E-LEARNING SYSTEM FOR HEARING IMPAIRED STUDENTS

Project ID: 2021-176

Project Proposal Report

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Bachelor of Science (Hons) Degree in Information Technology Specializing in Software Engineering

Department of Computer Science and Software Engineering

Faculty of Computing

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Supervised by – Miss. Janani Tharmaseelan

Bachelor of Science (Hons) Degree in Information Technology
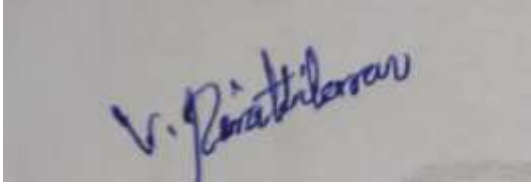Specializing in Software Engineering

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Declaration

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

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

Name of supervisor: Ms. Janani Tharmaseelan

Name of co-supervisor: Ms. Samanthi Erang Siriwardene

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Signature of the Supervisor: Date

(Ms. Janani Tharmaseelan)

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Signature of the co-supervisor: Date

(Ms. Samanthi Erang Siriwardene)

Abstract

During this pandemic due to COVID-19, most of the people have transferred to digital life especially education system from learning to e-learning. According to survey and research the better way of communicate with the hearing impaired people is sign language. The current pandemic situation gave more challenges to the deaf and dumb students to learn. In the past decades most of the researchers mainly focusing to ensure hearing impaired people without help from others can use an automatic interpretation of sign languages. The hearing impaired people can communicate themselves but cannot communicate with ordinary people, this is the barrier for both the community. The proposed system aims to make dual-way communication between hearing impaired and ordinary civilians.

The suggested system would create a video in sign language using machine language, video processing and Natural language processing. Pre-processing, skin segmentation, feature extracting, classification for recognizing the hand gestures. First students uploads doubt and question videos on particular forums system check the quality of the video and allow them to upload. The next step is, system convert video into the frame by frame image and detect the hand gestures and according to the hand, gestures make text format and fine-tune and make it meaning full sentence vice versa. It will make two-way communication and break the barriers between deaf-dumb and normal people.

Keywords: *Machine Learning, Video Processing, American sign language, deaf and dumb.*

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LIST OF ABBREVIATIONS

Abbreviations	Description
LMS	Learning Management System
WHO	World Health Organization
ASL	American Sign Language
ISL	Indian Sign Language
BSL	British sign language

1. INTRODUCTION

Background Study

Deaf and dumb people should only communicate by sign language. Deaf and dumb community can have communication between themselves but, when communicating with ordinary people, it is challenging for them. Each country has unique sign languages. The most popular languages are ISL, ASL, and BSL. Sign language using hand gestures and facial expression. ASL uses one hand gestures and the face to recognize the sign language. WHO conducted a survey, in that survey above 6% of the world's population are hearing impaired persons. In March 2018 hearing impaired persons were around 466 million, and it will increase to about 900 million by 2050 [8].

Sign language recognition is one of the most popular research topics nowadays. Many new innovations have been implemented in this field. We have to develop a proper system to use by the deaf and dumb community. It needs to be more user-friendly and straightforward. When comes to E-learning concept for the deaf and dumb student it is necessary to have a good system to educated their studies. Only a few institutions have e-learning method for deaf and dumb student because it will cost them. However, we should take the responsibility to create a standard e-learning platform for them [6]. In common techniques are used to detect sign language vision-based and sensor-based glove approaches are main [4, 9]. The user should wear gloves to the hand when using the sensor-based technique. Gloves are used to transport cables and sensors that are connected to the computer. However, gloves are still expensive, difficult to use, and not a portable system. In a vision-based approach work on taking images by the camera. It is common for users can have this facility to use the system. This approach overcomes the glove based problem. The acquisition, segmentation, filtering, representation, and classification of hand gestures are all part of the vision-based system [9].

In our research, we provide LMS try to solve all issue on the existing system for the deaf and dumb students' community. Common LMS always allow making two-way communication. Therefore in the deaf and dumb LMS also we should provide two-way communication. In our system student can ask a question through sign language and it will convert into text format also tutor can teach the lectures it will convert into sign language. Above the method, the deaf and dumb student can communicate with a tutor. The tutor also directly communicate with the deaf and dumb student without any interpreter.

