

**INTERACTIVE, VISUAL LEARNING-BASED TOOL FOR
HEARING-IMPAIRED CHILDREN TO IMPROVE
LANGUAGE SKILLS**

22_23-J 18

Status Document - 2

Udbhasa M M S

IT19188928

BSc (Hons) in Information Technology
Specializing in Data Science

Department of Information Technology

Sri Lanka Institute of Information Technology
Sri Lanka

May 2023

**INTERACTIVE, VISUAL LEARNING-BASED TOOL FOR
HEARING-IMPAIRED CHILDREN TO IMPROVE
LANGUAGE SKILLS**

22_23-J 18

Status Document - 2

Udbhasa M M S

IT19188928

BSc (Hons) in Information Technology
Specializing in Data Science

Department of Information Technology

Sri Lanka Institute of Information Technology
Sri Lanka

May 2023

TABLE OF CONTENTS

1 Introduction	4
2 Meetings	6
2.1 Physical Meetings.....	6
2.2 Online Meetings	10
3 Screenshots of Chats	15
4 User Interfaces of the Mobile Application	21
5 Streamlit app for demonstrating internal process	22
6 Task Outputs	23
7 Repository and documentation	27
8 Work Planner Graphs	30
9 Field Visits	31
10 Word Breakdown Structure	36
11 Gantt Chart	37

1. INTRODUCTION

Project introduction

Hearing impairment is a sensory disability that impedes the development of language skills. It has been observed that the proficiency of hearing-impaired individuals in language is relatively lower as compared to their hearing counterparts. Research has suggested that if a child does not learn their first language during early childhood, when the brain is highly adaptable, they may never attain full fluency in any language throughout their lifetime. Therefore, it is essential to engage children with language regularly and meaningfully during their early years.

Children with disabilities possess a different cognitive framework than their hearing peers, which may lead to sensory and/or motor deficits, resulting in challenges in reading and writing. Studies indicate that hearing-impaired individuals tend to encounter more difficulties in reading and writing than those with normal hearing. The complex process of writing involves the selection of appropriate words, organization, purpose, audience, clarity, sequence, and transcription. Writing proficiency is highly dependent on one's vocabulary, knowledge of syntactical structures, planning, reviewing, and revising.

Studies have also discovered a connection between disabilities and linguistic abilities. A lack of "phonological processing" is one of the leading causes of poor reading and writing skills among hearing-impaired children. The poor phonological awareness results in difficulty in identifying and recalling the orthographic forms of words and guessing the sequence of sounds, thereby hindering the reading and writing process.

Introduction to individual component

The speech therapy module is designed to enhance language skills and cognitive abilities of hearing-impaired children through the use of gamified training techniques. To validate speech in noisy environments, lip reading is employed, and facial landmarks and lip movements are captured through camera input.

For accurate facial landmark detection, the BlazeFace deep learning model is utilized as it is optimized for mobile devices and provides high precision. Its impressive speed of

200-1000+ FPS on top-end devices enables it to be seamlessly integrated into augmented reality applications that require precise facial region input for task-specific models. These models may include 2D/3D facial key point or geometry estimation, facial feature or expression classification, and face region segmentation. The coordinates relevant to the lips are extracted from the model output. When doing the training, a unique fingerprint is generated for specific pronounced word by mapping coordinates with time axis. When testing against the child pronunciation similarity score is calculated even the child's voice is not loud enough or noise is present.

The audio will also be captured concurrently to assess the similarity of pronunciation. It will be assessed using convolutional neural networks (CNN). A generated text will be shown, and corresponding lip movements also visualized for the pronunciation.

According to the user's pronunciation a composite score will be calculated based on both lip detection and the audio processing. Using the above-mentioned techniques, a feedback mechanism can be created where several speech therapy practices can be implemented in future.

