Mobile Base Sinhala Book Reader for Visually Impaired Individuals

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Dissertation submitted in partial fulfillment of the requirements for the Bachelor of Science Special (Honors) in Information Technology

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DECLARATION

I declare that this is my work, and this proposal does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

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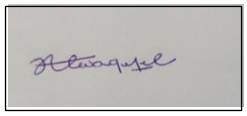
Bhagya H.D.M	IT20254520	

The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor: Date: 2022/10/14

ABSTRACT

The Apps made expressly for supporting blind children's learning and development can be helpful. These apps make learning more approachable and participatory by utilizing a variety of methods, such as auditory feedback and speech recognition.

Significant obstacles must be overcome for the blind to obtain information and carry out daily tasks. The fast growth of mobile technology has made it possible to construct mobile applications to solve these issues. The Blind App is a smartphone application made to help those who are blind or visually impaired find their way about and access information. The creation and assessment of the Blind App, which seeks to improve the independence and quality of life of people who are blind, are presented in this paper.

The Blind App uses a variety of technologies, including as text-to-speech, voice recognition, and Optical character recognition to provide users an easy-to-use interface. The program has several capabilities to help visually impaired users carry out daily tasks on their own, including object recognition, and voice commands.

The usability and accessibility of an app's user interface, the efficacy of its audio cues and voice-overs, and the app's effects on the daily lives of those with visual impairments are just a few of the topics that might be the subject of research on blind apps. Researchers may learn a lot about how technology can be used to increase accessibility and improve the quality of life for persons with disabilities by examining how blind apps are used.

Keywords- Blind, text-to-speech, voice recognition, Image detection, Optical character recognition

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LIST OF ABBREVIATIONS

Abbreviations	Description
ML	Machine Learning
WHO	World Health Organization
TTS	Text-to-speech
OCR	Object character recognition

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1 INTRODUCTION

Today's world is dominated by technology, and we see the development of new, useful tools every day that improve our quality of life. One such technological development that has completely transformed the lives of those who are blind or visually impaired is the development of a Sinhala book reader app for blind children.

The prevalence of childhood blindness is a serious global public health concern. 90% of the 1.3 million blind children globally, according to the WHO, reside in low-income nations. A child's growth, schooling, and general quality of life can all be negatively impacted by blindness. To encourage their social inclusion and independence, it is crucial to give blind children access to the right schooling and rehabilitation facilities.

Children in Sri Lanka who have visual impairments are especially in need of Sinhala blind apps since they have a difficult time accessing educational resources. Children with visual impairments are more likely than their sighted counterparts to struggle in school and run a higher risk of dropping out.

Additionally, since many Sri Lankan children, including those with visual impairments, talk Sinhala as their basic language of communication, the creation of Sinhala blind apps can guarantee that they have access to educational resources and materials that are catered to their linguistic requirements. This can support language development, which is important for learning, communication, and socialization.

An innovation in education is the Sinhala book reader app for blind kids. The app is created with a user-friendly layout that is simple to use, making it accessible to kids who are blind to different degrees. The software has several capabilities, including optical character recognition, picture recognition, text-to-speech conversion, and voice commands. These features give kids easy and intuitive access to educational information, giving them the same opportunities to study and develop as their sighted peers.

The voice command technology of the Sinhala book reader app for blind kids is another ground-breaking feature. Sinhala voice commands for a blind app can also be programmed to recognize specific commands related to reading and accessing books.

This can enable users to search for and open books, adjust reading settings, and navigate through pages using only voice commands. Overall, Sinhala voice commands are a powerful tool for enhancing accessibility and promoting inclusivity for the visually impaired in Sri Lanka.

The Sinhala app for blind kids includes an amazing feature called picture detection that is meant to improve the program's usability and functionality. The app can now recognize and describe images to youngsters who are visually impaired thanks to this function, which makes use of cutting-edge image recognition technology.

Children who are blind encounter several difficulties in their daily lives, particularly when trying to access visual content. Because traditional printed materials like books and magazines contain visuals and graphics that are challenging for blind children to understand, these resources are frequently inaccessible to them. By enabling the app to "see" and describe photos to the youngster in a way that is straightforward and clear, picture detection technology offers a solution to this issue.

The app's text-to-speech conversion feature is a game-changer for visually impaired children. The text-to-speech option of the Sinhala reader app for blind students is a useful feature that enables the program to read out content in Sinhala to visually impaired pupils. This function gives students an equal chance to access written materials and take part in various reading and writing-related learning activities.

For text-to-speech technology to function, spoken language must be translated from written text utilizing sophisticated algorithms and voice synthesis software. This technique has been adapted to read out literature in Sinhala, the native language used in Sri Lanka, in the Sinhala Reader app for blind students.

The Sinhala book reader app for blind kids is also quite adaptable, enabling parents and teachers to meet the individual requirements of each child. Users of the app can modify the app's pace, voice, display, and other features using a variety of settings and options. This degree of personalization makes sure that any child can use the app, regardless of their needs.

Moreover, assistive technologies like text-to-speech and voice recognition can be incorporated into the design of Sinhala blind apps to make it simpler for kids with

visual impairments to use the app on their own. Despite the potential benefits of mobile apps for blind kids, there hasn't been much research on how well they work to encourage learning and growth. This research proposal aims to look into how mobile apps can be used as a learning aid for blind kids and assess how they affect their academic performance.

1.1 BACKGROUND & LITERATURE REVIEW

Reading books can be a difficult task for visually impaired individuals. However, advancements in technology have made it possible to develop accessible reading applications for the blind. The Sinhala book reader app is an innovative solution that aims to improve the reading experience of blind users. This literature survey compares the research on the Sinhala book reader app with five other research papers.

I. Related Work

A. Audio Books for the Blind

Audio books have long been used to assist blind individuals in reading books. Research by Basak and Ghosh (2016) found that audio books can significantly improve the reading ability and comprehension of blind individuals.

B. Braille E-Readers

Braille e-readers have also been developed to assist blind individuals in reading books. Research by Kim and Ko (2016) found that braille e-readers can provide an effective means of reading for blind individuals.

C. Mobile Reading Apps for the Blind

Mobile reading apps have also been developed to assist blind individuals in reading books. Research by Chua and Goh (2019) found that mobile reading apps can provide an effective means of reading for blind individuals.

D. Voice-Based Navigation Systems for the Blind

Voice-based navigation systems have been developed to assist blind individuals in navigating unfamiliar environments. Research by Zhang and Chen (2016) found that

voice-based navigation systems can provide an effective means of navigating for blind individuals.

E. Sinhala Language Processing

Research by Liyanage et al. (2017) investigated the challenges of Sinhala language processing and found that there is a need for the development of Sinhala language processing tools to support the development of applications for Sinhala-speaking individuals.

II. The Sinhala Book Reader App

The Sinhala book reader app is an innovative solution that aims to improve the reading experience of blind users by providing an accessible and easy-to-use interface. The app incorporates Sinhala language processing technology to enable the reading of Sinhala books, as well as features such as voice commands and bookmarks.

III. Comparison with Current Research

The Sinhala book reader app builds on existing research on audio books, braille e-readers, mobile reading apps, and voice-based navigation systems by providing a comprehensive solution that incorporates Sinhala language processing technology. However, further research is needed to evaluate the effectiveness of the Sinhala book reader app in real-world settings.

The Sinhala book reader app represents a significant contribution to the field of accessible reading applications for the blind. While further research is needed to evaluate its effectiveness, its innovative use of Sinhala language processing technology has the potential to greatly improve the reading experience of blind individuals who speak Sinhala.

