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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

- Today Education has shifted from traditional learning style to Online. With this sudden shift many group of people encountered some problems.
- Online Learning for Hearing-impaired was a major problem.
- The Education sector needed a proper solution for hearing-impaired people to continue their learning.

Research

Implementing a learning environment which can be used by Hearing impaired students as well as tutors.

Objective

Objectives

- Enhancing the low-light videos and providing subtitles or Transcription in real time.
- Using the Transcription and generating sign language interpretation.
- Students clear doubts using sign language which can be converted into meaningful sentences.
- Teaching sign language for general Audience.

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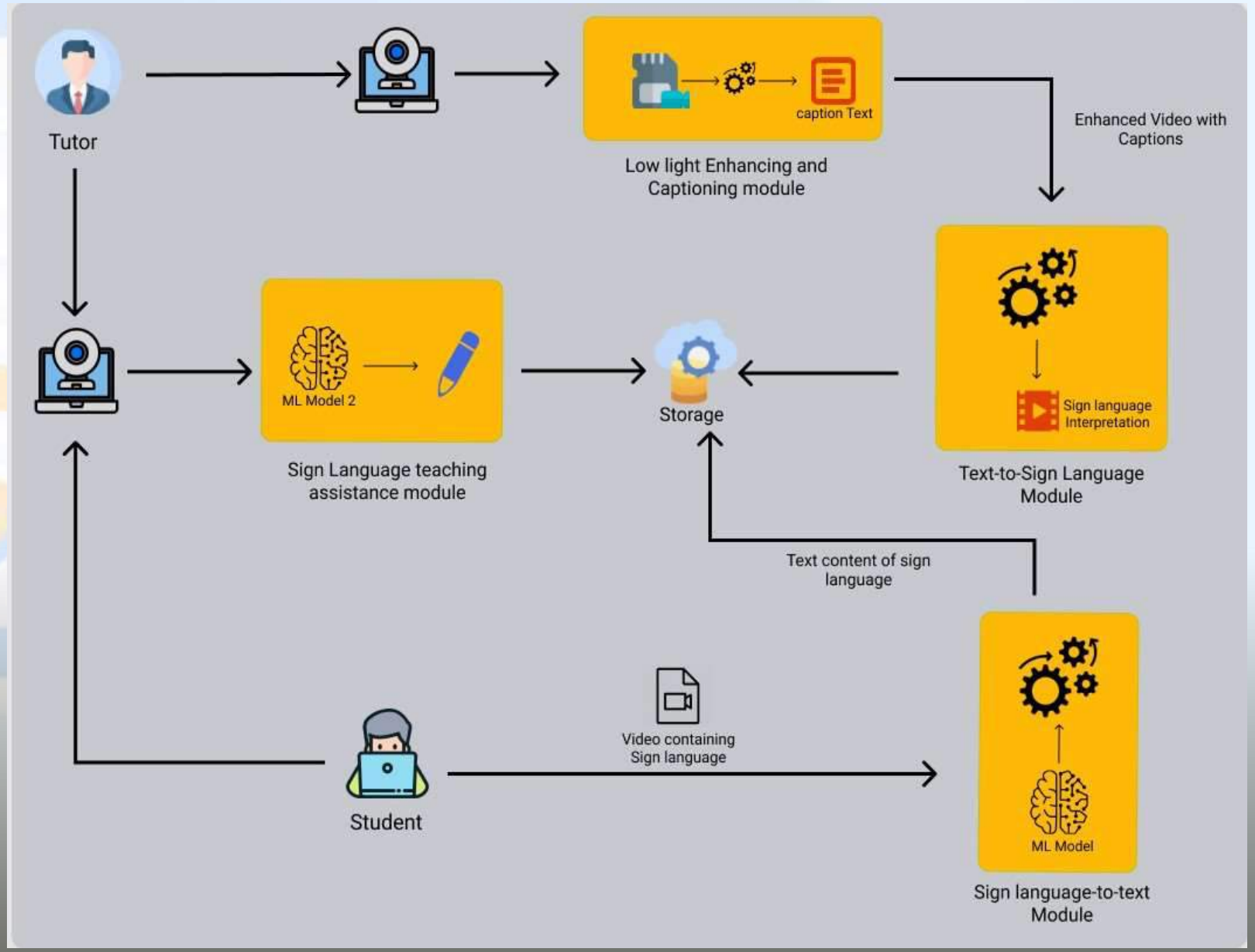
System Overview

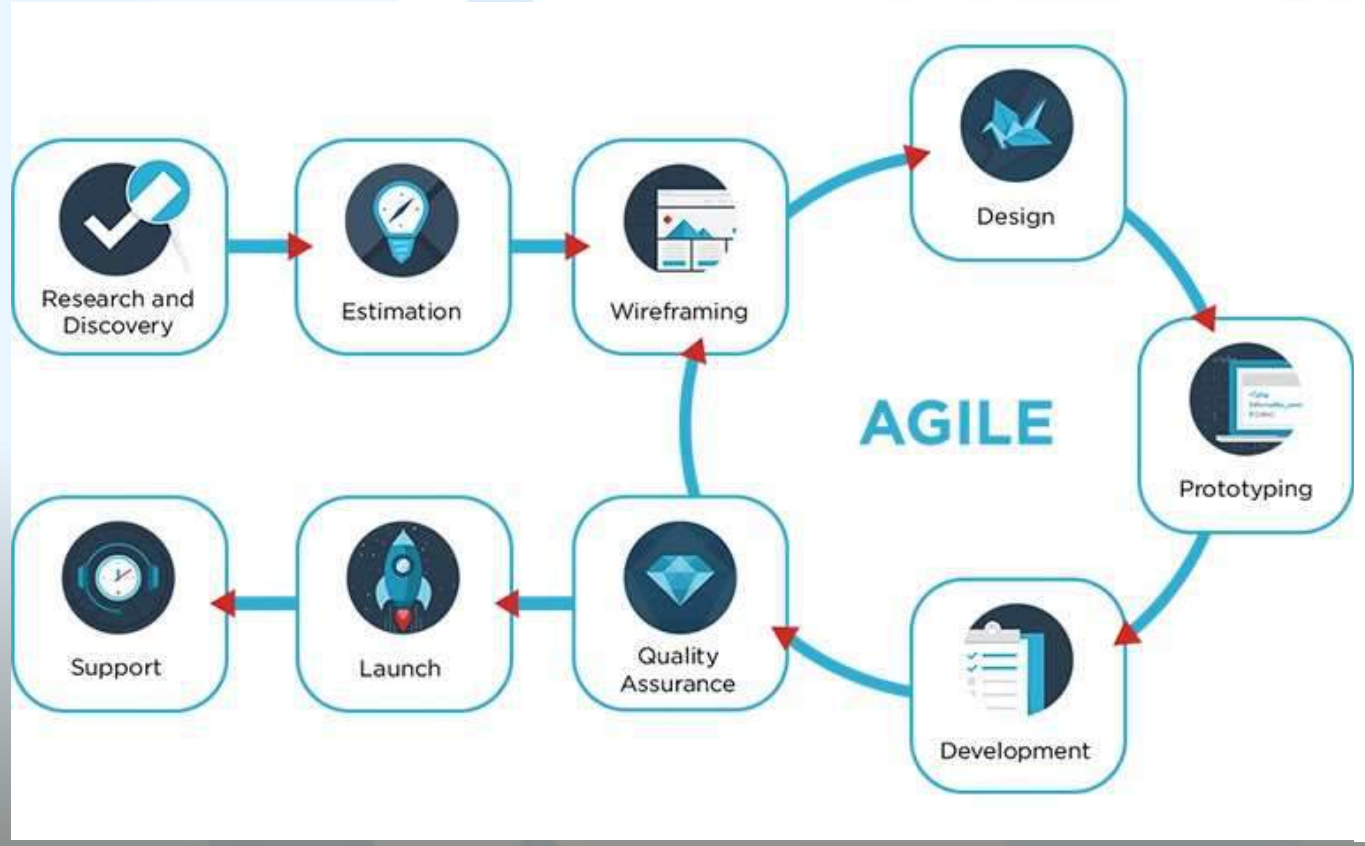


Methodology

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.**

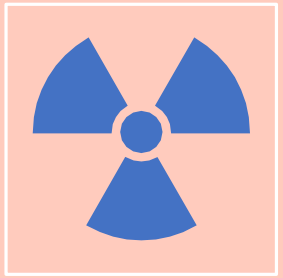
System Development



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 for omni-platform.