2. MEETINGS

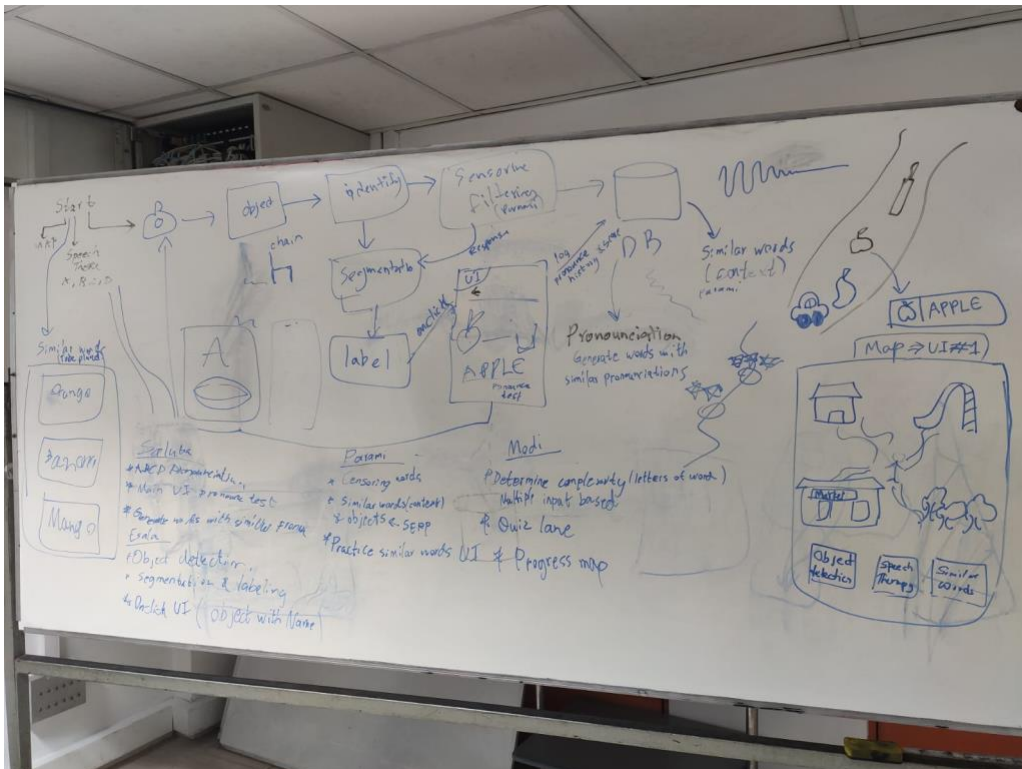
2.1 Physical Meetings







Photographs taken at physical group meetings and planning sessions

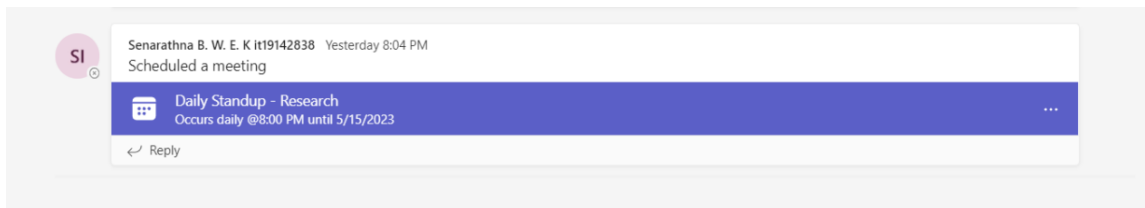




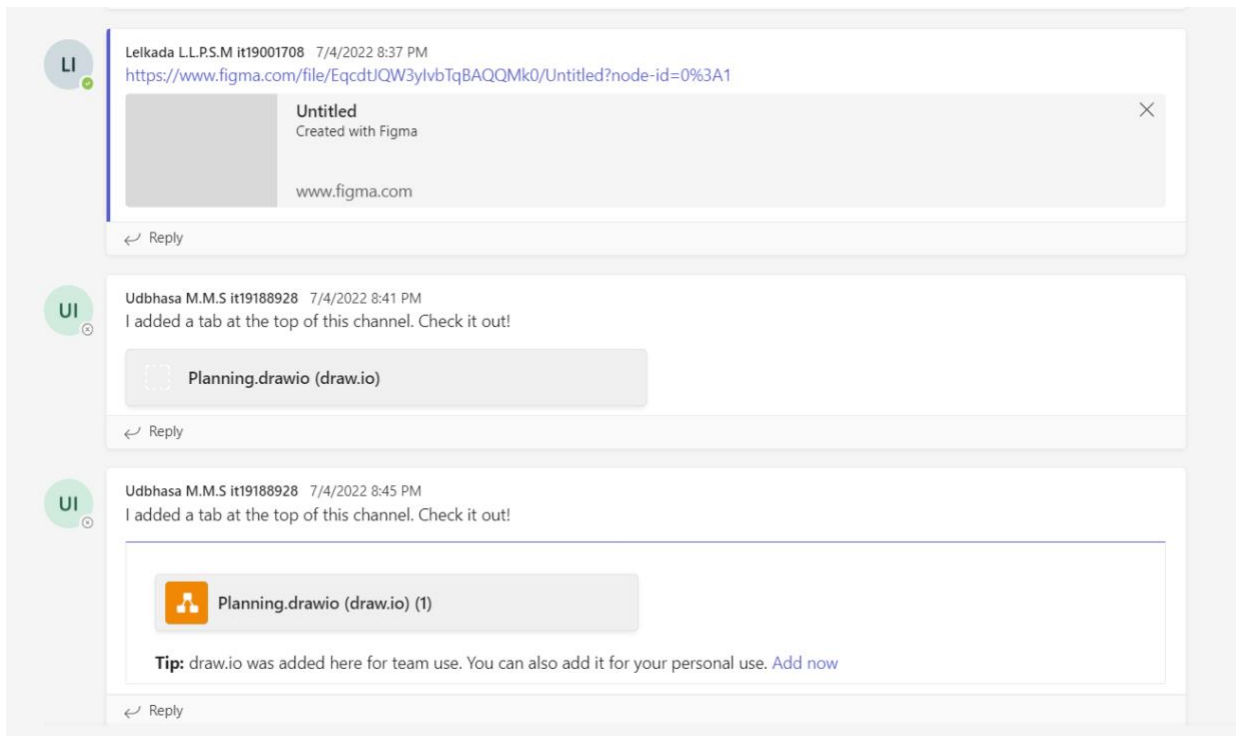
2.2 Online Meetings

Microsoft teams software is used as the primary communication method during the whole period

Daily Standup is being conducted for daily updates and progress check



Following snapshots are taken as a proof of online meetings conducted through MS Teams.



Tuesday, July 19, 2022

Meeting in "General" ended: 4h 16m

↓

Attendance report

Click here to download attendance report

↩ Reply

Tuesday, July 26, 2022

New meeting ended: 4m 19s

↩ Reply

Meeting in General started

3 replies from IT19142838, IT19954974, and IT19188928

↩ Reply

Wednesday, August 3, 2022

Sunday, January 22, 2023

Meeting in "General" ended: 1h 1m

↓


Attendance report

Click here to download attendance report

↩ Reply

Wednesday, January 25, 2023


Thursday, September 14, 2022



Priyanka P.D.M.K it19954974 9/13/2022 1:22 PM

Individual Components

[solo diagram.drawio](#)

 solo diagram.drawio

...

↩ Reply

Meeting in General ended: 54m 20s


↩ Reply

Meeting ended: 1h 3m

↩ Reply

Thursday, September 22, 2022

12




Priyanka P.D.M.K it19954974 11/22/2021 8:02 PM

2021-11-22 Meeting

> 7 replies from IT19954974, IT19142838, and IT19188928

Reply

Wednesday, December 29, 2021



Priyanka P.D.M.K it19954974 12/29/2021 7:51 PM

2021-12-29 Meeting


4 replies from IT19954974

Reply

Tuesday, January 4, 2022


Monday, January 9, 2023

Last read




Udbhasa M.M.S it19188928 1/9 2:28 PM




Scheduled a meeting

 Hearing Disability RP-Jun22 Progress Check


Monday, January 9, 2023 @ 8:00 PM

...

 Hearing Disability RP-Jun22 Progress Check ended: 1h 5m




Reply



Senarathna B. W. E. K it19142838 Yesterday 8:04 PM

Scheduled a meeting

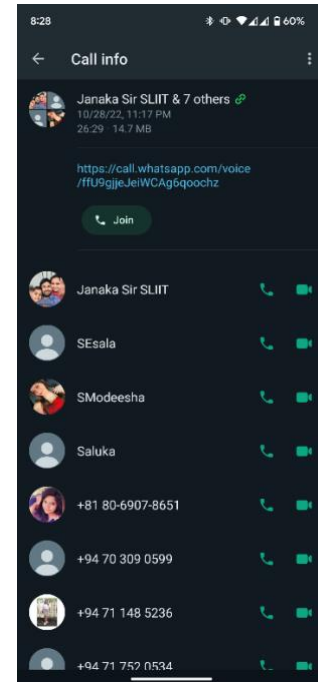
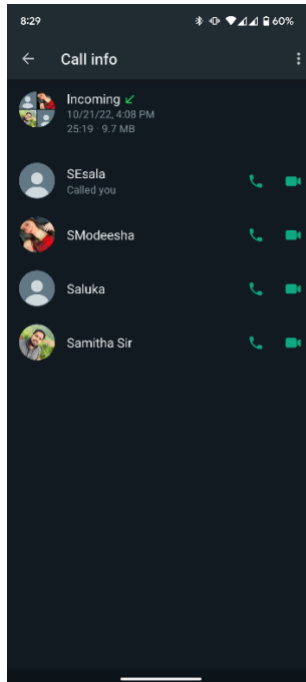
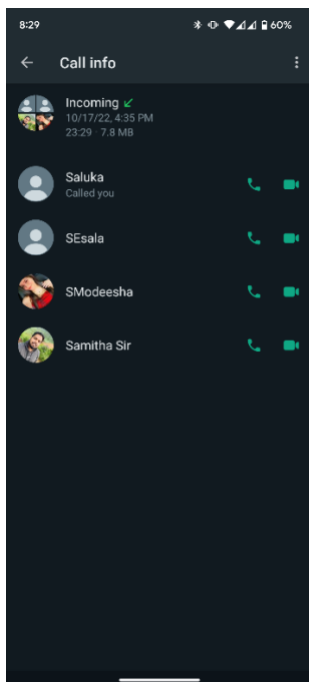
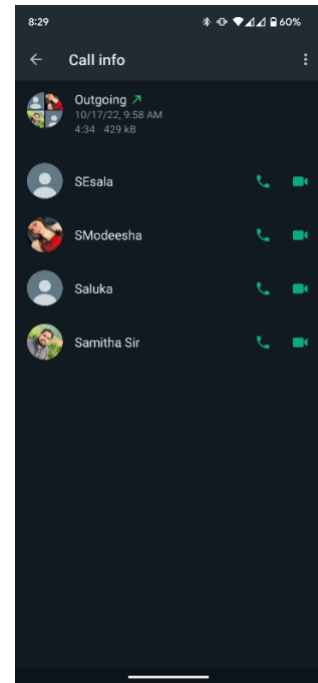
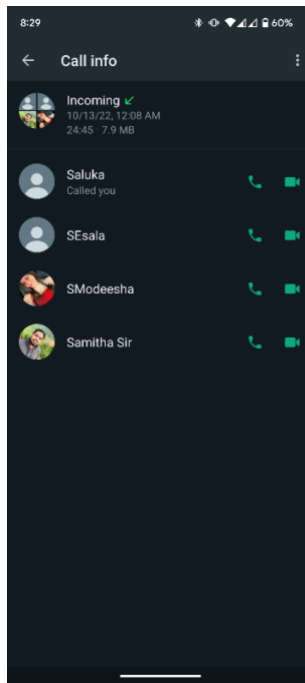
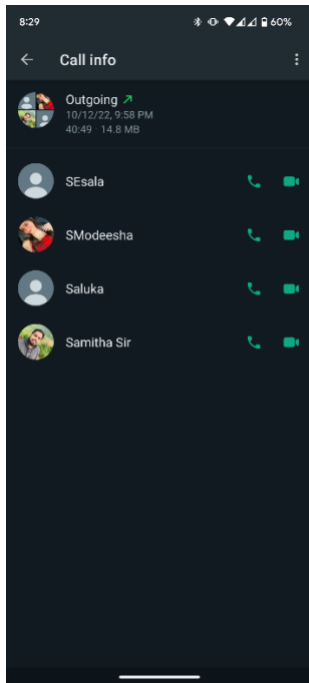
 Daily Standup - Research