In our research, we are developing an ASL e-learning platform. Figure 1.1.1 represents the alphabet letters of ASL and this is mostly to use one hand gestures to do communication. All hand gestures are unique possess. Our goal is for deaf and dumb students can be asking questions through our system and get a reply, then they can clarify their doubts.

Figure 1.1.1 – alphabet letters of ASL

1.1   Literature survey

Essentially conducting the literature survey for finding out existing researches have any similar functionalities and techniques, through that we can get clear understanding our system and find out research gaps and research problem. Here some most vital researches are analyzed.

In 2016, A. Mishra and A. Sood, in their paper *"AAWAAZ: A communication system for deaf and dumb."* [1] In their paper, a proposal a framework to reduce the gap between hearing impaired community and us using recognizing hand gestures. Their approaches were first to take an image applying skin segmentation using Hue-Saturation-value (HSV) histogram and finding edges detection. The other component is to feature extracting with help of Harris algorithm. By the following step feature matching and recognition, here calculating the minimum value of the matrix. In our research field, we can use the skin segmentation method to find a skin region on the image. It detects hand gestures.

In 2015, K. Raju K , S. A. Swamy B , K. Dutta, and S A. Kumar G.S, in their paper *"Double-handed Indian Sign Language to speech and text"* [2] proposed a system that detects both hands sign language gestures into written and spoken language. Here they used MATLAB to process image. In this paper, the Min Eigenvalue algorithm applied to extracting the interesting points, the extracted features are stored because it utilizes less space and computational will be smaller. Here, using a web camera of 5mp for reducing noise and artifacts. After analyzed, we can use the extracted feature for consuming limited space and using a quality web camera to decrease the level of noise and artifacts.

In 2012, S. Khupase, A. S. Ghotkar, R. Khatal, S. Asati and M. Hadap, in their paper "Hand gesture recognition for Indian Sign Language" [3]. The proposed system focusing on recognize ASL alphabets and double-handed gestures for deaf and dumb people. The four main components of their system are hand gesture component, hands segmentation component, real time hands track component, and features extract component. For their major four components, they used algorithms and methods. The

hand tracking gestures and segmentation were identified using the camshift (camelcase) method, and the saturation and hue, and intensity-HSV colour model. Then they have used a Genetic Algorithm to do the gesture recognition. Through this research paper, I can modify and use the Genetic algorithm to do gestures recognition.

In 2017, U. Gawande and S. Rathi in their paper *"Development of full duplex intelligent communication system for deaf and dumb people"* [4]. The suggested system aims to enable dual way communication among deaf-mutes & hearing persons. But this research identify some issues on dynamic hand gestures that give the same meaning. It is also challenging on this researches. Pre-processing, division, feature extraction, and classification are the techniques they used. Video pre-processing used Gaussian low for avoiding high-frequency noise from input images. Segmentation applied because of finding hand gestures regions from the image area. Feature extraction purpose they used Eigenvalues and Eigenvectors. Classification is used to recognize hand gestures using the Eigenvalue and Eigenvector. Through this research, we can use the classification stage to use it on our system.

In 2015, P. B. Warale, P. G. Ahire, K. B. Tilekar and T. A. Jawake "*Two Way Communicator between Deaf and Dumb People and Normal People*" [10]. The suggested system aims to enable hearing impaired and the general public should communicate in two directions. Here two different component were used. The first one was getting input from the native language and it mapping with relevant sign gestures image and it will convert as animated gestures. The second component was a real-time video of sign language that would be mapped to related text and converted into human-understandable speech. Using google text-to-speech API to translate text from speech In my future work, I can use the text to speech conversion method.

1.3   Research Gap

Students who are deaf and dumb have not yet fully utilized ways to voice their doubts. The existing system developed this feature but not a proper development and not user friendly. Still in the LMS, this feature is lacking. Only if students ask questions then only they can understand the lectures and clarify their doubts. In my part of the research, I'm mainly focusing on it and make a proper feature for the ask question scenario.

