Mobile Base Sinhala Book Reader for Visually Impaired Individuals

Project ID: 23-198

Project Proposal Report

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IT20254520

B.Sc. (Hons) Degree in Information Technology Specialized in Information Technology

Department of Information and Technology

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Declaration

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

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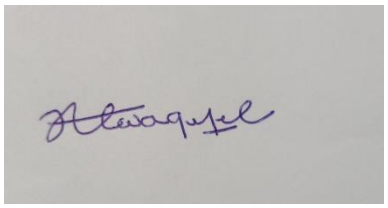
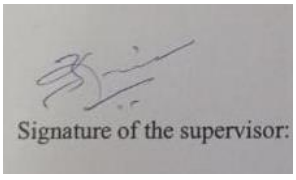
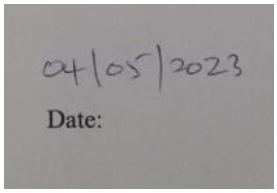
Bhagya	IT20254520	

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





Abstract

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.

Table of Contents

List of Figures

List of Tables

List of Abbreviation

Abbreviation	Description
ML	Machine Learning
DL	Deep Learning
WHO	World Health Organization
TTS	Text-to-speech
OCR	Object character recognition
NLP	Natural Language Processing

1. Introduction

1.1 Background

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.

1.2 Literature Survey

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.

1.3 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

1.4 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

2. Objectives

2.1 Main Objectives

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.

2.2 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.

