EMPOWERING THE VISUALLY IMPAIRED WITH A MOBILE APPLICATION FOR DOCUMENT READER

BY

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A REPORT

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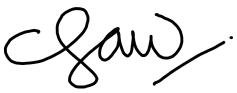

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ABSTRACT

In a rapidly evolving digital age, accessibility to information is a fundamental right that should extend to everyone, including individuals with visual impairments, who often encounter significant challenges in accessing text content during their daily lives. This project introduces a user-friendly and cross-platform mobile application designed to empower visually impaired individuals by providing them with a versatile tool for accessing and comprehending printed or written content, ultimately aiming to enhance their accessibility to the surrounding environment and promote their integration into various aspects of life.

Leveraging the Optical Character Recognition (OCR) and Text-to-Speech (TTS) technologies, the application seamlessly converts images containing text into speech output. OCR technology extracts text from images, while TTS technology converts the extracted text into speech. This innovative combination eliminates barriers to information, enabling visually impaired individuals to engage with their surrounding environment more actively. By addressing the limitations of previous studies and focusing on inclusivity, this project aspires to make a meaningful impact on the lives of visually impaired individuals, offering them independence and a sense of integration into a visually rich world. This project aims to cater to the diverse needs of visually impaired individuals, utilizing from the insights gained from the review of other works in the field.

Overall, through innovative technology, this application strives to bridge the information gap and enrich the daily lives of individuals with visual impairments, thereby fostering a greater sense of independence, confidence, and involvement to their surrounding environment and the broader world.

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LIST OF ABBREVIATIONS

OCR	Optical Character recognition
TTS	Text-to-Speech

Chapter 1

Introduction

In today's rapidly changing society, accessing information has become increasingly effortless for most individuals. However, for some individuals with disabilities, especially those who are visually impaired, this can be a significant challenge. What may be considered routine for many like reading articles, can be a daunting task for them. Braille, a tactile writing system used by blind individuals, has long been a vital tool for facilitating reading and writing. Although they have their own Braille system, its limitations and the lack of Braille translations for commonly use content underscore the need for alternative solutions. Many visually impaired individuals rely on Braille for reading, yet its utility is limited by the lack of resources and the considerable effort required for translation. Additionally, the vast majority of documents and resources available in the market lack of Braille version and translations [1], this further exacerbating the accessibility gap. Thus, this project introduces a mobile application aimed at enhancing the accessibility of textual content for visually impaired individuals.

Optical Character Recognition (OCR) represents a facet of computer vision employed by the mobile application to interpret textual content. Utilizing OCR algorithms, the software scans images or documents and extracts text from them. Another core technology is Text-to-Speech (TTS), which holds significant importance within this project. TTS serves as recognition software that transforms written text into spoken language through linguistic processing and text-to-speech conversion, this technique is also known as computer speech recognition.

In this project, the application harnesses advanced computer vision technologies, including Optical Character Recognition (OCR), to interpret textual content. OCR algorithms enable the software to scan images or documents and extract text from it. Besides that, the application utilizes Text-to-Speech (TTS) technology, which plays a central role in converting the extracted text into spoken language, enhancing accessibility for visually impaired users. In addition to its core functionalities, the

application also includes an translation feature that allows users to translate extracted text into multiple languages, thereby breaking down language barriers and further expanding its utility for users with diverse linguistic needs.

1.1 **Problem Statement and Motivation**

Visually impaired individuals encounter numerous challenges in their daily activities, which often hindering their participation in various aspects of life. These challenges include:

- Limited access to Braille material and content

The limited access to printed material experienced by visually impaired individuals is the core problem. in this era marked by the digital accessibility, this community still facing the obstacles to when reading the printed resources, product label and daily documents. Due to the lack of accessible printed materials and the logistical hurdles associated with obtaining Braille versions, there can be a challenge for those who are visually impaired. Despite the importance of Braille in facilitating reading for blind individuals, the availability of resources in Braille format remains limited. According to data from the Musee Louise Braille, only 10% of websites are made usable for the blind and visually impaired, and 6% of books are accessible in Braille version [2]. Besides, the lack of Braille writing impacts the ability of visually impaired individuals to access information and news both within and outside the country. Therefore, improving the availability of information in Braille would provide visually impaired individuals with opportunities to gain knowledge and enhance public access for this group [3].

- Challenges of learning Braille.

Braille is a form of written language for visually impaired. It represented the pattern of raised bit that can be fell with the fingertips. Braille is a tactile reading system but it confronts two major issues which is Braille can only accessible to those who specialized educated with training [1]. This is a time-consuming endeavor, and it may not be given opportunity to all individuals to receive such training as there must be a lot effort in it. Second, there is a significant information gap because most written resources in public

domain are not available in Braille format, further limiting the opportunities for visually impaired to access information independently.

- Smart devices accessibility challenges.

The accessibility of smartphones also present difficulties for visually impaired individuals. Screen combined with touch screen interface and visually focused apps increase the challenge to navigate and interact with the phone application. This might be a big challenge for visually impaired as smartphone user interfaces rely on touch movements and visual cues. These barriers limit their ability from using smartphone, which effecting on their daily activities and education.

Considering the challenges faced by visually impaired individuals in accessing essential information and navigating unfamiliar environments, the motivation behind this project is rooted in the vision of creating a world where accessibility knows no boundaries. Individuals who are visually impaired frequently encounter difficulties and confusion when adapting into new environments. These situations can lead to feelings of discomfort and insecurity as they struggle to gather essential information about their surroundings. Their anxiety increases by the lack of accessible knowledge, which also makes it challenging for them to interact with foreign environments independently and confidently. In essence, the aim of this project is driven by a visio of a world which accessibility has no limitations. Through this initiative, hope that this project will make this vision a reality, improving the lives of those visually impaired and advocating for a more inclusive and equitable society.

1.2 Objectives

The project goal is to develop a comprehensive mobile application meet to the needs of visually impaired individuals, with the main objective of enhancing their accessibility, independence, and involvement in daily activities.

The objectives of the project:

- **To facilitate users with visual impairments to access textual content more easily.**

This project is to develop a mobile application that empowers visually impaired to effortlessly access to text content from various materials such as printed resources and digital displays. This objective will enhance the independency and association of visually impaired individuals in their daily lives. By leveraging technologies such as Optical Character Recognition (OCR) and Text-to-Speech (TTS), the application will enable users to effortlessly convert printed text into audible speech. Additionally, the application will feature a translate function, allowing users to translate extracted text into multiple languages, thereby breaking down language barriers and further expanding its utility. This innovative solution will enhance the independence and autonomy of visually impaired individuals in their daily lives, allowing them to navigate their surroundings with greater ease and confidence.

- **To enhance daily activities of visually impaired by promoting greater accessibility and involvement with surroundings.**

In order to empower visually impaired users to participate more confidently and actively with their surroundings. This project allows users to access contextual information about their surroundings, receive real time assistance and navigate public spaces more independently. This will be contributing to an improvement in the quality of life to all users.

- **To develop a cross-platform mobile application.**

User-friendly and cross-platform mobile application that enable the compatibility with both Android and iOS devices users with consistent and accessible user experience. Project design will be simplicity and user-friendliness in mind, providing a clear interface across all platforms.

1.3 Project Scope and Direction

The aim of this project is to develop a mobile application that enhances the daily lives of visually impaired individuals who require assistance in accessing and

comprehending printed or written content. The project application will extract text from captured images and convert it into voice output, promoting increased efficiency in their daily activities. The feature and functionalities of the mobile application should have;

- Users will be able to capture images using the device's camera directly within the app.
- Upon capturing an image, the app utilizes OCR technology to automatically extract text from the image.
- The extracted text will be displayed within the app's interface, enabling users to review and navigate through the text content, including scrolling for longer documents.
- With Text-to-Speech (TTS) technology, allowing users to listen to the extracted text with clear and customizable voice output. Users can adjust the volume, pitch, and speed rate of the speech engine to suit their preferences.
- Users can translate the extracted text into multiple languages directly within the app. They have the ability to select the desired target language for translation.

1.4 Contributions

This project is dedicated to empowering visually impaired individuals by leveraging advanced OCR, TTS technologies, and a translation feature. By seamlessly integrating these functionalities, the project significantly improves accessibility to information and enhances understanding of surroundings. The key contributions include not only promoting independence and facilitating environmental awareness but also addressing language barriers to remove educational and professional obstacles. The user-centered design and adherence to accessibility standards ensure inclusivity, empowering visually impaired fully engage with their surroundings and access essential information in various environments. By providing the translate feature, the project enables users to adapt to different environments and engage with content in their preferred language,

fostering greater independence and integration. This project represents a meaningful step towards a more inclusive and informed world for the visually impaired.

1.5 Report Organization

This report is organized into 7 chapters: Chapter 1 Introduction, Chapter 2 Literature Review, Chapter 3 System Methodology, Chapter 4 System Design, Chapter 5 System Implementation, Chapter 6 System Evaluation and Discussion, and Chapter 7 Conclusion and Recommendation. Chapter offers an introduction to the mobile application for Document Reader which include problem statement, objectives, scope, contributions, and the organization of this report. Chapter 2 is about the literature review, examining the existing app and article, concluding with a summary. Chapter 3 outline the proposed method, system requirements and project timeline. Chapter 4 discuss about system model and focus on the system design, presenting a range of diagram and wireframe. Chapter 5 cover the system implementation, setup, and the showcasing of system operation. Chapter 6 evaluates the system through black box texting. Lastly, Chapter 7 provide a conclusion and recommendation.

Chapter 2

Literature Review

2.1 Review on existing Apps and Article

There are several document and text reader applications available in the market catering to the needs of users, each offering unique features and functionalities aimed at enhancing accessibility and improving the reading experience. In this literature review, three such applications, along with an article have been explore and discuss assistive technologies. It is important to examine the strengths and limitations of these applications and the insights provided by the article to gain a comprehensive understanding of current trends and challenges in the field of accessibility technology for visually impaired individuals.

2.1.1 Seeing AI

Seeing AI is a mobile application developed by Microsoft, the app can describe people, things, scene and text to help visually impaired users understand the world. This innovative app uses artificial intelligence (AI) to provide a real-time audio explanation of user's surroundings, granting people with visual impairments a new degree of accessibility and independence. [3]

One of the outstanding functions is the Short Text Mode. It provides users a quick and efficient access of short text in their surroundings. The app quickly scans and recognizes text in the camera field of vision using OCR technology. This function broadens the horizons of visually challenged people, giving them a greater ability to access to gather the information in their surroundings. For example, users can easily determine the label of the food package, understand the content and read a brief message with minimal effort (Figure 2.1.1.1).

Besides Short Text Mode, Seeing AI also provide a Document Reader Mode, which designed for reading and understanding longer texts such as article and printed material. This mode provide an efficient to visually impaired users when they want to read a lengthy content. Through the implementation of advanced edge detect OCR technology and with the collaboration of audio guidance, the app start to detect, scanning and identifying the text in the chosen region. It has the ability to preserve the style and maintain the structure together with the formatting of the document, ensuring the reading experience.

In short, Seeing AI's Short Text and Document Reader mode demonstrate the ap efficiency in meeting various of situation and a improved reading experience for those visually impaired individuals.

Strengths of Seeing AI

- Real-time Text Recognition

  The capability to speak short text as soon as it appears in front of the camera enhances users' independence and efficiency in accessing information in their surroundings.

- Ease of Use

  Designed with a user-friendly and clean interface, making it easy to navigate.

Weakness of Seeing AI

- Dependency on Internet Connection

  Some features, like cloud-based image processing for text recognition, require a stable internet connection, limiting usability in areas with poor network coverage.

- Platform Limitation

Currently available only for iOS devices, restricting accessibility for users on Android devices.