Two-way communication is not yet in use in the e-learning platform. The existing system developed this feature but, it should improve a lot. In our search, we are mainly considering the two-way communication between deaf-dumb and tutor. Then only we can provide a better solution for the deaf and dumb community to use this LMS. Deaf and dumb students should ask a question in sign language, which will be converted into text for the tutor to understand, and the tutor's response will be converted back into sign language. These systems allow for two-way communication on our LMS.

Paper	Tasks	Limitation	Our system
[12]	Using Two-way hand gesture	Developed but Not accuracy	Yes Accuracy level High
[2]	Sign language gestures detect word	Only detect Letters and Numbers	Yes Detect word and letters also
[3]	Make Two way communication	Developed but Cannot used in e-Learning Platform	Yes We using two way communication
[11]	Easy to use	Only using glove can detect sign language	Yes Without glove using video only

Table 1.3.1: Some of the previous researches' gaps

1.4   Research Problem

My research first problem is the tutor cannot understand sign language. In our LMS's tutors cannot understand any sign languages. However, tutors should understand the deaf and dumb students question and doubts. Then the tutor can explain it. Otherwise, there is a barrier between student and tutor. We overcome this issue by convert sign language into text and make a meaningful sentence. Figure 1.4.1 represents our survey, it shows the majority of responses want to clarifying doubts using sign language.

All around the world, each country has unique sign languages and own action also. It differs from each country. The main problem is when we creating LMS it is very difficult to develop all sign languages are out there. We can be focusing on one sign language. In our LMS we use the ASL.
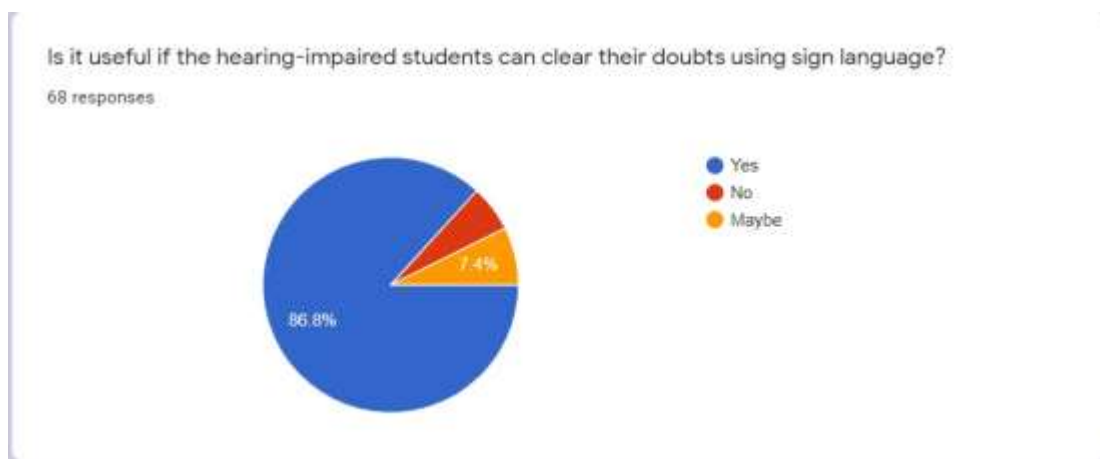

Is it useful if the hearing-impaired students can clear their doubts using sign language?

68 responses

● Yes
● No
● Maybe

86.8%

7.4%

Figure 1.4.1 – Illustration of the survey

2. OBJECTIVES

2.1   Main Objectives

The goal of this proposed system is to find a better solution to the hearing impaired community to communicate with a normal persons without the use of an interpreter. Mostly e-learning platform deaf and mute students want to interact, ask questions and clarify the doubt using sign language. The goal is to students' sign language video recognize, convert them into text and fine-tune to the native language. It makes tutors can understand the students' requirements.

2.2   Specific Objectives

The following sub-goals are the first step in achieving the principal objectives.