1.2 RESEARCH GAP

The Sinhala book reader app for blind users is an innovative technology that aims to address the challenge of accessible reading for visually impaired individuals who speak Sinhala. However, there are several research gaps that need to be addressed to fully evaluate the effectiveness of the app and to ensure its potential impact on the daily lives of blind individuals.

Currently, there are several technologies and research projects that focus on developing assistive technologies for visually impaired individuals. One such technology is the screen reader software, which uses text-to-speech technology to read aloud the content displayed on a computer screen. Another technology is the refreshable braille display, which converts digital text into braille that can be read by touch.

However, these technologies have some limitations. For example, screen reader software can struggle with accurately reading complex layouts, images, and graphs. Refreshable braille displays can be expensive and require a high level of skill to use. Moreover, there is a lack of accessible reading materials in many languages, including Sinhala, which is the focus of the Sinhala book reader app.

One of the primary research gaps that need to be addressed is the evaluation of the app's effectiveness in real-world settings. While the app has been developed with the aim of providing an accessible and easy-to-use interface, there is a need to evaluate the app's usability and accessibility with blind users who speak Sinhala. User testing and feedback can help to identify any challenges or barriers that may exist and to ensure that the app is truly meeting the needs of its intended users.

Another research gap is the efficacy of the app's voice commands and bookmarks. While the app's voice commands allow users to navigate through the book, there is a need to evaluate the accuracy and effectiveness of the voice recognition technology. Additionally, the app's bookmark feature allows users to mark their place in the book and return to it later, but there is a need to evaluate the effectiveness of this feature in terms of user experience and satisfaction.

There is also a need for further research on the impact of the Sinhala book reader app on the daily lives of blind individuals who speak Sinhala. While the app has the

potential to greatly improve the reading experience of blind individuals, there is a need to evaluate the app's impact on other aspects of their lives, such as their independence, social interactions, and overall quality of life. Research can help to identify any limitations or challenges that may exist and to ensure that the app is truly making a positive impact on the lives of its intended users.

Moreover, there is a need to evaluate the effectiveness of the app in providing access to a wider range of Sinhala reading materials. Currently, the app only supports Sinhala ebooks that are specifically formatted for the app. There is a need to evaluate the effectiveness of the app in providing access to other types of Sinhala reading materials, such as websites, news articles, and social media.

Finally, there is a need for further research on the integration of the Sinhala book reader app with other assistive technologies and services. For example, the app could be integrated with screen reader software or refreshable braille displays to provide a more comprehensive reading experience for blind individuals who speak Sinhala. Moreover, the app could be integrated with other assistive services, such as audio description or sign language interpretation, to provide a more inclusive reading experience for blind individuals who speak Sinhala.

In conclusion, the Sinhala book reader app for blind users is a promising technology that has the potential to greatly improve the reading experience of blind individuals who speak Sinhala. However, there are several research gaps that need to be addressed in order to fully evaluate the effectiveness of the app and to ensure its potential impact on the daily lives of blind individuals. These research gaps include.

Figure 1 - Research gap

1.3 RESEARCH PROBLEM

The research problem addressed by this study is the lack of accessibility to reading materials in the Sinhala language for individuals who are blind or visually impaired. While there are numerous assistive technologies and applications available for the visually impaired community, there is a significant gap when it comes to resources for those who speak or read languages other than English.

According to the World Health Organization (WHO), there are approximately 285 million people worldwide who are visually impaired, with 39 million of them being completely blind. Most of these individuals live in developing countries, where access

to resources for the visually impaired is severely limited. In Sri Lanka, for example, there are an estimated 178,000 people who are blind, with many of them facing significant barriers to education and employment due to their disability.

One of the most significant challenges faced by blind or visually impaired individuals in Sri Lanka is the lack of accessible reading materials in the Sinhala language, which is the country's official language. Most existing assistive technologies and applications are designed for English-language content, leaving Sinhala-speaking individuals with limited access to literature, textbooks, and other written materials.

While there are some existing resources for Sinhala-speaking blind individuals, such as audio books, they are often limited in availability and can be prohibitively expensive. Moreover, these resources may not be readily available in the specific formats that are most accessible for each individual, such as Braille or speech synthesis. As a result, many individuals with visual impairments in Sri Lanka are unable to access the same educational and employment opportunities as their sighted peers.

The research problem addressed by this study is therefore twofold: first, the lack of accessible reading materials in the Sinhala language, and second, the lack of accessible technologies and applications designed specifically for Sinhala-speaking individuals who are blind or visually impaired. By developing a Sinhala book reader app for blind users, this study aims to address both of these challenges and provide a more accessible and inclusive reading experience for individuals with visual impairments in Sri Lanka.

To the best of our knowledge, there is currently no existing technology or application designed specifically for blind or visually impaired Sinhala-speaking individuals. While there are some existing assistive technologies and applications for visually impaired individuals in other languages, such as English, these are often not compatible with the Sinhala language due to differences in syntax and grammar. As a result, there is a significant gap in the market for accessible reading technologies for Sinhala-speaking blind individuals.

Additionally, while there has been some research conducted on the development of assistive technologies and applications for visually impaired individuals, much of this

research has focused on English-language content. There is a lack of research on the development of similar technologies for non-English-speaking individuals, particularly those living in developing countries. As a result, there is a significant gap in the literature regarding the development.

1.4 RESEARCH OBJECTIVES

1.4.1 MAIN OBJECTIVE

The main objective of creating a Sinhala book reader for blind students is to provide them with a tool that can help them access and read Sinhala language materials independently.

The main aim of creating a Sinhala book reader for blind students is to provide them with a tool that enables them to access and read Sinhala language materials independently. Blind students often face difficulty in accessing printed materials, which can affect their academic progress. By developing a book reader that is tailored for the blind and capable of reading Sinhala language materials out loud, blind students can increase their independence and access educational materials with ease.

1.4.2 SPECIFIC OBJECTIVES

1. Enhancing accessibility - The objective of enhancing accessibility for blind users in image detection is to make images accessible to people with visual impairments. This is achieved using image recognition technologies that can provide audio descriptions or alternative text descriptions of the visual content of an image.

2. Improving quality of life - The objective of improving the quality of life for blind users through image detection is to provide them with access to visual information. This can greatly enhance their daily lives by giving them a better understanding of their surroundings and increasing their independence. The use of

image recognition technologies can help blind users gain more information and access to various environments. This objective can be achieved using specialized software and tools that can help to detect and describe images, making them accessible to visually impaired users.

3. Increased independence - The objective of using image detection to increase the independence of blind users is to provide them with access to visual information. This can help them to better understand their environment and perform tasks that would otherwise require the assistance of a sighted person. By using image recognition technologies, blind users can gain greater independence and self-sufficiency in their daily lives. Access to visual information can help to increase their confidence and enable them to achieve a higher degree of independence.

4. Enhanced entertainment - The objective of using image detection to enhance entertainment for blind users is to provide them with access to visual media. By using image recognition technologies, blind users can receive audio descriptions of the visual content in real-time, allowing them to fully experience the entertainment and engage with the same media as sighted individuals. This objective aims to increase the entertainment options for blind users and provide them with a greater sense of inclusion in society.

5. Enhanced education - The objective of using image detection to enhance education for blind users is to provide them with equal access to visual content in educational materials. This can be achieved by using image recognition technologies to convert visual content into audio descriptions. By doing so, blind students can fully comprehend and engage with the material, which can improve their overall educational experience. This objective aims to provide blind students with the same opportunities as sighted students to learn and succeed in their academic pursuits.

