Technical Design Document

Memory Enhancer App

RELEASE 1.0

VERSION 1.0

PREPARED BY TEAM AMAZING

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Revision History

Name	Date	Reason For Changes	Version
Shawn Kelly	07/02/21	Initial release	1.0

1. INTRODUCTION

1.1. PURPOSE

The intention behind this Technical Design Document (TDD) is to produce a comprehensive look at the overall design and structure of the Memory Enhancer App. The following sections in the TDD will detail the business logic and UI of the application as well as the rationale behind decisions that were made within the scope of the project. In addition to the Stakeholder, the TDD is intended to be utilized by Software Developers, Test Engineers Project Managers, Business Analysts, and any other technical staff that is involved in the creation of the project.

1.1. OVERVIEW

About 14 million people in the United States have a disability that impairs their short-term memory (STM), which represents the different systems of memory involved in the retention of pieces of data for a relatively short time (usually up to 30 seconds). The causes of the disability range from aging to dementia to Alzheimer's. According to the U.S. Centers for Disease Control and Prevention (CDC), noticing a decline in your mental abilities ("cognitive decline") is one of the earliest signs of impending Alzheimer's disease or dementia. There is a need for solutions to assist those with STM challenges.

STM disability seriously impacts the lives of those affected, by limiting their abilities to remember crucial information when needed such as date of birth, social security number or conversation details. People, suffering from STM disability, withdraw from social gatherings and activities because of the fear to be embarrassed or ridiculed in front of others. Many of us are either impacted personally by STM disability or have loved ones impacted by it, which is where our motivation to develop a memory assistance solution for a critical and underserved market segment originates from.

To meet this need, United Global Masters Coders proposes the development of a mobile application that will provide memory reminder support to users through the speech recognition capabilities of mobile phones, thus enabling users to live a fuller life despite their disabilities.

1.2. SCOPE

The overall scope of the document is to give a low-level description of the technical design of the Memory Enhancer App while the scope of the project is to develop an application that is capable of recognizing and transcribing a specific users' words into a text file without the need to initiate the action. This is to ensure that key details that may be said in conversation are noted and can be reviewed later.

Sections 1.2.1 and 1.2.2 will cover the part of the project that are both in and out of scope.

1.2.1. IN SCOPE

- User Interface: How the application's front end will be displayed
- User Experience: How a user may interact with the application
- Business Logic: Flow of the innerworkings of the application
- Problem Solution: How we plan to solve the stated problem with the application

1.2.2. OUT OF SCOPE

- Specific Application Functions:
    - Recognizing and recording other users' voices
    - Manually writing new notes
    - Maintaining user profiles
    - Creating external database

1.3. DEFINITIONS, ACRONYMS, AND ABBREVIATIONS

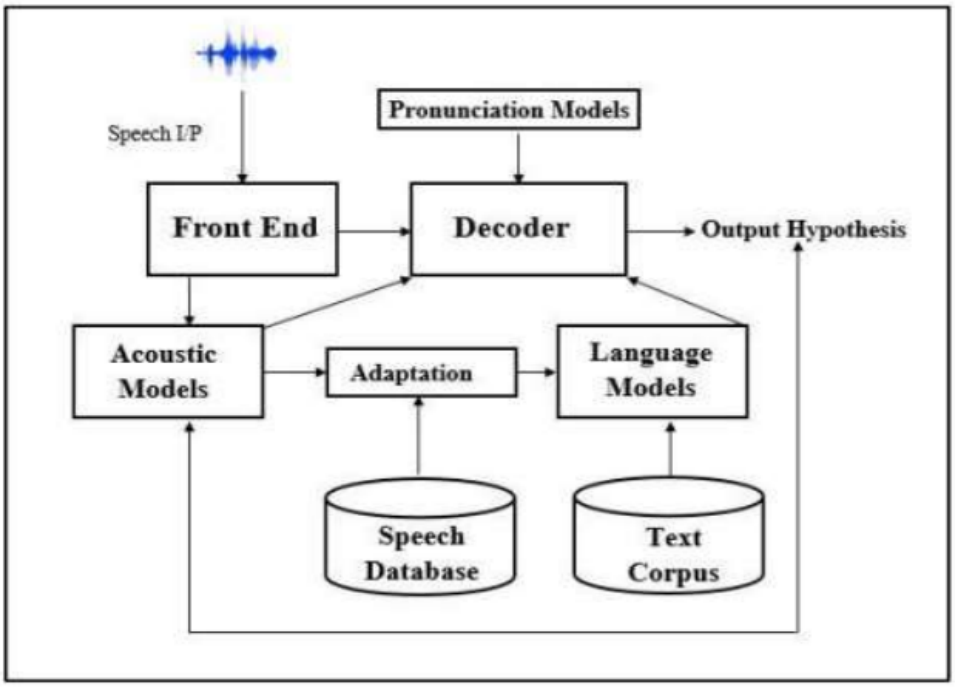
Word/Abbreviation	Meaning
API	Application Programming Interface- connection between computers or computer programs.
CDC	United States Center for Disease Control and Prevention
FAQ	Frequently Asked Questions
STM	Short Term Memory
TDD	Technical Design Document
UI	User Interface
US	United States