1. Do the preprocessing video and get frame by frame.

2. Removal of background and objects

3. Convert Image in binary form.

4. Feature Extraction

5. Recognize text and fine tune to native language.

3. METHODOLOGY

In our research, my basic functionality is to convert sign language into text and make a meaningful sentence. Deaf and dumb student can ask questions by uploading their questions as a video file. Then the system saves the video and does the relevant steps. The first system does video pre-processing. In the video pre-processing has three steps. The first step is converting the video into a frame by frame image, the second step is to adjust the contrast and the final step is to resize the image. After video pre-processing image background removal, the next step is to convert the image in binary form, the following step is the feature extraction, and the later step is to do the gesture recognition and finally taking output text, fine-tune and save it into the database.
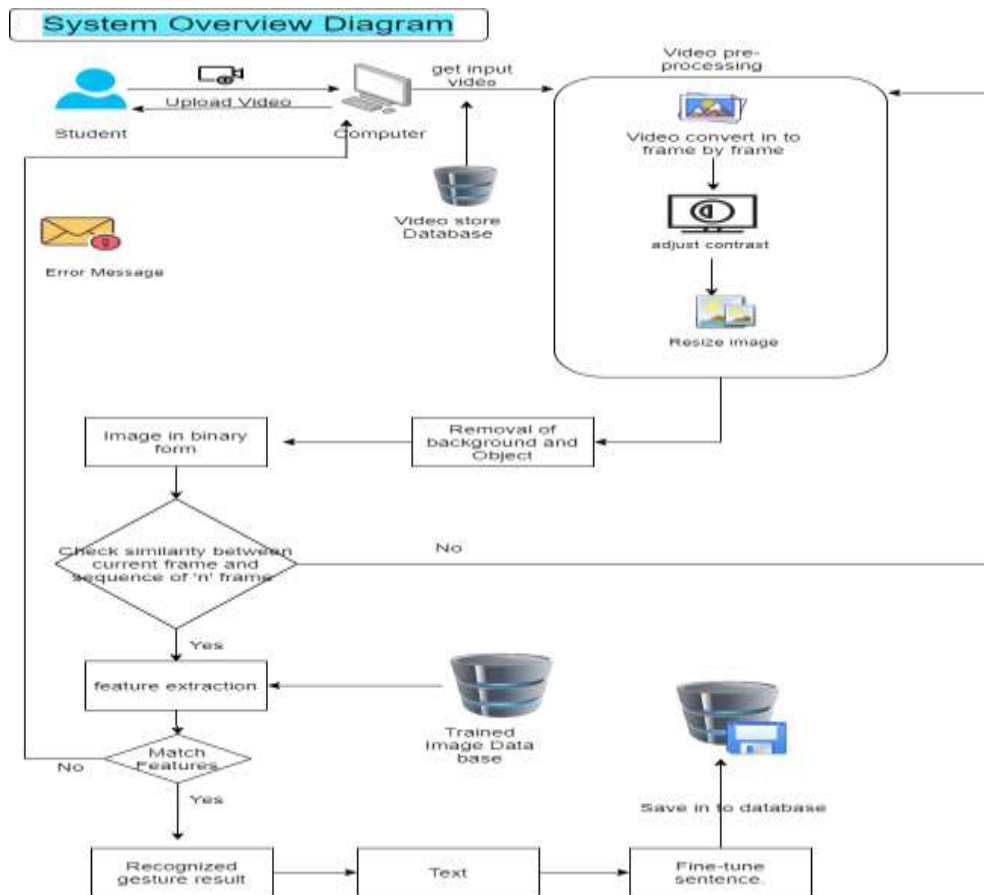
3.1   System Diagram

Figure 3.1.1 – Illustration of the system overview

3.2 Video pre-processing

This is contains three sub processing. Converting video to a frame-by-frame format, adjusting contrast, and resizing images are all examples of sub processing. First of all, the system taking video from the database and start video-processing. In the first step of video pre-processing video input will convert frame by frame and store as sequences of images [4][13]. The second step is taking images one by one and analysis the contrast and adjust the contrast according to the requirement. The last step is to resize the image. This step is maintaining a unique size of image and resolution for all images. It will deduce the analysis time for the calculations.

3.3 Removal background object

After the video pre-processing image will take it for the next step. In this step image's background and objects will remove from here. It makes the image more definition to identify the hand region.