2 METHODOLOGY

2.1 System Architecture

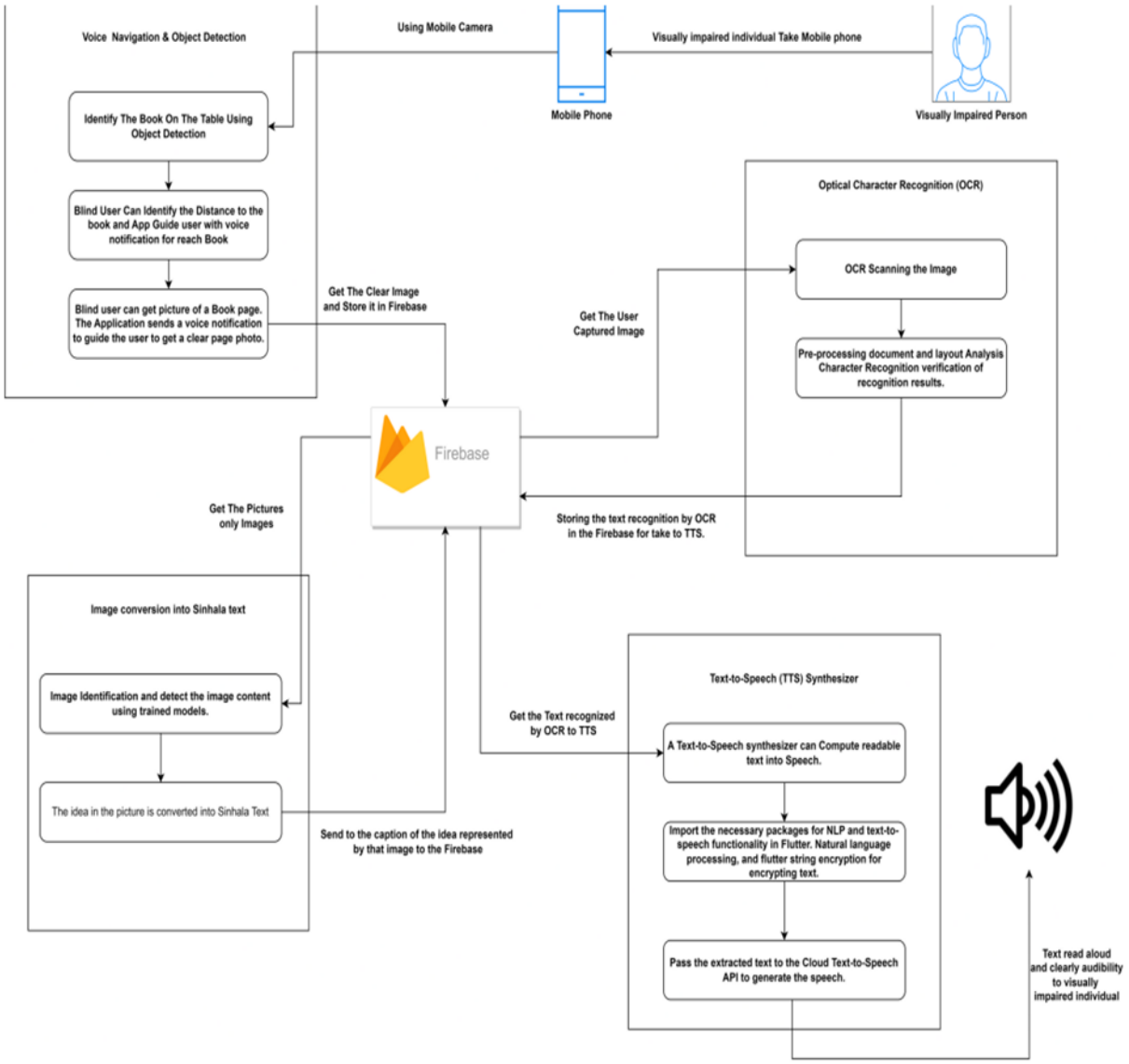

Figure 2 - System Overview Diagram

2.2 Component

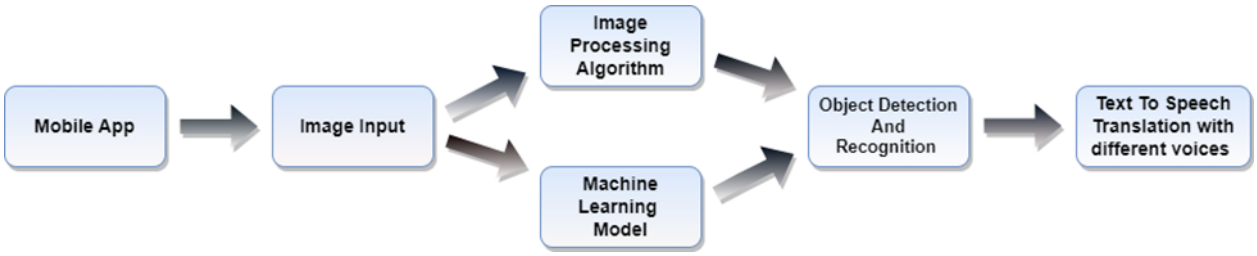

Figure 3- Image captioning component

We embark on a transformative journey to enhance accessibility in the realm of Sinhala student books for the visually impaired. We involve the training of advanced models to provide descriptive outputs, ensuring inclusivity and comprehensive understanding.