Standards Maintained

- Coding Standards Maintained
- HCI Standards Maintained

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IT18144772 – Niroshan K

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

Research

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

- **Sign Language cannot be directly interpreted from sound it needs to be converted to text format**[2].

Research Gap

System	Automated low light enhancement for the uploaded tutor videos	System Generated Captions for the tutor 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 and provide captions or transcripts for them.**

Sub Objective

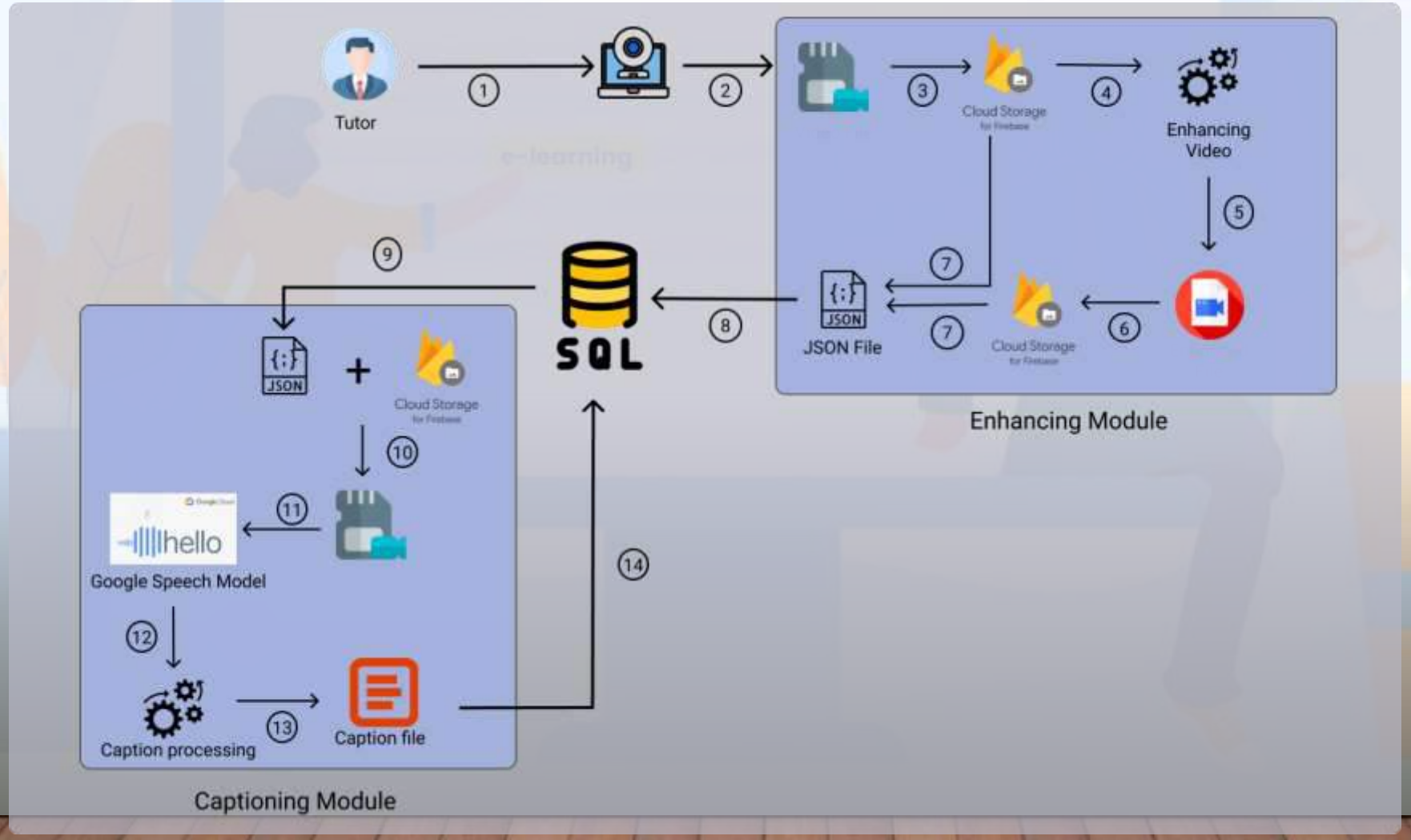
Automated Video Enhancement

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

Automated Captioning

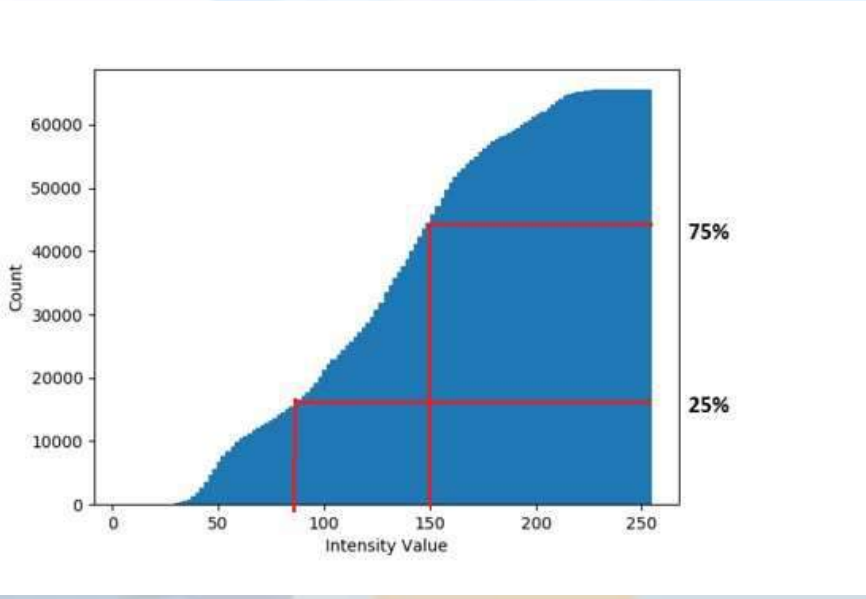
- **Extracting Audio from the video content.**
- **Convert the Speech to Text using Speech-to-Text Model and the generated text as captions to the video**

