Online Learning Platform for hearing Impaired People

Project ID : 2022-59

Team Members

Supervisor : Dr. Lakmini Abeywardhana

Co-Supervisor : Mr. Yasas Mallawarachchi

| Student Name	Student ID
Wanasinghe W. A. D. B (Leader)	IT19201160
Munasinghe M. W. S. S. M. T. M. B	IT19162706
Maddugoda C. D	IT19153346
Ramawickrama H. N	IT19174686

Introduction

- As a result of the current pandemic situation, most of the companies have taken steps to function through online systems.

- Educational institutes migrated to online learning methods.

- While majority of people can learn using these systems still there is a portion of people who are unable to learn through these systems.

- Hearing impaired people are one such group of people.

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Introduction

- Who are hearing impaired people?

- How do they communicate?

- What are the main features of expressing sign language?
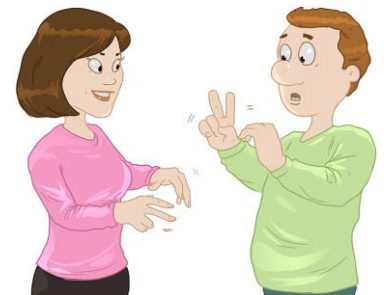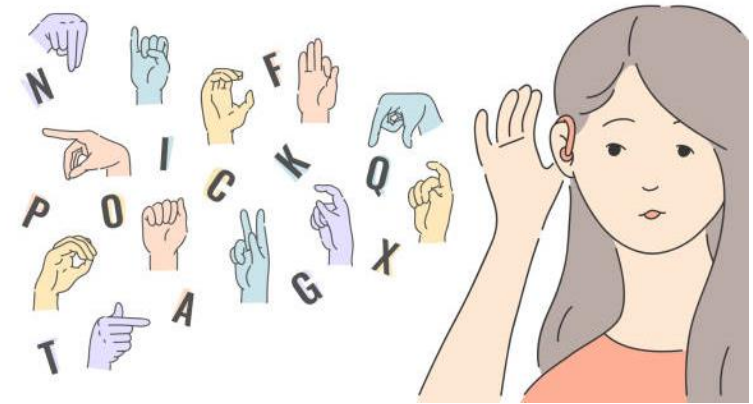
Objectives

Main Objective:

Solving issues faced by Hearing impaired people of Sri Lanka by developing an online learning platform based on Sri Lankan sign language.

Sub Objectives:

- **Sub Objective 1:** Helping hearing impaired to learn Sri Lankan sign language happily with online fun games.

- **Sub Objective 2**: Create the opportunity for deaf and mute community in Sri Lanka to learn and communicate with different types of sign languages that they are unaware of.

- **Sub Objective 3:** Helping hearing impaired to find solutions and seek answers using the systems support system.

- **Sub Objective 4:** Translation of a given video to Sri Lankan sign language to give the opportunity for a hearing-impaired person to be able to access videos to gain knowledge.

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System Overall Diagram
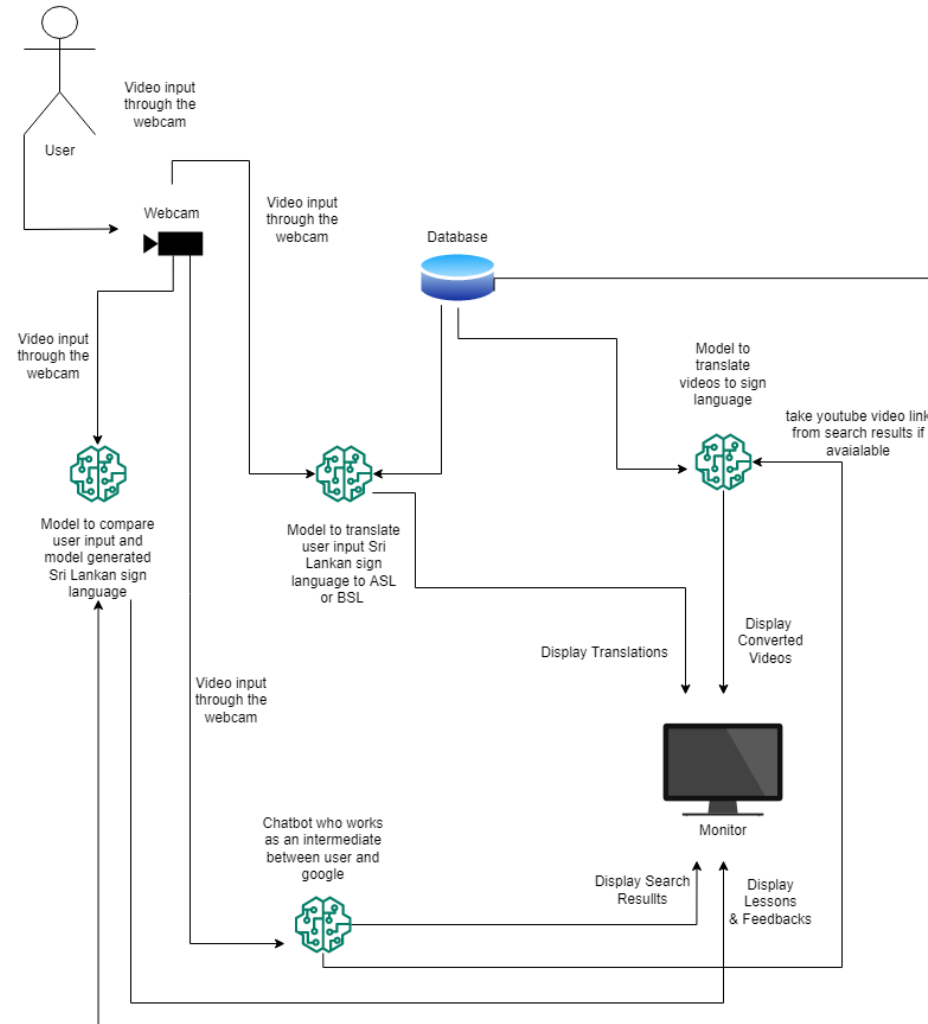
Research Gap

- Existing learning platforms are not for Sri Lankan deaf and mute community.

- Existing learning platforms use text as caption.

- Translating one dialect of sign language to another or teaching one dialect of sign language using another sign language does not exist.

Research Gap

Feature	Wanbo Li, Hang Pu, Ruijuan Wang [1]	Pinar Uluer, Neziha Akalin, Hatice Köse [2]	Fernando M. De Paula Neto [3]	SNAP – eLearning [4]	Our solution
Sign language recognition using computer vision	✓	✓	✓	✓	✓
Detect accuracy of user input gestures and provide feedback	✗	✗	✗	✓	✓
Based on real time gesture detection	✗	✓	✗	✓	✓
Ability to search and get answers in Sri Lankan sign language	✗	✗	✗	✗	✓
Based for Sri Lankan based community (Usage of Sri Lankan sign language)	✗	✗	✗	✗	✓

IT19162706 | MUNASINGHE M.W.S.S.M.T.M.B

Bachelor of Science (Hons) in Information Technology Specializing in
Data Science

Introduction

Background

- 9% of Sri Lankans suffer from hearing loss while 15% of them are completely deaf [1]
- These numbers will keep increasing as for the statistics by WHO from 131 million to 267 million by 2050 in South Asia region
- Majority of HIP does not read better than elementary level.

Research Gap

- Systems use text as caption and does not use sign language as caption

- Existing learning platforms or translations do not use emotion analysis

Research Gap Summary

Feature	Research A [3]	Research B [4]	Research C [5]	Research D [6]	Proposed system
Based on SLSL	✘	✘	✔	✘	✔
Generating captions in the form of sign language	✘	✘	✘	✘	✔
Analyzing of emotion in each video	✘	✘	✘	✘	✔

Research Questions

- How to analyze and identify emotion in a video?