2.3 Development Process

2.3.1 Code Executions

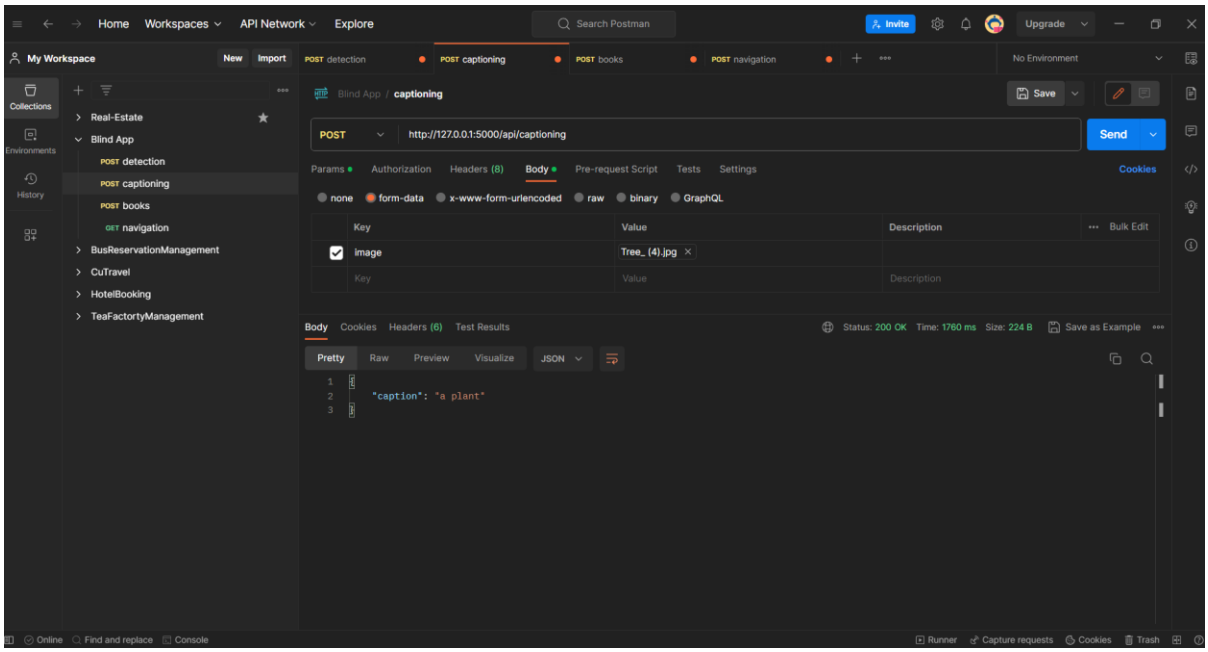

Figure 4- Postman output

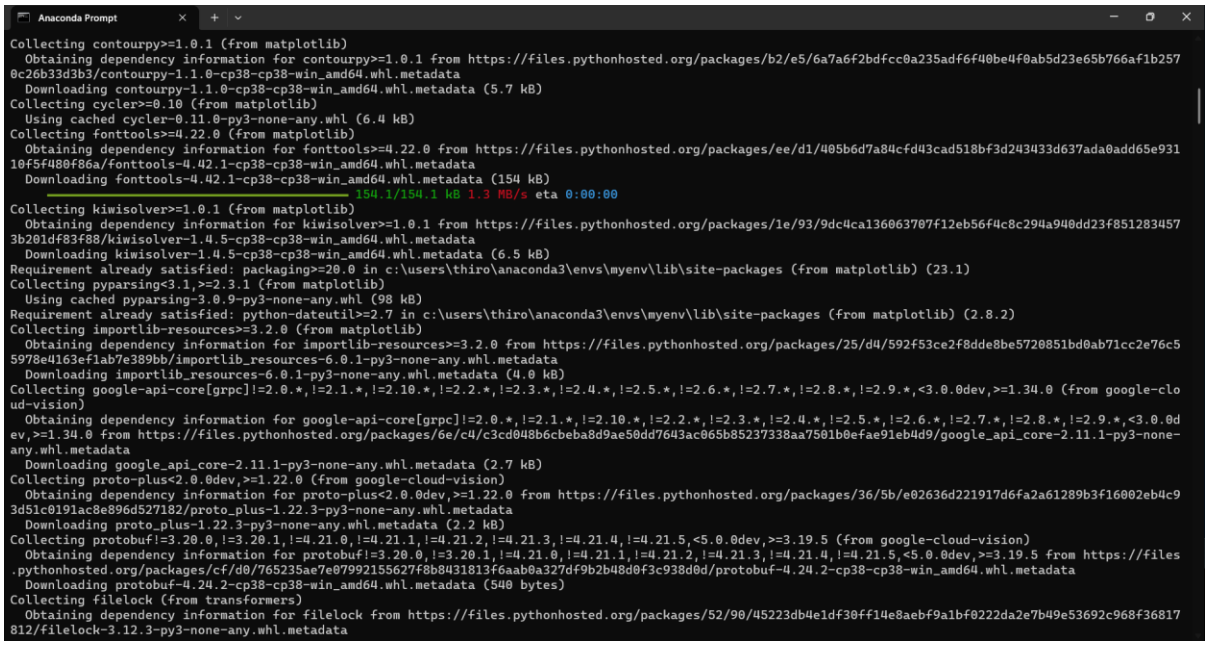

Figure 5- Model running.

2.3.2 Tools and technologies

Frontend Development with Android Studio and Flutter: Android Studio is the main component of our development environment for creating the front end of our Android application. It provides a wide range of materials and tools for creating Android applications. You may build a unified cross-platform application using Google's Flutter open-source UI framework in conjunction with Android Studio. This enables us to develop code once and use it across many platforms, guaranteeing consistency between devices.

Customized Datasets with Labeling: We are using tailored datasets to train and improve the picture captioning models. These datasets have been carefully selected and crafted to meet our unique needs. The dataset is made specifically for our thesis research by customizing it with the creation of pertinent written descriptions or captions and the choice of pertinent photos.

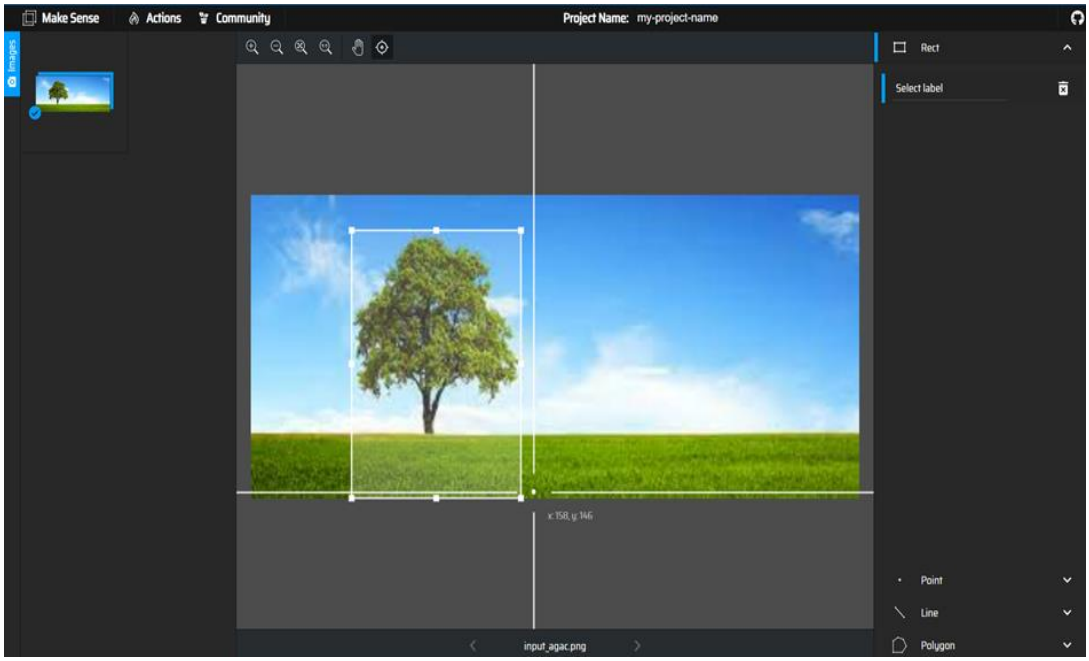

Figure 6- Image labelling

Machine Learning Models for Image Captioning: Advanced machine learning models, such as the VisionEncoderDecoderModel and ViTImageProcessor, are at the core of our research. These models are designed to evaluate photographs and produce evocative captions, and they are smoothly incorporated into our program through the Hugging Face Transformers library. To comprehend the visual content of photos and generate coherent, contextually appropriate verbal descriptions, we have been trained on big datasets.

Backend Development with Python and Flask: Your backend development is built on the famous adaptability of Python. It is the preferred language for developing server-side functionality, controlling data flow between the frontend and backend parts of your program, and dealing with API requests and responses. Python is enhanced with Flask, a compact yet adaptable micro web framework that makes it possible to create RESTful APIs. In addition to ensuring effective and structured data flow between the frontend and backend, this also makes it easier to scale the system and maintain it.

