Mobile Base Sinhala Book Reader forVisually Impaired Individuals

TMP-23-198

Logbook

Semini J.P.D.L.

IT20241346

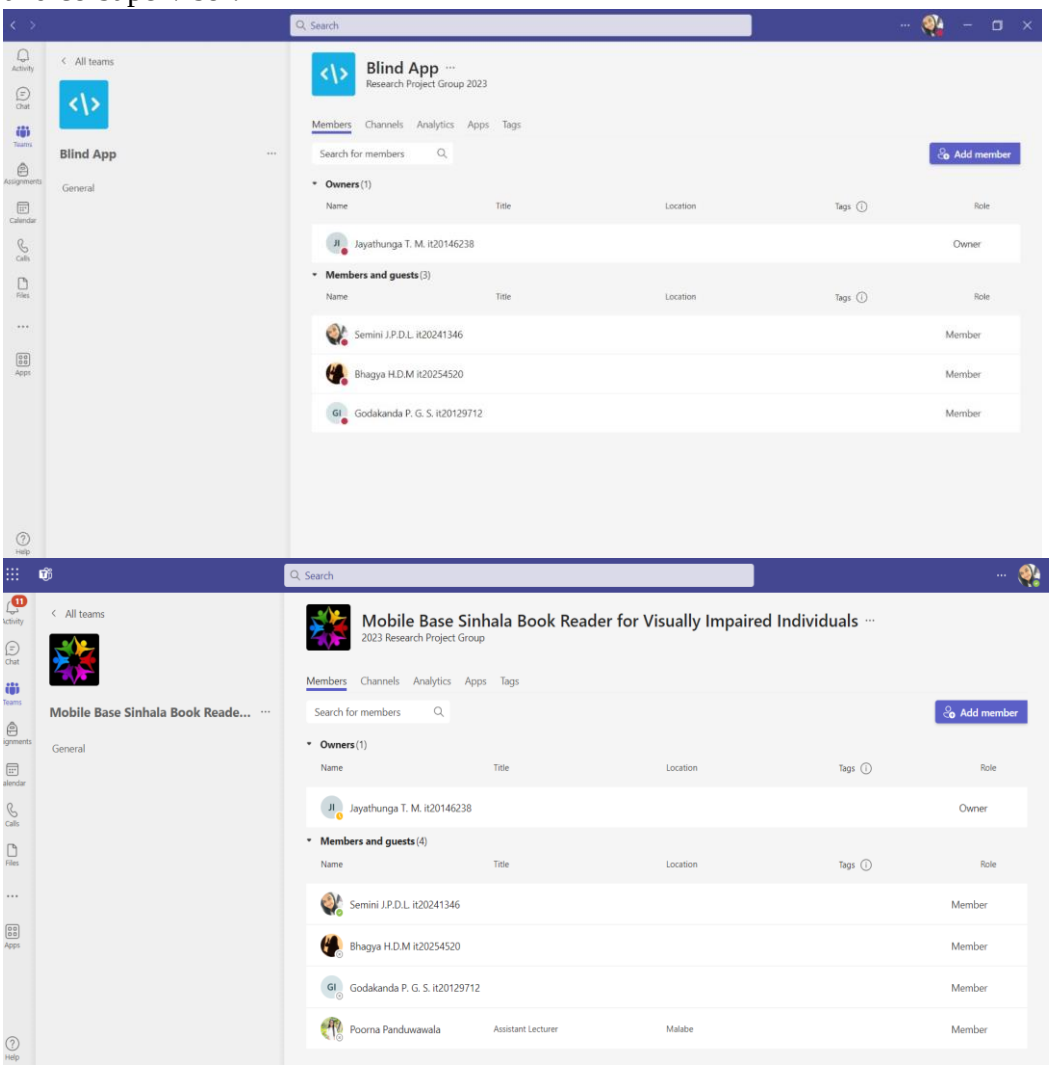
Bachelor of Science (Hons) Degree in Information Technology,Specializing in Information Technology

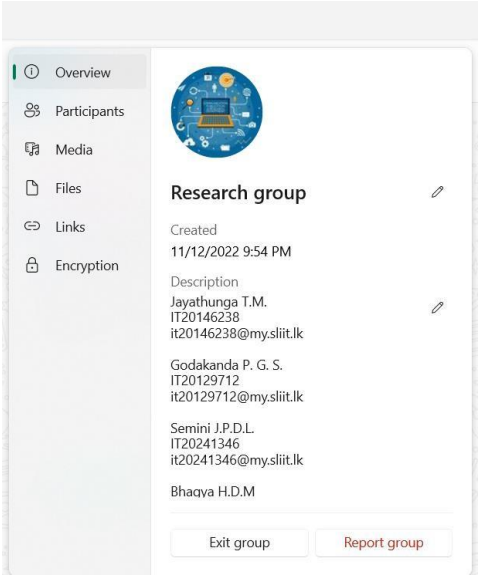
Sri Lanka Institute of Information Technology
Sri Lanka

October 2023

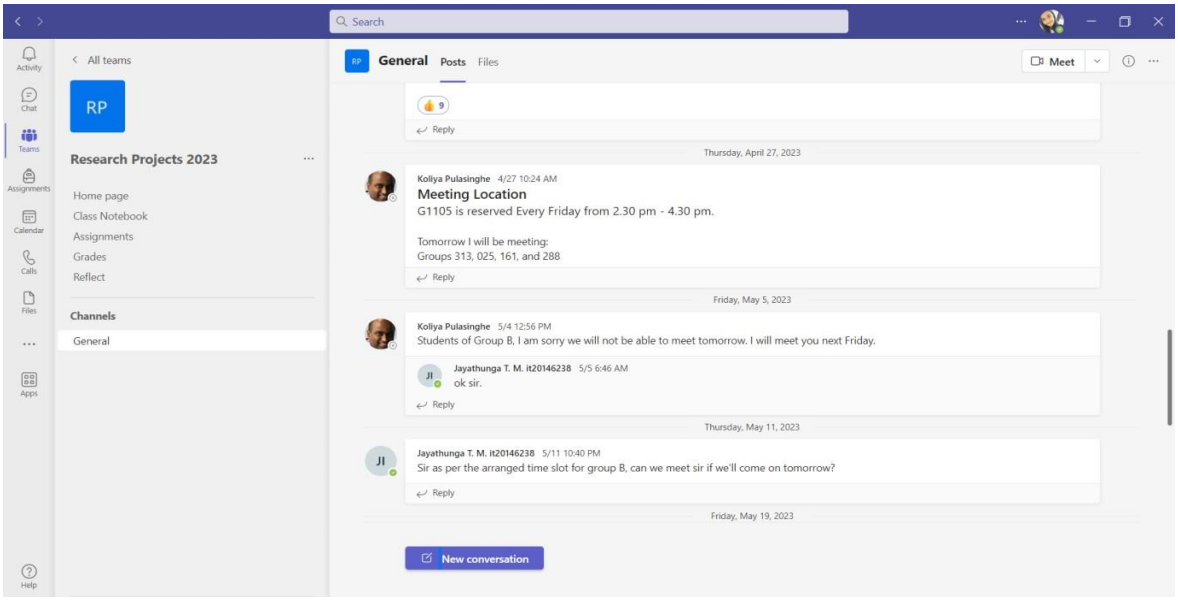
Task
Completed Tasks and conversation highlights

- Gathering team members and suggest a suitable topic .
- Creating WhatsApp , Teams channels for communicating with group members , supervisor and co-supervisor.

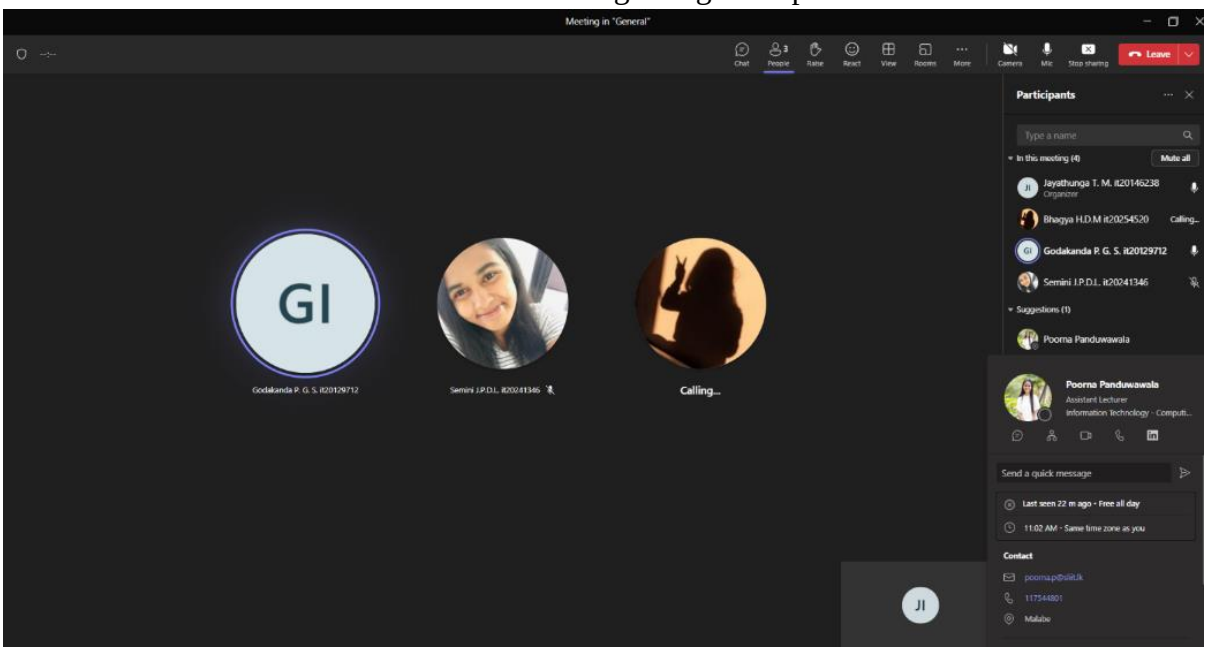




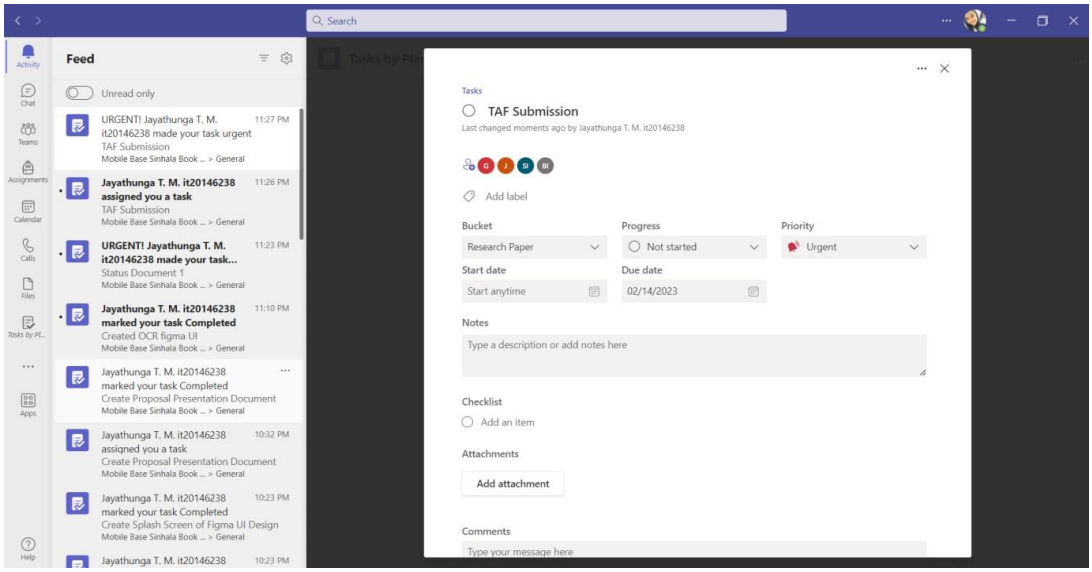
- Contacting Prof. Koliya Pulasinghe regarding the research topic.



- Narrowing of the scope as suggested by the supervisor.
- Conversation with Ms. Poorna Panduwawala regarding the topic.