- How to translate content of video to sign language?

- How to combine identified emotions and the translated sign language?

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Objectives

Specific Objective : Objective of this component is to give the opportunity for a HIP to gain knowledge through referencing videos which will be captioned in SLSL.

Sub Objectives

- Implement an algorithm to identify emotions using speech recognition.
- Implement an algorithm to map converted sign language and the identified emotions.
- Implement an algorithm to translate content to SLSL

Methodology

System Overview Diagram
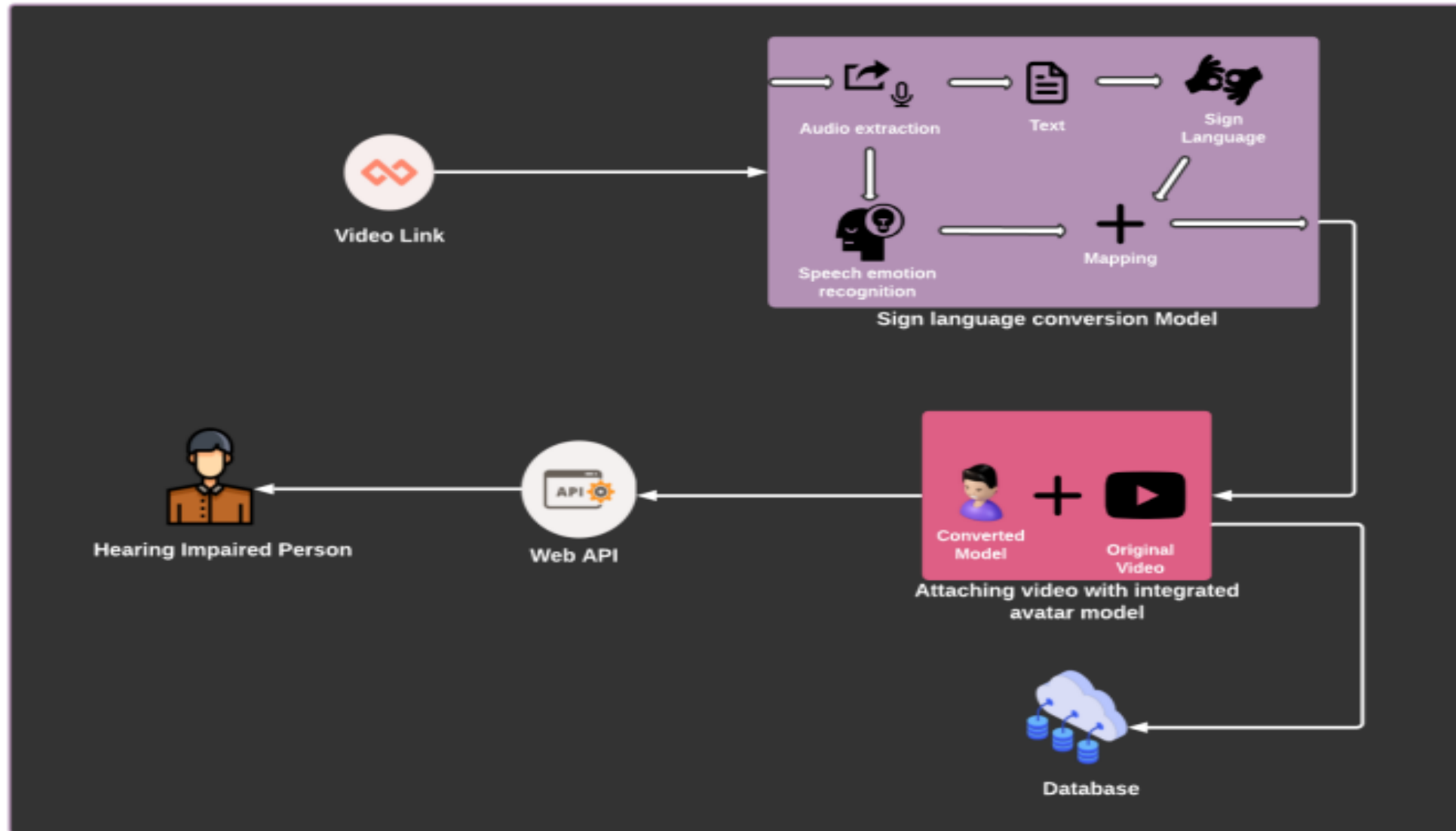
Tools, Technologies and Algorithms

Technologies
- Speech Recognition

Tools
- Speech to text conversion – Google STT module
- Emotion analysis – Python libraries (librosa , numpy , Sklearn)
- Visual Studio code as the IDE for model implementation
- Google colab – For implementation needs
- Front end – React JS

Algorithms
- Multi layer perceptron
- Mel-frequency cepstral coefficients for feature extraction
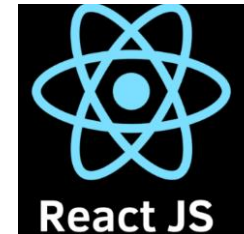
Requirements

Functional Requirements
- Ability to convert video content to SLSL
- Ability to observe facial expression from avatar.

Non-Functional Requirements
- Performance – To generate captions in SLSL in meaningful way where the user can understand it correctly.
- Usability – System should be easy to understand and use for the users who are going to use the system
- Accuracy – Generated captions and the associated facial expressions should be accurate and relevant with the used video.

User Requirements
- HIP person should be able to see the video content in SLSL.
- HIP should be able to understand the emotion while looking at the content in SLSL.

Work breakdown Structure

Gannt Chart

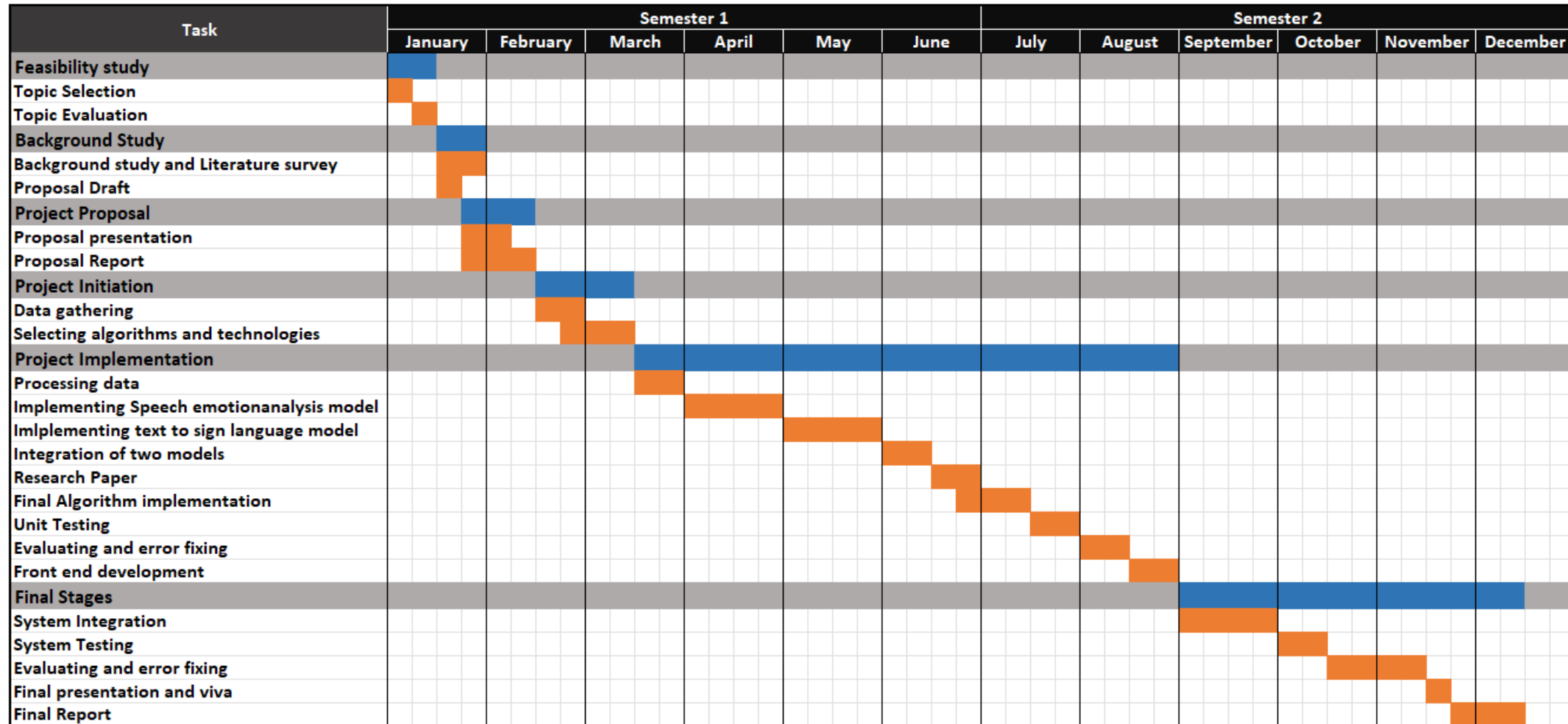| Task	Semester 1						Semester 2					
	January	February	March	April	May	June	July	August	September	October	November	December
Feasibility study	■											
Topic Selection	■											
Topic Evaluation	■											
Background Study		■										
Background study and Literature survey		■										
Proposal Draft		■										
Project Proposal		■										
Proposal presentation		■										
Proposal Report		■										
Project Initiation			■									
Data gathering			■									
Selecting algorithms and technologies			■									
Project Implementation				■	■	■	■	■				
Processing data				■								
Implementing Speech emotionanalysis model					■							
Imlplementing text to sign language model						■						
Integration of two models						■						
Research Paper							■					
Final Algorithm implementation							■					
Unit Testing							■					
Evaluating and error fixing								■				
Front end development								■				
Final Stages									■	■	■	
System Integration									■			
System Testing										■		
Evaluating and error fixing										■		
Final presentation and viva											■	
Final Report												■