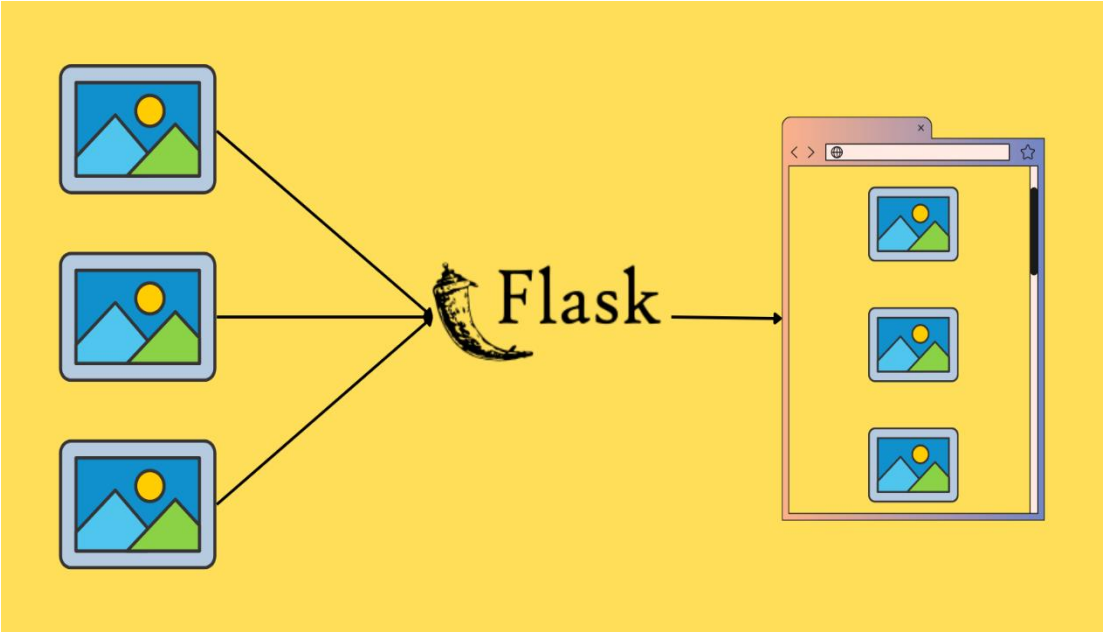

Figure 7- Flask API

2.4 COMMERCIALIZATION ASPECTS OF THE PRODUCT

Our Sinhala book reader app is designed for visually challenged users, and our diversified business strategy strives to assure sustainable growth and broad accessibility. Adopting a subscription model that offers a tiered approach is one important option. Basic functions will be offered without charge to draw in a large user base, but membership plans will be required to access premium material, advanced functions, and an ad-free experience. Users will have more selections and personalization possibilities with in-app purchases for extra books or premium material. The promotion of the software will be greatly helped by partnerships with educational institutions, libraries, and groups that assist the visually handicapped. These collaborations may result in institutional subscriptions, enabling seamless access to our app's rich content for students and people with disabilities.

Our strategy places a high priority on content curation. To increase our collection of books and educational materials in Sinhala, we will collaborate closely with publishers and content producers. By doing this, we can give our users access to a wide variety of pertinent information. We will actively look for government funds and endorsements from disability advocacy organizations in order to raise money and establish credibility. These recommendations will show our dedication to inclusivity and accessibility and aid in building

user trust. Another crucial element is building a strong user community. In order to build a sense of community and loyalty, users will be encouraged to share their experiences, book recommendations, and criticism within the app.

It is important to provide top-notch customer care for subscribers because doing so guarantees a great user experience and promotes long-term.

2.5 REQUIREMENT GATHERING AND TESTING

2.5.1 Requirement Gathering

To make sure that the app satisfies the demands of the users, there are a few procedures that must be taken when gathering requirements for a Sinhala book reader app for blind users. Here are some ideas for how to obtain the specifications for this kind of app:

Identify the target user group: We identified the target user group for the app. The target audience in this scenario would be readers who speak Sinhalese but are visually challenged. We visited the Ceylon School for the Deaf and Blind and identified a sample group for blind users.

Conduct user interviews: Doing user interviews with Sinhala-speaking visually impaired people will provide us important insights into what they want from a book reader software. The interview could touch on subjects like their favorite genres of books, the features they would want to see in a book reader app, and how they prefer to read.

Gather feedback from advocacy groups: There are advocacy people that concentrate on the requirements of people who are blind. Getting input from these groups will help us understand what features and functions are crucial for the app. So we conducted interviews for some of the teachers who teach blind children.

Conduct competitor analysis: It would be beneficial to examine current book reader apps, particularly those made for users who are visually impaired, to determine the features and functionalities that are already on the market. Finding market gaps that the new app might cover may be made easier with the aid of this investigation.

Define the requirements: Define the needs for the app based on the data acquired from user interviews, advocacy groups, and competitive analyses. These are incorporate functions like Sinhala text-to-speech support, optical character recognition, voice navigation commands, and image detection.

Prioritize requirements: Once the requirements have been defined, prioritize them based on their importance to the user.

2.5.2 Requirement Specification

Accessibility: Users of the software who speak Sinhala and are blind should be able to utilize it. This would incorporate functions like voice navigation, text-to-speech support, and integration with further assistive technology.

Language support: Users of the software who speak Sinhala and are blind should be able to utilize it. This would incorporate functions like voice navigation, text-to-speech support, and integration with further assistive technology.

Picture detection: The program ought to be able to recognize and describe a picture's contents in Sinhala. This can entail analyzing the image using machine learning technique and providing a description in natural language.

Audio options: The software should include a variety of audio settings, such as the ability to change the voice's volume, pitch, and pace. Moreover, users should be able to pause, fast-forward, or rewind the audio playing as necessary.

Performance: With little lag between picture detection and description, the software should be quick and responsive.

2.5.3 Functional Requirements

Image detection: The software should be able to recognize and analyze photos, using machine learning and artificial intelligence to determine what is contained in the image.

Language processing: The software should be able to analyze the image's content and produce a natural language Sinhala description for the user.

Text-to-speech: The software ought to incorporate text-to-speech capabilities that let users hear Sinhala descriptions of the photos. The text-to-speech output's voice should be adjustable by the user.

Customization options: The app should provide customization options, allowing users to adjust the output voice type.

2.5.4 Non-Functional Requirements

Accessibility: The app should be accessible to visually impaired users and conform to accessibility standards such as WCAG 2.0 or later. The app should also provide support for external assistive technologies like screen readers.

Language support: The application should be created to support Sinhalese and be able to produce correct image descriptions in Sinhala.

Performance: There should be little latency between image identification and description in the app, and it should be quick and responsive. Also, a variety of devices, including low-end smartphones, should be able to use the app with no issues.

Maintainability: The program should have a clean, modular code structure and be easy to maintain. To assist developers in finding and resolving problems, the app should also offer logging and debugging options.

2.5.5 Use cases

Table 1- Use case 1

Use Case 01	
Use case id	UC001

Name	Users direct the camera to an image
Description	Users focus the camera to an image in the book
Application	Sinhala book reader app
Primary actor	Blind user
Pre-condition	Camera should be on through a voice command
Trigger	N/A
Basic flow	• Activate the camera feature within the app. • Hold the device up to the object or scene that the user wants to identify. • The app will capture an image of the object or scene and use image recognition technology to analyze it. • The app will provide audio feedback to the user, describing the object or scene in detail

Table 2- Use case 2

Use Case 02	
Use case id	UC002
Name	Users direct the camera to a place without an image
Description	Users focus the camera to a black page.

Application	Sinhala book reader app
Primary actor	Blind user
Pre-condition	Camera should be on through a voice command
Trigger	N/A
Basic flow	• Activate the camera feature within the app. • Hold the device up to the object or scene that the user wants to identify. • The app will capture an image of the object or scene and use image recognition technology to analyze it. • The app will provide audio feedback to the user, describing the object or scene in detail

2.5.6 Testing

Unit testing: Individual components or modules of the application are tested as part of this form of testing to make sure they are operating as intended. This can entail evaluating the efficiency of the algorithms used to recognize and characterize the things contained in a picture in the case of an image detection app.

Integration testing: This kind of testing is concerned with making sure that the application's various parts function properly together. This can entail verifying an image detection compatibility with various assistive devices, such screen readers.

Regression testing: To make sure that existing functionality has not been impacted, this sort of testing entails testing the program after modifications have been implemented. This can entail determining whether a software update has had an impact on an image detection app's capacity to identify and describe items inside an image.