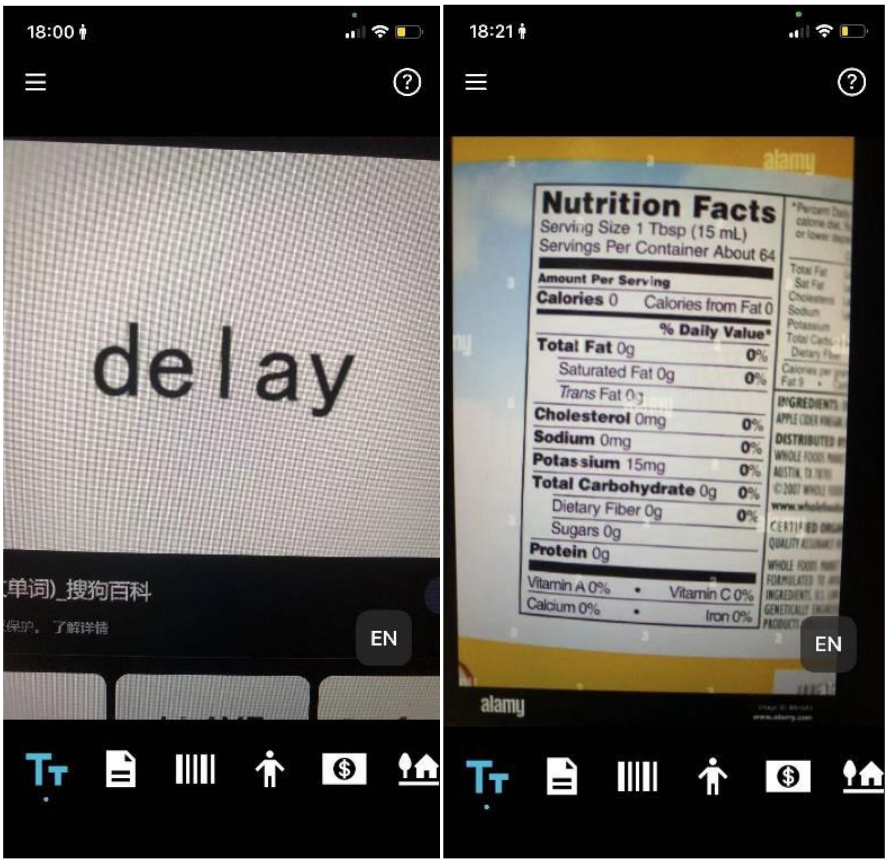

Figure 2.1.1.1 Seeing AI on capture image

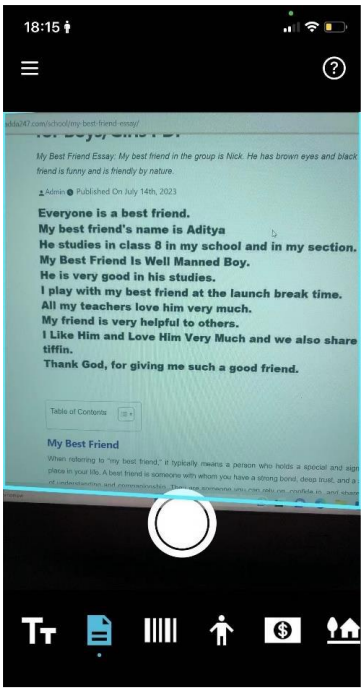

Figure 2.1.1.2 Document Reader

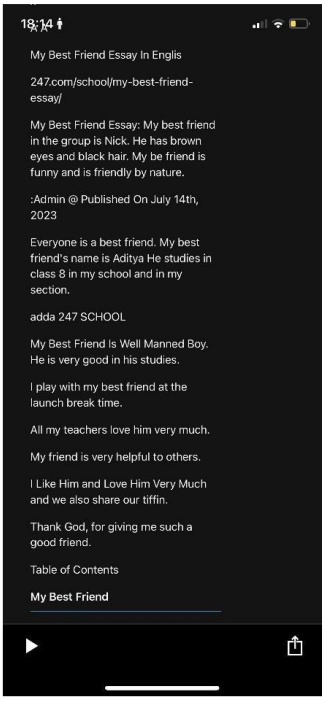

Figure 2.1.1.3 Extracted Text

2.1.2 Speechify Text to Speech Voice

Speechify is a mobile application that read text using computer-generated voice which convert printed text or physical books into audio using ORC technology. This application is founded by Cliff Weitzman, which is a word blindness college student at Brown University. The very first version of the App is to keeping up with class reading. Speechify turns written text into spoken words in natural-sounding language with the implement of TTS technology. This program removes the barrier for people who struggling with reading and individuals who rely on auditory information especially as those who have visual impairment.

Scan Pages function allow user to convert books and document to audio with the granted permission of camera. Once the text is within Speechify, TTS technology narrate the text content into a clean and natural voice. To ensure a personalized listening experience, users have the flexibility to adjust the tempo, pitch and even the voice of output to meet their preferences.

Speechify enables users to access and interact with a wide range of textual content without the limitation of conventional reading. Additionally, it promotes a greater independence for visual impairments by offering the access to printed information that was previously challenging to obtain.

Strength of Speechify

- Realistic AI Voice

  Offers the most realistic and human-like voices with native-sounding accents.

- Accessibility Features

  Adjustable playback speed, highlighting of text being read, and easy capture of progress.

Weakness of Speechify

- Subscription-Based Model

  Requires users to pay a subscription fee to access premium features and unlimited app usage.

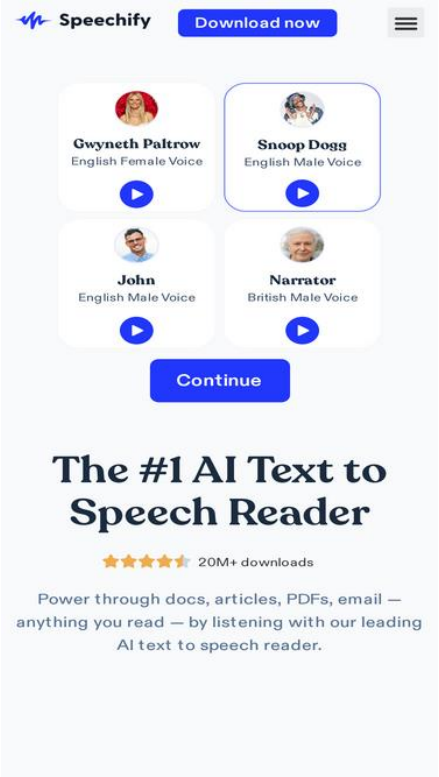

Figure 2.1.2.1 Speechify intro

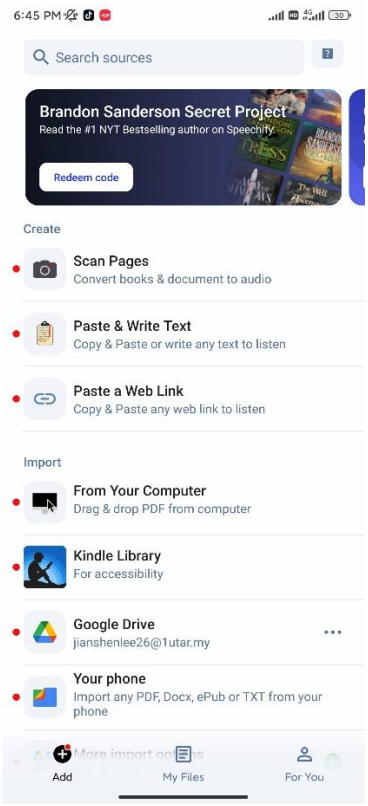

Figure 2.1.2.2 Speechify MainPage

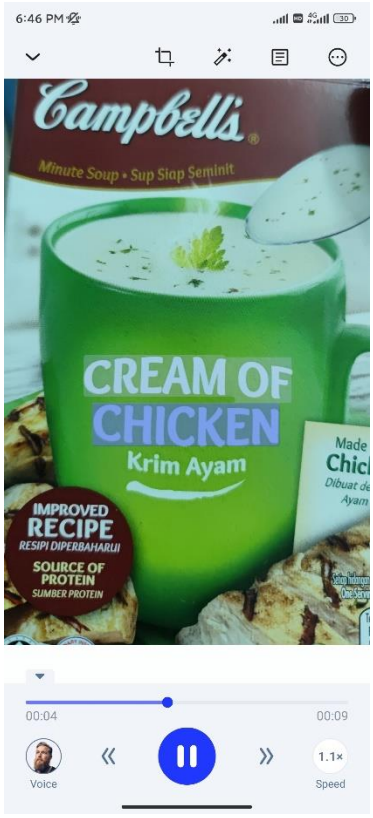

Figure 2.1.2.3 Speechify voice output

2.1.3 NaturalReader – Text to Speech

Natural Reader is flexible TTS mobile application that designed to make written content more accessible for a variety of users. The application was developed by Vancouver, BC, Canada, Natural soft Ltd. Natural Reader was created with the goal of improving transparency to written information, creating a level playing field for all readers.
This application achieves this by utilizing cutting-edge text-to-speech technology, ensure that the textual content is conveyed in a interesting and simple way to understand.
Natural Reader play a crucial part in improving visually impaired users' daily life by providing them a effective way to access to written content. It provides a alternative solution for anyone who trouble in reading written document. Natural Reader incorporates OCR technology, which allowing user to transform scanned material into digital text. OCR functionalities enhance the accessibility by converting textual content into spoken audio, thus benefiting visually impaired individuals.

Strength of Natural Reader:

- Customization Options

  Provides a range of customization options, allowing users to adjust voice speed, pitch, and volume to suit their preferences.

- Wide Language Support

  Supports multiple languages and accents, enhancing usability for users worldwide.

Weakness of Natural Reader:

- Free User Limitation

  Offers only a daily limit of 2000 page views and 500 text-to-speech requests per day, potentially impacting users with moderate text conversion needs.

Figure 2.1.3.1 Natural Reader TTS output

2.1.4 Text Reader for Visually Impaired Person

In the article [3], stated that visual impairment affects a significant portion of the global population. There are approximately 1.3 billion of people struggle with vision impairment challenges. Traditionally, Braille has been used by people with visual impairments to read printed text, but this method has limitation, particularly when the content is not available in Braille. Meanwhile, a professional reading electronic solution have frequently been unaffordable. Thus, the gap in accessibility has spurred the development of a mobile application designed specifically for visually impaired individuals.

To address the challenges faced by visually impaired individuals, our proposed mobile application leverages advanced technology to make printed materials accessible. The core functionality of the application involves capturing images of printed material using a mobile camera and converting these images into text through Optical Character Recognition (OCR). Subsequently, the converted text is seamlessly transformed into speech using Text-to-Speech (TTS) technology. This innovative approach empowers visually impaired individuals by providing auditory access to printed material, even if it's not available in Braille. The user-friendly design ensures ease of navigation, and audio guidance is incorporated to assist users throughout the application's process. By harnessing the power of smartphone technology, our application offers a convenient and cost-effective solution, bringing accessibility to the fingertips of visually impaired individuals. It overcomes the limitations of Braille, offering a versatile tool for accessing a wide range of materials and ultimately enhancing independence and quality of life for those with visual impairments.

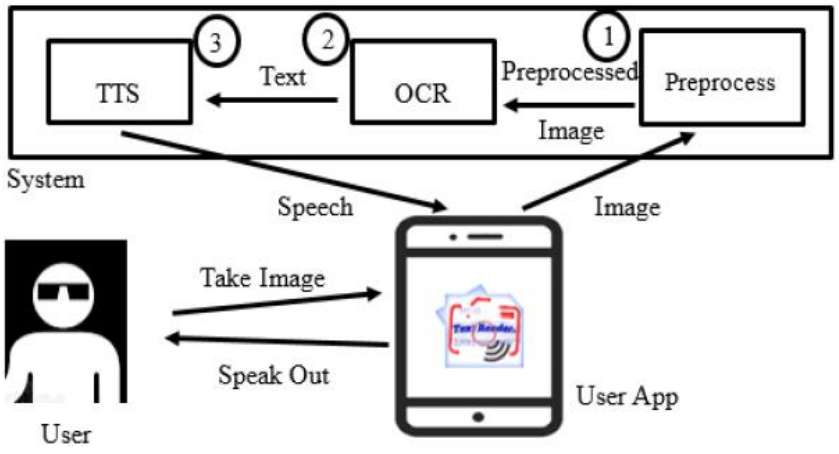

Figure 2.1.4.1 System Architecture of Text Reader

2.2 Summary of Previous Studies

Certain apps, such as Seeing AI, Speechify, and NaturalReader, offer an impressive array of features for assisting individuals with visual impairments. However, the fact that some of these apps are only available on specific platforms prompts questions about inclusivity and accessibility. For example, Seeing AI is currently limited to iOS devices, while Speechify and NaturalReader may have platform-specific features or limitations. Expanding support to Android and other platforms would greatly enhance the reach and user-friendliness of these apps, ensuring that a broader user base can benefit from their valuable features.

Furthermore, while these apps boast user-friendly interfaces and customizable options, they also have their limitations. For instance, Speechify's subscription-based model may pose financial challenges for some users, potentially limiting access to premium features and unlimited usage. Similarly, NaturalReader's free user limitations, such as a daily cap on page views and text-to-speech requests, may impact users with moderate text conversion needs.

Moreover, previous studies have highlighted the complexity of user interfaces within certain applications. While apps like Seeing AI strive to provide intuitive and clean interfaces, challenges may arise, particularly in crowded layouts and small text. This defect in design can lead to user frustration and inefficiency, especially for individuals with visual impairments who rely on touch-based interactions. To improve the overall user experience and ensure comfortable and successful use for visually impaired users, addressing interface design issues is imperative.

Chapter 3

System Methodology/Approach

The development of the document reader application is categorized into few phrases which involves the key steps of gathering requirement, analysis, algorithm selection, design, implementation and deployment.

3.1 Methodology

This project will be developed using OCR and TTS approach to create a comprehensive document reader application. Additionally, the application will incorporate a translation feature, allowing users to translate extracted text into multiple languages. In the early stage of development, OCR algorithms will be implemented using Google ML kit vision API. This initiative is to leverage the on-device text recognition capabilities, ensuring the on demand extraction of textual content from image and document captured. 'google_ml_kit_text_recognition' package was integrated to driven the efficient of OCR functionality. The flowchart of OCR algorithms will be shown is Figure 3.1.1

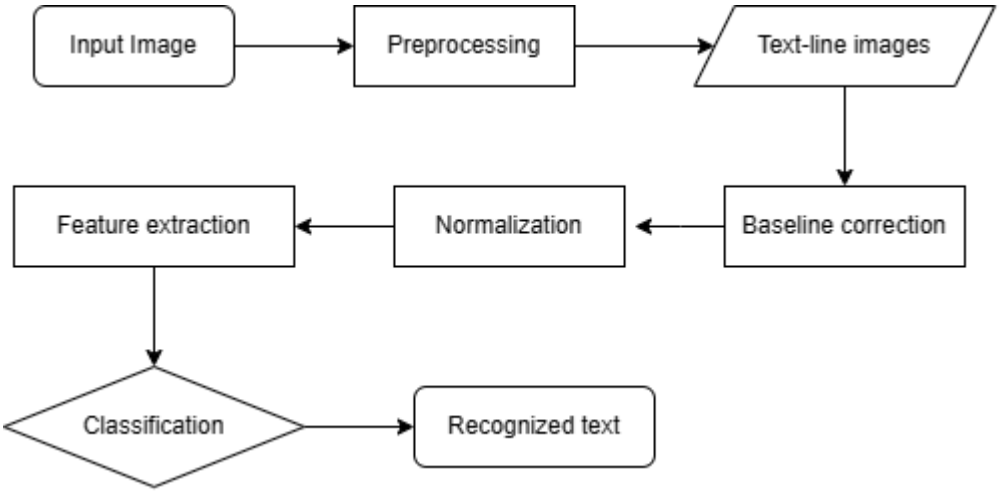

Figure 3.1.1 OCR algorithm flowchart

Besides, the TTS algorithm was integrated into the system to form a complete document reader application. TTS package of ‘flutter_tts’ will be used to convert the extracted text into auditable speech. The flowchart of TTS algorithm will be illustrating the process in Figure 3.1.2. This functionality enhancing the accessibility and provides visually impaired a better reading experience.