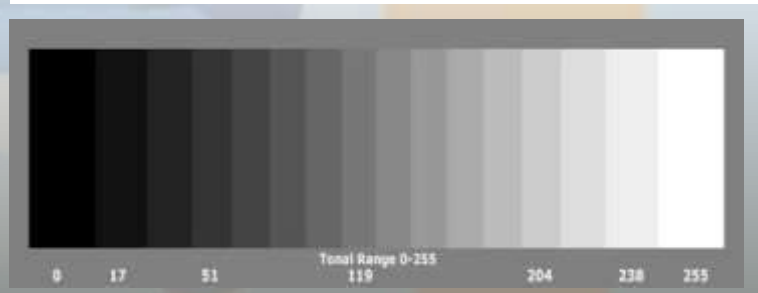
Methodology



Methodology

- **Construct cumulative intensity histogram for the image or frame of a video.**
- **Identify a threshold to differentiate low-light images and normal light images.**
- **Create an algorithm which can intelligently identify the low light images and normal light images separately.**
- **Use Low light enhancement techniques to improve the intensities of the low-light images and frames.**





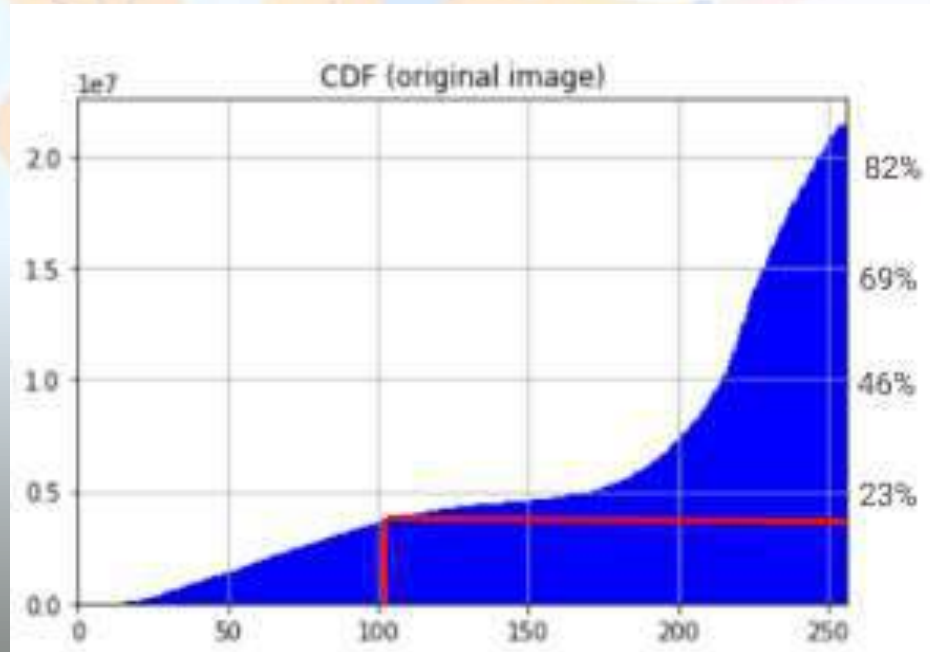
Thresholding value to identify low light frames

```
In [126]: threshold = 103
```

Methodology

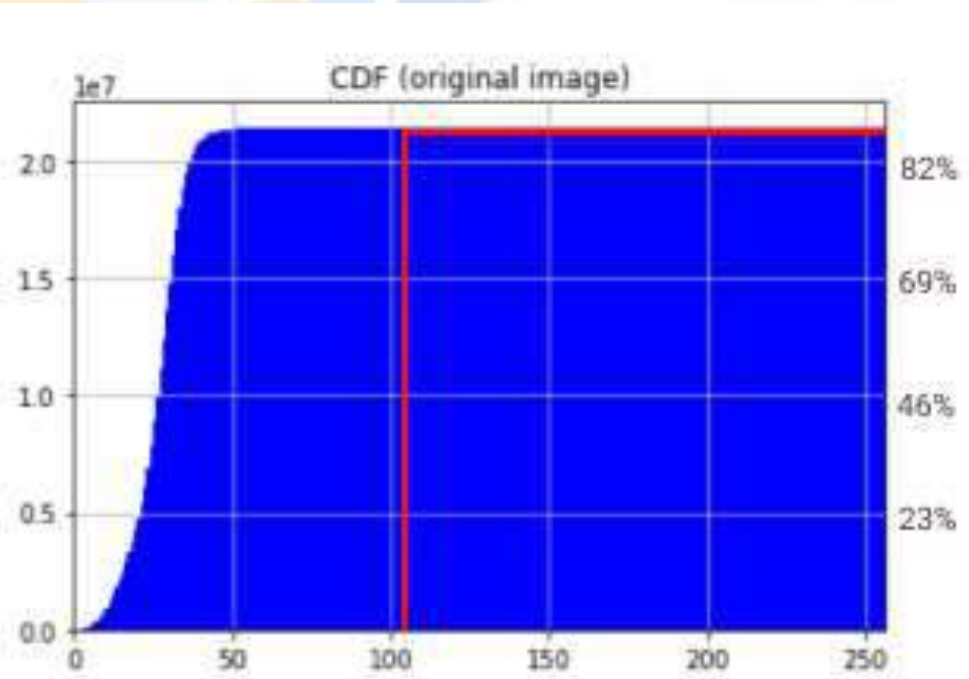
Enhancement Technique

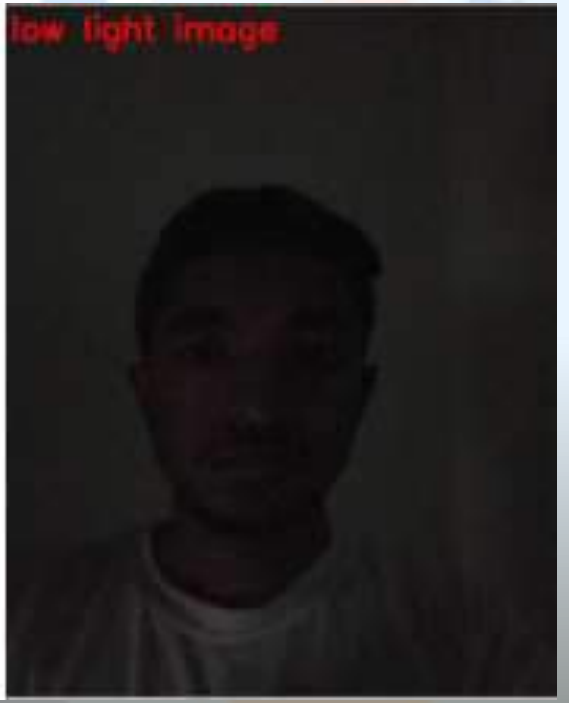
- **Implementing the algorithm to identify low-light images and normal light images.**



Methodology

Enhancement Technique





Methodology

Enhancement Technique

- **Enhancing low light images using the Gamma correction technique.**
- **Lookup table created for input and output pixels after gamma correction**

This algorithm is then adopted for Videos.

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.
- Select an accurate timestamp to divide the transcript into individual sentences.

Methodology

Captioning Technique

- Audio File is extracted from the video file
- Transcription is generated using the Google STT model
- Algorithm for transcription to divided into sentences of 6 words using timestamps.
- Average time to read a word is taken as 0.5s [4].

Test Results

Low light enhancement

I used special low-light videos recorded using webcam and images taken from webcam as well as mobiles.