2. SYSTEM OVERVIEW

The Memory Enhancement application provides the user assistance with their short-term memory for up to a week at a time. This app will be able to remember important notes through voice recognition or the manual press of a button. The notes will be searchable, editable, and can be organized by subject to give the user a greater chance to remember personal information or important upcoming events. The application will utilize location storage for their encrypted notes while utilizing three services to have organic conversation begin a new note, transcribe audio to text, and playback notes in an audible form.

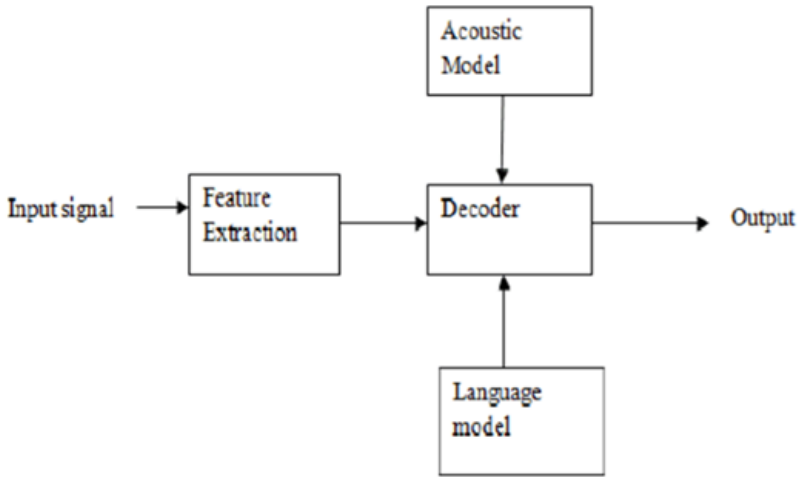
3. ARCHITECTURAL DESIGN

The System architecture design represents the conceptual design that defines the Anatomy and performance of the memory Enhance Application system. It is a formal description of the system that supports the reasoning about the structural properties of system. It also defines the system components or building blocks and system developed, that will work together to implement the overall system. Memory enhancer system is a speech-to- text application that is capable of listening to capture user's voice through a mobile phone microphone, convert the user's voice to text using an Android studio and flutter dart programing language facilities and Android hardware display system via a compactable communication protocol and then displayed the user spoken speech as a text on an LCD display. The system Architecture diagram is shown below.



System Architecture

Acoustic model is used for the voice recognition task in the transcription module. The model is used as automatic voice recognition tool to represent the relationship between the audio signal and the phonemes in the speech. The model works by taking audio recordings of speech with their text transcriptions using software to create statistical and appropriate representations of the sounds that make up each word in the speech. The hardware part of the system handles the output text display. The figure below represents the system overview.