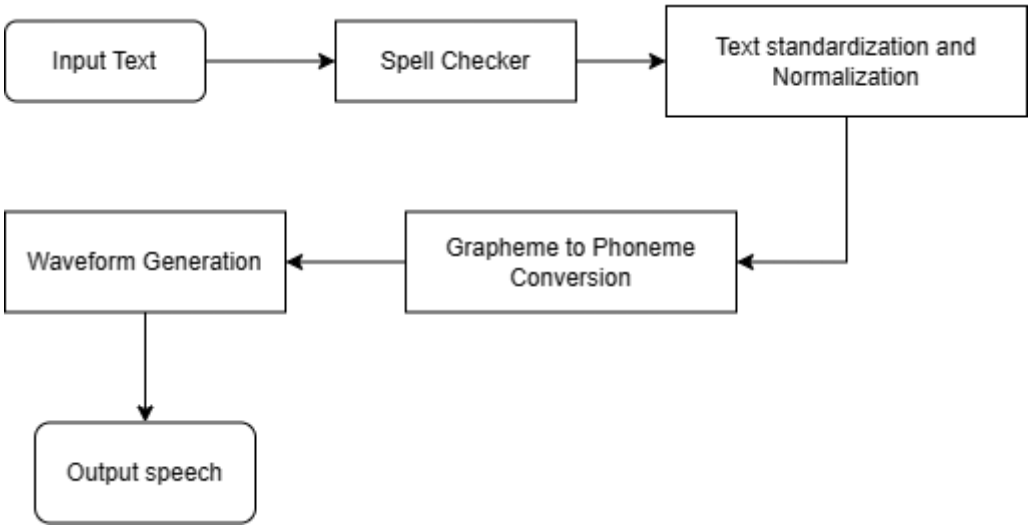

Figure 3.1.2 TTS algorithm flowchart

Additionally, the translation feature of the application utilizes the 'translator' package version 1.0.0, available on Flutter's pub.dev platform. This package enables users to seamlessly translate extracted text into multiple languages, enhancing accessibility and inclusivity for visually impaired individuals. The flowchart of translator module will be shown is Figure 3.1.1

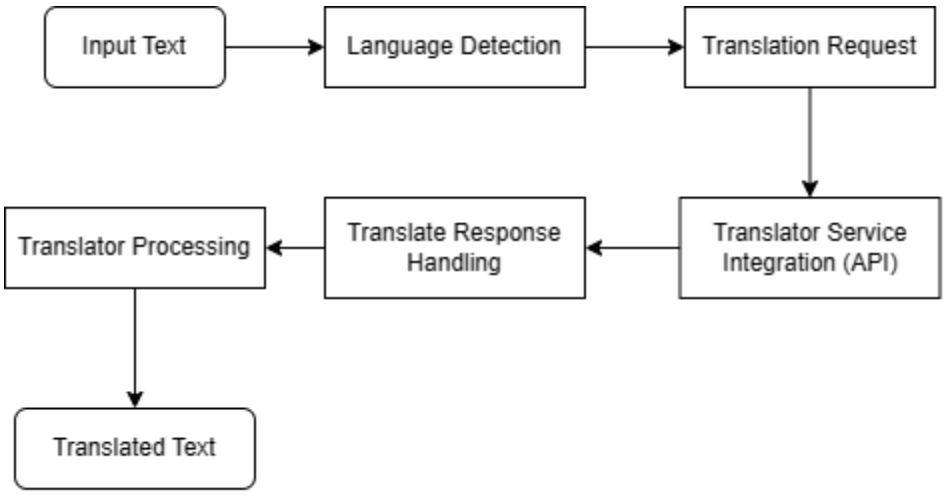

Figure 3.1.3 Translator Module flowchart

3.2 System Requirement

The hardware involved in this project is laptop and iOS/android mobile device. The coding process, testing and debugging is done by using laptop. While the mobile device is to demonstrate the project and showcasing the mobile application's functionality.

Description	Specifications
Model	Dell Inspiron 15 3000
Processor	11th Gen Intel(R) Core (TM) i5-1135G7
Operating System	Windows 11
Graphic	Intel(R) Iris(R) Xe Graphics
Memory	16BG DDR4 RAM
Storage	500GB SSD

Table 3.2.1 Specification of the laptop

3.2.2 Software

The development environment consists of Flutter which for cross platform mobile applications development. Visual Studio Code act as the IDE for coding and debugging. While the testing part is facilitated by Android Emulator provided by Android Studio.

Tool: Flutter, Visual Studio Code, Android Studio
Programming Language: Dart
Software module: OCR, TTS, Translator

3.3 Timeline

3.3.1 Timeline FYP1

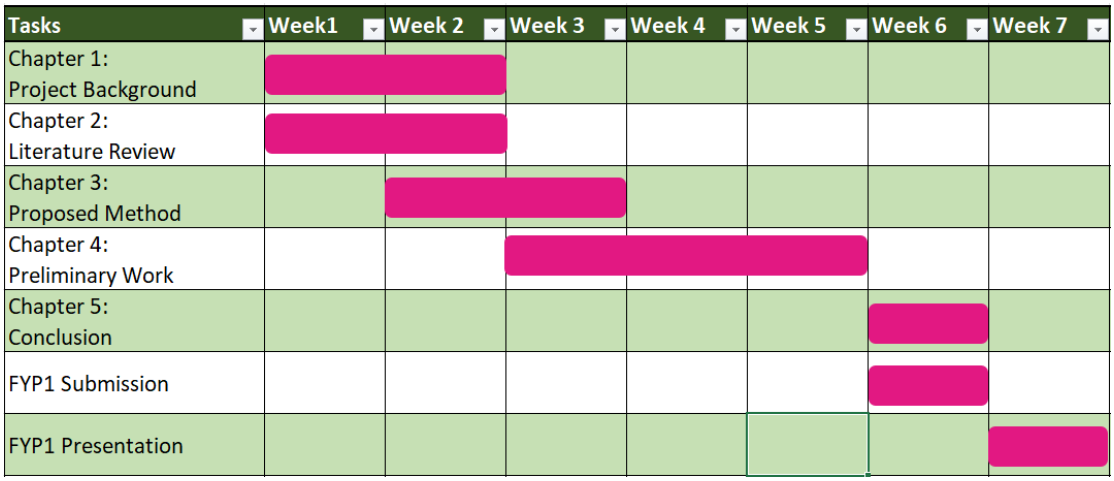

Figure 3.3.1 FYP1 Timeline

3.3.2 Timeline FYP2

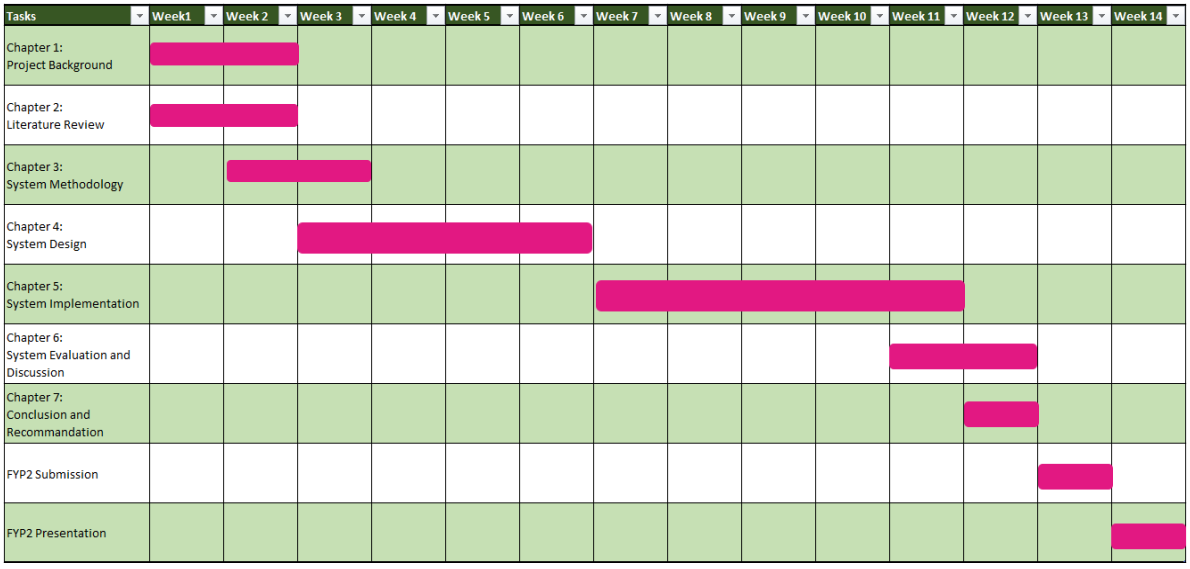

Figure 3.3.2 FYP2 Timeline

Chapter 4

SYSTEM DESIGN

4.1 System Architecture Design

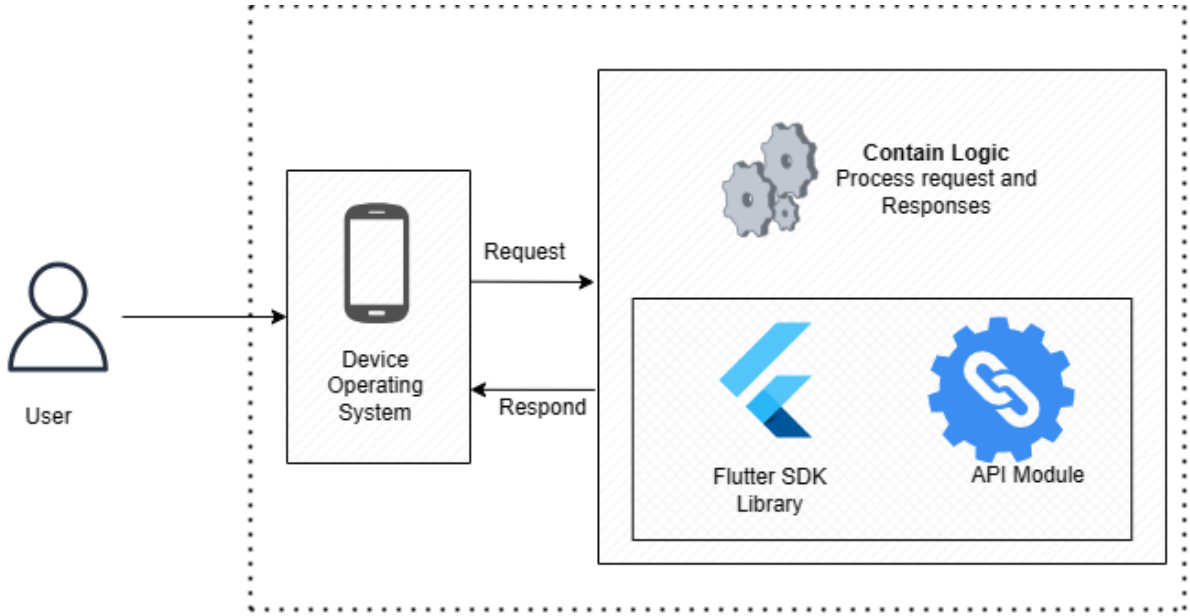

Figure 4.1.1 System Architecture Diagram

The architecture of our application is designed to ensure seamless interaction between the user interface and the underlying functionality. At its core, the architecture consists of several layers: the user interface layer, the logic layer, the SDK layer, and the API module.

The user interface layer serves as the entry point for user interactions, allowing users to input requests and receive responses. These requests are then passed to the logic layer, which handles the processing of requests and generation of appropriate responses.

Once processed, the requests are transmitted to the SDK layer, where they interact with the application's core functionality and services. This layer facilitates the integration of various features such as OCR, TTS, and translation capabilities.

Additionally, the requests may also interact with the API module, enabling access to external services or resources. This modular design allows for flexibility and scalability, as new features or services can be easily integrated into the architecture.

