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

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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

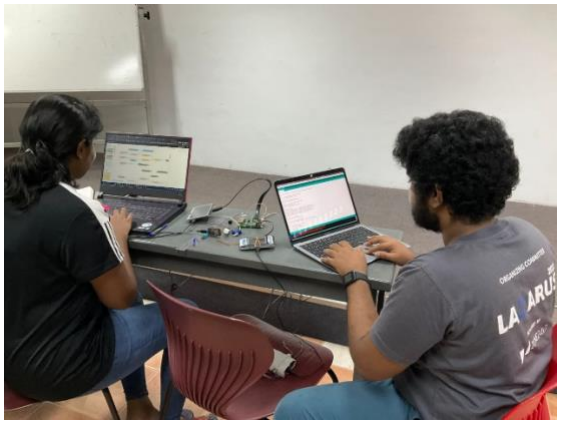
200-1000+ FPS on top-end devices enables it to be seamlessly integrated into augmented reality applications that require precise facial region input for task-specific models. These models may include 2D/3D facial key point or geometry estimation, facial feature or expression classification, and face 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.

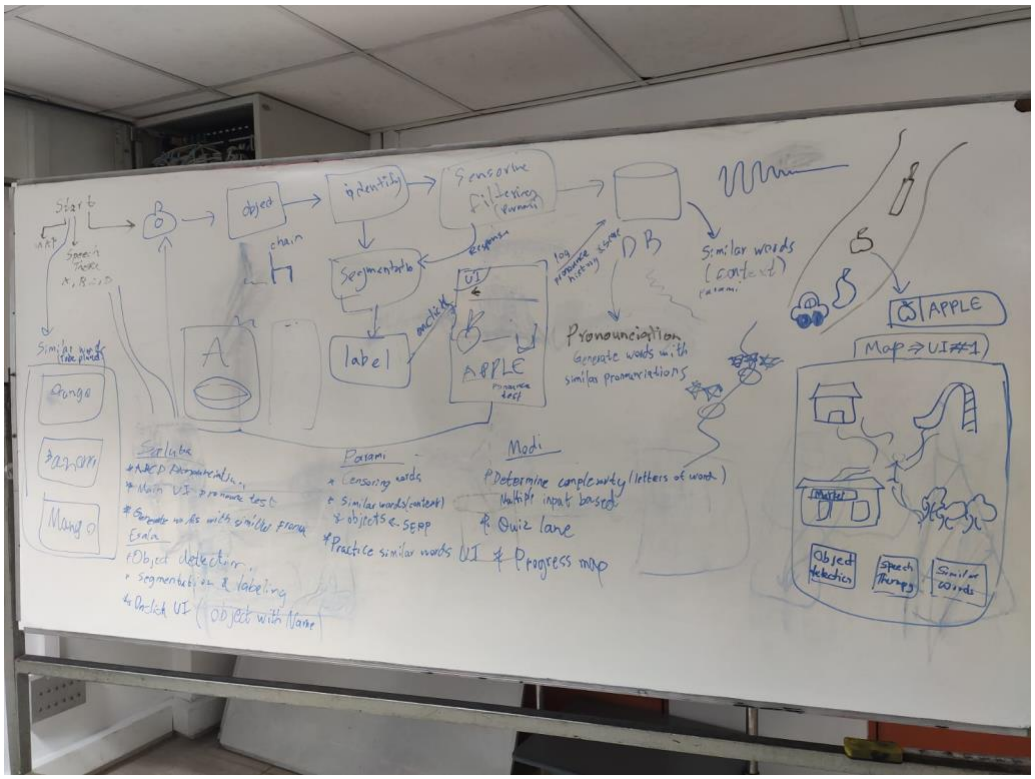
2. MEETINGS

2.1 Physical Meetings




CEHIC

Photographs taken at physical group meetings and planning sessions

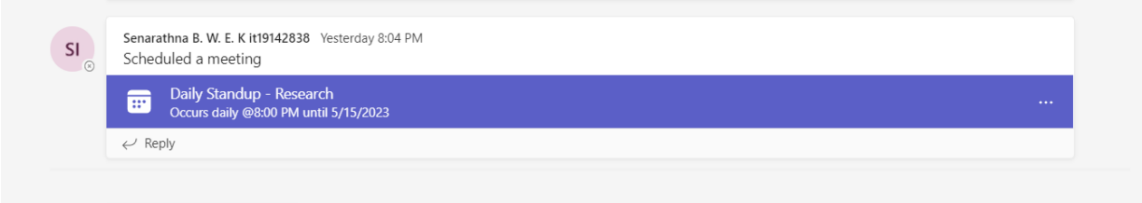



CULTY OF

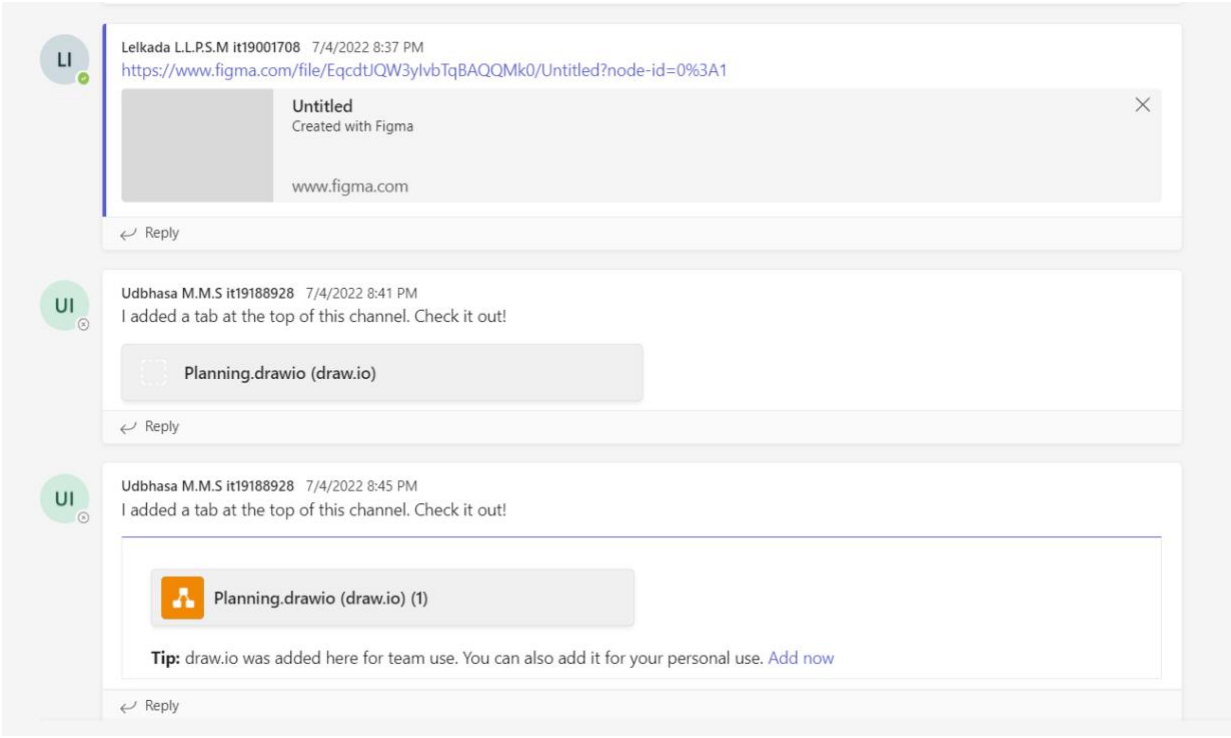
2.2 Online Meetings

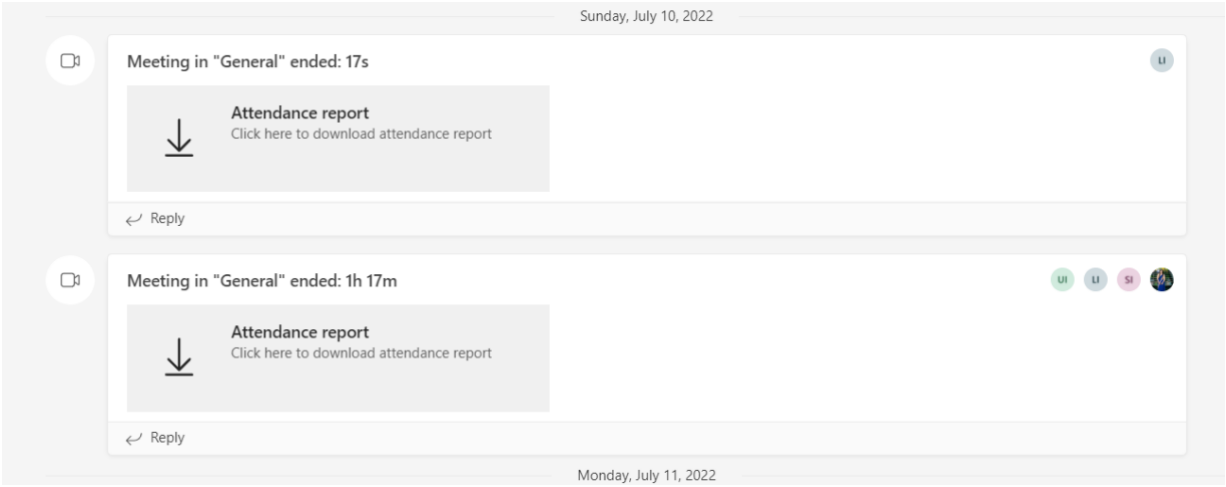
Microsoft teams software is used as the primary communication method during the whole period

