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E-learning System For Hearing-Impaired Students

Project ID : 2021-176

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Team Member

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Introduction

- With the wide spread of Covid-19 it became a global pandemic in 2020.
- Most of the services and industries shifted to online.
- Education was an important area which shifted to online. With this sudden shift many group of people encountered some problems.
- Online Learning for Hearing-impaired was a major problem. **Why?**

Introduction

- **The Education sector needed a proper solution for hearing-impaired people to continue their learning.**

We have proposed a web solution which addresses this issue.

Objective

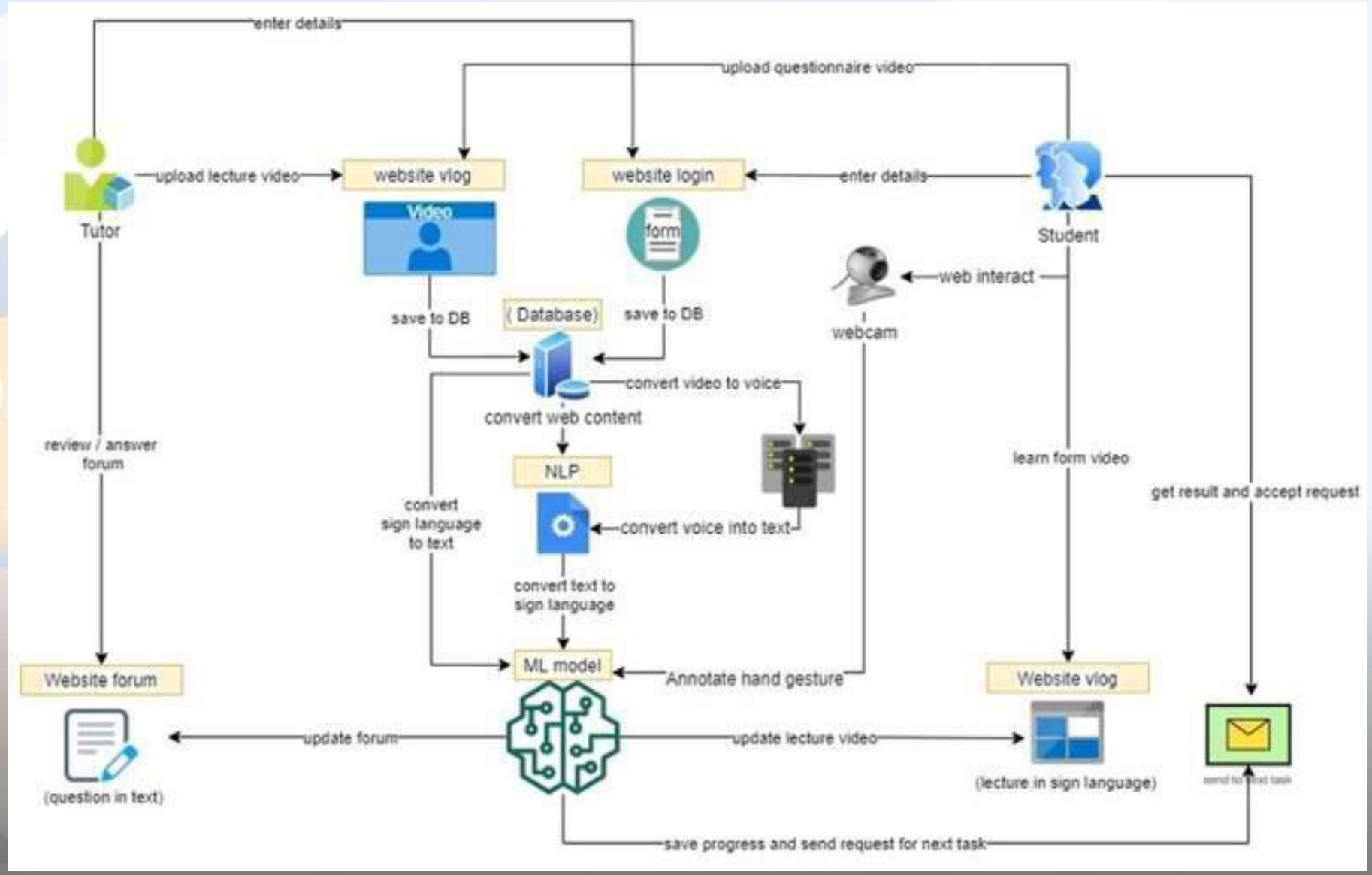
Main Objective

- **Solving communication and learning barrier between tutors and hearing-impaired students through learning Management System.**

Sub Objective

- **Changing physical learning environment to virtual environment for hearing impaired students**
- **Motivating hearing-impaired students to adapt virtual learning.**
- **Improving Engagement of hearing-impaired students in Web contents.**
- **Providing hearing-impaired students to involve in clearing their doubts through Sign Language.**

System Overview



Research Gap

- **Communication Gap between hearing impaired students and tutors**
- **No proper eLearning System for hearing-impaired Community**
- **Existing Systems Only have Recorded Videos of Sign Language Representation which takes additional human effort.**
- **Hearing-impaired community couldn't clear their doubts using any eLearning System.**

Research Gap

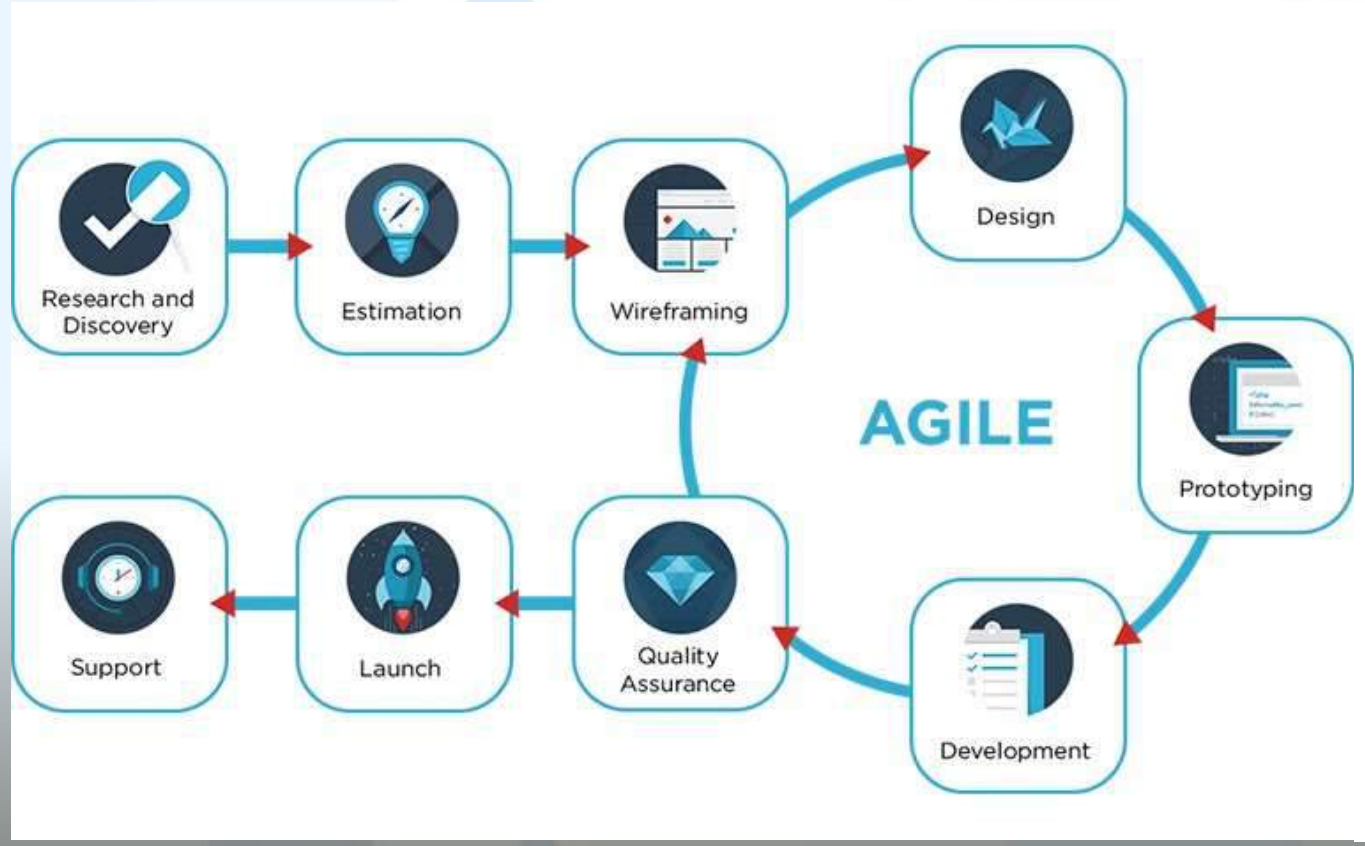
Features	System proposed by			Our solution
	M. S. Nair, N. A. P and S. M. Idicula	T. Jamil	A.S. Drigas, D. Kouremenos, S. Kouremenos and J. Vrettaros	
Sign language tutoring	X	-	-	✓
Availability of study materials like tests, quiz, etc.	-	-	X	✓
Reliable translation of words	-	X	-	✓

