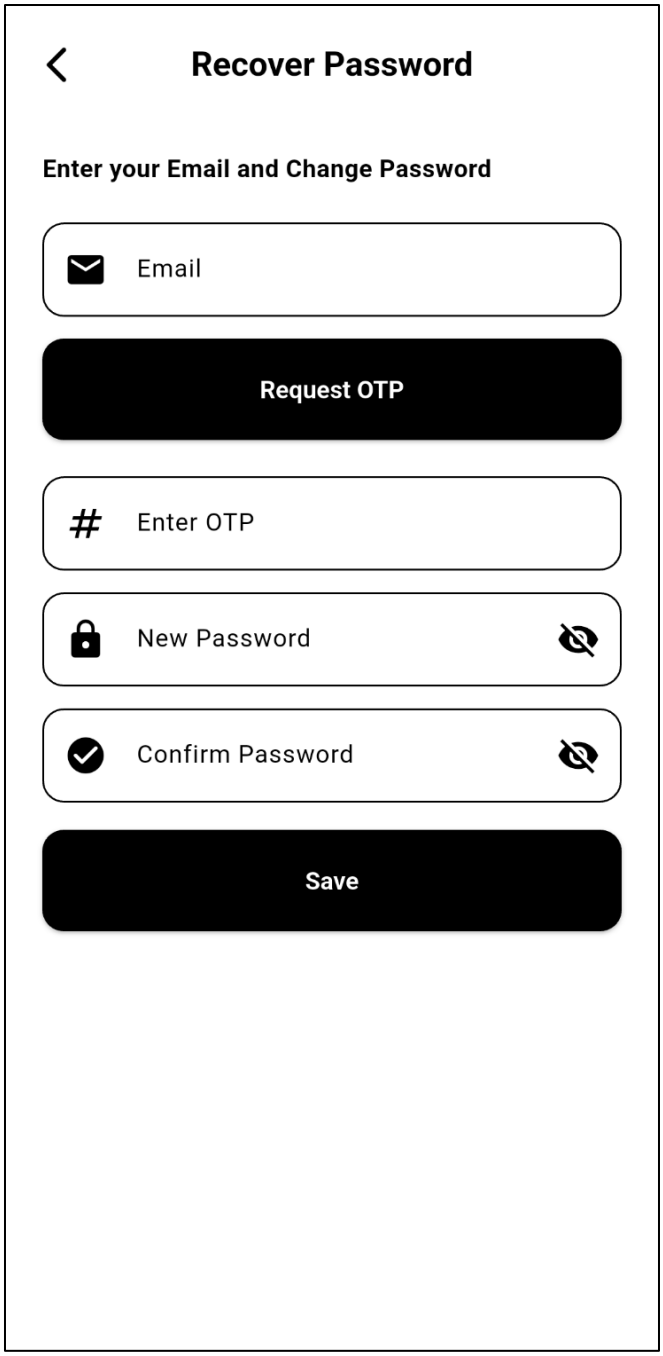

Figure 8: PID_3 Recover Password and Enter OTP Screen

3.6.2 Supervisors Screens

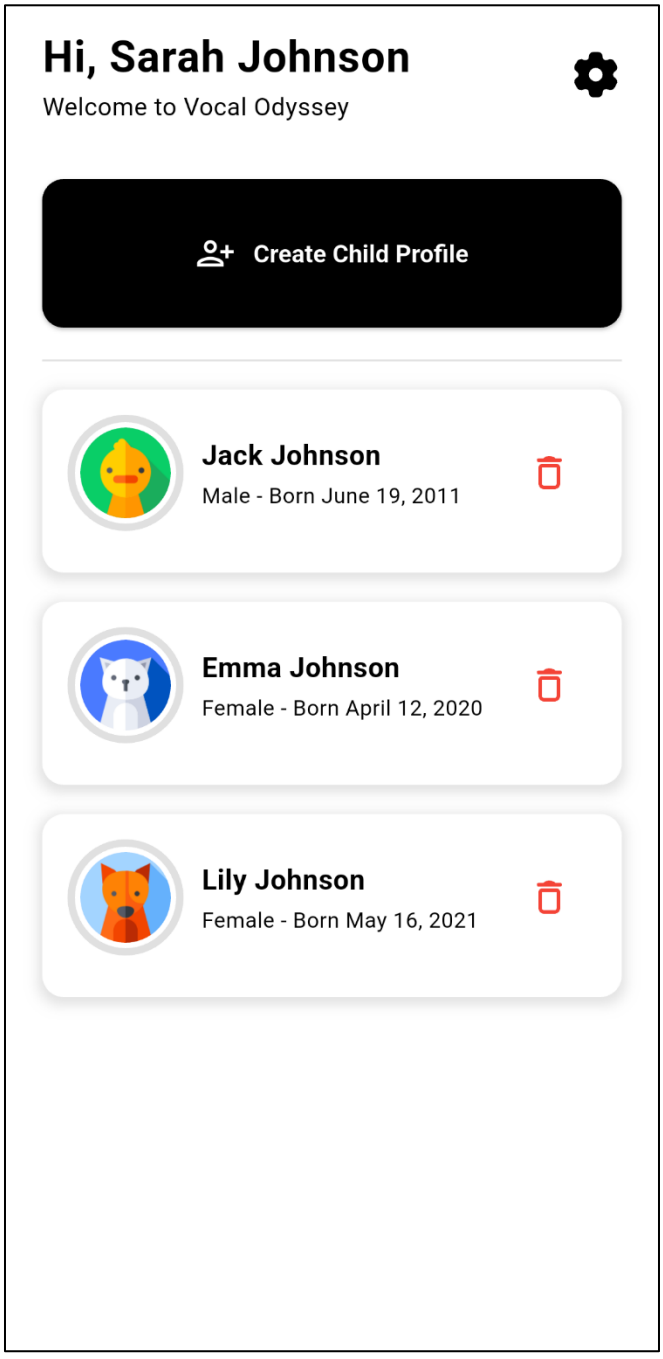

Figure 9: PID_4 Child profiles Screen

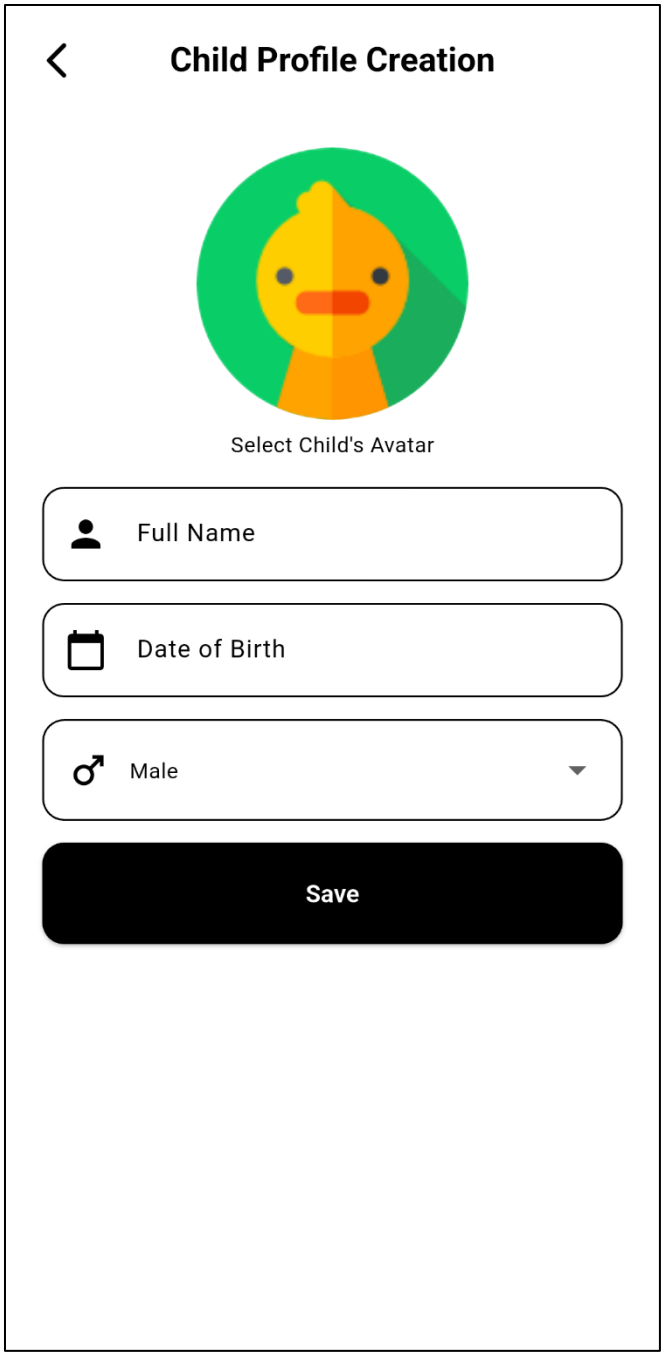

Figure 10: PID_5 Create Child Profile Screen

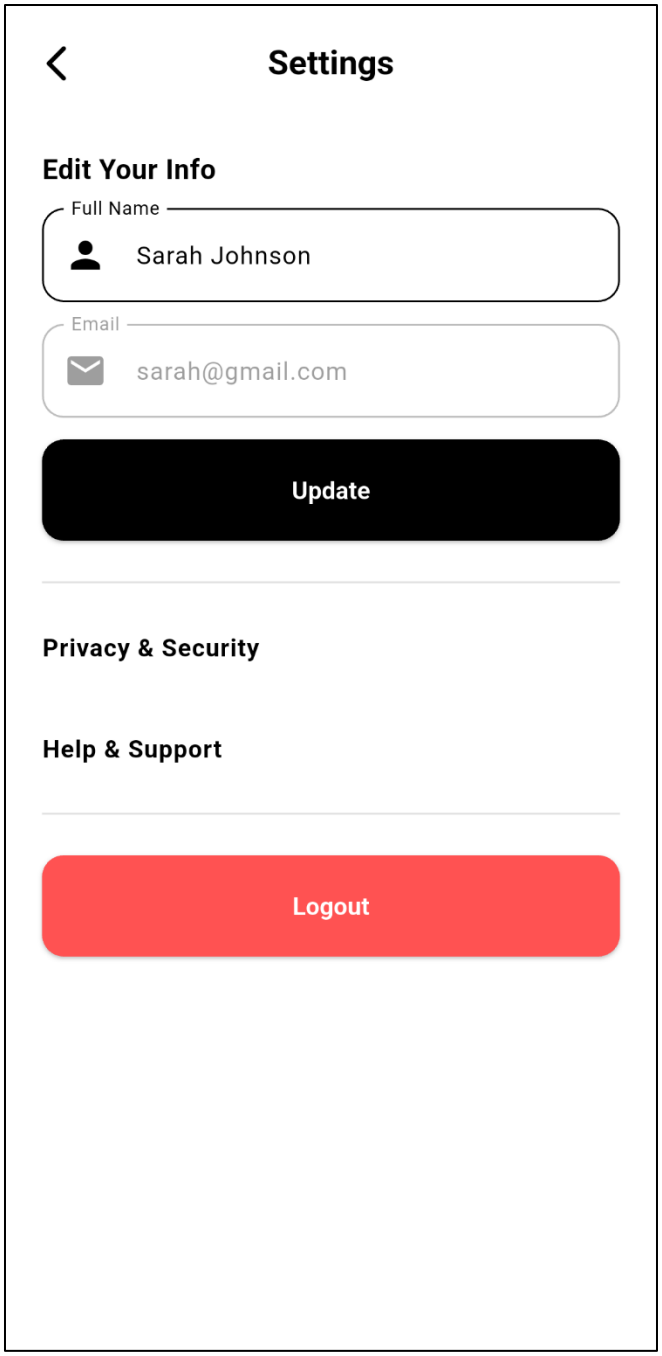

Figure 11: PID_6 Edit Supervisor Information and Logout Screen

3.6.3 Child Screens

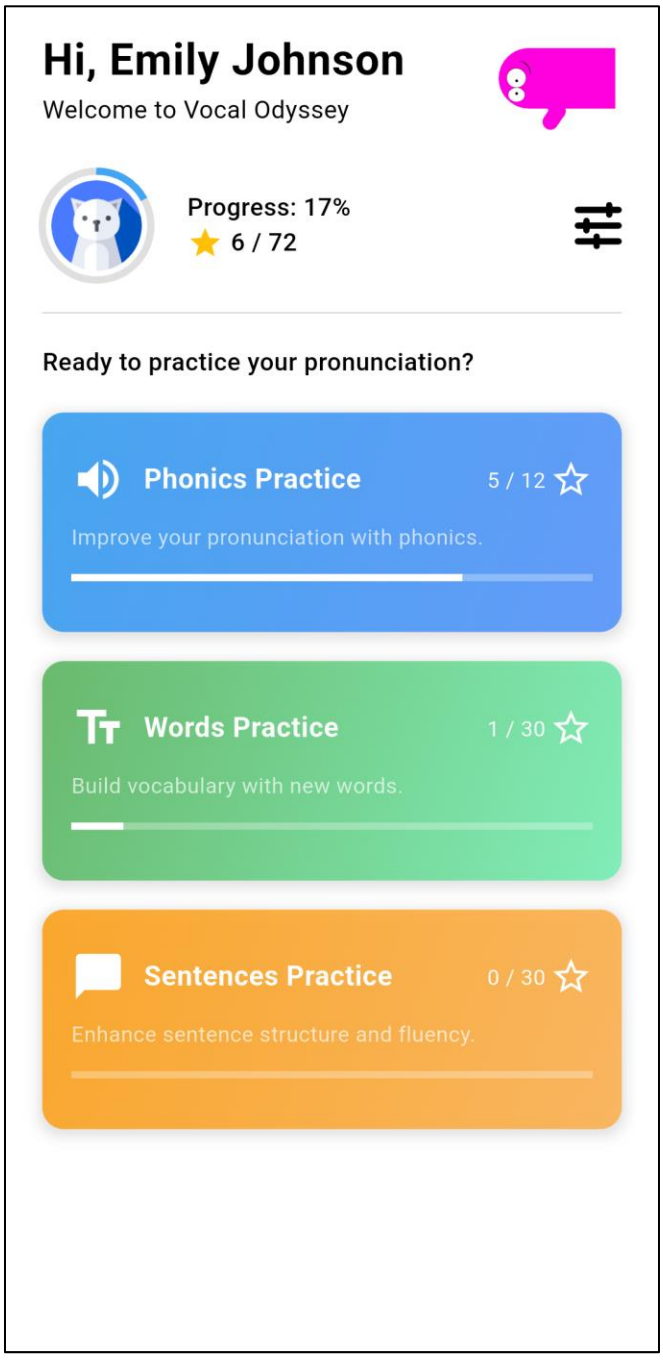

Figure 12: PID_7 Child Home Page Screen

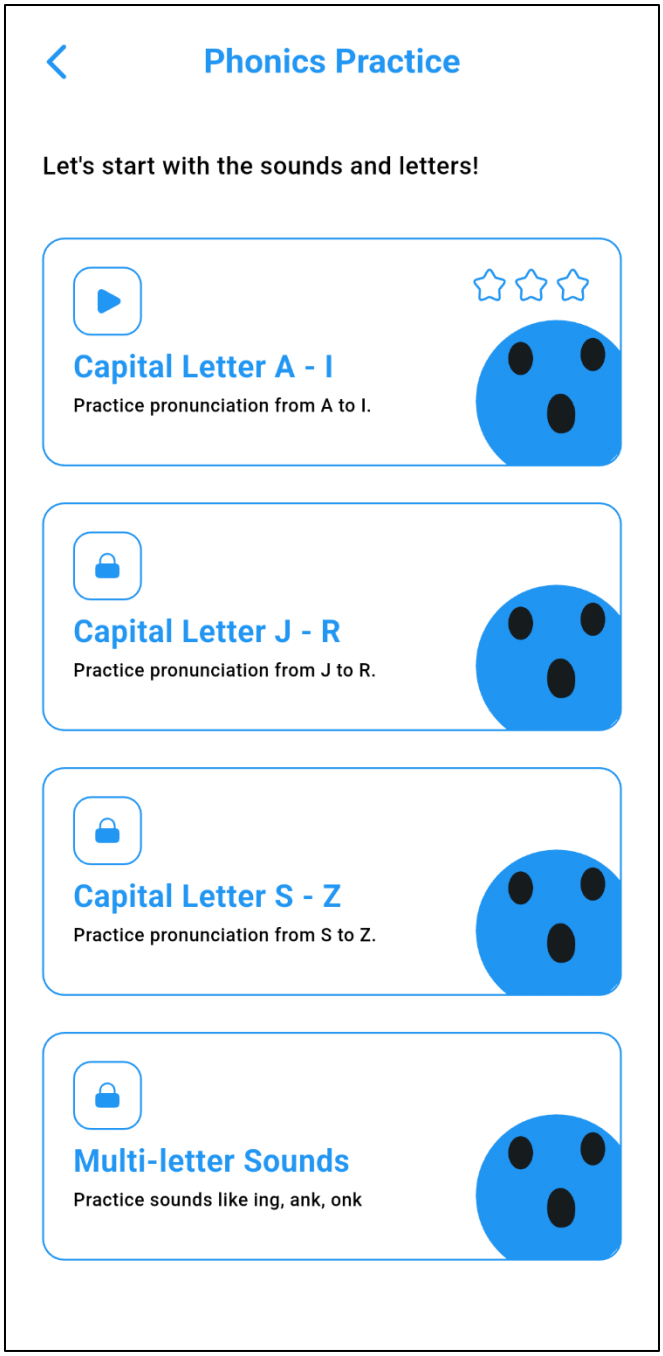

Figure 13: PID_8 Phonics Module Screen

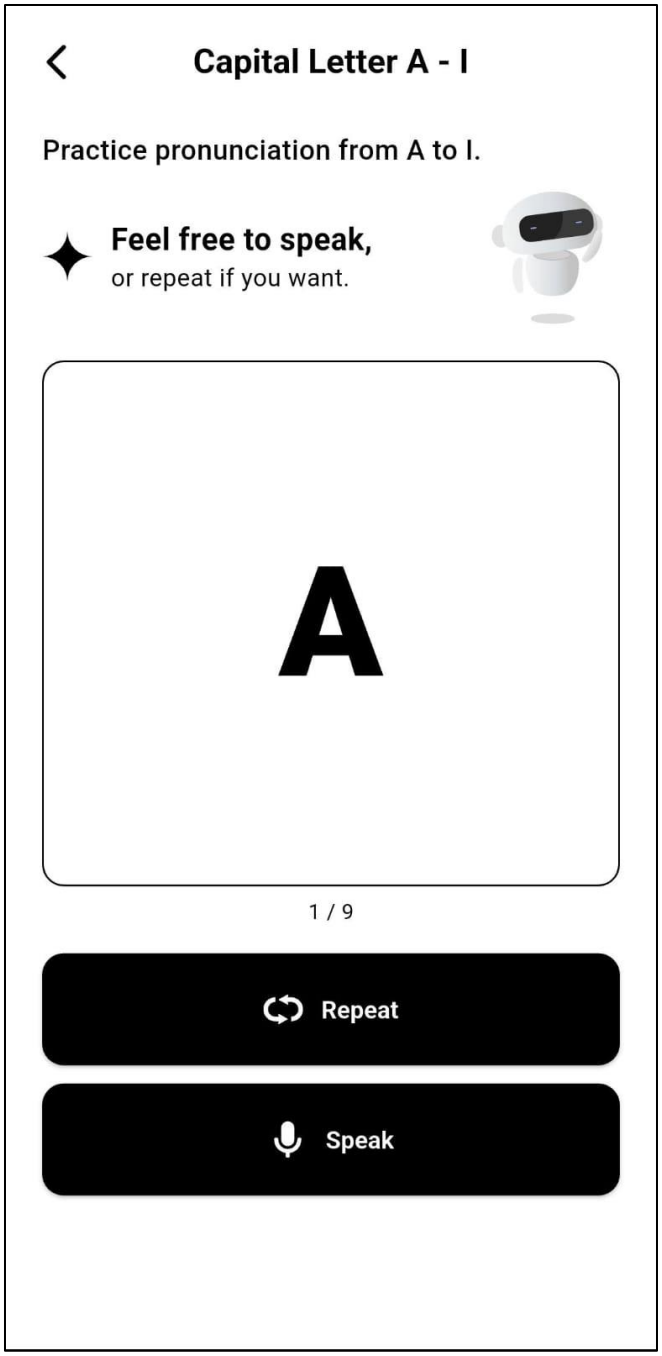

Figure 14: PID_9 Phonics Practice Screen

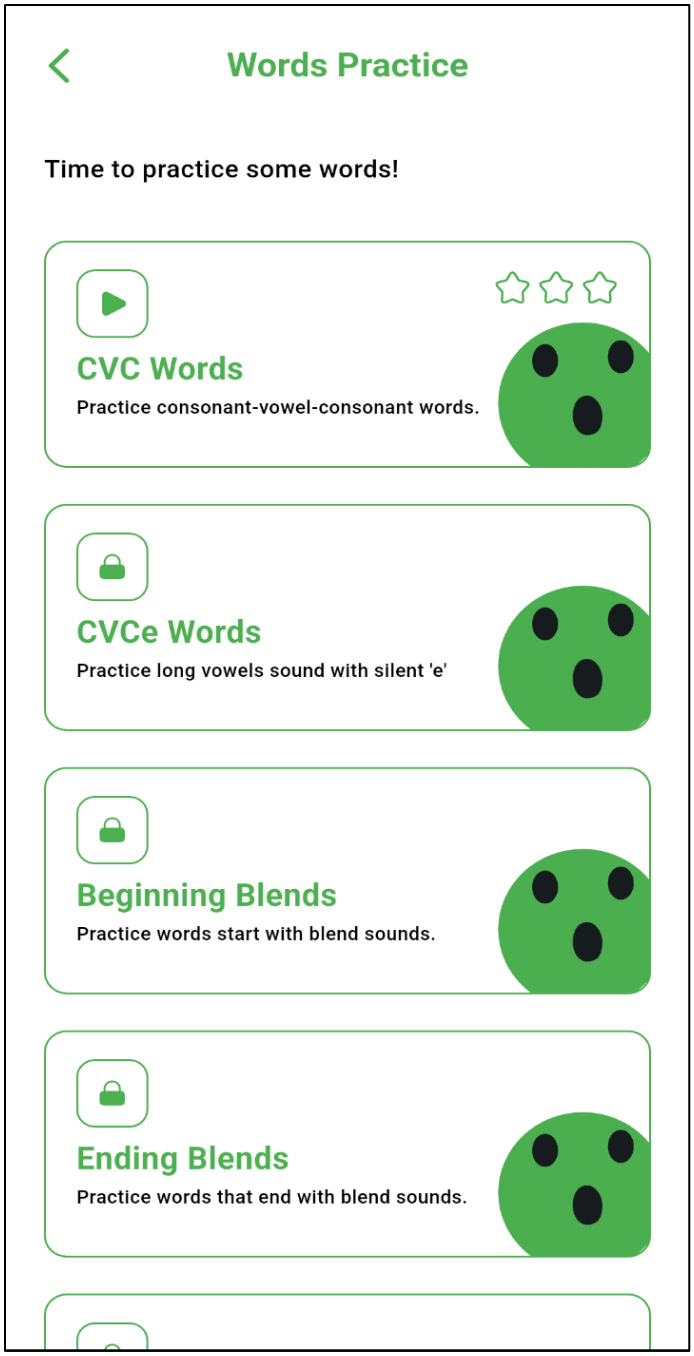