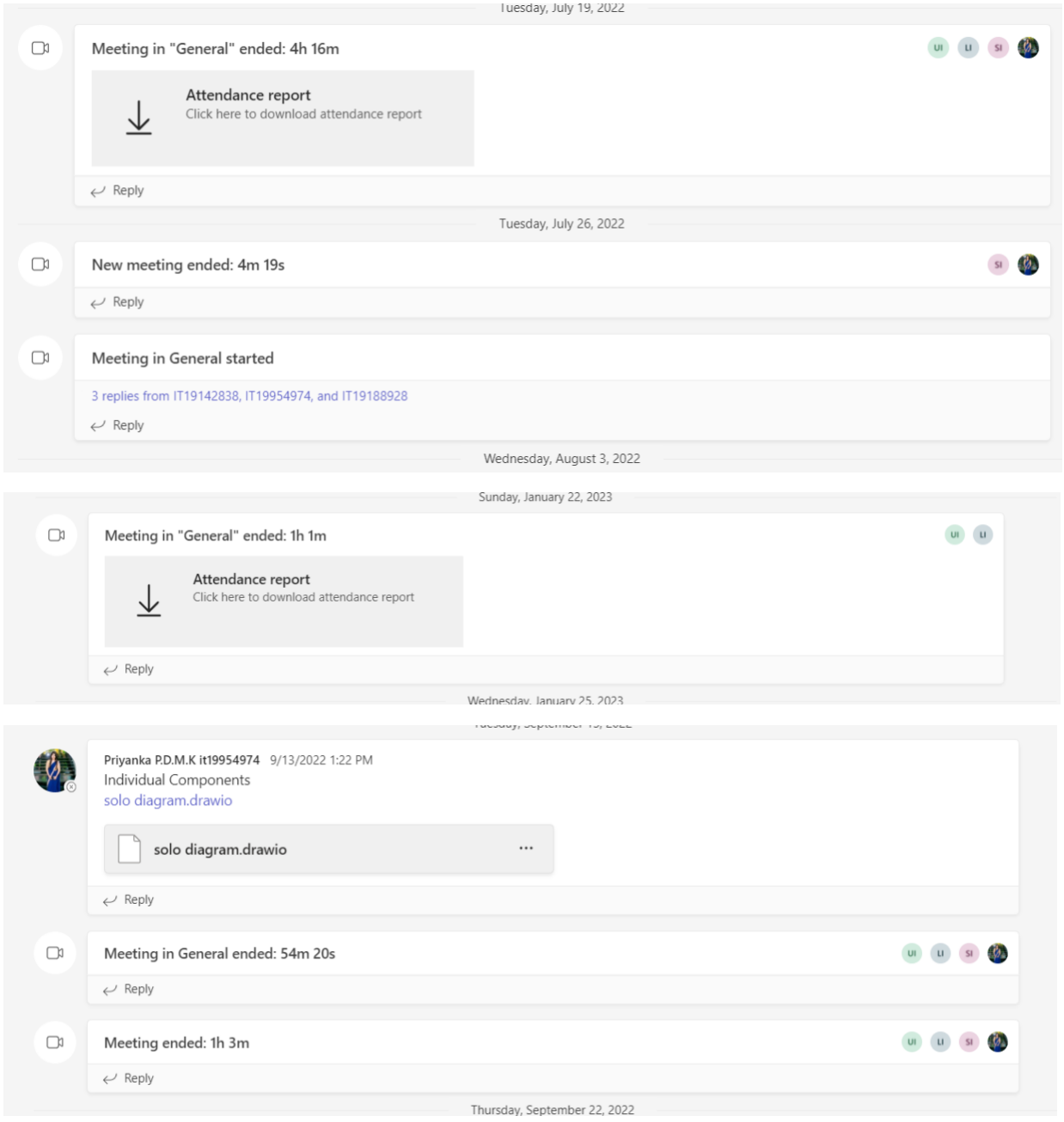
Daily Standup is being conducted for daily updates and progress check

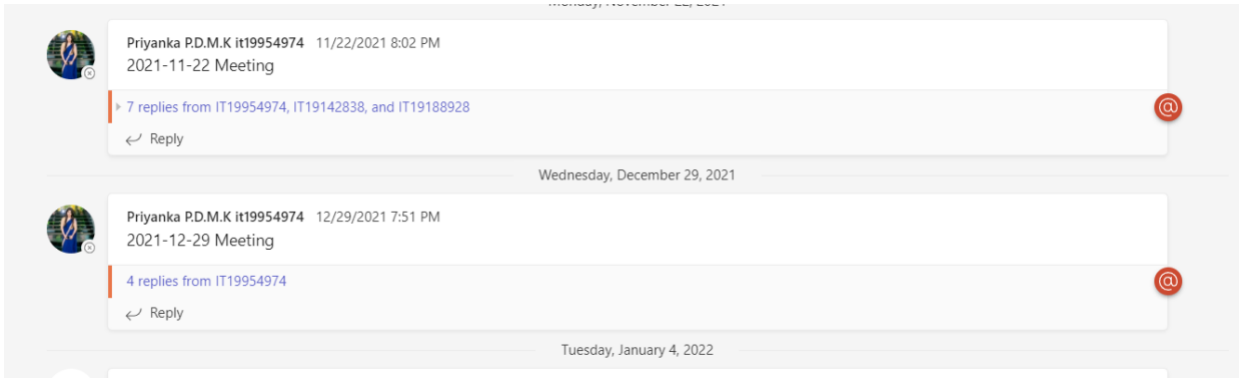


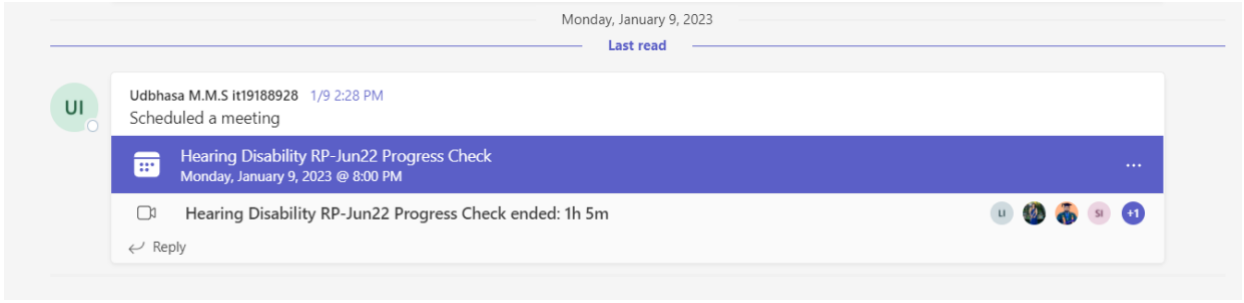
Following snapshots are taken as a proof of online meetings conducted through MS Teams.

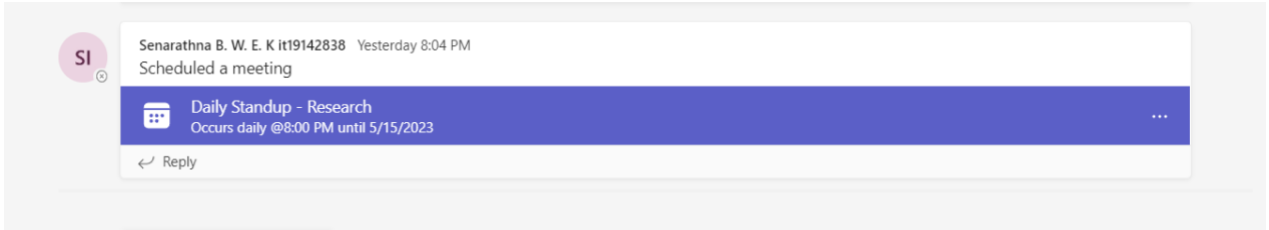




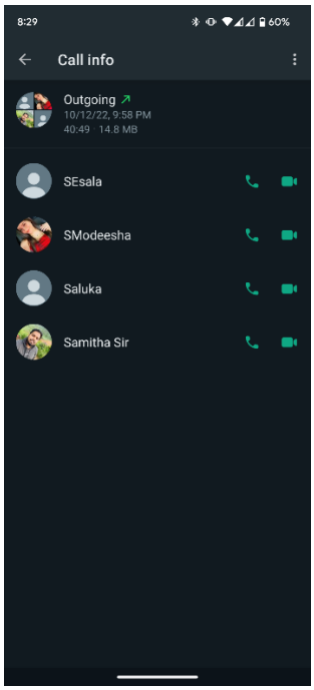

Tuesday, July 19, 2022
Meeting in "General" ended: 4h 16m
Attendance report
Click here to download attendance report
Reply
Tuesday, July 26, 2022
New meeting ended: 4m 19s
Reply
Meeting in General started
3 replies from IT19142838, IT19954974, and IT19188928
Reply
Wednesday, August 3, 2022
Sunday, January 22, 2023
Meeting in "General" ended: 1h 1m
Attendance report
Click here to download attendance report
Reply
Wednesday, January 25, 2023
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

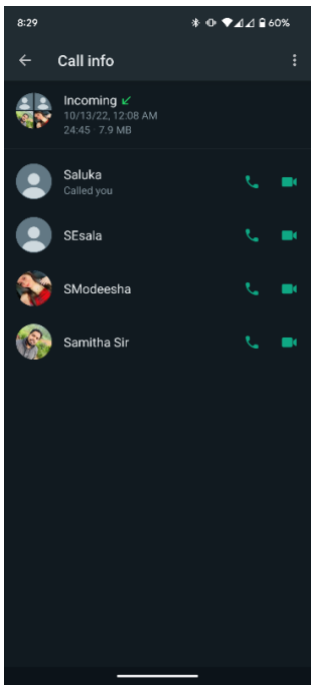

Priyanka P.D.M.K it19954974 11/22/2021 8:02 PM
2021-11-22 Meeting
7 replies from IT19954974, IT19142838, and IT19188928
Reply
Wednesday, December 29, 2021
Priyanka P.D.M.K it19954974 12/29/2021 7:51 PM
2021-12-29 Meeting
4 replies from IT19954974
Reply
Tuesday, January 4, 2022

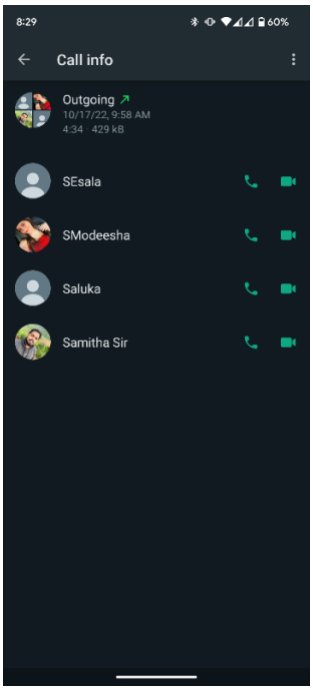

Monday, January 9, 2023
Last read
UI
Udbhasa M.M.S it19188928 1/9 2:28 PM
Scheduled a meeting
Hearing Disability RP-Jun22 Progress Check
Monday, January 9, 2023 @ 8:00 PM
Hearing Disability RP-Jun22 Progress Check ended: 1h 5m
Reply

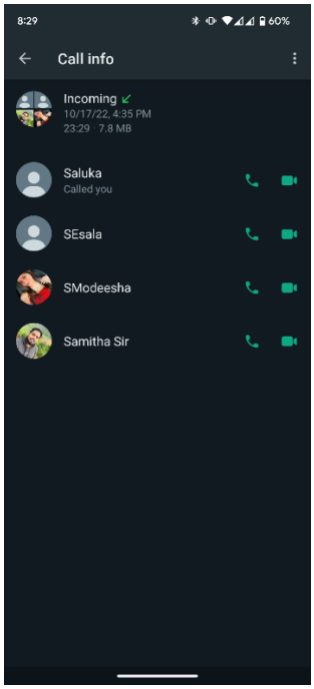

SI
Senarathna B. W. E. K it19142838 Yesterday 8:04 PM
Scheduled a meeting
Daily Standup - Research
Occurs daily @8:00 PM until 5/15/2023
Reply

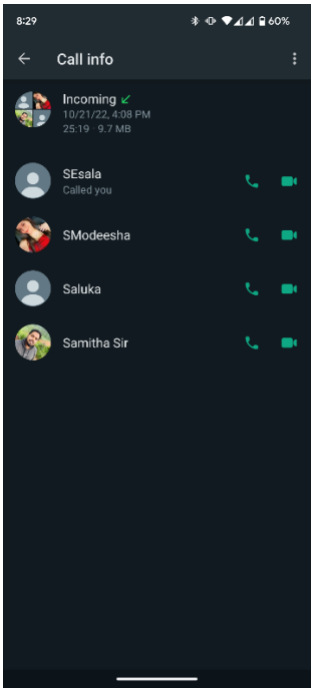
Following snapshots are taken as a proof of online meetings conducted with supervisor and co-supervisor via WhatsApp.