Methodology

The proposed LMS is divided into some main components

- **Enhancing uploaded video and producing caption for video content.**
- **Converting the captioned text to sign-language.**
- **Converting the Hearing-impaired student's video to meaningful text.**
- **Detecting user motion and analyzing the sign-language gesture for quiz.**

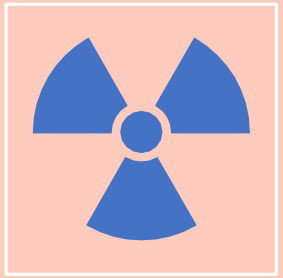
System Development



Business Potential

Provide as SaaS with one time subscription.

Can monetize the website using advertisements



A Freemium plan.

Future Scope

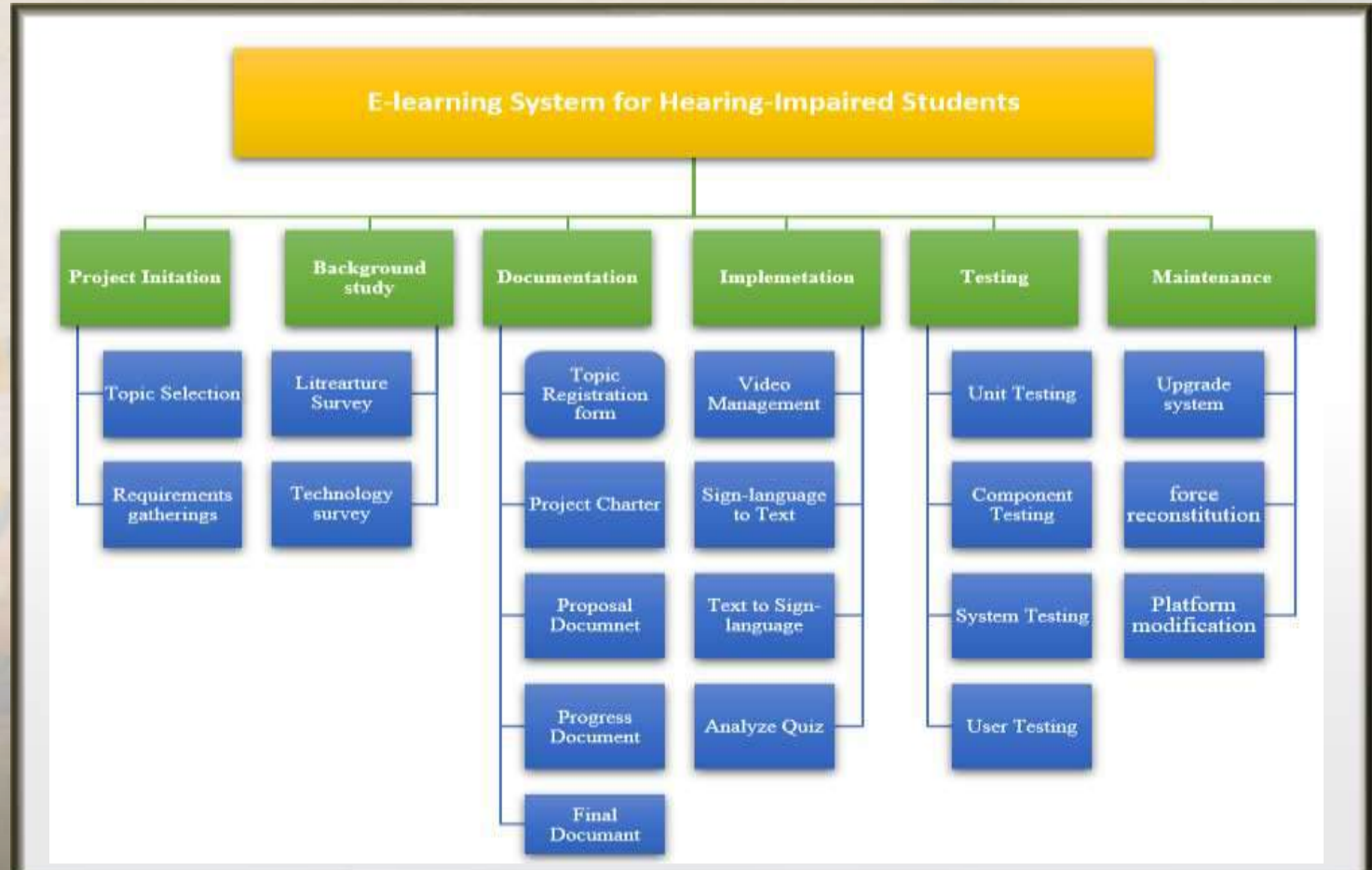
Can be developed for other sign languages.

Can be developed omni-platform.

Budget Summary

Phase	Description	Amount
Development	Setting Up AWS Cloud	12 * 5 = 60 USD

WORK BREAK DOWN



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Gantt Chart

Task Name | Timeline

Description	December	January	February	March	April	May	June	July	August	September	October	November	December
Project Initiation													
Evalation													
Topic Assessment form													
Charter													
Proposal Draft													
Proposal Presentation													
Project Phase													
System Planning													
Collecting Required Data													
Selecting Algoritham techonologies													
Implementation Phase													
Video Management													
Sign-language to Text													
Text to Sign-language													
Analyze Quiz													
Exprimental Analysis													
Testing Phase and Evaluation													
Testing													
Final Report and Research paper													
Final Evaluation													

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IT18144772 – Niroshan K

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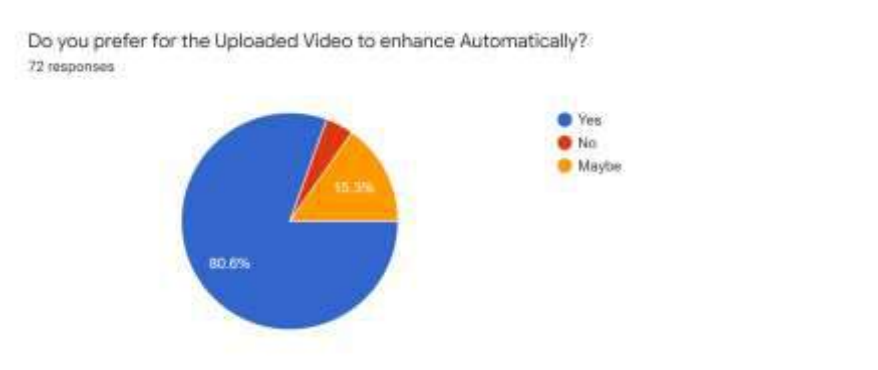
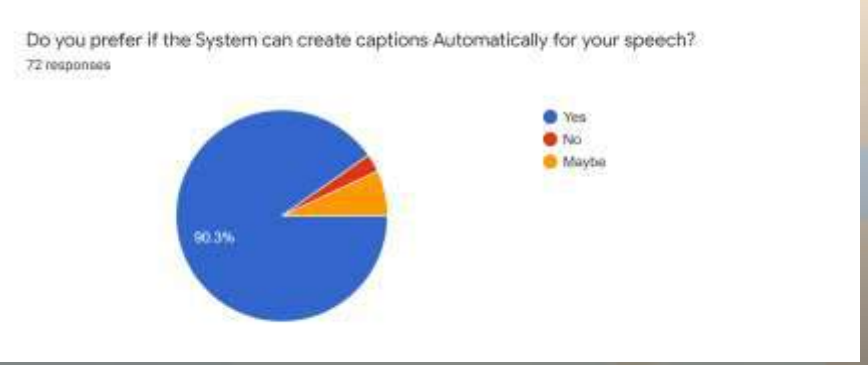
Introduction