Commercialization

- This specific feature has the potential to be integrated into any educational system as an accessibility feature.

- This could be introduced to universities and educational institutes that would allow universities to expand their educational services to the deaf and mute as well combined with other accessibility features.

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Lanka", p. Single, 2019. [Online]. Available: https://www.ft.lk/Opinion-andIssues/Sinhala-Sign-Language-the-main-communication-mode-for-the-Deaf-in-SriLanka/14-67107

[2] J. Elfein, "Statista," 11 June 2020. [Online]. Available:

https://www.statista.com/statistics/888654/number-of-people-with-hearingloss-worldwide-projections-by-region/.

[3] J. R. Ferreira Brega, I. A. Rodello, D. R. Colombo Dias, V. F. Martins and M. de Paiva Guimarães, "A virtual reality environment to support chat rooms for hearing impaired and to teach Brazilian Sign Language (LIBRAS)," 2014 IEEE/ACS 11th International Conference on Computer Systems and Applications (AICCSA), 2014, pp. 433-440, Available: 10.1109/AICCSA.2014.7073231.

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[5] K. Fernando and H. Wickramarathne, 2018, August. "Sri Lankan Sign Language Tutor," presented at 1st International Conference on Business Innovation 2018.

[6] N. Krishnamoorthy, A. Raveendran, P. Vadiveswaran, S. R. Arulraj, K. Manathunga and S. Siriwardana, "E-Learning Platform for Hearing Impaired Students," 2021 3rd International Conference on Advancements in Computing (ICAC), 2021, pp. 122-127, doi: 10.1109/ICAC54203.2021.9671113.

IT19153346 | MADDUGODA C.D

Bachelor of Science (Hons) in Information Technology Specializing in Data Science

Introduction

Background

Learning with game-based approach is popular among kids around the world

There are two types of signs in every Sign language

Static sign

Dynamic sign

Research Gap

- Most learning platforms are not based on SLSL

- The few platforms that are available for SLSL are mostly focused on SLSL to voice and voice to SLSL translation.

➢"Wadhan" application

➢"Nihanda Ridma"

➢"Sawadana" mobile application

Research Gap

- knowledge evaluation is not available in any of the online learning platforms

➢Online learning platform "Nihanda"

➢E-learning platform for hearing impaired students: "Snap E-Learning"

Research Gap Summary

Feature	Based on SLSL	dynamic detection of sign language enabled	Detect if the answer given is correct	Provides feedback on the answer	learning platform	Exists an avatar with expressive emotions
Wadan	✓	✗	✗	✗	✗	✗
Nihanda Ridma	✓	✓	✗	✗	✗	✗
Sawadana	✓	✗	✗	✗	✗	✗
Nihanda	✓	✓	✗	✗	✓	✗
snap e-learning	✗	✓	✗	✗	✓	✗
E-learning system for ISL	✗	✓	✓	✗	✓	✗
Proposed system	✓	✓	✓	✓	✓	✓

Objectives

Specific Objective : The objective of teaching research component is to provide a game-based teaching component with evaluations at each level to check if the user has grabbed the content as expected

Sub Objectives

- To make learning of SLSL interesting to kids through game-based approach

- To pay individual attention to each child in learning

- To help the child/user identify their mistakes by evaluating the user and providing feedback on what percentage they got correct for each question and what has to be corrected at the end of each level in the game

- To encourage child/user to provide completely correct answers by avatar with expressive emotions.

Methodology

System Overview Diagram
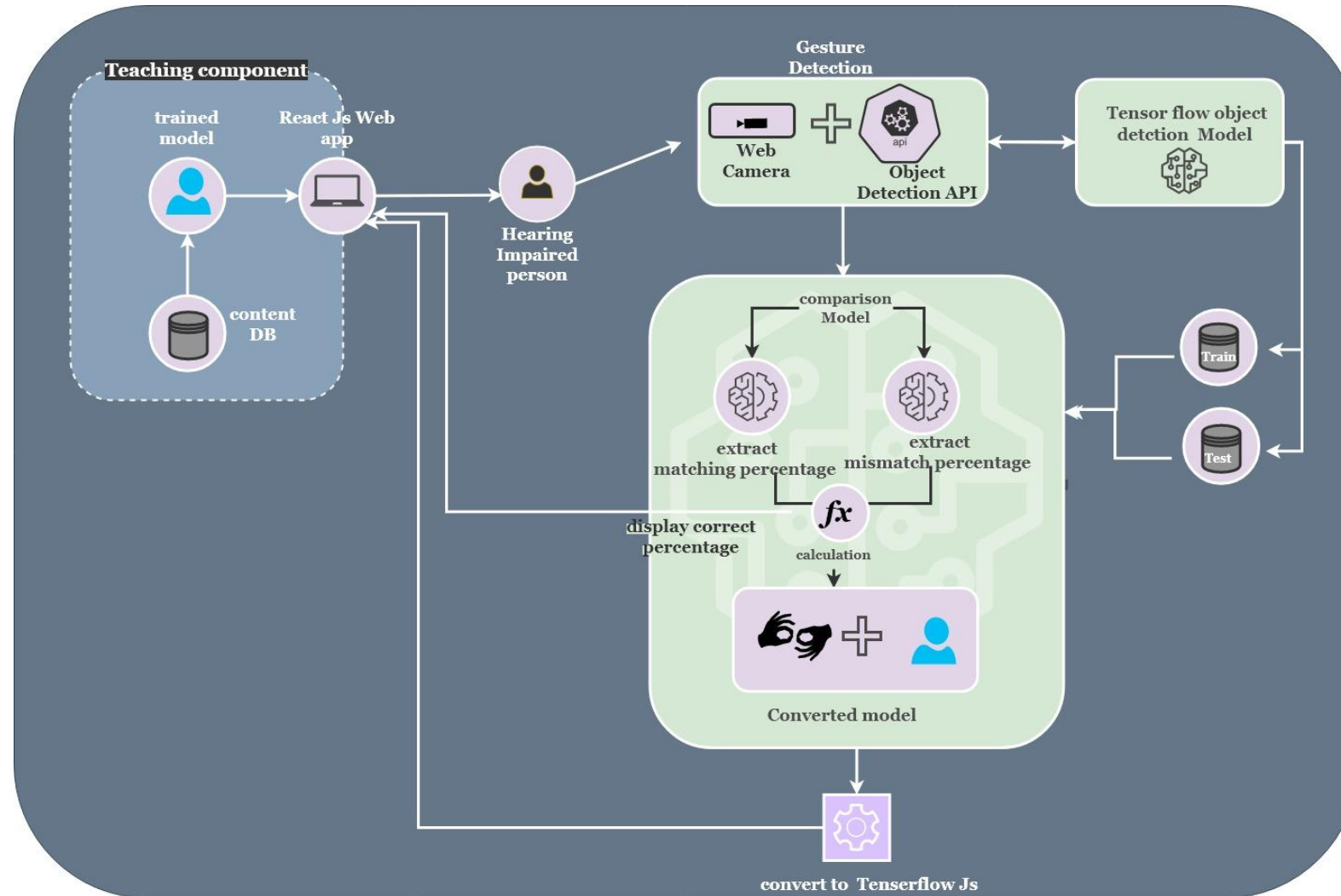
Tools and Technologies