Figure 15: PID_10 Words Module Screen

Figure 16: PID_11 Practice Words Module Screen

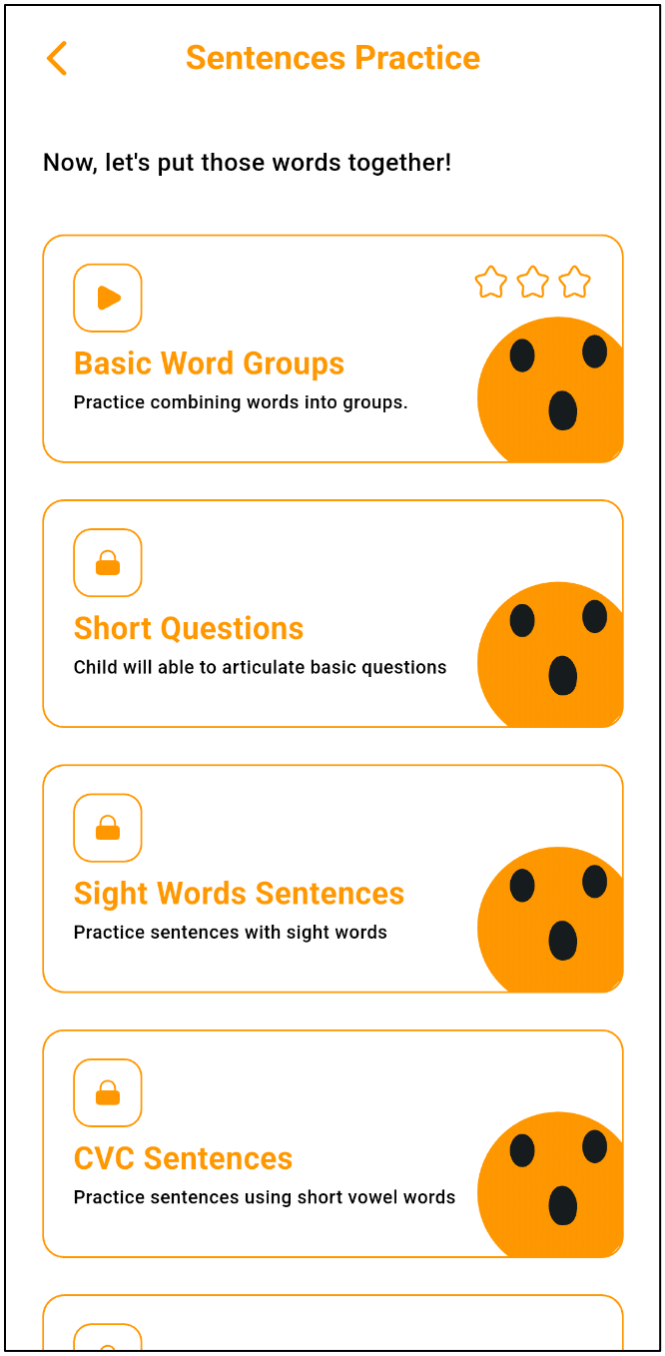

Figure 17: PID_12 Sentence Module Screen

Figure 18: PID_13 Practice Sentence Module Screen

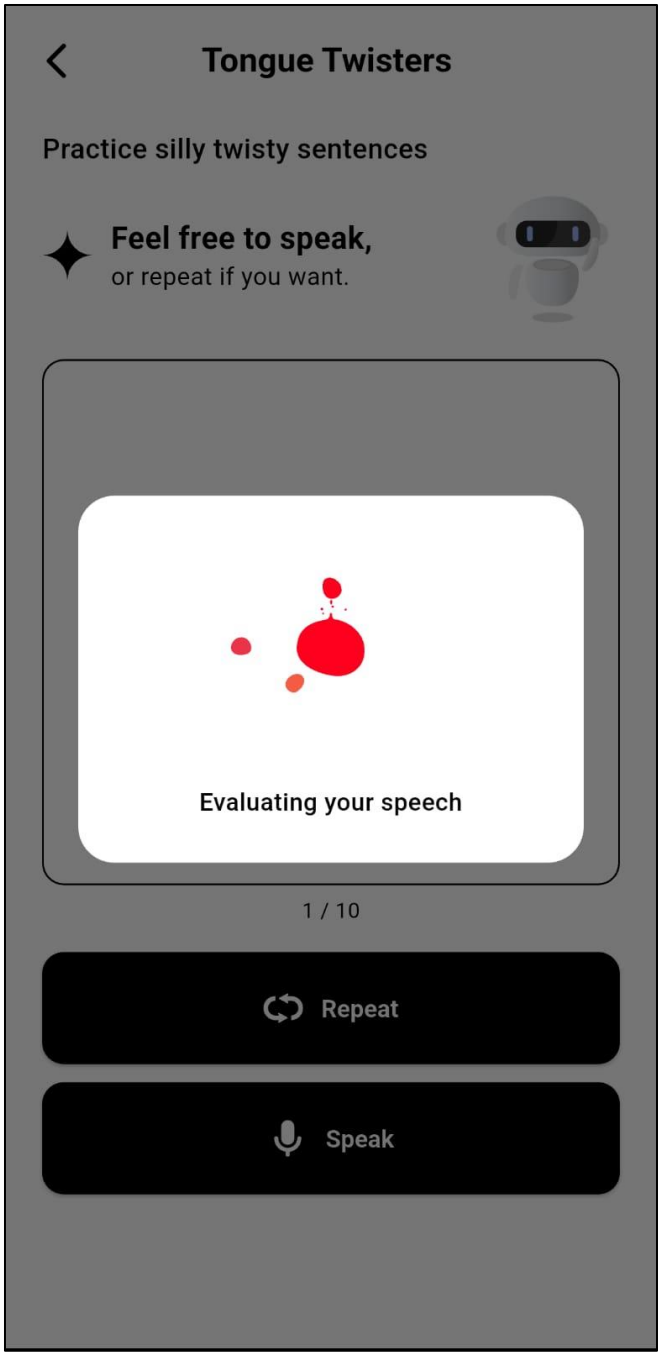

Figure 19: PID_ 14 Evaluating Speech Screen

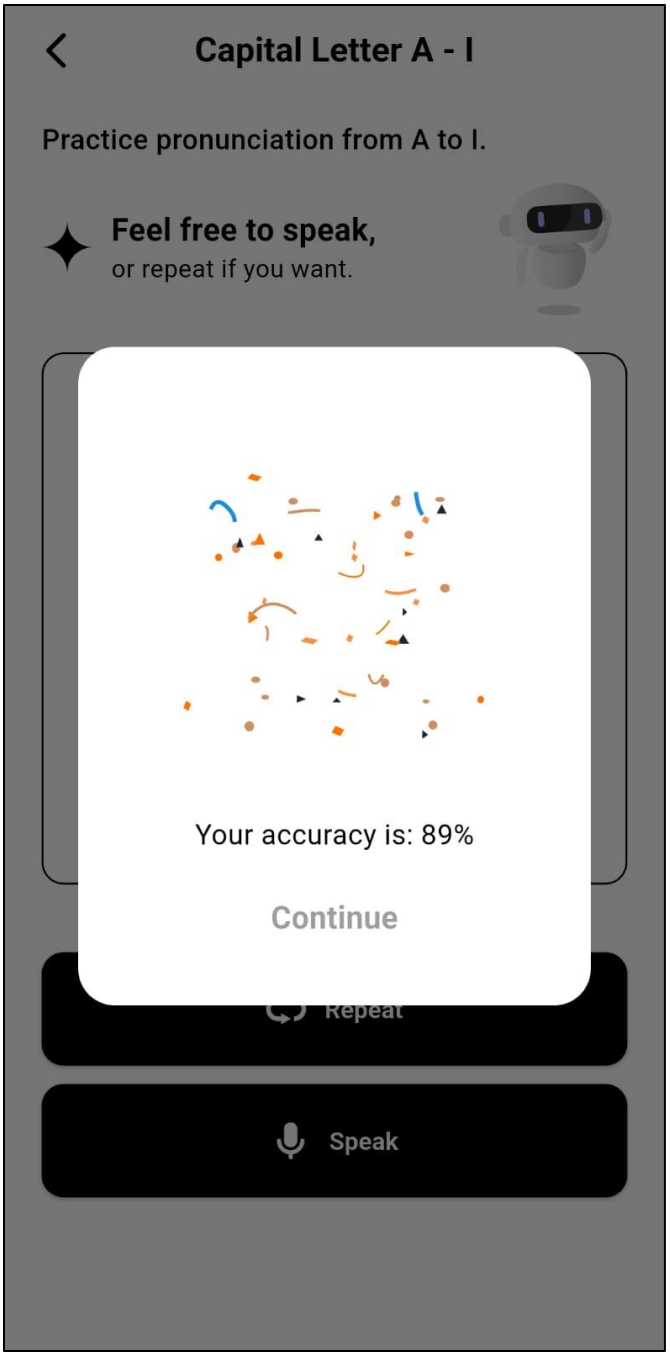

Figure 20: PID_ 15 Pronunciation Feedback Screen

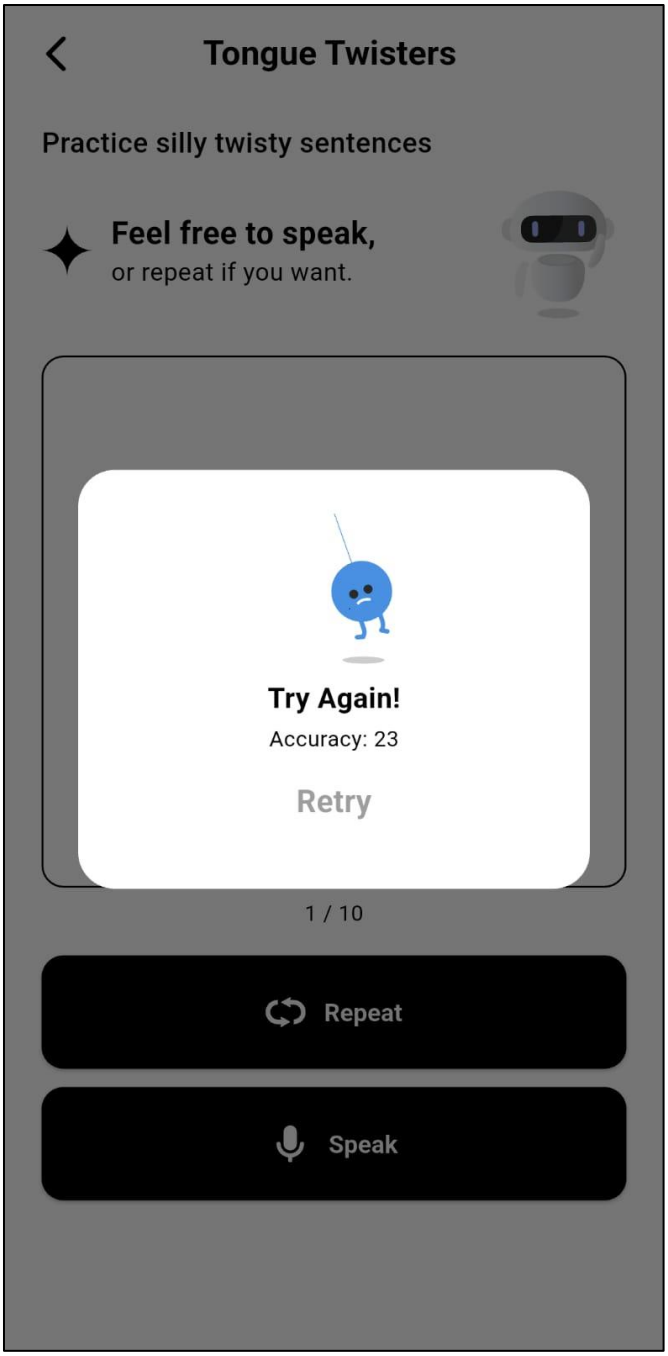

Figure 21: PID_ 16 Failed Attempt Screen

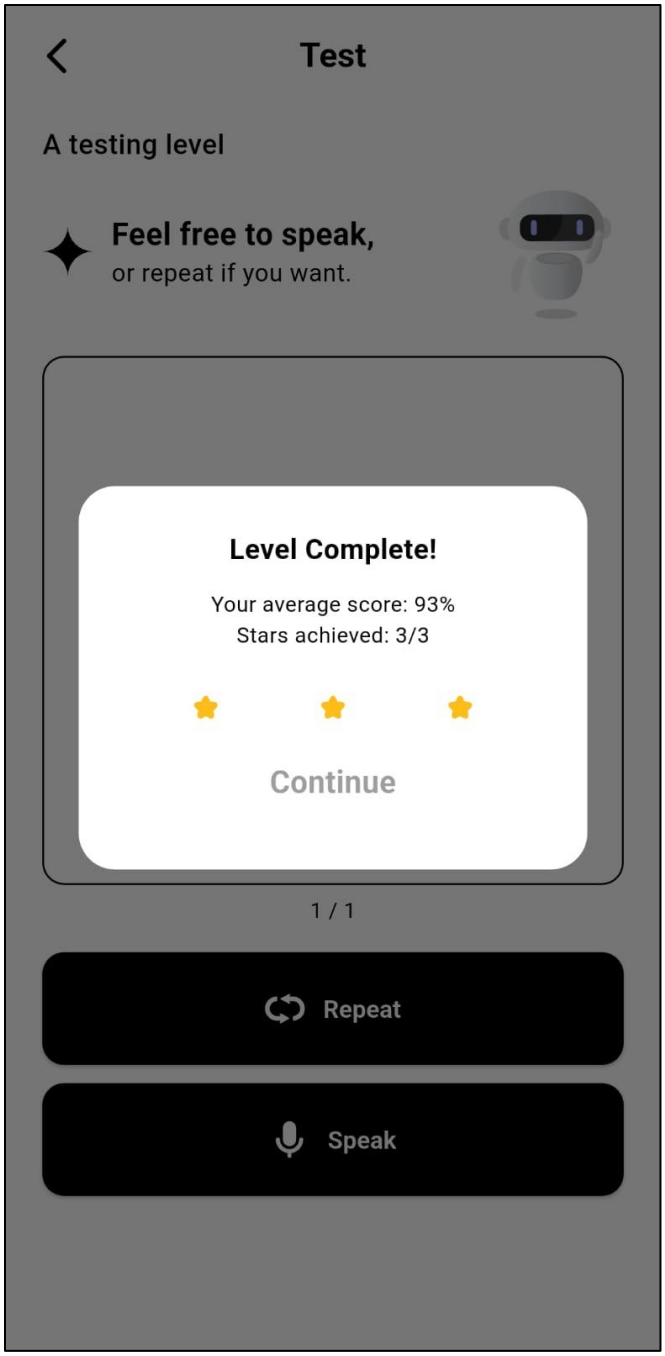

Figure 22: PID_ 17 Stars Earned Screen

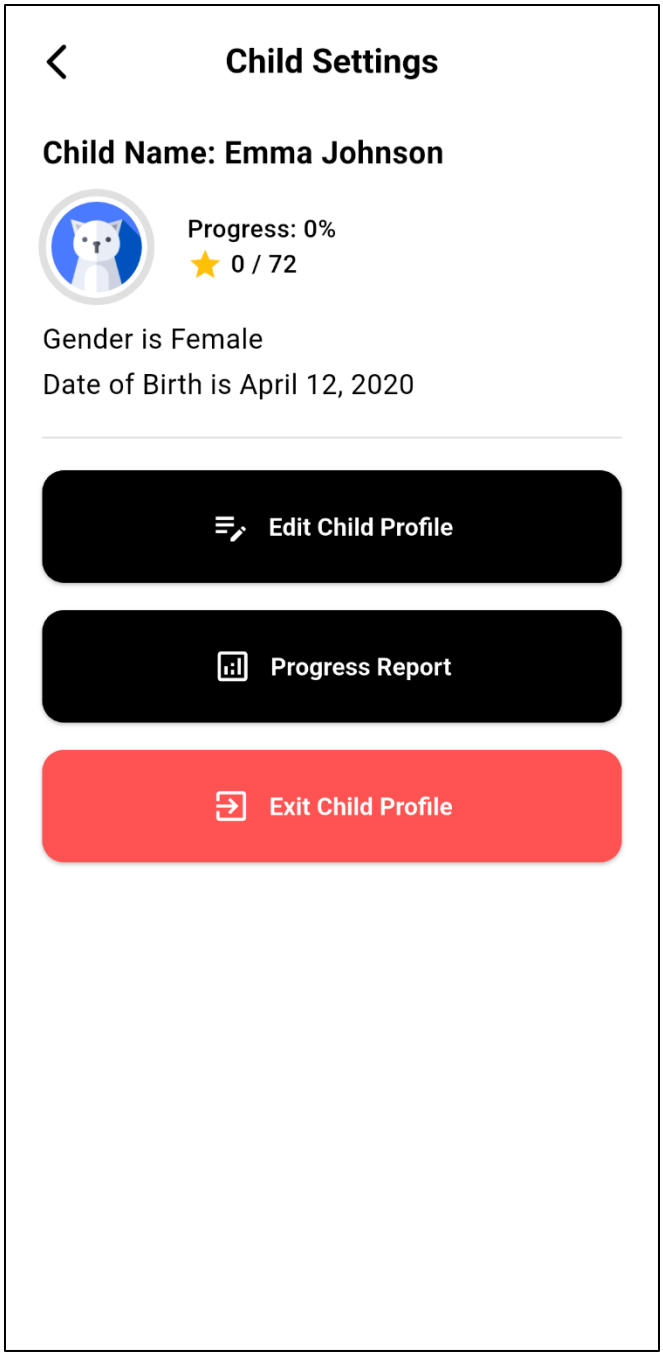

Figure 23: PID_18 Parental Dashboard and Child Setting Screen

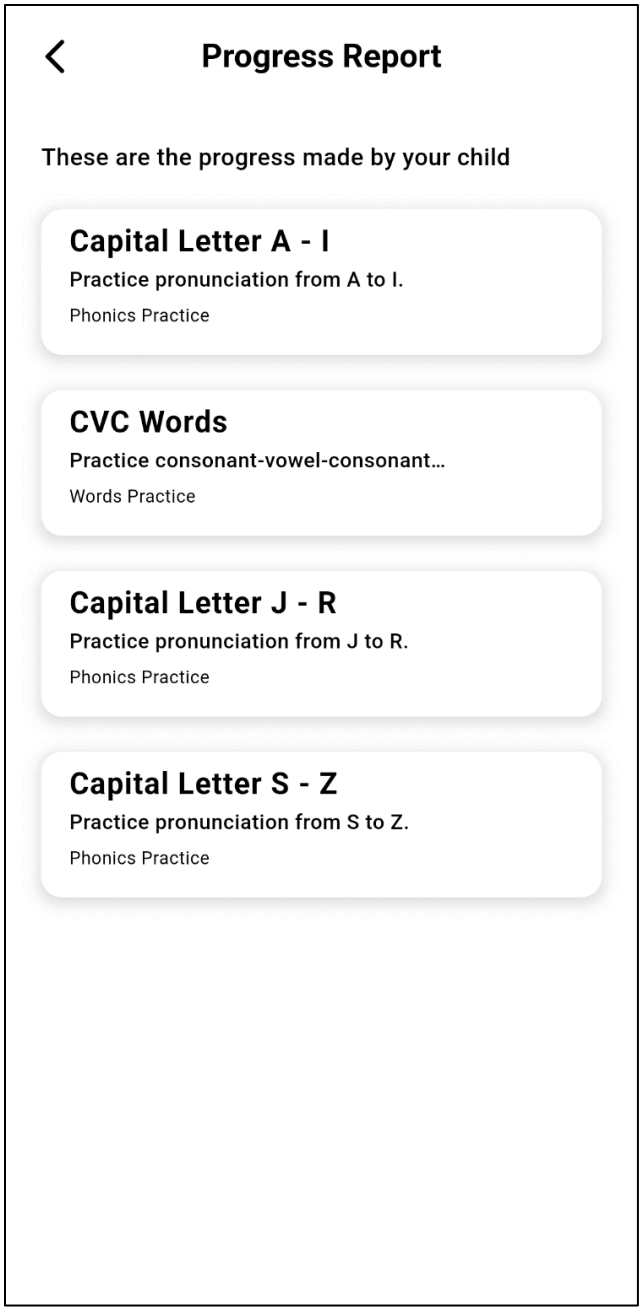