- **Hearing-impaired students must need quality video content.**
- **If no proper gear for video recording is used most the videos are noisy and need editing.**
- **A good quality video gets more attention from the Audience than a low-quality video.**





Research Gap & Problem

- **Existing e-learning system has no automated video enhancement feature, it always need human effort to do it.**
- **Most of the tutors lack the knowledge of video Editing.**

Research Gap & Problem

- **Implementing low light algorithm for normal light images result in over exposed bright images.**

- **Finding a Solution for this issue in Videos is needed.**

Research Gap & Problem

- **Needed a feature to Automate the process of captioning.**
- **Available eLearning systems needed to upload the transcript as a separate process.**

System	Automated enhancement of the video quality for the uploaded lecture	System Generated Captions for the lecture videos
System proposed by W. Farhan and J.Razmak [1]	X	X
System proposed by R.Ranchel, Teresa, Y. Guo and K. Bain [2]	X	X
Our System	✓	✓

Objective

Main Objective

- **Enhance the uploaded video quality using an effective noise reduction technique and provide machine generated real time captions for the uploaded videos**

Sub Objective

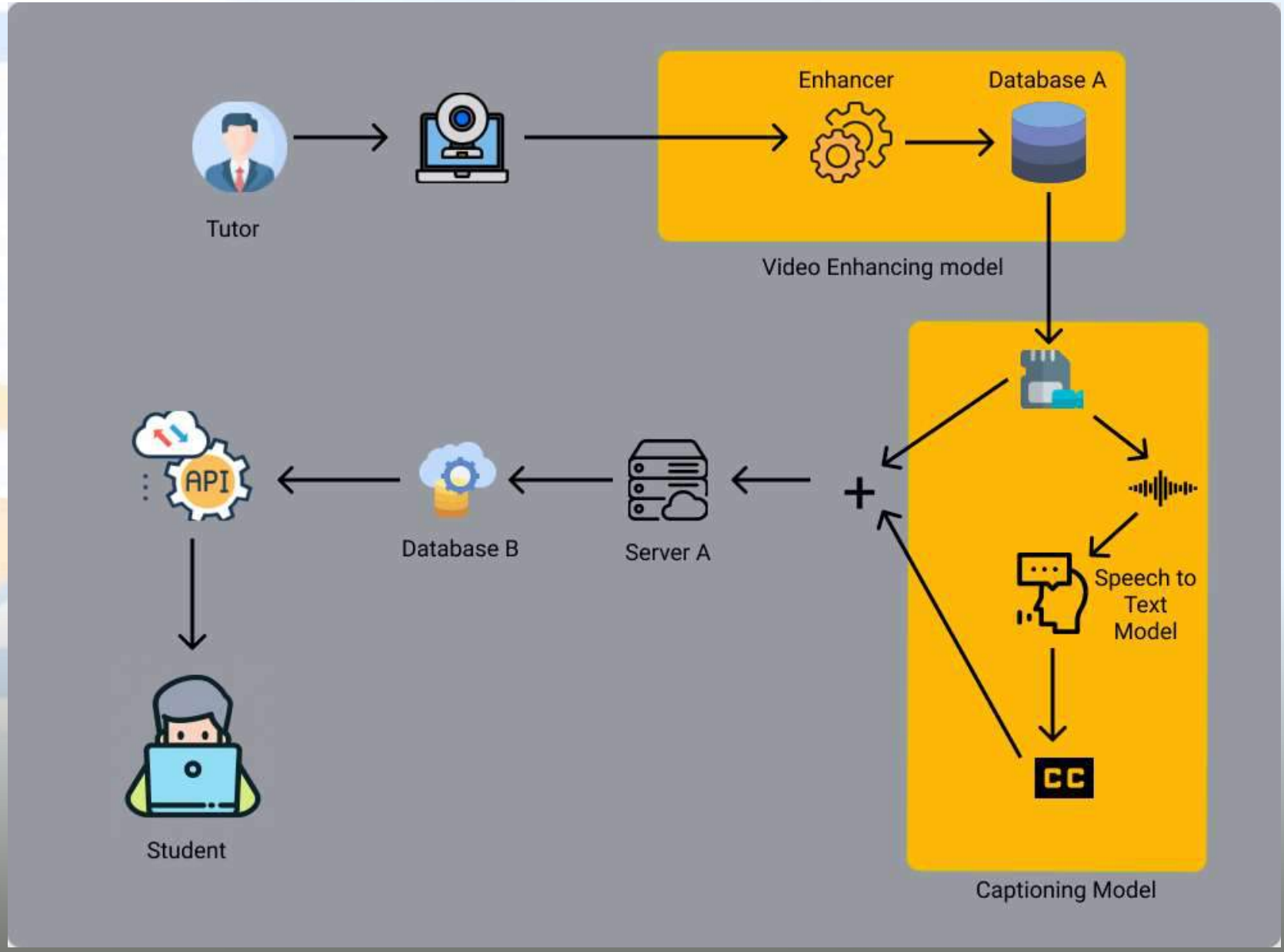
Video Enhancement

- **Use an algorithm to identify low light videos.**
- **Enhance the low light videos and reduce the noise in them**

Automated Captioning

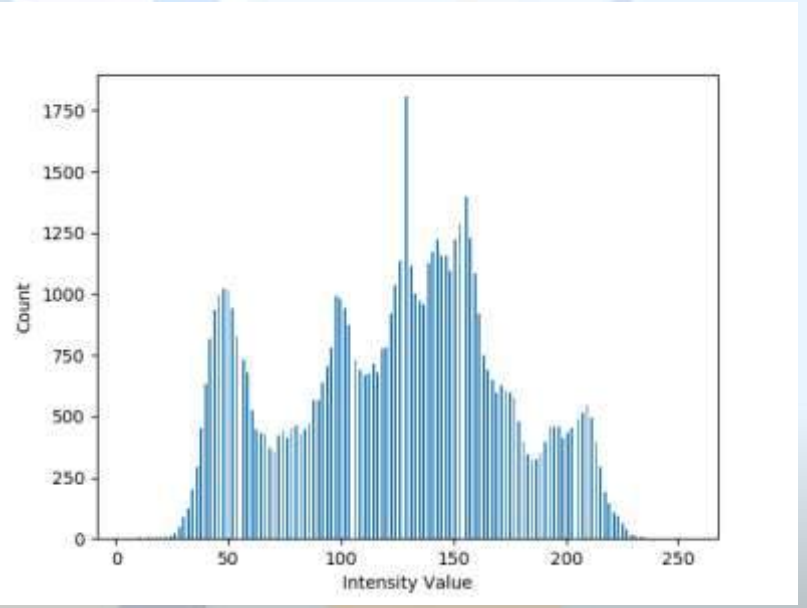
- **Extracting Audio from the video content.**
- **Convert the Speech to Text using Speech-to-Text Model and the generated text as captions to the video**

Function Overview



Methodology

- For Enhancing low light videos, video is turned to grey scale and broken down into frames.
- Calculate the intensity of the frames using Cumulative intensity histograms.
- For low-light condition more than 50% of total number of pixels has low values[3].
- Using the histogram value identify the low light frames and normal light frames
- Denoising and contrast-enhancement based algorithms will be used to improve the quality of low-light frames.
- Enhanced Video will be saved in Database A.



Methodology

- For Automated Captioning, Audio is extracted from the video.
- Google's Speech-to-Text model will be used to extract the text output of the speech.
- Use timestamps from the video to attach the text to the enhanced video as captions and Store it in database B.
- Display the captions to the user along with the video.

TESTING

- I'm Planning to use special low-light videos recorded using webcam and manually collected from YouTube.