Technology stack:

- Object detection -Tensor flow
- Video processing -OpenCv
- Version controlling-GIT
- Frontend-ReactJs

Programming Languages:

- Python

Tools:

- Google Colab
- Cuda Toolkit
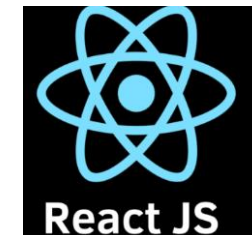
Requirements

Functional Requirements

- Teaching SLSL using the avatar
- Detect the answer using the webcam
- Display the correct percentage, fault part in the answer and correct answer in SLSL

Non-Functional Requirements

- User friendly interface
- Avatar with expressive emotions to encourage answering
- Fast loading of the web page and sign language display(teaching) without any lag

Work Breakdown Structure

Gantt Chart

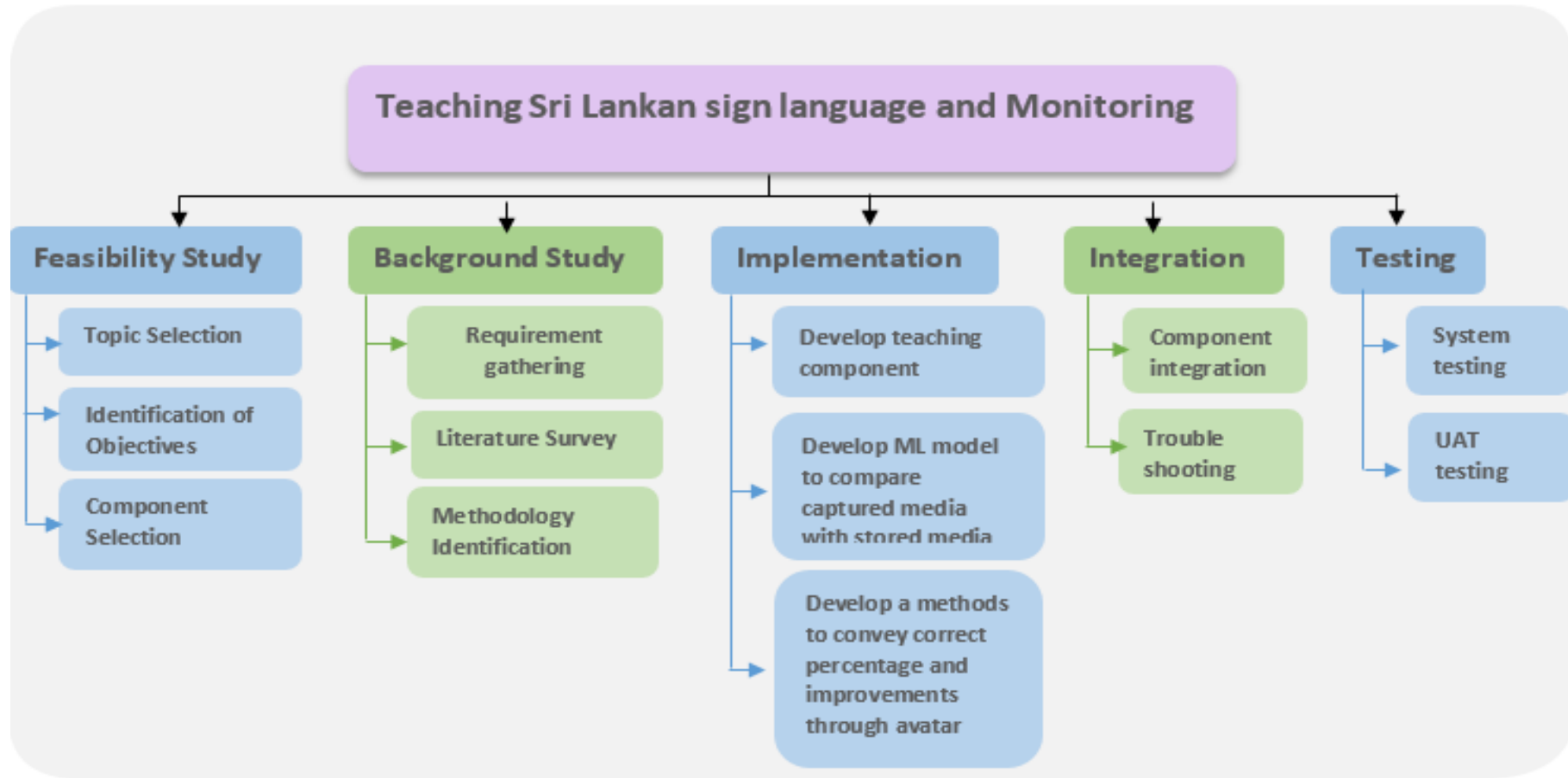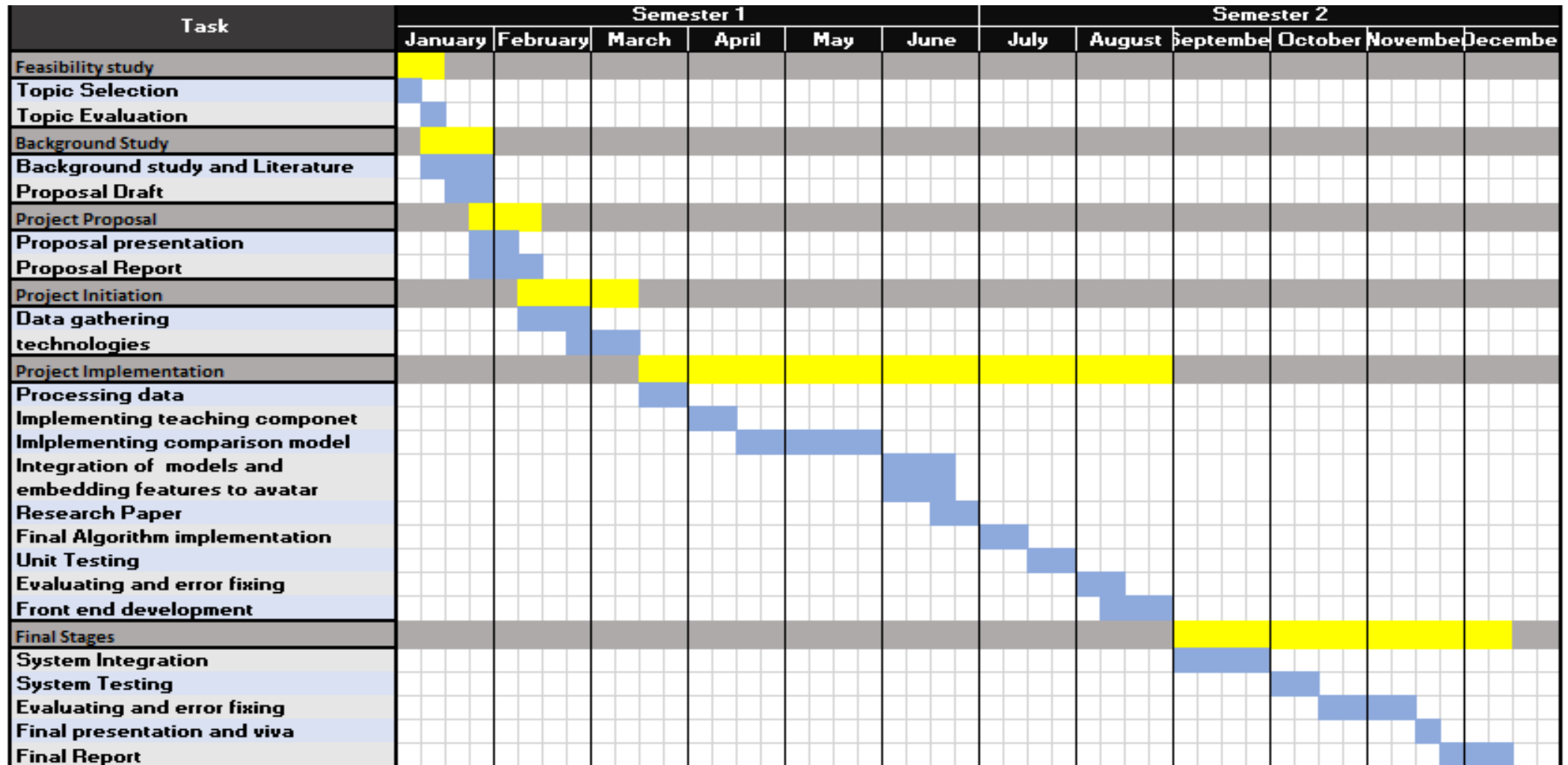| Task	Semester 1						Semester 2					
	January	February	March	April	May	June	July	August	September	October	November	December
Feasibility study	■											
Topic Selection												
Topic Evaluation												
Background Study	■											
Background study and Literature												
Proposal Draft												
Project Proposal		■										
Proposal presentation												
Proposal Report												
Project Initiation			■									
Data gathering												
technologies												
Project Implementation				■	■	■	■	■				
Processing data												
Implementing teaching componet												
Imlplementing comparison model												
Integration of models and embedding features to avatar												
Research Paper												
Final Algorithm implementation												
Unit Testing												
Evaluating and error fixing												
Front end development												
Final Stages									■	■	■	■
System Integration												
System Testing												
Evaluating and error fixing												
Final presentation and viva												
Final Report												