Figure 24: PID_19 Progress report Screen

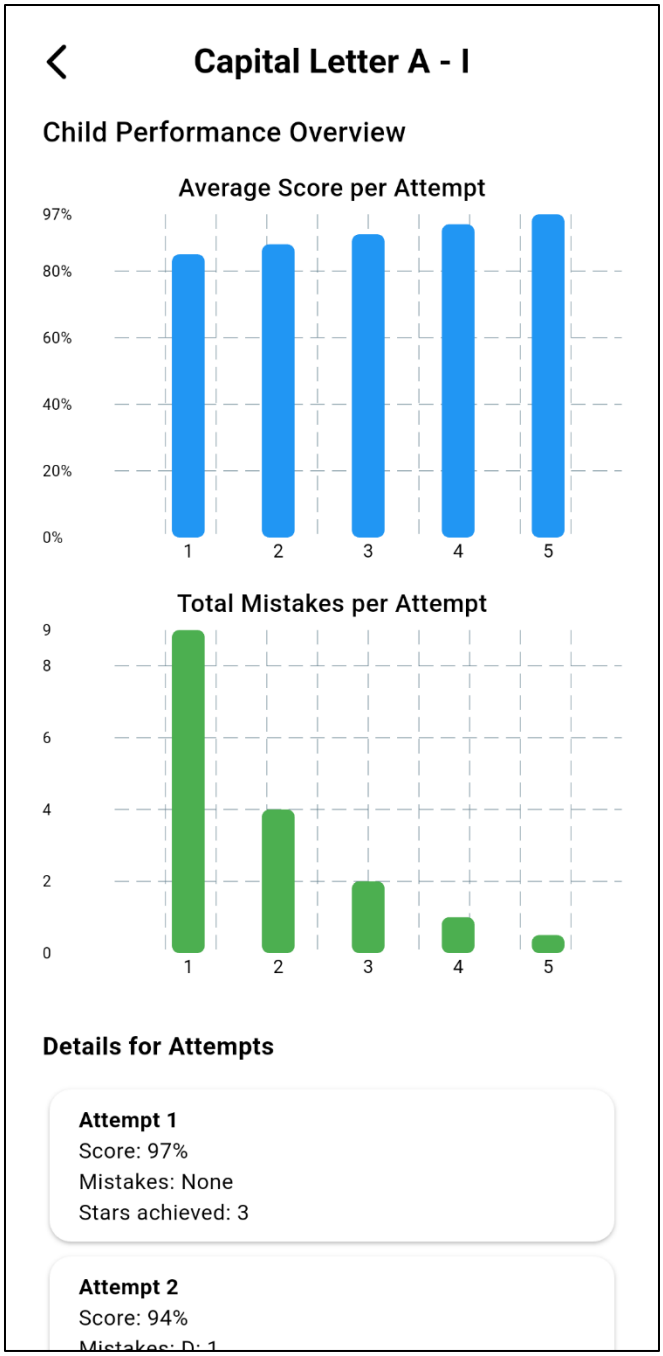

Figure 25: PID_20 Progress Report of Child per Level Screen

3.6.4 Admin Screens

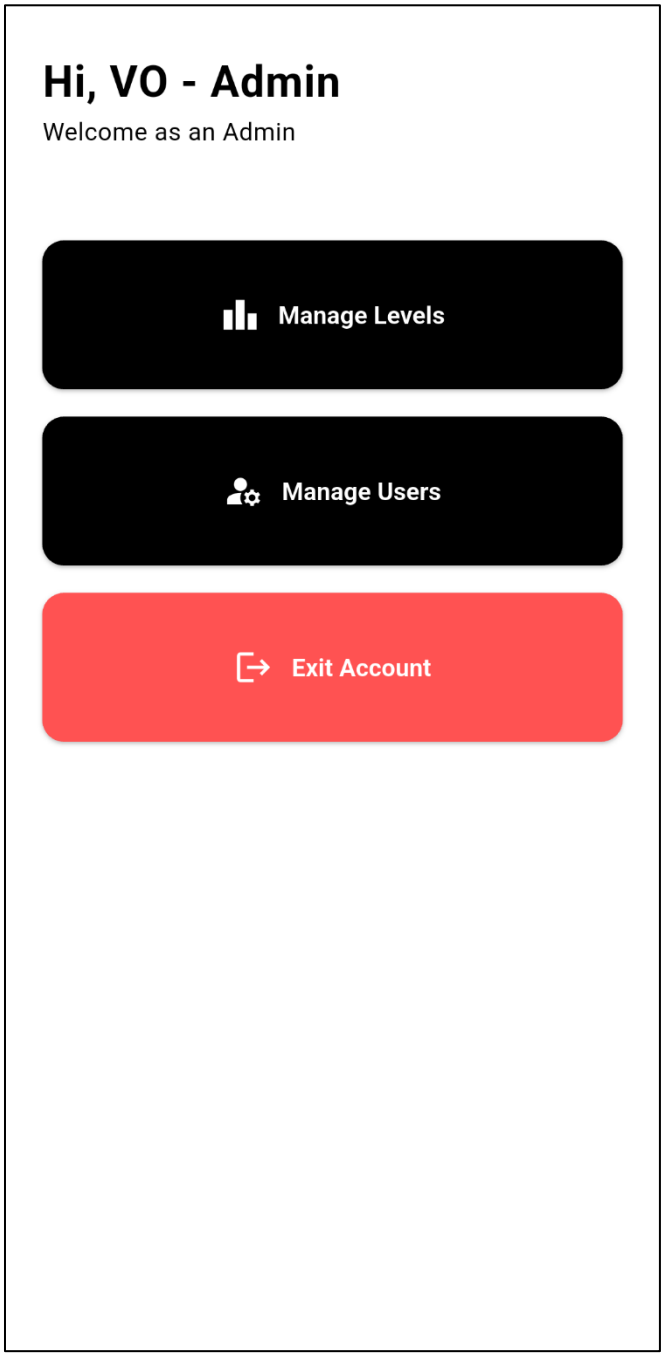

Figure 26: PID_21 Admin Home Page Screen

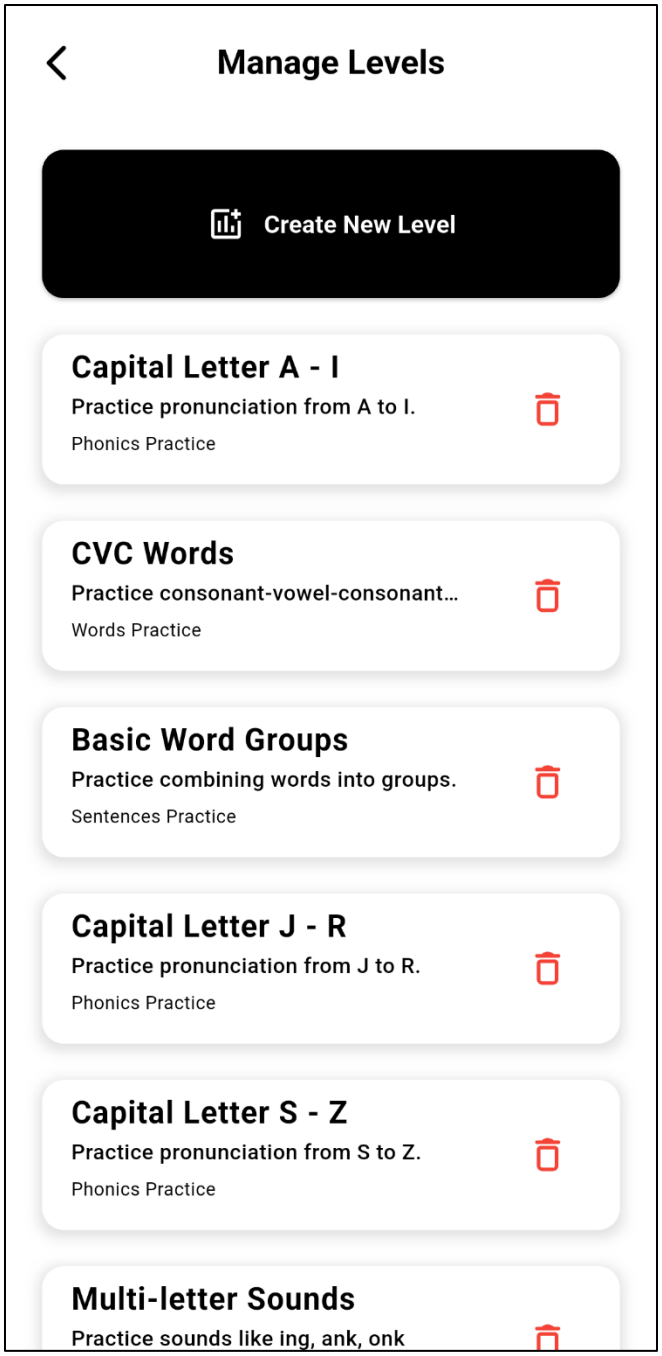

Figure 27: PID_22 Admin Manage Level Screen

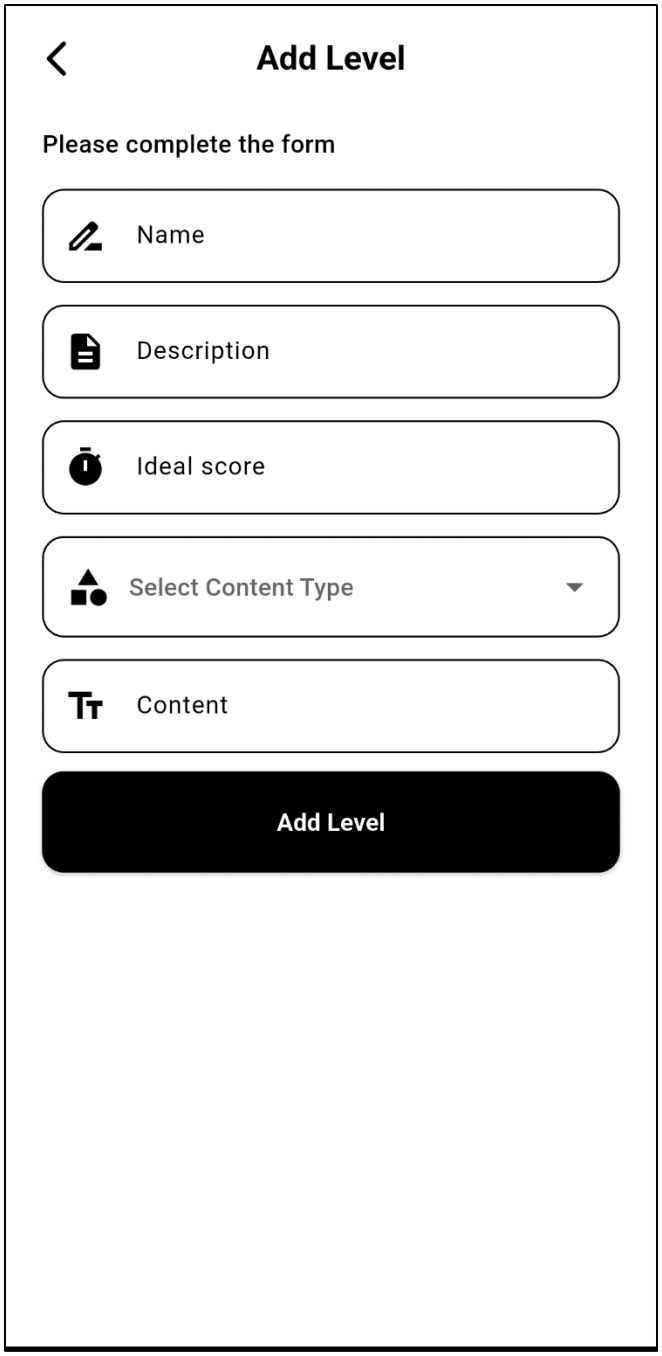

Figure 28: PID_23 Admin Add Levels Screen

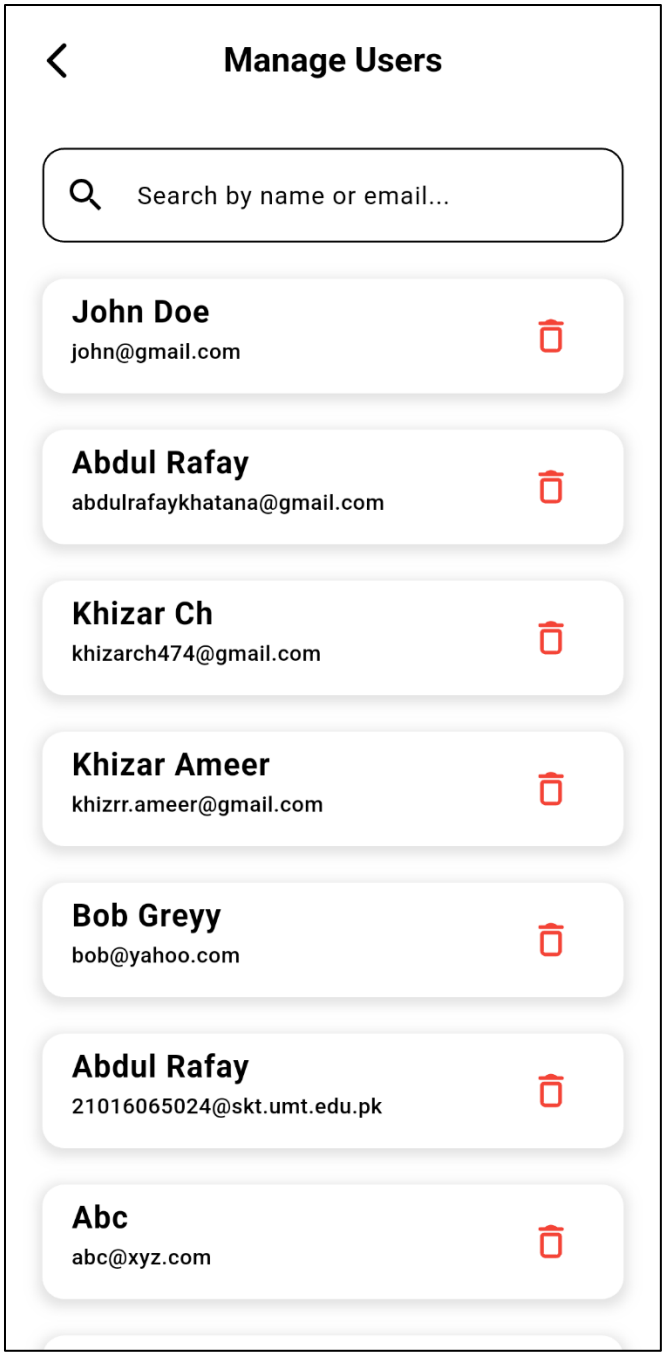

Figure 29: PID_24 Admin Manage User Screen

4. DFD (DATA FLOW DIAGRAM)

4.1 DFD Level 0

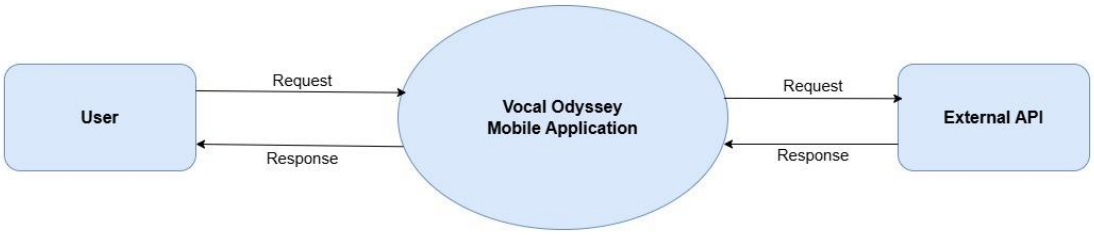

Figure 30: Data Flow Diagram Level 0

In figure high level of system abstraction is represent using Data flow diagrams. Two external entities is displayed user and ecternal API and complete application.