Occurs daily @8:00 PM until 5/15/2023


...

Reply


Following snapshots are taken as a proof of online meetings conducted with supervisor and co-supervisor via WhatsApp.



3 SCREENSHOTS OF CHATS

**General** Posts Files Task Planner Work plan +

Meet ⓘ ⋮





Let's get the conversation started
Try @mentioning a student or teacher to begin sharing ideas.


SI ⓘ

Senarathna B. W. E. K it19142838 2022-06-08 13:00


Activity log and Individual Progress Tracker

 Activity log & Individual Progress Tracker.xlsx ⋮

 3

 Samitha Vidhanaarachchi 2022-06-08 14:52

I have also created a folder for "Log Book" which you will need to submit later. It would be easy if you maintain that document from now onwards. Pls create separate documents using that template and start recording what you have done throughout the research.


 2

↩ Reply

10 September 2022

UI ⓘ

Uddhaya M.M.S it19188928 2022-09-10 14:27 Edited





This audio cd was received as a gift to [Leikada L.L.P.S.M it19001708](#) during her last visit to Delkanda Wikramarachchi hearing care centre.


Audio clips : [Speech Audiometry in Sinhala](#)

[See less](#)


↩ Reply



General
Posts
Files
Task Planner
Work plan
+



Meet


Reply


16 June 2022



Samitha Vidhanaarachchi 2022-06-16 22:26
 Added a new tab at the top of this channel. Here's a link.



Task Planner



Reply


5 July 2022


Udbhasa M.M.S it19188928 2022-07-04 15:47
 Scheduled a meeting



RP June 2022-New : RP meeting with Saluka & the team
 Tuesday, 5 July 2022 @ 11:00


RP June 2022-New : RP meeting with Saluka & the team ended: 49m 36s



Attendance report
 Click here to download attendance report



Reply


14 July 2022


Meeting in "General" started


5 October 2022



Udbhasa M.M.S it19188928 2022-10-05 22:42
 I added a tab at the top of this channel. Check it out!



Work plan


Reply

10 October 2022


Lelkada L.L.P.S.M it19001708 2022-07-04 20:37
<https://www.figma.com/file/EqcdtJQW3yIvTqBAQQMk0/Untitled?node-id=0%3A1>


Untitled
 Created with Figma
www.figma.com


Reply

Udbhasa M.M.S it19188928 2022-07-04 20:45

I added a tab at the top of this channel. Check it out!

Reply

General

[Posts](#)
[Files](#)
[Task Planner](#)
[Work plan](#)

[All Documents](#)

Documents > **General**

Name	Modified	Modified By	+ Add column
Log Book	June 8, 2022	Samitha Vidhanaa...	
Speech Audiometry in Sinhala	September 10, 20...	Udbhasa M.M.S it...	
Activity log & Individual Progress Tracker....	December 13, 2022	Leikada L.L.P.S.M ...	
CEHIC Questionnaire.docx	October 26, 2022	Udbhasa M.M.S it...	
Meeting Minutes.xlsx	September 11, 2022	Priyanka P.D.M.K i...	
SLIIT endorsement letter 22_23-J 18 .pdf	September 26, 20...	Udbhasa M.M.S it...	
TAF.docx	October 14, 2022	Leikada L.L.P.S.M ...	
TMP-2022_23-29-ProjectCharter.docx	August 16, 2022	Senarathna B. W. ...	

General

[Posts](#)
[Files](#)
[Task Planner](#)
[Work plan](#)

[All Documents](#)

Documents > General > **Speech Audiometry in Sinhala**

Name	Modified	Modified By	+ Add column
01 Track 1.mp3	September 10, 20...	Udbhasa M.M.S it...	
02 Track 2.mp3	September 10, 20...	Udbhasa M.M.S it...	
03 Track 3.mp3	September 10, 20...	Udbhasa M.M.S it...	
04 Track 4.mp3	September 10, 20...	Udbhasa M.M.S it...	

823 kB

MEDIA DOCS LINKS

01/03/2022

PDF

Notability Notes.pdf

1 page • PDF • 171 kB

01/06/2022 ✓

Esala SLIIT

XLSX

Team Log.xlsx

XLSX • 14 kB

08/06/2022

Esala SLIIT

PDF

Plus_Go_Intelligent_Complementary_Ride-Sharing_System.pdf

7 pages • PDF • 823 kB

08/06/2022

Esala SLIIT

PDF

HopOn_A_Personalized_Ride-Sharing_System_based_on_So...

6 pages • PDF • 2 MB

08/06/2022

Esala SLIIT

PDF

Decision_Support_System_Employee_Recommendation_using...

08/06/2022

←

MEDIA DOCS LINKS

05/08/2022

DOCX

TMP-22-XXX-ProjectCharter.docx

DOCX • 33 kB

13/08/2022 ✓

Modeesha - SLIIT

DOCX

RpTopicAssessmentForm_TMP-2022_23_07.docx

DOCX • 325 kB

13/08/2022

Esala SLIIT

Forwarded

PDF

Sample.pdf

8 pages • PDF • 10 MB

14/08/2022

DOCX

TMP-2022_23-29-ProjectCharter.docx

DOCX • 1 MB

19/08/2022 ✓

Syncing older messages. [See progress.](#)

←

MEDIA

DOCS

LINKS

📄

cehic letter.docx

DOCX • 13 kB

22/09/2022 ✓

➦ Forwarded

Project Proposal - Practice session

Item	Name	Start Date	End Date	Status
1	101-1001	2022/09/20	2022/09/20	Completed
2	101-1002	2022/09/20	2022/09/20	Completed
3	101-1003	2022/09/20	2022/09/20	Completed
4	101-1004	2022/09/20	2022/09/20	Completed
5	101-1005	2022/09/20	2022/09/20	Completed

📄

Meeting Schedule.pdf

1 page • PDF • 386 kB

14/10/2022 ✓

Esala SLIIT

📄

Gannt Chart.xlsx

XLSX • 9 kB

14/10/2022

Download "Gannt Chart.xlsx"

➦ Forwarded

Project Proposal - Practice session

Item	Name	Start Date	End Date	Status
1	101-1001	2022/09/20	2022/09/20	Completed
2	101-1002	2022/09/20	2022/09/20	Completed
3	101-1003	2022/09/20	2022/09/20	Completed
4	101-1004	2022/09/20	2022/09/20	Completed
5	101-1005	2022/09/20	2022/09/20	Completed

📄

Meeting Schedule.pdf

1 page • PDF • 386 kB

15/10/2022 ✓

Syncing older messages. See progress.