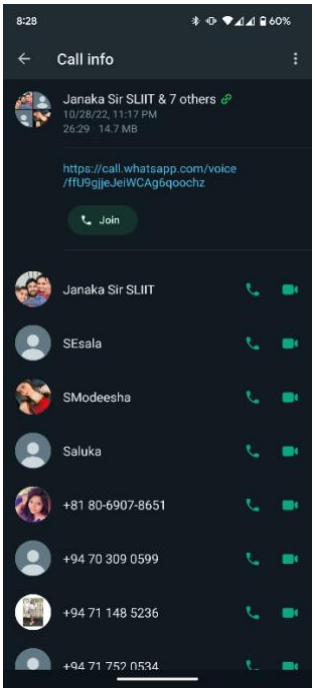




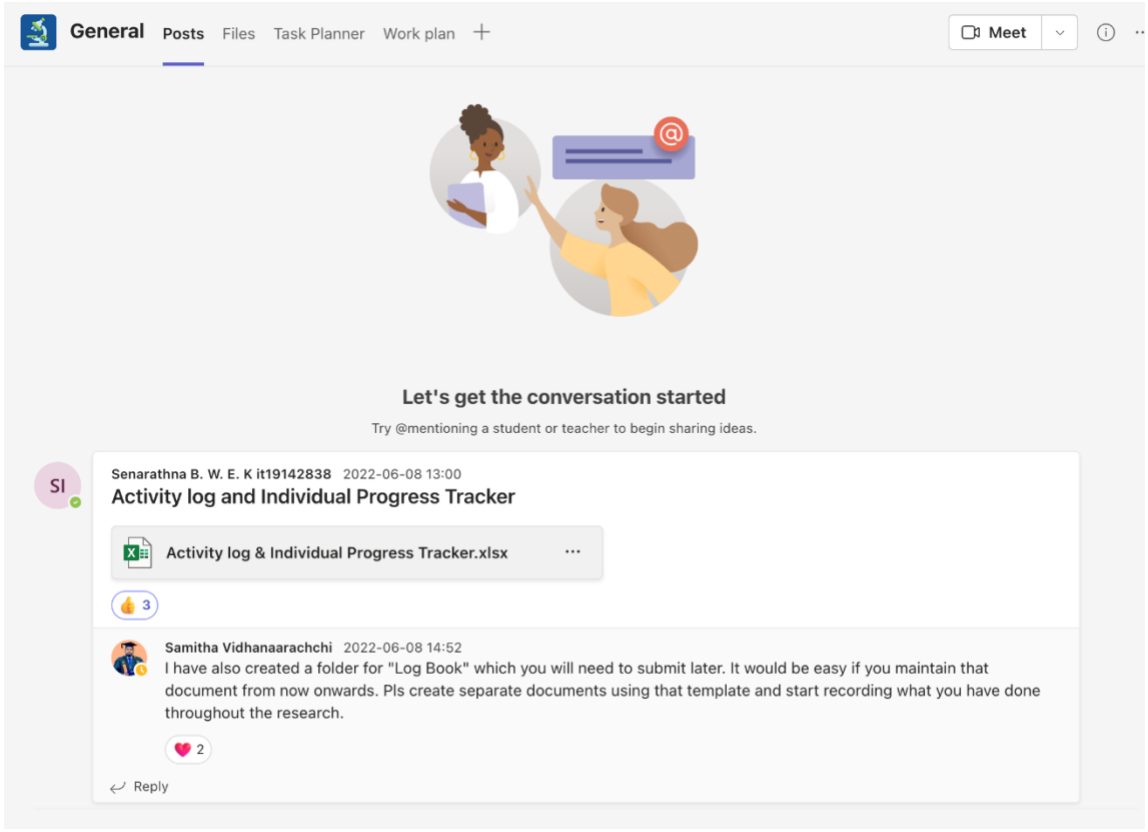


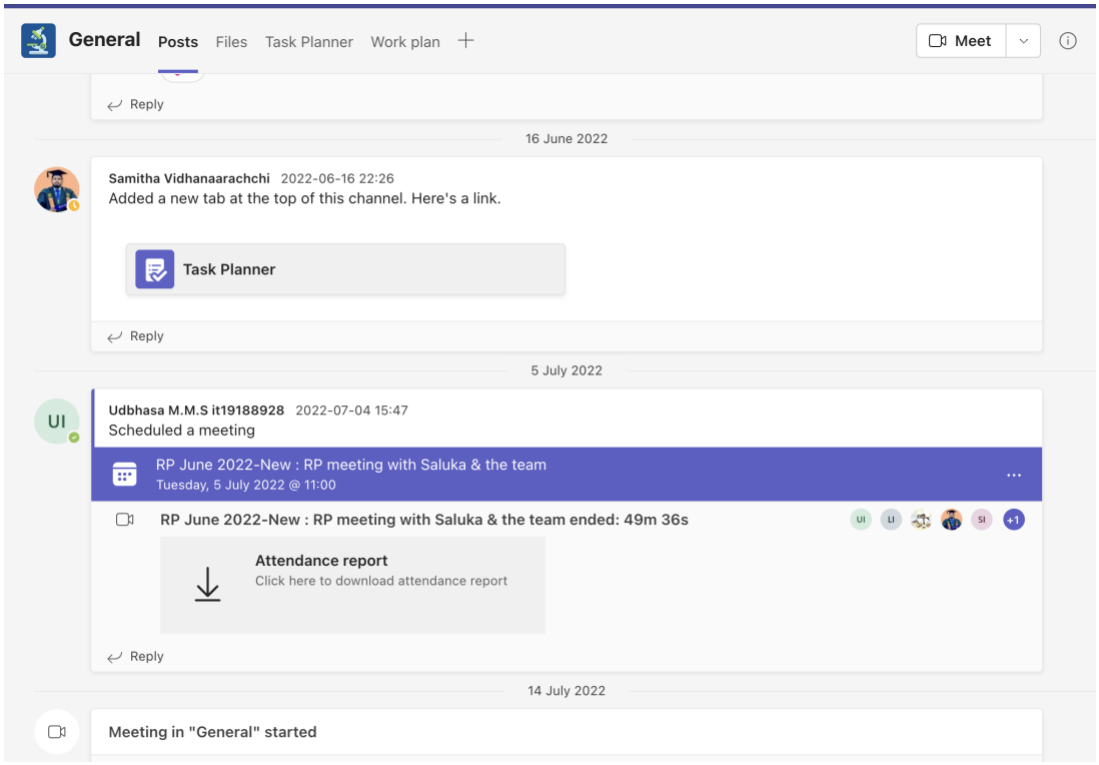


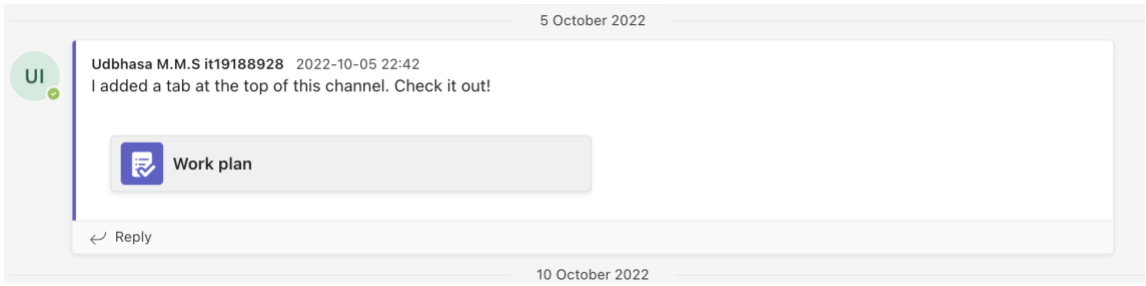




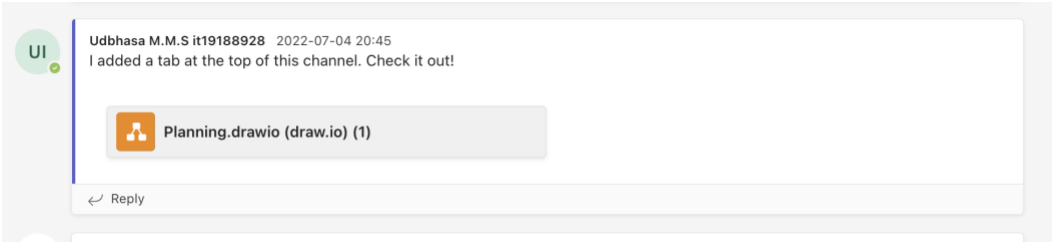
3 SCREENSHOTS OF CHATS

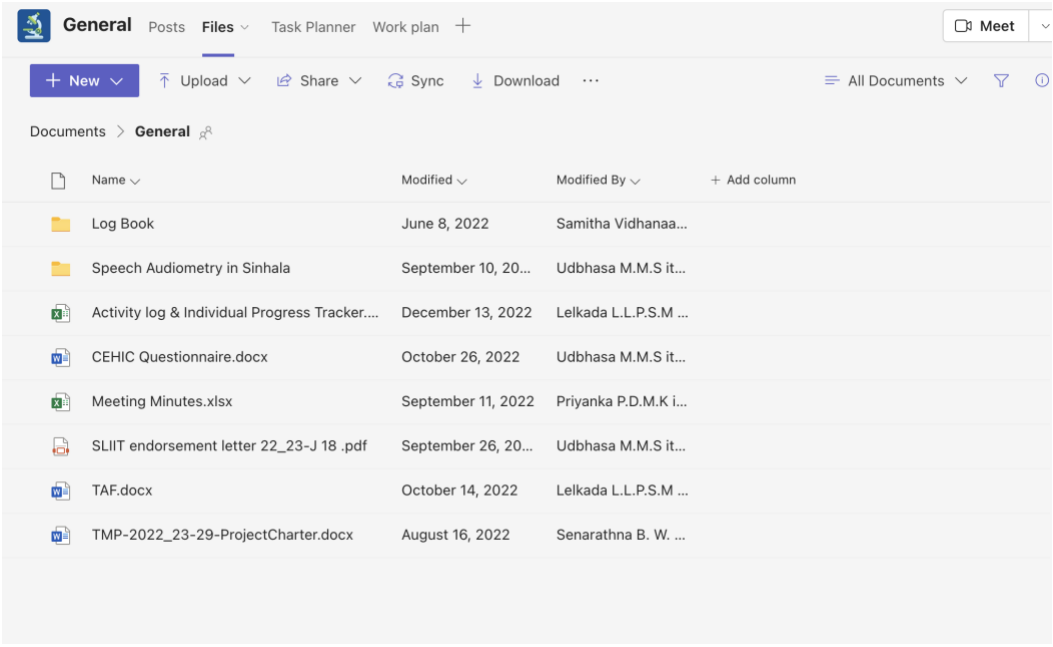


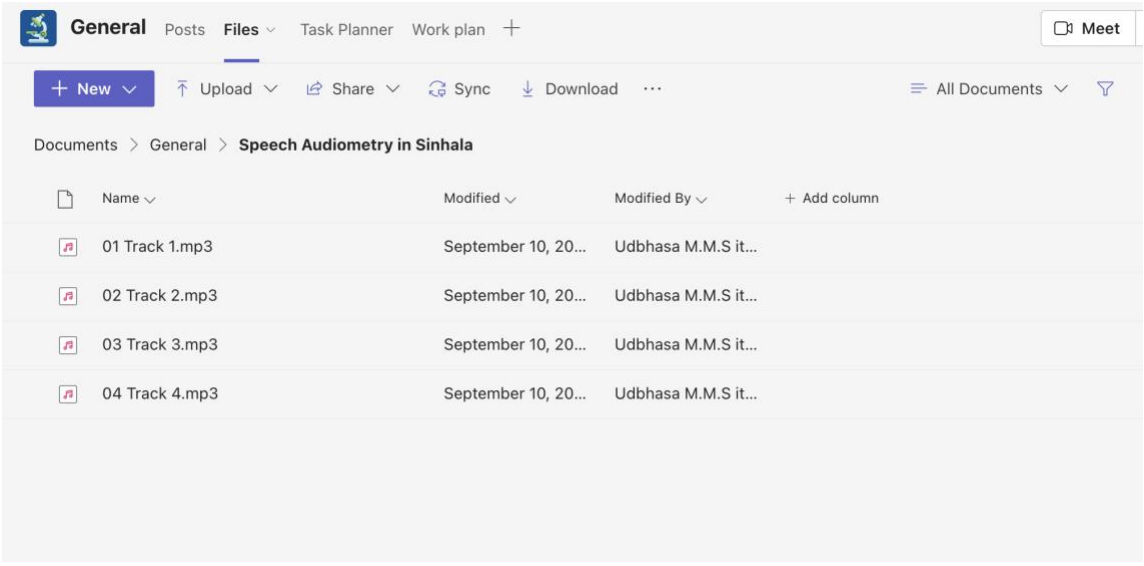

General
Posts
Files
Task Planner
Work plan
Meet
Reply
16 June 2022
Samitha Vidhanaarachchi 2022-06-16 22:26
Added a new tab at the top of this channel. Here's a link.
Task Planner
Reply
5 July 2022
UI
Udbhasa M.M.S it19188928 2022-07-04 15:47
Scheduled a meeting
RP June 2022-New : RP meeting with Saluka & 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