3.3 Convert Image in binary form

The image will be converted to a binary form in this step. The image segmentation approach is used to recognize the hand gesture area in this step [5].

3.4 Feature Extraction

Feature extraction is used to extract specific characteristics from each identity's distinctive hand picture. The existing frame and the trained picture will be identical. If the hand gestures match each other, then Eigenvectors and Eigen values will extract from the trained image [4].

3.5 Recognize text and fine tune to native language.

In this step, the feature extraction result will use to find the relevant image's text and gives the text output. It is not a meaningful sentence. Then fine-tune will occur. It will convert raw text result into the meaningful sentences and save into the database.

3.6 Dataset collection

In our research mainly focus on the American sign langue. Therefore I'm using the American Sign Language data set from kaggle and Microsoft-ASL.

3.7 Software Development Life Cycle

At the beginning of a research project requirements may be unclear or undefined due to presence of various sign language and will be subjected to lot of changes throughout the development cycle. The Agile Scrum model Figure 3.7.1 represents the scrum process is an ideal methodology for this kind of a project because it adds more

Flexibility to the software development life cycle and encourages requirement changes throughout the process of development. Agile follows an incremental and iterative development approach, and each iteration will focus on delivering a working product by adding more dataset. Because our team consists of four people, having daily scrum meetings will allow each member to gain a broad understanding of the project and be aware of issues that other members are experiencing, as all of the functionalities are interdependent. Also, this will improve the collaboration between team members encouraging better team work.
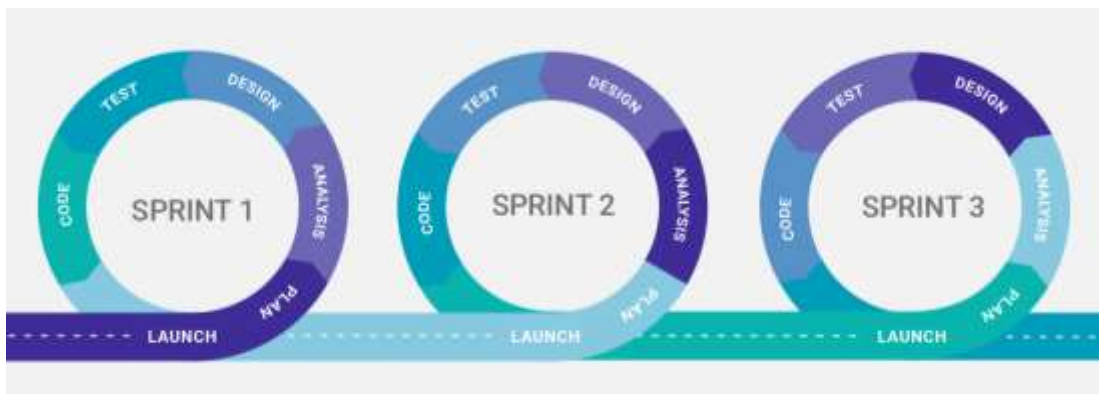

Figure 3.7.1 – Agile Scrum Process

4 PROJECT REQUIREMENTS

4.1 Functional Requirements

1. Converting sign language into text and fine-tune.

4.2 Non-Functional Requirements

1. Less manual work to translate sign language.
2. Take less time to covert the sign language into text.
3. Accurate recognition.

5 DESCRIPTION OF PERSONAL AND FACILITIES

Registration No	Name	Task Description
IT 18152074	Sangeeth Raj A	• Develop algorithm for identify and extract user's motion and analyse from sign language video transcript. • Develop algorithm for generate quiz and distractors using extracted ML model. • Documentation • Testing
IT18068610	Pirathikaran V	• Develop algorithm for identify the user's hand gestures and convert into text using ML model. • Develop algorithm for fine-tune the text into meaning full sentence according native language using NLP technique. • Documentation • Testing
IT18144772	Niroshan K	• Using Video processing techniques to enhance video quality

		• Creating an Algorithm to produce real time caption for speech recognized from Audio • Documentation • Testing
IT18069600	Accash R	• Using NLP techniques preprocessing the extracted data • Develop algorithm for converting the text / captions to the sign language using ML technique • Documentation • Testing