Methodology

2.3 System Architecture

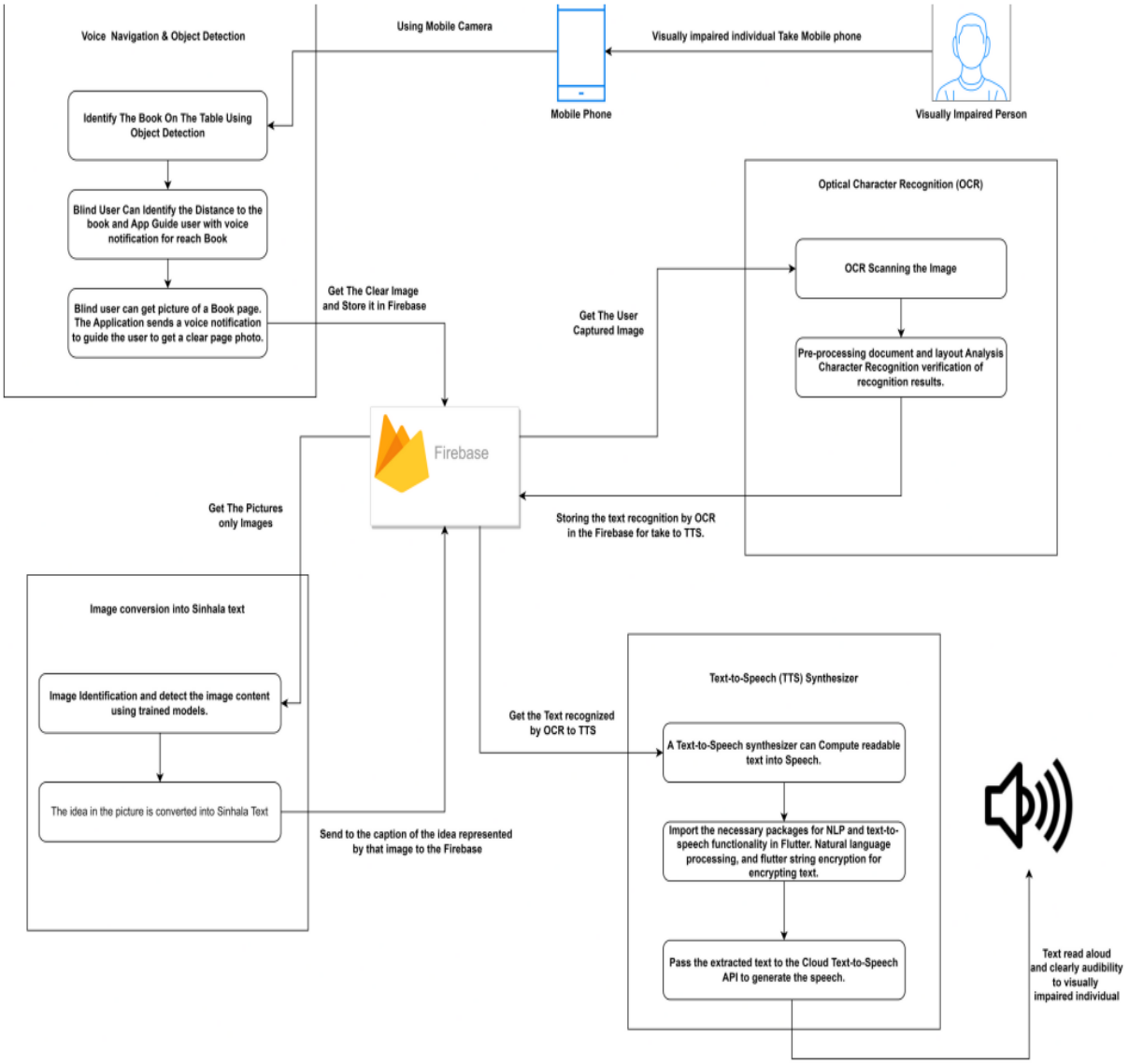


FIGURE 2: SYSTEM DIAGRAM

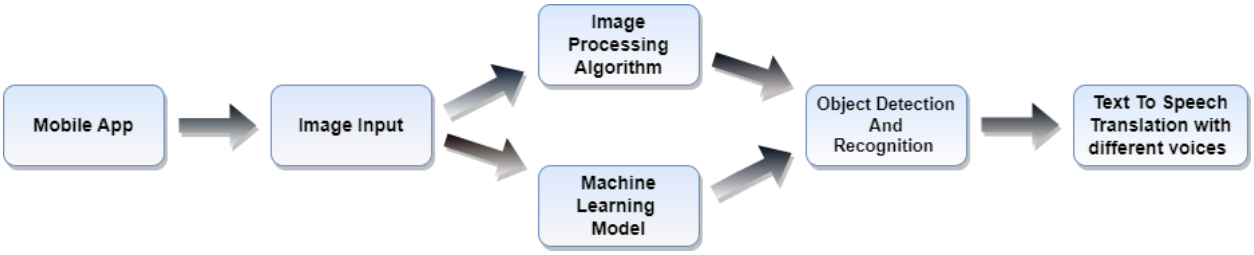


FIGURE 3: INDIVIDUAL COMPONENT

3.1.1Software Solutions

The Software Development Life Cycle will be considered using the agile methodology (SDLC). Scrum will be the methodology employed under the agile approach. A variety of iterative and incremental projects can be managed and controlled using the straightforward agile project management methodology known as Scrum. The authors' solution will be based on the hypothesis derived from the literature review and the survey implemented, which will lead to ongoing modifications, because scrum has the capacity to inspect and adapt to changing requirements.

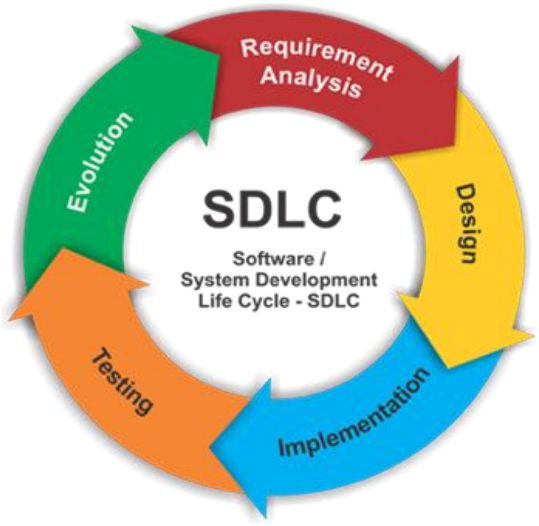


FIGURE 4: SOFTWARE DEVELOPMENT LIFECYCLE

3.1.2 Hardware Solutions

Smartphones and tablets: A smartphone or tablet could be used as the primary device for the Sinhala book reader app. Smartphones and tablets are portable and convenient, and many models have built-in accessibility features such as text-to-speech and screen readers.