- Creating the project ‘Topic Assessment Form’ and submit it .



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IT4010 – Research Project - 2023
Topic Assessment Form

6. Brief description of the research problem including references (200 – 500 words max) – references not included in word count.

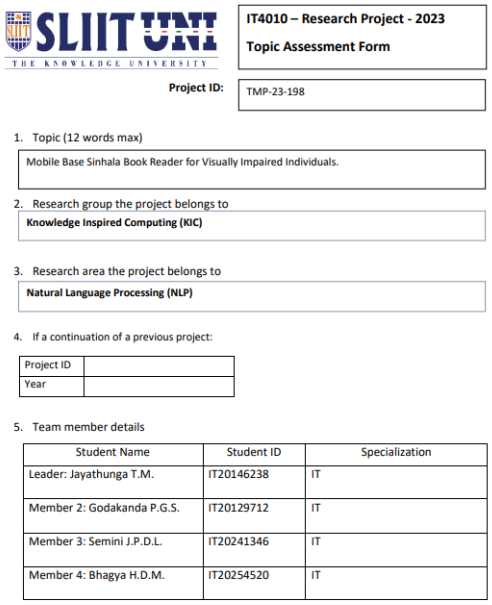
Blind people face several challenges when reading books, but the main problem is a lack of accessibility to printed materials. Despite advancements in assistive technology, such as text-to-speech software and Braille displays, most books are still not accessible to blind individuals in an easily readable format. This can limit the opportunities for blind people to gain knowledge, engage in literary experiences, and improve their education and employment prospects.

One issue is the cost of specialized devices and software, which can be prohibitively expensive for many blind people. Even when these tools are available, they may not provide an experience that is comparable to reading a traditional printed book. For example, text-to-speech software can struggle with complex language and formatting, and Braille displays can be slow and clunky.

Another issue is the limited availability of audiobooks and Braille materials. While more audiobooks are being produced, the selection is still limited compared to the vast number of printed books. Braille books are even harder to come by, as the process of translating printed books into Braille is time-consuming and costly. This means that blind people may not have access to the latest best-selling books or popular educational materials.

In conclusion, the main problem that blind people face in reading books is a lack of accessibility to printed materials. Despite advances in assistive technology, there are still significant barriers to overcome, such as the cost of specialized devices and software, the limited availability of audiobooks and Braille materials, and the difficulty in providing a comparable reading experience to that of a traditional printed book. To address these challenges, there needs to be a concerted effort to make books more accessible to blind people and to ensure they have the same opportunities to engage with literature and gain knowledge as sighted individuals.

World Health Organization: https://www.who.int/en/news-room/fact-sheets/detail/blindness-and-visual-impairmen



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IT4010 – Research Project - 2023
Topic Assessment Form

Project ID: TMP-23-198

1. Topic (12 words max)

Mobile Base Sinhala Book Reader for Visually Impaired Individuals.

2. Research group the project belongs to

Knowledge Inspired Computing (KIC)

3. Research area the project belongs to

Natural Language Processing (NLP)

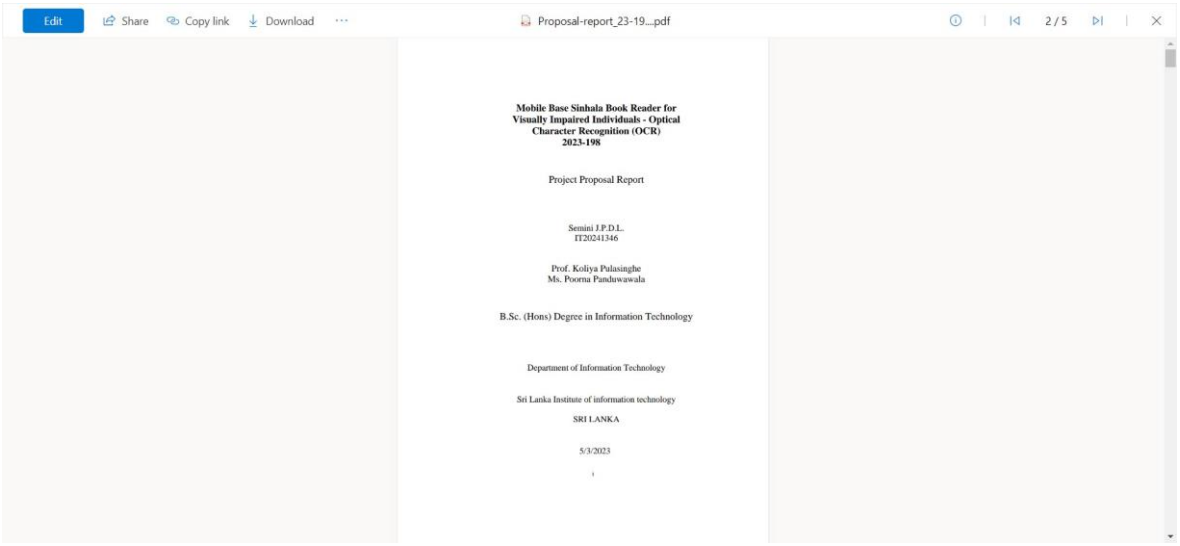
4. If a continuation of a previous project:

Project ID	
Year	

5. Team member details

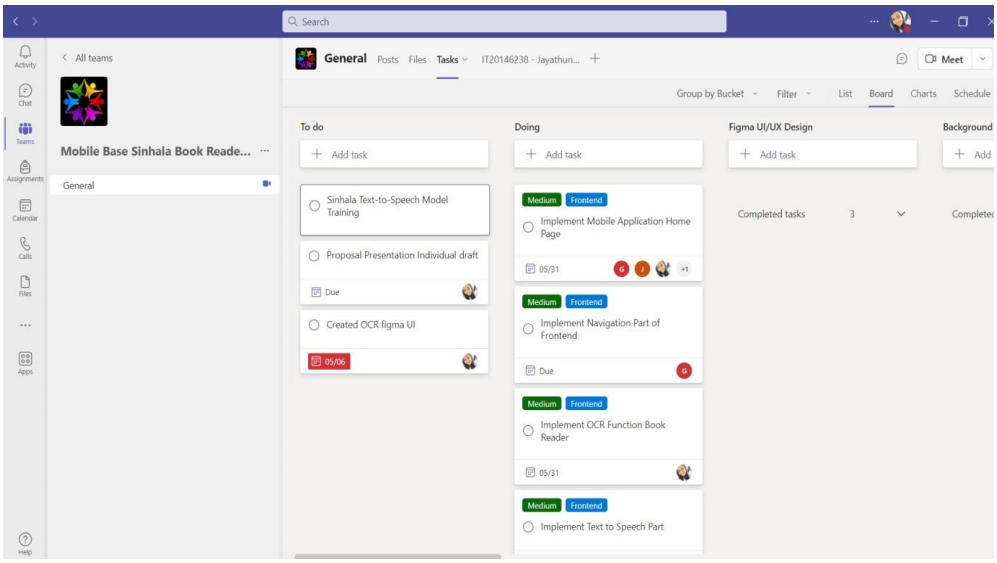
Student Name	Student ID	Specialization
Leader: Jayathunga T.M.	IT20146238	IT
Member 2: Godakanda P.G.S.	IT20129712	IT
Member 3: Semini J.P.D.L.	IT20241346	IT
Member 4: Bhagya H.D.M.	IT20254520	IT

- Submitting proposal draft.



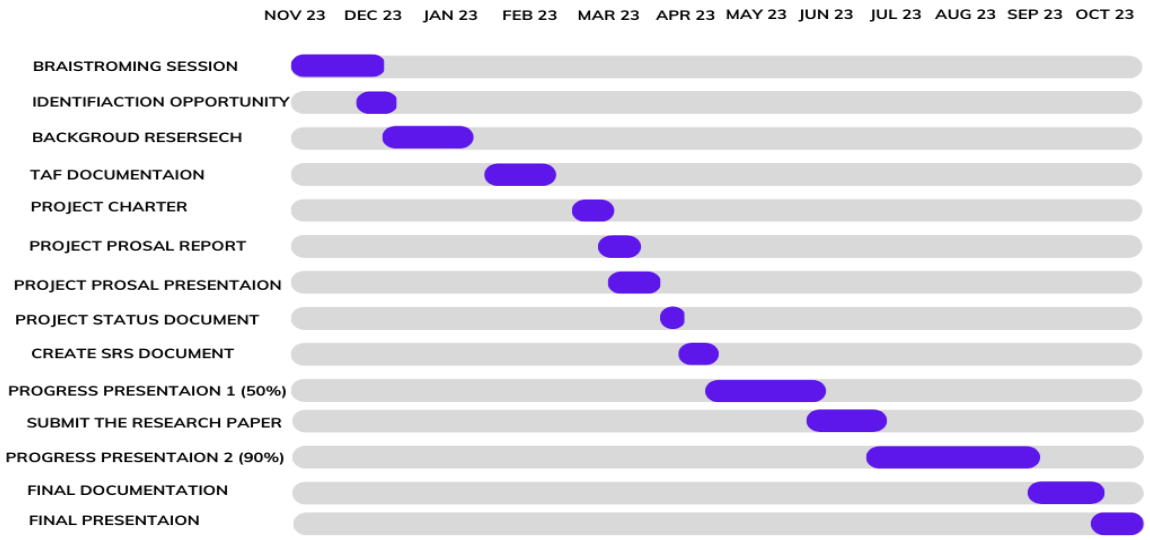
- Accepting the proposal.

- Making a task planner with team members .

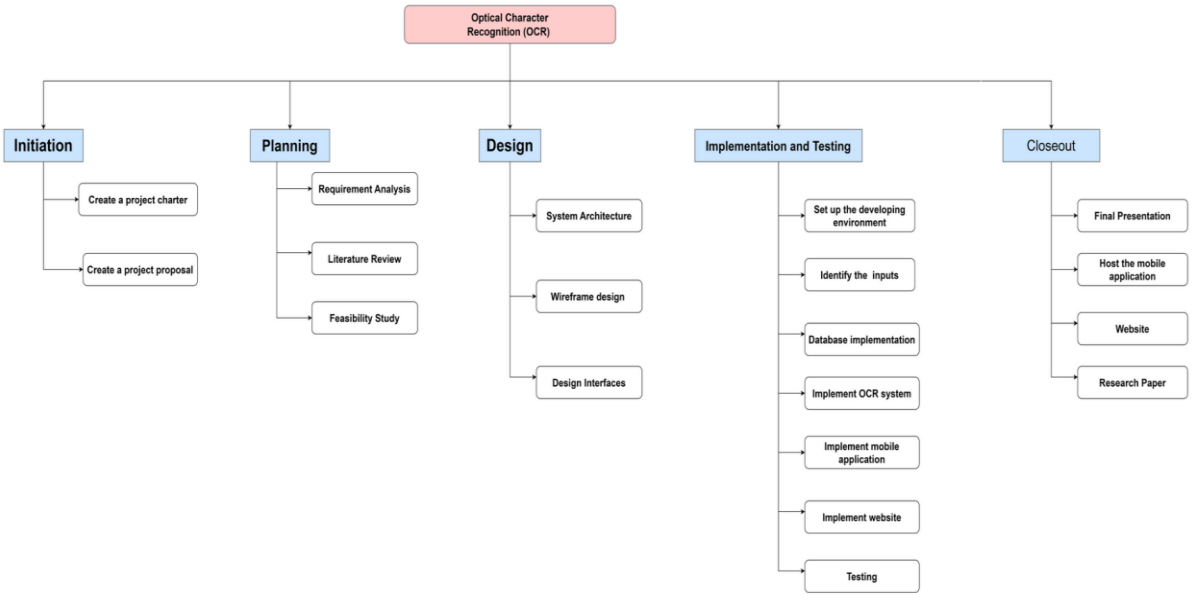


- Communicating with group members and deciding how to start the developing process of the project.
- Selecting tools and technologies.

- Making the Gantt chart.



- Making system breakdown chart .



- Getting the field visit permission letter .