4.2 DFD Level 1

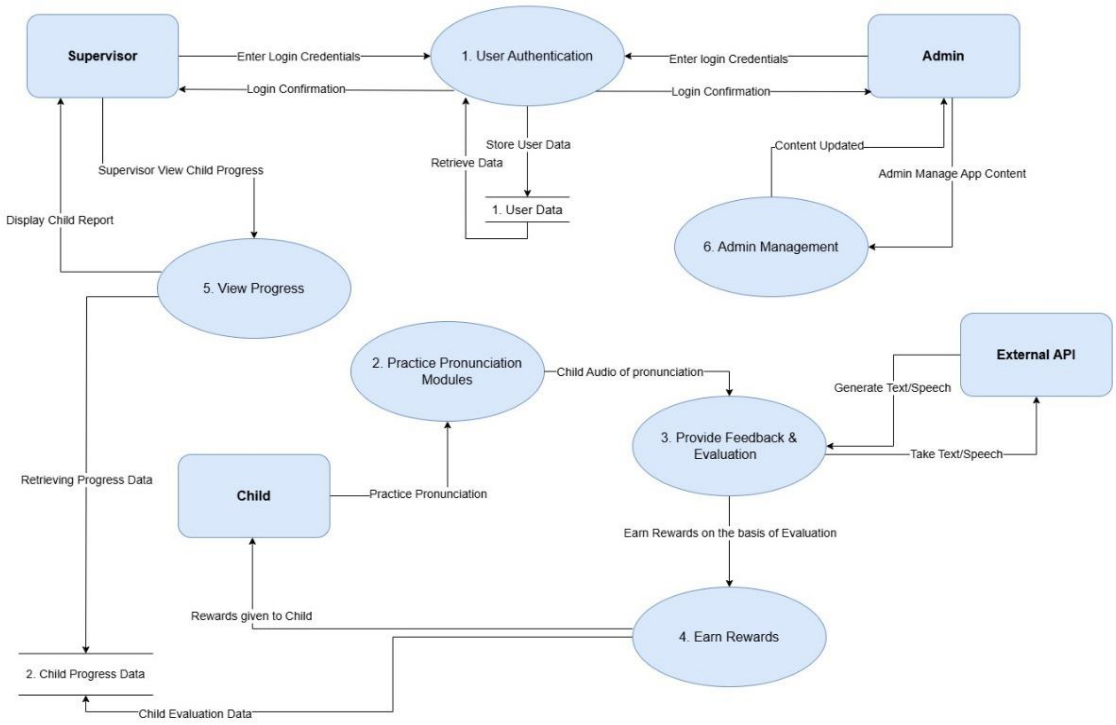

Figure 31: Data Flow Diagram Level 1

In this figure we expand our Data flow diagram into level 1 in which we expand the external entities like child, supervisor, admin and external API and we also expand our system into different processes like 1. User authentication, 2. Practice pronunciation module and more show in figure and represents how data is flowing between these processes and entities.

4.3 DFD Level 2

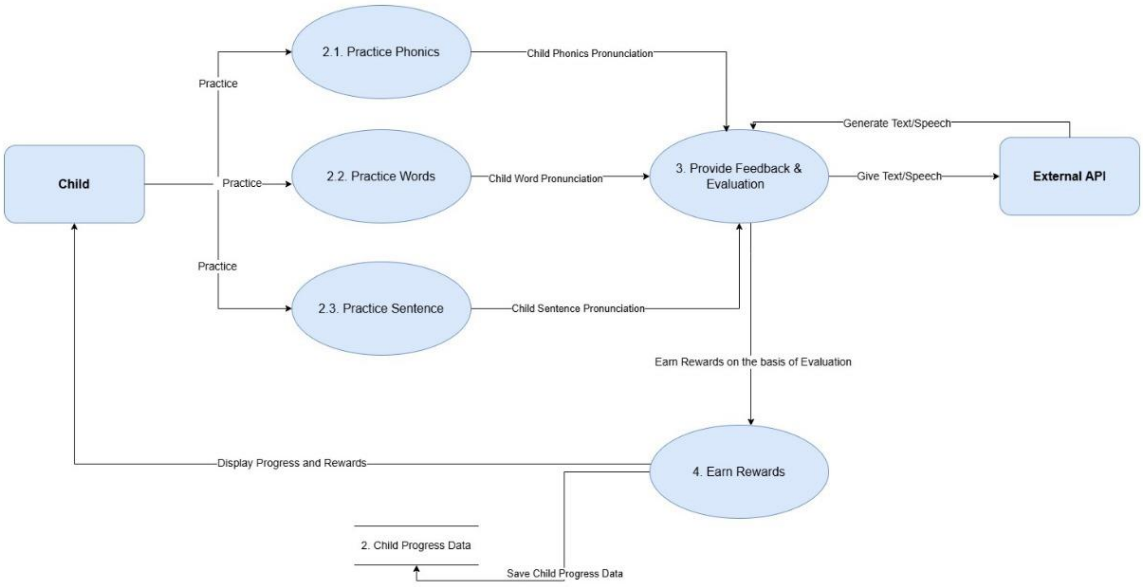

Figure 32: Data Flow Diagram Level 2

In DFD level 2 diagram we expand our process 2 name practice pronunciation module and draw its data flow.