Project Requirements

Functional Requirements

- Enhancing the video quality of the uploaded video
- Providing machine generated subtitle for the video

Non-Functional Requirements

- Less manual work to Enhance the video
- Less manual work to Provide Captions
- Performance

Technology & Tool Selection

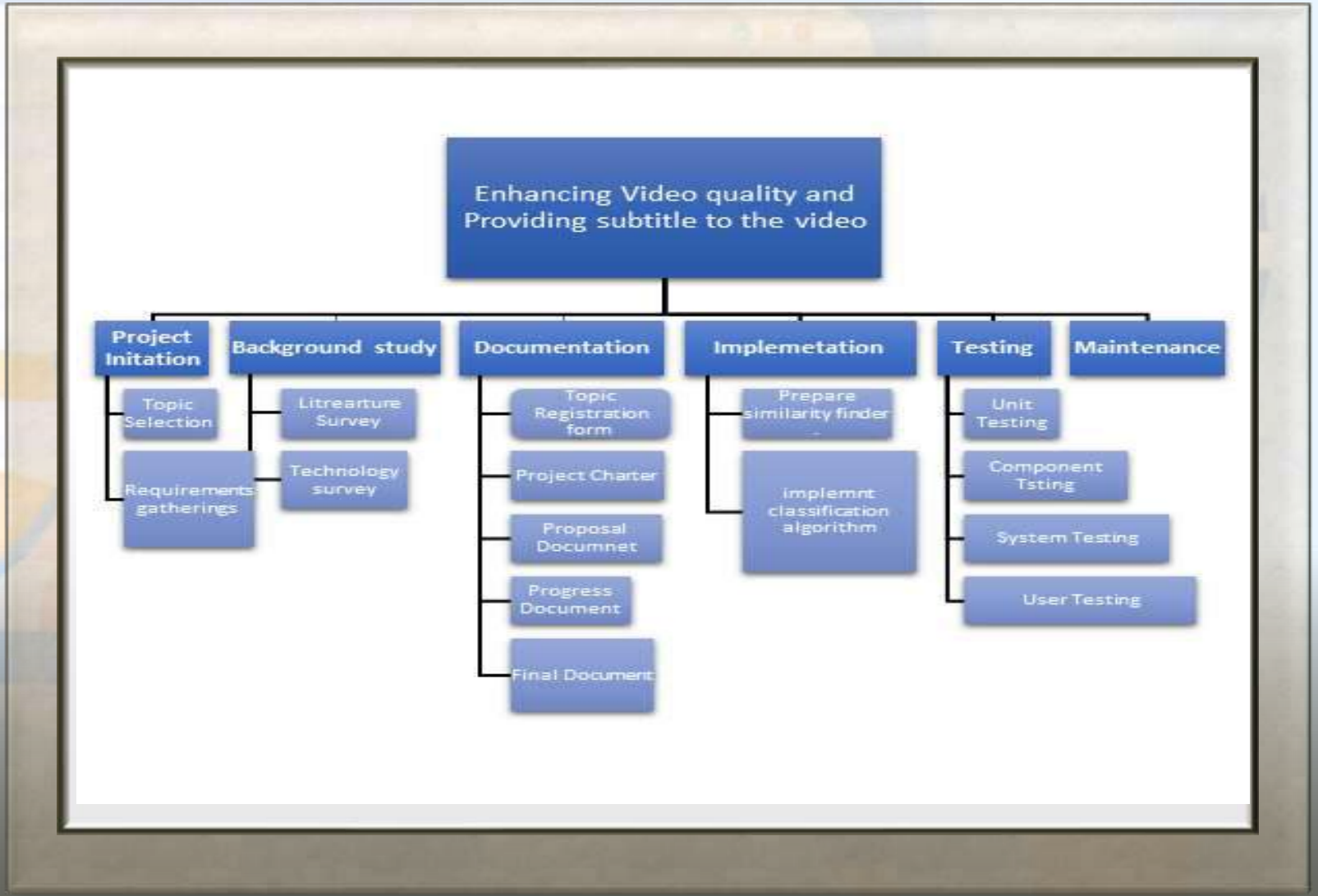
Technologies

- Video Processing
- Speech Recognition

Tools

- For Video Processing– OpenCV
- For Speech Recognition– GCP STT
- For version controlling – GIT
- Project Management – Azure Boards

FUNCTION WORK BREAK DOWN



References

- [1] W. Farhan and J. Razmak, "A comparative study of an assistive e-learning interface among students with and without visual and hearing impairments," in *Disability and Rehabilitation Assistive Technology*, 2020.
- [2] R.Ranchel, Teresa, Y. Guo and K. Bain, "Using speech recognition for real-time captioning and lecture transcription in the classroom," in *IEEE Transactions of Learning Technologies*, 2013.
- [3]R. Krutsch and D. Tenorio, "Histogram Equalization," F*ree. Semicon. Doc. Number AN4318, Appl. Note,* 2011.

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IT18069600 – Accash R.

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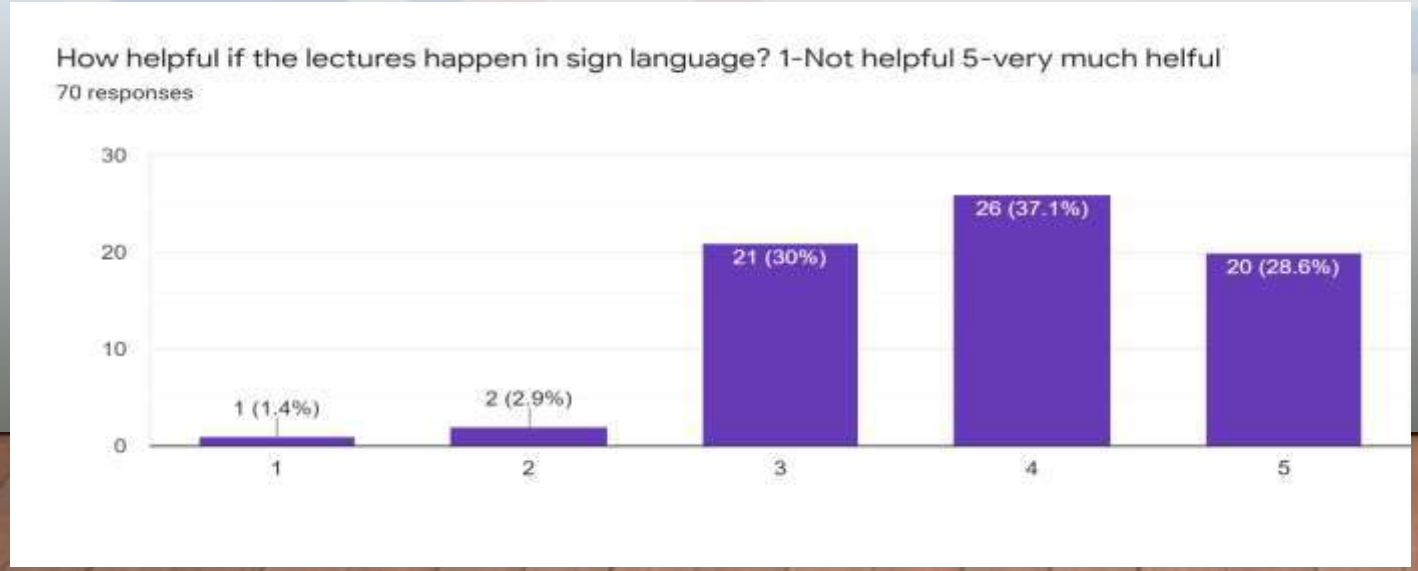
Introduction

- **Understanding the study content through the usual lecture videos in the LMS is difficult for the hearing-impaired students.**
- **Therefore, it is required that an automated mechanism for translation to sign language is developed.**
- **This will facilitate the students and make way for more students to be engaged in the education system.**



Research Gap & Problem

- Lack of automated study resources in sign language for hearing-impaired students.
- No proper e-learning system for these students in American Sign Language.
- Incorrect translation of the existing automated systems, regarding similar words which are nouns and verbs and have different meanings. [1]
- Lack of clarity in facial expressions and lip movements in the sign language illustrations/animations. [2]

Research Gap & Problem

System proposed by	Main objective	Limitation/Problem	Our solution
M. S. Nair, N. A. P and S. M. Idicula	Conversion of Malayalam text into Indian Sign Language	Unclear facial expression in sign language illustrations	Will provide a clear picture of facial expressions
T. Jamil	Conversion of Arabic text into Arabic Sign Language	Unable to distinguish between noun and verb	Will be able to represent the correct meanings of words