SRI LANKA
INSTITUTE OF INFORMATION TECHNOLOGY

16th Floor, BoC Merchant Tower, No. 28, St. Michael's Road, Colombo 03

Date:28/04/2023 Your Ref : My Ref : 2023-198

The Ceylon School for the Deaf &
Blind RDC Donations office 521,
Galle Road,
Ratmalana
Sri Lanka

Dear Sir / Madam,

Certifying the project titled "Mobile Base Sinhala Book Reader for Visually Impaired Individuals" is conducting as a BSc in IT final year research project.

The Sri Lanka Institute of Information Technology (SLIIT) is the largest Degree Awarding Institute in the field of information Technology recognized by the University Grants Commission under the Universities Act. It was established in the year 1999 to educate and train Information Technology (IT) Professionals required by the fast-growing IT Industry in Sri Lanka.

This letter is to certify that the following students.
IT20146238 - Jayathunga T.M.
IT20129712 - Godakanda P.G.S.
IT20241346 - Semini J.P.D.L.
IT20254520 - Bhagya H.D.M.

They are final year undergraduate students who conduct research entitled "Mobile Base Sinhala Book Reader for Visually Impaired Individuals" as partial fulfillment of the B.Sc. in Information Technology degree at Sri Lanka Institute of Information Technology (SLIIT). The students are conducting the research under the supervision of Prof. Koliya Pulasinghe

I kindly request your assistance in enabling these students to collect data from your organization to build their dataset for the research project. If you have any questions or require further clarification about the project, please do not hesitate to contact me.

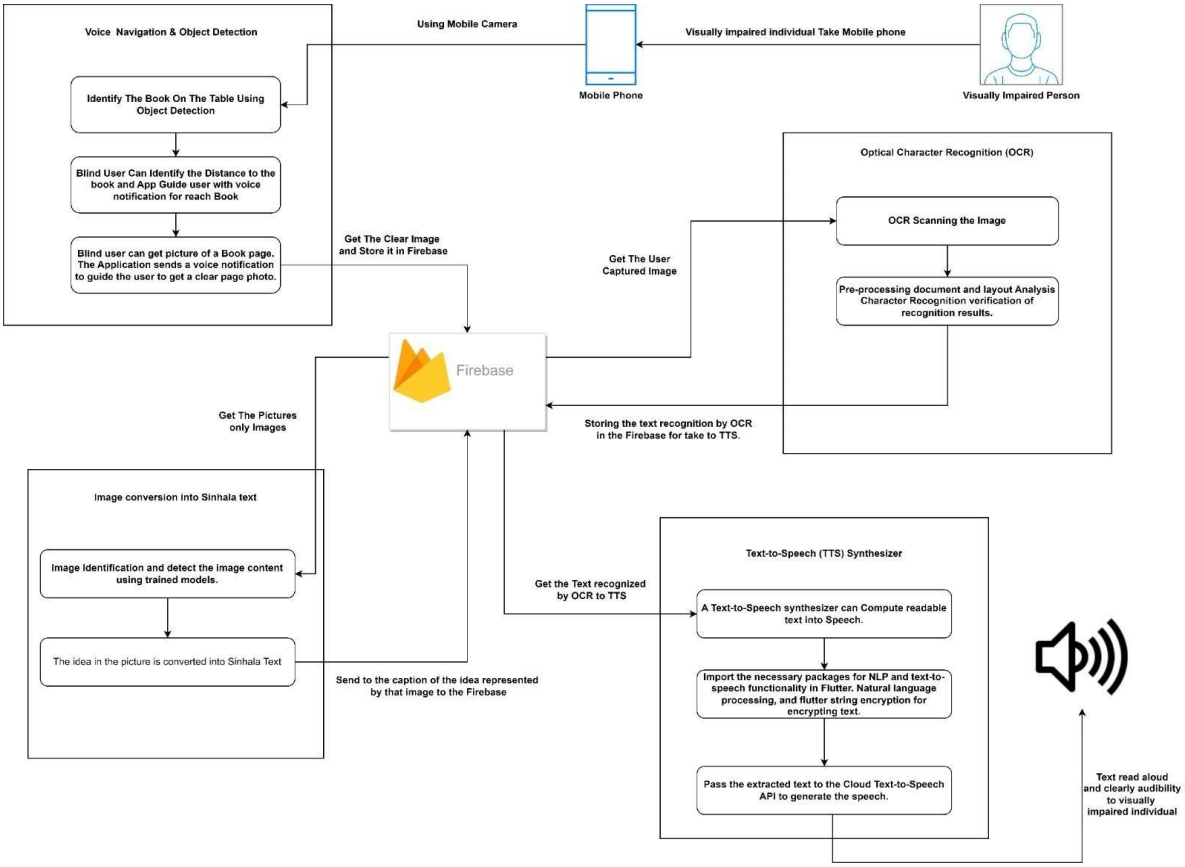
Thank you for your cooperation

.....

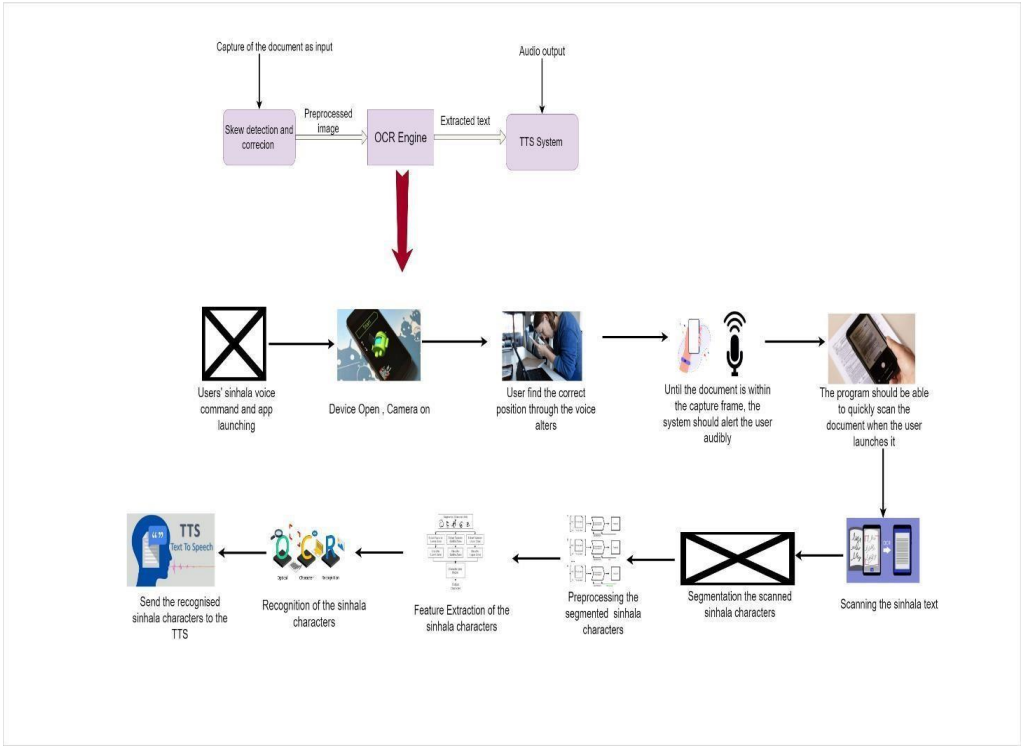
Dr. Jayantha Amararachchi
Assistant Professor/
Research Project Coordinator,
jayantha.a@sliit.lk
+94 11 754 4103

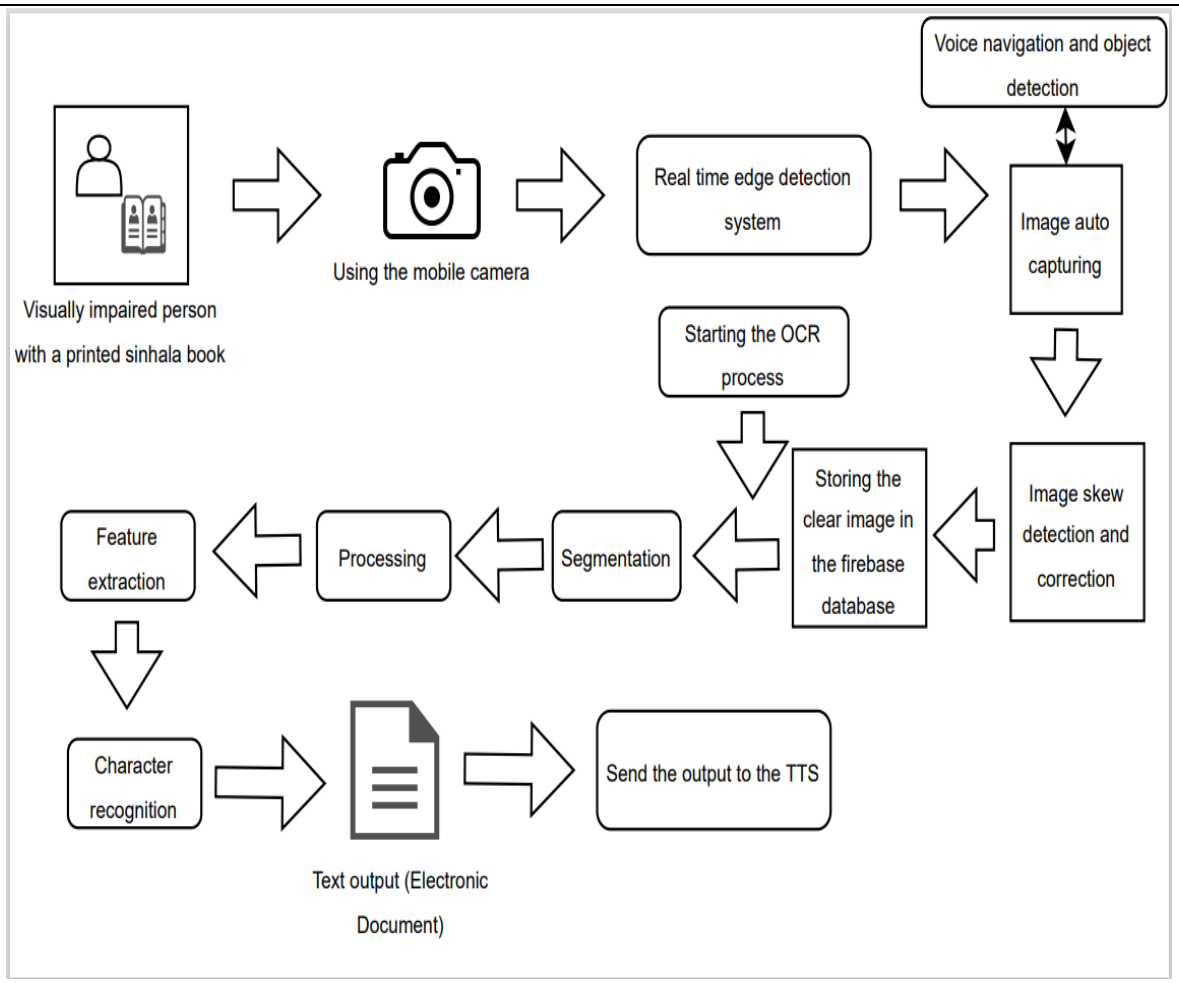
Tel: +94(0)11 2301904 - 5 **Fax:** +94(0)11 2301906 **E-mail:** info@sliit.lk **URL:** www.sliit.lk

- Designing the system overview diagram .