Test Results

Captioning Module

```
---------- Extract Audio Start----------
MoviePy - Writing audio in audio.wav
MoviePy - Done.
---------- Extract Audio Complete----------
---------- Subtitle Generate Start----------
number of words: 134
1
00:00:00-->00:00:03
is going to be a long

2
00:00:03-->00:00:06
video which contains all the information

3
00:00:06-->00:00:09
related to the audio fraction now

4
00:00:09-->00:00:12
I am going to talk to

5
00:00:12-->00:00:15
sentence by sentence this is the

6
00:00:15-->00:00:18
first sentence online Tik Tok sentence

7
00:00:18-->00:00:21
is going to be hello I

8
00:00:21-->00:00:24
am near ocean and the second

9
00:00:24-->00:00:27
sentence is going to be hello

10
00:00:27-->00:00:30
Humne Roshan from can now I
```

Technology & Tool Selection

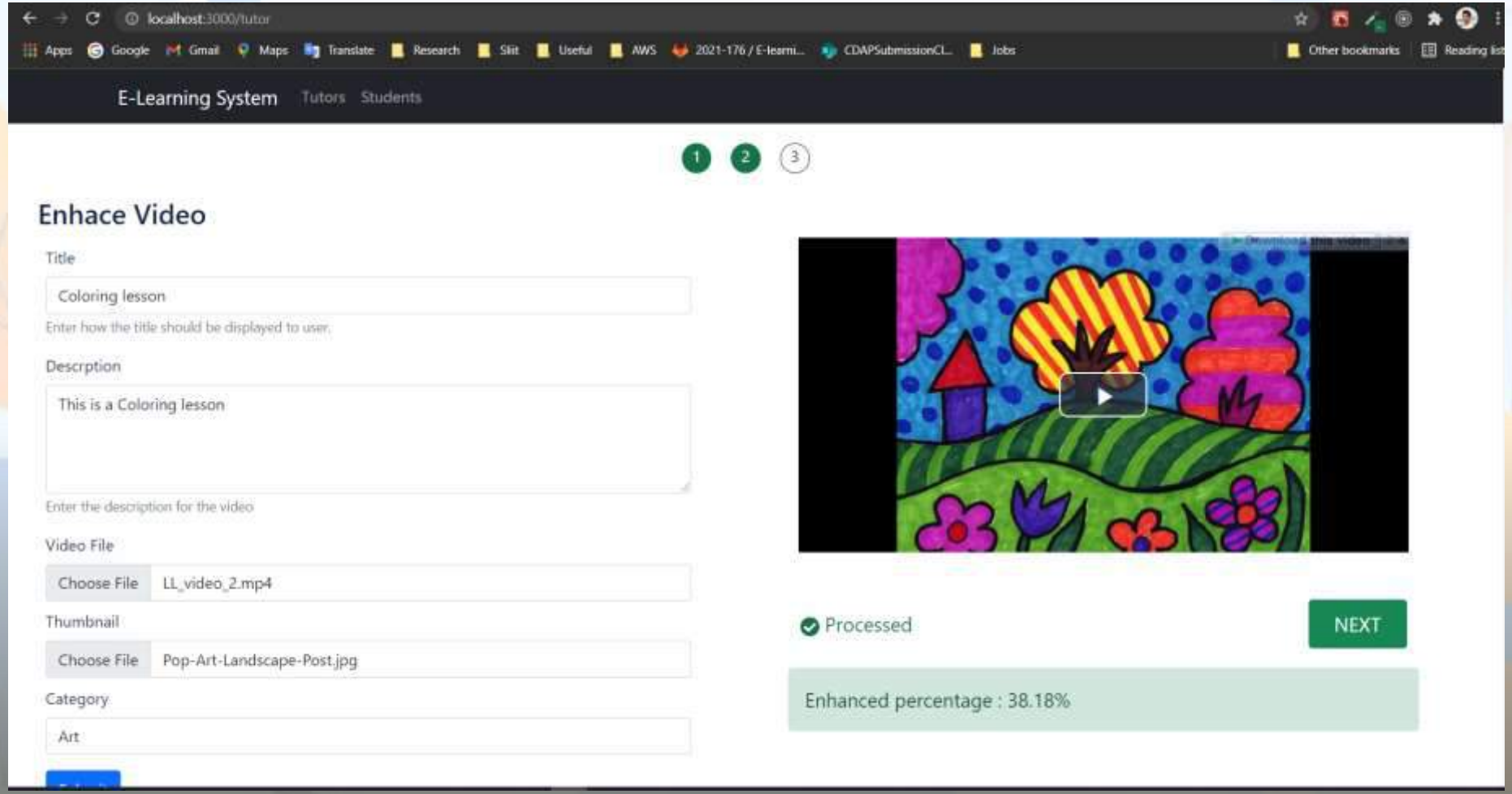
Technologies

- Image/Video Processing
- Speech Recognition

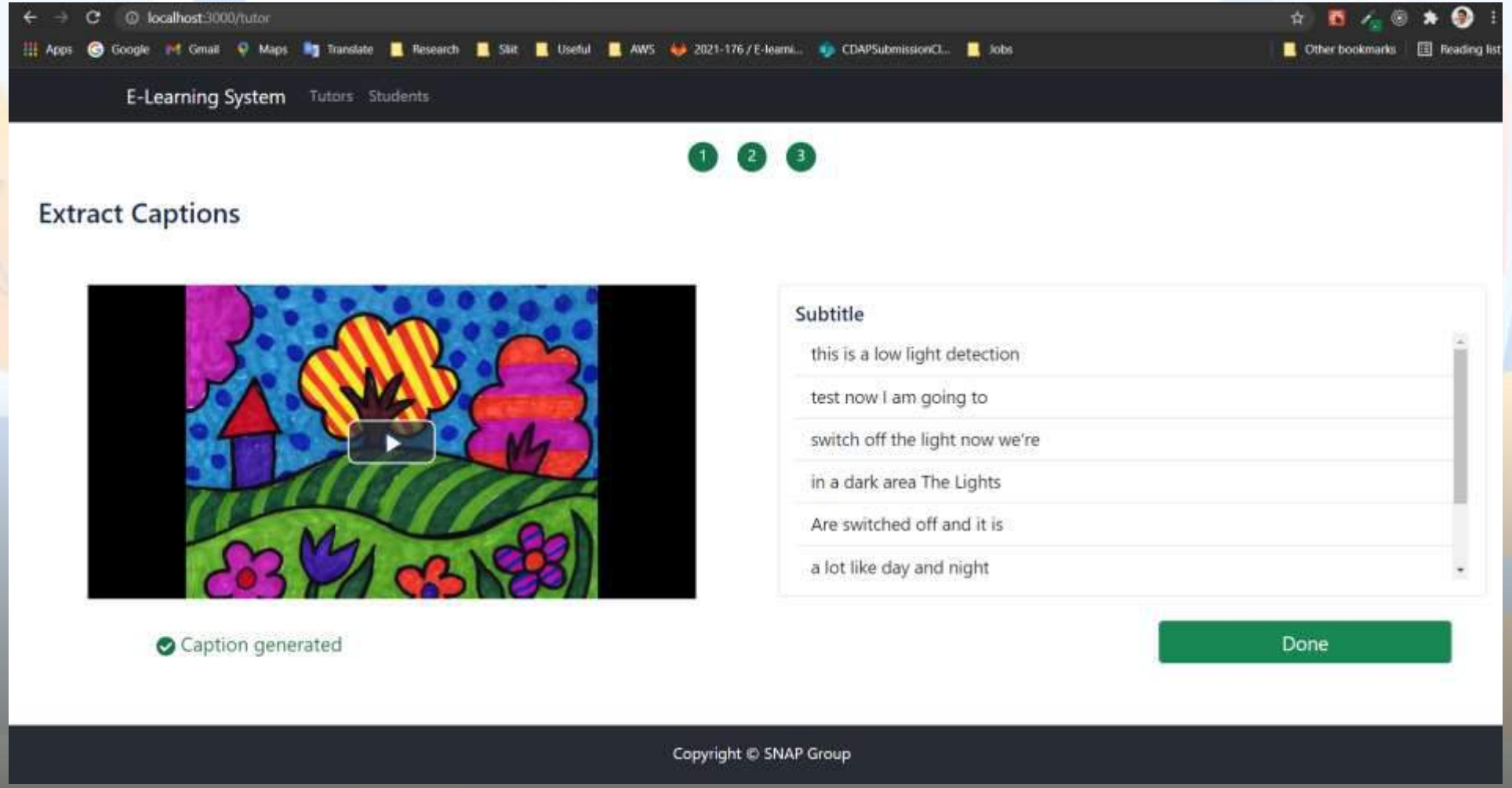
Tools

- For Video Processing– OpenCV
- For Speech Recognition– GCP STT
- Project Management– GitLab / MS Planner
- Web development – Flask / ReactJS