Commercialization

- Online learning platforms for kids are popular

- Game based approach and Avatar with expressive emotions grabs the child attention

- System will be adversited through welfare organizations

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[1] D. Dewasurendra, A. Kumar, I. Perera, D. Jayasena and S. Thelijjagoda, "Emergency Communication Application for Speech and Hearing-Impaired Citizens," 2020 From Innovation to Impact (FITI), 2020, pp. 1-6, doi: 10.1109/FITI52050.2020.9424899.

[2] Kulaveerasingam, N., Wellage, S., Samarawickrama, H., Perera, W., & Yasas, J. (2014). "The Rhythm of Silence" - Gesture Based Intercommunication Platform for Hearing-impaired People (Nihanda Ridma).

[3] Y. Perera, N. Jayalath, S. Tissera, O. Bandara and S. Thelijjagoda, "Intelligent mobile assistant for hearing impairers to interact with the society in Sinhala language," 2017 11th International Conference on Software, Knowledge, Information Management and Applications (SKIMA), 2017, pp. 1-7, doi: 10.1109/SKIMA.2017.8294116.

[4] N. Krishnamoorthy, A. Raveendran, P. Vadiveswaran, S. R. Arulraj, K. Manathunga and S. Siriwardana, "E-Learning Platform for Hearing Impaired Students," 2021 3rd International Conference on Advancements in Computing (ICAC), 2021, pp. 122-127, doi: 10.1109/ICAC54203.2021.9671113.

IT19174686 | RAMAWICKRAMA H.N

Bachelor of Science (Hons) in Information Technology Specializing in Data Science

Introduction

Background

- There is no universally accepted sign language worldwide.

- Sign language vary across countries.

- Majority of the hearing-impaired communities lacks communication due to the absence of knowledge on other sign languages.

- Lack of access to learn sign language due to economic limitations.

- Enhancing the knowledge on a foreign sign language may increase opportunities to communicate.

Research Gap

- Systems that are been implemented for one particular sign language cannot be directly used to understand another.

- Most of the existing systems were implemented to translate from a sign language to a spoken language or vice versa.

- Need for a system that can translate SSL to a non-native sign language.

Research Gap Summary

	Conversion of natural language(text/audio) to sign language	Conversion of sign language to natural language (text/audio)	Translation of one sign language to another	Based on SSL	Computer Vision based approach
Utalk: Sri Lankan Sign Language Converter Mobile App [1]	✗	✓	✗	✓	✓
Static Sign Language Recognition Using Deep Learning. [2]	✗	✓	✗	✗	✓
Sanwadha: Mobile Assistant for Hearing Impairers. [3]	✓	✗	✗	✓	✓
A Machine Translation System from English to American Sign Language. [4]	✓	✗	✗	✗	✓
EasyTalk: A Translator for Sri Lankan Sign Language. [5]	✓	✓	✗	✓	✓
Proposed System	✓	✓	✓	✓	✓

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Research Questions

- How to recognize a hand gesture?

- How to convert a hand sign gesture to a text format?

- How to translate a text to a selected sign language?

Objectives

> • **Specific Objective :** Create a system to translate SSL into ASL/BSL
>
> **Sub Objectives**
>
> • Real time gesture recognition.
>
> • Convert the detected image into a binary image.
>
> • Build a model and train to identify the hand gestures.
>
> • Recognize hand gesture and converting into text format .
>
> • Convert the identified text into ASL/BSL.