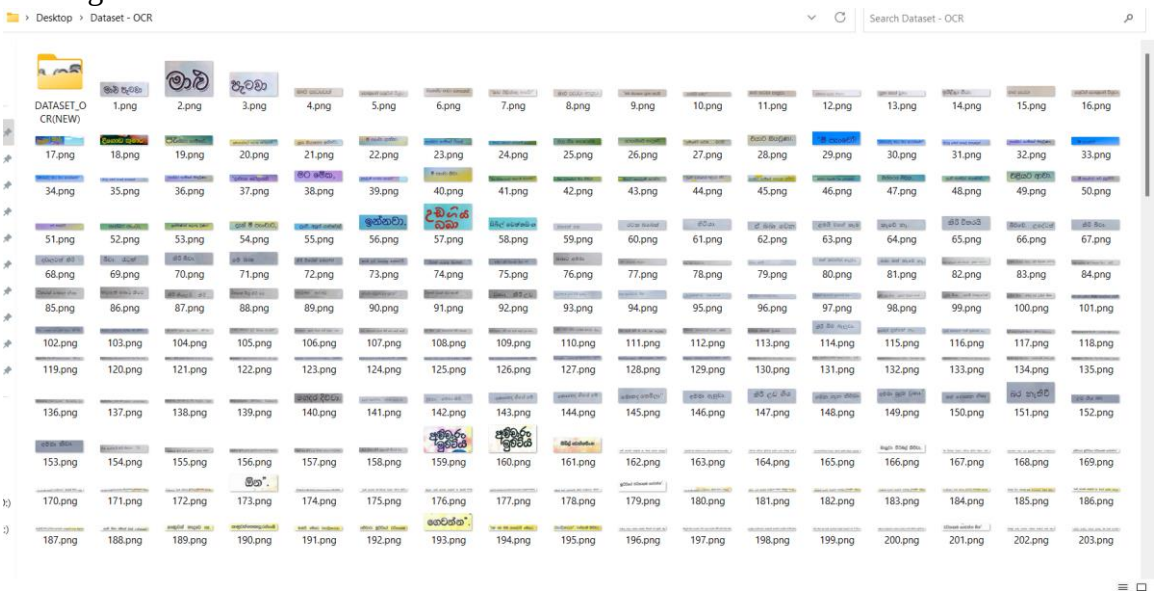


- Designing the system overview diagram for my component ; OCR .





- Making the data set.



- Labeling the data set

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	A
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3	පැටවා
4	මාළු පැටවෙක්
5	පොකුණේ සතුටින් පීනුවා
6	එතනට ආවා කොකෙක්
7	මාව ගිලින්නද ආවේ
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9	මම ඔයාගෙ පුතා තරම්
10	පොඩියි නේද
11	මාළු පැටවා ඇහුවා
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15	මාළු පැටවා
16	සතුටින් පොකුණේ පීනුවා
17	පැස්බර පැංචා
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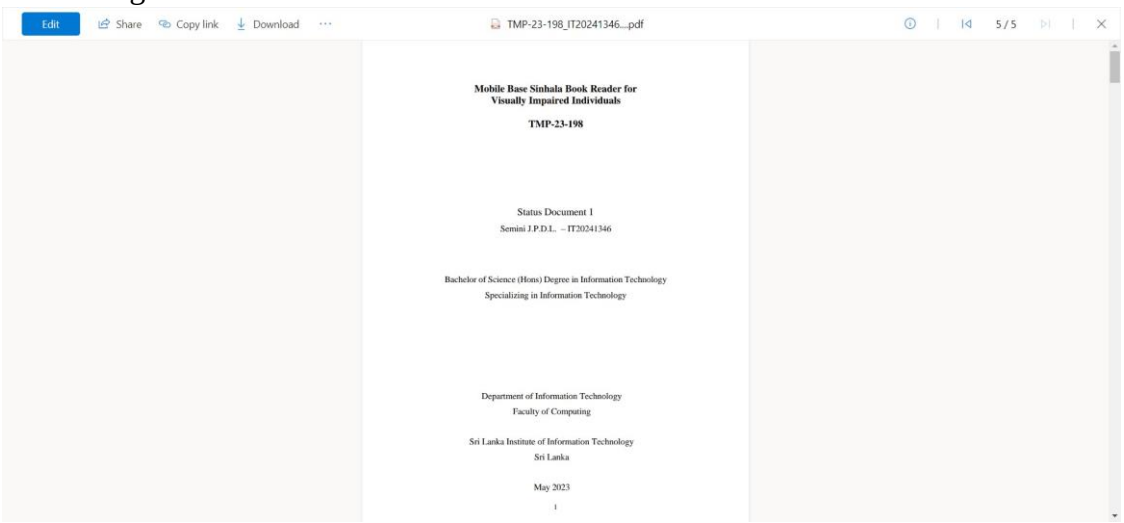
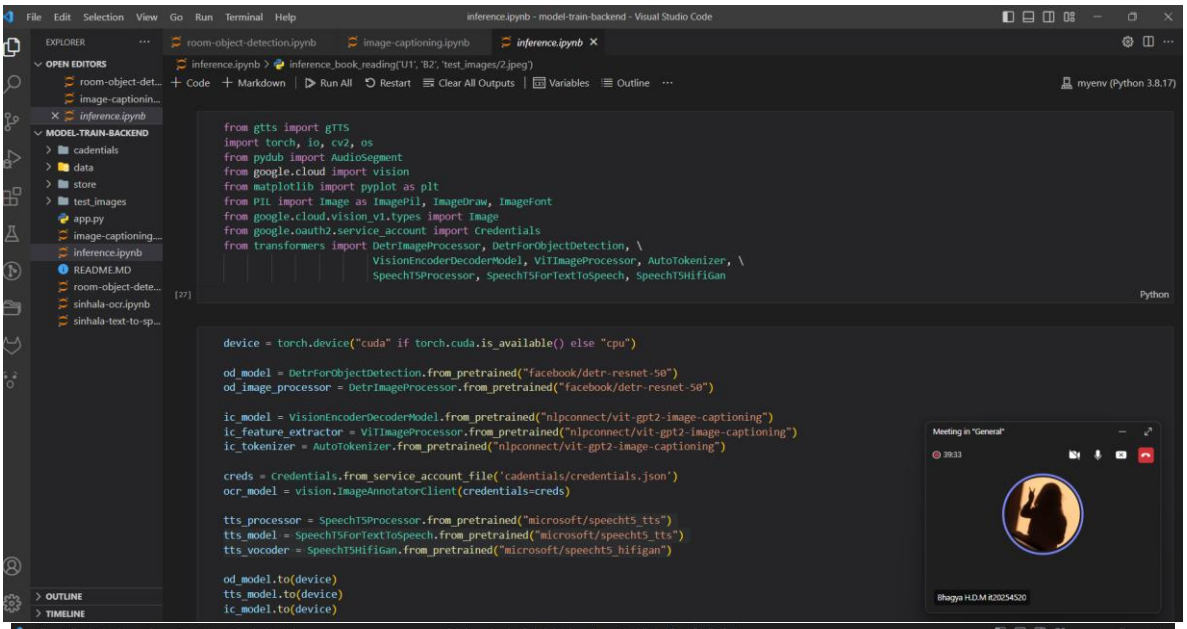
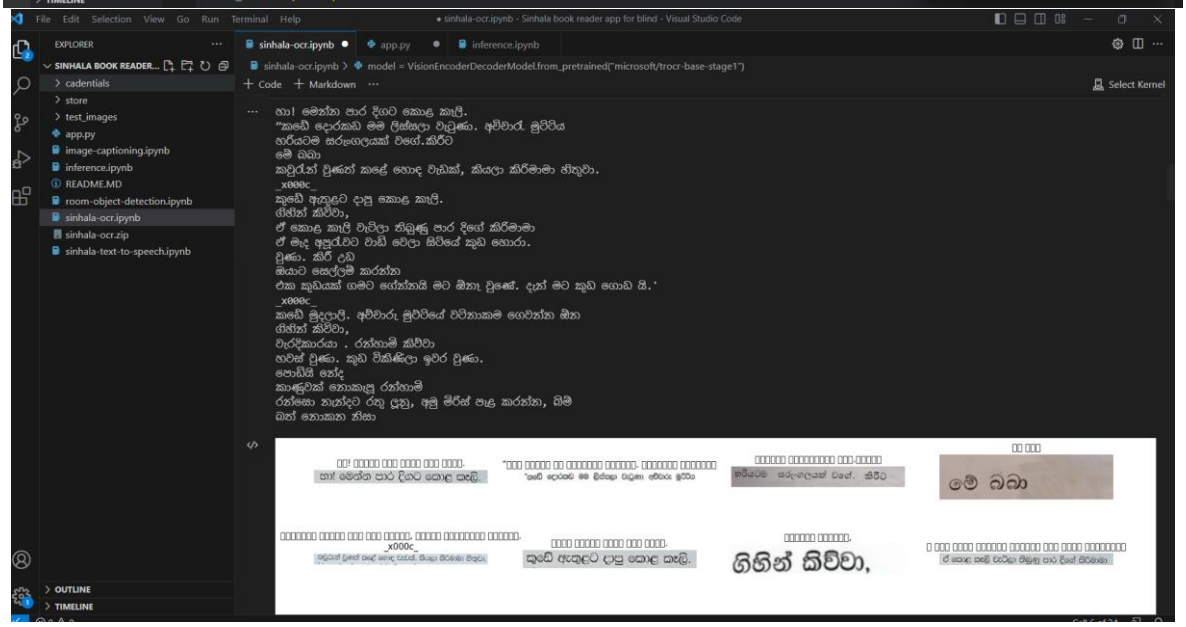
22	මී පැංචා දැක්කා
23	පැස්බර හාමිනේ පිකක්
24	එහෙට ඔබිහාට ඔවිහාකම් ඉලෝ

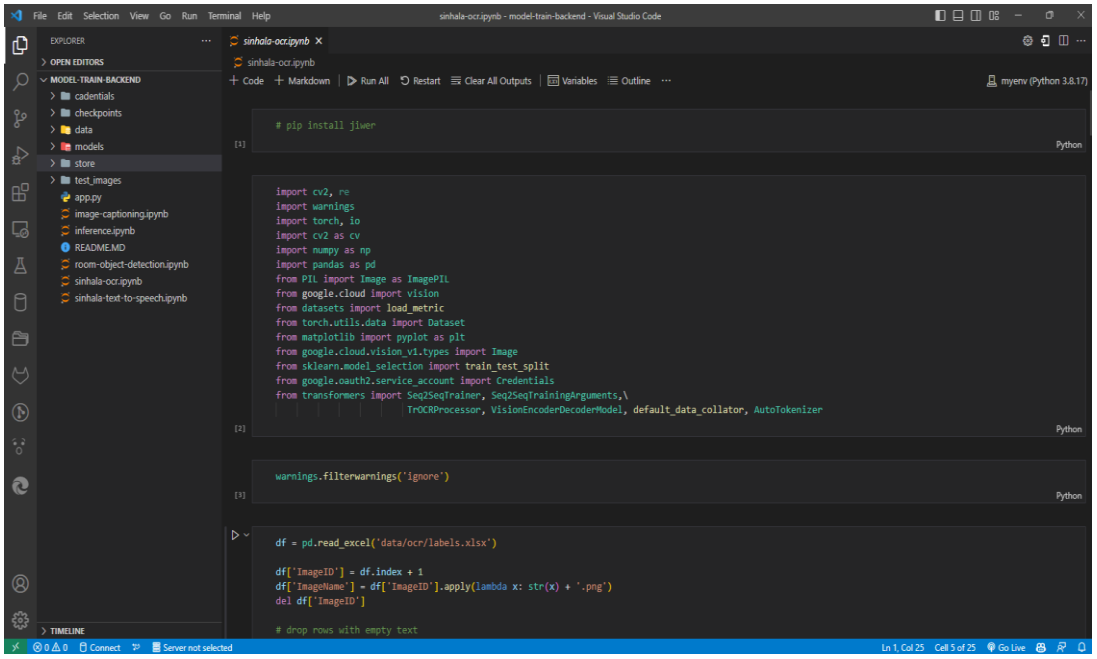
- Submitting status document .