System Overview Diagram

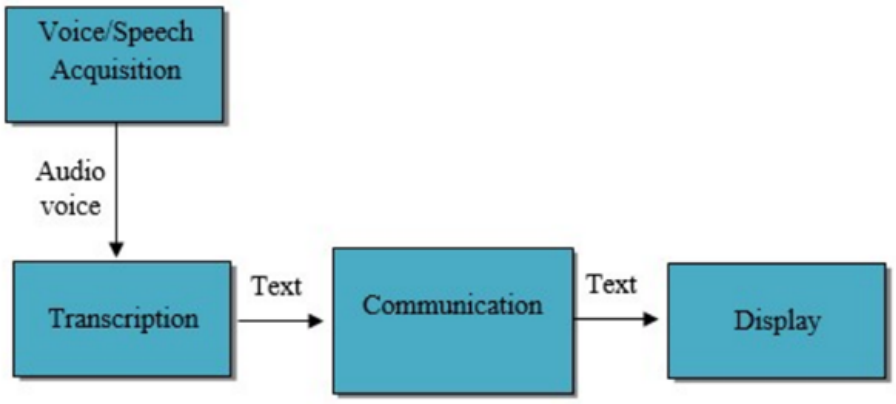
3.1. DECOMPOSITION DESCRIPTION

This system operates in phases. First, a training phase, during which the system learns the reference patterns representing the different speech sounds that constitute the trigger words of the application. Each reference is learned from spoken examples and stored in the system local storage. Second, a recognizing phase, during which an unknown input pattern, is identified by considering the set of references.

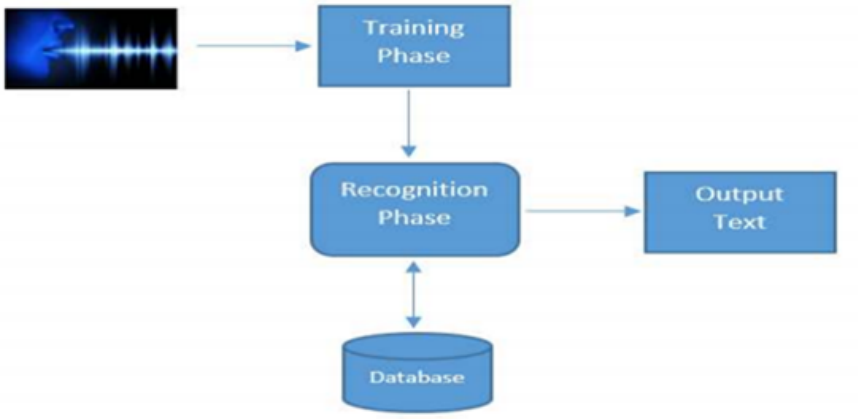
This section highlights the system development module that shows phases the system passes through to capture and display user's voice to text.

- Voice/speech Acquisition: The microphone takes the speech heard and sends it to the android app for transcription.
- Transcription: The recorded words are transcribed to English sounds through the android application with the support of Google voice engine which matched to the trigger words in the application database.
- Communication: The converted text is then sent to the android-based hardware system via applicable communication protocol.
- Display: The converted text is then displayed on LCD module.

The figures below represent the system development module, and the system recognition phases respectively.



System Development Modules



4. DATA DESIGN

Based on the system requirements, this system shall make use of its local storage and make use of SQLite database via the SQLite plunging on Flutter pub.dev. SQLite is a Database plugin for flutter. It is a highly reliable and embedded Database engine.

5. COMPONENT DESIGN

The system comprises several major components which are outlined below.

Data acquisition: consists of the microphone, audio card, and the multimedia services application programming interface (API) that provides support for the sound.

The front-end processor: analyzes a stream of digitized data and differentiates between silence, noise, and speech; it then extracts a set of computed features from the speech signals.

The recognizer. This is the speech recognition engine that accepts the computed representation of the speech in the form of feature packets which drive the Hidden Markov Models to recognize utterances.

The finite state grammar: This is a state machine that contains a representation of the vocabulary or trigger words supported by the system. Each state contains words, phrases, or sentences; their associated actions; and the information needed to transition to the next state.