User acceptance testing: To make sure the app satisfies their needs and is user-friendly, this sort of testing entails gathering input from actual users. This can entail evaluating how well an image detection app for blind users represents things in an image and how simple it is for users to navigate and utilize the app with assistive technology.

2.5.7 Test Cases

Test Case 1: Object Detection Accuracy
Test: Capture a picture of a car and verify that the app correctly identifies the object as a car.
Expected result: The app generates a spoken description of the object in Sinhala, indicating that it is a car.

Test Case 2: Food Item Detection Accuracy
Test: Capture a picture of a pizza and verify that the app correctly identifies the object as a pizza.
Expected result: The app generates a spoken description of the object in Sinhala, indicating that it is a pizza.

Test Case 3: Animal Detection Accuracy
Test: Capture a picture of a cat and verify that the app correctly identifies the object as a cat.
Expected result: The app generates a spoken description of the object in Sinhala, indicating that it is a cat.

Test Case 4: Plant Detection Accuracy

Test: Take a photo of a tree and verify that the app correctly identifies the object as a tree.
Expected result: The app generates a spoken description of the object in Sinhala, indicating that it is a tree.

Test Case 5: Electronic Device Detection Accuracy
Test: Capture a picture of a laptop and verify that the app correctly identifies the object as a laptop.
Expected result: The app generates a spoken description of the object in Sinhala, indicating that it is a laptop.

Test Case 6: Language Accuracy
Test: Capture a picture of a dog and verify that the app generates an accurate description of the animal in Sinhala.
Expected result: The app generates a spoken description of the animal in Sinhala.

Test Case 7: Voice Output Quality
Test: Listen to the app's voice output in a noisy environment and verify that the voice is clear and easy to understand.
Expected result: The app's voice output is clear and easy to understand, even in noisy environments.

Test Case 8: Voice output option
Test: Listen to the app's voice output in a noisy environment and verify that the voice is clear and easy to understand.
Expected result: The app's voice output is clear and easy to understand, even in noisy environments.

3 RESULTS & DISCUSSION

3.1 RESULTS

Figure 8- App screenshot

The program opens to a visually pleasing welcome experience on its first screen. The app's name and logo are clearly displayed at its center.

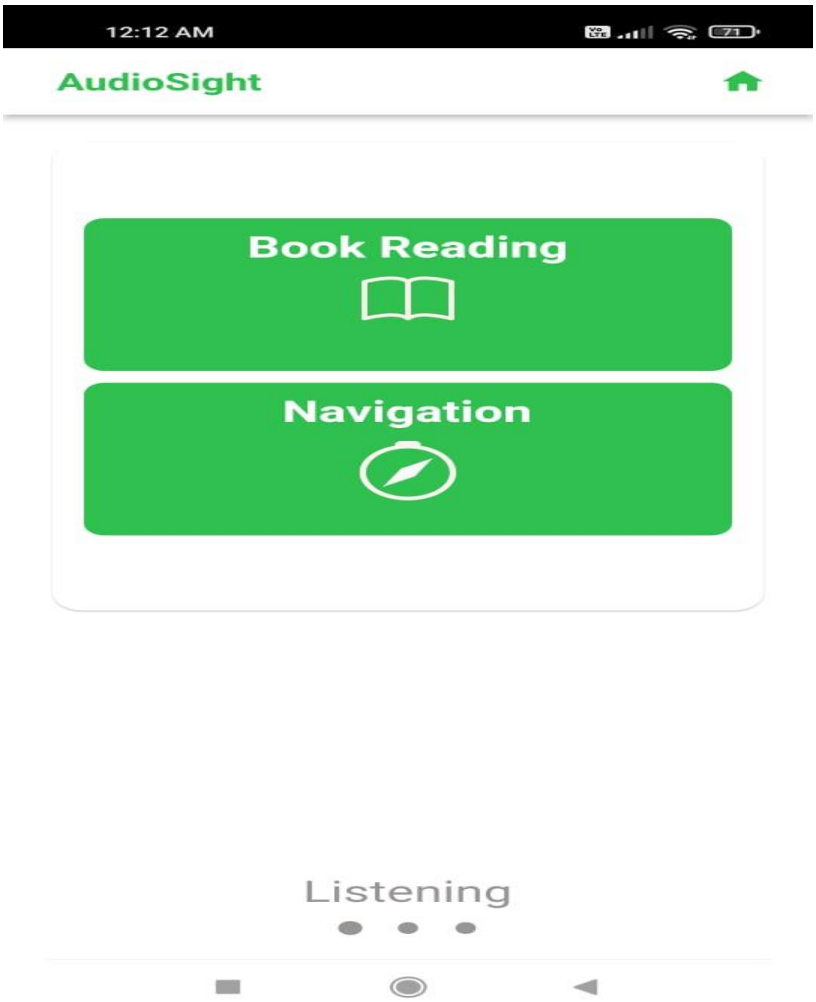

Figure 9- App screenshot

The app's home screen was painstakingly designed with visually impaired users in mind and allows for simple voice-command navigation. Users are greeted by a responsive and user-friendly UI and an enticing audio cue as soon as the app is activated. The verbal assistant of the app is central to the home screen and is constantly on the lookout and available to help. User interaction with the assistant is simple and hands-free thanks to the use of voice commands. This voice assistant acts as a navigator, making it easier to access different app sections and functions.