3.2 Tools and Technologies

3.2.1 Tools

Jupyter Notebook

An especially open-source web tool called Jupyter Notebook permits the creation of papers that, in all actuality, subtly contain live code. They fundamentally believed that this application might be used for machine learning in general.

Machine Learning Algorithms

Machine learning algorithms can be used to improve the accuracy of OCR or NLP processes. For example, machine learning models can be trained to recognize and accurately translate Sinhala text, or to identify and extract specific types of information from the text.

Natural Language Processing (NLP)

NLP technology can be used to analyze and understand the written text in Sinhala, which can be helpful for developing more advanced features such as automatic summarization or sentiment analysis.

GitHub

In general, GitHub is an online host that focuses on software development and version control utilizing Git, which is unquestionably very important. It demonstrates how it contains GitHub's distributed version control and source code management functions, as well as its own, in a very significant way. It also includes the distributed version control and source code management functions of GitHub.

3.2.2 Technologies

How does image detection work?

A computer vision system that uses cutting-edge methods to recognize and describe objects and scenes in real-time is an image detection software for blind students. The program takes pictures of the user's surroundings using the camera on a smartphone or tablet. The objects and their characteristics are then identified from these photos using image processing techniques like edge detection, color analysis, and feature extraction. After locating the things in the image with the use of object detection algorithms, machine learning models are used to identify and categorize the objects. These models use methods like convolutional neural networks (CNNs) to recognize objects in real-time and are trained on massive datasets of annotated photos.

After objects are found and identified, the software gives the user audio feedback that succinctly and clearly describes the objects. According to the user's choices, the audio feedback can be altered to provide additional information or to use a certain language or accent. Students who are blind can more successfully and freely explore their environment with the aid of an image detecting software. They can now recognize items and comprehend their environment in a way that was previously impossible thanks to this technology, which improves their everyday lives and promotes better accessibility for people who are blind or visually impaired.

Training and Testing Dataset

We will need a dataset of photos to train and test an image detection model for a blind user app. Pictures of the scenes or things you want the model to recognize. We'll compile a picture dataset. For object detection, some well-liked datasets are COCO, Pascal VOC, and ImageNet. These datasets, which include many photos and annotations, can be used to develop and evaluate models for a range of object detection applications.

The diversity of the photographs should be considered when choosing them for the dataset. Images of objects and settings from various angles, with various lighting setups, and against various backgrounds should all be included in our dataset. This will make it more likely that your model will be able to recognize objects and settings in a range of actual-world scenarios.

After gathering or choosing our dataset, we will divide it into training and testing sets. The testing set is used to assess how well the model performs when applied to new data, whereas the training set is used to train the model.

A typical ratio is 80:20 or 70:30, meaning that the training set will typically be larger than the testing set. Moreover, you may employ methods like cross-validation to

3.3 Evaluation Plan

Phase 1: Basic functionality

Develop the basic functionality of the app, including the ability to take a picture and identify objects in the image.

Use pre-trained machine learning models for image recognition, such as those available in TensorFlow or Keras

Include simple navigation controls for the user, such as the ability to view the identified objects and their descriptions.

Phase 2: Image enhancement

Implement image enhancement techniques to improve the quality of images before object recognition, such as image denoising, contrast enhancement, or color correction.

Use deep learning models to remove image noise and improve image clarity, enabling better object recognition accuracy.