5. SYSTEM DESIGN

In this chapter we're going to discover different diagrams for better elaboration of our system.

5.1 System Architecture Diagram

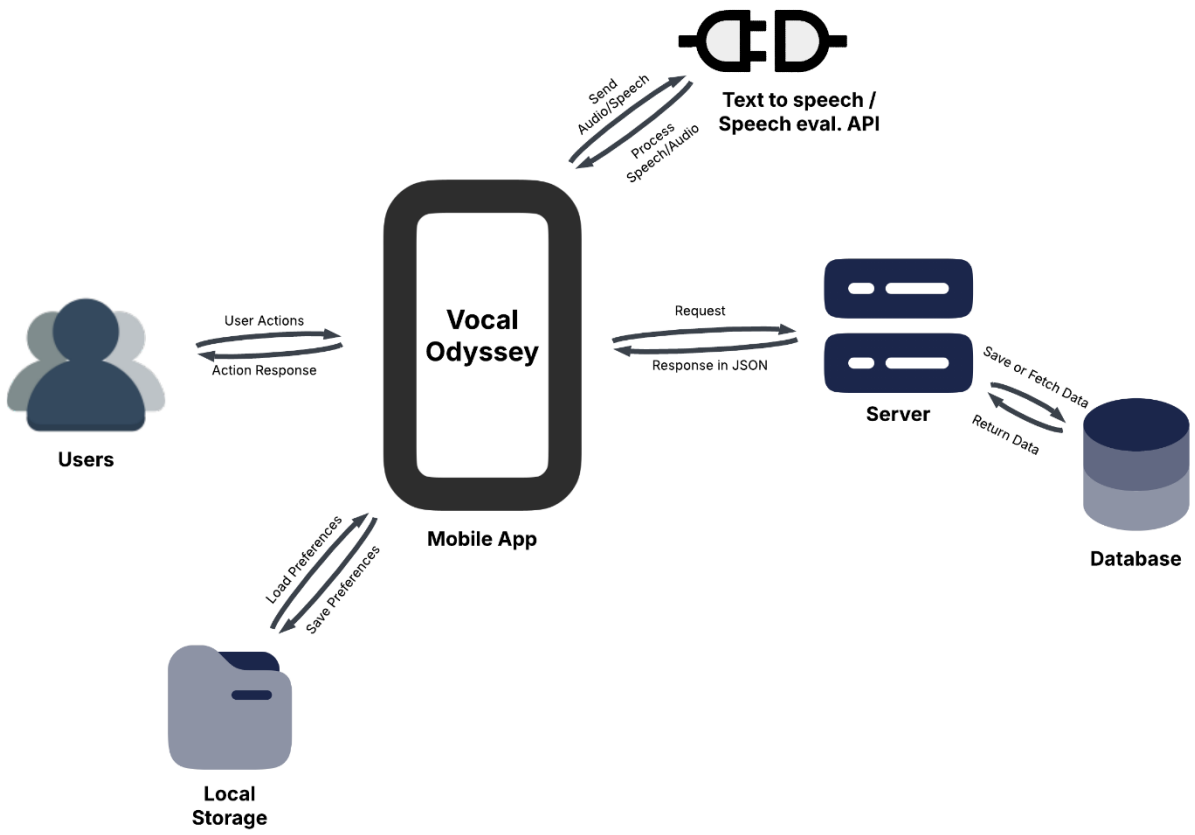

Figure 33: System Architecture Diagram

This diagram represents the app's high-level design, connecting Users to a Backend Server for authentication and data management through the Database. The TTS and speech evaluation API handles speech/audio processing, while the Local Storage caches preferences e.g. selected child, for a smoother experience.

5.2 Class Diagram

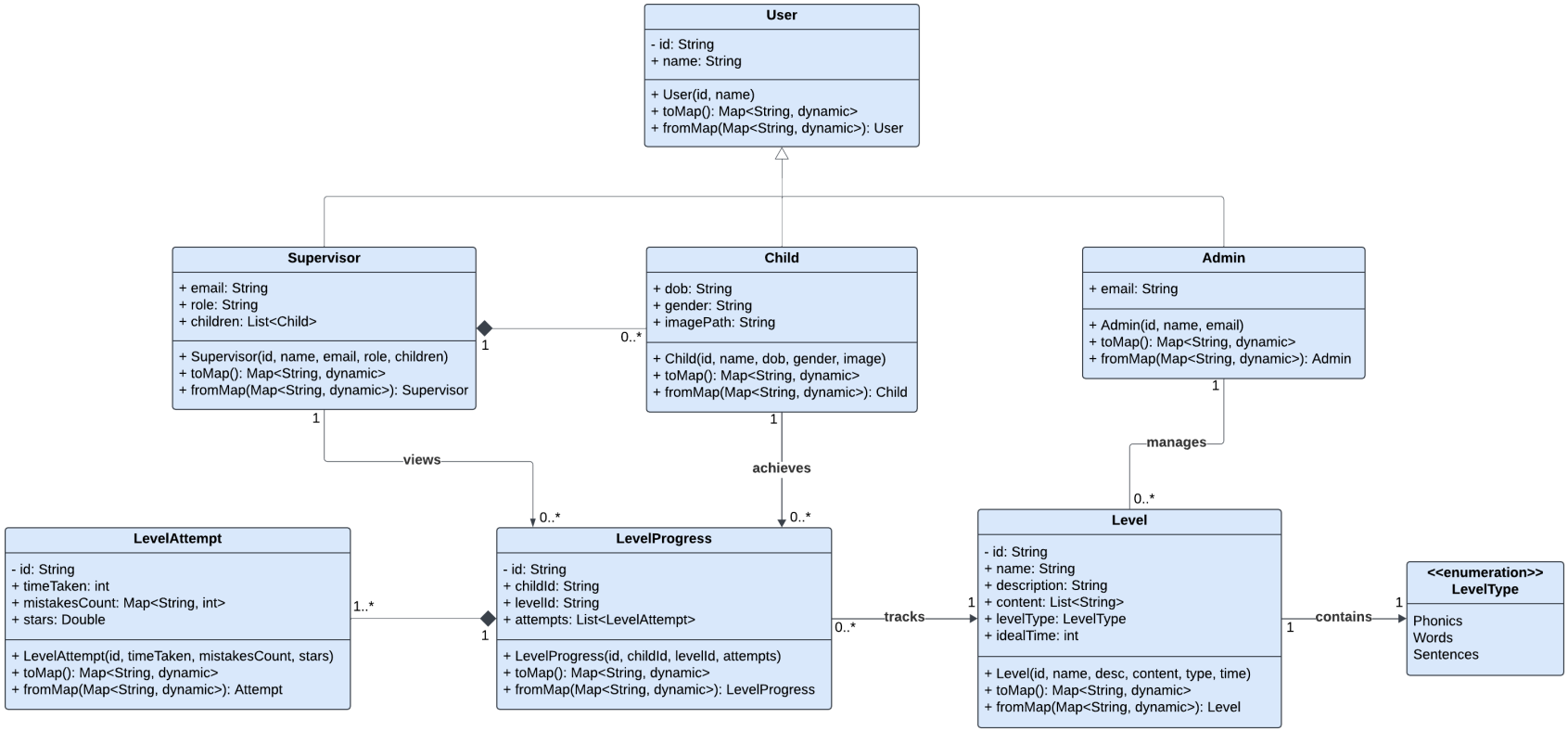

Figure 34: System Class Diagram

5.3 Sequence Diagrams

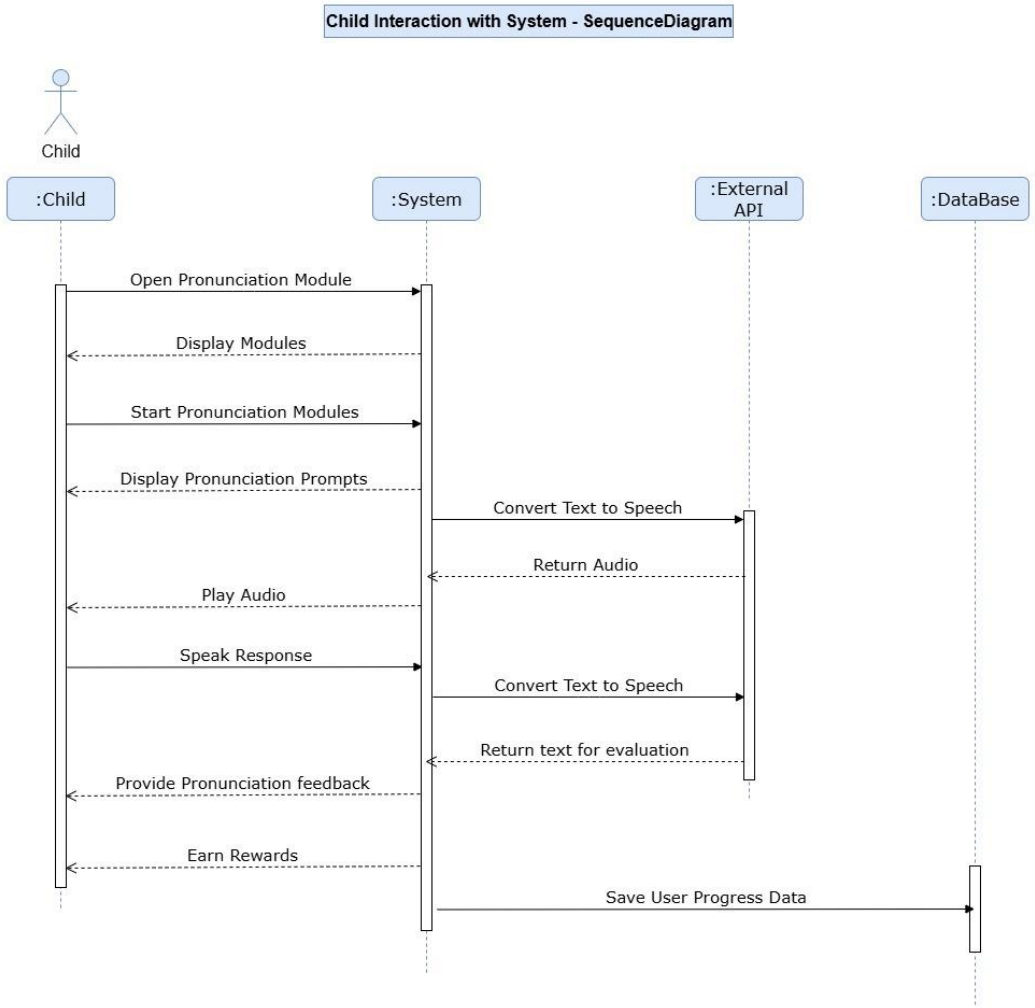

Figure 35: Child Interaction with System Sequence Diagram

In this sequence diagram we illustrate our main functionality of a system that how child interact with the system represents behavior in an order to achieve the better understanding of the system.

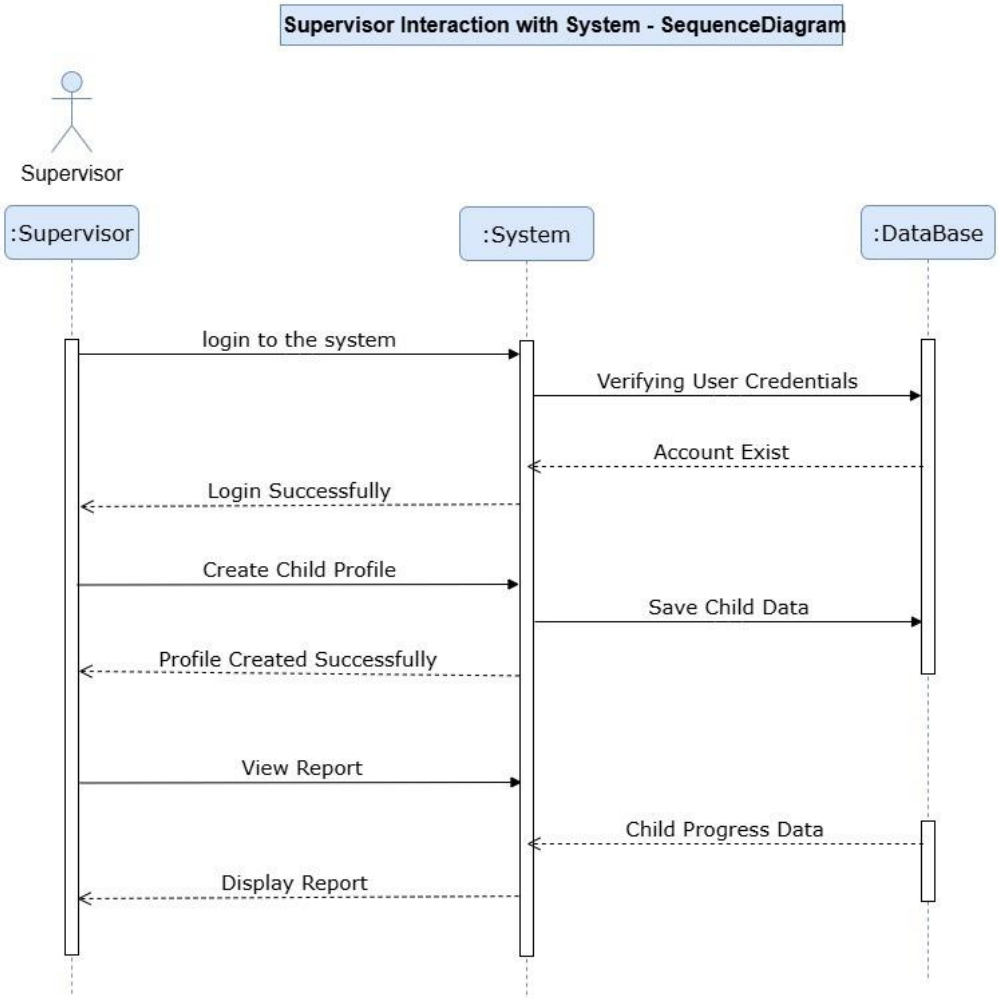

Figure 36: Supervisor Interaction with System Sequence Diagram

In this diagram we illustrate Sequence behavior in a sequence diagram. It represents that supervisor first login to the system creates child profile and also able to review the progress report.