- Dataset processing and training .Backend implementations



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OPEN EDITORS
MODEL-TRAIN-BACKEND
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checkpoints
data
models
store
test_images
app.py
image-captioning.ipynb
inference.ipynb
README.MD
room-object-detection.ipynb
sinhala-ocr.ipynb
sinhala-text-to-speech.ipynb
TIMELINE
sinhala-ocr.ipynb
+ Code + Markdown Run All Restart Clear All Outputs Variables Outline
myenv (Python 3.8.17)
pip install jiwer
Python
import cv2, re
import warnings
import torch, io
import cv2 as cv
import numpy as np
import pandas as pd
from PIL import Image as ImagePIL
from google.cloud import vision
from datasets import load_metric
from torch.utils.data import Dataset
from matplotlib import pyplot as plt
from google.cloud.vision_v1.types import Image
from sklearn.model_selection import train_test_split
from google.oauth2.service_account import Credentials
from transformers import Seq2SeqTrainer, Seq2SeqTrainingArguments,\
TrOCRProcessor, VisionEncoderDecoderModel, default_data_collator, AutoTokenizer
Python
warnings.filterwarnings('ignore')
Python
df = pd.read_excel('data/ocr/labels.xlsx')
df['ImageID'] = df.index + 1
df['ImageName'] = df['ImageID'].apply(lambda x: str(x) + '.png')
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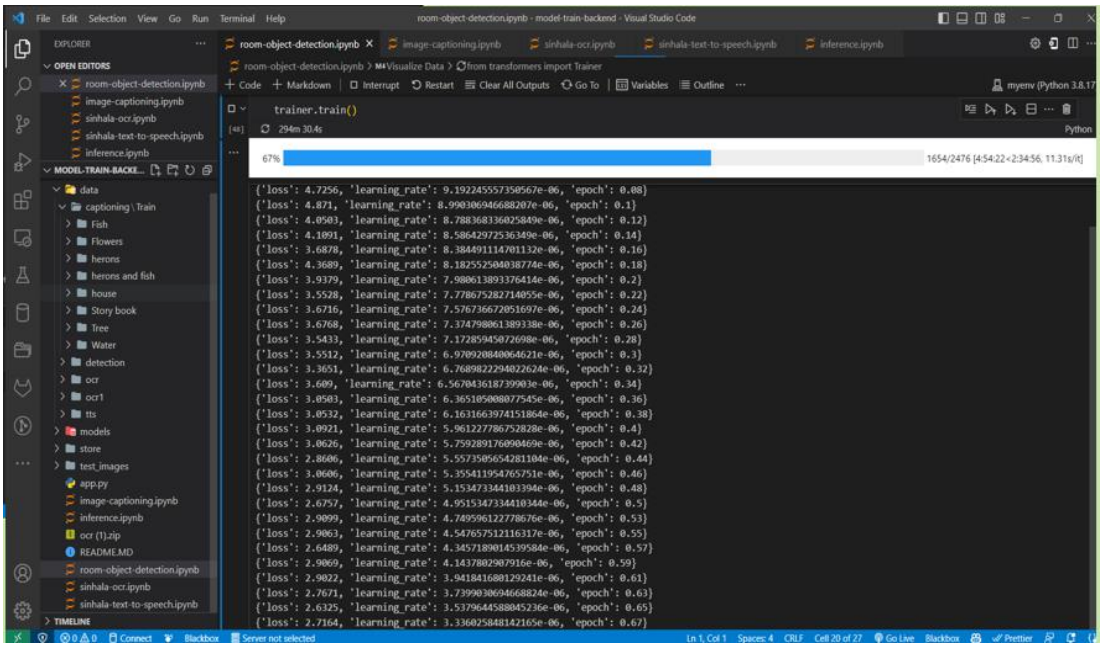
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room-object-detection.ipynb - model-train-backend - Visual Studio Code
room-object-detection.ipynb
image-captioning.ipynb
sinhala-ocr.ipynb
sinhala-text-to-speech.ipynb
inference.ipynb
room-object-detection.ipynb > Visualize Data > from transformers import Trainer
+ Code + Markdown Interrupt Restart Clear All Outputs Go To Variables Outline
myenv (Python 3.8.17)
trainer.train()
294m 30.4s
Python
67%
1654/2476 [4:54:22<2:34:56, 11.31s/it]
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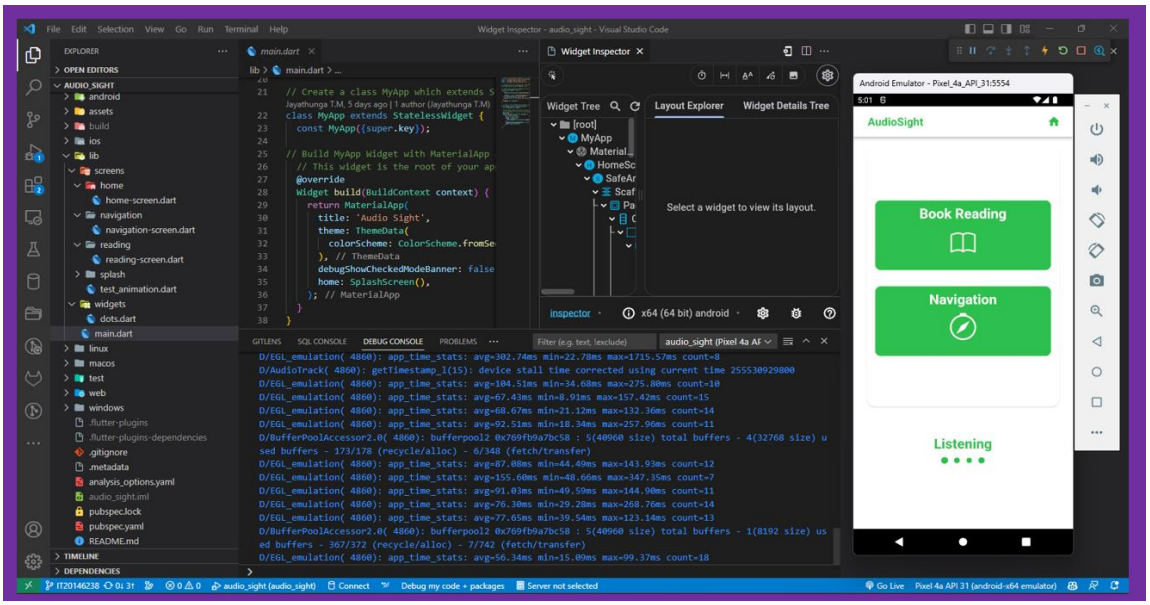
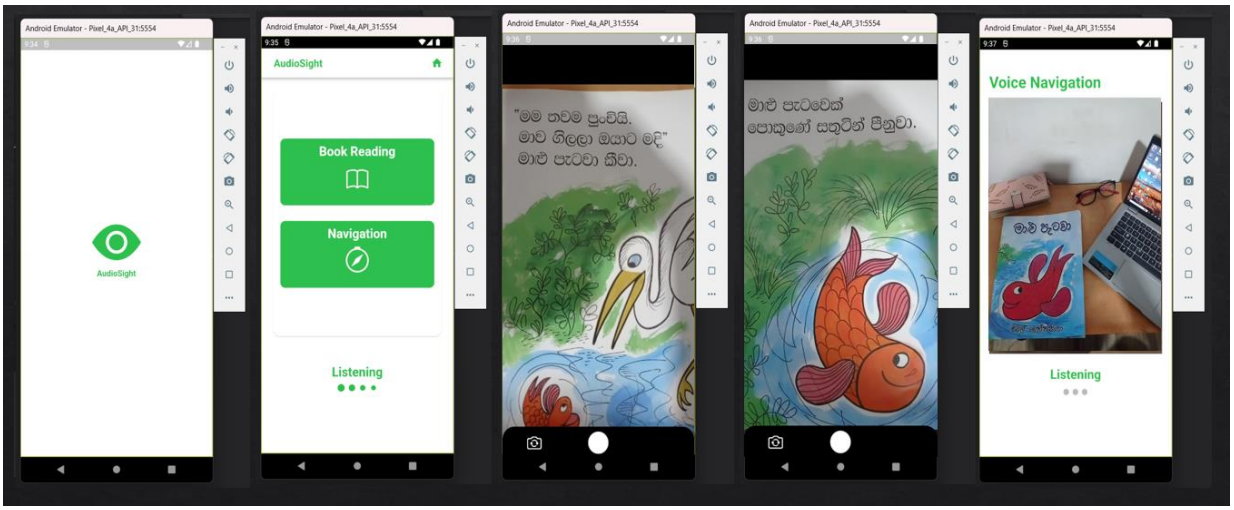
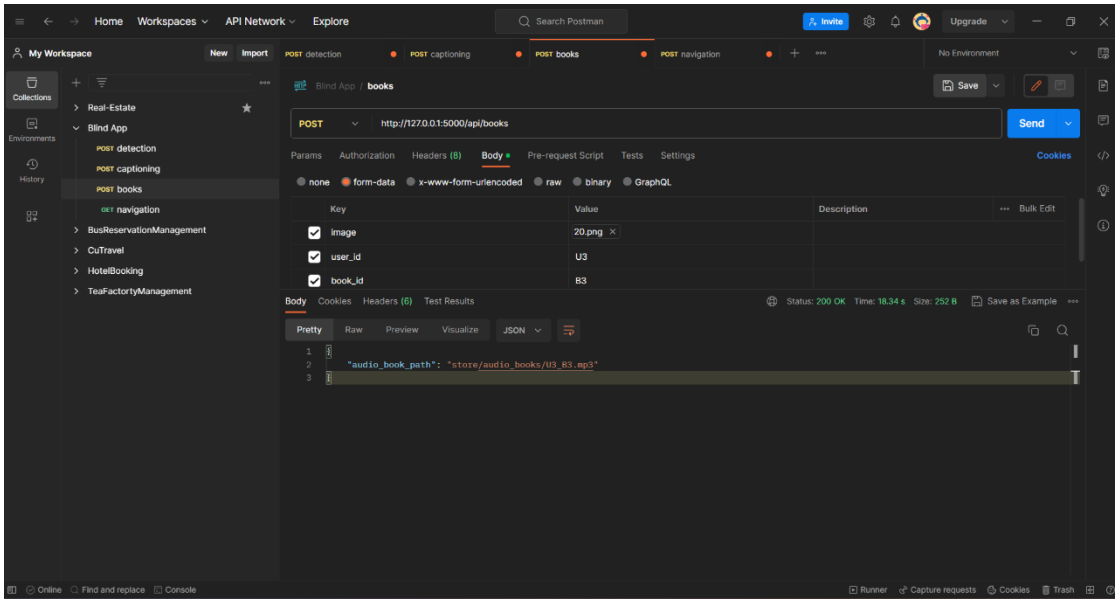
- Frontend implementations