Objective

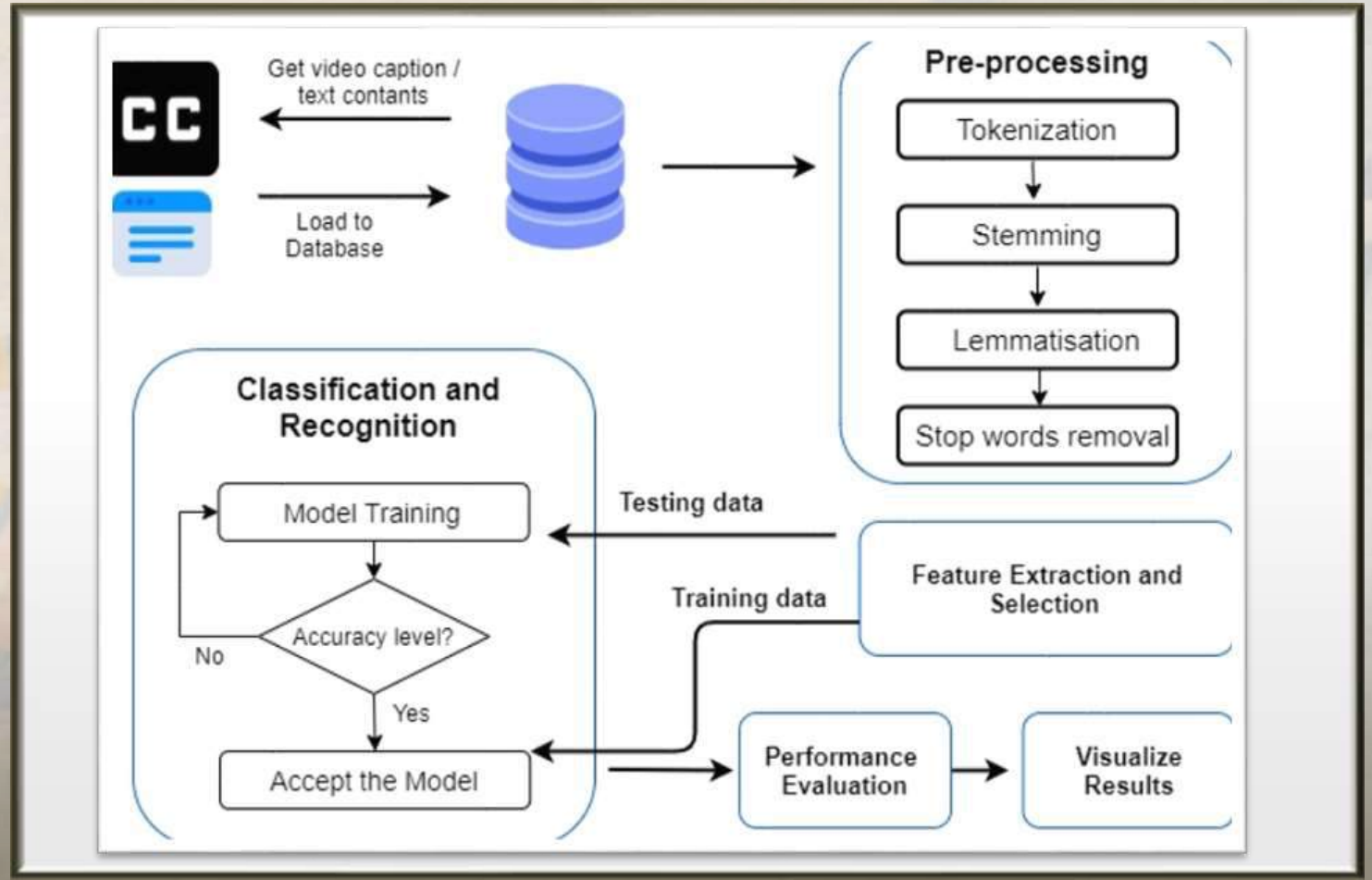
Main Objective

- **Converting lecture videos into sign language through the video captions.**

Sub Objective

- **Perform a complete analysis of the most used sign language which will be helpful to implement in the system.**
- **Design a user-friendly system to improve user interaction and user experience.**
- **Build a reliable translator within the system to ensure correct conveyance of the study material.**

Function Overview



Methodology

Natural Language Processing

- It is difficult create the ML model, using the extracted text from the video. Therefore, we must use the following NLP techniques to preprocess the data.

1. Tokenization - Breaks the raw text into words
2. Stemming - Reducing a word to its word stem
3. Lemmatization - Aiming to remove inflectional endings only and to return the base or dictionary form of a word
4. Stop words removal - Removing the words that occur commonly across all the documents in the corpus

Methodology

Machine Learning

- Using supervised learning technique ML models will be created.

  These ML models mainly come under Classification Algorithm.

  E.g. - Support Vector Machine

  - Naïve Bayes

  - Random Forest

- The model with the highest accuracy will be selected to solve the problem

Project Requirements

Functional requirements

- Converting the extracted text / captions to the sign language.

Non-Functional requirements

- Less manual work to translate into sign language.
- Take less time to covert text to the sign language.
- Accurate translation.

Technology & Tool Selection

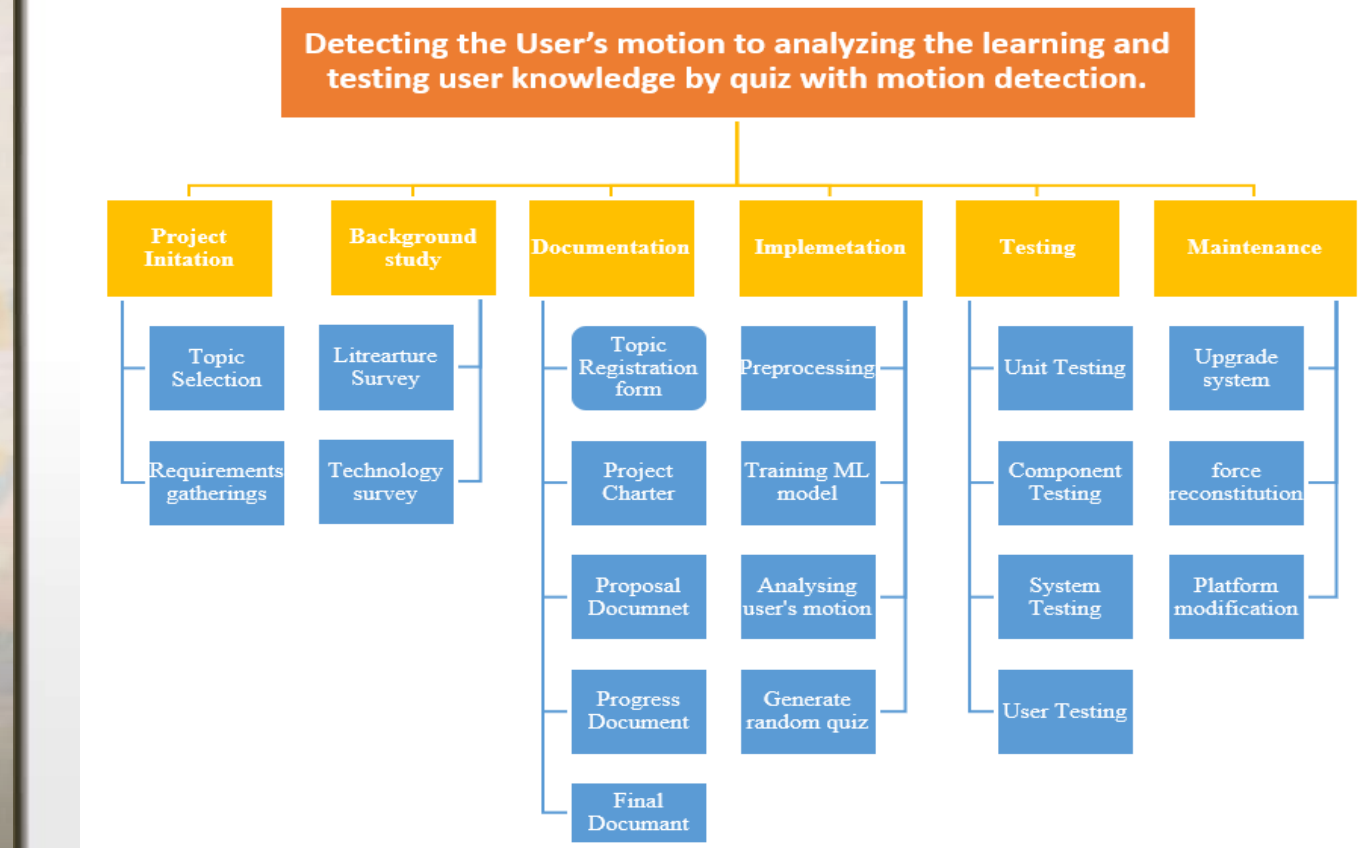
Technologies

- Natural Language Processing
- Machine learning

Tools

- Machine learning – Jupyter Notebook
- Natural Language Processing - NLTK
- Version control – Git
- Project Management – Azure Board

FUNCTION WORK BREAK DOWN



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[1] T. Jamil, "Design and Implementation of an Intelligent System to translate Arabic Text into Arabic Sign Language," 2020. [Online]. Available:

Design and Implementation of an Intelligent System to translate Arabic Text into Arabic Sign Language - IEEE Conference Publication

[2] M. S. Nair, N. A. P and S. M. Idicula, "Conversion of Malayalam Text to Indian Sign Language Using Synthetic Animation," 2016. [Online]. Available:

Conversion of Malayalam text to Indian sign language using synthetic animation - IEEE Conference Publication

[3] M. M. Nasr, "An Enhanced e-Learning Environment for Deaf/HOH Pupils," 2010. [Online]. Available:

An enhanced e-learning environment for Deaf/HOH pupils - IEEE Conference Publication

[4] A. Drigas, D. Kouremenos, S. Kouremenos and J. Vrettaros, "An e-Learning System for the Deaf people," 2005. [Online]. Available:

An e-learning system for the deaf people - IEEE Conference Publication

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IT18068610 – Pirathikaran V.