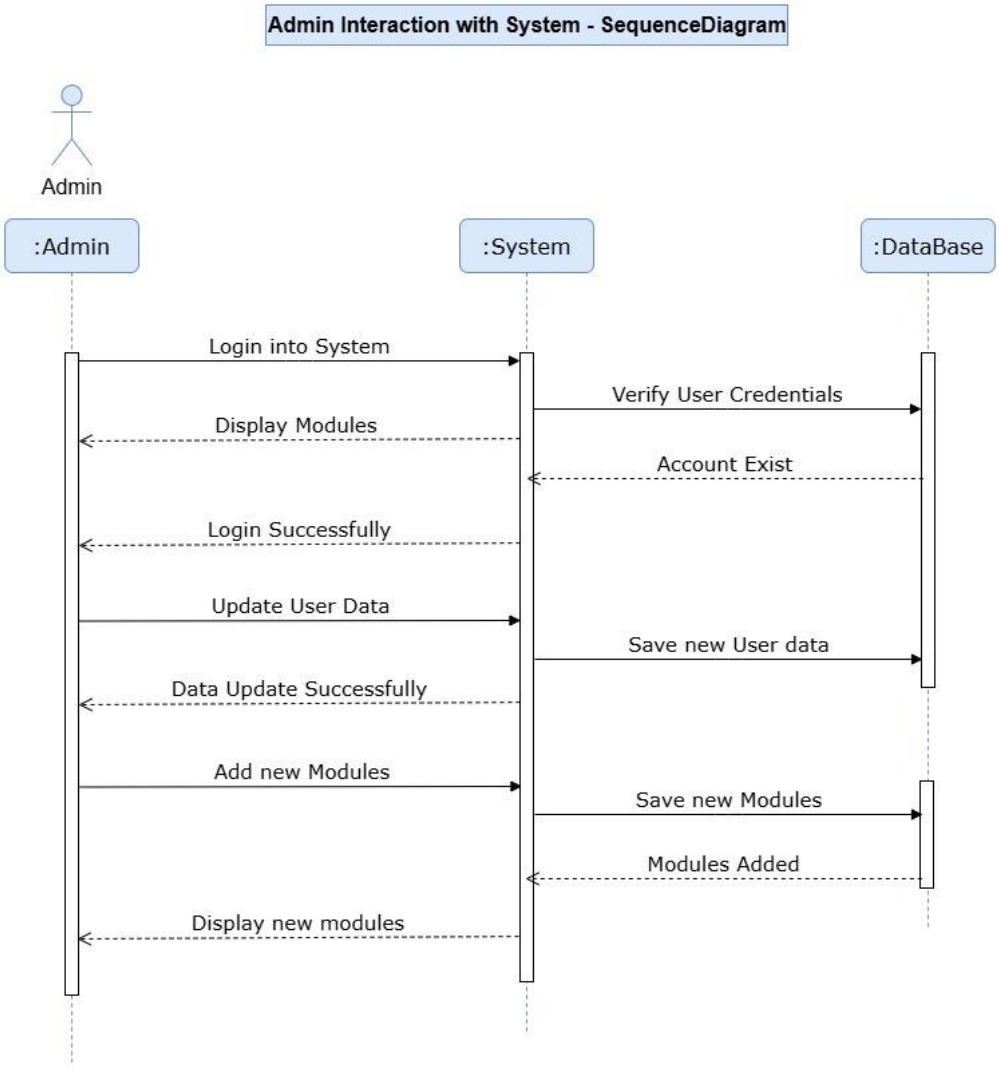

Figure 37: Admin Interaction with System Sequence Diagram

In this diagram we illustrate admin behavior in a sequence diagram. It represents that admin first login to the system update the user data and able to add new modules in a system.

5.4 Collaboration Diagrams

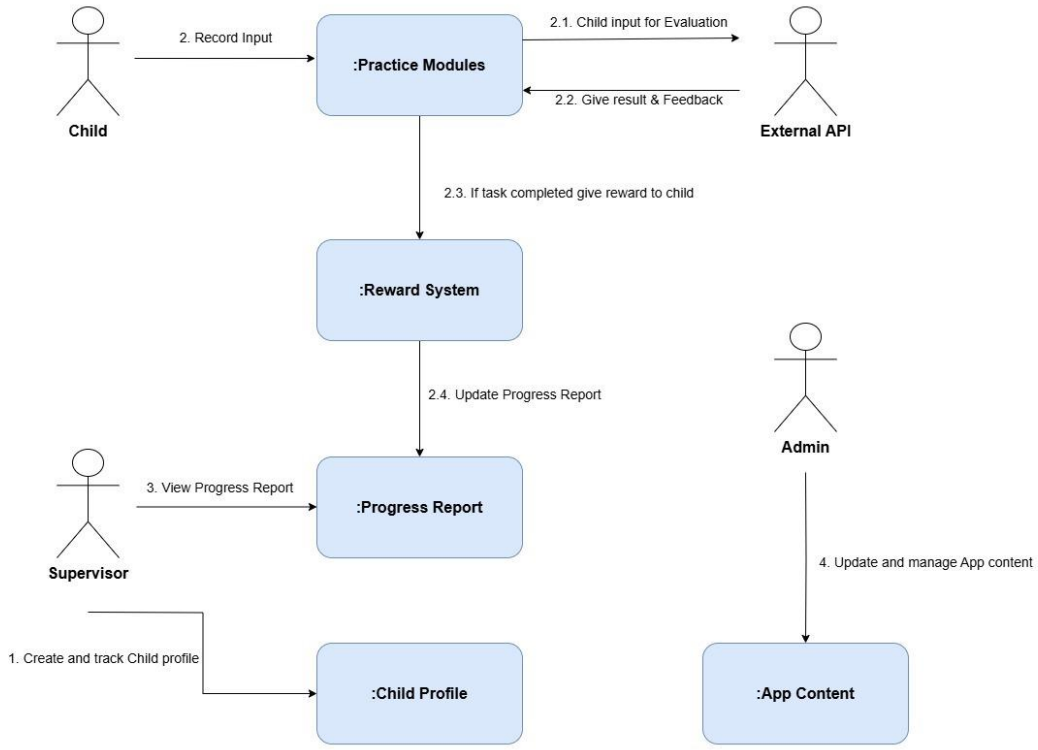

Figure 38: System Collaboration Diagram

The collaboration diagram illustrates the object communication among different entities for our case first supervisor creates profile of child then child interact with the pronunciation module and this goes to the progress report and so on.

5.5 Entity Relationship Diagram

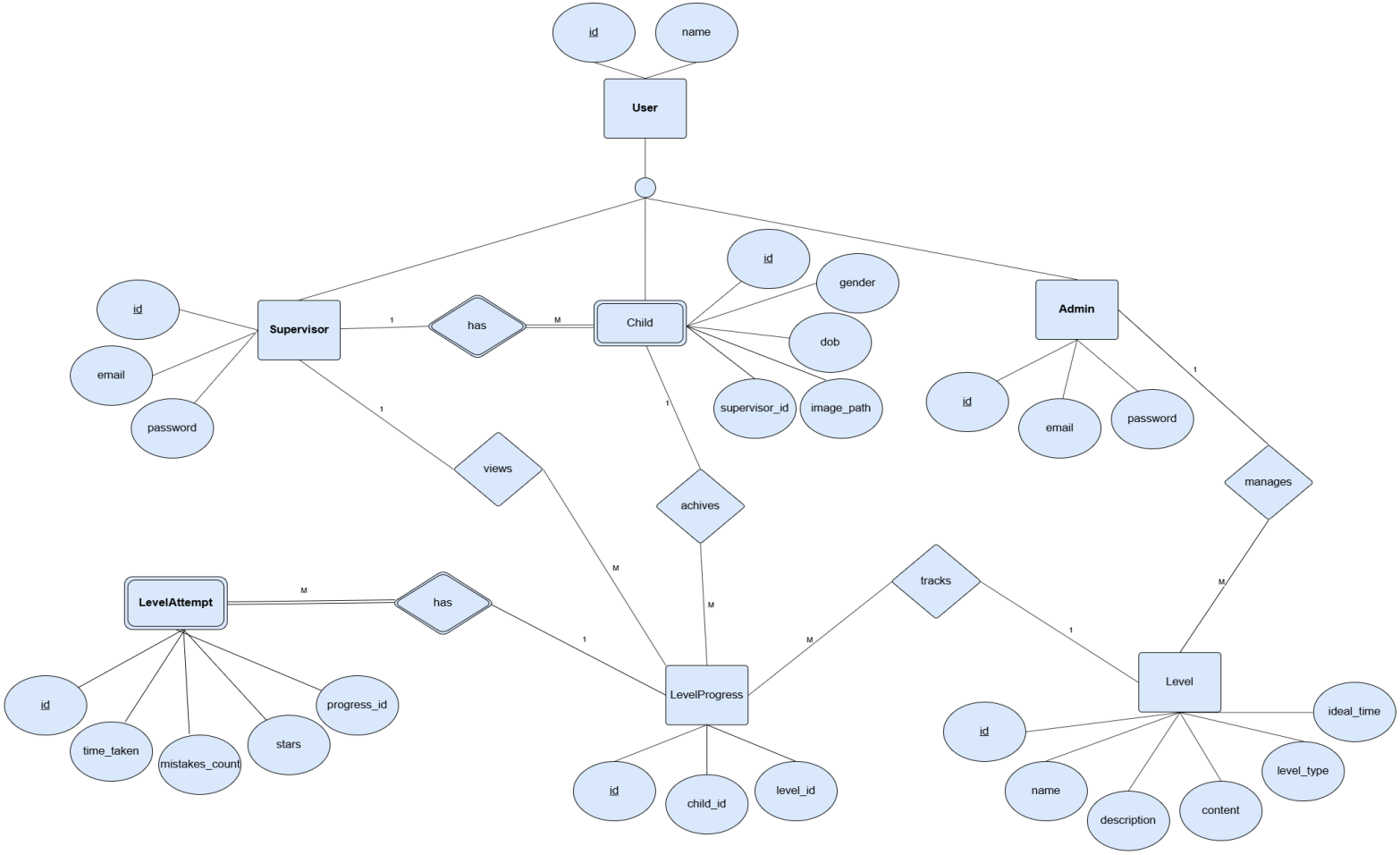

Figure 39: System ERD

5.6 Data Dictionary

5.6.1 Supervisor Collection

Table 35: Supervisor Collection Data Dictionary

Field Name	Data Type	Description
id	String (UUID)	Unique identifier for each supervisor.
email	String	Supervisor's email address for authentication.
password	String (Hashed)	Secure password for authentication.

5.6.2 Child Collection

Table 36: Child Collection Data Dictionary

Field Name	Data Type	Description
id	String (UUID)	Unique identifier for each child user.
name	String	Name of the child.
supervisor_id	String (UUID)	References the supervisor managing this child.
gender	String	Gender of the child.
dob	Date	Date of birth of the child.
image_path	String	Path to child's profile image.

5.6.3 Admin Collection

Table 37: Admin Collection Data Dictionary

Field Name	Data Type	Description
id	String (UUID)	Unique identifier for the admin user.
email	String	Admin email for authentication.
password	String (Hashed)	Secure password for authentication.

5.6.4 Level Collection

Table 38: Level Collection Data Dictionary

Field Name	Data Type	Description
id	String (UUID)	Unique identifier for each level.
name	String	Name of the level.
description	String	Description of the level content.
content	String	Details of phonics, words, or sentences to practice.
level_type	String	Defines the type (Phonics, Words, Sentences).
ideal_time	Integer	Recommended time to complete the level (in seconds).

5.6.5 LevelProgress Collection

Table 39: LevelProgress Collection Data Dictionary

Field Name	Data Type	Description
id	String (UUID)	Unique identifier for progress entry.
child_id	String (UUID)	References the child associated with progress.
level_id	String (UUID)	References the level being tracked.

5.6.6 LevelAttempt Collection

Table 40: LevelAttempt Collection Data Dictionary

Field Name	Data Type	Description
id	String (UUID)	Unique identifier for each attempt.
progress_id	String (UUID)	References the LevelProgress entry.
time_taken	Integer	Time taken to complete the attempt (in seconds).
mistakes_count	Integer	Number of pronunciation mistakes.
stars	Integer	Rewards earned (stars or badges).

6. IMPLEMENTATIoN DETAILS

6.1 Development Setup

The mobile application is developed using the following tools and technologies:

- **Frontend:** Flutter (Dart) - Used for building a cross-platform mobile application for both Android and iOS.
- **Backend:** Node.js (Express.js) - Handles API requests, authentication, and interaction with the database.
- **Database:** MongoDB - NoSQL database used for storing user progress, authentication details, and game-related data.
- **Speech Evaluation:** SpeechAce API – Converts the child's speech into text and evaluates pronunciation accuracy by comparing it with the expected phonics, word, or sentence.
- **Text-to-Speech (TTS):** Murf.ai API Generates AI-assisted spoken prompts for phonics, words, and sentences to guide pronunciation practice.
- **Hosting:** The mobile application is published and hosted on the **Google Play Store** and **Apple App Store** for Android and iOS users respectively and host Backend Server node.js on Render [9].
- **Version Control:** Git & GitHub - Used for collaboration and code management.

6.2 Deployment setup

Mobile Application Deployment:

- Published on Google Play Store (Android 8.0+) and Apple App Store (iOS 13.0+).
- CI/CD pipelines configured using GitHub Actions for automated builds and releases.

Backend Deployment:

- Uses render to host backend server and MongoDB Atlas as database solutions.

Challenges Faced & Solutions:

- **Latency Issues:** Initial API response time was higher than expected (e.g. >3 sec). Optimized by sequence frequent API responses and reducing multiple API calls.
- **Compatibility Issues:** Encountered minor UI inconsistencies across different iOS and Android devices. Resolved using Flutter's responsive design practices.

6.3 Algorithms

Pronunciation Evaluation Algorithm:

- Uses SpeechAce API to convert the child's speech to text and evaluate pronunciation by comparing it with the expected output.
- Compares transcribed text with target word/sentence.
- Provides real-time feedback (pass/fail, encouragement, retry option).

Gamification Algorithm:

- Tracks user progress based on accuracy score.
- Unlocks new words/sentences if accuracy > threshold.
- Awards stars dynamically based on performance.

Parental Dashboard Data Aggregation:

- Collects pronunciation attempts and accuracy scores.
- Computes and visualizes child's improvement trends over time.
- Ensures secure data access with role-based authentication.

6.4 Constraints

6.4.1 Assumptions

- Internet access is available when using speech-related features.
- Users will have basic familiarity with mobile applications.
- SpeechAce API will provide reliable pronunciation analysis.

6.4.2 System constraints

- Speech recognition accuracy depends on environmental noise conditions.
- Performance must be optimized to meet response time constraints (≤3 sec feedback).
- The app should work on devices with at least 2GB RAM for smooth operation.

6.4.3 Restrictions

- Cannot store raw voice data for privacy reasons.
- Requires third-party authentication options for parental accounts.
- Uses SpeechAce and Murf.ai APIs due to budget constraints.

6.4.4 Limitations

- No offline pronunciation analysis due to reliance on cloud-based STT.
- No real-time multiplayer mode due to technical complexity and project scope.
- Speech recognition may not be 100% accurate for diverse accents and dialects.

7. TESTING

7.1 Extended Test Cases

Table 41: Extended test case no 1

TID: TC_1			**Test Created by:** Khizar Ameer		
Module for Test: Register User Via Email			**Date of test design:** 1/06/2025		
Priority of Test: High			**Test performed by:** Abdul Rafay		
Test case: To test the sign-up functionality with email.			**Date for Test Execution:**5/06/2025		
Explanation: Verify that the user can sign-up using email.					
Pre-Conditions: User download and open the app to interact with sign-up page.					
Dependencies					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Navigate to Signup page		Signup page is displayed	Signup Screen loaded Successfully	Pass
2	Enter details to signup page	Email khizarch474@gmail.com Password: khizar098	User is signed up successfully	User is registered and move to user creation screen.	Pass
Post Condition: Sign up using email is verified and account successfully created by user to perform tasks.					

Table 42: Extended test case no 2

TID: TC_2			**Test Created by:** Khizar Ameer		
Module for Test: Register User Via Google			**Date of test design:** 1/06/2025		
Priority of Test: High			**Test performed by:** Abdul Rafay		
Test case: To test the sign-up functionality via Google account.			**Date for Test Execution:**5/06/2025		
Explanation: Verify that the user can sign-up using a Google account.					
Pre-Conditions: User has internet connection and Google account available.					
Dependencies: Internet connection, valid Google account.					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Navigate to Signup page		Signup page is displayed	Signup Screen loaded Successfully	Pass
2	Click on "Continue with Google" Button		Google sign-in popup appears	Google sign-in popup loaded	Pass
3	Select Google Account		User is signed up successfully	User registered and redirected	Pass
Post Condition: Sign up using email is verified and account successfully created by user to perform tasks.					