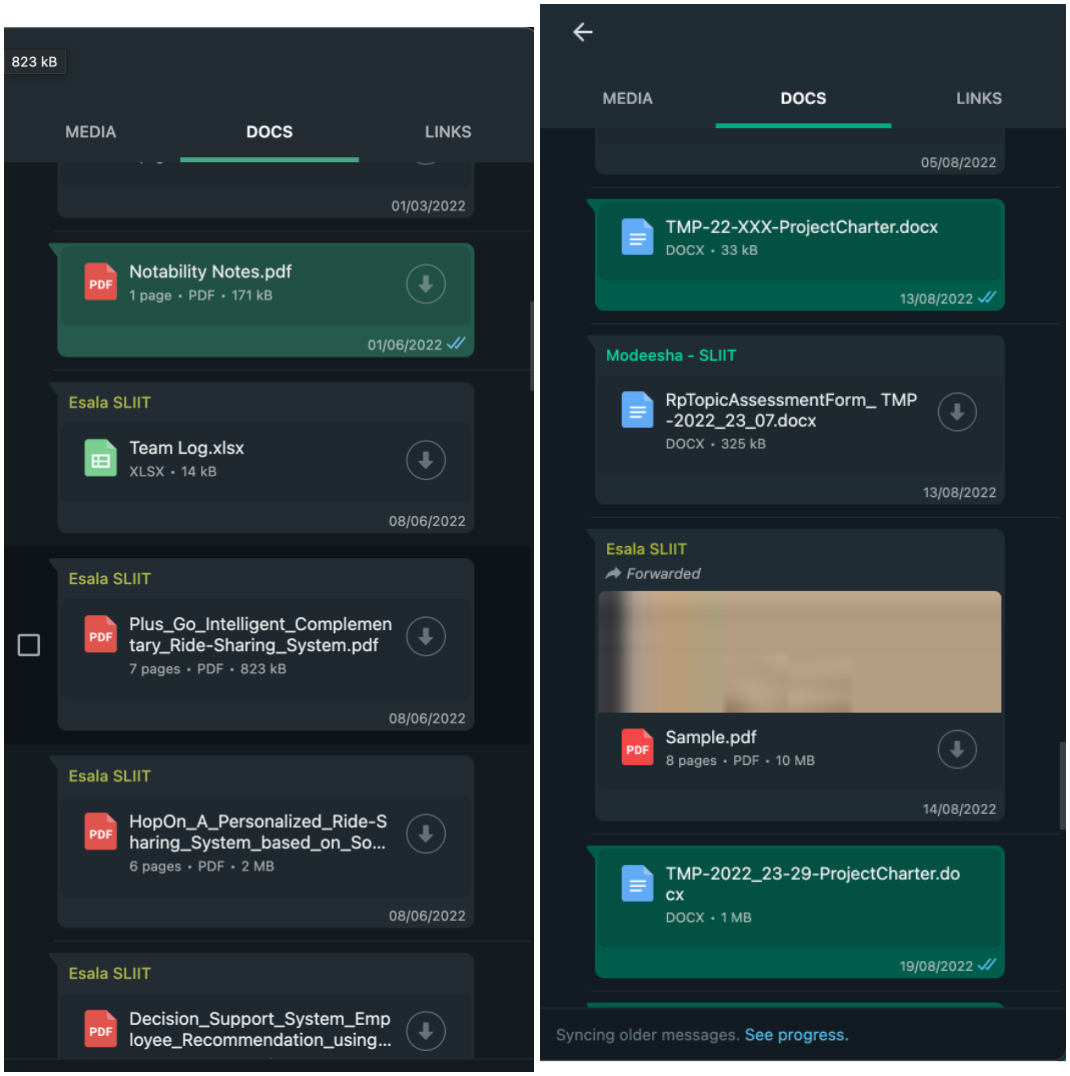

5 October 2022
UI
Udbhasa M.M.S it19188928 2022-10-05 22:42
I added a tab at the top of this channel. Check it out!
Work plan
Reply
10 October 2022

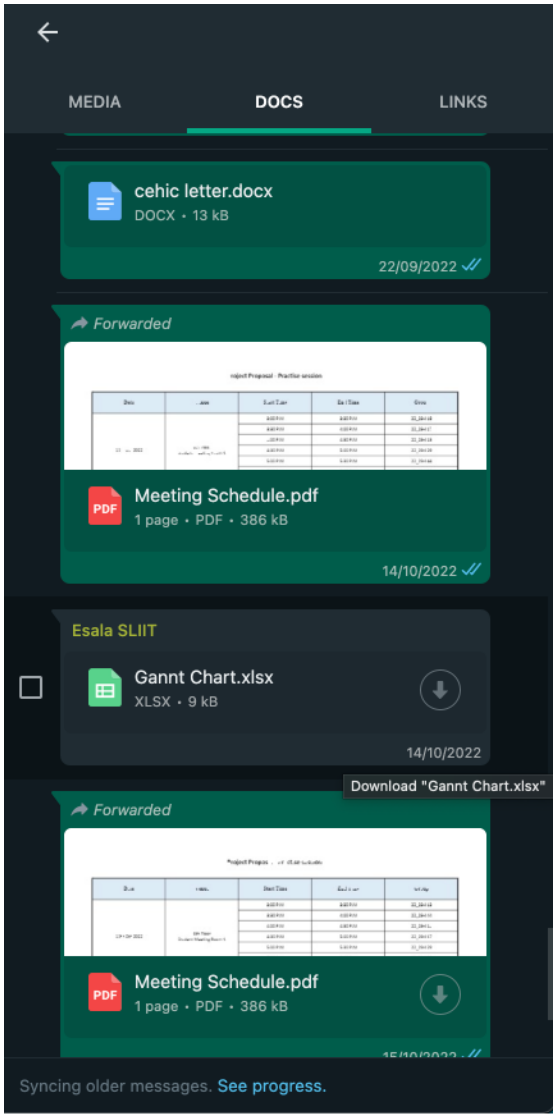

LI
Lelkada L.L.P.S.M it19001708 2022-07-04 20:37
https://www.figma.com/file/EqcdtJQW3yIvbTqBAQQMk0/Untitled?node-id=0%3A1
Untitled
Created with Figma
www.figma.com
Reply

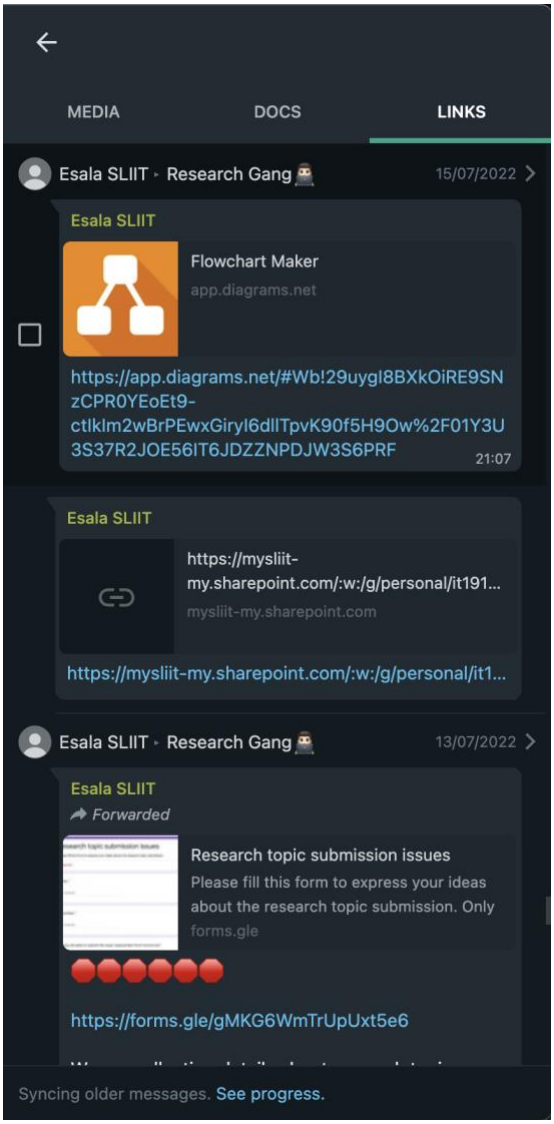

UI
Udbhasa M.M.S it19188928 2022-07-04 20:45
I added a tab at the top of this channel. Check it out!
Planning.drawio (draw.io) (1)
Reply