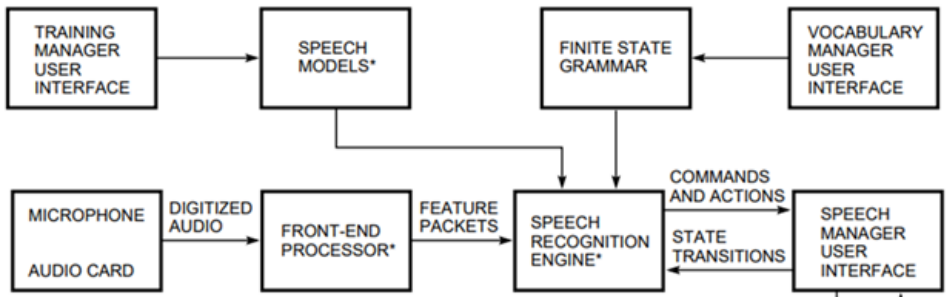
The speech models are a set of utterance models used by the recognizer. Users will enable to add trigger words using the Vocabulary Manager user interface.

The Speech Manager: is the main user-interface component. The Speech Manager window provides visual feedback to users. It also keeps track of the current window in focus and acts as the agent to control focus in response to users' speech commands.

The Vocabulary Manager user-interface window displays the current hierarchy of the finite state grammar file. The Vocabulary Manager allows the user to customize using the functions for addition, deletion, and modification of words. Also in this window, the command-utterance to keystroke translations are displayed, created, or modified.

In the Training Manager: the user may train newly created trigger words or phrases in the user vocabulary files and retrain trigger words.

The bellow diagram represents the system components block.



System Components Block

6. HUMAN INTERFACE DESIGN

6.1. OVERVIEW OF USER INTERFACE

The Memory Enhancer App User Interface (UI) will be developed using Google's Flutter UI toolkit. Upon opening the application, the user will be presented with a splash page that will have the Memory Enhancer App name displayed. The splash page will appear until the app loads, and then the home screen is displayed on the screen. When the user uses the app for the first time, the application will ask the user for permission to use the device's microphone to capture the user's voice.

Each screen of the application will contain a menu of screen choices that are represented by different icons (home for the home screen, note icon for notes screen, gear wheel for settings screen, and a question mark for the help screen). There will also be a top menu provided, three-line icon, where the user can display a menu on the right-hand side of the screen that will have links to the main screens of the app. The user will be able use their voice to record notes detailing their personal information that will stored within an encrypted text file and record notes of conversations containing important details that must be remembered. The conversational notes will also be encrypted with at least an AES 256 algorithm.

On the **Home** screen, the user is presented with a text box that states for them to "Press the microphone and start speaking." The big microphone icon is displayed for them to tap to start the recording. Also, the app is utilizing a wake word system that will listen for a wake word. If the wake word is said, then the transcribed text that is displayed in the text box is record at a reminder note. The user can hit the microphone again or it will automatically shut off when there is a big enough pause during speech recognition.

On the **Notes** screen, the user will be able to view their recorded notes in text boxes on the screen. The screen will be scrollable to view more notes. Each text box will contain one note. The user will be able to edit and delete notes from this screen. The user can click on the red X button on each of the individual text boxes to delete the note. If the user clicks on one of the delete buttons, a message will be displayed asking for confirmation on whether the user is sure that they want to delete the note. If the user double taps within a text box, the app will display the **Edit Note** screen for the user to edit the note.

On the **Edit Notes** screen, the user will be able to edit each recorded note. The note is displayed in a text box where the user can use the keyboard to make changes to the text. There is a *SAVE* option on the top right-handed side of the screen for the user to save the changes that were made. After clicking on the *SAVE* option, the screen will display a confirmation message that the changes are about to be saved to file. If the user clicks *Yes*, then the changes are saved. If the user clicks *No*, then the changes are not saved. The user is taken back to the **Edit Notes** screen.

On the **Settings** screen, the user will be able to view the trigger keywords that are saved in the system. The trigger keywords are broken down into the following: *to start recording*, *to stop recording*, and *to playback note*. Each category is shown in a text box. If the user double taps in one of the boxes, they can edit their trigger words. The user is

given the choice to save their edited/new trigger keywords by clicking on the *SAVE* option in the top right-hand side of the screen. Once *SAVE* is clicked, the screen displays a confirmation message that the keywords were saved.