Methodology

System Overview Diagram
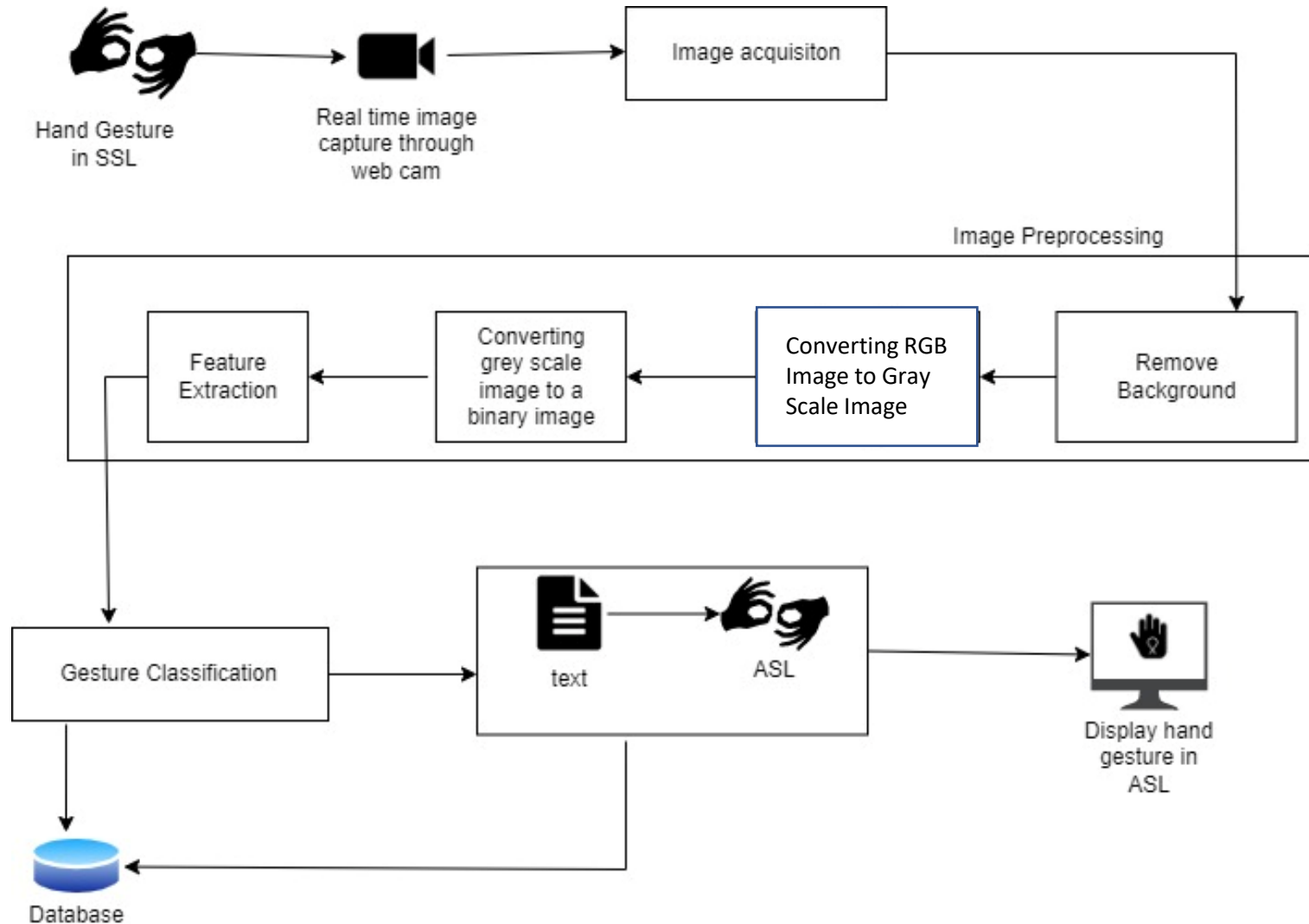
Methodology

- Using the web camera to capture the hand gesture.

- Background removal

- Transforming image into a grayscale and then to a binary image.

- Resizing the image by scaling into relevant pixel values to extract the sufficient features.

- Labelling the images and creating XML files for each image.

Methodology

- Dividing the XML files into training data and validating data.

- Building a CNN model

- Training and classifying images.

- Retrieve the corresponding hand gesture in ASL for the text output from a predefined database.

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Tools, Technologies and Algorithms

Technologies

- Image processing

Tools

- Image processing - Python and Open CV
- Labelling images - LabelImg tool
- Building the CNN model –Tensorflow and Keras

Algorithm

- Training and classifying images -Convolutional Neural network(CNN)
- Color space conversion Algorithms
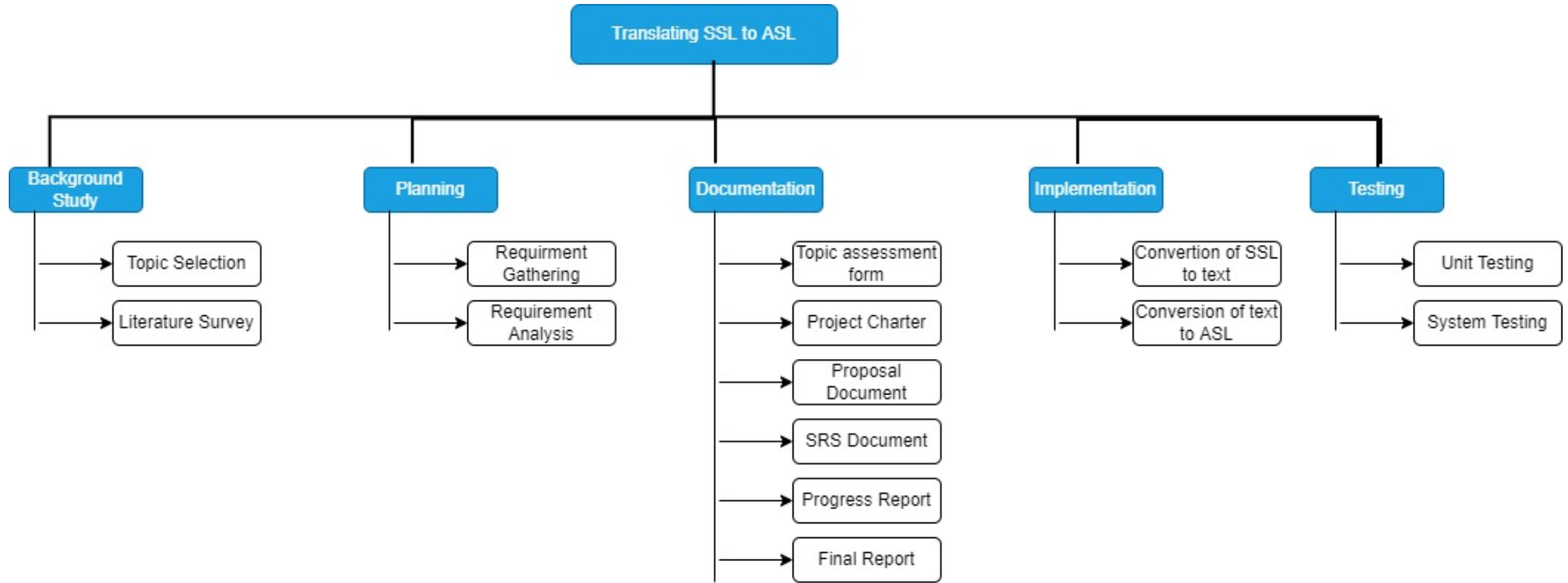 - HSV – Background removal