4.2 Use Case Diagram and Description

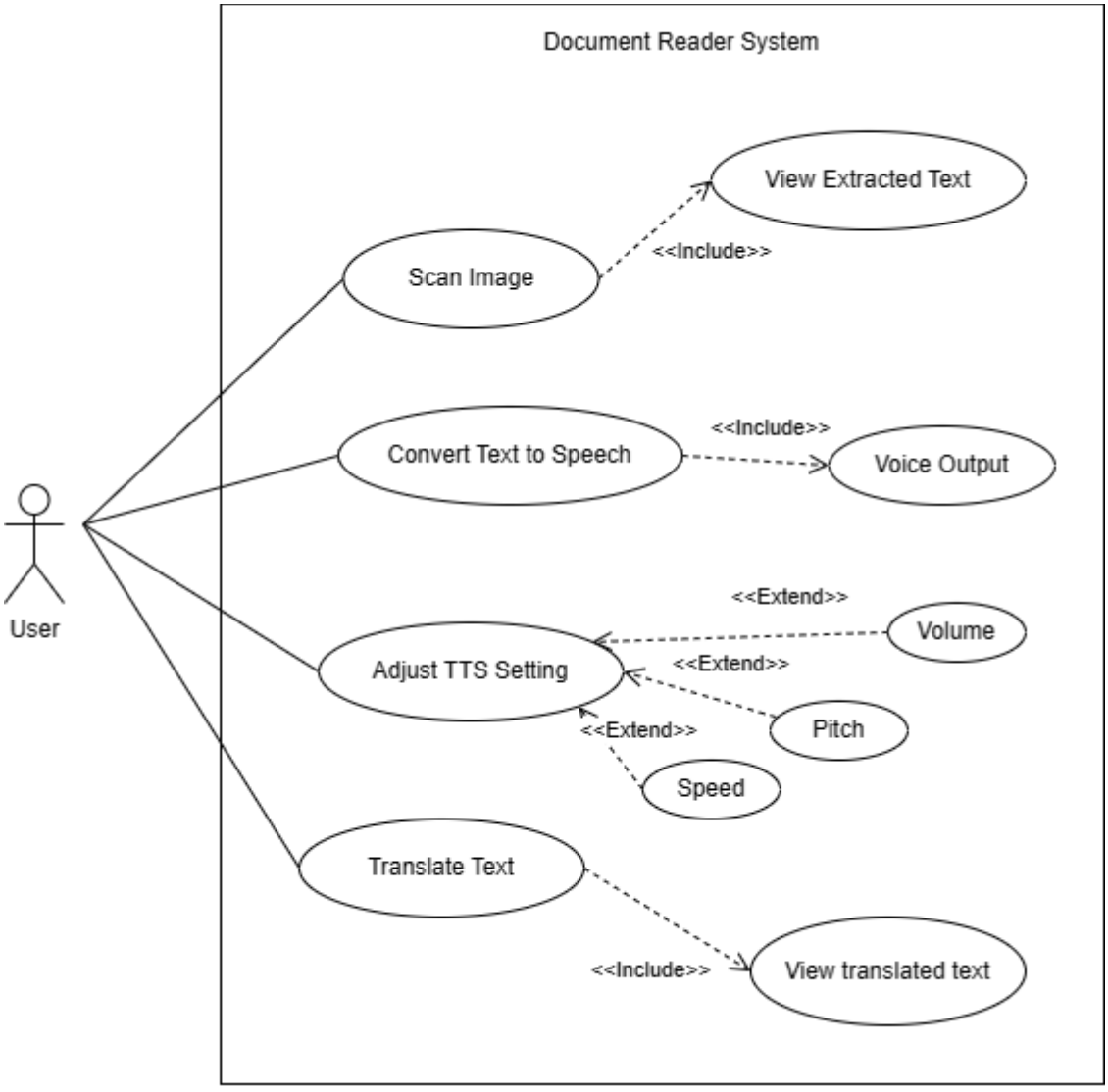

Figure 4.2. Use case diagram of Document Reader application

Use Case Description

Use Case Name	Scan Image and Extract Text	**ID:**	001
Description	This use case allow user to capture image that contain text using device's camera functionality. Then precess image using OCR technology to extract text from image.		
Actor	User		
Precondition	User has launched the application and granted camera permission.		
Normal Flow	1. The user initiate the application.		
	2. The application active device camera the display viewfinder.		
	3. The user capture an image containing text and press 'Scan Image' button		
	4. The application process the captured image using OCR technology to extract the text		
	5. The extracted text is displayed at the result screen for user to view and interact with.		

Table 4.2.1 Scan Image and Extract Text

Use Case Name	Convert Text to Speech	**ID:**	002
Description	This use case enable the use to convert the extracted text into audible speech using TTS technology. The application utilizes the algorithm to generate speech output from text.		
Actor	User		
Precondition	Successfully extract text from image using OCR functionality.		
Normal Flow	1. The user select 'speak' button to trigger TTS function.		
	2. Extracted text will then pass through the TTS algorithm to generate spoken audio.		
	3. The generated speech is played through the devise audio output.		

Table 4.2.2 Convert Text to Speech

Use Case Name	Adjust the TTS setting	**ID:**	003
Description	This use case allow user to adjust the setting related to the TTS functionality. User can customize the parameter such as volume, pitch and speed rate according to their preferences.		
Actor	User		
Precondition	Application successfully extract text from image using OCR functionality and accessed the TTS functionality.		
Normal Flow	1. The user navigate to the TTS setting section within the application.		
	2. The application presents the option for adjust such as volume, pitch and speed rate.		
	3. User adjust the selected parameter using interface control, such as slider.		
	4. The user confirm the change by clicking on the 'Apply' button.		
	5. The application update the TTS setting based on user's adjustment.		

Figure 4.2.3 Adjust TTS setting

Use Case Name	Translate text	**ID:**	004
Description	This use case enable the user to translate the displayed text from one language to another using translation functionality. User can choose the preferred language to translate the text.		
Actor	User		
Precondition	Application successfully extract text from image using OCR functionality.		
Normal Flow	1. User select their preferred language from translate feature.		
	2. The application process the translation request by sending the display text to translator function.		
	3. The application convert the text form the source language to target language.		

Figure 4.2.4 Translate Text

4.3 Activity Diagram

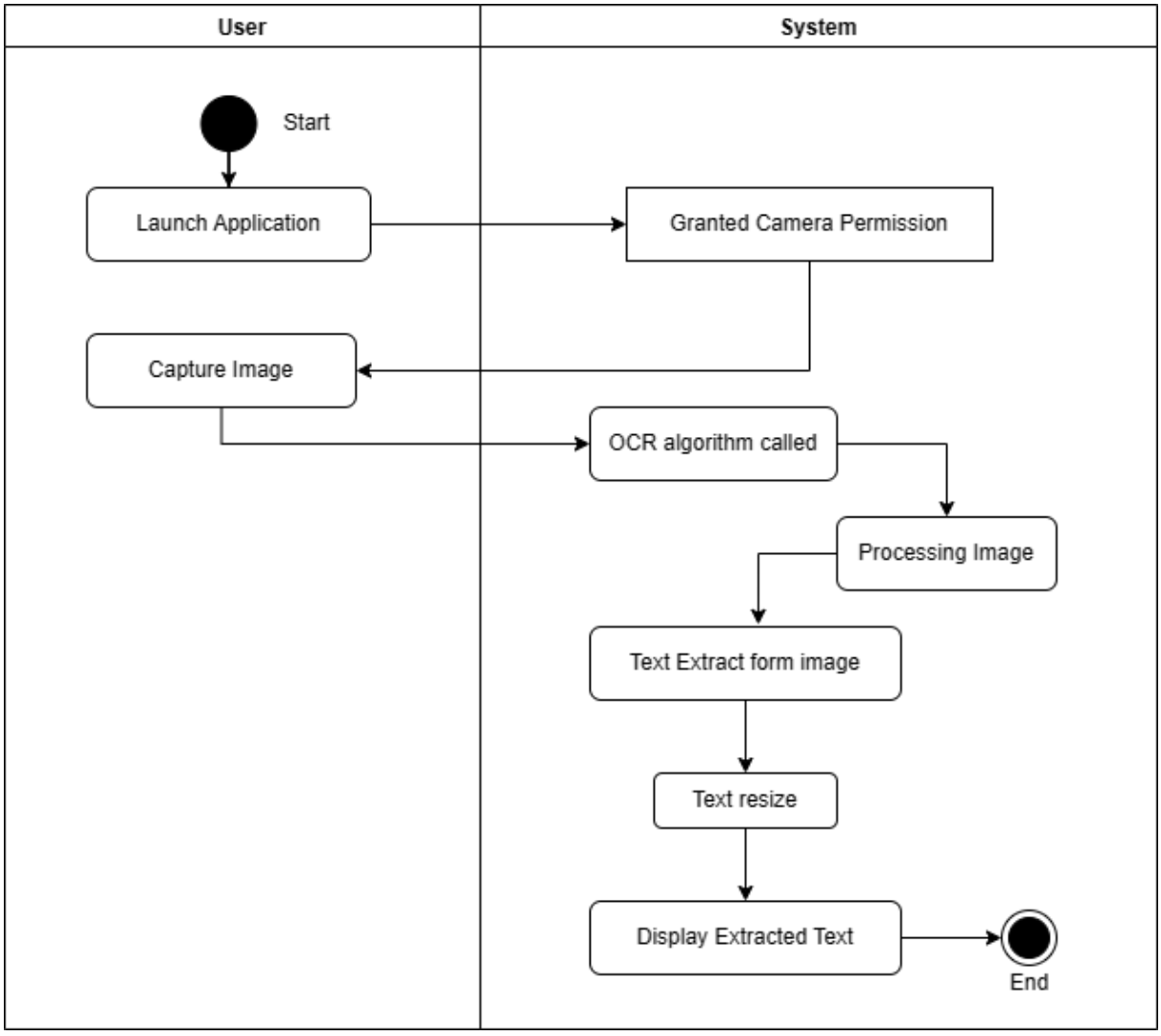

Figure 4.3.1 Activity Diagram of Scan and Extract Text

The activity diagram illustrates the step-by-step procedure for scanning and extracting text within the app. It begins with the user initiating the process by launching the application. Upon launch, the system prompts the user to grant camera permissions. Once permissions are secured, the user proceeds to capture an image using the device's camera. The system then employs Optical Character Recognition (OCR) technology to extract text from the captured image. Subsequently, the extracted text undergoes

resizing by the system to ensure optimal presentation. Finally, the resized text is displayed within the app's interface,

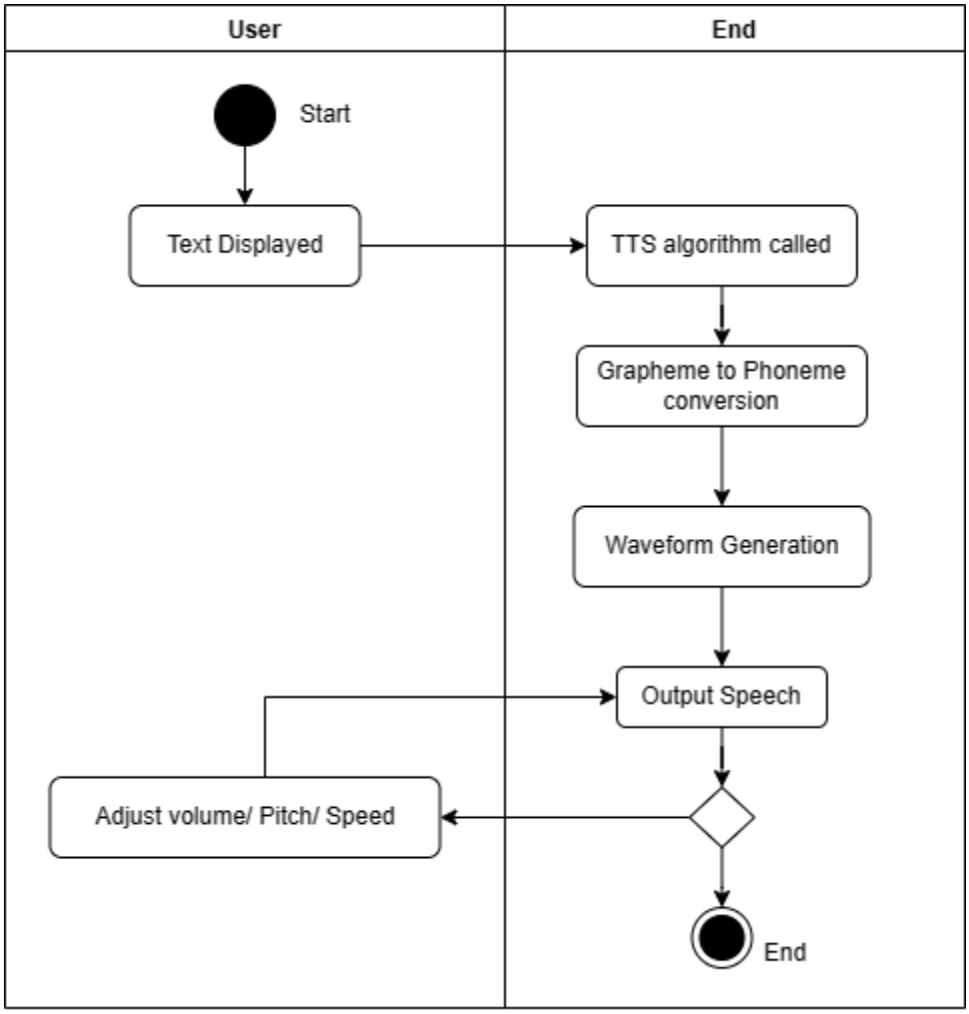

Figure 4.3.2 Activity Diagram of Text to Speech

The activity diagram outlines the process of Text-to-Speech (TTS) conversion within the application. It commences with the user providing the displayed text to the system. Upon receiving the text input, the system invokes the TTS algorithm to initiate the conversion process. The algorithm begins by converting graphemes to phonemes, followed by waveform generation to produce the synthesized speech output. If the user adjusts the volume, pitch, or speed parameters during playback, the system loops back to the waveform generation step to incorporate the modifications. This loop continues until the user is satisfied with the settings or chooses to end the playback.