On the **Help Screen**, the user is presented with a scrollable list of Frequently Asked Questions (FAQ). Here the user can find out how to properly operate the application. It will also list any reference material that would be helpful to them, such as training videos.

6.2. SCREEN IMAGES

The screens of the user interface are shown below along with explanation of what the user's experience will be on each screen. Below screens are presented for the following:

- View Home
- Show Top Menu
- View Notes
- Edit Notes
- Delete Notes
- Save Changes to Notes
- View Settings
- Save Settings
- Save Keywords
- View Help

View Home

In Figure 1, the **Home** screen is displayed. On the **Home** screen, the user will be able to start and stop recording personal notes and notes from conversations.

FIGURE 1: HOME SCREEN

Show Top Menu

In the top menu, represented by a three-line icon, there will be navigation to each screen within the app. The menu will be hidden until the user presses the icon. Once the icon is pressed, the menu rolls in from right-to-left of the screen, shown in Figure 2.

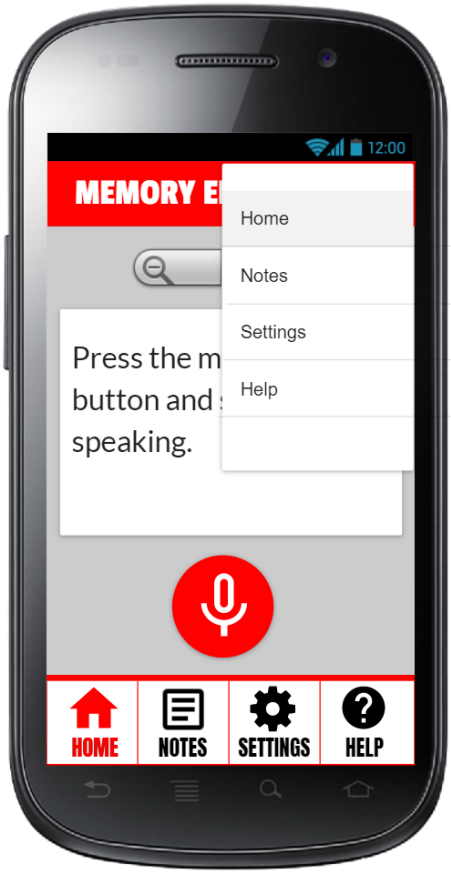


FIGURE 2: TOP MENU

View Notes

The **Notes** screen is shown in Figure 3. On the **Notes** screen, the user will be able to read notes, edit notes, and delete notes. Each note has a date and timestamp when it was recorded. The notes are shown in scrollable boxes and the text is able to be changed with the minus and plus zoom buttons at the top of the screen. On this screen, and subsequent sub-screens, a microphone is displayed in the top right-hand side of the screen for easier access to start the listening service for commands or saving notes. When the user double clicks in one of the notes text boxes, it will take the user to the **Edit Note** screen, see Figure 4, where the user will be able to edit a note.

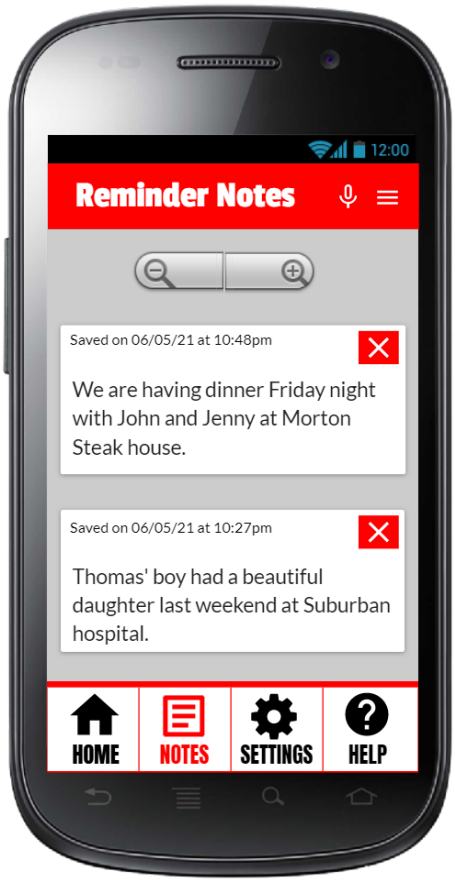


FIGURE 3: NOTES SCREEN

Edit Notes

The **Edit Note** screen is shown in Figure 4. This screen will allow the user to edit a particular note and save it to the text file. When the user clicks on *Save*, a dialog box will display with a confirmation message, see Figure 5, of whether the user is sure that the changes are to be saved or cancelled.