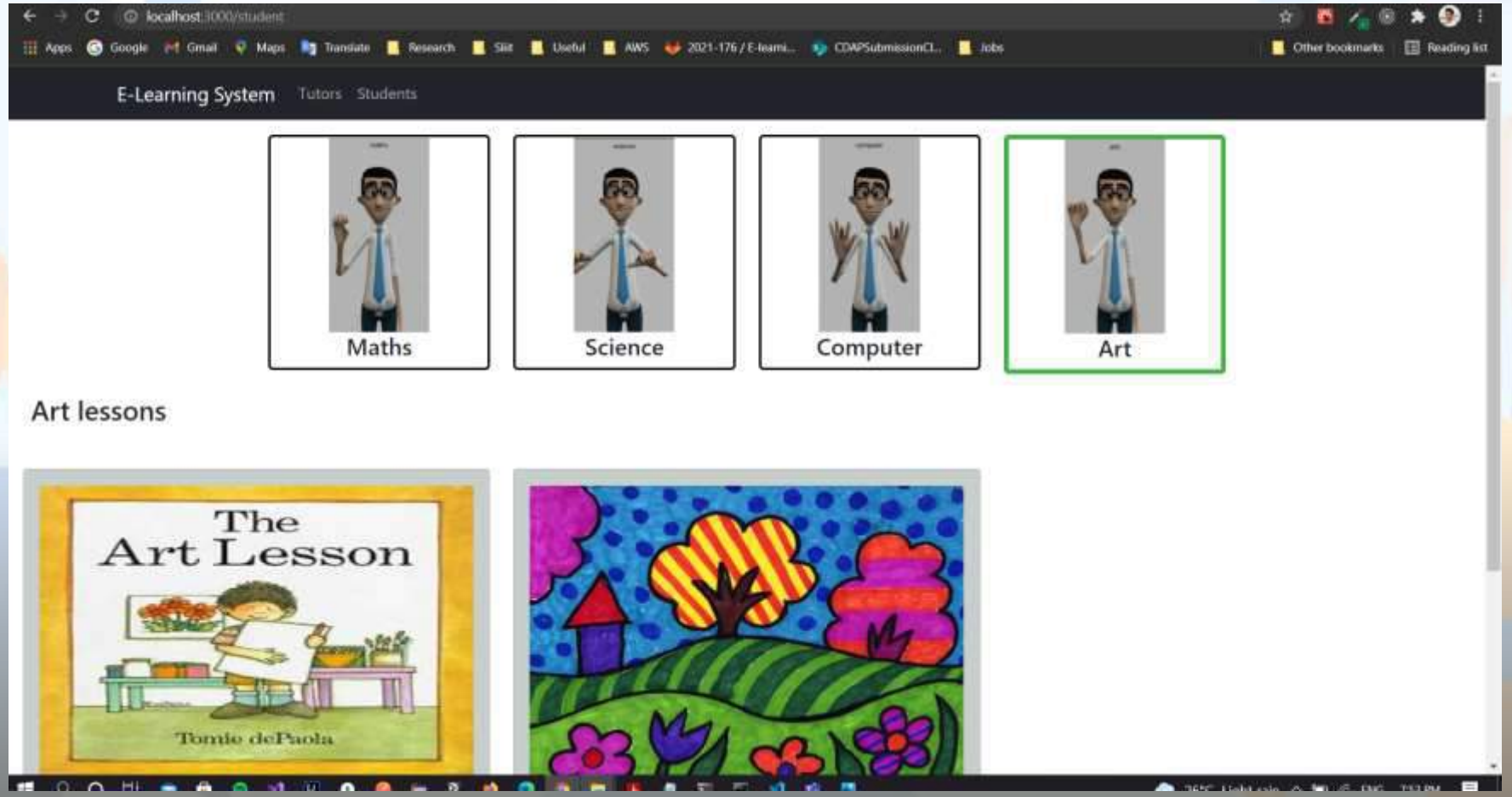
Completion of Project



Completion of Project



Completion of Project

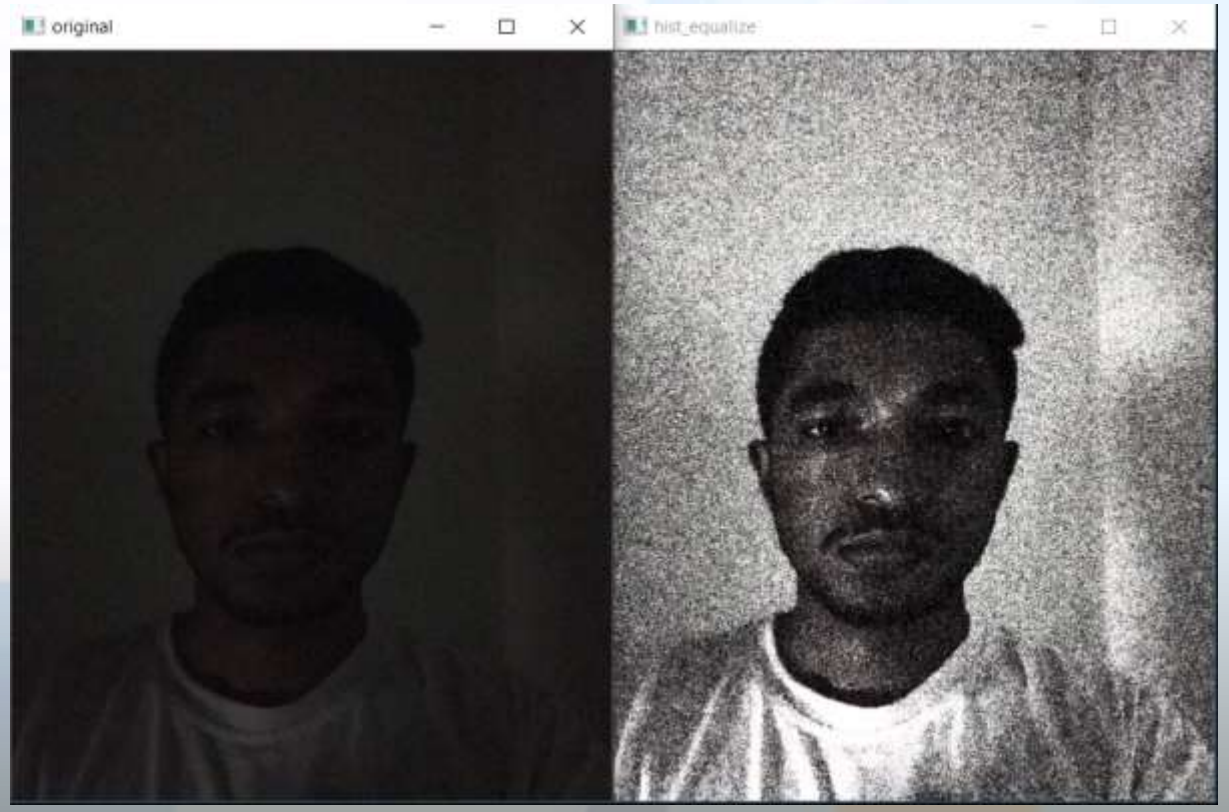


Completion of Project

Failed Attempts

- **Enhancing low light images using histogram equalization produces high noise in the image.**