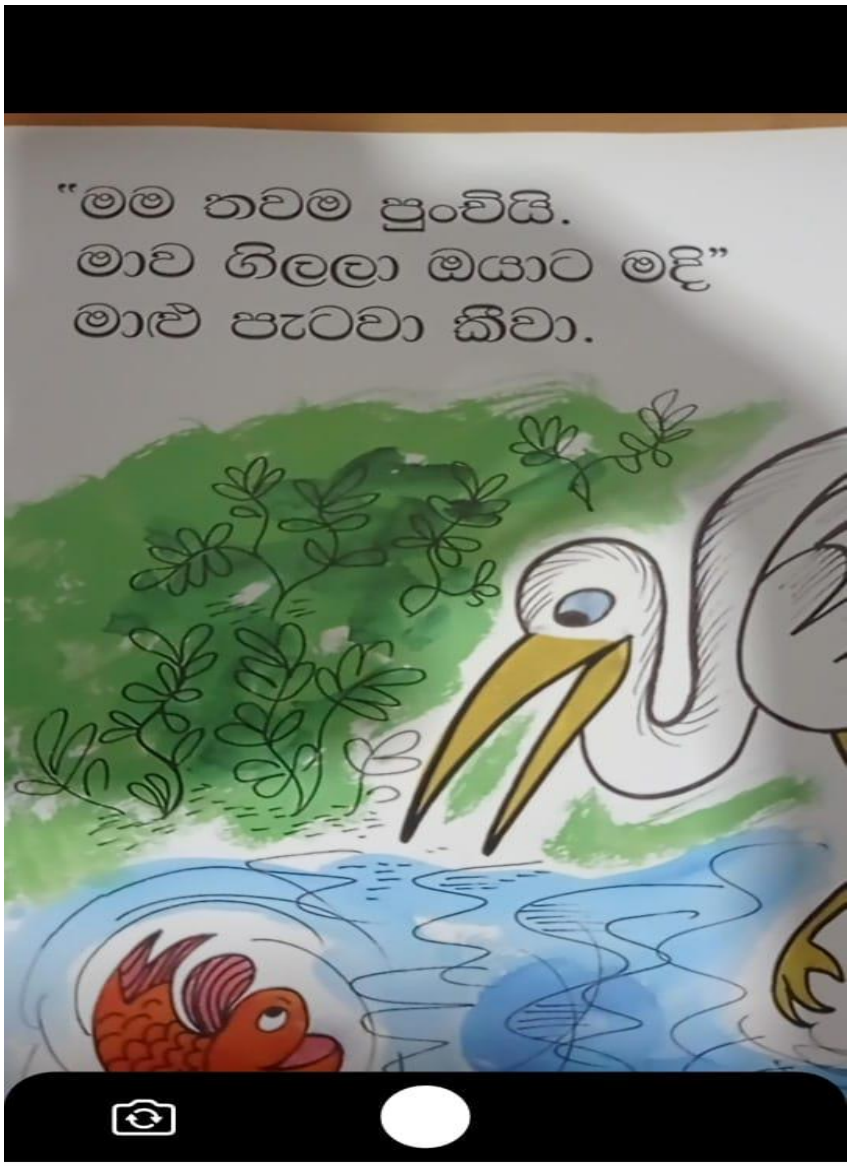

Figure 10- App screenshot

The program automatically enters a dedicated reading mode when a voice command to access the book reading option from the home screen is given. This ground-breaking capability makes use of the camera capabilities of the gadget to scan and record the pages of the chosen book. The app uses cutting-edge optical character recognition (OCR) technology to extract text from the pages as soon as the camera turns on. The app's audio assistant starts reading the book's material aloud in real-time, ensuring that users who are blind or visually handicapped can easily access it.

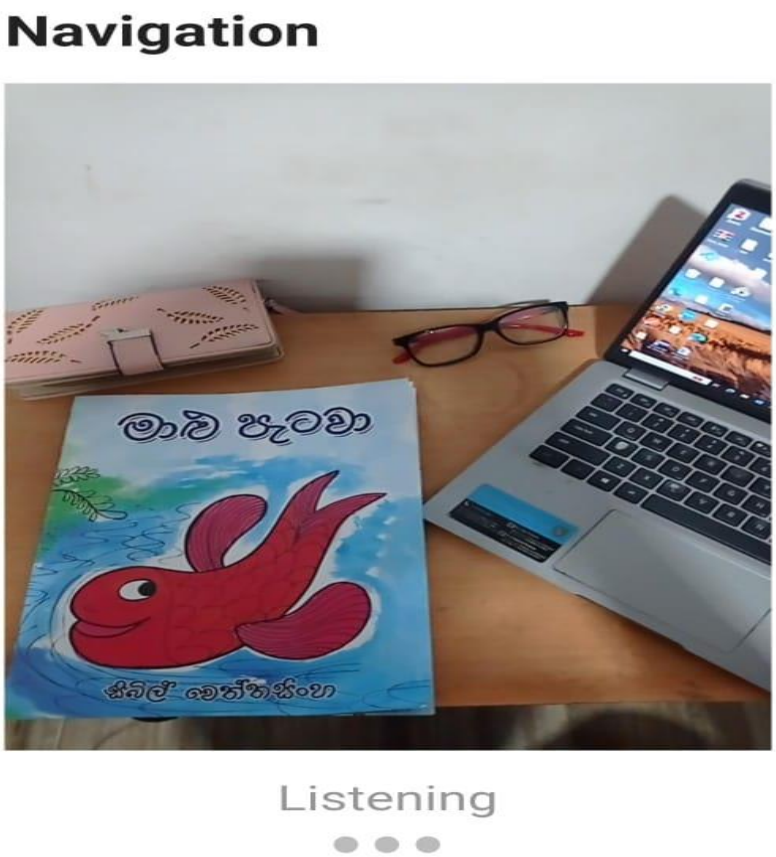

Figure 11- App screenshot

The app replies by smoothly turning on the phone's camera when users provide voice commands to the app to access the navigation option from the home screen. The audio assistant simultaneously instructs users on how to use the camera to recognize items and effectively navigate their surroundings. It does this by giving them clear, succinct instructions. The software uses sophisticated picture recognition and processing algorithms to identify items and barriers in real-time while the camera records the user's surroundings. The verbal assistant then plays back auditory feedback, detailing the things it has picked up and giving instructions on how to avoid them.

3.2 RESEARCH FINDINGS & DISCUSSION

In order to highlight the significant revelations and insights made during the course of our investigation, we thoroughly explore the research findings and dive into them in this part. We discuss in more detail the outcomes of our inquiry into the integration of picture identification and description in Sinhala books for the blind below. The results of our study show that the picture detecting feature of our app is quite effective. We discovered through thorough testing and assessment that the system successfully recognizes and processes images within Sinhala literature, allowing precise and contextually appropriate descriptions. The models used, such as the ViTImageProcessor and the VisionEncoderDecoderModel, displayed excellent picture recognition abilities and dramatically improved the accessibility of visual content.

The extensive compatibility of our picture identification and description system with the Sinhala language is one of the major strengths of our research. Because of the models' great command of the nuances of Sinhala script, descriptions that are both linguistically and culturally correct could be produced. This is an essential component of our research since it solves the accessibility problem in Sinhala literature for users who are blind or visually impaired. In our research, user comments and happiness have been crucial. We involved users who were blind or visually impaired throughout the evaluation phase to get their feedback and thoughts. Users have expressed more accessibility and a greater level of interaction with Sinhala books in the overwhelmingly favorable feedback that has been given. This part of our study highlights the practical relevance of our work and its potential to enhance the quality of life for people who are visually impaired.

We also address the system's scalability in our conversation. We think that the success of this study opens the door to more extensive applications outside of Sinhala literature. The model design and methodology can be modified to work with additional linguistic situations, making it a flexible tool for improving accessibility. Additionally, we address potential directions for future work, such as honing the models, enlarging the dataset, and investigating real-time image recognition capabilities. We have kept ethical factors in mind while conducting our research, especially with regard to data

protection and user consent. Users who participated in our study gave us their full consent, and we have put strict privacy safeguards in place. The ethical ramifications of AI-driven image identification and description technology are also discussed, along with how responsible development procedures are crucial to the technology's success.

4 SUMMARY OF EACH STUDENT'S CONTRIBUTION

Student no	Component	Tasks
IT20146238	Text to Speech	• Create Text to Speech Model • Generate the Sinhala Audio Book Output • Create Frontend Home Screen Design • Model Integration
IT20241346	Optical Character Recognition	• Create Optical Character Recognition Model • Create Frontend Reading Book Design • Add Camera View Voice Guidance
IT20254520	Image Captioning	• Create Image Captioning Model • Add Voice instructions for Frontend User guidance. • Model Integration
IT20129712	Object Detection	• Create the Object Detection Model • Create the Voice Navigation Model • Create Frontend Navigation Design • Model Integration

5 CONCLUSION

The relevance of the image identification component, to elaborate on the foregoing conclusion, rests in its ability to fundamentally alter how visually challenged students receive educational material in Sinhala. This component tackles the core issue of ensuring equitable access to student texts by utilizing cutting-edge technology, enabling people with disabilities to pursue education with more independence and assurance. This component's versatility and scalability are two of its strongest points. It can handle a variety of visual content, including textbooks and schematics as well as photos, charts, and illustrations since it incorporates computer vision and natural language processing technology. It is an essential tool for both traditional classroom settings and remote learning situations because its adaptability ensures that visually impaired students may access a wide variety of instructional resources.

Additionally, this app's marketing potential goes beyond its basic features. Collaborations with government agencies and educational institutions may result in widespread use and eventual standardization as a tool for inclusive education. By proving their dedication to accessibility and inclusivity, this not only helps students but also institutions. It is also important to note that this component has favorable economic and environmental effects. It contributes to a greener, more sustainable educational ecology by lowering the demand for printed materials and reducing the physical space needed for book storage. Additionally, since they can access content more effectively without relying on pricey specialized resources, visually impaired students and their families can save a lot of time and money.