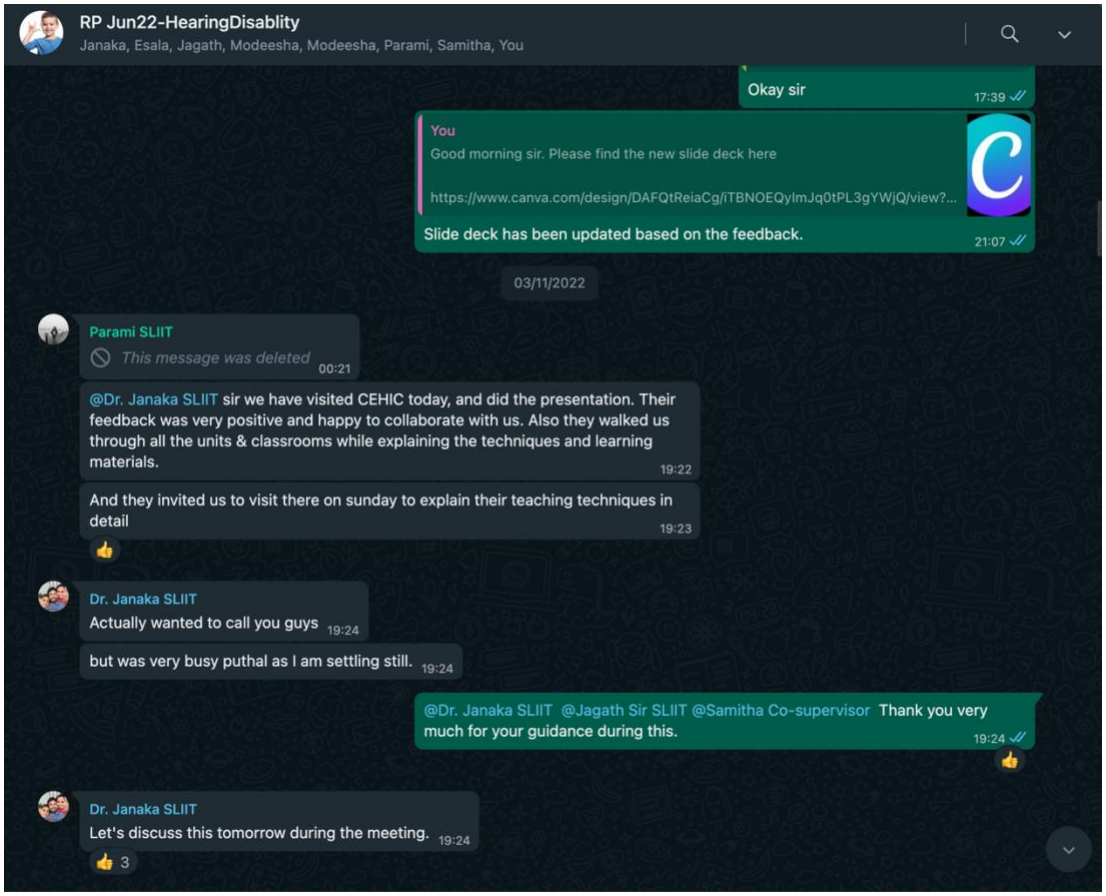

General
Posts
Files
Task Planner
Work plan
Meet
New
Upload
Share
Sync
Download
All Documents
Documents > General
Name
Modified
Modified By
Add column
Log Book June 8, 2022 Samitha Vidhanaa...
Speech Audiometry in Sinhala September 10, 20... Udbhasa M.M.S it...
Activity log & Individual Progress Tracker.... December 13, 2022 Lelkada 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 Lelkada L.L.P.S.M ...
TMP-2022_23-29-ProjectCharter.docx August 16, 2022 Senarathna B. W. ...


General
Posts
Files
Task Planner
Work plan
Meet
New
Upload
Share
Sync
Download
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...

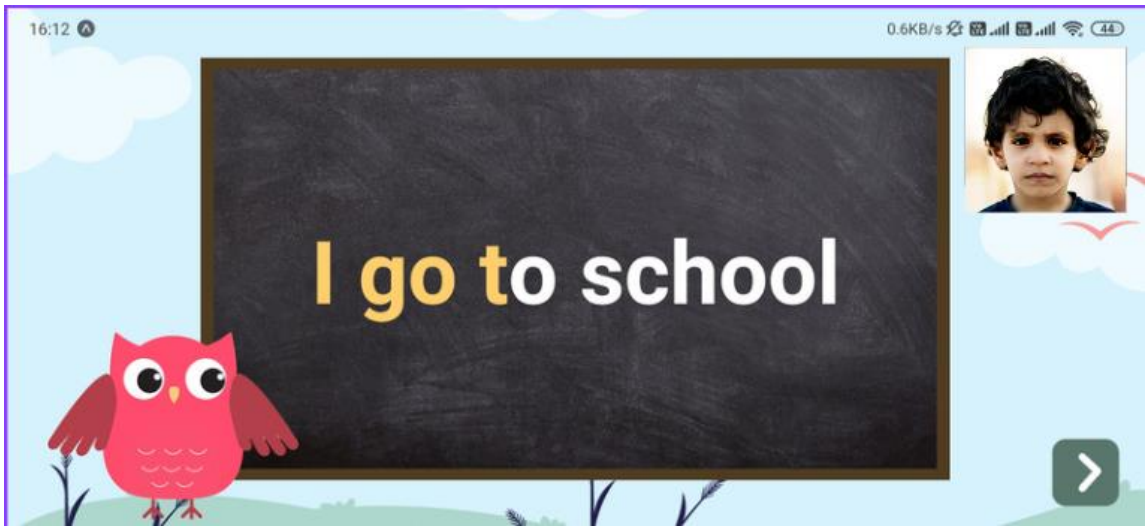

823 kB
MEDIA
DOCS
LINKS
01/03/2022
Notability Notes.pdf
1 page • PDF • 171 kB
01/06/2022
Esala SLIIT
Team Log.xlsx
XLSX • 14 kB
08/06/2022
Esala SLIIT
Plus_Go_Intelligent_Complementary_Ride-Sharing_System.pdf
7 pages • PDF • 823 kB
08/06/2022
Esala SLIIT
HopOn_A_Personalized_Ride-Sharing_System_based_on_So...
6 pages • PDF • 2 MB
08/06/2022
Esala SLIIT
Decision_Support_System_Employee_Recommendation_using...
MEDIA
DOCS
LINKS
05/08/2022
TMP-22-XXX-ProjectCharter.docx
DOCX • 33 kB
13/08/2022
Modeesha - SLIIT
RpTopicAssessmentForm_ TMP-2022_23_07.docx
DOCX • 325 kB
13/08/2022
Esala SLIIT
Forwarded
Sample.pdf
8 pages • PDF • 10 MB
14/08/2022
TMP-2022_23-29-ProjectCharter.docx
DOCX • 1 MB
19/08/2022
Syncing older messages. See progress.

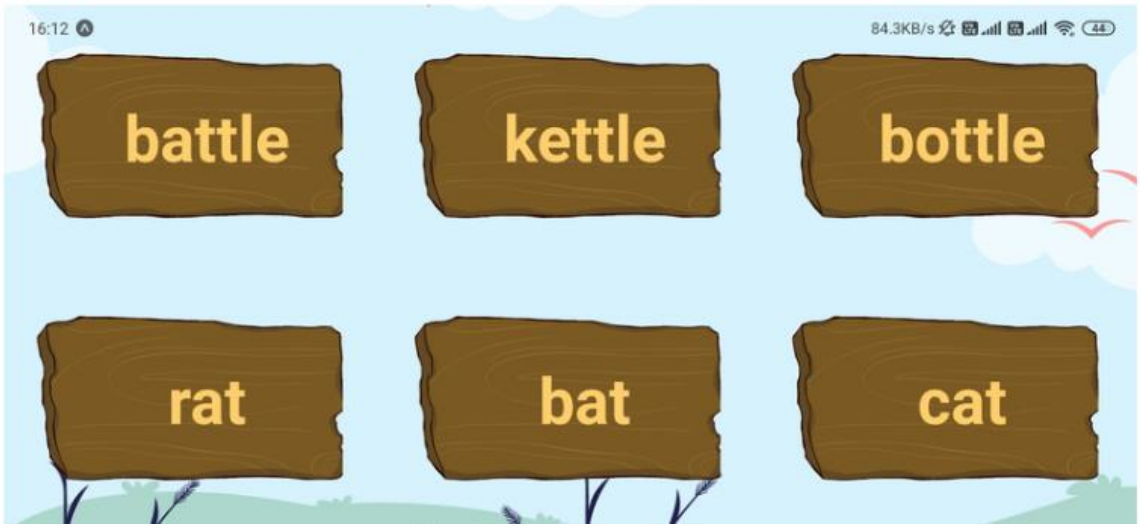

MEDIA
DOCS
LINKS
cehic letter.docx
DOCX • 13 kB
22/09/2022
Forwarded
Meeting Schedule.pdf
1 page • PDF • 386 kB
14/10/2022
Esala SLIIT
Gannt Chart.xlsx
XLSX • 9 kB
14/10/2022
Download "Gannt Chart.xlsx"
Forwarded
Meeting Schedule.pdf
1 page • PDF • 386 kB
Syncing older messages. See progress.


MEDIA
DOCS
LINKS
Esala SLIIT • Research Gang
15/07/2022
Esala SLIIT
Flowchart Maker
app.diagrams.net
https://app.diagrams.net/#Wb!29uygI8BXkOiRE9SNzCPR0YEoEt9-ctlklm2wBrPEwxGiryI6dllTpvK90f5H9Ow%2F01Y3U3S37R2JOE56IT6JDZZNPDJW3S6PRF
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/it1...
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.


RP Jun22-HearingDisablity
Janaka, Esala, Jagath, Modeesha, Modeesha, Parami, Samitha, You
Okay sir
17:39
You
Good morning sir. Please find the new slide deck here
https://www.canva.com/design/DAFQtReiaCg/iTBNOEQyImJq0tPL3gYWjQ/view?...
Slide deck has been updated based on the feedback.
21:07
03/11/2022
Parami SLIIT
This message was deleted
00:21
@Dr. Janaka SLIIT sir we have visited CEHIC today, and did the presentation. Their feedback was very positive and happy to collaborate with us. Also they walked us through all the units & classrooms while explaining the techniques and learning materials.
19:22
And they invited us to visit there on sunday to explain their teaching techniques in detail
19:23
Dr. Janaka SLIIT
Actually wanted to call you guys
19:24
but was very busy puthal as I am settling still.
19:24
@Dr. Janaka SLIIT @Jagath Sir SLIIT @Samitha Co-supervisor Thank you very much for your guidance during this.
19:24
Dr. Janaka SLIIT
Let's discuss this tomorrow during the meeting.
19:24
3

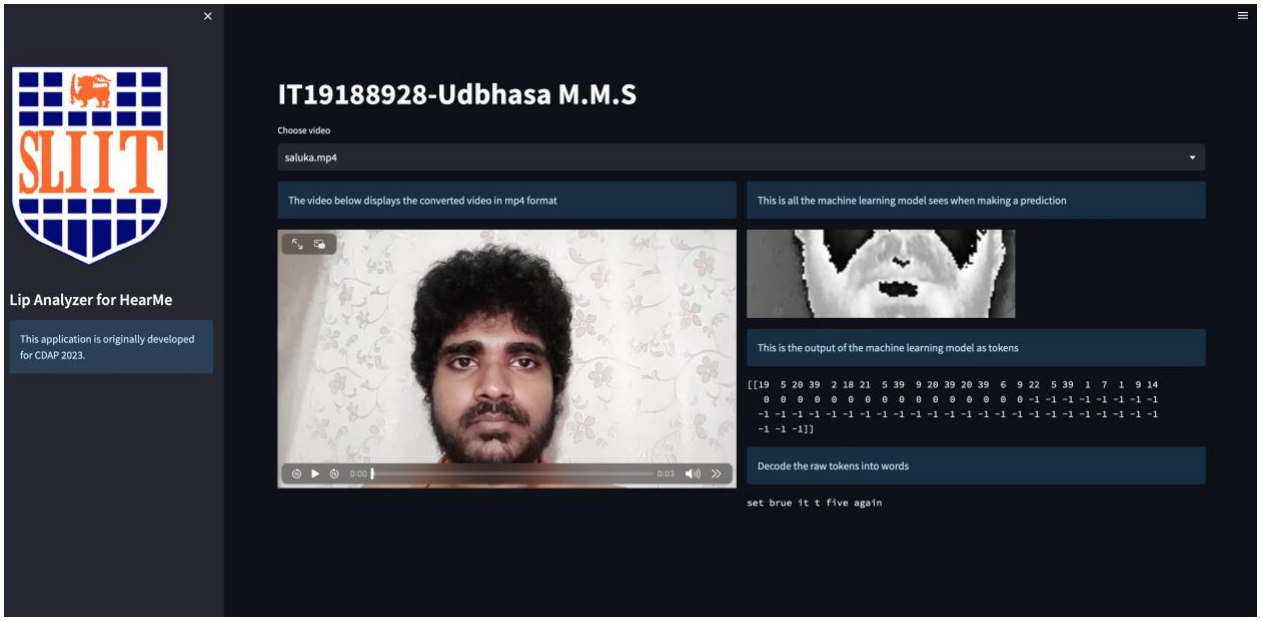
4 USER INTERFACES OF THE MOBILE APPLICATION