Table 43: Extended test case no 3

TID: TC_3			**Test Created by:** Abdul Rafay		
Module for Test: Login User			**Date of test design:** 1/06/2025		
Priority of Test: High			**Test performed by:** Khizar Ameer		
Test case: To test login functionality using email and password.			**Date for Test Execution:**5/06/2025		
Explanation: Verify that the user can login using valid credentials.					
Pre-Conditions: User is registered and has valid login credentials.					
Dependencies: Valid user account, internet connection.					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Navigate to Login page		Login page is displayed	Login page loaded successfully	Pass
2	Enter Valid Email and Password	Email: khizarch474@gmail.com Password: khizar098	User is logged in successfully	User logged in and redirected	Pass
3	Click on "Login" button		User is authenticated and redirected	User successfully logged in	Pass
Post Condition: User logged in successfully and access granted to app features.					

Table 44: Extended test case no 4

TID: TC_4			**Test Created by:** Khizar Ameer		
Module for Test: Logout User			**Date of test design:** 1/06/2025		
Priority of Test: Medium			**Test performed by:** Abdul Rafay		
Test case: To test logout functionality.			**Date for Test Execution:**5/06/2025		
Explanation: Verify that the logged-in user can logout successfully.					
Pre-Conditions: User is logged in.					
Dependencies: Active user session.					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Click on "Logout" button.		User is logged out successfully	User session ended, login screen appears	Pass
Post Condition: User logged out and redirected to login screen.					

Table 45: Extended test case no 5

TID: TC_5	**Test Created by:** Abdul Rafay
Module for Test: Recover Password	**Date of test design:** 1/06/2025
Priority of Test: High	**Test performed by:** Khizar Ameer
Test case: To test password recovery via registered email.	**Date for Test Execution:**5/06/2025
Explanation: Verify that the user can reset their password by entering the correct OTP received via email within a 10-minute window.	
Pre-Conditions: User must be registered and have access to their registered email.	
Dependencies: Active internet connection and email service working.	

Step	Steps for test	Data for test	Predicted Outcome	Actual Outcome	Status (Pass/Fail)
1	Navigate to Login page		Login page is displayed	Login page loaded successfully	Pass
2	Click on "Forgot Password?" link		Password recovery page displayed	Password recovery page opened	Pass
3	Provide email and click “Request OTP”	Email: khizarch474@gmail.com	OTP is sent to the entered email	OTP received in inbox	Pass
4	Enter OTP and set new password	OTP: 675685 Password: newpass123	OTP and new password are entered	User add OTP and new password	Pass
5	Click on “Save” button		OTP verifies and password reset successfully.	Password reset successfully	Pass

Post Condition: User can login with the new password.

Table 46: Extended test case no 6

TID: TC_6			**Test Created by:** Abdul Rafay		
Module for Test: Enter OTP			**Date of test design:** 1/06/2025		
Priority of Test: High			**Test performed by:** Abdul Rafay		
Test case: To test the OTP verification functionality			**Date for Test Execution:**5/06/2025		
Explanation: Ensure the system accepts valid OTPs within time limit and rejects invalid or expired ones.					
Pre-Conditions: A valid OTP must be generated and sent via registered email.					
Dependencies: Active internet connection and email service working.					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Enter email click on "Request OTP" button	Email: khizarch474@gmail.com	OTP is sent to the registered email	OTP received	Pass
2	Enter the received OTP and set new password	OTP: 839201 Password: newpass123	Valid OTP entered under 10 minutes and password entered	OTP and password entered	Pass
3	Click on "Save" button	Password: newpass123	Password is reset with valid OTP	Password reset and user redirected to login screen	Pass
Post Condition: User can login with the new password.					

Table 47: Extended test case no 7

TID: TC_7			**Test Created by:** Khizar Ameer		
Module for Test: Create Child Profile			**Date of test design:** 1/06/2025		
Priority of Test: High			**Test performed by:** Khizar Ameer		
Test case: To test the creation of a child profile by the supervisor			**Date for Test Execution:**5/06/2025		
Explanation: Ensure the supervisor can create a child profile with valid details					
Pre-Conditions: Supervisor must be logged in					
Dependencies: Active internet, access to child profile form					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Navigate child profile section		Profile creation screen is displayed	Loaded successfully	Pass
2	Click "Create Child Profile" button		Form appears	Form displayed	Pass
3	Enter child details	Name: Ali, Date of Birth, Gender: Male	Data accepted	Entered successfully	Pass
4	Click "Save"		Profile is created	Profile created successfully	Pass
Post Condition: New child profile is visible under the supervisor's dashboard					

Table 48: Extended test case no 8

TID: TC_8			**Test Created by:** Khizar Ameer		
Module for Test: Edit Child Profile			**Date of test design:** 1/06/2025		
Priority of Test: Medium			**Test performed by:** Khizar Ameer		
Test case: To test editing an existing child profile			**Date for Test Execution:**5/06/2025		
Explanation: Ensure the supervisor can update child profile details					
Pre-Conditions: Child profile must exist					
Dependencies: Logged-in supervisor, editable profile interface					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Open child profile list		Child list is displayed	Loaded successfully	Pass
2	Open any child profile to edit e.g. Ali		Profile opens	Profile and content displayed	Pass
3	Drag down setting button and click on "Edit Child Profile" Button	Name: sugi, Date of Birth, Gender: female	Profile details shown to edit	Details loaded	Pass
4	Click "Save"		Profile is updated	Changes Saved	Pass
Post Condition: Profile reflects updated information.					

Table 49: Extended test case no 9

TID: TC_9			**Test Created by:** Khizar Ameer		
Module for Test: Delete Child Profile			**Date of test design:** 1/06/2025		
Priority of Test: Medium			**Test performed by:** Abdul Rafay		
Test case: To test deletion of a child profile			**Date for Test Execution:**5/06/2025		
Explanation: Ensure the supervisor can delete a child profile successfully					
Pre-Conditions: Child profile must exist					
Dependencies: Logged-in supervisor, Internet connection, confirmation dialog					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Open child profile list		Child list is displayed	Loaded successfully	Pass
2	Select child profile to delete	Sugi	Profile selected	Profile selected	Pass
3	Click on Delete logo		Delete confirmation box appears	Confirm dialog box displayed	Pass
4	Click “Delete”		Profile is deleted	Profile deleted from Database	Pass
Post Condition: Profile is removed and no longer listed.					

Table 50: Extended test case no 10

TID: TC_10			**Test Created by:** Khizar Ameer		
Module for Test: View Report			**Date of test design:** 1/06/2025		
Priority of Test: Medium			**Test performed by:** Abdul Rafay		
Test case: To test if supervisor can view child performance reports			**Date for Test Execution:**5/06/2025		
Explanation: Ensure report is generated and displayed correctly					
Pre-Conditions: At least child has activity data					
Dependencies: Child practice some modules, Report generation backend, chart module					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Open child profile		Child profile is opened	Loaded successfully	Pass
2	Open any child profile to view report	Sugi	Profile selected	Profile selected	Pass
3	Drag down setting button and click on "Progress Report" Button		Progress Report is displayed	Progress report displayed	Pass
Post Condition: Report is accessible and understandable for supervisor					

Table 51: Extended test case no 11

TID: TC_11			**Test Created by:** Abdul Rafay		
Module for Test: Manage User Data			**Date of test design:** 1/06/2025		
Priority of Test: High			**Test performed by:** Khizar Ameer		
Test case: To verify admin can view and delete user data			**Date for Test Execution:**5/06/2025		
Explanation: Ensure admin can manage user accounts					
Pre-Conditions: Admin is logged in with access to User Management					
Dependencies: Database connection, valid admin credentials					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Navigate to the login panel	Email: admin@vo.com Pass: pass***	Admin panel login successfully	Loaded successfully and move to admin dashboard.	Pass
2	Click on "Manage Users"		List of registered users Displayed	Registered Users list display	Pass
3	Click on Delete logo for any user	Ali	Confirmation box displayed	Dialog box displayed	Pass
4	Click on Delete		User Deleted successfully	User is deleted	Pass
Post Condition: User data is successfully managed and updated in the system.					

Table 52: Extended test case no 12

TID: TC_12			**Test Created by:** Khizar Ameer		
Module for Test: Manage Level Content			**Date of test design:** 1/06/2025		
Priority of Test: High			**Test performed by:** Abdul Rafay		
Test case: To verify that admin can edit, update or delete app content			**Date for Test Execution:**5/06/2025		
Explanation: Ensure admin can manage app content like phonics words and sentences					
Pre-Conditions: Admin logged in with content access					
Dependencies: Database connection, content section active					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Navigate to the login panel	Email: admin@vo.com Pass: pass***	Admin panel login successfully	Loaded successfully and move to admin dashboard.	Pass
2	Click on "Manage Levels"		List of contents Displayed	Contents displayed properly	Pass
3	Click on Delete logo for any content	Blend words	Confirmation box displayed	Dialog box displayed	Pass
4	Click on Delete		Content Deleted successfully	Content is deleted	Pass
Post Condition: Content changes are reflected in the app immediately.					

Table 53: Extended test case no 13

TID: TC_13			**Test Created by:** Khizar Ameer		
Module for Test: Add new Phonics			**Date of test design:** 1/06/2025		
Priority of Test: Medium			**Test performed by:** Khizar Ameer		
Test case: To verify that admin can add new phonics			**Date for Test Execution:**5/06/2025		
Explanation: Ensure admin can input and save a new phonics sound					
Pre-Conditions: Admin logged in with content access					
Dependencies: Database connection, content section active					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Navigate to the login panel	Email: admin@vo.com Pass: pass***	Admin panel login successfully	Loaded successfully and move to admin dashboard.	Pass
2	Click on "Manage Levels"		List of contents Displayed	Contents displayed properly	Pass
3	Click on "Create new Level"		Level creation form appears	Form displayed successfully	Pass
4	Add level details	Name, Description, Ideal time, Content type: Phonics, Content	Form fields entered	Fields are entered	Pass
5	Click on "Add Level" button		New phonics level entered into phonics section	New phonics level enters into phonics section	Pass
Post Condition: New phonics is stored and visible in the phonics section.					

Table 54: Extended test case no 14

TID: TC_14			**Test Created by:** Abdul Rafay		
Module for Test: Add new Words			**Date of test design:** 1/06/2025		
Priority of Test: Medium			**Test performed by:** Abdul Rafay		
Test case: To verify that admin can add new words			**Date for Test Execution:**5/06/2025		
Explanation: Ensure admin can input and save a new word					
Pre-Conditions: Admin logged in with content access					
Dependencies: Database connection, content section active					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Navigate to the login panel	Email: admin@vo.com Pass: pass***	Admin panel login successfully	Loaded successfully and move to admin dashboard.	Pass
2	Click on "Manage Levels"		List of contents Displayed	Contents displayed properly	Pass
3	Click on "Create new Level"		Level creation form appears	Form displayed successfully	Pass
4	Add level details	Name, Description, Ideal time, Content type: Words, Content	Form fields entered	Fields are entered	Pass
5	Click on "Add Level" button		New words level entered into words section	New words level enters into words section	Pass
Post Condition: New words are stored and visible in the words section.					

Table 55: Extended test case no 15

TID: TC_15			**Test Created by:** Abdul Rafay		
Module for Test: Add new Sentence			**Date of test design:** 1/06/2025		
Priority of Test: Medium			**Test performed by:** Abdul Rafay		
Test case: To verify that admin can add new sentence			**Date for Test Execution:**5/06/2025		
Explanation: Ensure admin can input and save a new sentence					
Pre-Conditions: Admin logged in with content access					
Dependencies: Database connection, content section active					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Navigate to the login panel	Email: admin@vo.com Pass: pass***	Admin panel login successfully	Loaded successfully and move to admin dashboard.	Pass
2	Click on "Manage Levels"		List of contents Displayed	Contents displayed properly	Pass
3	Click on "Create new Level"		Level creation form appears	Form displayed successfully	Pass
4	Add level details	Name, Description, Ideal time, Content type: Sentence, Content	Form fields entered	Fields are entered	Pass
5	Click on "Add Level" button		New sentences level entered into sentences section	New sentences level enters into sentences section	Pass
Post Condition: New sentences are stored and visible in the sentences section.					

Table 56: Extended test case no 16

TID: TC_16			**Test Created by:** Abdul Rafay		
Module for Test: Practice Phonics			**Date of test design:** 1/06/2025		
Priority of Test: High			**Test performed by:** Khizar Ameer		
Test case: Verify that children can practice phonics sounds			**Date for Test Execution:**5/06/2025		
Explanation: Ensure phonics exercises are loaded with audio					
Pre-Conditions: Child is logged in and phonics module is unlocked					
Dependencies: Audio files, phonics data loaded					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Navigate to the phonics module		Phonics module appeared	Phonics module displayed	Pass
2	Open "Capital letter" level		Capital Letter level is opened and display text	Capital letter is displayed	Pass
3	Click on speak button to pronounce letter	A	Prompt audio instructs child to pronounce letter	Audio played	Pass
4	Child speak and submit	A	AI evaluates pronunciation	Evaluation done	Pass
Post Condition: Phonics pronunciation and understanding enhanced					

Table 57: Extended test case no 17

TID: TC_17			**Test Created by:** Khizar Ameer		
Module for Test: Practice Words			**Date of test design:** 1/06/2025		
Priority of Test: High			**Test performed by:** Khizar Ameer		
Test case: Verify that children can practice words			**Date for Test Execution:**5/06/2025		
Explanation: Ensure words exercises are loaded with audio					
Pre-Conditions: Child is logged in and words module is unlocked					
Dependencies: Audio files, words data loaded					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Navigate to the word module		Words module appeared	Words module displayed	Pass
2	Open "CVC words" level		CVC words level is opened and display text	CVC words displayed	Pass
3	Click on speak button to pronounce word	Cat	Prompt audio instructs child to pronounce word	Audio played	Pass
4	Child speak and submit	Cat	AI evaluates pronunciation	Evaluation done	Pass
Post Condition: Words pronunciation and understanding enhanced.					

Table 58: Extended test case no 18

TID: TC_18			**Test Created by:** Khizar Ameer		
Module for Test: Practice Sentences			**Date of test design:** 1/06/2025		
Priority of Test: High			**Test performed by:** Khizar Ameer		
Test case: Verify that children can practice sentences			**Date for Test Execution:**5/06/2025		
Explanation: Ensure sentence exercises are loaded with audio					
Pre-Conditions: Child is logged in and sentence module is unlocked					
Dependencies: Audio files, words data loaded					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Navigate to the sentence module		Sentence module appeared	Sentence module displayed	Pass
2	Open "Basic Words Group" level		Basic Words Group level is opened and display text	Basic Words Group displayed	Pass
3	Click on speak button to pronounce sentence	Big Cat	Prompt audio instructs child to pronounce sentence	Audio played	Pass
4	Child speak and submit	Big Cat	AI evaluates pronunciation	Evaluation done	Pass
Post Condition: Sentence pronunciation and understanding enhanced					

Table 59: Extended test case no 19

TID: TC_19			**Test Created by:** Abdul Rafay		
Module for Test: Task Completion			**Date of test design:** 1/06/2025		
Priority of Test: High			**Test performed by:** Abdul Rafay		
Test case: Verify that completed tasks are tracked as progress			**Date for Test Execution:**5/06/2025		
Explanation: Ensure task completion updates progress metrics and moves to next level					
Pre-Conditions: Child complete assigned tasks					
Dependencies: Task module, database tracking					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Child completes a learning task	Pronounce: A	Task marked as completed	Completion mark shown	Pass
2	System updates progress bar and moves to the next level		Progress shown and moves to next level	Progress and levels updates successfully	Pass
Post Condition: Child's progress is saved and move to the next level for practice.					