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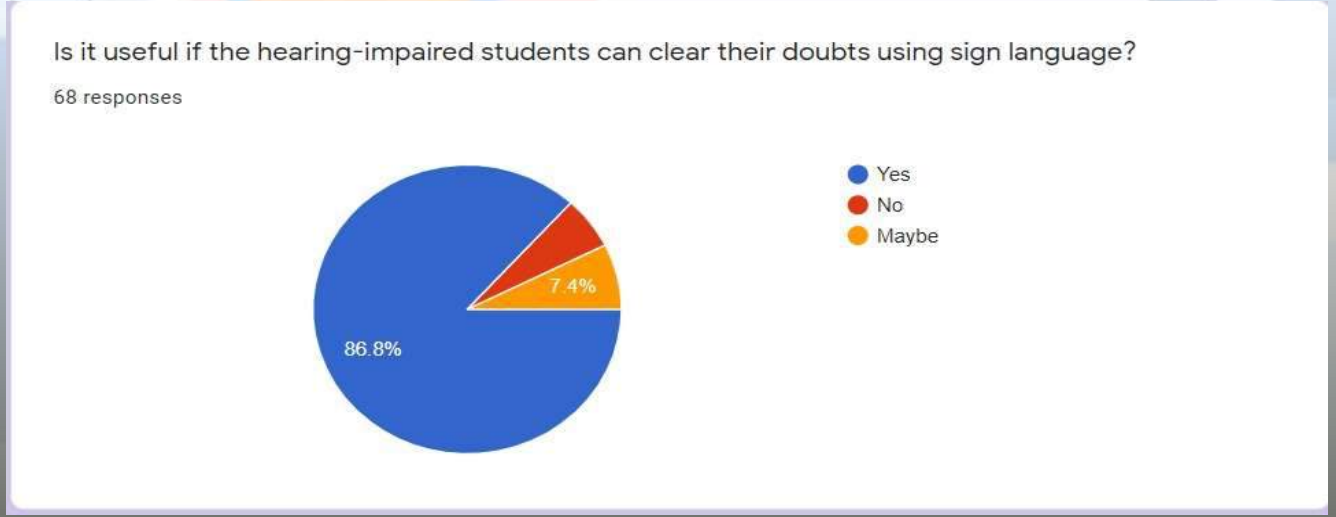
Introduction

- **Hearing-impaired students want to communicate with others.**
- **Hearing-impaired can ask a question and clarify with the tutor.**
- **Deaf and dumb students can overcome their education issues and, all students encourage to follow their education.**



Research Gap & Problem

- **Students who are deaf and dumb have not yet fully utilized ways to voice their doubts.**
- **Two-way communication is not yet in use in e-learning platform.**

Paper	Tasks	Limitation	Our system
[1]	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
[4]	Easy to use	Only using glove can detect sign language	Yes Without glove using video only

Research Gap & Problem

- **A tutor cannot understand sign language.**
- **Deaf and dumb student only way to communicate with ordinary people through sign language.**
- **Each country has unique sign languages.**

Objective

Main Objective

- Recognize sign language and convert it into Text.

Sub Objective

- Do the preprocessing video and get frame by frame.
- Removal of background and objects
- Convert Image in binary form.
- Feature Extraction
- Recognize text and fine tune to native language.

Function Overview

Methodology

- Taking input video and do the video pre-processing.
- In the pre-processing video convert into frame by frame
- Adjust contrast
- Image resize
- Image background and object removal
- Image into binary form
- Feature Extraction
- Recognize gestures text
- Training ML model data set from keggle
- Fine tune the text to native language

Project Requirements

Functional requirements

- Converting sign language into text and fine-tune.

Non-Functional requirements

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

Technology & Tool Selection

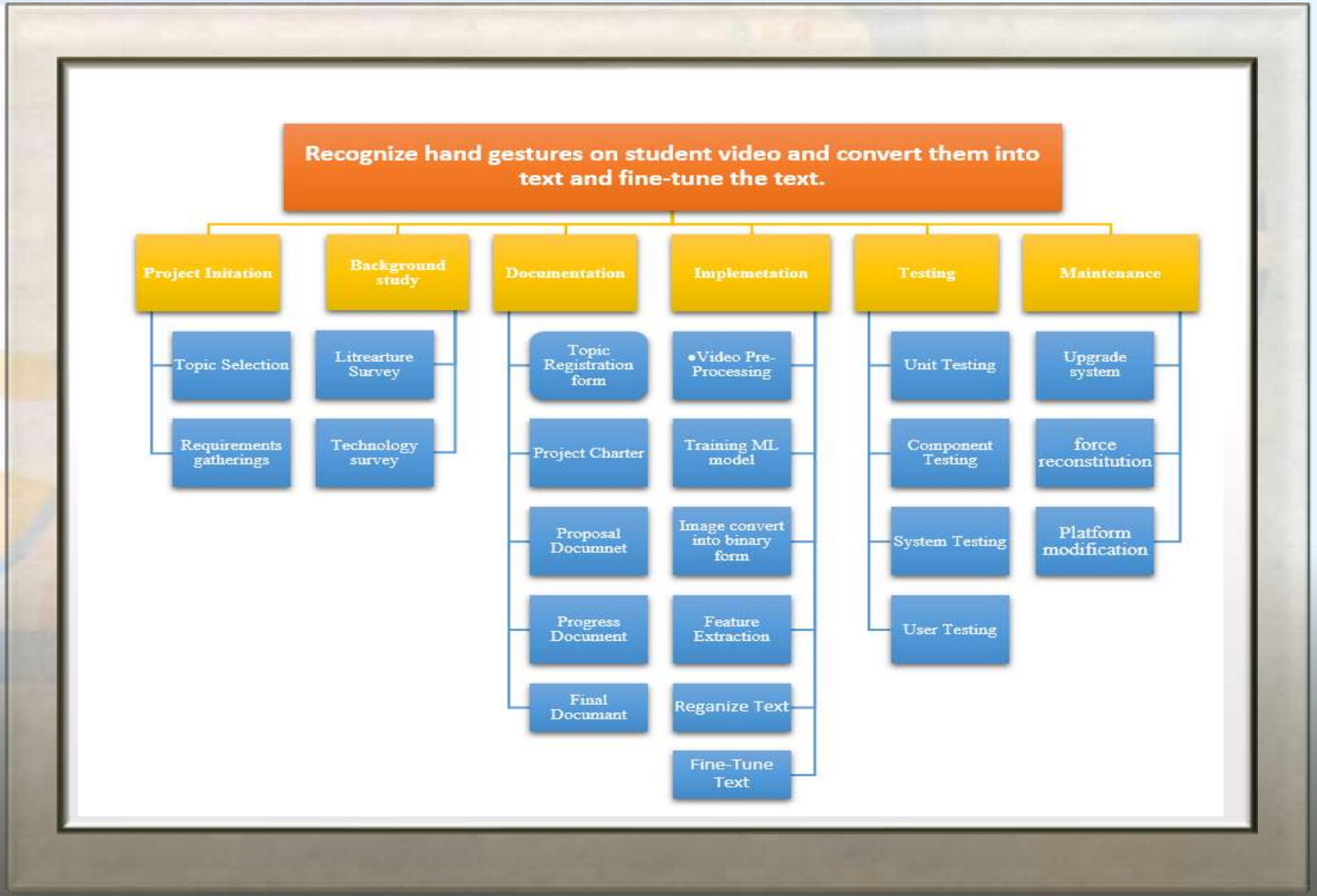
Technologies

- **Video Processing**

Tools

- **For Video Processing– OpenCV**
- **For version controlling – GIT**
- **Project Management – Azure Boards**

FUNCTION WORK BREAK DOWN



Reference

[1] K. K. Dutta, S. K. Raju K., A. Kumar G.S. and S. A. Swamy B., "Double handed Indian Sign Language to speech and text," 2015 Third International Conference on Image Information Processing (ICIIP), Waknaghat, India, 2015, pp. 374-377, doi: 10.1109/ICIIP.2015.7414799.