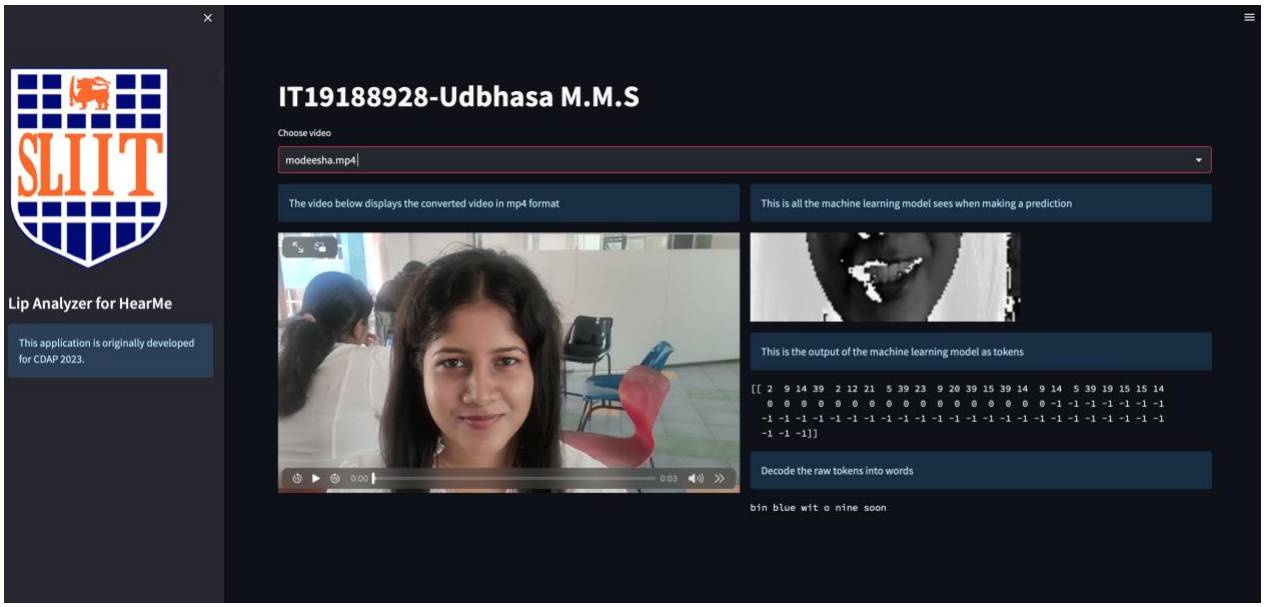




5. STREAMLIT APP FOR DEMONSTRATION

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.



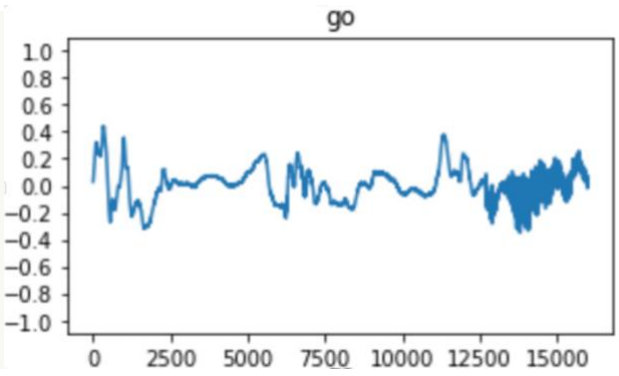


6. TASK OUTPUTS

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

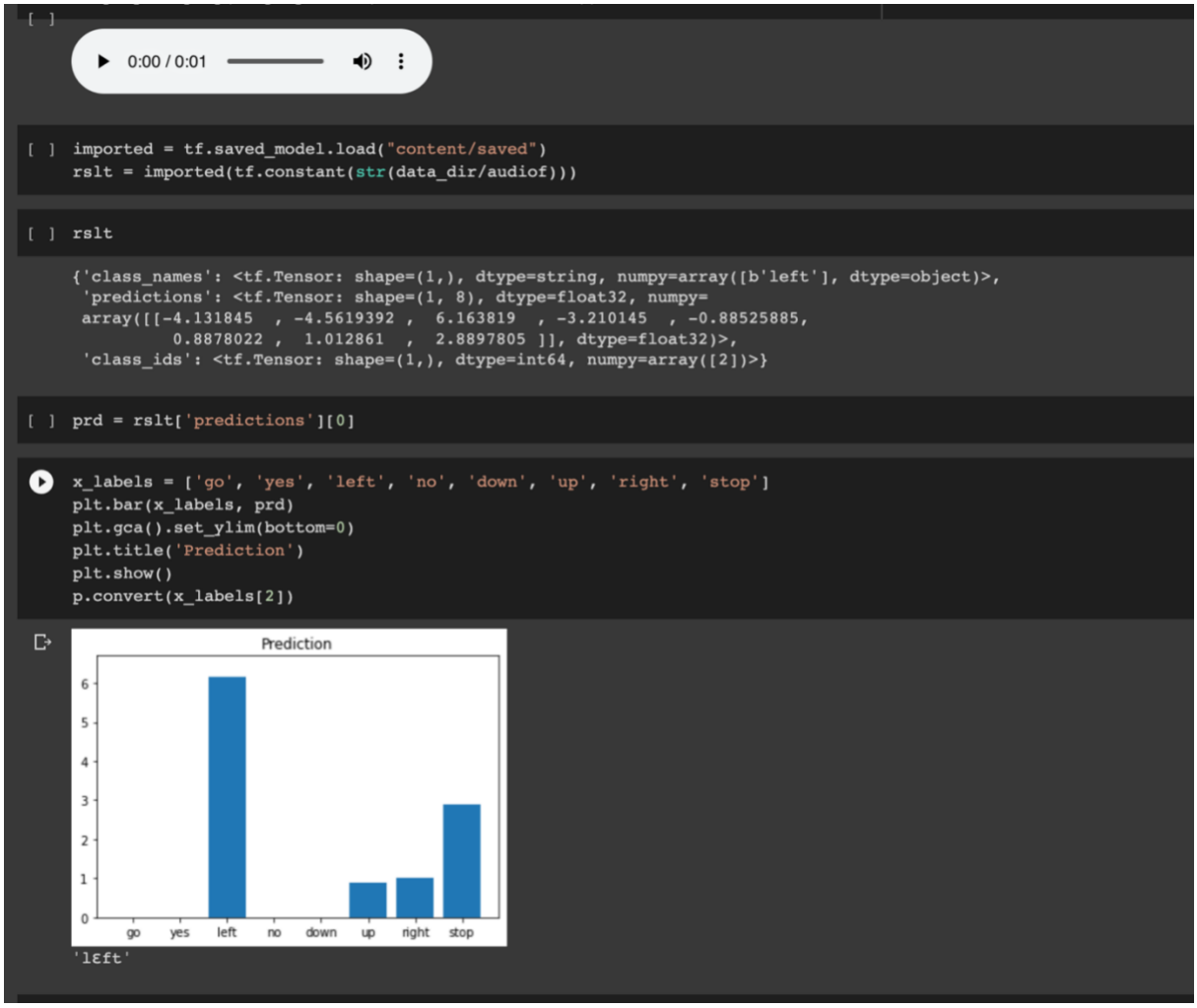
Face detetction model perfortmance comparison

```
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**

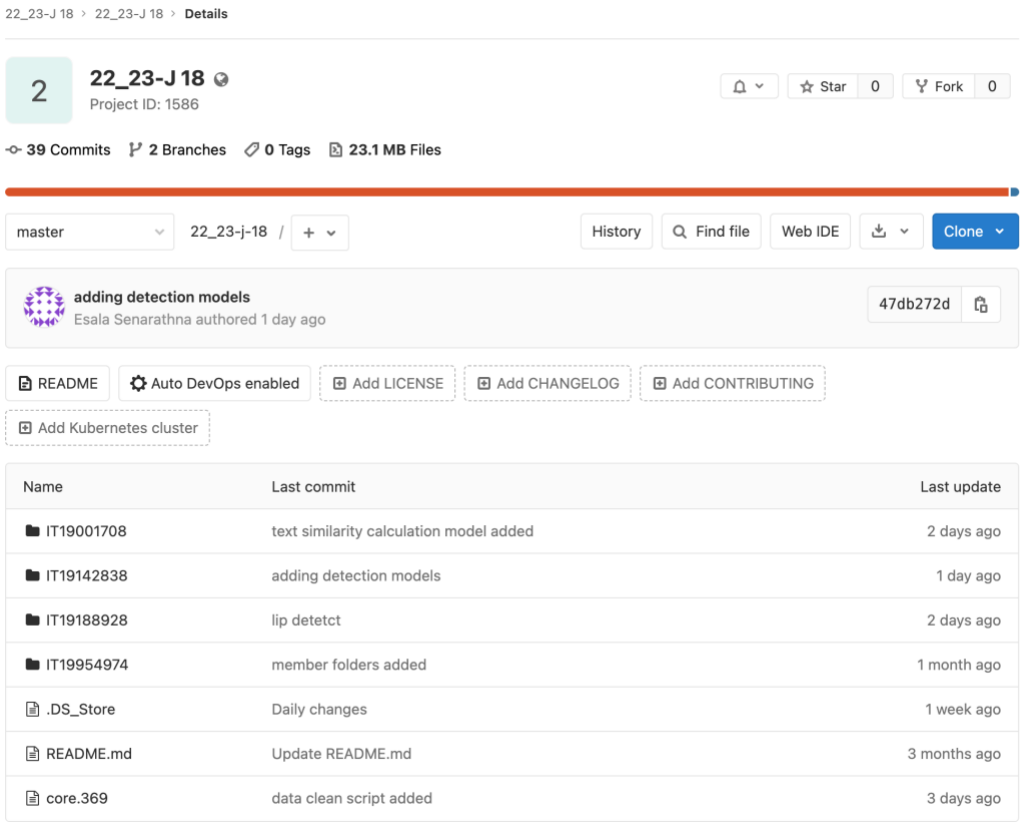
```
landmark {
  x: 0.5541493
  y: 0.5755461
  z: 0.004211265
}