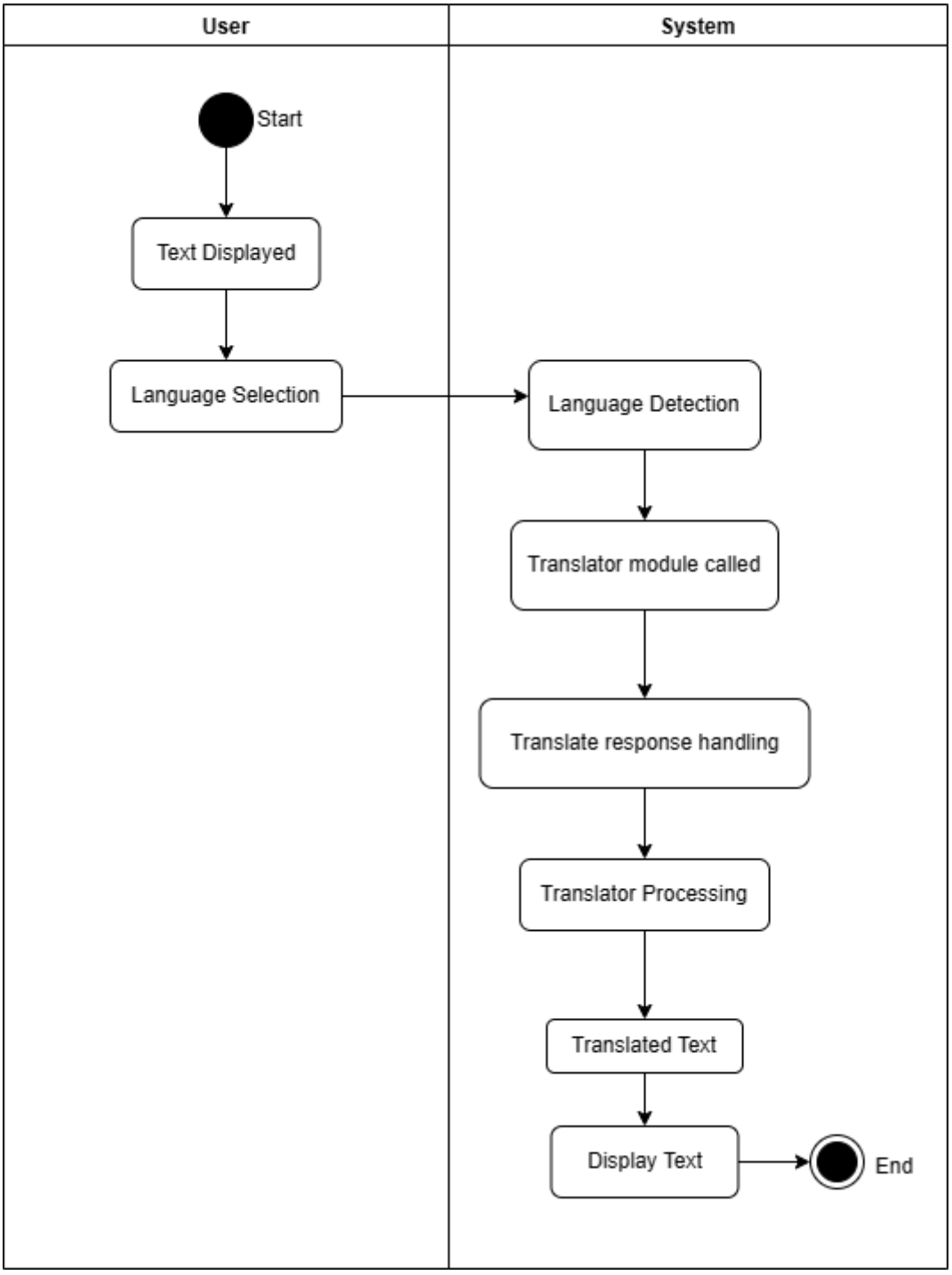

Figure 4.3.3 Activity Diagram of Translator Text

The Translate Text activity diagram illustrates the process of translating text within the application. It begins with the user selecting the desired language for translation from the translate feature. Subsequently, the system performs language detection to identify the original language of the text. Upon detecting the language, the translator module is invoked to initiate the translation process. The system then handles the translation response, processing the translated text accordingly. Finally, the translated text is displayed to the user, providing them with the desired content in their preferred language.

4.4 Sequence Diagram

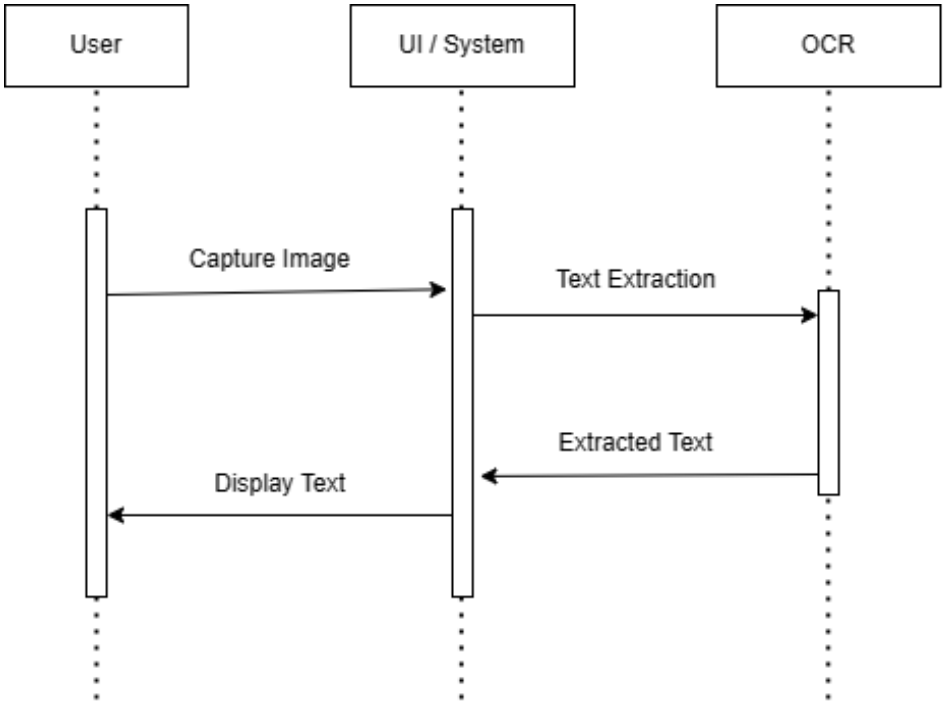

Figure 4.4.1 Sequence Diagram of OCR function

The process begins with the user capturing an image using the application's UI. The UI then sends the captured image to the OCR algorithm for processing. Upon receiving the image, the OCR algorithm extracts the text from it and returns the extracted text to the

UI. Finally, the UI displays the extracted text to the user, completing the OCR function. This sequence diagram illustrates the step-by-step interaction between the user interface and the OCR algorithm, facilitating the conversion of image-based text into machine-readable format.

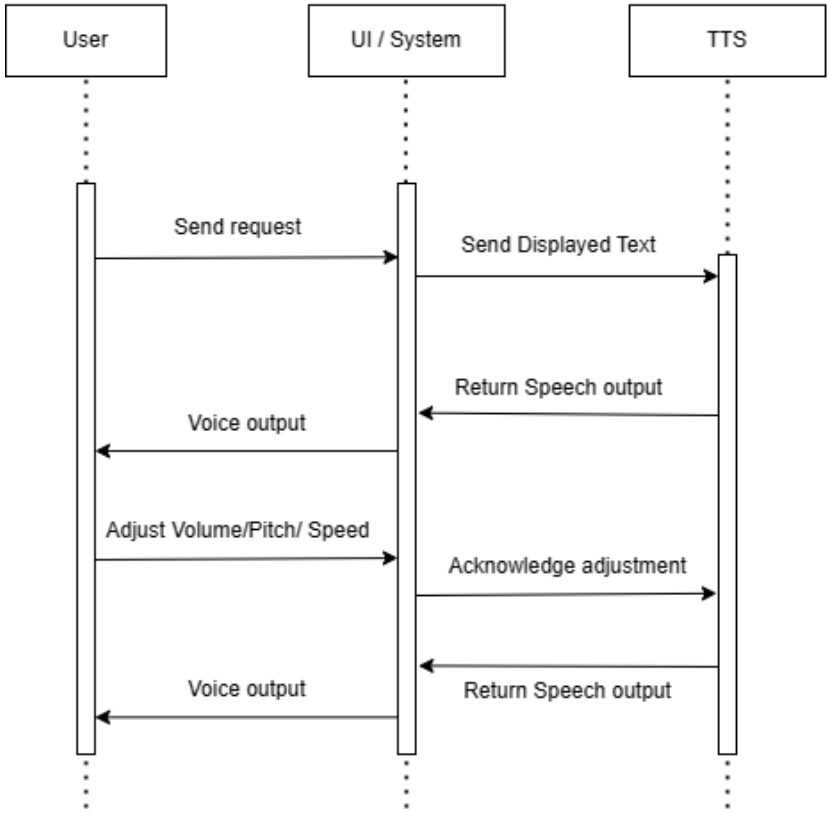

Figure 4.4.2 Sequence Diagram of TTS function

The sequence Diagram begin with the user sending a request to the UI, which then forwards the display text to the TTS algorithm. The TTS algorithm processes the text and returns the speech output to the UI and UI output voice to user. If the user adjusts the volume, pitch, or speed, the UI acknowledges the adjustment and sends the updated parameters to the TTS algorithm. The TTS algorithm adjusts the speech output accordingly and returns the updated speech speed to the UI, which then provides the modified voice output to the user.

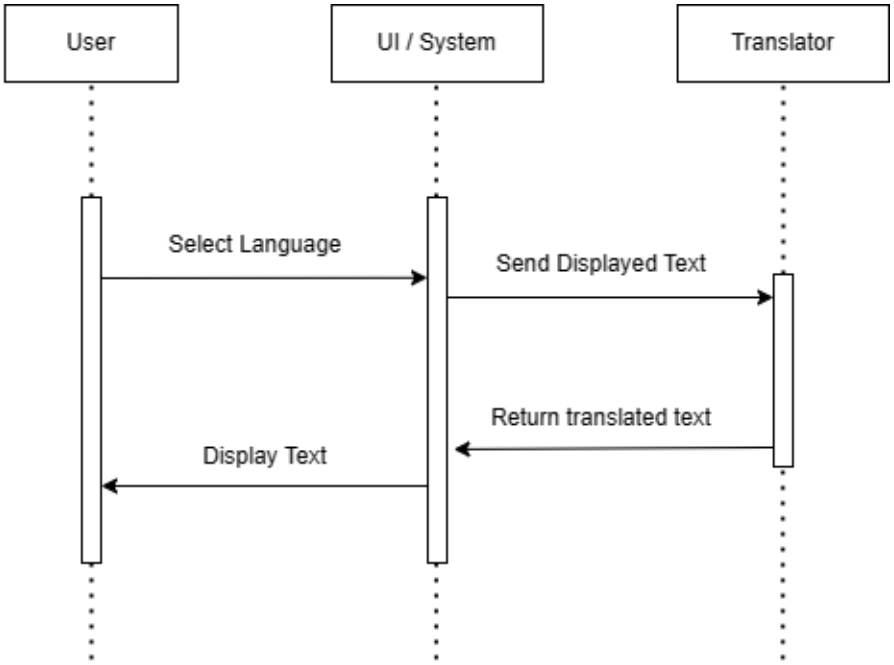

Figure 4.4.3 Sequence Diagram of Translate function

The sequence diagram start with user selecting the preferred language, after this UI will send the displayed text to translator module. The translator module then process the text and return the translated text to UI, Finally, UI will display the translated text to user.

4.5 Block Diagram

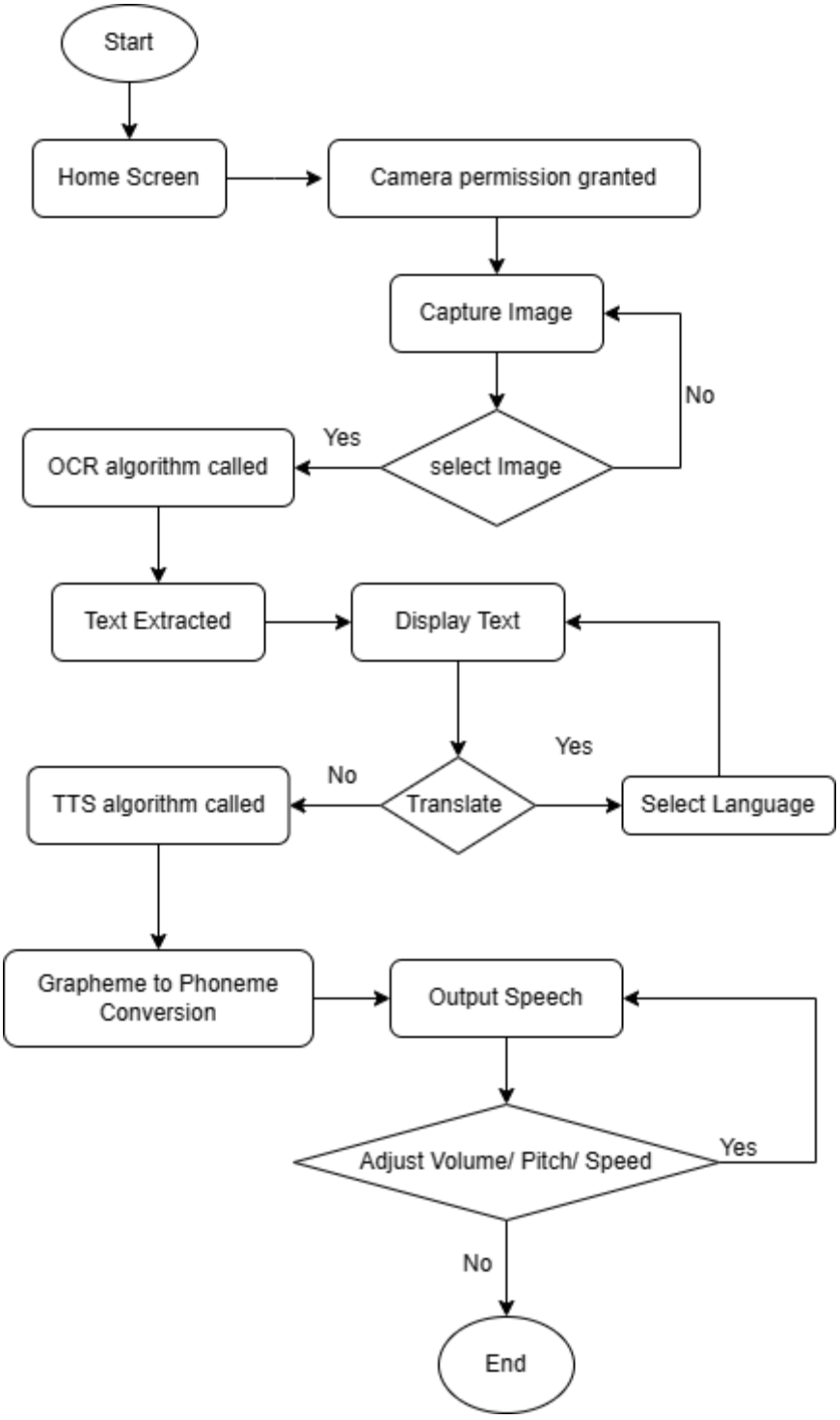

Figure 4.5.1 Block Diagram of Document Reader application

This block diagram represents a Document Reader application, designed to provide a seamless of user experience. The procedure involving the capturing of the images, extracting text using OCR algorithm, grapheme to phoneme conversion using TTS algorithm, and finally output the speech. When user launch the application first time, a

message to grant camera permission is prompted to ensure the process of capturing images and document reading process. User can capture the images of document, written text and any textual content using the device camera. Captured images will undergoes OCR algorithm with the use of Google ML Kit Vison API. This on-device OCR allows users a real-time conversion from visual textual content to machine-readable text.