FIGURE 4: EDIT NOTE SCREEN

Save Changes to Notes

If the user hits NO, then the changes are not saved to file. If the user clicks YES, then the changes are saved to file.

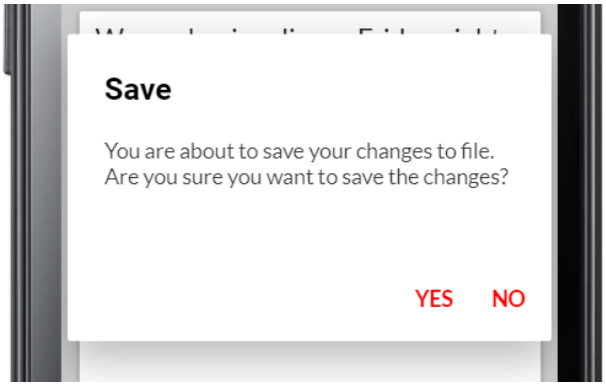


FIGURE 5: SAVE NOTE CONFIRMATION SCREEN

View Settings

On the **Settings** screen, Figure 6, users are able to read and edit their triggers words for starting recording, stopping recording, and playing back reminder notes. A message will be shown after they save any changes made, see Figure 7.

FIGURE 6: SETTINGS/TRIGGER KEYWORDS SCREEN

Save Settings

Once the user clicks on the Save option, the dialog box in Figure 7 is displayed confirming that their keywords have been saved.

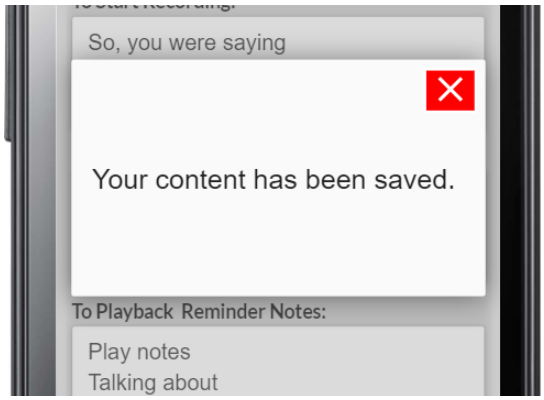


FIGURE 7: SAVE TRIGGER WORDS SUCCESS SCREEN

View Help

The **Help** screen shown in Figure 6 is where the user can search for answers on how to operate the Memory Enhancer application. On this screen, there will be a list of Frequently Asked Questions (FAQ) with details on how to accomplish the tasks within the application.

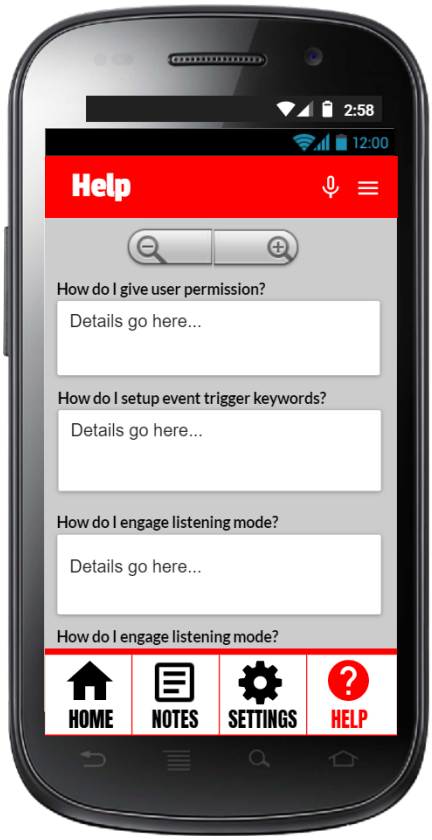


FIGURE 8: MEMORY ENHANCER APP HELP SCREEN

6.3. SCREEN OBJECTS AND ACTIONS

A discussion of screen objects and actions associated with those objects.