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), (390, 373), (267, 269)
Frames per second using video.get(cv2.CAP_PROP_FPS) : 30.0
```

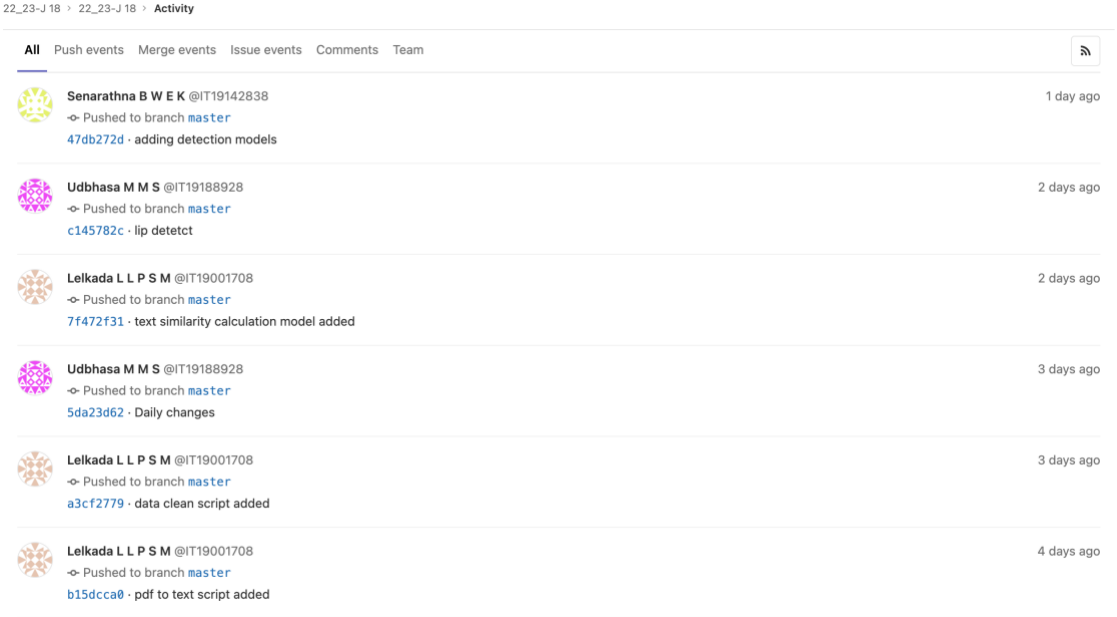
Lip mesh points

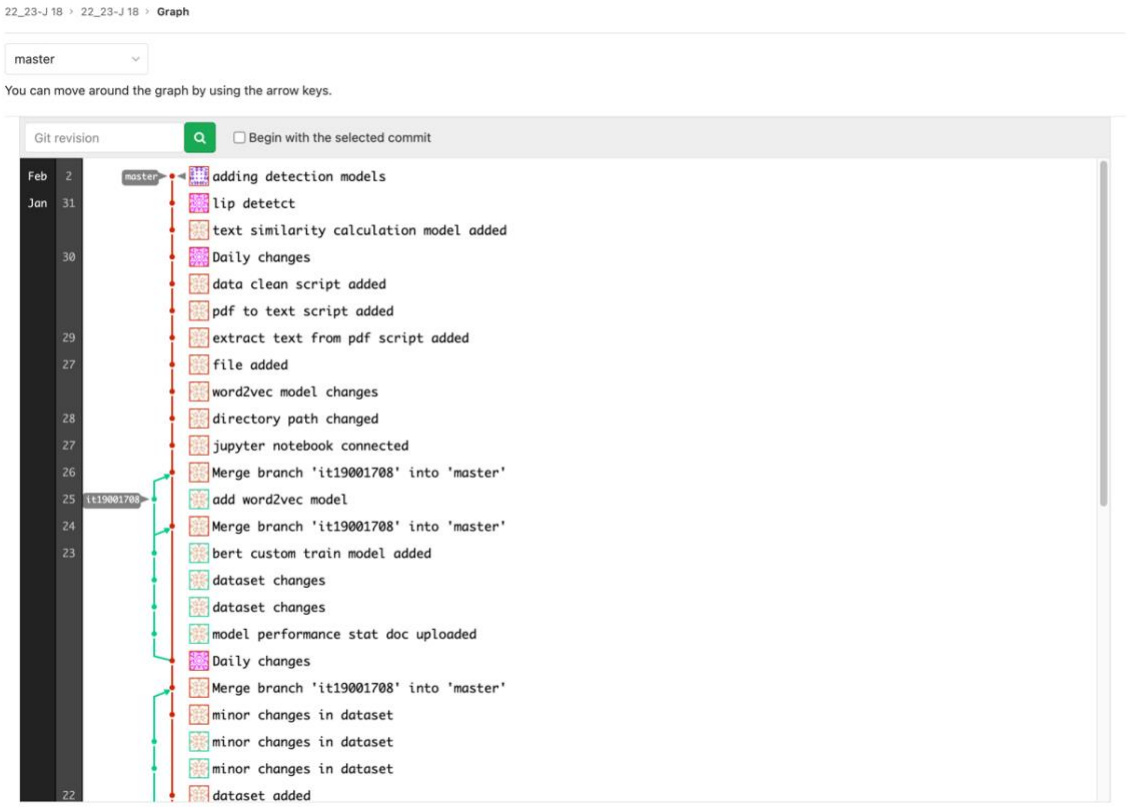


Audio processing

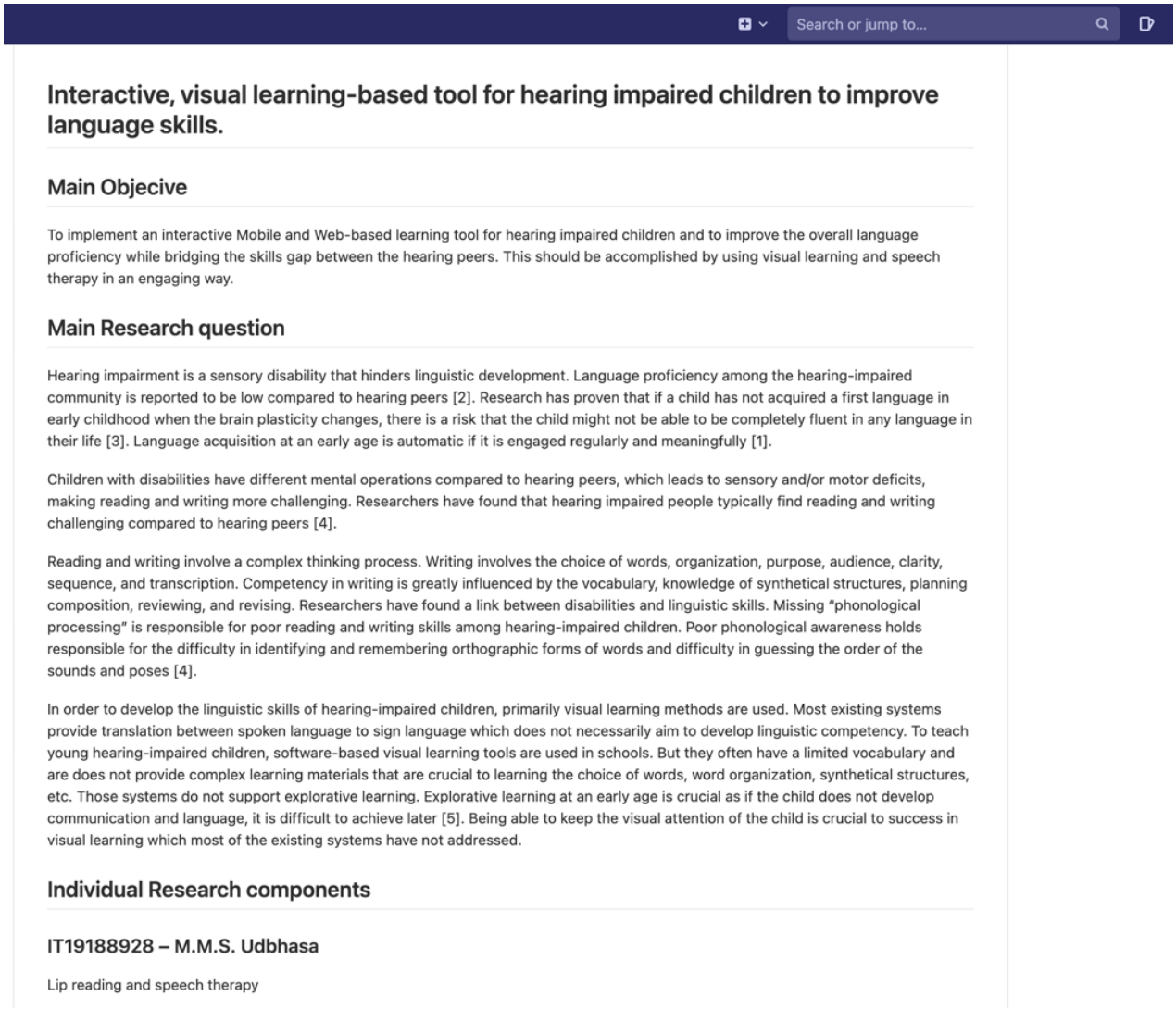
7. REPOSITORY AND DOCUMENTATION



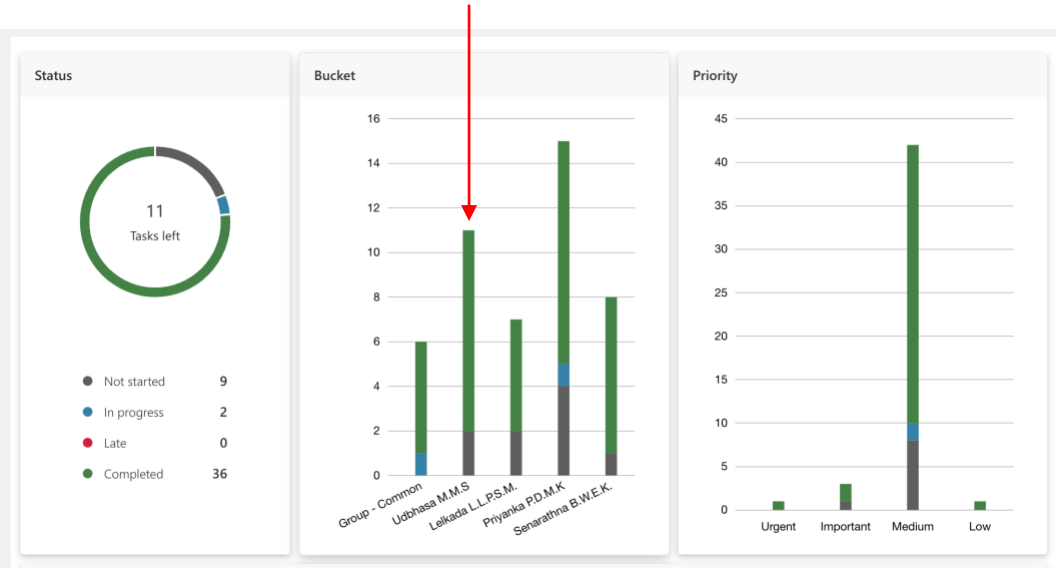


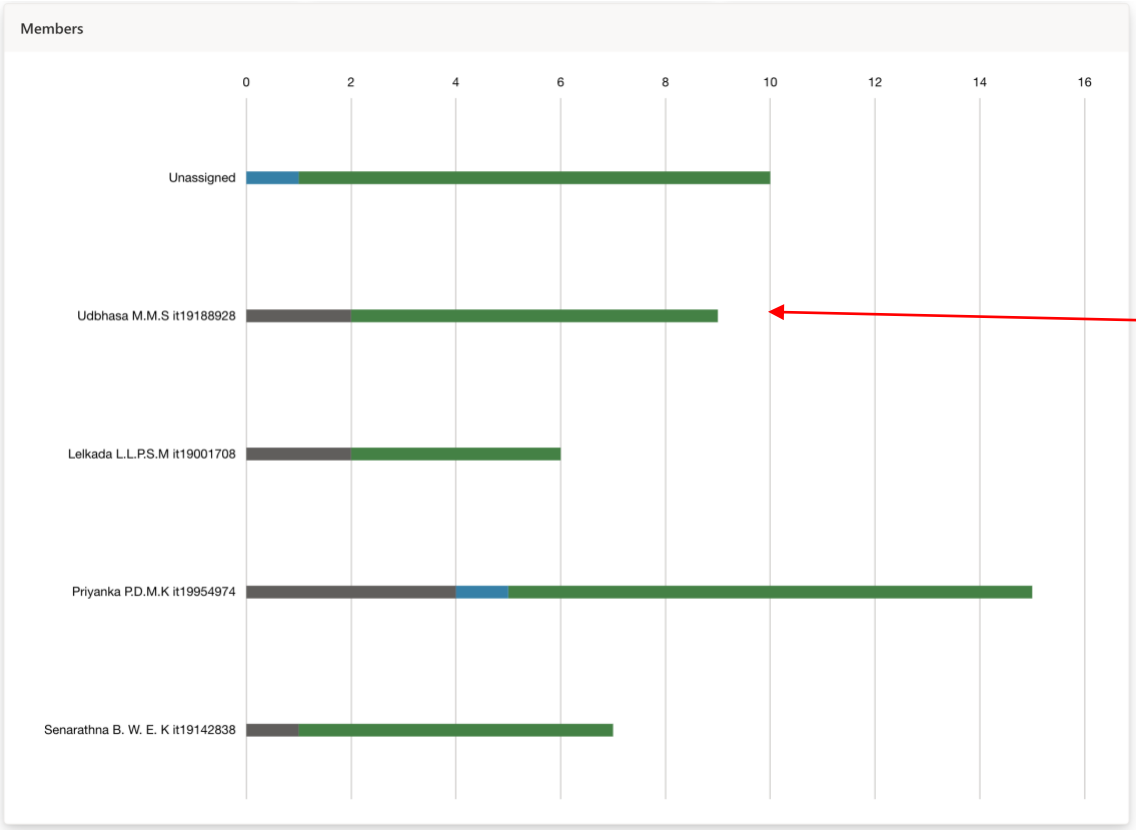

22_23-J 18 › 22_23-J 18 › Graph
master
You can move around the graph by using the arrow keys.
Git revision
Begin with the selected commit
Feb 2
Jan 31
30
29
27
28
27
26
25
24
23
22
master
it19001708
adding detection models
lip detetct
text similarity calculation model added
Daily changes
data clean script added
pdf to text script added
extract text from pdf script added
file added
word2vec model changes
directory path changed
jupyter notebook connected
Merge branch 'it19001708' into 'master'