- **Using gamma correction for videos in HSV format destroyed the low light parts of the video.**



Achievement

Completion

- Low light identification and enhancement algorithm
- Captioning Algorithm
- Backend
- Fronted

On going

- Fine tuning User interfaces

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Gantt Chart- Function

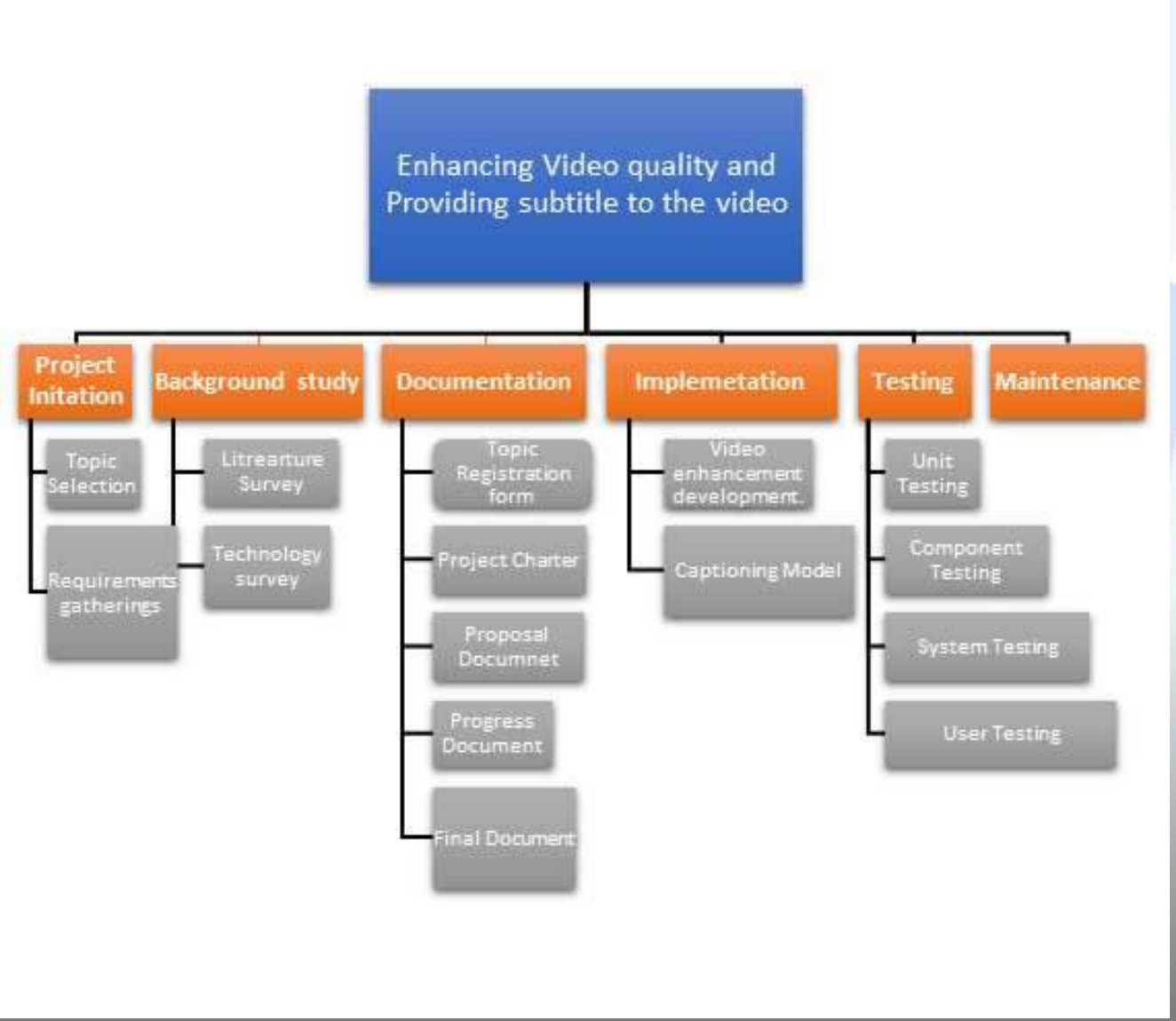
Task Name | Timeline

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 and Developing													
Research Paper													
Implementation Phase													
Implementing Algorithm													
Applying Video Enhancement													
Getting Captions from Video													
Adding Captions for Video													
Testing Phase and Evaluation													
Testing													
Final report													
Final Evaluation													

Completed Not Completed

IT18144772 – Niroshan K.

FUNCTION WORK BREAKDOWN



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.
- [4]https://capitalizemytitle.com/reading-time/10-words/

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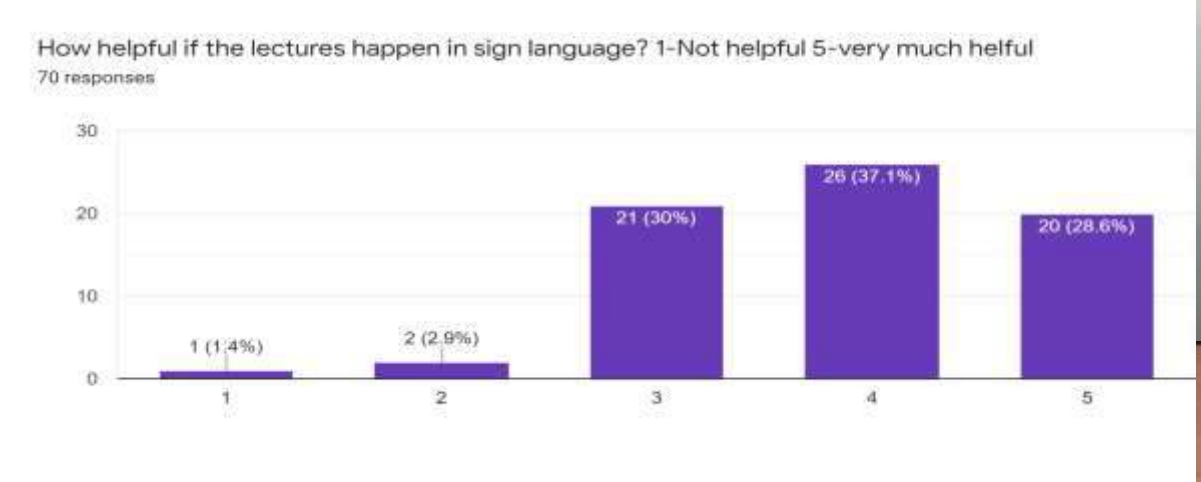
Bachelor of Science (Hons) in Information Technology Specializing in Data Science