The three-line icon is used to represent the top menu for the app. When clicked, a menu displays on the screen with links to the screens of the application.

The *Zoom* icons allows the user to change the size of the text on the page by percentage from 0-100%. When the user clicks on the minus icon, the text on screen will decrease in size. When the user clicks on the plus icon, the text on screen will

increase in size.

When pressed, the *microphone* icon allows the user to start recording and stop recording.

The *Home* icon is a part of the bottom navigation, and it allows the user to navigate to the **Home** screen when clicked.

The *Notes* icon allows the user to navigate to the **Notes** screen when clicked.

The *Settings* icon allows the user to navigate to the **Settings/Trigger Keywords** screen when clicked.

The *Help* icon allows the user to navigate to the **Help** screen when clicked.

7. Requirements Matrix

Requirement Name	Code	Description
Request User Permission to Use the Device Microphone	R.01	Given that the user has successfully installed the Memory Enhancer application on their smartphone device and has launched it for the first time since its installation, this functionality allows the user to give the application permission to access and use the microphone of the device. A pop-up request to approve microphone use is displayed to the user with options to accept or decline. If the user declines the permission request, the application cannot function as its access to the microphone will be blocked by the device, and this is a critical component for the proper operation of the application.

Initial Setup Trigger Keywords for Recording and Playback	R.02	Given that the user has successfully installed the Memory Enhancer application on their smartphone device and has launched it for the first time, this functionality allows the user to set up the keywords that will be used to trigger the recording of the user's spoken words and to replay previously saved conversations.
Manage Trigger Keywords for Recording and Playback	R.03	Given that the user has already setup trigger keywords, this functionality allows the user to manage (add, update, and delete) the keywords that will be used to trigger the recording of the user's spoken words and to replay previously saved conversations.
Activate Conversation Listening Mode	R.04	Given that the user has successfully installed the Memory Enhancer application and completed the initial setup (i.e., allow microphone use and setting up the trigger keywords), this functionality allows the user to activate the conversation listening mode by tapping a button on the home screen or speaking the assigned trigger word.
Terminate Conversation Listening Mode	R.05	Given that the user has initiated the conversation listening mode, this functionality allows the user to terminate the conversation listening mode by tapping the same button that activated the conversation listening mode or speaking the assigned trigger word.
Transcribe and Save User's Speech	R.06	Given that the user has initiated the conversation listening mode, this functionality allows the user's speech to be listened to, transcribed, analyzed, and saved as reminder notes, if necessary. No voices other than the user's voice shall be recognized by the application.
Retrieve and Playback User's Reminder Notes	R.07	Given that the user has initiated the conversation listening mode, this functionality allows the user to seek reminder assistance from the application by uttering trigger keywords. Once the appropriate trigger keywords are recognized by the system, matching reminder notes are retrieved, synthetized, displayed and played back to the user.
Manage Reminder Notes	R.08	Given that the user has had his/her spoken words successfully converted in reminder notes, this functionality allows the user to view and manage saved reminder notes.
Navigate through the System	R.09	Given that the user has successfully installed the Memory Enhancer application, this functionality allows the user to navigate through the various views of the application (i.e., Homepage, Reminder Notes, Trigger Keywords and Help Section) using the menu bar.
Zoom In/Out	R.10	Given that the user has successfully installed the Memory Enhancer application, this functionality allows the user to zoom in and out of any area of the application currently presented on-screen for greater clarity on text and images.

Training Videos	R.11	Given that the user has successfully installed the Memory Enhancer application, this functionality provides the user with access to official training video tutorials. The expectation is that the user easily understands functional aspects of the application once the requested training video on any particular subject is viewed.
Search	R.12	Given that the user has successfully installed the Memory Enhancer application, this functionality provides the user with a way to search through saved messages. This can be done by typing a word or phrase to search for or by using a voice queue.