add word2vec model
Merge branch 'it19001708' into 'master'
bert custom train model added
dataset changes
dataset changes
model performance stat doc uploaded
Daily changes
Merge branch 'it19001708' into 'master'
minor changes in dataset
minor changes in dataset
minor changes in dataset
dataset added

Documentation



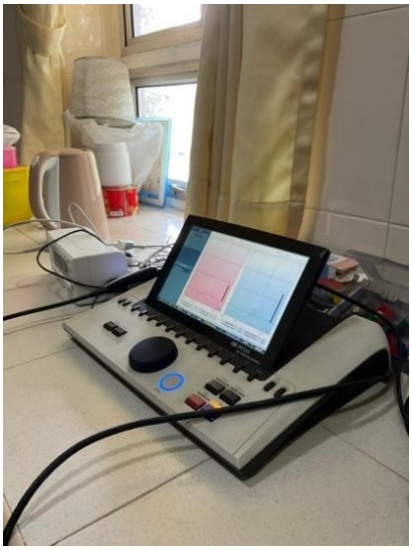
8. WORK PLANNER RECORDS



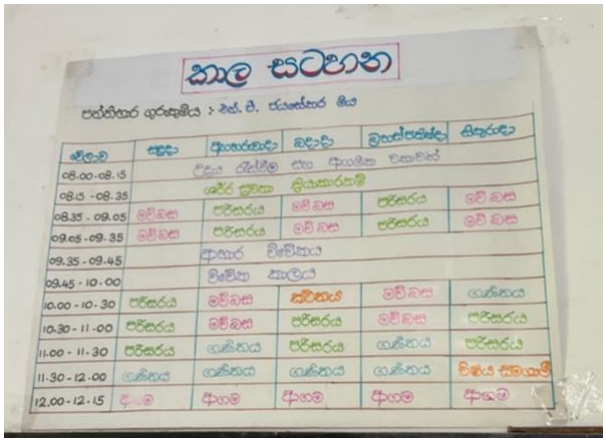


9. FIELD VISITS

Lady Ridgeway Hospital for Children (LRH)



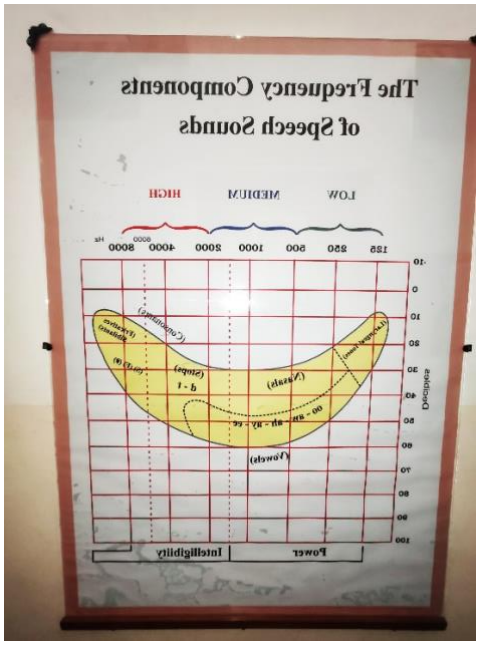
The School for the Deaf, Ratmalana

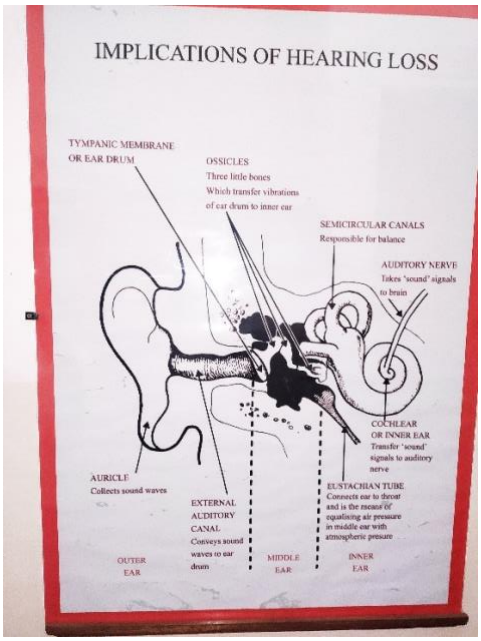


Photographs taken on multiple field visits to CEHIC, Dalugama


CE HIC

Photographs taken from field visit to Wickramarachchi Hearing Care Centre





10.WORK-BREAKDOWN STRUCTURE

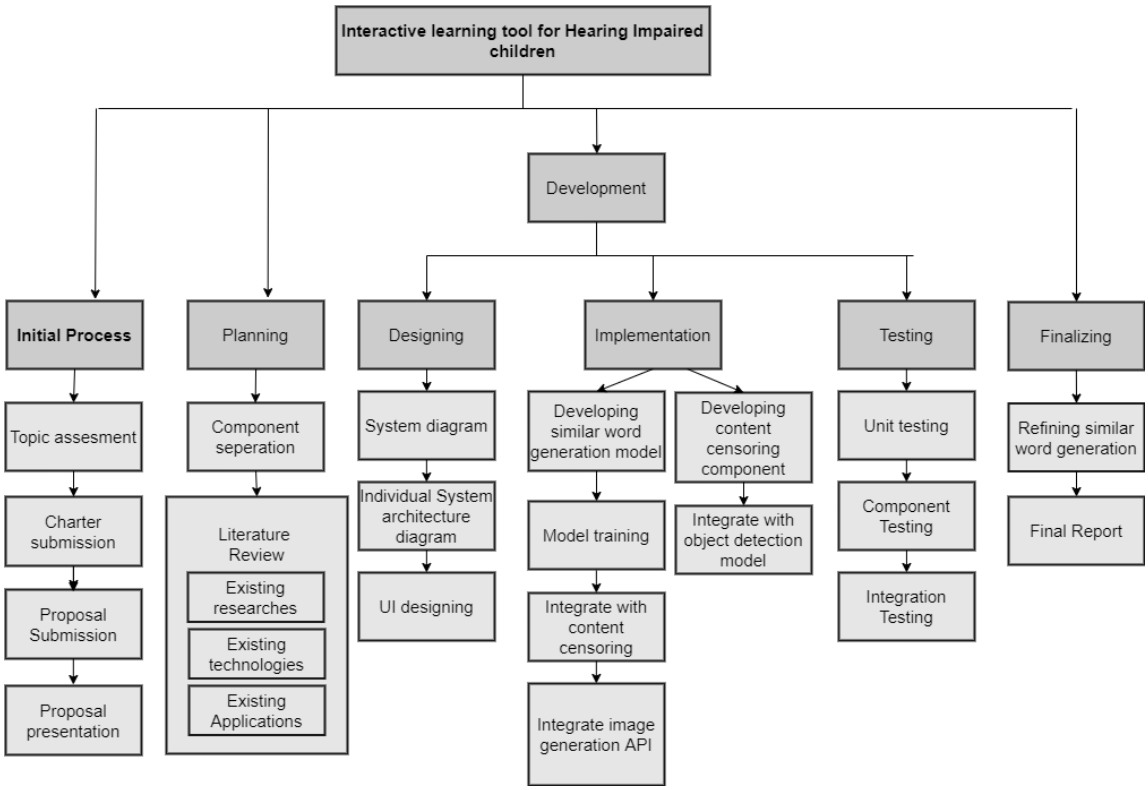


Figure 1: WBS

11. GANTT CHART

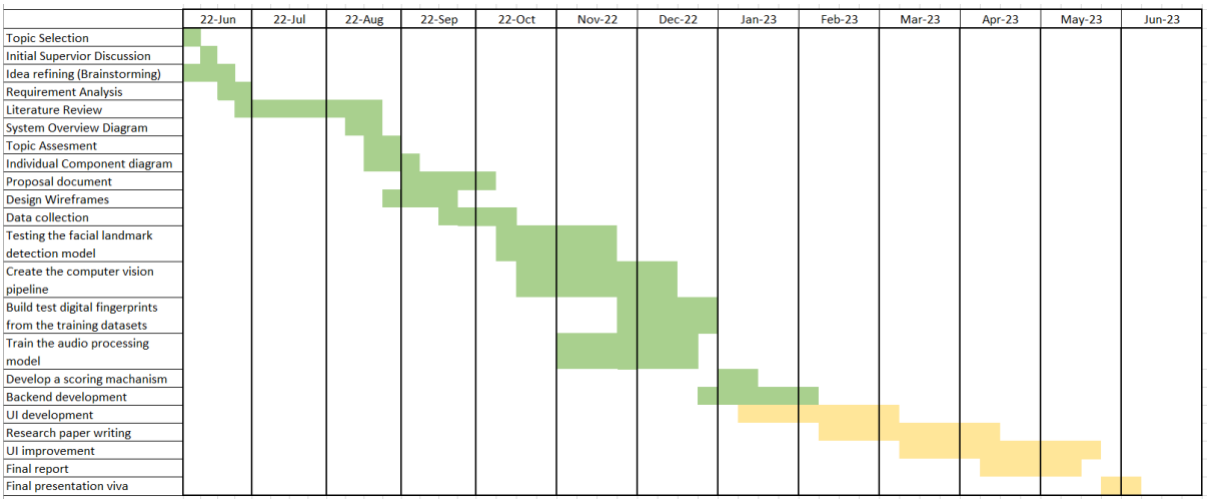


Figure 2: Gantt chart