[2] A. S. Ghotkar, R. Khatal, S. Khupase, S. Asati and M. Hadap, "Hand gesture recognition for Indian Sign Language," 2012 International Conference on Computer Communication and Informatics, Coimbatore, India, 2012, pp. 1-4, doi: 10.1109/ICCCI.2012.6158807.

[3] S. Rathi and U. Gawande, "Development of full duplex intelligent communication system for deaf and dumb people," 2017 7th International Conference on Cloud Computing, Data Science & Engineering - Confluence, Noida, 2017, pp. 733-738, doi: 10.1109/CONFLUENCE.2017.7943247.

[4] M. Elmahgiubi, M. Ennajar, N. Drawil and M. S. Elbuni, "Sign language translator and gesture recognition," 2015 Global Summit on Computer & Information Technology (GSCIT), Sousse, Tunisia, 2015, pp. 1-6, doi: 10.1109/GSCIT.2015.7353332.

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IT18152074 – Sangeeth Raj A

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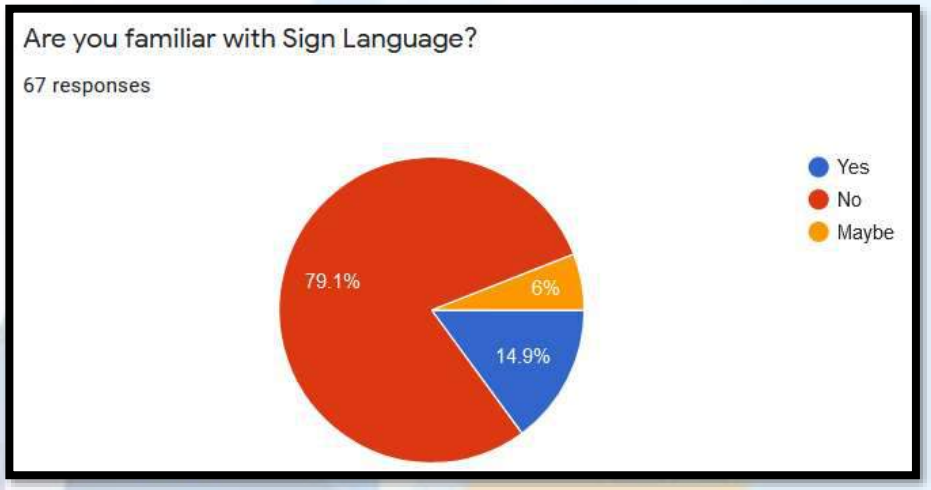
Introduction

- **Are people willing to learn sign language?**
- **Use LMS to teach sign language.**
- **User friendly feature.**
- **Quality video content**
- **Low-resolution laptop webcams**
- **Appreciate user's work.**



Research Questions

1. What are the current trending software used for motion detection?
2. What design aspects have been considered when designing LMS for hearing impaired community?
3. What ML technologies to be used?
4. What algorithms to be used to analyze user data?
5. What is the source of dataset?
6. Will dataset be used effectively in training and testing?
7. Will the proposed LMS make an impact in community?

Research Gap & Problem

Research Problem

- **There is no LMS on teaching sign language**[4].
- **The sign language tutors are lack of knowledge in teaching online platform.**
- **Lack of dataset for sign language**[4].
- **Collecting a considerable amount of dataset takes time.**

Research Gap & Problem

Research Gap

- **Algorithms used in hand gesture detection has limitations.**
- **Mostly research are done on hand gesture in image dataset.**
- **Increase the high mean accuracy in detection.**

Features	*Finger-Earth Mover's Distance [2]*	*Superpixel-Based Hand Gesture Recognition [2]*	*Recognizing Chinese Sign Language Based on Deep Neural Network[1]*	*Our Solution*
Achieve accuracy in detection	✔	✔	✔	✔
Fast recognition speed in analyzing	✗	✔	✗	✔
Achieve high mean accuracy in detection	✗	✗	✔	✔

Objective

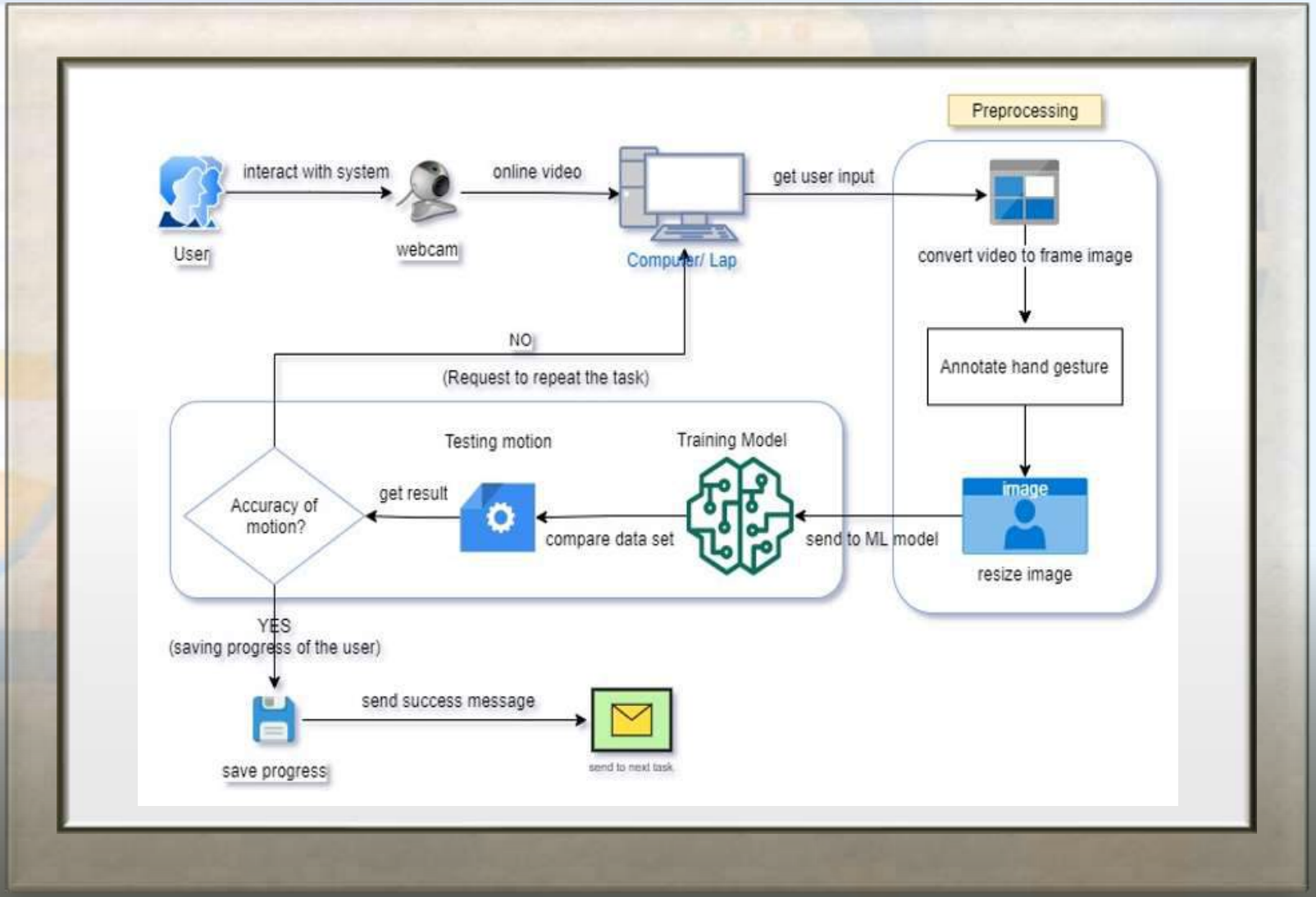
Main Objective

- Detecting the user's motion and analyses motion whether it is similar with the system

Sub Objective

- Feeding the system with tutorial of the module(dataset).
- Providing correct instruction to user and to follow.
- Getting optimized video from the user(800x600pixel).
- Detect the user's motion using TensorFlow.
- Analyze whether the dataset is accurate by CNN.
- Using algorithm to initialize next stage in module.
- Testing user with random sign language object to check there knowledge.