Functionality – Converting Text to Sign language

Research

- **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.**
- **The module for translation will help hearing disabled people to understand in an efficient and easy way by providing them with a video to convey them the message of text.**



Research Gap

System	Reliable translation of words	Sign Language translation in E-Learning platform
M. S. Nair, N. A. P and S. M. Idicula	X	X
System proposed A.S. Drigas, D. Kouremenos, S. Kouremenos and J. Vrettaros	X	X
Our System	✓	✓

Objective

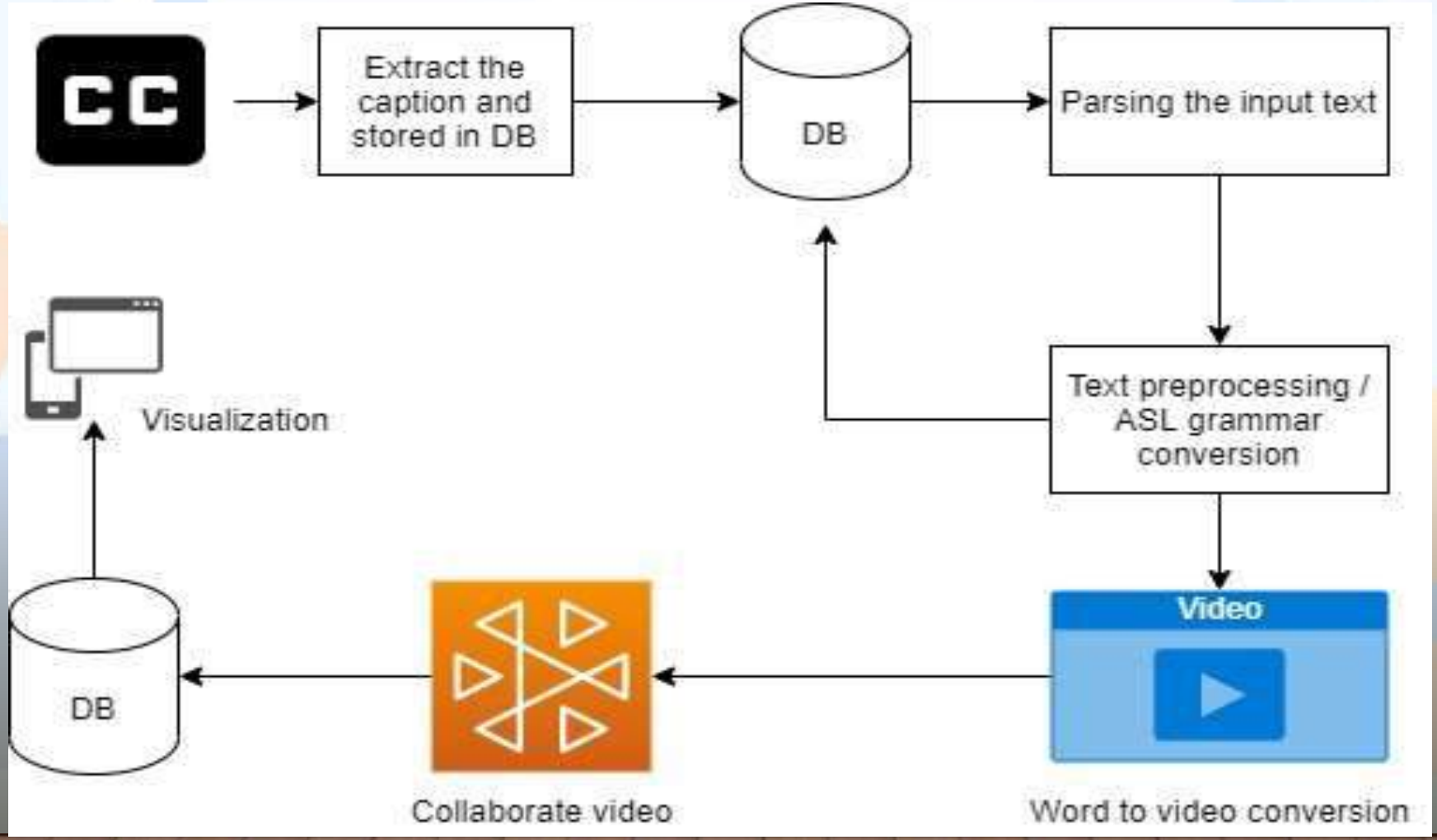
Main Objective

- **Converting lecture videos into sign language through the video captions (text) using Natural Language Processing technique.**

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

1. I used MS-ASL to download the video clips of each and every word.

2. Converting English grammar into American sign language grammar

   - A parser will be used to parse the English text.
   - The sentences will be reordered based on the ASL grammar rules.
   - An eliminator will be used for stop words removal.
   - Stemming will be done for getting the root words and replacing the synonyms.

3. Video conversion will be done.

Methodology

- **Video conversion**

In this final step, the ASL transformed text will be made to find matches from the downloaded video data set available for each word, using its label.

Then, a set of videos will be displayed as a sequence on the screen, representing the captions of the lecture video.

Test Results

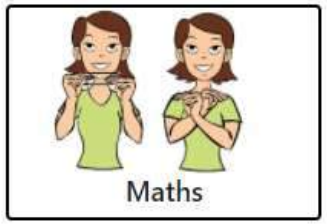
```
inputString = " "

java_path = "C:\\Program Files\\Java\\jdk-13.0.1\\bin\\java.exe"
os.environ['JAVAHOME'] = java_path

for each in range(1, len(sys.argv)):
    inputString += sys.argv[each]
    inputString += " "

# inputString = raw_input("Enter the String to convert to ISL: ")
inputString = "I am going to School to do my Presentation tomorrow."

# D:\accash\stanford-postagger-full-2015-12-09\models
parser = StanfordParser(
    model_path='D:/accash/stanford-parser-full-2015-12-09/edu/stanford/nlp/models/lexparser/englishPCFG.ser.gz')

o = parser.parse(inputString.split())

englishtree = [tree for tree in parser.parse(inputString.split())]
parsetree = englishtree[0]

dict = {}
```

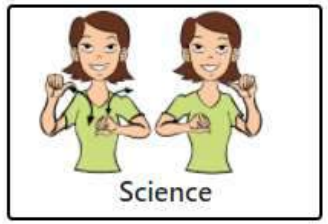
Test Results

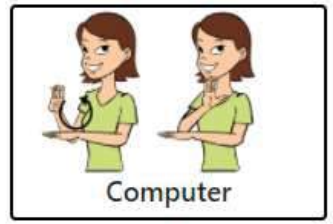
```
(NP (PRP$ my) (NNP Presentation) (NN tomorrow.))
3
1
(PRP$ my)
1
0
(NNP Presentation)
1
0
(NN tomorrow.)
1
0
(PRP$ my)
1
0
(NNP Presentation)
1
0
(NN tomorrow.)
1
0
school present tomorrow. go
PS D:\accash>
```

Completion of project

E-Learning System Tutors Students





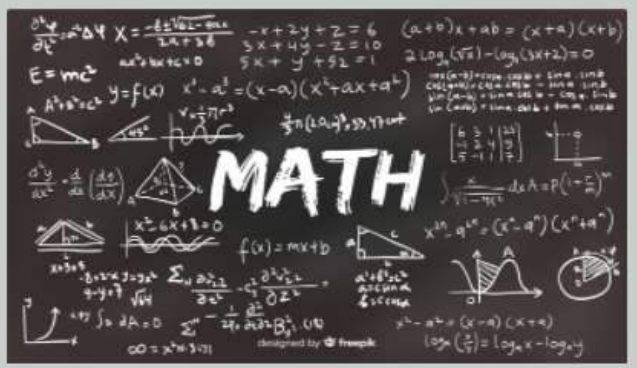


All lessons

Parts of computer

Computer

This lesson teaches the parts of a computer



Numbering systems

Maths

This lesson teaches the numbering systems

Mammals

Science

This lesson teaches the mammals in the environment

Completion of project

E-Learning System Tutors Students

Parts of computer

Computer

This lesson teaches the parts of a computer

Ask Questions!