Extracted text will pass to the next handler, which is TTS algorithm, the application then performs grapheme to phoneme conversion that mapping extracted text into synthesized speech. With the utilization of TTS package 'flutter_tts', the application convert the extracted text into audible speech. Additionally, the application incorporates a translation feature, allowing users to select their preferred language. This feature employs the translator module to process the text, providing translated content to the user. Furthermore, users can adjust the volume, pitch, and speed of the synthesized speech output, enhancing the customization and usability of the application. The complete application serves as a valuable tool for visually impaired which providing them more accessible to textual content.

4.6 Wireframe

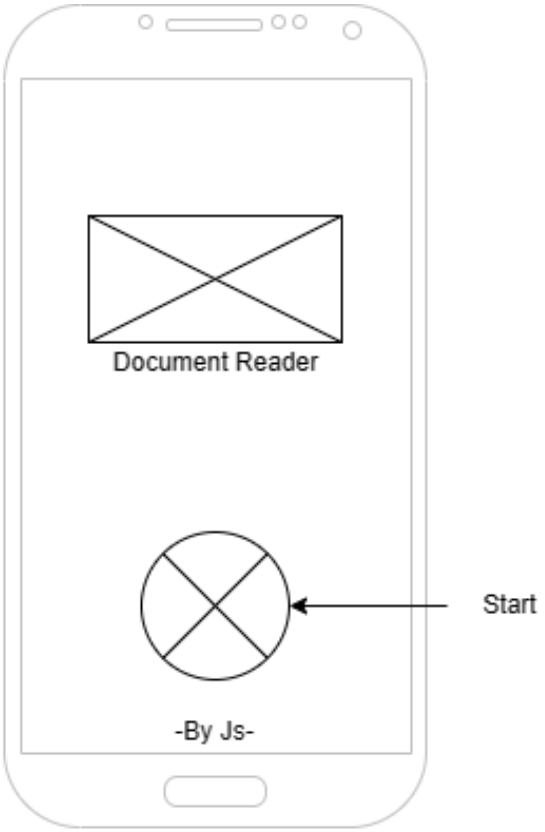

Figure 4.6.1 Main Screen

Low fidelity wireframes and prototypes was designed for future refencing purposes, simple and user-friendly user interfaces that helps to enhance more accessible for visually impaired. Figure 4.6.1 shows the main screen of the Document Reader.

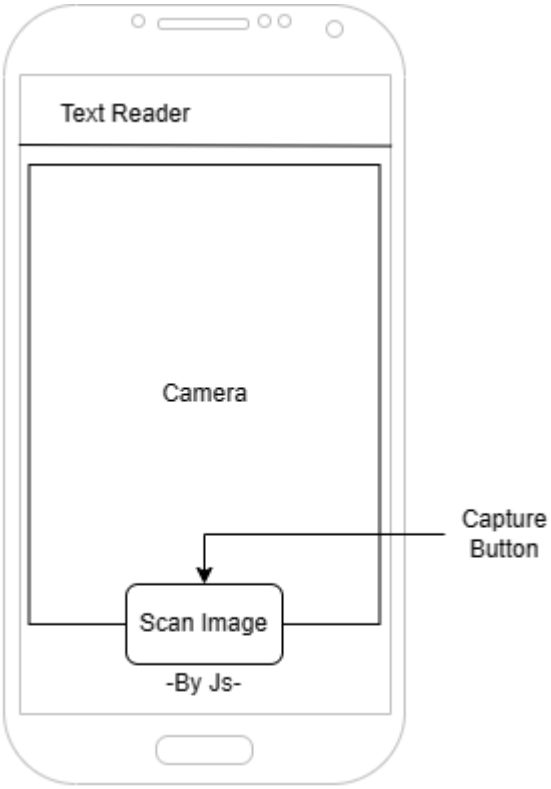

Figure 4.6.2 Image Capture Screen

Figure 4.6.2 shows the image capture screen, which allowing users capture the textual content image using their mobile device's camera. After image has been captured, the application will redirect user to a result page which show the extracted text after OCR function.

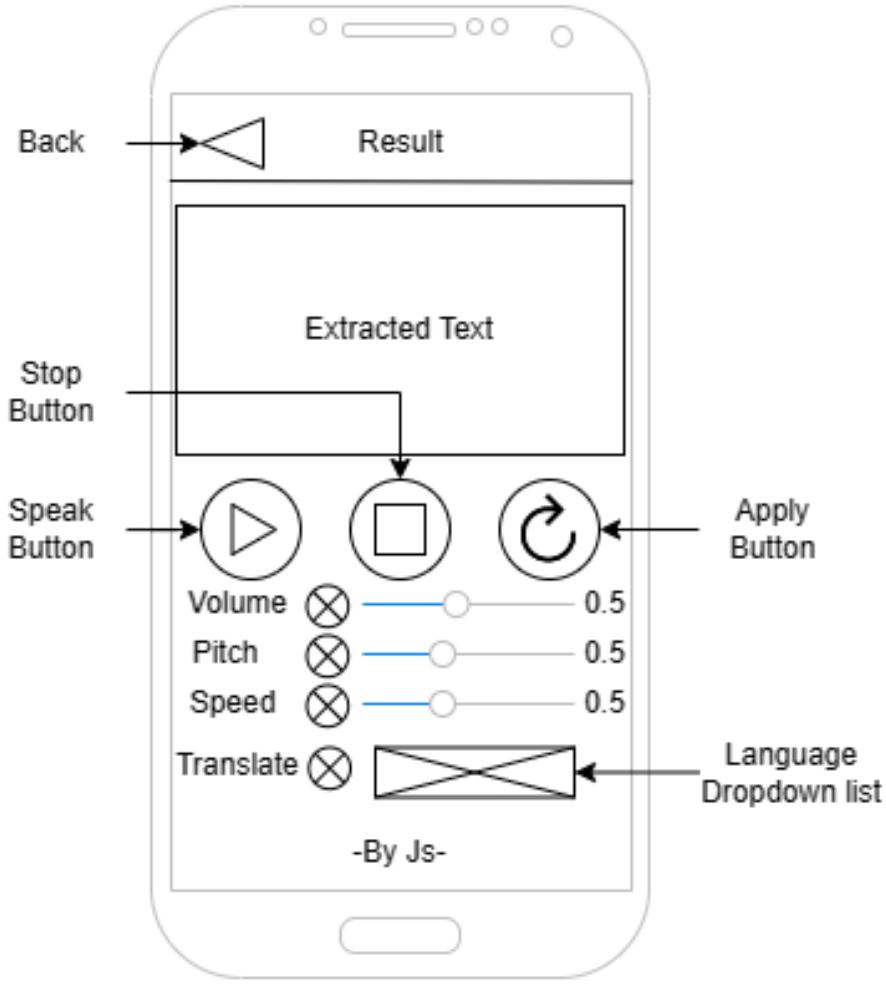

Figure 4.6.3 Result Screen

Figure 4.6.3 shows the result screen after text extract into machine-readable text. TTS then convert text from Grapheme to Phoneme. The application will output the synthesized speech to provide a accessible experience for visually impaired users. Additionally, the screen includes a "Stop" button for users to halt the TTS conversion process, ensuring control over the synthesized speech playback. An "Apply" button allows users to apply adjustments made to the volume, pitch, and speed settings, while sliders enable fine-grained control over these parameters for customized TTS output. The wireframe also reserves space for integrating a translate feature, offering users the option to translate the extracted text into multiple languages for enhanced accessibility and comprehension.

Chapter 5

SYSTEM IMPLEMENTATION

5.1 Setting up

5.1.1 Software Setup

Before starting to develop a mobile application, there are some software with latest version needed to be installed and downloaded to my laptop.

1. Visual Studio Code
2. Android Studio 2022
3. Flutter 3.16.2

1. Download and install Visual Studio Code

a. Visit the official website: https://code.visualstudio.com/

b. On the homepage, select ‘Download’ option according to the operating system.

c. Download and run the installer.

d. Follow on-screen instruction to complete the installation.

2. Download and install Android Studio 2022

a. Visit the official website: https://developer.android.com/studio

b. Select ‘Download Android Studio’ and website will detect the operating system.

c. Once download is complete, run the installer.

d. Follow the instructions to complete the installation, including the installation if Android SDK components.

3. Download and install Flutter SDK

a. Visit to Flutter official website: https://flutter.dev/

b. On the homepage, select ‘Get Started’ button and select the version based on the operating system.
c. Follow the instructions provided to download Flutter SDK.
d. Once download complete, extract the file and add the directory to system’s path.

5.1.2 Emulator Setting

The Android emulator used is Pixel 4 XL with API 30 and the version of Android 11.

5.1.3 Project and Code

After setting up Visual Studio Code, Android Studio and Flutter. Create a flutter project in Visual Studio Code using the Dart Programming language. While Android Studio provide an emulator to test the application.

5.2 Linkage between software

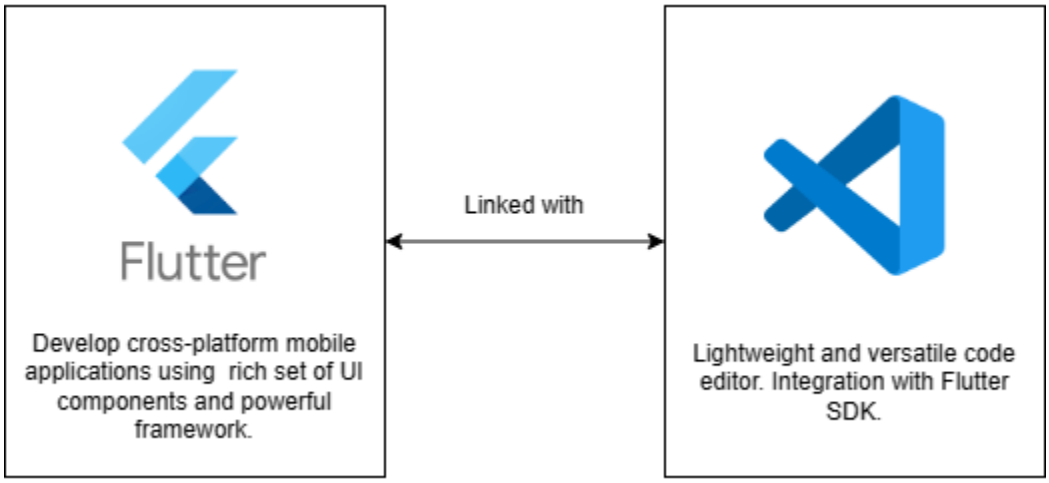

Figure 5.2.1 Relationship among Software

Visual Studio Code is required to be linked with Flutter for development of Flutter applications.

1. Open visual Studio Code
2. Go to Extensions, search for 'Dart' and download the dart extension.
3. Similar to step 2, go to Extensions and search for Flutter extension and download.
4. In the Command Platte, type 'Flutter: New Project' to select option or type 'flutter create <project_name>' to create a New Flutter Project in the selected folder.

5.3 Screenshot of System Operation

5.3.1 Granted Camera Permission

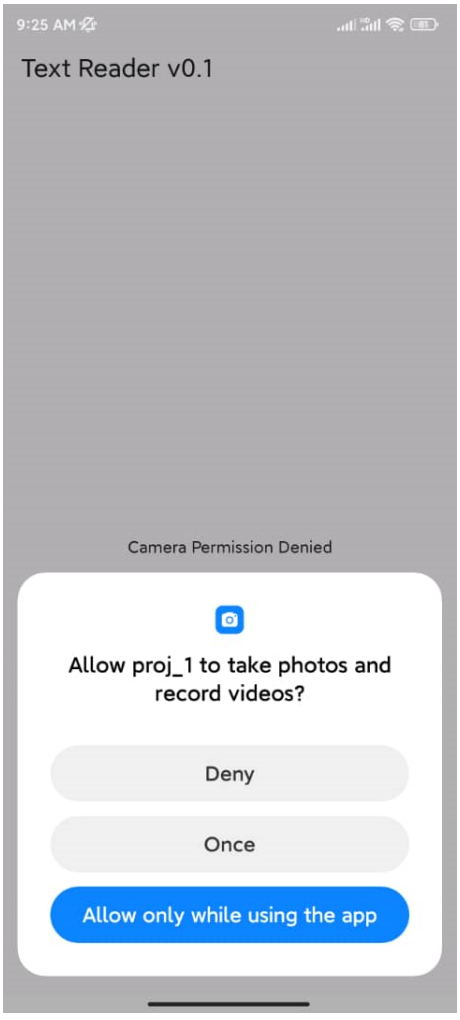

Figure 5.3.1.1 Permission Granted Page

Figure 5.3.1.1 shows that a message prompted when user first time launch the application. The application requests the camera permission with a concise prompt. This is to enable the application to have access to device's camera.

5.3.2 Image Capture Screen

Figure 5.3.2.1 Image Capture Screen

Figure 5.3.2.1 shows that the image capture screen. Image capture is a pivotal component is our application. This function is align with the core of the application

which allow visually impaired to access to textual content. Image captured will be process in the background and OCR functionality is integrated to undergoes text extraction process.