←

MEDIA

DOCS

LINKS

Esala SLIIT • Research Gang

15/07/2022 >

Esala SLIIT

📄

Flowchart Maker

app.diagrams.net

<https://app.diagrams.net/#Wb!29uygl8BXkOiRE9SNzCPR0YEoEt9-ctlkim2wBrPEwxGiryI6dIItpvK90f5H9Ow%2F01Y3U3S37R2J0E56IT6JDZZNPDJW3S6PRF>

21:07

Esala SLIIT

🔗

<https://mysliit-my.sharepoint.com/:w:/g/personal/it191...>

mysliit-my.sharepoint.com

<https://mysliit-my.sharepoint.com/:w:/g/personal/it191...>

Esala SLIIT • Research Gang

13/07/2022 >

Esala SLIIT

➦ Forwarded

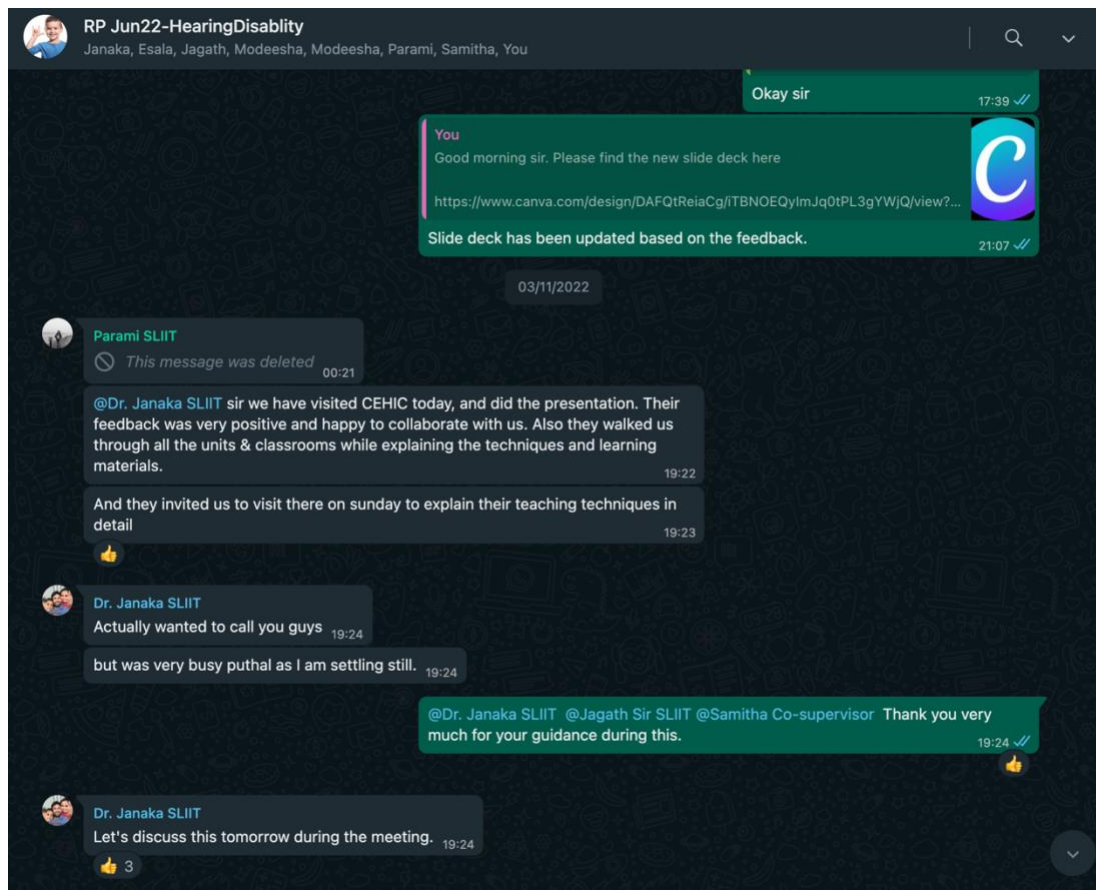
Research topic submission issues

Please fill this form to express your ideas about the research topic submission. Only forms.gle

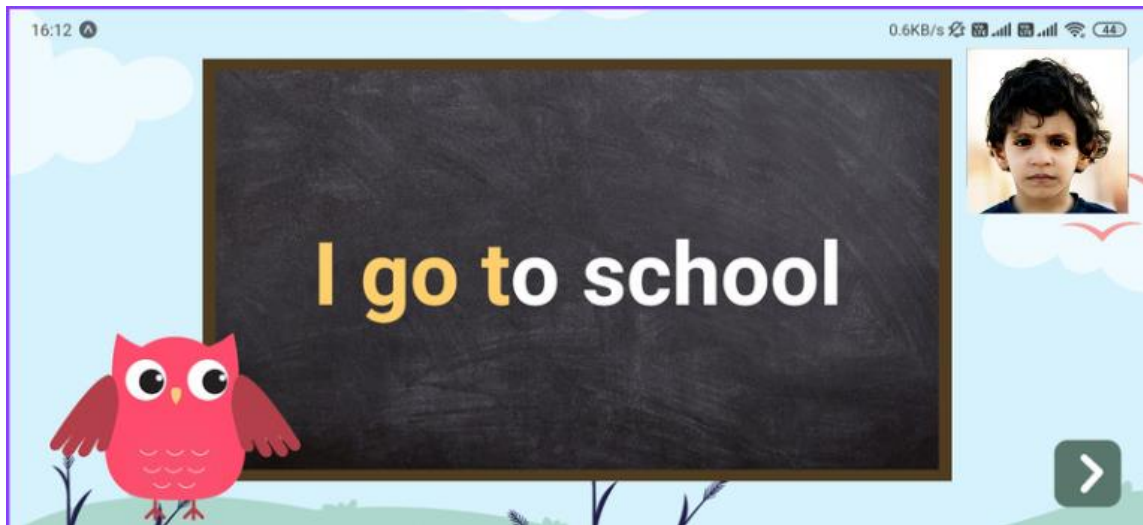
<https://forms.gle/gMKG6WmTrUpUxt5e6>

Syncing older messages. See progress.