Requirements

Functional Requirements
- Identifying the correct hand gestures
- Converting the input hand gesture in SSL into text format.
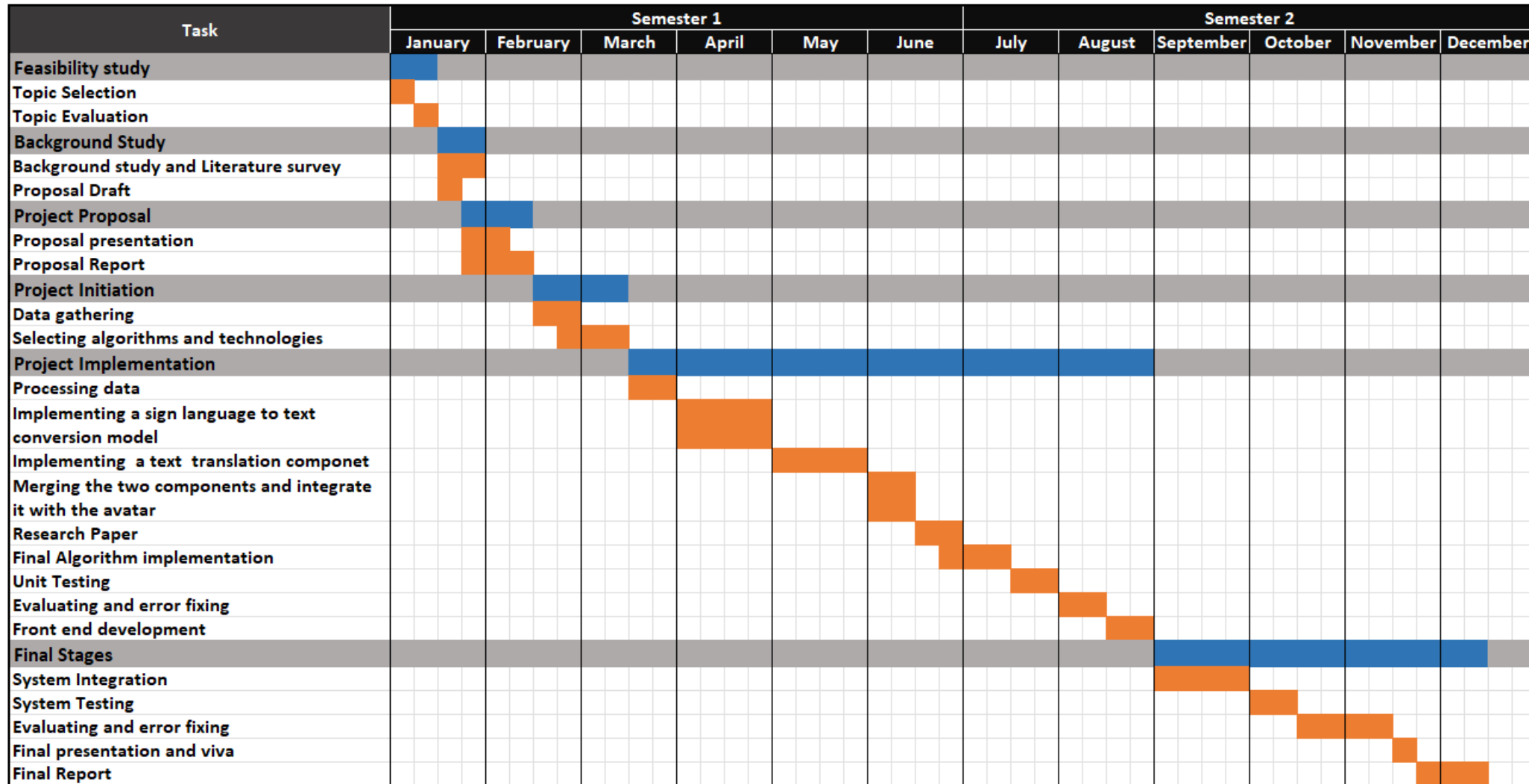- Converting the relevant text into ASL/BSL.

Non-Functional Requirements
- Accuracy
- Usability
- Reliability
- Availability

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Work breakdown Structure

Gannt Chart

Task	Semester 1						Semester 2					
	January	February	March	April	May	June	July	August	September	October	November	December
Feasibility study	■											
Topic Selection	■											
Topic Evaluation	■											
Background Study		■										
Background study and Literature survey		■										
Proposal Draft												
Project Proposal		■										
Proposal presentation		■										
Proposal Report		■										
Project Initiation			■									
Data gathering			■									
Selecting algorithms and technologies			■									
Project Implementation				■	■	■	■	■				
Processing data			■									
Implementing a sign language to text conversion model				■								
Implementing a text translation componet					■							
Merging the two components and integrate it with the avatar						■						
Research Paper						■						
Final Algorithm implementation							■					
Unit Testing							■					
Evaluating and error fixing								■				
Front end development								■				
Final Stages									■	■	■	■
System Integration									■			
System Testing										■		
Evaluating and error fixing										■	■	
Final presentation and viva											■	
Final Report												■

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Commercialization

- Enhance communication opportunities with a wide range of people even in a different geographical location.

- Access information that could be off-limit due to language limitations.

- Access to more carrier opportunities.

References

[1] I. S. M. Dissanayake, P. J. Wickramanayake, M. A. S. Mudunkotuwa and P. W. N. Fernando, "Utalk: Sri Lankan Sign Language Converter Mobile App using Image Processing and Machine Learning," 2020 2nd International Conference on Advancements in Computing (ICAC), 2020, pp. 31-36, doi: 10.1109/ICAC51239.2020.9357300.
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 Available: http://www.ijmlc.org/vol9/879-L0320.pdf

[3] Y. Perera, N. Jayalath, S. Tissera, O. Bandara and S. Thelijjagoda, "Intelligent mobile assistant for hearing impairers to interact with the society in Sinhala language," 2017 11th International Conference on Software, Knowledge, Information Management and Applications (SKIMA), 2017, pp. 1-7, doi: 10.1109/SKIMA.2017.8294116.
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Available: https://ieeexplore.ieee.org/document/9357154

IT19201160 | WANASINGHE W. A. D. B.

Bachelor of Science (Hons) in Information Technology Specializing in
Data Science

Introduction

Background

- Interacting with Google Search service to give user to search and hard for since google search is not supported for Sign Language

- Majority of HIP users are not interacting with Google Search or any other digital services.

- Learning methods are very low for Hearing Impaired people and then engage with digital services for learning purposes also very low

Research Gap

- Most learning platforms are not based on SLSL
- Sign language Chatbots are existing but not as an intermediate between Google and User
- Again the existing Chatbots are not return results through Sign Language.
- Any Sign language learning platform does not offer Chatbot service to find and learn through google

Research Gap Summary

Feature	Based on SLSL	Sign Langugae identifying dynamically	Text Content to Sign Language	Search on Google and return results in Sign Language	learning platform	3D Avatar model with Expressive Emotions
Wadan	✓	✗	✓	✗	✗	✗
Nihanda Ridma	✓	✓	✓	✗	✗	✗
Sawadana	✓	✗	✓	✗	✗	✗
Nihanda	✓	✓	✓	✗	✓	✗
snap e-learning	✗	✓	✓	✗	✓	✗
E-learning system for ISL	✗	✓	✓	✗	✓	✗
Proposed system	✓	✓	✓	✓	✓	✓

Research Questions

- How to identify user's query and search through

Google?

- How to identify title of search results and bundle it with 10 results together in each time to present to the user?

- How to automatically navigate and read content in Google and web pages?