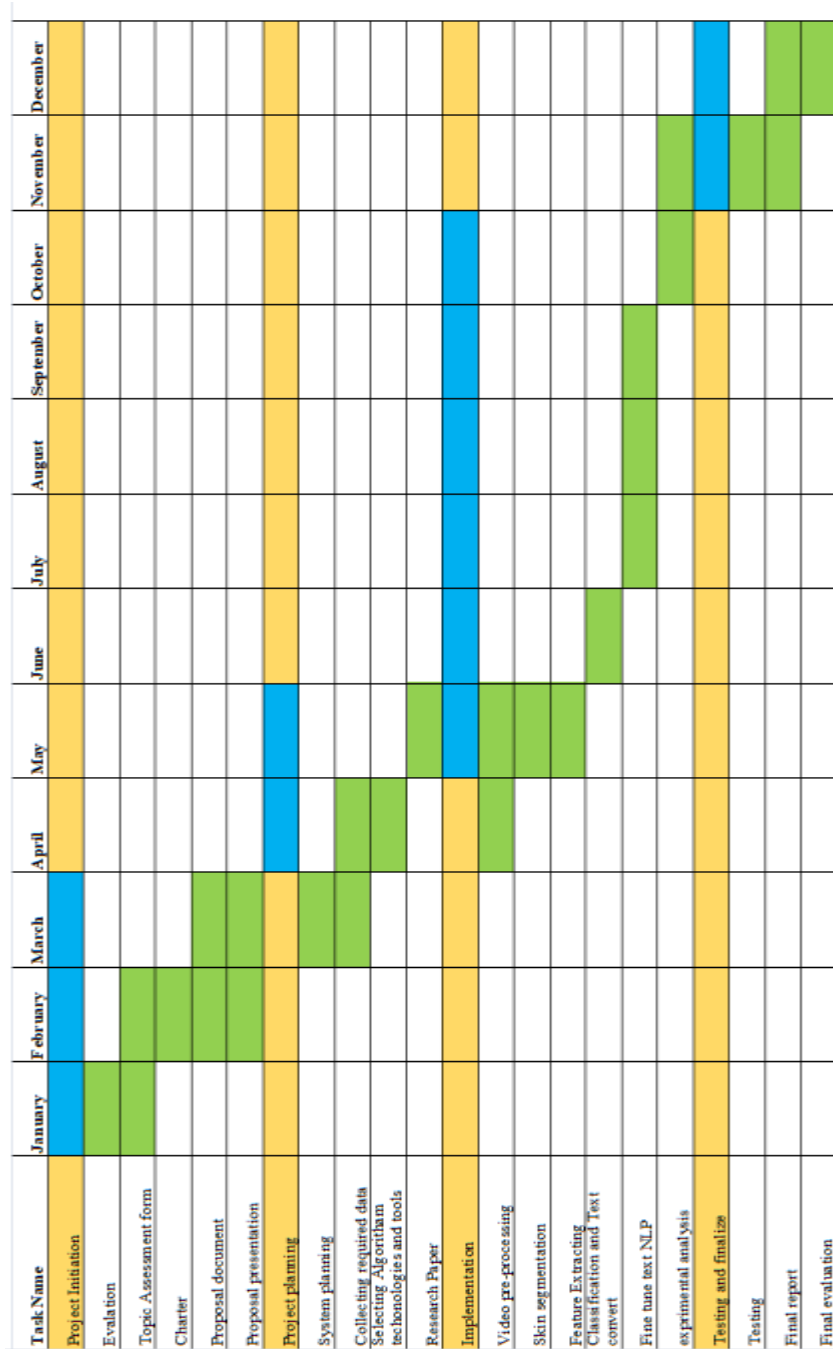*Table 5.1 Description of Personal and Facilities*