5.3.3 Result Screen

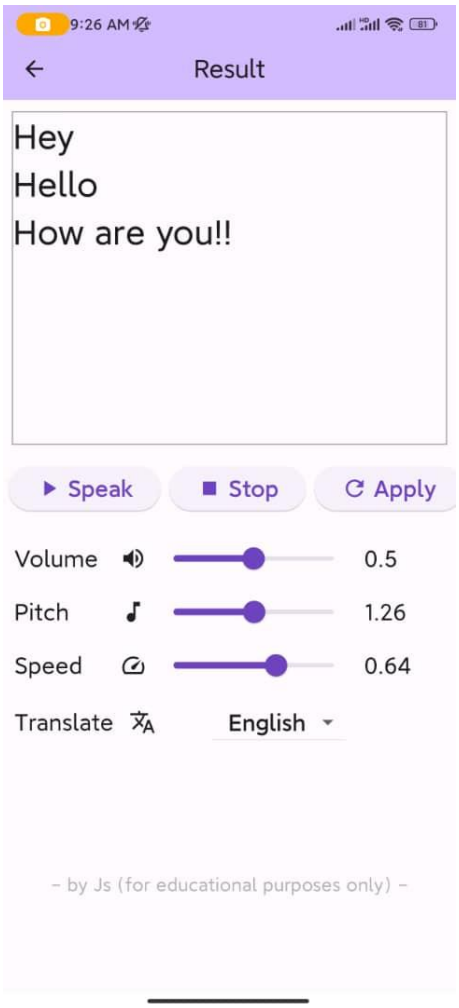

Figure 5.3.3.1 Result Screen

Figure 5.3.3.1 shows the result screen. Upon the successful outcome of OCR process, users will be redirect to the result screen. The extracted text will be displayed and it is set to interact with the upcoming enhancement which is TTS feature. Once TTS feature is implemented, users will not only have a view of extracted text but also listen to the content through synthesized speech.

5.3.4 Translate Module

Figure 5.3.4.1 and Figure 5.3.4.2 shows the translate features that user can select their preferred language view the extracted display text.

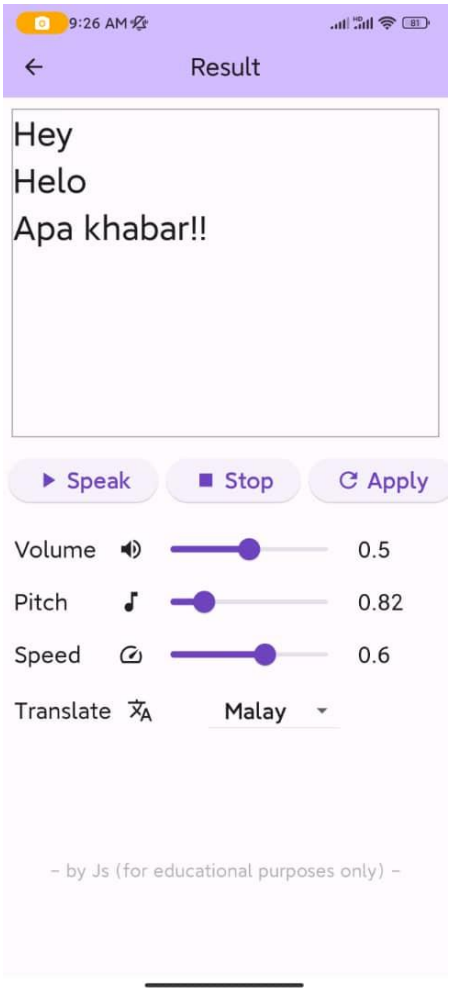

Figure 5.3.4.1 Translate Malay

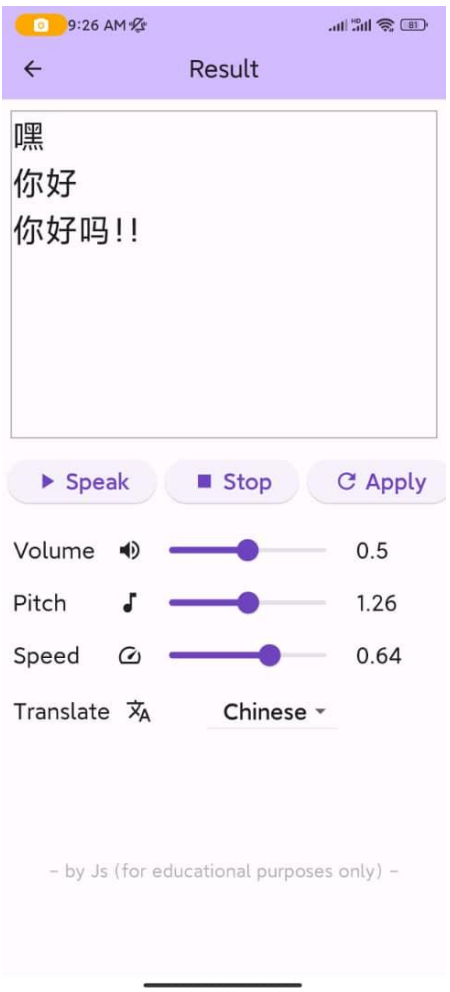

Figure 5.3.4.2 Translate Chinese

Figure 5.3.4.1 and Figure 5.3.4.2 shows the translate features that user can select their preferred language view the extracted display text.

Chapter 6

SYSTEM EVALUATION AND DISCUSSION

6.1 Black Box Testing

Black box testing is selected to test and evaluate the functionality of and responsiveness of the mobile application. There are 4 test cases which are: Successful OCR function, Image capture failure, Successful TTS function, and Successful text translation.

Test Case ID	T01	**Test Case Name**	Successful OCR funtion
Test Case Description	To test that the application can successfully capture an image that contain text and extract text using OCR technology		
Pre-condition	Granted camera permission.		
Steps	1. Launch the application. 2. Capture an image that containing text using device camera by clicking on the 'Scan image' button. 3. Verify the captured image is processed, the text is extracted accurately. 4. Extracted text display.		
Expected Result	The extracted text displayed.		
Actual Result	The extracted text displayed.		
Status	Pass		

Table 6.1.1 Test case T01

Test Case ID	T02	**Test Case Name**	Image capture failure

Test Case Description	To test the application's behavior when image capture fail.
Pre-condition	Launched the application and granted camera permission.
Steps	1. Launch the application. 2. Capture an image that containing text using device camera using 'Scan image' button. 3. Click again on the 'Scan image' button before the application proceed to the OCR technology. 4. Check the application response to the image capture failure. 5.
Expected Result	An error message is display and prompt user about the failure of image capture.
Actual Result	An error message is display and prompt user about the failure of image capture.
Status	Pass

Table 6.1.2 Test case T02

Test Case ID	T03	**Test Case Name**	Successful TTS function
Test Case Description	To verify that the application can successfully convert extracted text to speech using TTS technology.		
Pre-condition	Text extracted from OCR functionality.		
Steps	1. Initiate the TTS function. 2. Select the 'Speak' button. 3. Verify that the generated speech is play through device's audio output.		
Expected Result	The extracted text is accurately converted into audible speech and played.		
Actual Result	The extracted text is accurately converted into audible speech and played.		

Status	Pass

Table 6.1.3 Test case T03

Test Case ID	T04	**Test Case Name**	Successful text translation
Test Case Description	Verify that the application can successfully translate extracted text from one language to another.		
Pre-condition	Text extracted from OCR functionality.		
Steps	1. Initiate the "Translate Text" function. 2. Select the source and target languages for translation. 3. Verify that the translated text is displayed within the application's interface.		
Expected Result	The extracted text is accurately translated from the source language to the target language.		
Actual Result	The extracted text is accurately translated from the source language to the target language.		
Status	Pass		

Table 6.1.4 Test case T04

6.2 Component Test

For the component testing, some of the feature are tested to verify the functionality of the application.

Inputs	**Expected Output**	**Status**
User press back button at result screen	Back to image capture page.	Pass
User press ‘Scan image’ button	OCR function called and extracted text.	Pass

User press ‘Speak’ button	Voice output from the extracted text	Pass
User select language to translate	Extracted text being translate into target language	Pass

Table 6.2.1 Component test

6.3 Objective Evaluation

Objective	**Evaluation**	**Achievement**
• To facilitate users with visual impairments to access textual content more easily.	The development of the mobile application focused on creating a seamless and user-friendly experience for visually impaired individuals. Through the integration of OCR (Optical Character Recognition) technology, users can effortlessly capture and extract text from various materials, including printed resources and digital displays. The extracted text is then converted into audible speech using TTS (Text-to-Speech) functionality, allowing users to listen to the content without relying	Achieved

	on visual cues. This approach significantly enhances the accessibility of textual content for visually impaired users, enabling them to engage with a wide range of materials independently. Additionally, the inclusion of features such as adjustable volume, pitch, and speed further enhances the user experience, catering to individual preferences and needs. By prioritizing ease of access and usability, the project effectively facilitates visually impaired users in accessing textual content more easily.	
• To enhance daily activities of visually impaired by promoting greater accessibility and involvement with surroundings.	The application was designed with a user-centric approach, focusing on features that promote accessibility and interaction with the surrounding environment. Through features such as OCR (Optical Character Recognition) and TTS (Text-to-Speech)	Achieved

	functionalities, users are empowered to access textual content in their surroundings effortlessly. The seamless integration of these technologies enables users to engage with various printed materials and digital displays, thereby enhancing their independence and facilitating greater participation in daily activities. Additionally, the inclusion of a translate feature further broadens the accessibility of the application, allowing users to overcome language barriers and engage with content in their preferred language. By prioritizing accessibility and user involvement, the project successfully fulfills the objective of enhancing the daily activities of visually impaired individuals.	

• To develop a cross-platform mobile application.	The project utilized Flutter, a popular open-source framework developed by Google, to achieve cross-platform compatibility. Flutter's ability to compile code into native ARM machine code for both Android and iOS platforms from a single codebase facilitated the development of a unified mobile application. By leveraging Flutter's rich set of UI components and hot reload feature, developers were able to streamline the development process and ensure consistency across different platforms. This choice of technology enabled the project to meet the objective of creating a mobile application accessible to users on both Android and iOS devices.	Achieved

Chapter 7

CONCLUSION AND RECOMMANDATION

7.1 Conclusion

This project creates a vital bridge between visually impaired individuals and their surroundings, enabling seamless interaction with textual content. Our primary objective is to empower the visually impaired by fostering integration and independence in their daily lives. Leveraging Optical Character Recognition (OCR) and Text-to-Speech (TTS) technologies, the project overcomes barriers to accessing textual content. OCR ensures the extraction of text into machine-readable format, while TTS technology converts it into auditory speech. Additionally, the inclusion of a translate feature allows for the seamless translation of text into multiple languages, breaking down language barriers. Moreover, users have the flexibility to adjust voice parameters such as volume, pitch, and speed, enhancing the personalized user experience. In summary, our initiative aims to contribute to a more inclusive world where visually impaired individuals can easily access written material, promoting a sense of equality and independence for all.

7.2 Recommendation

there are several avenues for further development and enhancement of the Document Reader application. Firstly, we recommend exploring additional features to further improve accessibility and user experience. This could include the integration of advanced language processing algorithms to enhance the accuracy of text extraction and translation. Additionally, incorporating features such as document summarization and voice commands could provide users with more comprehensive tools for interacting with textual content.

Furthermore, we suggest conducting user feedback sessions and usability studies to gather insights and suggestions for improving the application. This iterative process

will help refine existing features and identify areas for enhancement based on user needs and preferences.

In terms of technical considerations, optimizing the performance of the OCR and TTS algorithms to reduce processing time and improve efficiency would be beneficial. This could involve exploring parallel processing techniques or leveraging cloud-based solutions for resource-intensive tasks.

Lastly, we recommend expanding the platform compatibility of the application to reach a broader audience. This could involve developing versions of the application for other mobile operating systems such as Android, as well as exploring web-based or desktop versions to cater to users across different devices and platforms.

By prioritizing these recommendations and continuously iterating on the application based on user feedback and technological advancements, we can further enhance the accessibility and utility of the Document Reader application for visually impaired individuals.

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[3]“Lack of braille facilities pose challenges to visually impaired,” thesun.my. https://thesun.my/local_news/lack-of-braille-facilities-pose-challenges-to-visually-impaired-AX1321727

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[5] M. Nadhir Ab Wahab, A. Sufril Azlan Mohamed, A. Syafiq Abdull Sukor, and O. Chia Teng, “Text reader for visually impaired person,” Journal of Physics: Conference Series, vol. 1755, no. 1, p. 012055, 2021. doi:10.1088/1742-6596/1755/1/012055

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	**Study week no.: 2**
Student Name & ID: Lee Jian Shen 19ACB03844	
Supervisor: Ts Dr Saw Seow Hui	
Project Title: EMPOWERING THE VISUALLY IMPAIRED WITH A MOBILE APPLICATION FOR DOCUMENT READER	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

-Review the code and report of FYP1

2. WORK TO BE DONE

Start to implement TTS technology and function

3. PROBLEMS ENCOUNTERED

-None

4. SELF EVALUATION OF THE PROGRESS

-None

Supervisor's signature

Student's signature

(Project II)

Trimester, Year: Trimester 3, Year 3	**Study week no.: 4**
Student Name & ID: Lee Jian Shen 19ACB03844	
Supervisor: Ts Dr Saw Seow Hui	
Project Title: EMPOWERING THE VISUALLY IMPAIRED WITH A MOBILE APPLICATION FOR DOCUMENT READER	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- TTS function and technology implementation

2. WORK TO BE DONE

- TTS parameter customization

3. PROBLEMS ENCOUNTERED

- TTS engine version not compatible

4. SELF EVALUATION OF THE PROGRESS

-None

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	**Study week no.: 6**
Student Name & ID: Lee Jian Shen 19ACB03844	
Supervisor: Ts Dr Saw Seow Hui	
Project Title: EMPOWERING THE VISUALLY IMPAIRED WITH A MOBILE APPLICATION FOR DOCUMENT READER	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- TTS customization parameter adjustment

2. WORK TO BE DONE

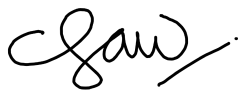
- Test the TTS module

3. PROBLEMS ENCOUNTERED

-None

4. SELF EVALUATION OF THE PROGRESS

-None



Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	**Study week no.: 8**
Student Name & ID: Lee Jian Shen 19ACB03844	
Supervisor: Ts Dr Saw Seow Hui	
Project Title: EMPOWERING THE VISUALLY IMPAIRED WITH A MOBILE APPLICATION FOR DOCUMENT READER	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- TTS parameter adjustment function. (change voice output parameter)

2. WORK TO BE DONE

- Translator API module implementation

3. PROBLEMS ENCOUNTERED

-Language code not found/ not match

4. SELF EVALUATION OF THE PROGRESS

-None

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	**Study week no.: 10**
Student Name & ID: Lee Jian Shen 19ACB03844	
Supervisor: Ts Dr Saw Seow Hui	
Project Title: EMPOWERING THE VISUALLY IMPAIRED WITH A MOBILE APPLICATION FOR DOCUMENT READER	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

-Translator module and tested with different target language.