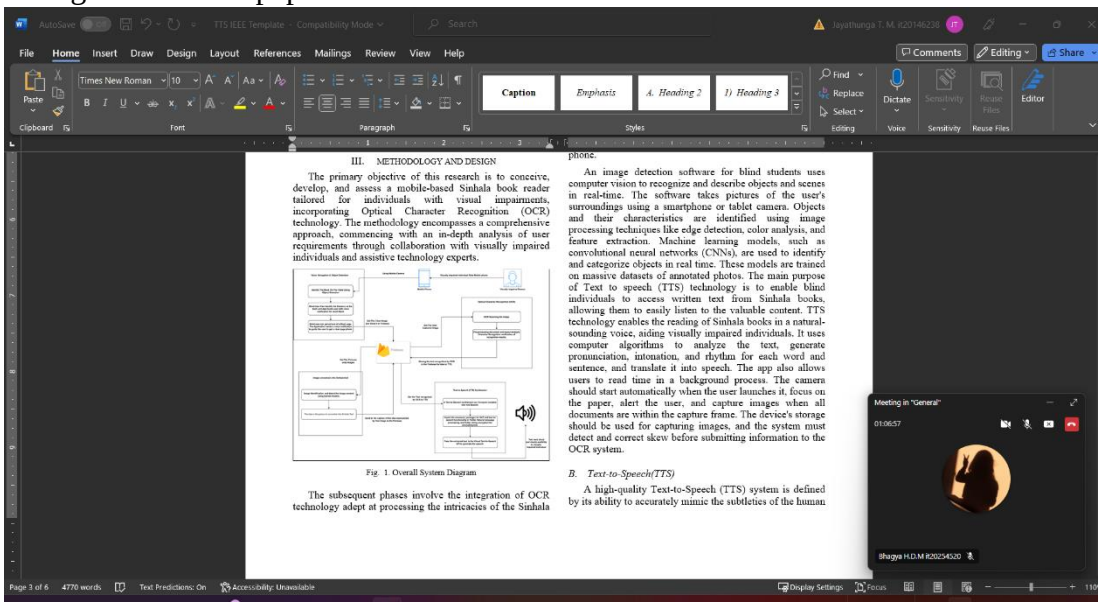




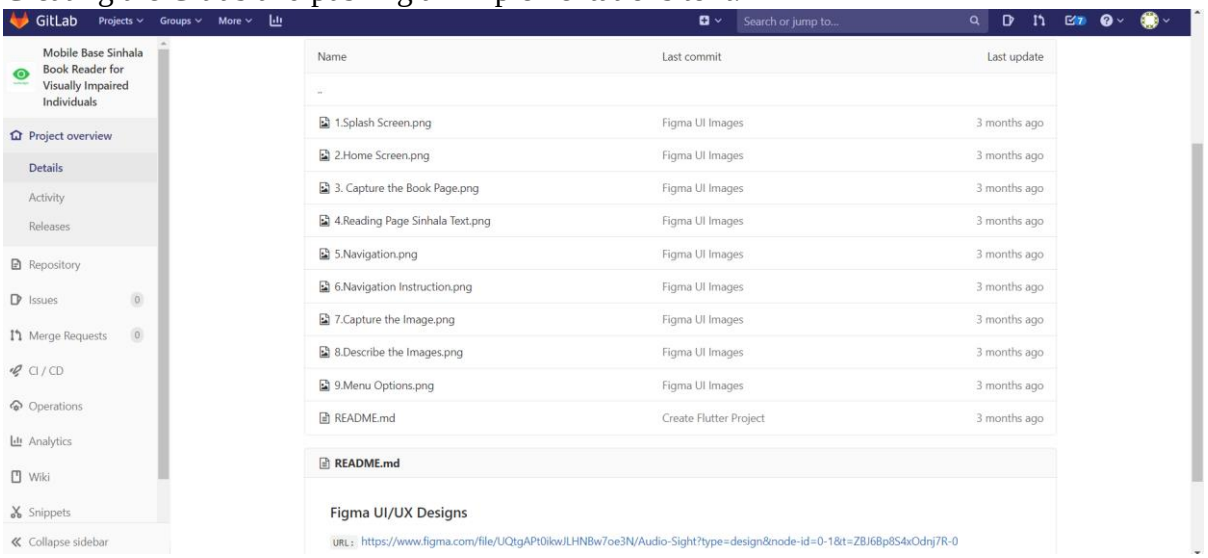
- API testing

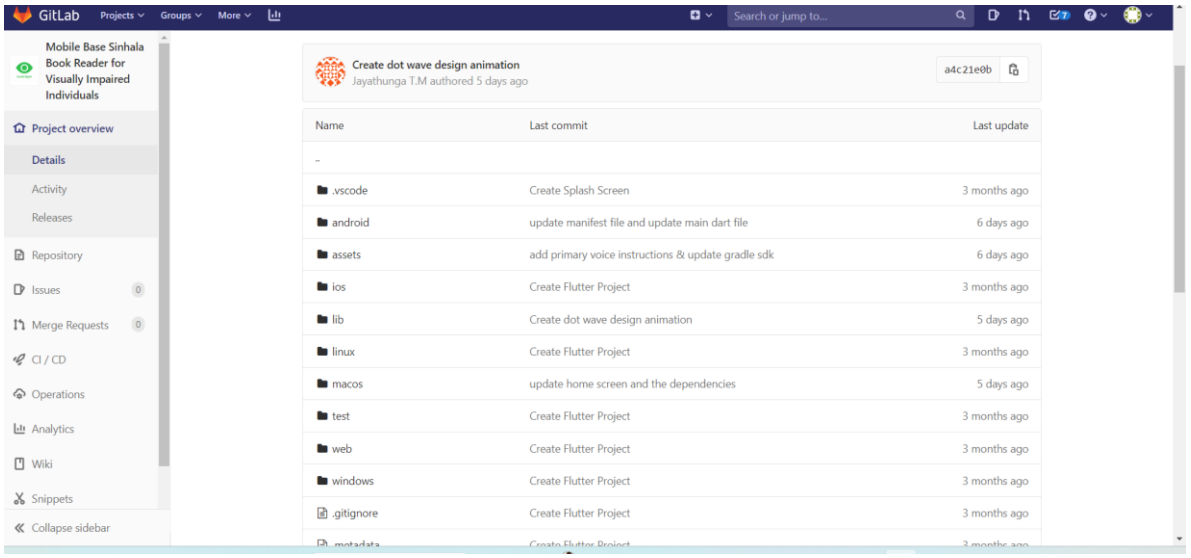


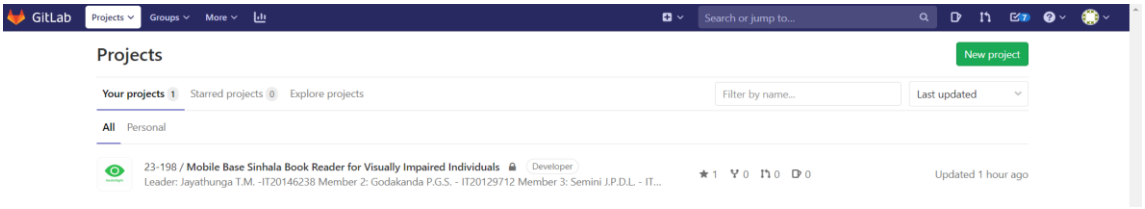
- Making the research paper .



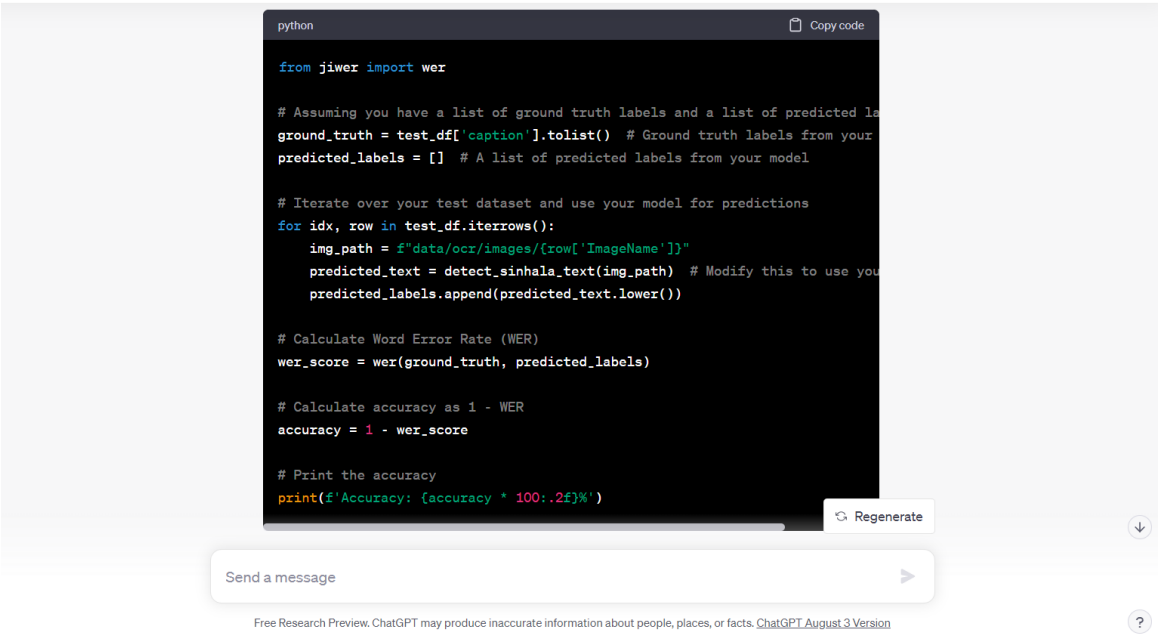
- Creating the Gitlab and pushing all implementations to it.

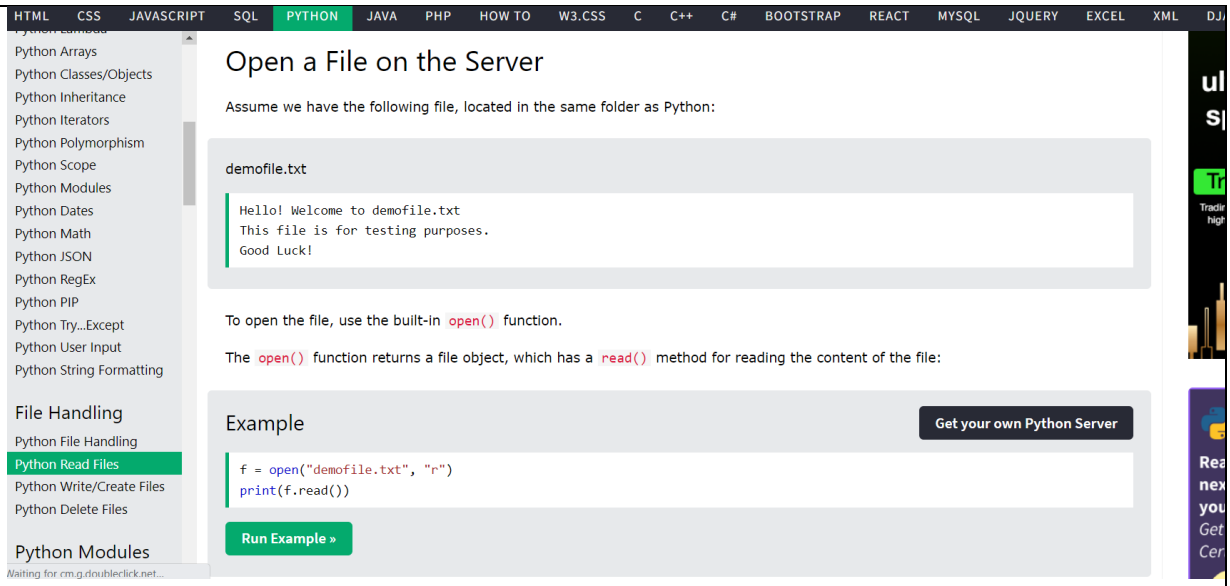




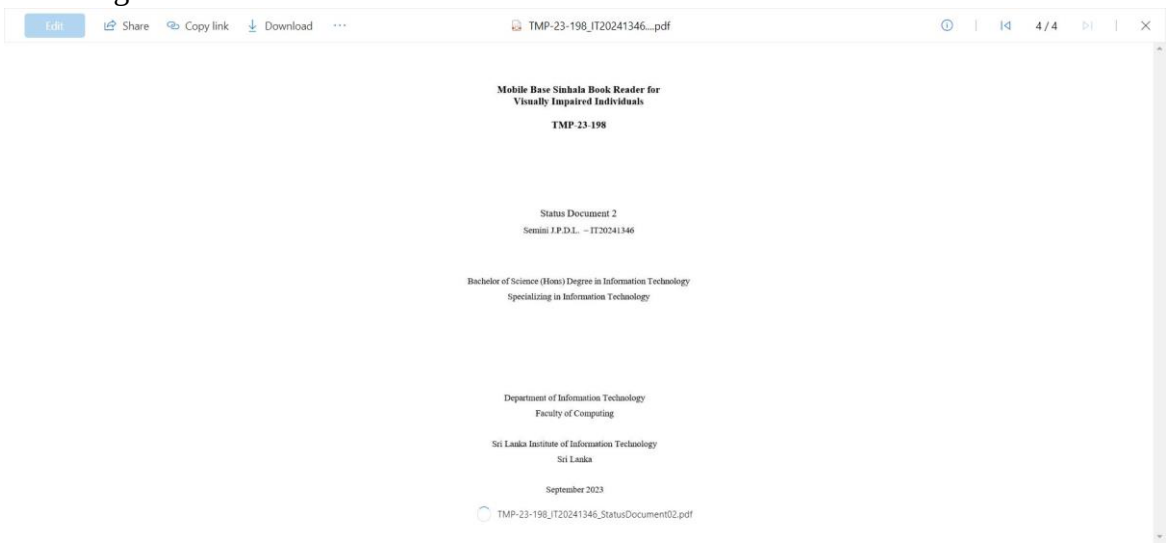


- Getting help from extra resources .





- Submitting the status document 2 .