5.1 Gantt chart

Task Name	January	February	March	April	May	June	July	August	September	October	November	December
Project Initiation	████		████									████
Evaluation	████											
Topic Assessment form		████										
Charter		████										
Proposal document		████	████									
Proposal presentation		████	████									
Project planning	████		████		████							████
System planning			████	████								
Collecting required data				████								
Selecting Algoritham technologies and tools				████								
Research Paper					████	████						
Implementation	████				████	████	████	████	████	████		████
Video pre-processing					████	████						
Skin segmentation					████	████						
Feature Extracting					████	████						
Classification and Text convert						████						
Fine tune text NLP							████	████	████			
exprimental analysis										████	████	
Testing and finalize	████									████	████	████
Testing											████	████
Final report											████	████
Final evaluation											████	████

Figure 5.1.1 – Gantt Chart

14

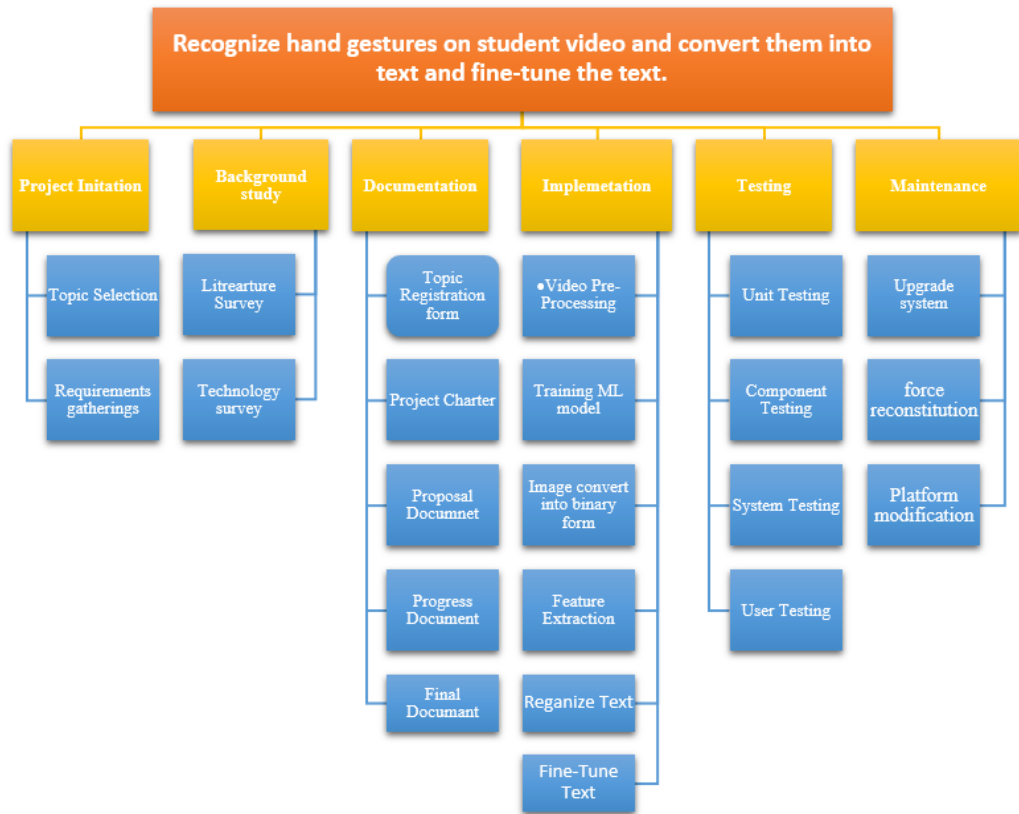## 5.2 Work Breakdown Structure

Figure 5.2 .1– Work Breakdown Structure

6. Budget and Budget Justification

The research involves the requirement of various resource types and the budget allocation is given below.

Resource type	Amount (LKR)
Preparation of reports and printing	Rs. 400
Internet usage for researching	Rs. 2000
Cloud charges	Rs. 2000
AWS Cost	Rs. 3000
Total	Rs. 7400

Table 6.1 Budget details

7 Business Potential

The web-based nature of the platform we propose has several advantages when considering its potential LMS value.

- It can be hosted on a cloud platform and provided as a *Software as a Service* (SaaS) product, where the customer will pay a one-time fee or a subscription to use it.
- It can be developed as a website and advertisements can be incorporated into the system.
- It can be developed as a Freemium model, where services are provided free of charge and certain premium services can be provided for a fee such downloading feature, certification and etc.

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