Objectives

Specific Objective : The objective of letting user to learn through Google easily by using Google search service
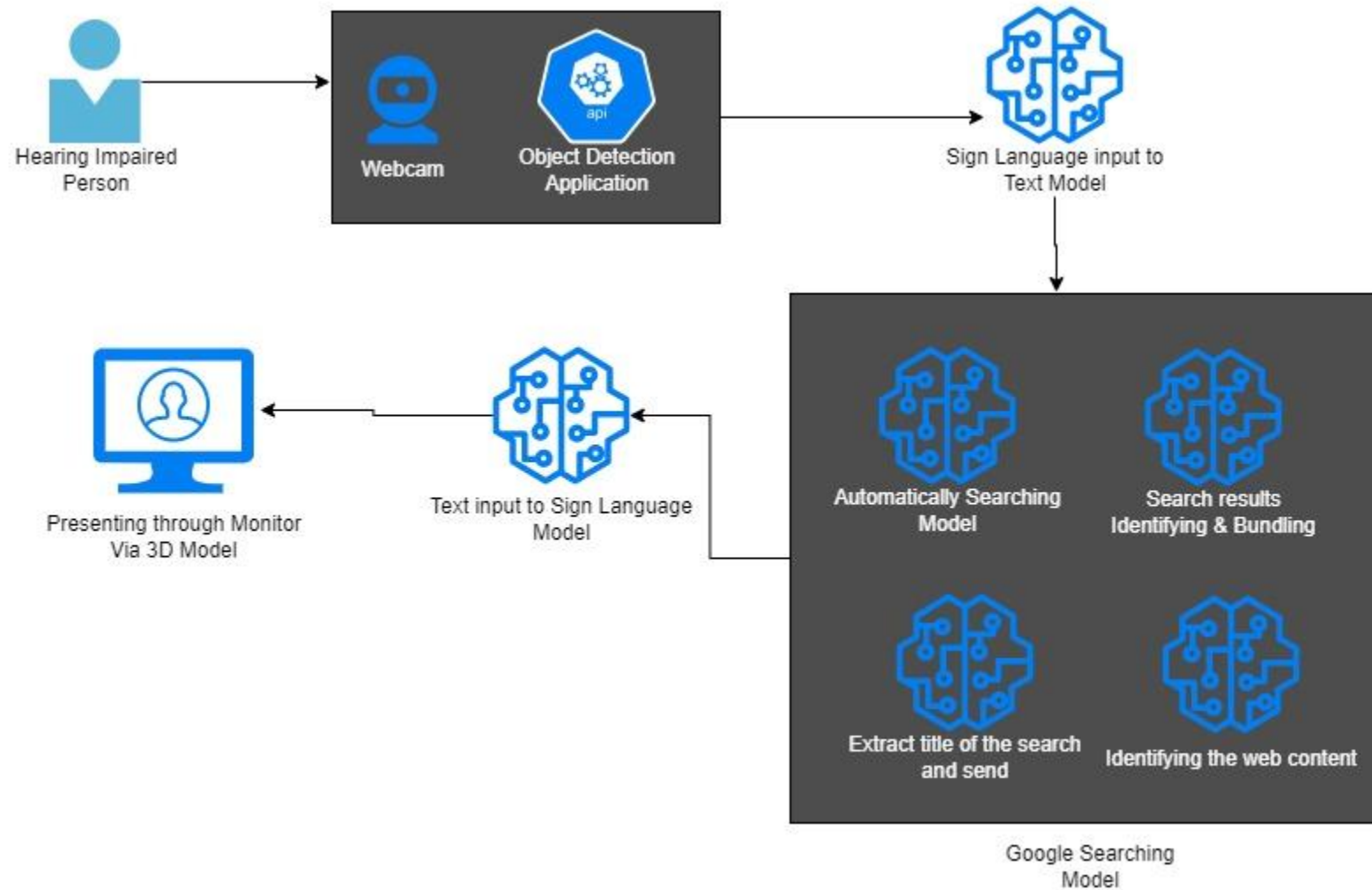
Sub Objectives

• To make the scope wider to the user in the learning process.

• Engage with the digital world easily and gain the new knowledge

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Methodology

System Overview Diagram
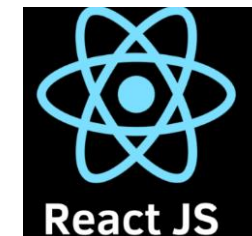
Tools and Technologies

Technology stack:

- Object detection -Tensor flow

- Video processing - OpenCv

- Version controlling-GIT

- 3D Avatar Model - Maya

- Frontend-ReactJs

Programming Languages:

- Python

Tools:

- Google Colab

- Cuda Toolkit

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Requirements

Functional Requirements

- Identifying Sign Language and converts it into the text
- Search through Google search and identify title of search results
- Present first 10 results to user through sign language
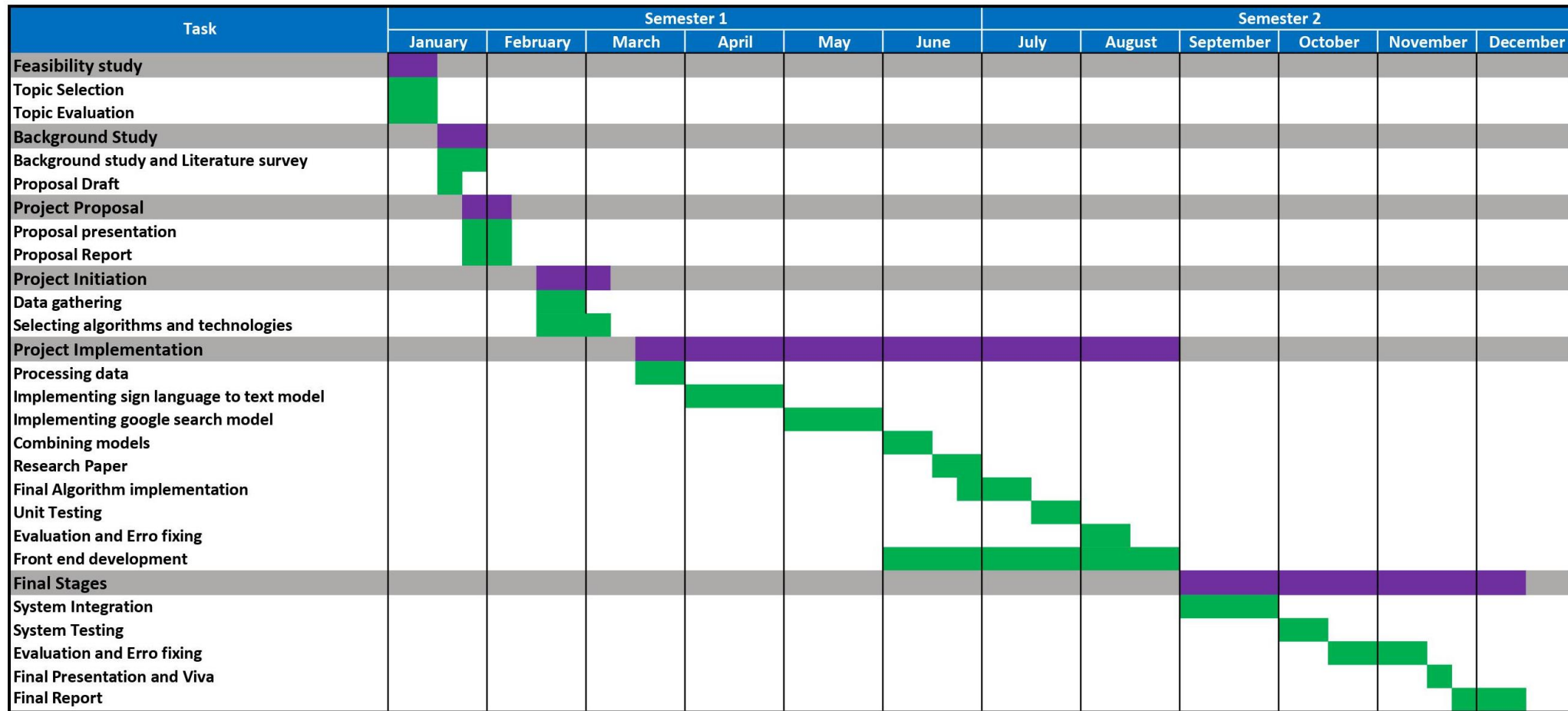- Read web content

Non-Functional Requirements

- User friendly UI/UX
- Fast process to identify search results and web content then convert it into Sign language
- 3D Avatar model having accurate movements

Work Breakdown Structure

Gantt Chart

Task	Semester 1						Semester 2					
	January	February	March	April	May	June	July	August	September	October	November	December
Feasibility study												
Topic Selection												
Topic Evaluation												
Background Study												
Background study and Literature survey												
Proposal Draft												
Project Proposal												
Proposal presentation												
Proposal Report												
Project Initiation												
Data gathering												
Selecting algorithms and technologies												
Project Implementation												
Processing data												
Implementing sign language to text model												
Implementing google search model												
Combining models												
Research Paper												
Final Algorithm implementation												
Unit Testing												
Evaluation and Erro fixing												
Front end development												
Final Stages												
System Integration												
System Testing												
Evaluation and Erro fixing												
Final Presentation and Viva												
Final Report												

IT19201160 | Wanasinghe W. A. D. B. | 2022-059

Commercialization

- It is rare to find tools that use for Google search with Sign Language
- Attractive 3D avatar model to present Sign Language and that makes HIP users to identify content correctly

References

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