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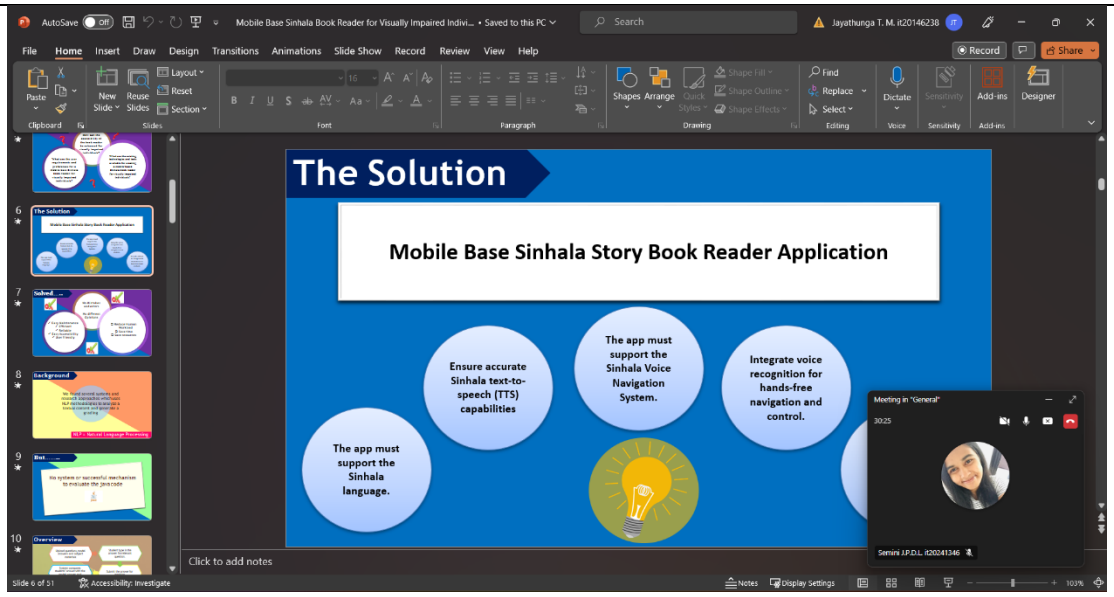
The Solution
Mobile Base Sinhala Story Book Reader Application
Ensure accurate Sinhala text-to-speech (TTS) capabilities
The app must support the Sinhala Voice Navigation System.
Integrate voice recognition for hands-free navigation and control.
The app must support the Sinhala language.
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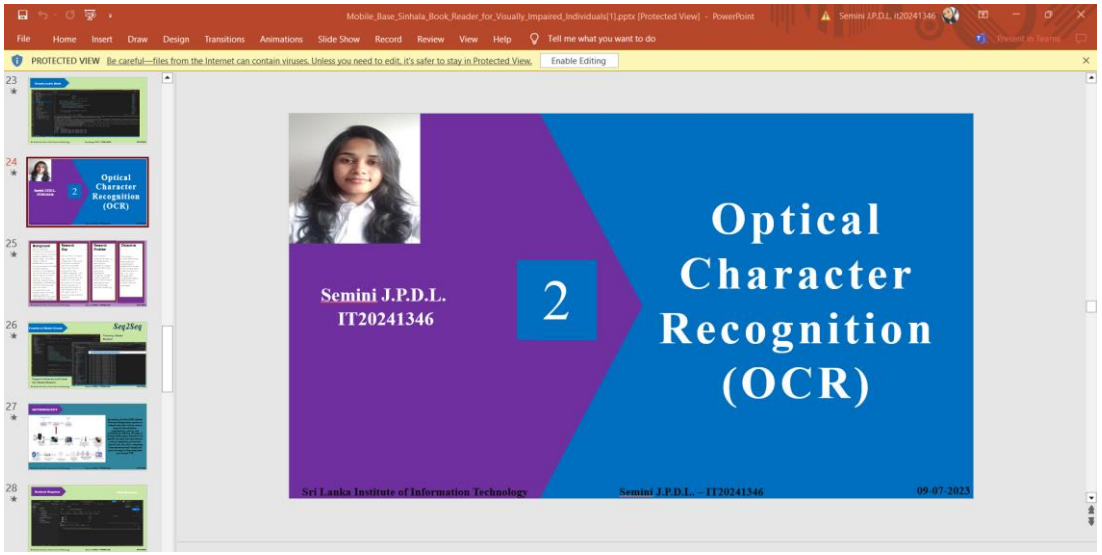
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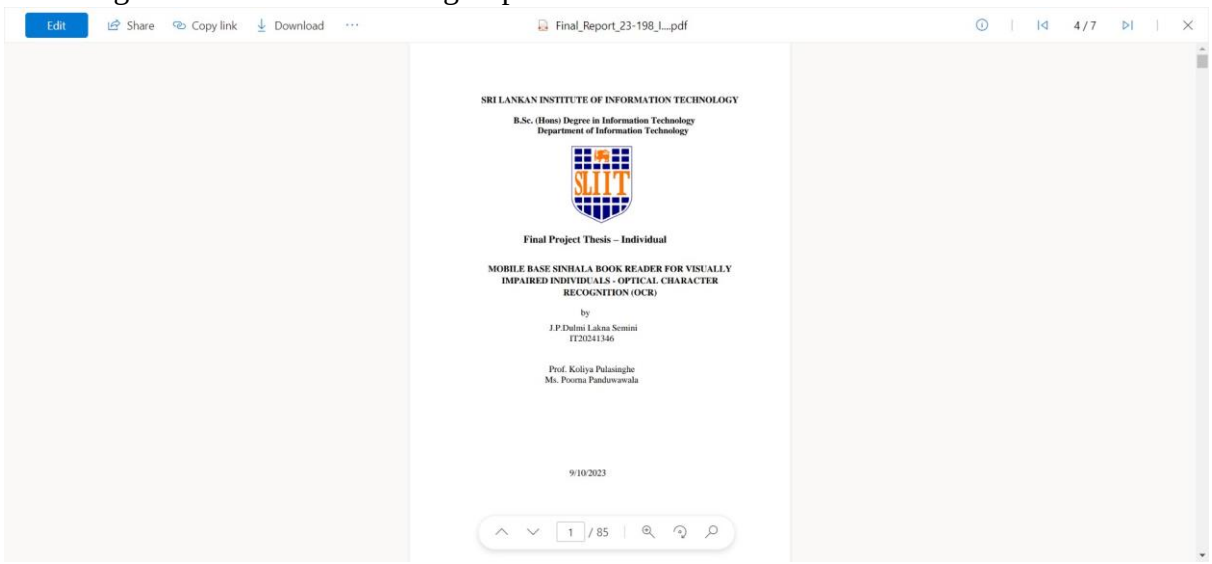

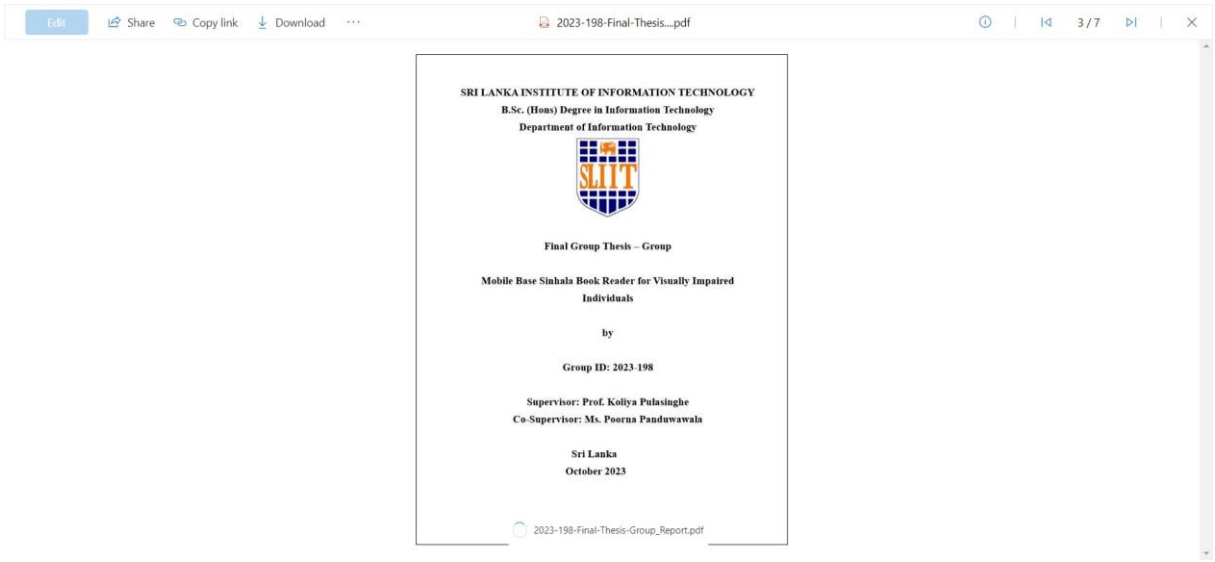

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Mobile Base Sinhala Book Reader For Visually Impaired Students

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***Abstract*—The project aims to improve the reading experience and skills of visually impaired students in Sri Lanka by creating a mobile application that allows them to easily read printed books and stationery in Sinhala. The mobile application uses optical character recognition (OCR) technology and voice navigation, incorporating text-to-speech features of the event synthesis framework. The application accurately captures characters on a page of a Sinhala book and distinguishes them using OCR technology, enabling visually impaired people to convert text into accessible digital formats. The extracted text is then made audible via text-to-speech. Sinhala Voice Navigation support is provided for users to navigate the app, get feedback from the user, and identify objects in the surrounding room. The application uses image recognition and description algorithms to describe pictures in Sinhala, helping visually impaired children understand the visual content and improve their reading skills. The platform also offers features to adjust reading speed and choose between male or female voices.**

***Keywords*—Visually Impaired Individuals, Sinhala Text-to-Speech(TTS), Sinhala Optical Character Recognize(OCR), Sinhala Voice Navigation, Image Recognition, Sinhala Object Detection**

I. Introduction

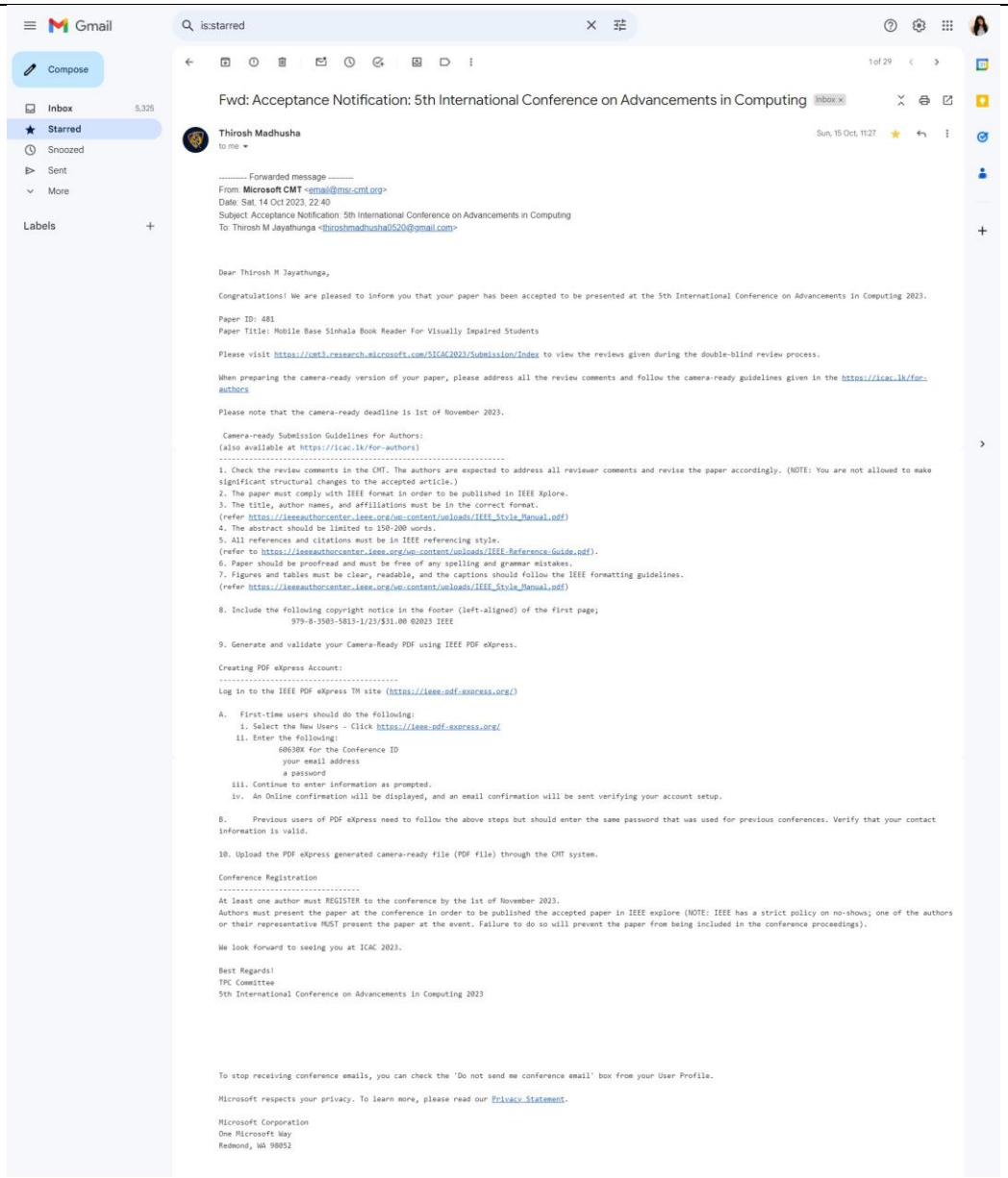
Knowledge is the most important factor for surviving in this century. One way to gain knowledge is through reading, even for those who are visually impaired, who can use the braille system [1]. However, traditional braille systems are becoming outdated as computer-assisted braille systems and text-to-speech systems are becoming more common. Unfortunately, these technologies are not widely available in Sinhala, and these devices are too expensive for the average Sri Lankan. An Android-based solution using OCR, TTS, image recognition, and voice navigation was considered for this study to improve the reading experience and accessibility for the visually impaired "Sinhala Book Reader Mobile Application".