19

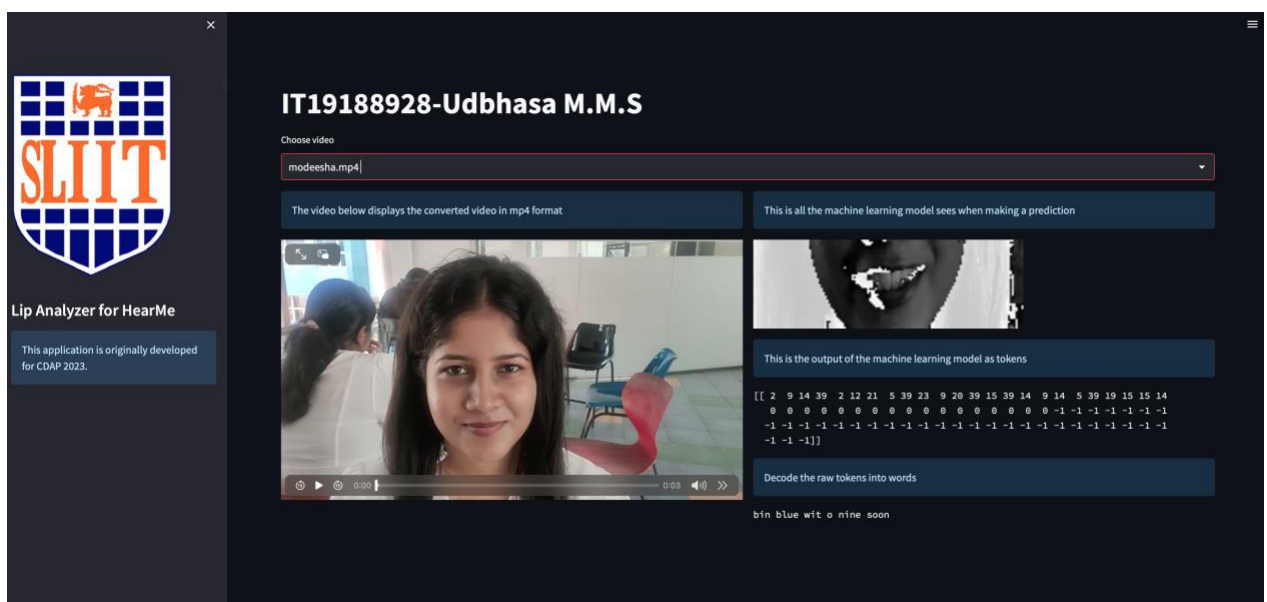
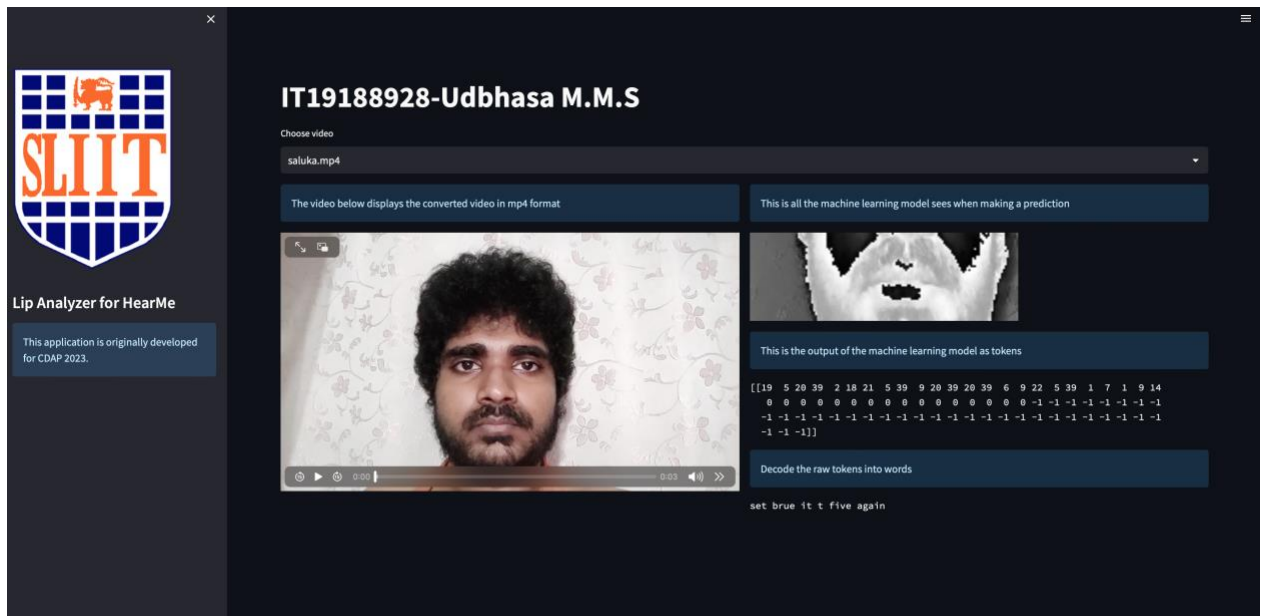


4 USER INTERFACES OF THE MOBILE APPLICATION



5. STREAMLIT APP FOR DEMONSTRATION

Screenshots of Streamlit web application which was created to demonstrate the inner working of computer vision pipeline and the model performance. This was done to provide more transparency, since mobile application does not showcase the internal process due to UI/UX reasons.



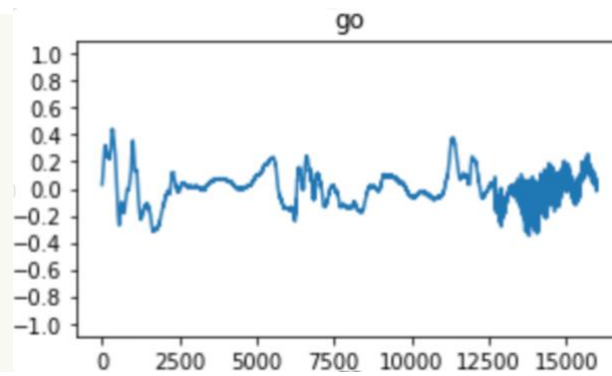
6. TASK OUTPUTS

Model training/testing



Model testing

	PER validation	PERtest
Wav2Vec2 Base	50.30	45.23
Hubert Large	37.34	32.68
WavLM Base	43.65	40.55



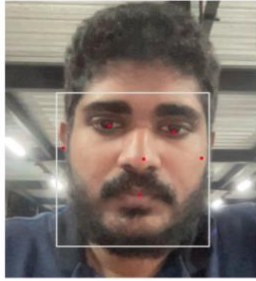
Model	FPS (On Colab GPU)	FPS (On Apple M1 CPU)
Haar cascade	-	19.95
Dlib	-	33.92
SSD	19.90	15.58
MTCNN	2.11	1.81
Blazeface	323.63	225.34
RetinaFace Resnet50	72.24	1.43
RetinaFace MobilenetV1	69.50	28.89
Dual Shot Face Detector	18.89	0.22
YuNet	-	49.43

Face detection model performance comparison

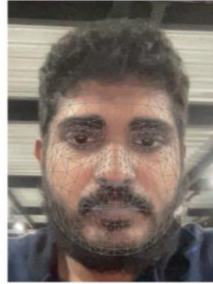
```

Hi, Starting face detection
INFO: Created TensorFlow Lite XNNPACK delegate for CPU.
Frames per second using video.get(cv2.CAP_PROP_FPS) : 23.976023976023978
Frames per second using video.get(cv2.CAP_PROP_FPS) : 23.976023976023978
Frames per second using video.get(cv2.CAP_PROP_FPS) : 23.976023976023978
Frames per second using video.get(cv2.CAP_PROP_FPS) : 23.976023976023978
Frames per second using video.get(cv2.CAP_PROP_FPS) : 23.976023976023978
Frames per second using video.get(cv2.CAP_PROP_FPS) : 23.976023976023978
Frames per second using video.get(cv2.CAP_PROP_FPS) : 23.976023976023978

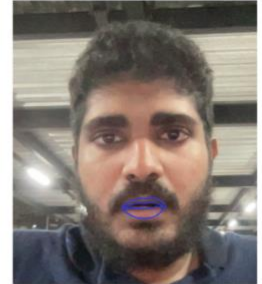
```