Function Overview



Methodology

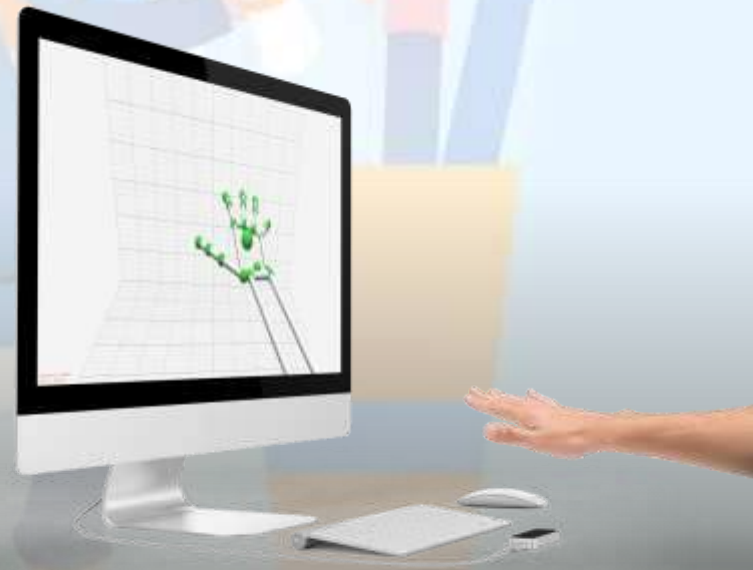
Annotate Hand Gesture

- **TensorFlow model trainer and Faster RCNN configuration**[5]**.**
- **Using low-resolution images for training ML.**
  1) Faster training
  2) Storage efficiency
  3) Low latency network connections (low internet speed)
- **Using labelling tool in PASCAL Visual Object Classes(VOC) format to get an XML.**
- **Images are converted into CSV for train and test image datasets.**
- **Training ML Model.**
- **Test with webcam, detects images using the pre-trained model.**

Methodology

Image Classification

- **Implement ML model with Convolutional Neural Networks(CNN)**[3].
- **Using 'keras' library to build a CNN model.**
- **Dataset alphabet of American sign language.**
- **Minimum 100-150 images per class to train.**
- **Image going through different stage in CNN classifier**
  1) Convolutional Layer
  2) Nonlinearity
  3) Pooling Layer
- **Notifies user's result.**



Project Requirements

Functional Requirements

- Analyze user hand gestures effectively and correctly.
- Analyze user knowledge on learning.

Non-Functional Requirements

- Giving accurate result of user's hand gestures without further ado
- High mean accuracy of detection and analyze motion

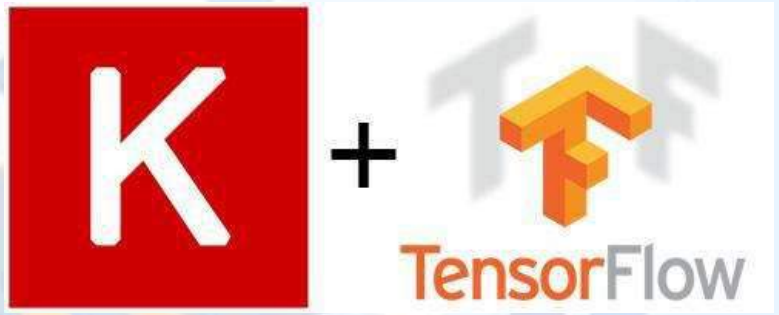
User Requirements

- Personal computer / Laptop
- Webcam
- Internet connection

Technology & Tool Selection

Technologies

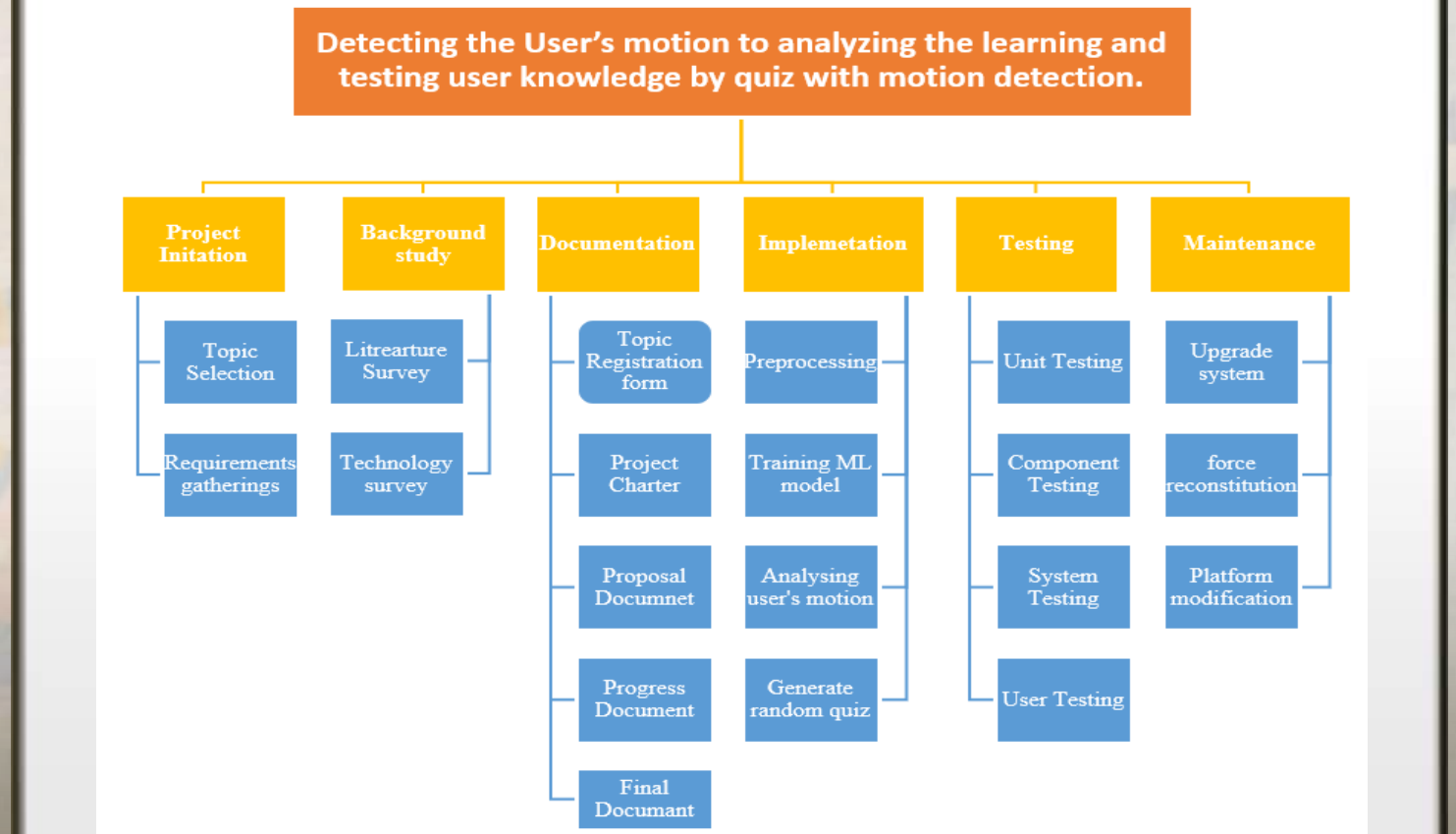
- Annotate Hand Gesture
- Image Classifier



Tools

- Annotate Hand Gesture – TensorFlow, Fast RCNN
- Image Classifier – Python Keras, CNN
- For version controlling – GIT
- Project Management – Azure Boards

FUNCTION WORK BREAK DOWN



Reference

[2] C. Wang, Z. Liu and S. Chan, "Superpixel-Based Hand Gesture Recognition With Kinect Depth Camera," in IEEE Transactions on Multimedia, vol. 17, no. 1, pp. 29-39, Jan. 2015, doi: 10.1109/TMM.2014.2374357.

[3] Jiang, Xianwei & Zhang, Yu-Dong. (2019). Chinese Sign Language Fingerspelling via Six-Layer Convolutional Neural Network with Leaky Rectified Linear Units for Therapy and Rehabilitation. Journal of Medical Imaging and Health Informatics. 9. 2031-2090. 10.1166/jmihi.2019.2804.

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THANK YOU

ANY QUESTIONS?