The quality of a Text-to-Speech (TTS) system depends on its ability to imitate human speech and ensure clear understanding. The absence of natural expressions in TTS output has a substantial influence on application usability. This emphasizes a key issue in TTS development for creating a synthesized speech [2] that closely matches the human voice from the text. TTS technology's major goal is to recreate the complete range of human speech, including different speech patterns, subtleties, and intonations, while reducing the mechanical or robotic quality of the output voice.

The Sinhala language, the mother tongue of most Sri Lankans, is a crucial area for TTS development due to its complexities and nuances. Despite the large number of Sinhala speakers in Sri Lanka, there is a need for research on Sinhala voice recognition. The complexities of the Sinhala language make it difficult for computers to understand and reproduce it. Currently, there is little progress in developing TTS systems for the Sinhala language. However, this is a key research frontier that must be explored. An efficient TTS system for Sinhala would bridge the gap between human language skills and machine-generated speech [1], improving user experiences and bridging the gap between human language skills and machine-generated speech. There have been only a few attempts made to develop a Sinhala language TTS. This is still a major research area that requires investigation, which is one of the key motivations for this research.

In an increasingly digitized world, accessibility to information and literature remains a challenge for visually impaired individuals. Mobile technology and Optical Character Recognition (OCR) can solve this issue. This introduction elucidates the significance of mobile-based Sinhala book readers employing OCR technology as a transformative solution for individuals with visual impairments. By harnessing the power of mobile devices and OCR, these readers offer the potential to convert printed Sinhala text into accessible digital formats, thereby facilitating independent and inclusive access to literature for visually impaired individuals. This section introduces the key components of this paper, including the integration of OCR technology, the unique context of the Sinhala language, and the overarching goal of enhancing accessibility and enriching the reading experiences of visually impaired individuals [3].

Our Sinhala book reader app for blind users delivers a ground-breaking feature: picture detection within Sinhala children's books, at the nexus of accessibility and education. By allowing those who are blind to enjoy the rich world of



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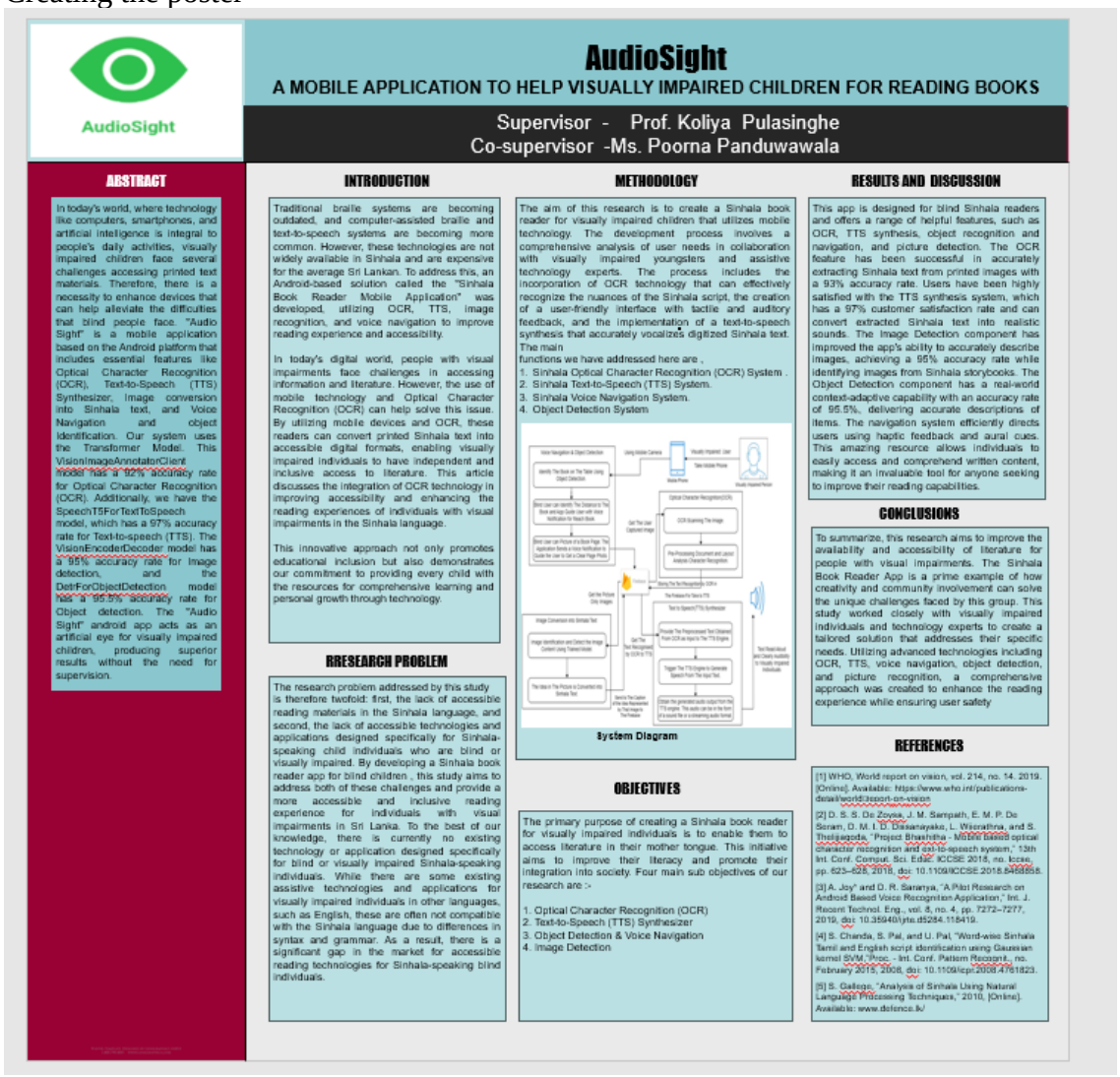

AudioSight

AudioSight

A MOBILE APPLICATION TO HELP VISUALLY IMPAIRED CHILDREN FOR READING BOOKS

Supervisor - Prof. Koliya Pulasinghe
Co-supervisor -Ms. Poorna Panduwawala

ABSTRACT

In today's world, where technology like computers, smartphones, and artificial intelligence is integral to people's daily activities, visually impaired children face several challenges accessing printed text materials. Therefore, there is a necessity to enhance devices that can help alleviate the difficulties that blind people face. "Audio Sight" is a mobile application based on the Android platform that includes essential features like Optical Character Recognition (OCR), Text-to-Speech (TTS) Synthesizer, Image conversion into Sinhala text, and Voice Navigation and object identification. Our system uses the Transformer Model. This VisionImageAnnotatorClient model has a 92% accuracy rate for Optical Character Recognition (OCR). Additionally, we have the SpeechT5ForTextToSpeech model, which has a 97% accuracy rate for Text-to-speech (TTS). The VisionEncoderDecoder model has a 95% accuracy rate for Image detection, and the DetrForObjectDetection model has a 95.5% accuracy rate for Object detection. The "Audio Sight" android app acts as an artificial eye for visually impaired children, producing superior results without the need for supervision.

INTRODUCTION

Traditional braille systems are becoming outdated, and computer-assisted braille and text-to-speech systems are becoming more common. However, these technologies are not widely available in Sinhala and are expensive for the average Sri Lankan. To address this, an Android-based solution called the "Sinhala Book Reader Mobile Application" was developed, utilizing OCR, TTS, Image recognition, and voice navigation to improve reading experience and accessibility.

In today's digital world, people with visual impairments face challenges in accessing information and literature. However, the use of mobile technology and Optical Character Recognition (OCR) can help solve this issue. By utilizing mobile devices and OCR, these readers can convert printed Sinhala text into accessible digital formats, enabling visually impaired individuals to have independent and inclusive access to literature. This article discusses the integration of OCR technology in improving accessibility and enhancing the reading experiences of individuals with visual impairments in the Sinhala language.

This innovative approach not only promotes educational inclusion but also demonstrates our commitment to providing every child with the resources for comprehensive learning and personal growth through technology.

RRESEARCH PROBLEM

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 child individuals who are blind or visually impaired. By developing a Sinhala book reader app for blind children , 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.

METHODOLOGY

The aim of this research is to create a Sinhala book reader for visually impaired children that utilizes mobile technology. The development process involves a comprehensive analysis of user needs in collaboration with visually impaired youngsters and assistive technology experts. The process includes the incorporation of OCR technology that can effectively recognize the nuances of the Sinhala script, the creation of a user-friendly interface with tactile and auditory feedback, and the implementation of a text-to-speech synthesis that accurately vocalizes digitized Sinhala text. The main
functions we have addressed here are ,

1. Sinhala Optical Character Recognition (OCR) System .
2. Sinhala Text-to-Speech (TTS) System.
3. Sinhala Voice Navigation System.
4. Object Detection System

System Diagram

OBJECTIVES

The primary purpose of creating a Sinhala book reader for visually impaired individuals is to enable them to access literature in their mother tongue. This initiative aims to improve their literacy and promote their integration into society. Four main sub objectives of our research are :-

1. Optical Character Recognition (OCR)
2. Text-to-Speech (TTS) Synthesizer
3. Object Detection & Voice Navigation
4. Image Detection

RESULTS AND DISCUSSION

This app is designed for blind Sinhala readers and offers a range of helpful features, such as OCR, TTS synthesis, object recognition and navigation, and picture detection. The OCR feature has been successful in accurately extracting Sinhala text from printed images with a 93% accuracy rate. Users have been highly satisfied with the TTS synthesis system, which has a 97% customer satisfaction rate and can convert extracted Sinhala text into realistic sounds. The Image Detection component has improved the app's ability to accurately describe images, achieving a 95% accuracy rate while identifying images from Sinhala storybooks. The Object Detection component has a real-world context-adaptive capability with an accuracy rate of 95.5%, delivering accurate descriptions of items. The navigation system efficiently directs users using haptic feedback and aural cues. This amazing resource allows individuals to easily access and comprehend written content, making it an invaluable tool for anyone seeking to improve their reading capabilities.

CONCLUSIONS

To summarize, this research aims to improve the availability and accessibility of literature for people with visual impairments. The Sinhala Book Reader App is a prime example of how creativity and community involvement can solve the unique challenges faced by this group. This study worked closely with visually impaired individuals and technology experts to create a tailored solution that addresses their specific needs. Utilizing advanced technologies including OCR, TTS, voice navigation, object detection, and picture recognition, a comprehensive approach was created to enhance the reading experience while ensuring user safety

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