Face detection



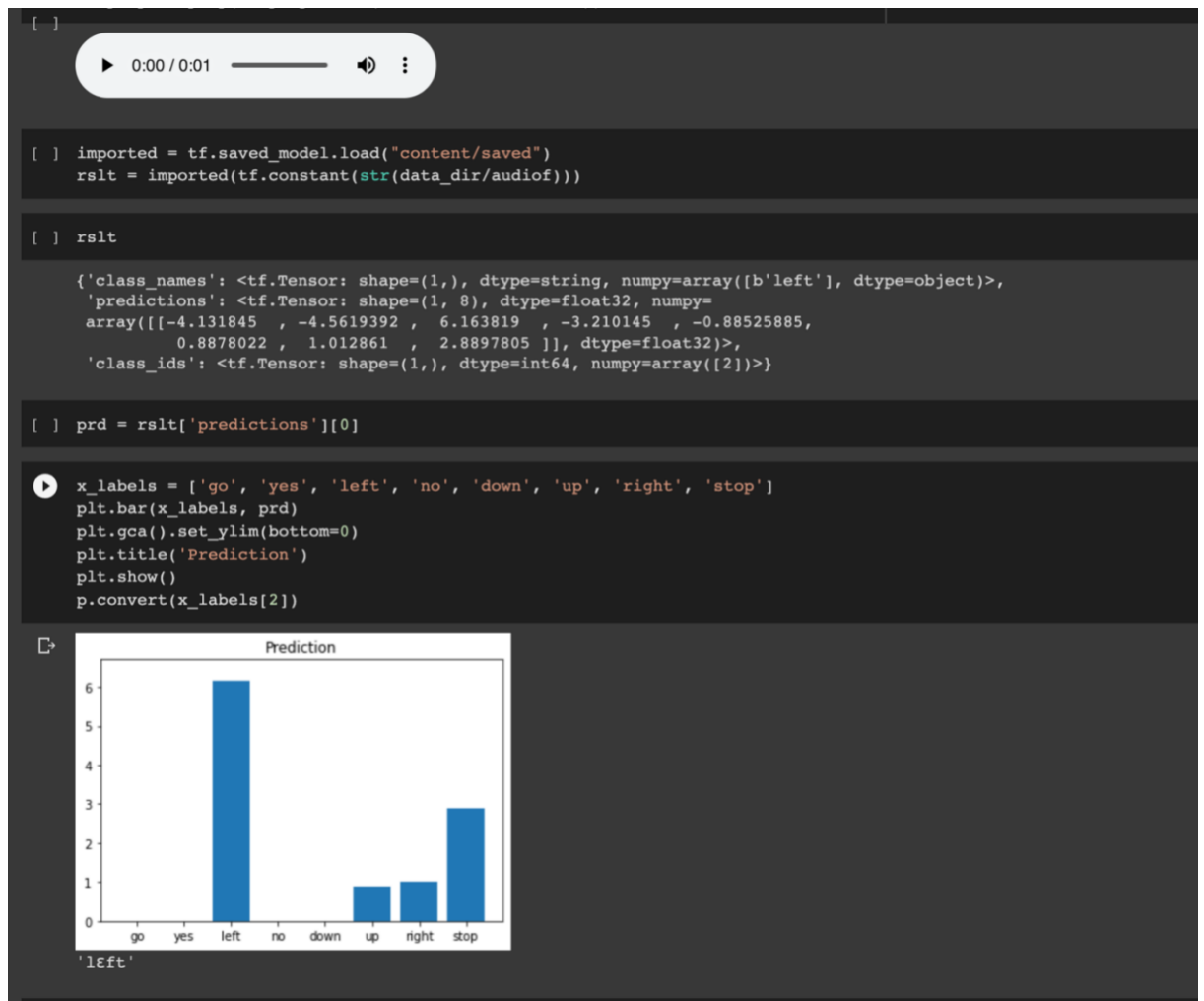
Extract mesh points



Lip detection

```
landmark {  
  x: 0.5541493  
  y: 0.5755461  
  z: 0.004211265  
}  
  
frozenset({(270, 409), (176, 149), (37, 0), (84, 17), (318, 324), (293, 334), (386, 385), (7, 163), (33, 246), (17, 314), (374, 380), (251, 389), (398, 373), (267, 269)})  
Frames per second using video.get(cv2.CAP_PROP_FPS) : 30.0
```

Lip mesh points



Audio processing

7. REPOSITORY AND DOCUMENTATION

22_23-J 18 > 22_23-J 18 > Details

2

22_23-J 18

Project ID: 1586

Star 0 Fork 0

39 Commits 2 Branches 0 Tags 23.1 MB Files

master

22_23-j-18 / +

History

Find file

Web IDE

Clone

adding detection models

Esala Senarathna authored 1 day ago

47db272d

README

Auto DevOps enabled

Add LICENSE

Add CHANGELOG

Add CONTRIBUTING

Add Kubernetes cluster

Name	Last commit	Last update
IT19001708	text similarity calculation model added	2 days ago
IT19142838	adding detection models	1 day ago
IT19188928	lip detetct	2 days ago
IT19954974	member folders added	1 month ago
.DS_Store	Daily changes	1 week ago
README.md	Update README.md	3 months ago
core.369	data clean script added	3 days ago