Table 60: Extended test case no 20

TID: TC_20			**Test Created by:** Khizar Ameer		
Module for Test: Rewards			**Date of test design:** 1/06/2025		
Priority of Test: High			**Test performed by:** Abdul Rafay		
Test case: Verify that user earns rewards after completing tasks			**Date for Test Execution:**5/06/2025		
Explanation: Ensure reward logic is triggered correctly					
Pre-Conditions: Task is completed					
Dependencies: Reward system backend					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Complete a task successfully	Score ≥ 85	Stars given to the child	Stars displayed on screen	Pass
2	View stars in dashboard		Stars are stored in child profile and progress report	Stars are listed in child profile and progress report	Pass
Post Condition: Reward is credited to the child's profile and visible in the progress report.					

Table 61: Extended test case no 21

TID: TC_21			**Test Created by:** Abdul Rafay		
Module for Test: Motivation for Retry			**Date of test design:** 1/06/2025		
Priority of Test: Medium			**Test performed by:** Khizar Ameer		
Test case: Verify system encourages user after failed attempts			**Date for Test Execution:**5/06/2025		
Explanation: Ensure retry prompts are triggered when needed					
Pre-Conditions: Task attempt failed					
Dependencies: User failed to attempt the level, motivation prompts logic					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Child practice words pronunciation	Pronounce Cat	AI evaluates pronunciation	Evaluation done	Pass
2	Child fails to meet required score threshold	Score < 85	System displays motivational message or audio	"Try Again! You can do it!" shown	Pass
Post Condition: User encouraged to retry and allowed to continue practicing.					

Table 62: Extended test case no 22

TID: TC_22			**Test Created by:** Abdul Rafay		
Module for Test: Audio Prompt Imitation			**Date of test design:** 1/06/2025		
Priority of Test: High			**Test performed by:** Khizar Ameer		
Test case: Verify that the system gives clear audio prompts			**Date for Test Execution:**5/06/2025		
Explanation: Ensure user receives audio examples to mimic					
Pre-Conditions: Task is active, click on repeat button					
Dependencies: Audio files, playback module					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Navigate to pronunciation module		Pronunciation modules display	Modules displayed	Pass
2	Click on words module level		Audio prompt speaks the words first.	Audio speaks first	Pass
3	Click on retry button to listen audio again		Audio repeats again	Audio play again	Pass
Post Condition: Child listens and prepares to imitate audio.					

Table 63: Extended test case no 23

TID: TC_23			**Test Created by:** Khizar Ameer		
Module for Test: Audio Evaluation			**Date of test design:** 1/06/2025		
Priority of Test: High			**Test performed by:** Abdul Rafay		
Test case: Verify that child's audio is evaluated for accuracy			**Date for Test Execution:**5/06/2025		
Explanation: Ensure voice input is analyzed and feedback is given					
Pre-Conditions: Microphone access granted					
Dependencies: Audio analysis models/API's					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Navigate to the pronunciation module and open words module		Words module is displayed	Module is displayed	Pass
2	Child speaks and submits audio	Pronounce Cat	AI evaluates pronunciation	Evaluation done	Pass
3	Check evaluation result	Score ≥ 85	Proceeds to next letter	Next level ready for practice	Pass
4	Check evaluation result	Score < 85	Stays on same letter, asks to retry	Child asked to retry the level	Pass
Post Condition: System moves to next letter until 85% accuracy is achieved.					

Table 64: Extended test case no 24

TID: TC_24			**Test Created by:** Khizar Ameer		
Module for Test: Edit Supervisor Profile			**Date of test design:** 1/06/2025		
Priority of Test: Medium			**Test performed by:** Abdul Rafay		
Test case: Verify that the supervisor can edit and save profile details			**Date for Test Execution:**5/06/2025		
Explanation: Ensure the supervisor can update their name successfully					
Pre-Conditions: Supervisor is logged in and on dashboard					
Dependencies: Internet connection					
Step	**Steps for test**	**Data for test**	**Predicted Outcome**	**Actual Outcome**	**Status (Pass/Fail)**
1	Navigate to settings page		Profile page is displayed	Profile page loaded	Pass
2	Click on name filed option		Input field for name is editable	Name field editable	Pass
3	Enter name for edit and click on update button	khiz	Name updated and reflected in dashboard	Name saved and displayed	Pass
Post Condition: Supervisor's updated name is stored securely and reflected across the application.					

7.2 Decision Table

7.2.1 Decision Coverage Table

Table 65: Decision coverage table

Conditions	**Rule 1**	**Rule 2**	**Rule 3**	**Rule 4**
1. Child audio is successfully recorded	Yes	Yes	No	No
2. Speech API returns a valid analysis	Yes	No	Yes	No
3. Pronunciation accuracy is greater than or equal to 85%	Yes	–	–	–
Actions				
A1. Display success message and feedback	Yes	No	No	No
A2. Grant reward like stars	Yes	No	No	No
A3. Provide motivational feedback to retry	No	Yes	Yes	Yes
A4. Prompt user to record pronunciation again	No	Yes	Yes	Yes
A5. Display error message for failed processing	No	No	No	Yes

Explanation of Rules:

- **Rule 1**: All conditions are met. The child records audio, the speech API processes it successfully, and the pronunciation accuracy meets or exceeds the required threshold of 85%. The system displays a success message and rewards the child.
- **Rule 2**: The audio is recorded, but the API fails to return a valid response. The system encourages the child to try again and prompts for a new recording.
- **Rule 3**: Audio is not recorded properly but is passed to the API. The child is prompted to retry, accompanied by motivational feedback.
- **Rule 4**: Neither audio is recorded nor is the API able to process anything. An error message is displayed, and the child is advised to retry.

7.3 Traceability Matrix

7.3.1 RID vs UCID (requirements vs use cases)

UCID/RID	R1.1	R1.2	R1.3	R1.4	R1.5	R1.6	R1.7	R1.8	R1.9	R1.10	R1.11	R1.12	R1.13	R1.14	R1.15	R1.16	R1.17
UC_1.1	✓																
UC_1.2		✓															
UC_1.3			✓														
UC_1.4				✓													
UC_1.4.1				✓													
UC_2.1														✓			
UC_2.1.1														✓			
UC_2.1.2														✓			
UC_2.2													✓				
UC_2.3																	✓
UC_3.1																✓	
UC_3.2															✓		
UC_3.2.1															✓		
UC_3.2.2															✓		
UC_3.2.3															✓		
UC_4.1					✓												
UC_4.2						✓											
UC_4.3							✓										
UC_4.4										✓							
UC_4.4.1												✓					
UC_4.5											✓						
UC_4.6								✓									
UC_4.7									✓								

Figure 40: Traceability Matrix RID vs UCID

7.3.2 Prototypes (RID vs PID)

RID/PID	PID_1	PID_2	PID_3	PID_4	PID_5	PID_6	PID_7	PID_8	PID_9	PID_10	PID_11	PID_12	PID_13	PID_14	PID_15	PID_16	PID_17	PID_18	PID_19	PID_20	PID_21	PID_22	PID_23	PID_24
R1.1		✓																						
R1.2	✓																							
R1.3						✓																		
R1.4			✓																					
R1.5								✓	✓															
R1.6										✓	✓													
R1.7												✓	✓											
R1.8																								
R1.9														✓	✓									
R1.10																								
R1.11																✓								
R1.12																	✓							
R1.13																		✓	✓	✓				
R1.14				✓	✓																			
R1.15																						✓	✓	
R1.16																								✓
R1.17						✓																		

Figure 41: Traceability Matrix RID vs PID

7.3.3 Test Cases (RID vs TID)

RID/TID	TC_1	TC_2	TC_3	TC_4	TC_5	TC_6	TC_7	TC_8	TC_9	TC_10	TC_11	TC_12	TC_13	TC_14	TC_15	TC_16	TC_17	TC_18	TC_19	TC_20	TC_21	TC_22	TC_23	TC_24
R1.1	✓	✓																						
R1.2			✓																					
R1.3				✓																				
R1.4					✓	✓																		
R1.5																✓								
R1.6																	✓							
R1.7																		✓						
R1.8																						✓		
R1.9																							✓	
R1.10																			✓					
R1.11																					✓			
R1.12																				✓				
R1.13										✓														
R1.14							✓	✓	✓															
R1.15												✓	✓	✓	✓									
R1.16											✓													
R1.17																								✓

Figure 42: Traceability Matrix RID vs TID

7.3.4 Coverage (UCID vs TID)

UCID/TID	TC_1	TC_2	TC_3	TC_4	TC_5	TC_6	TC_7	TC_8	TC_9	TC_10	TC_11	TC_12	TC_13	TC_14	TC_15	TC_16	TC_17	TC_18	TC_19	TC_20	TC_21	TC_22	TC_23	TC_24
UC_1.1	✓	✓																						
UC_1.2			✓																					
UC_1.3				✓																				
UC_1.4					✓																			
UC_1.4.1						✓																		
UC_2.1							✓																	
UC_2.1.1								✓																
UC_2.1.2									✓															
UC_2.2										✓														
UC_2.3																								✓
UC_3.1											✓													
UC_3.2												✓												
UC_3.2.1													✓											
UC_3.2.2														✓										
UC_3.2.3															✓									
UC_4.1																✓								
UC_4.2																	✓							
UC_4.3																		✓						
UC_4.4																			✓					
UC_4.4.1																				✓				
UC_4.5																					✓			
UC_4.6																						✓		
UC_4.7																							✓	

Figure 43: Traceability Matrix UCID vs TID

8. RESULTS/OUTPUT/STATISTICS

This section presents a quantitative evaluation of the traceability matrices developed in Chapter 7. The purpose is to assess the completeness, accuracy, and correctness of the system requirements in terms of their mapping to use cases and test cases.

8.1 %Completion

The Requirement vs Use Case traceability matrix in section 7.3.1 was analyzed to determine whether each functional requirement is adequately addressed by at least one use case.

- All requirements from R1.1 to R1.16 are linked to one or more usecases.
- There is full coverage of all requirements in terms of functional use cases.

Completion Rate: 100%

8.2 %Accuracy

The Requirement vs Test Case Matrix in Section 7.3.3 was analyzed to verify that all defined requirements are validated by specific test cases.

- Every requirement is associated with at least one or more test cases, ensuring traceability from requirements to validation.
- All functional requirements have been implemented and validated through the test suite.

Accuracy Rate: 100%

8.3 %Correctness

The Use Case vs Test Case Matrix in Section 7.3.4 was analyzed to ensure that each use case has been tested thoroughly via one or more test cases.

- All use cases from UC_1.1 to UC_4.7 are linked to at least one test case, ensuring their execution and verification.
- Functional behavior defined in the use cases has been tested and verified successfully.

Correctness Rate: 100%

9. CONCLUSION

The Vocal Odyssey project successfully demonstrates the potential of AI-powered mobile applications in enhancing children's pronunciation and speech articulation. By integrating Murf AI for natural-sounding voice prompts and SpeechAce for real-time pronunciation evaluation, the app provides an interactive, personalized, and child-friendly learning environment. Gamification elements like rewards and progress tracking help sustain engagement, while the parental dashboard empowers supervisors to monitor and support each child's learning journey. Through this project, we've addressed a key gap in traditional language learning by combining educational goals with intuitive technology.

This project not only serves as a digital speech practice tool but also contributes meaningfully to early childhood education by making pronunciation learning accessible, motivating, and measurable.

10. FUTURE WORK

While Vocal Odyssey achieves its core goals, several improvements and enhancements can be made in future iterations:

1. **Multilingual Support**

Add support for other languages like for Urdu, Spanish and German to make the app accessible to a broader global audience.

2. **Offline Mode**

Enable offline practice for core modules by pre-downloading essential content, especially useful in low-connectivity regions.

3. **Custom Learning Paths**

Allow supervisors to design personalized learning tracks based on each child's specific needs and weaknesses.

4. **Interactive Games and Stories**

Introduce storytelling modules and pronunciation-based games to make learning more immersive and dynamic.

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12. APPENDIX

12.1 Glossary of Terms

Table 66: Glossary of terms

Term	Definition
Accuracy Score	A numeric value showing how closely a user's pronunciation matches the expected pronunciation.
Admin	A user role responsible for managing users, content, and system configurations in the app.
AI (Artificial Intelligence)	Technology that mimics human intelligence, used here for speech recognition and feedback generation.
API	A set of tools and protocols that allow different software systems to communicate.
Authentication	The process of verifying a user's identity before granting access to the system.
Backend	The server-side component of the application responsible for processing logic, database management, and API handling.
Class Diagram	Represents system structure by showing classes, attributes, and relationships.
Child Profile	A record that contains specific details for each child user including age, progress, and preferences.
Collaboration Diagram	Visualizes object interactions and relationships for a specific task or scenario.
Dashboard	A visual panel that displays metrics such as accuracy, completed levels, and progress graphs.
Data Dictionary	A structured list of database entities and attributes, used to describe the data structure of the app.
Database	A structured system for storing and retrieving data. In this project, MongoDB is used.
DFD (Data Flow Diagram)	Shows how data moves through a system using processes, data stores, and external entities.
Entity-Relationship Diagram (ERD)	A diagram that shows relationships between data entities in a database.
Express.js	A Node.js web framework used to build the backend server of the application.
External Requirement	A requirement that depends on external systems, services, or APIs that the system must interface with or rely on.

Feedback	Responses or messages generated by the system to guide and motivate users during practice.
Flutter	A UI toolkit from Google used to build natively compiled mobile apps for Android and iOS.
Functional Requirement	A specification of the **functions or behaviors** the system must perform, such as features and services.
Gamification	Integration of game-like features such as rewards and levels to enhance user engagement.
Level	A stage of learning content (phonics, words, or sentences) that a child completes to progress in the app.
MongoDB	A document-based NoSQL database used for storing user data and app content.
Motivational Feedback	Encouraging phrases like "Try again!" used to engage children and prevent discouragement.
Node.js	A JavaScript runtime for executing backend server logic in the application.
Non-Functional Requirement	Describes how the system should perform, including speed, usability, reliability, and availability.
OTP (One-Time Password)	A temporary password sent to the user for secure authentication, especially during recovery.
Parental Control	A feature that allows parents or supervisors to monitor and manage child profiles and activity.
Phonics	A method of teaching children how to connect sounds with letters or groups of letters.
Practice Module	A set of activities in phonics, words, or sentences to improve a child's pronunciation.
Pronunciation	The way in which a word is spoken; a core aspect of the app's evaluation process.
Real-time Feedback	Instant evaluation and response provided to a child's speech attempt for immediate correction.
Requirement	A statement of need that defines what the system must achieve or support, including its behavior, features, and constraints.
Reward	Stars, badges, or incentives given to encourage task completion and engagement.
Scalability	The ability of the system to handle increasing amounts of work or users without performance loss.
Serverless	A cloud-native backend deployment model (e.g., Firebase Functions) that automatically scales based on demand.
Sequence Diagram	Displays the step-by-step interaction flow between system components over time.

Supervisor	A parent, guardian, or educator who manages and monitors a child's learning progress in the app.
System Requirement	Hardware, software, and platform needed to run the system.
TTS (Text-to-Speech)	Technology that converts written content into audio output to guide users through learning tasks.
Use Case	A specific functionality or interaction scenario described from the user's point of view.
User Interface (UI)	The visual elements through which users interact with the app, such as buttons and screens.
Voice Prompt	Pre-recorded or generated audio that children listen to and imitate during practice.

12.2 Pre-Requisites

Development Tools

- **Flutter SDK:** For building the cross-platform mobile application.
- **Dart:** Programming language used with Flutter.
- **Node.js + Express:** Backend framework used for API creation, authentication, and database interaction.
- **MongoDB Atlas:** Cloud-hosted NoSQL database for storing users, progress, and content.
- **Android Studio:** Primary IDE used for developing and debugging the Flutter application.

External Dependencies

- **Murf AI**: Used for generating natural, child-friendly voice prompts from Text-to-Speech.
- **SpeechAce API:** Integrated for evaluating pronunciation accuracy and providing speech evaluation feedback.
- **GitHub Repository:** Used for version control, code collaboration, and CI/CD automation.

Deployment Information

- **Backend Hosting:** Hosted on Render, providing a live server for APIs and backend logic.
- Mobile Platform Compatibility:

    - Android: version 8.0+

    - IOS: version 13.0+

Minimum Device Specifications

- At least 2GB RAM
- Built-in microphone
- Internet connectivity required for speech services