Enable the user to edit and enhance the images before object recognition, such as cropping or resizing.

Phase 3: Multi-object detection

Implement multi-object detection, enabling the app to detect and identify multiple objects in the same image.

Use advanced deep learning models for multi-object detection, such as YOLO (You Only Look Once) or SSD (Single Shot Detector)

Enable the user to view and select individual objects within the image and display their descriptions.

3.4 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.

3. Project Requirements

3.1 Requirements 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 identify 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 teaches for 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.

3.2 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.

3.3 Functional Requirement

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.

3.4 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.

3.5 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

4.6 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.

4. Description of Personal and Facilities

To develop an image detection functionality for blind user's app, several resources and facilities are necessary. These include technical expertise in computer vision, machine learning, and software development. The development team should also have access to image databases for training and testing purposes, and the app should be compatible with assistive technologies such as text-to-speech software or screen readers. Blind users should be involved in the testing and development process to ensure that the app meets their needs and is accessible to them. The app should also include accessibility features such as high contrast modes and adjustable color schemes, as well as regular maintenance and support. Cloud infrastructure is also required to process images and provide results in real-time. Overall, with the right resources and facilities in place, an image detection app can be developed to help blind users access and interpret visual information.

5. Work Breakdown Chart

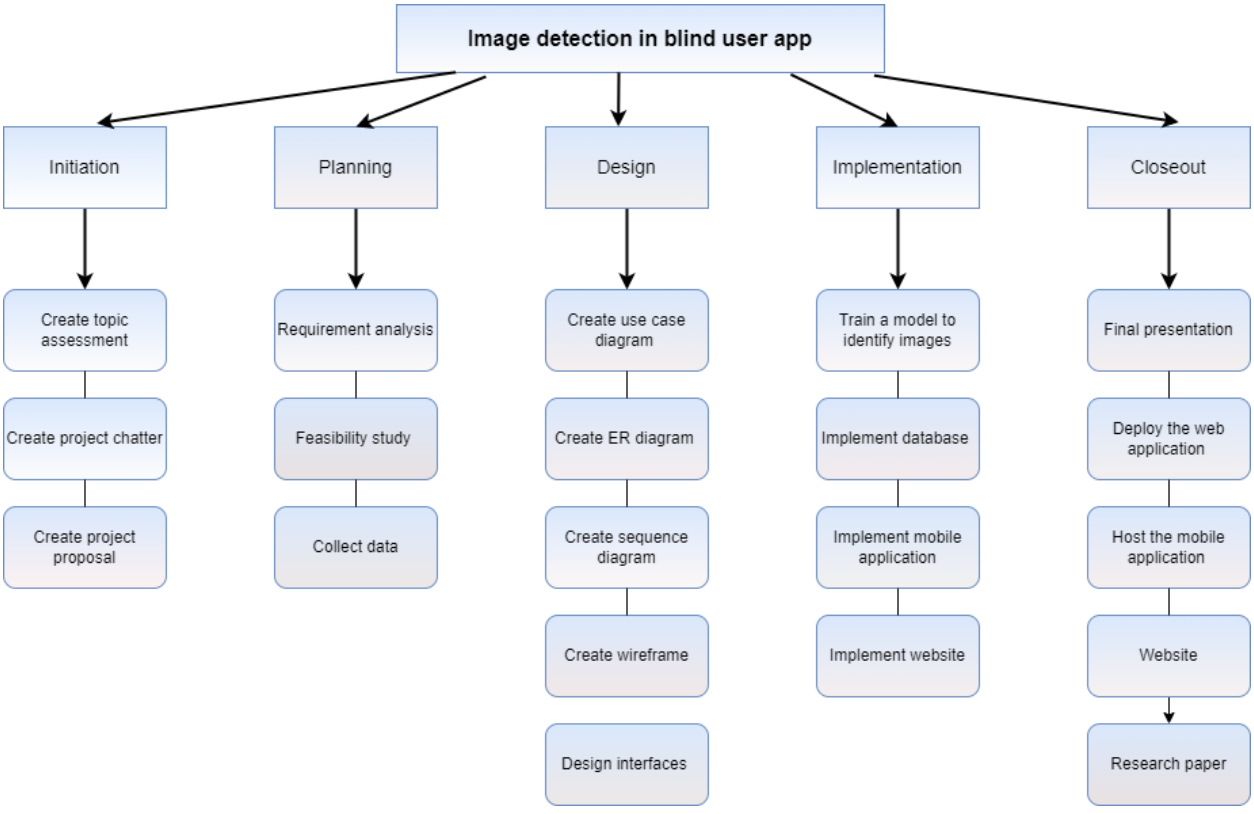


FIGURE 5: WORK BREAK DOWN CHART

6. Gantt Chart

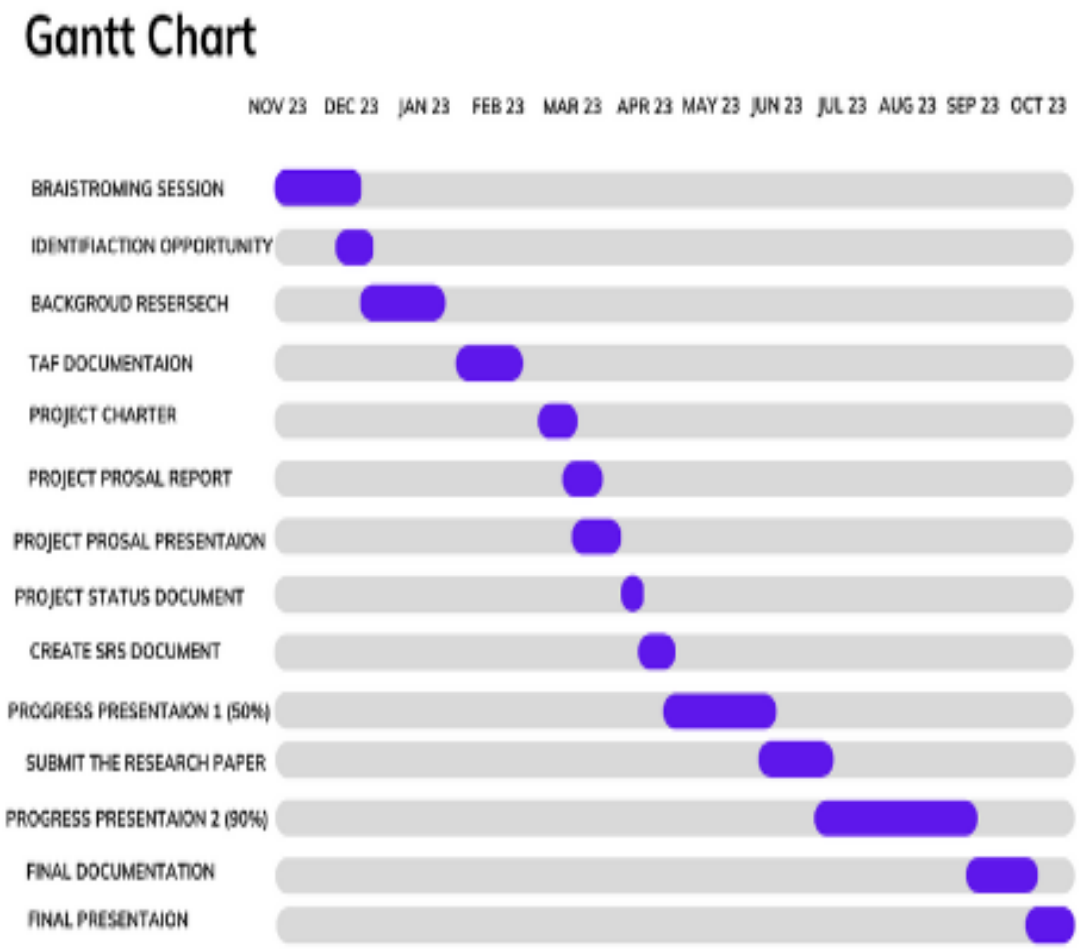


FIGURE 6: GANNT CHART

7. Budget

- Development Cost
- Server & Hosting Cost
- Marketing Budget
- Purchasing necessary Software
- Maintenance Budget
- Legal & Administrative Expenses