22_23-J 18 > 22_23-J 18 > Activity

All

Push events

Merge events

Issue events

Comments

Team

Senarathna B W E K @IT19142838

1 day ago

Pushed to branch **master**

47db272d · adding detection models

Udbhasa M M S @IT19188928

2 days ago

Pushed to branch **master**

c145782c · lip detetct

Lelkada L L P S M @IT19001708

2 days ago

Pushed to branch **master**

7f472f31 · text similarity calculation model added

Udbhasa M M S @IT19188928

3 days ago

Pushed to branch **master**

5da23d62 · Daily changes

Lelkada L L P S M @IT19001708

3 days ago

Pushed to branch **master**

a3cf2779 · data clean script added

Lelkada L L P S M @IT19001708

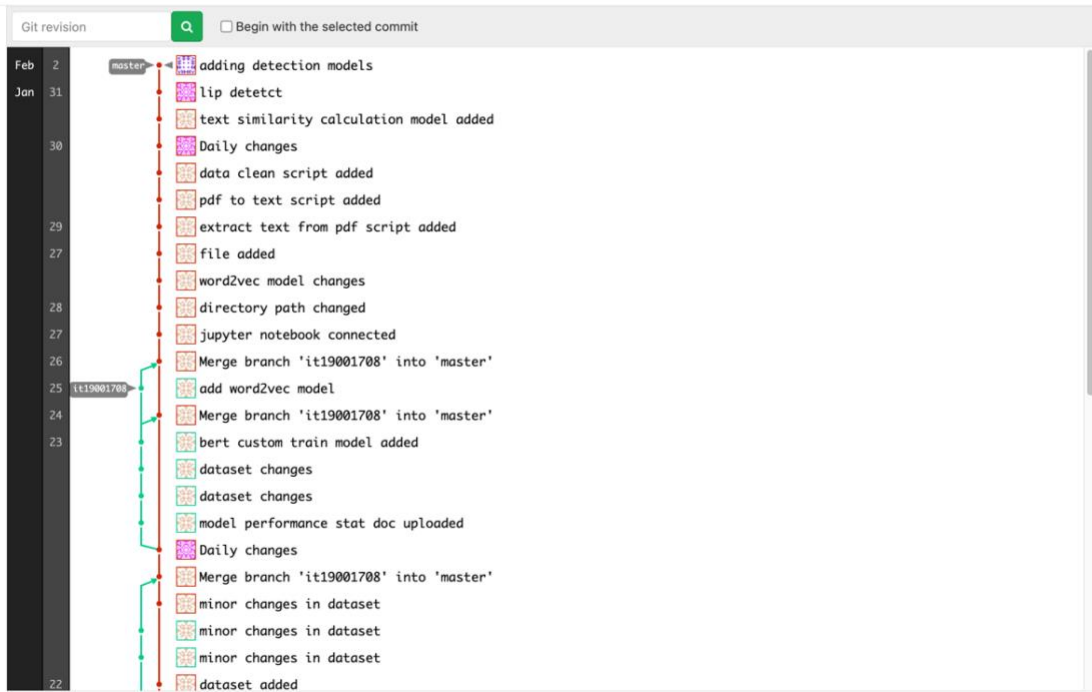
4 days ago

Pushed to branch **master**

b15dcca0 · pdf to text script added

master

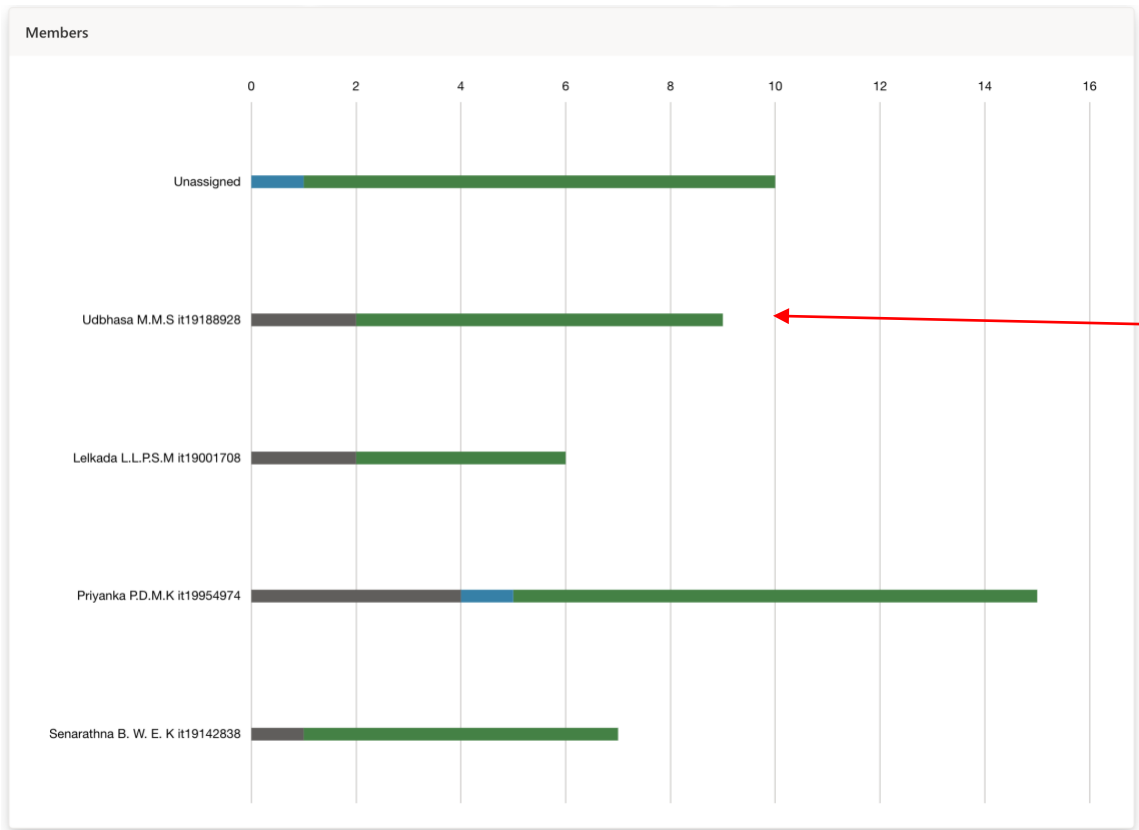
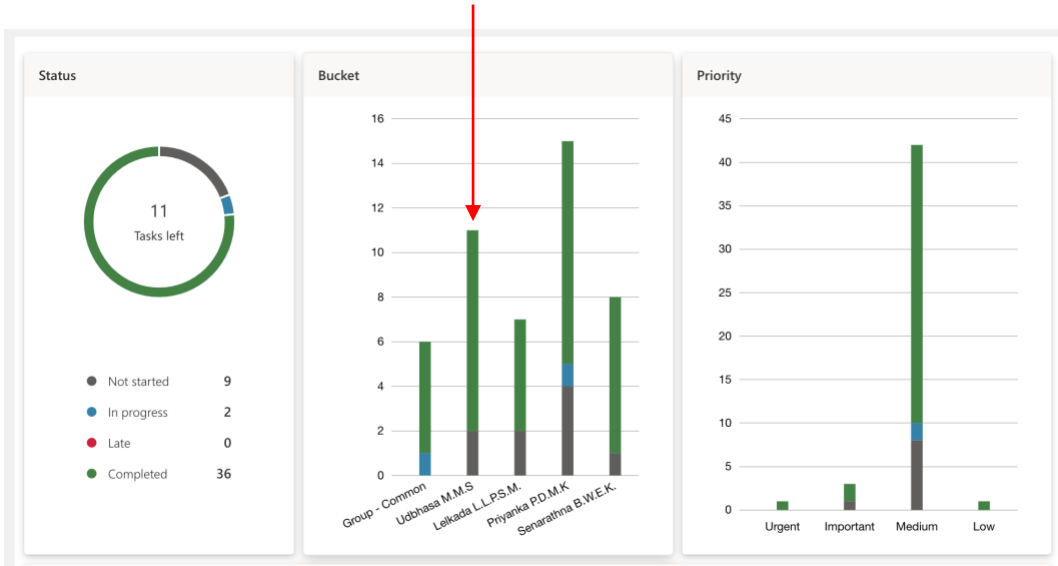
You can move around the graph by using the arrow keys.



Documentation

+ Search or jump to... 🔍	
Interactive, visual learning-based tool for hearing impaired children to improve language skills.	
Main Objective	
To implement an interactive Mobile and Web-based learning tool for hearing impaired children and to improve the overall language proficiency while bridging the skills gap between the hearing peers. This should be accomplished by using visual learning and speech therapy in an engaging way.	
Main Research question	
<p>Hearing impairment is a sensory disability that hinders linguistic development. Language proficiency among the hearing-impaired community is reported to be low compared to hearing peers [2]. Research has proven that if a child has not acquired a first language in early childhood when the brain plasticity changes, there is a risk that the child might not be able to be completely fluent in any language in their life [3]. Language acquisition at an early age is automatic if it is engaged regularly and meaningfully [1].</p> <p>Children with disabilities have different mental operations compared to hearing peers, which leads to sensory and/or motor deficits, making reading and writing more challenging. Researchers have found that hearing impaired people typically find reading and writing challenging compared to hearing peers [4].</p> <p>Reading and writing involve a complex thinking process. Writing involves the choice of words, organization, purpose, audience, clarity, sequence, and transcription. Competency in writing is greatly influenced by the vocabulary, knowledge of syntactical structures, planning composition, reviewing, and revising. Researchers have found a link between disabilities and linguistic skills. Missing "phonological processing" is responsible for poor reading and writing skills among hearing-impaired children. Poor phonological awareness holds responsible for the difficulty in identifying and remembering orthographic forms of words and difficulty in guessing the order of the sounds and poses [4].</p> <p>In order to develop the linguistic skills of hearing-impaired children, primarily visual learning methods are used. Most existing systems provide translation between spoken language to sign language which does not necessarily aim to develop linguistic competency. To teach young hearing-impaired children, software-based visual learning tools are used in schools. But they often have a limited vocabulary and are does not provide complex learning materials that are crucial to learning the choice of words, word organization, syntactical structures, etc. Those systems do not support explorative learning. Explorative learning at an early age is crucial as if the child does not develop communication and language, it is difficult to achieve later [5]. Being able to keep the visual attention of the child is crucial to success in visual learning which most of the existing systems have not addressed.</p>	
Individual Research components	
IT19188928 – M.M.S. Udbhasa	
Lip reading and speech therapy	

8. WORK PLANNER RECORDS



9. FIELD VISITS

Lady Ridgeway Hospital for Children (LRH)