2. WORK TO BE DONE

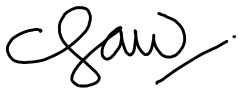
- Build APK and Test the complete mobile application

3. PROBLEMS ENCOUNTERED

-None

4. SELF EVALUATION OF THE PROGRESS

-None



Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 3, Year 3	**Study week no.: 12**
Student Name & ID: Lee Jian Shen 19ACB03844	
Supervisor: Ts Dr Saw Seow Hui	
Project Title: EMPOWERING THE VISUALLY IMPAIRED WITH A MOBILE APPLICATION FOR DOCUMENT READER	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

-Complete Testing of the whole application system and functionality.

2. WORK TO BE DONE

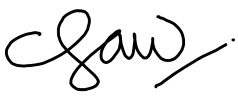
-Report Writing

3. PROBLEMS ENCOUNTERED

-None

4. SELF EVALUATION OF THE PROGRESS

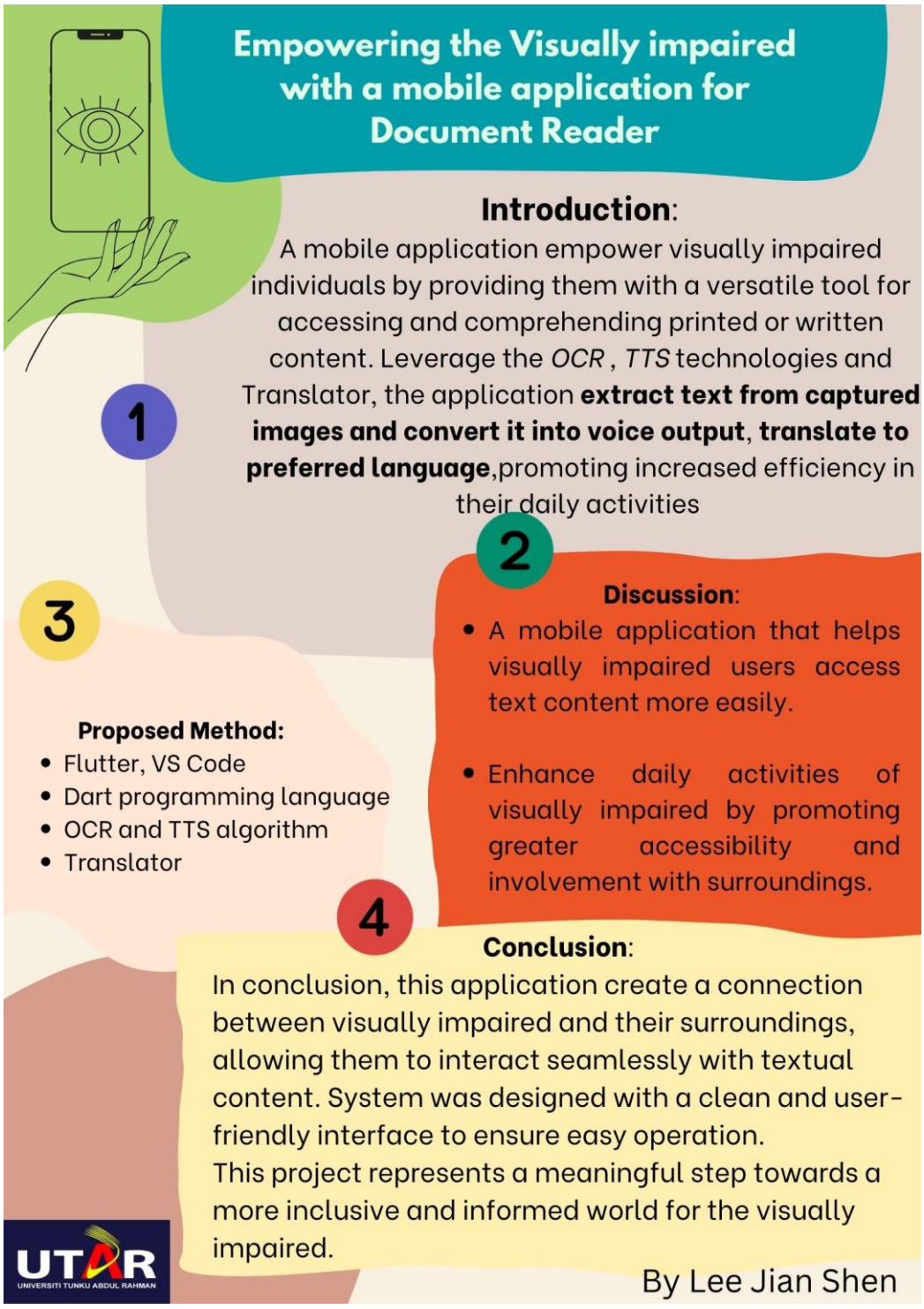
-None



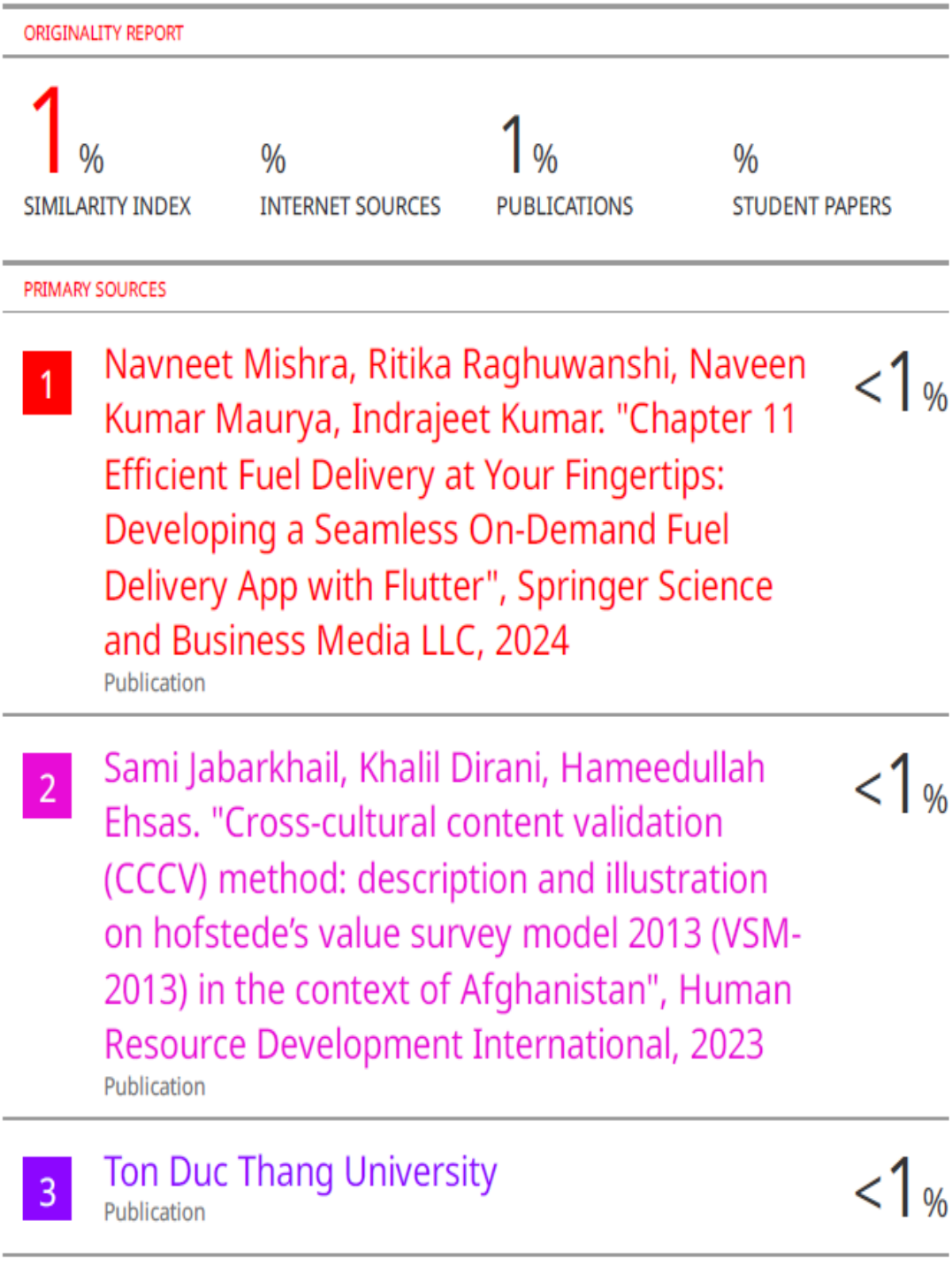
Supervisor's signature

Student's signature

POSTER


Empowering the Visually impaired with a mobile application for Document Reader
Introduction:
A mobile application empower visually impaired individuals by providing them with a versatile tool for accessing and comprehending printed or written content. Leverage the OCR , TTS technologies and Translator, the application extract text from captured images and convert it into voice output, translate to preferred language,promoting increased efficiency in their daily activities
1
2
Discussion:
A mobile application that helps visually impaired users access text content more easily.
Enhance daily activities of visually impaired by promoting greater accessibility and involvement with surroundings.
3
Proposed Method:
Flutter, VS Code
Dart programming language
OCR and TTS algorithm
Translator
4
Conclusion:
In conclusion, this application create a connection between visually impaired and their surroundings, allowing them to interact seamlessly with textual content. System was designed with a clean and user-friendly interface to ensure easy operation.
This project represents a meaningful step towards a more inclusive and informed world for the visually impaired.
By Lee Jian Shen
UTAR
UNIVERSITI TUNKU ABDUL RAHMAN

PLAGIARISM CHECK RESULT



ORIGINALITY REPORT

1%	%	1%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Navneet Mishra, Ritika Raghuwanshi, Naveen Kumar Maurya, Indrajeet Kumar. "Chapter 11 Efficient Fuel Delivery at Your Fingertips: Developing a Seamless On-Demand Fuel Delivery App with Flutter", Springer Science and Business Media LLC, 2024 Publication	<1%
2	Sami Jabarkhail, Khalil Dirani, Hameedullah Ehsas. "Cross-cultural content validation (CCCV) method: description and illustration on hofstede's value survey model 2013 (VSM-2013) in the context of Afghanistan", Human Resource Development International, 2023 Publication	<1%
3	Ton Duc Thang University Publication	<1%

Universiti Tunku Abdul Rahman			
Form Title : Supervisor's Comments on Originality Report Generated by Turnitin for Submission of Final Year Project Report (for Undergraduate Programmes)			
Form Number: FM-IAD-005	Rev No.: 0	Effective Date: 01/10/2013	Page No.: 1of 1

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

Full Name(s) of Candidate(s)	Lee Jian Shen
ID Number(s)	1903844
Programme / Course	Bachelor of Computer Science (Honours)
Title of Final Year Project	Empowering The Visually Impaired With A Mobile Application For Document Reader

Similarity	**Supervisor's Comments (Compulsory if parameters of originality exceeds the limits approved by UTAR)**
Overall similarity index: 1 % **Similarity by source** Internet Sources: 0 % Publications: 1 % Student Papers: 0 %	The percentage meets the requirement.
Number of individual sources listed of more than 3% similarity: 0	N/A.
Parameters of originality required and limits approved by UTAR are as Follows: **(i) Overall similarity index is 20% and below, and** **(ii) Matching of individual sources listed must be less than 3% each, and** **(iii) Matching texts in continuous block must not exceed 8 words** ***Note: Parameters (i) – (ii) shall exclude quotes, bibliography and text matches which are less than 8 words.***	

Note Supervisor/Candidate(s) is/are required to provide softcopy of full set of the originality report to Faculty/Institute

Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

Signature of Supervisor

Name: Ts Dr Saw Seow Hui

Date: 26/4/2024

Signature of Co-Supervisor

Name: _____

Date: _____

UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY (KAMPAR CAMPUS)

CHECKLIST FOR FYP2 THESIS SUBMISSION

Student Id	1903844
Student Name	Lee Jian Shen
Supervisor Name	Ts Dr Saw Seow Hui

TICK (√)	DOCUMENT ITEMS Your report must include all the items below. Put a tick on the left column after you have checked your report with respect to the corresponding item.
√	Title Page
√	Signed Report Status Declaration Form
√	Signed FYP Thesis Submission Form
√	Signed form of the Declaration of Originality
√	Acknowledgement
√	Abstract
√	Table of Contents
√	List of Figures (if applicable)
√	List of Tables (if applicable)
√	List of Symbols (if applicable)
√	List of Abbreviations (if applicable)
√	Chapters / Content
√	Bibliography (or References)
√	All references in bibliography are cited in the thesis, especially in the chapter of literature review
	Appendices (if applicable)
√	Weekly Log
√	Poster
√	Signed Turnitin Report (Plagiarism Check Result - Form Number: FM-IAD-005)
√	I agree 5 marks will be deducted due to incorrect format, declare wrongly the ticked of these items, and/or any dispute happening for these items in this report.

*Include this form (checklist) in the thesis (Bind together as the last page)

I, the author, have checked and confirmed all the items listed in the table are included in my report.

_____

(Signature of Student)

Date:26/4/2024