8. Commercialize

- Identifying the Target Audience: In this case, the target audience would be visually Impaired Individuals who could benefit from the features of the Mobile Application.

- Revenue Generation: Commercialization also involves generating revenue from the mobile application. This could involve charging for the application itself, offering premium features for a fee.

- Promotions: The target audience should be reached through targeted campaigns on social media and other channels. Collaboration with organizations that work with visually impaired individuals, such as libraries or schools, can also be an effective way to reach the target audience.

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Appendix

FIGURE 9: SPLASH SCREEN

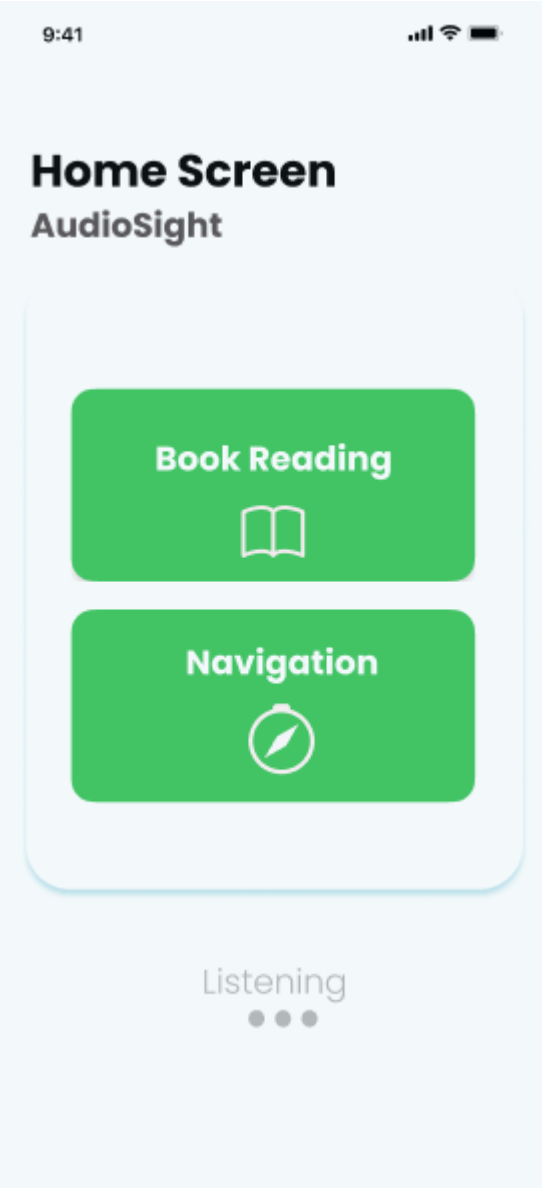

FIGURE 10: HOME PAGE

FIGURE 11: NAVIGATION

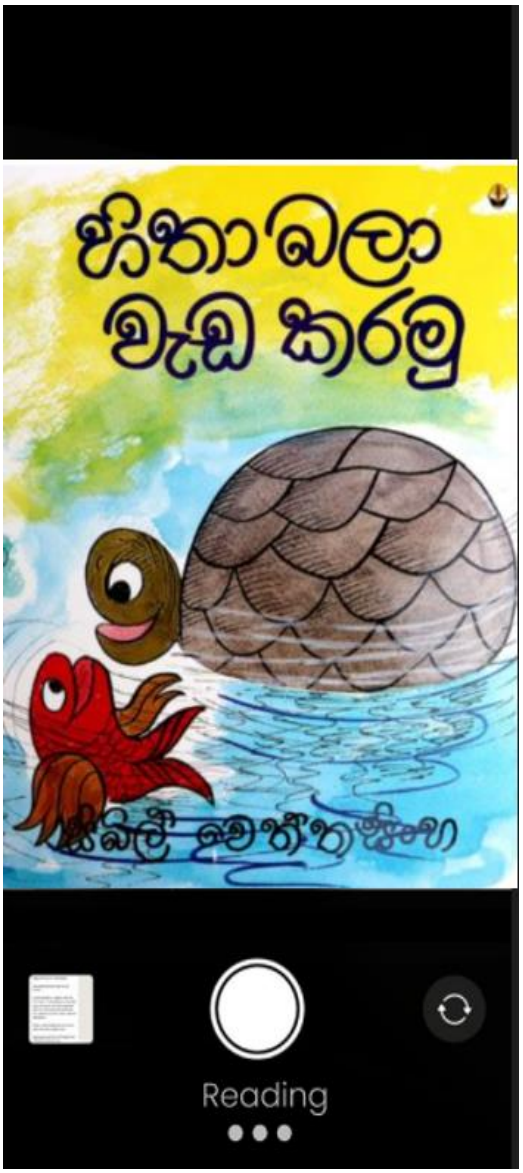

FIGURE 12: IMAGE DETECTION

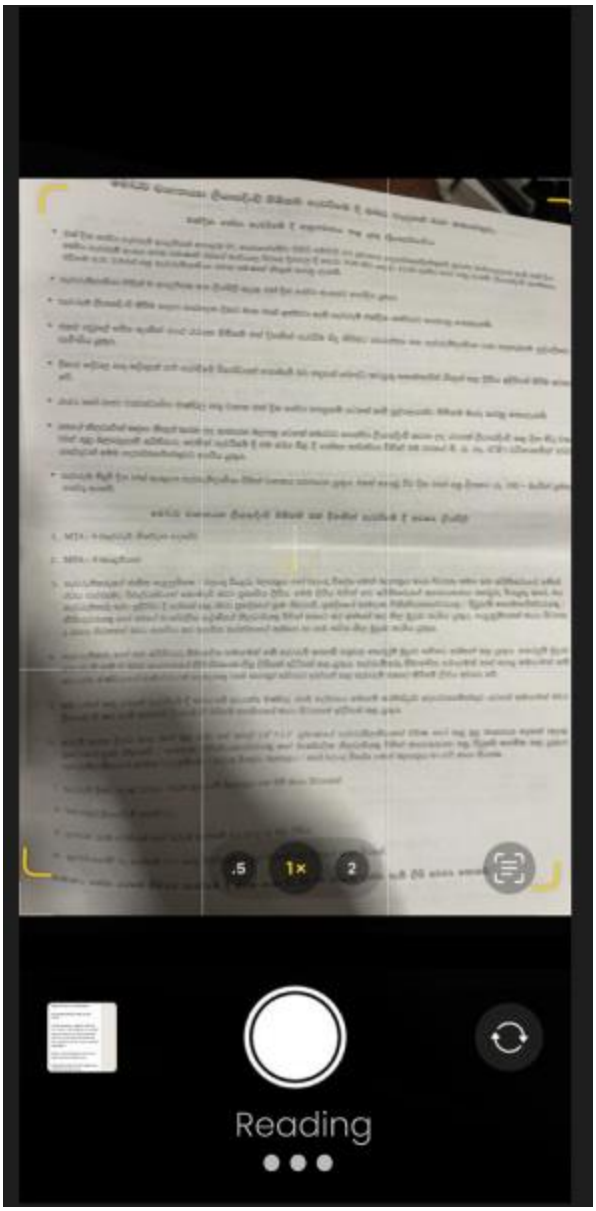

FIGURE 13: READING