The School for the Deaf, Ratmalana



වි.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං
08.00 - 08.15	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං
08.15 - 08.35	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං
08.35 - 09.05	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං
09.05 - 09.35	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං
09.35 - 09.45	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං
09.45 - 10.00	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං
10.00 - 10.30	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං
10.30 - 11.00	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං
11.00 - 11.30	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං
11.30 - 12.00	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං
12.00 - 12.15	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං	ප්‍ර.සං



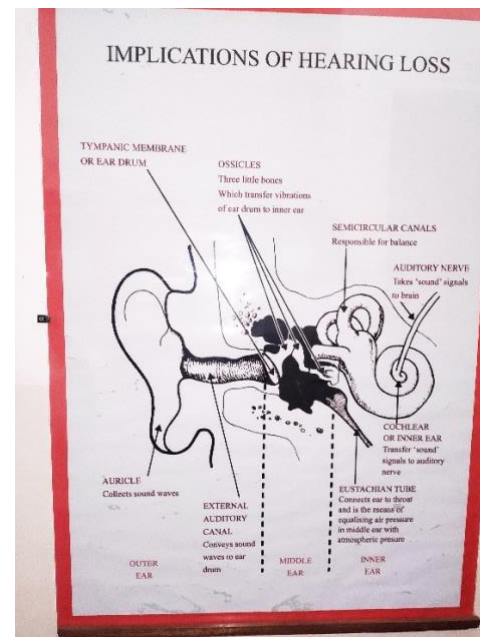
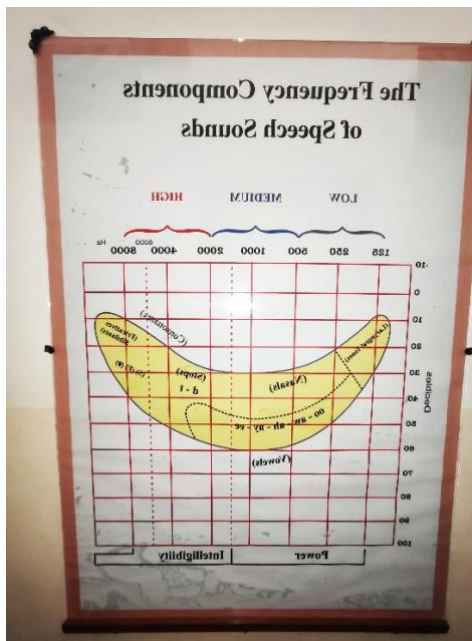
Photographs taken on multiple field visits to CEHIC, Dalugama







Photographs taken from field visit to Wickramarachchi Hearing Care Centre



10.WORK-BREAKDOWN STRUCTURE

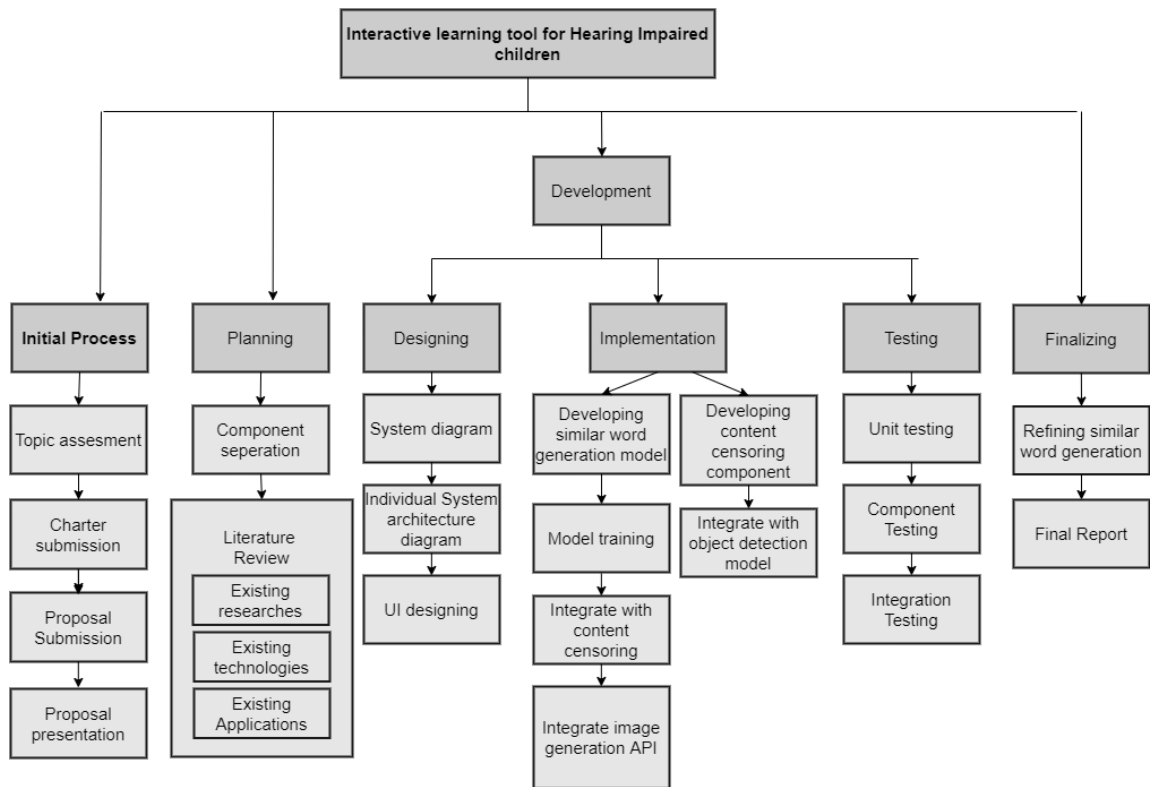


Figure 1: WBS

11. GANTT CHART

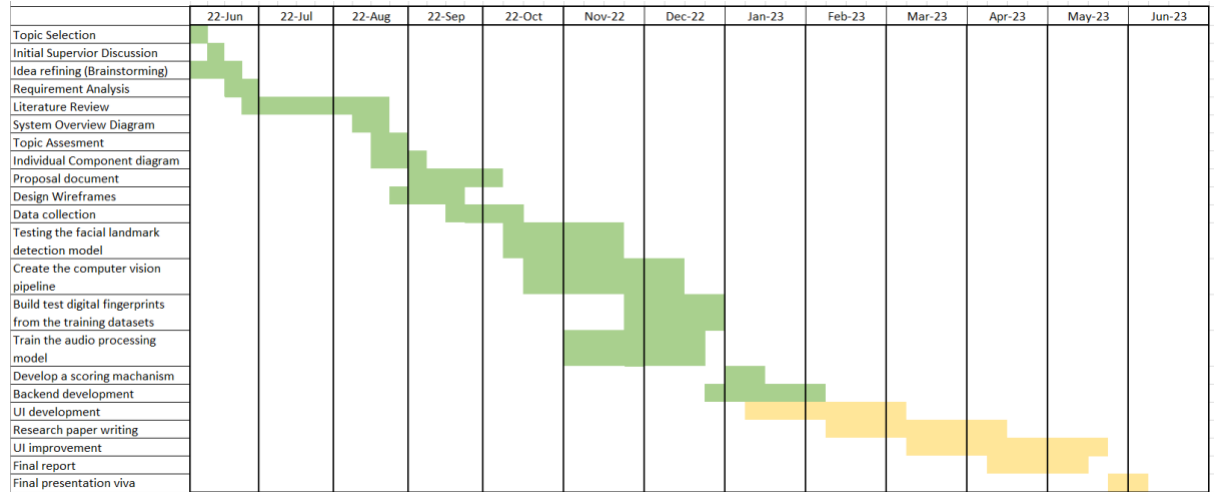


Figure 2: Gantt chart