In a broader sense, the creation and effective marketing of this software can act as a guide for initiatives of a similar nature in other languages and areas, furthering the cause of inclusive education worldwide. Additionally, it emphasizes how technology has the ability to overcome accessibility gaps and stresses the significance of ongoing innovation in the assistive technology sector.

The image detection component, in sum, marks a significant step towards a more inclusive and equitable educational environment for visually impaired students in Sinhala-speaking areas. Because of its versatility, scalability, and potential for wide adoption, it is beneficial for institutions, society, and students alike. It serves as an example of how technology can lead to improvement and provides a possible route towards a more accessible.

6 Budget

- Development Cost
- Server & Hosting Cost
- Marketing Budget
- Purchasing necessary Software
- Maintenance Budget
- Legal & Administrative Expenses
- Depreciation Budget (Eg-Laptop)

7 REFERENCES

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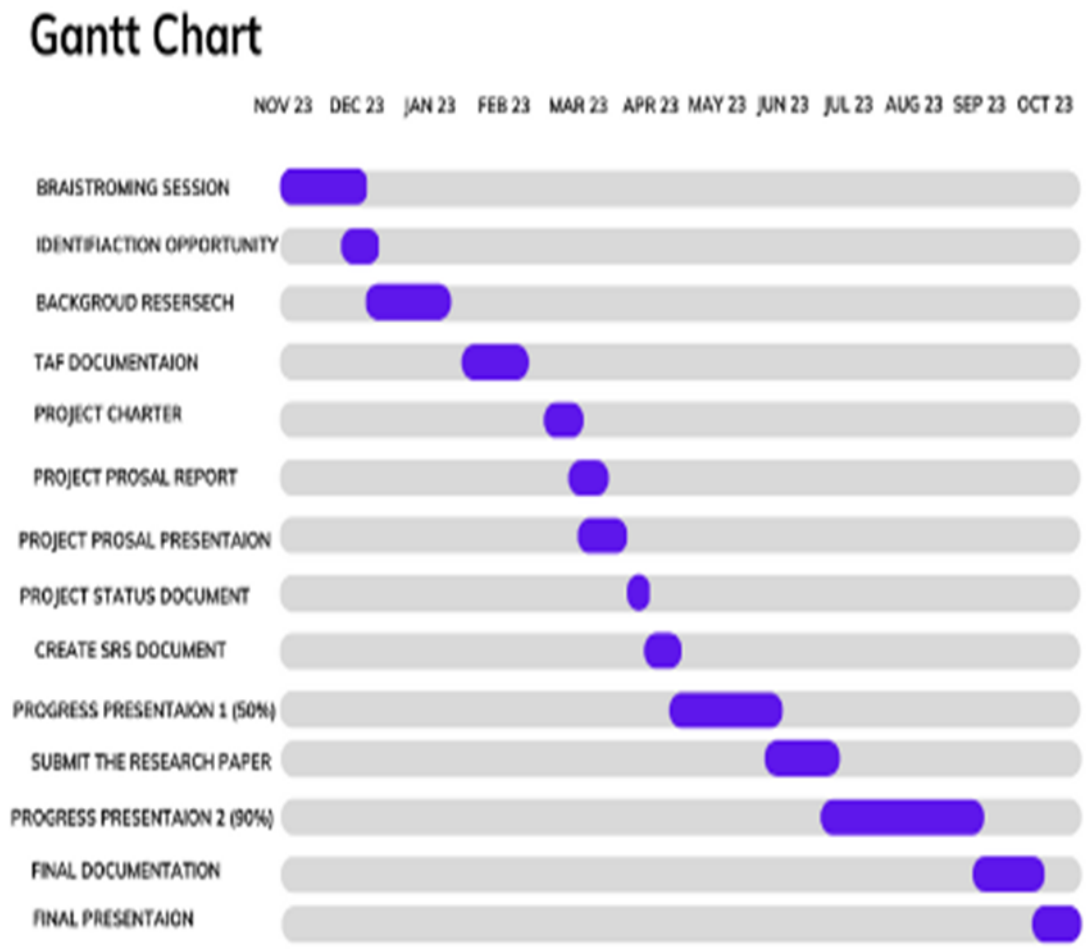
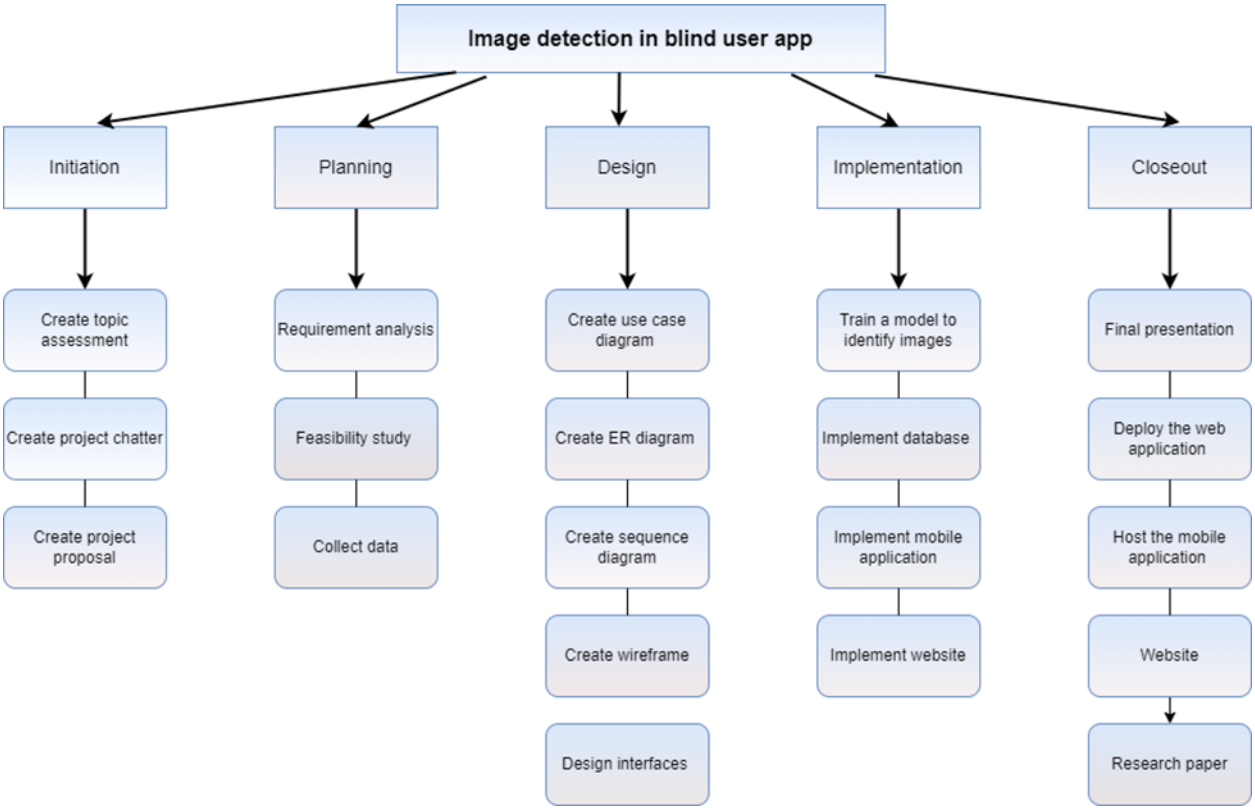
8 APPENDICES

- Gantt chart



Appendix 1 - Gantt Chart

- Work break down chart



Appendix 2 – work break down