Post your question in Sign language

Choose File No file chosen

Post question

Copyright © SNAP Group

Achievement

Completion

- English grammar to ASL grammar conversion
- Text to video conversion
- Backend
- Fronted

On going

- Fine tuning User interfaces.

Technology & Tool Selection

Technologies

- Natural Language Processing

Tools

- Natural Language Processing - NLTK
- For version controlling – GitLab
- Project Management – MS Planner

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Gantt Chart - Function

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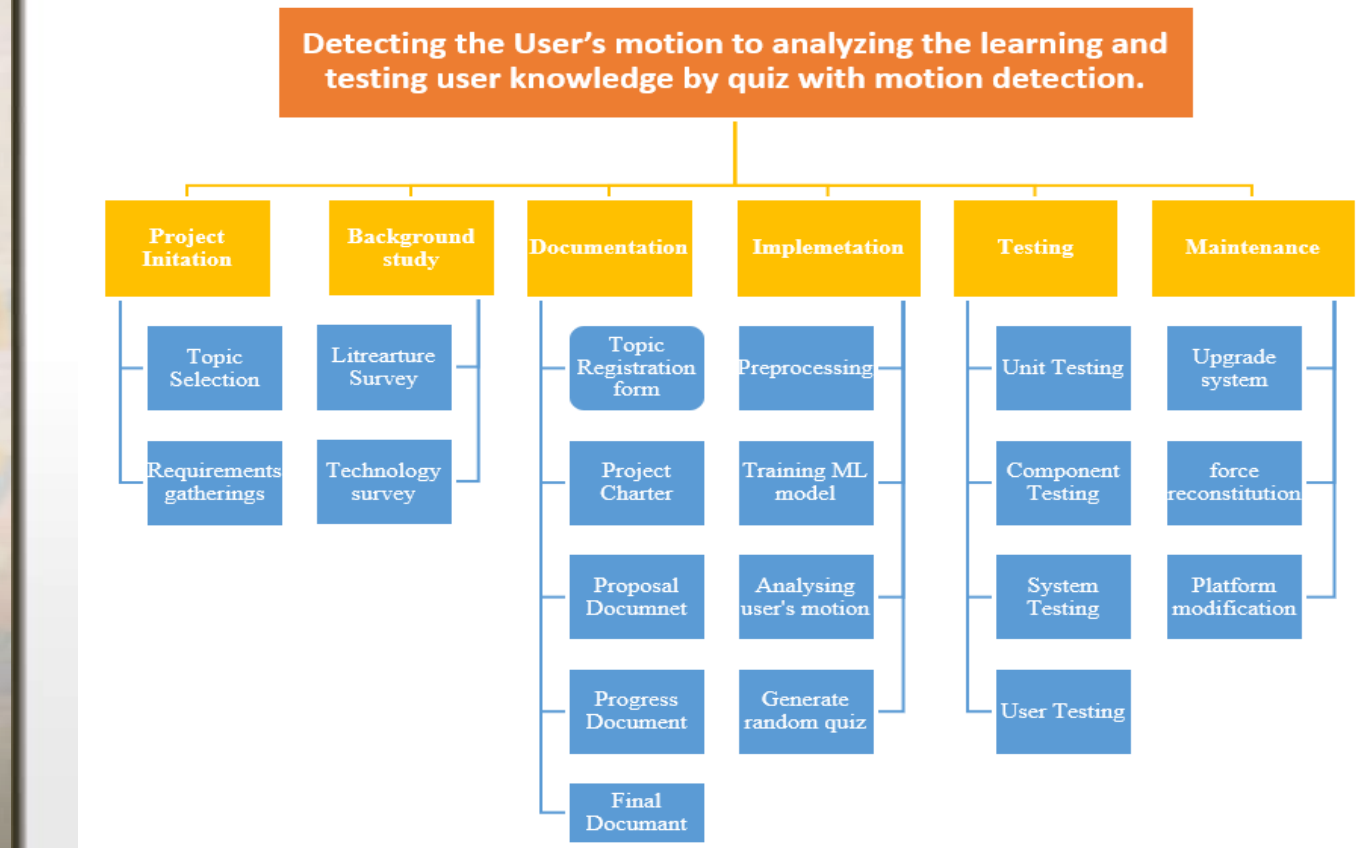
Selecting Algoritham techonologies													
Implementation Phase													
NLP Preprocessing													
Model Creation													
Connecting Models													
Exprimental Analysis													
Testing Phase and Evaluation													
Research Paper													
Testing													
Final report													
Final Evaluation													

FUNCTION WORK BREAK DOWN



References

[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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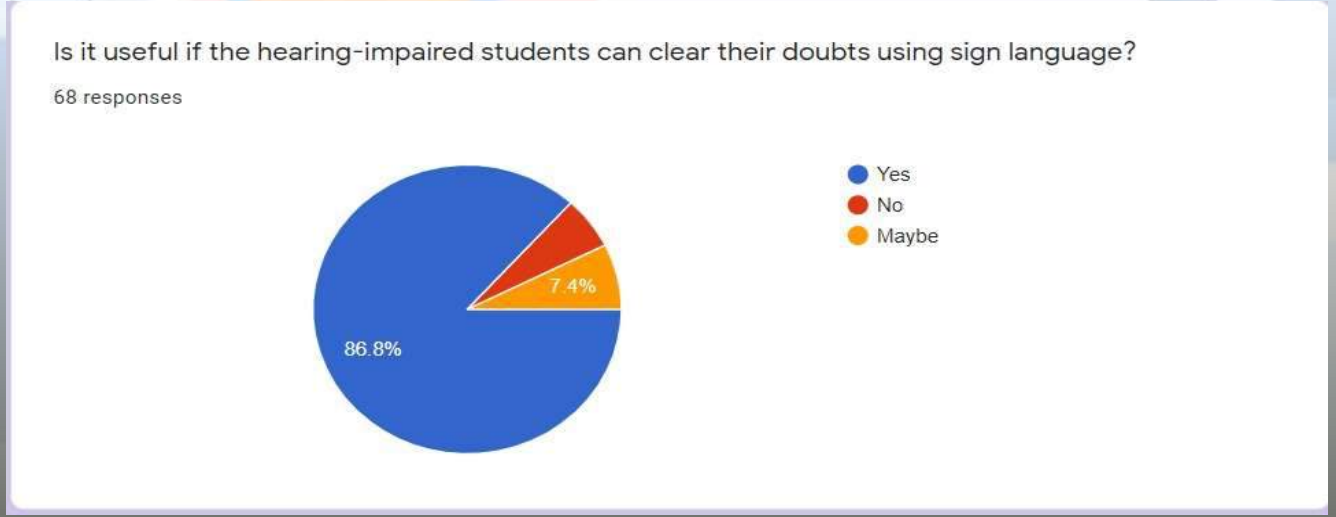
Functionality – Converting Sign language into text

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

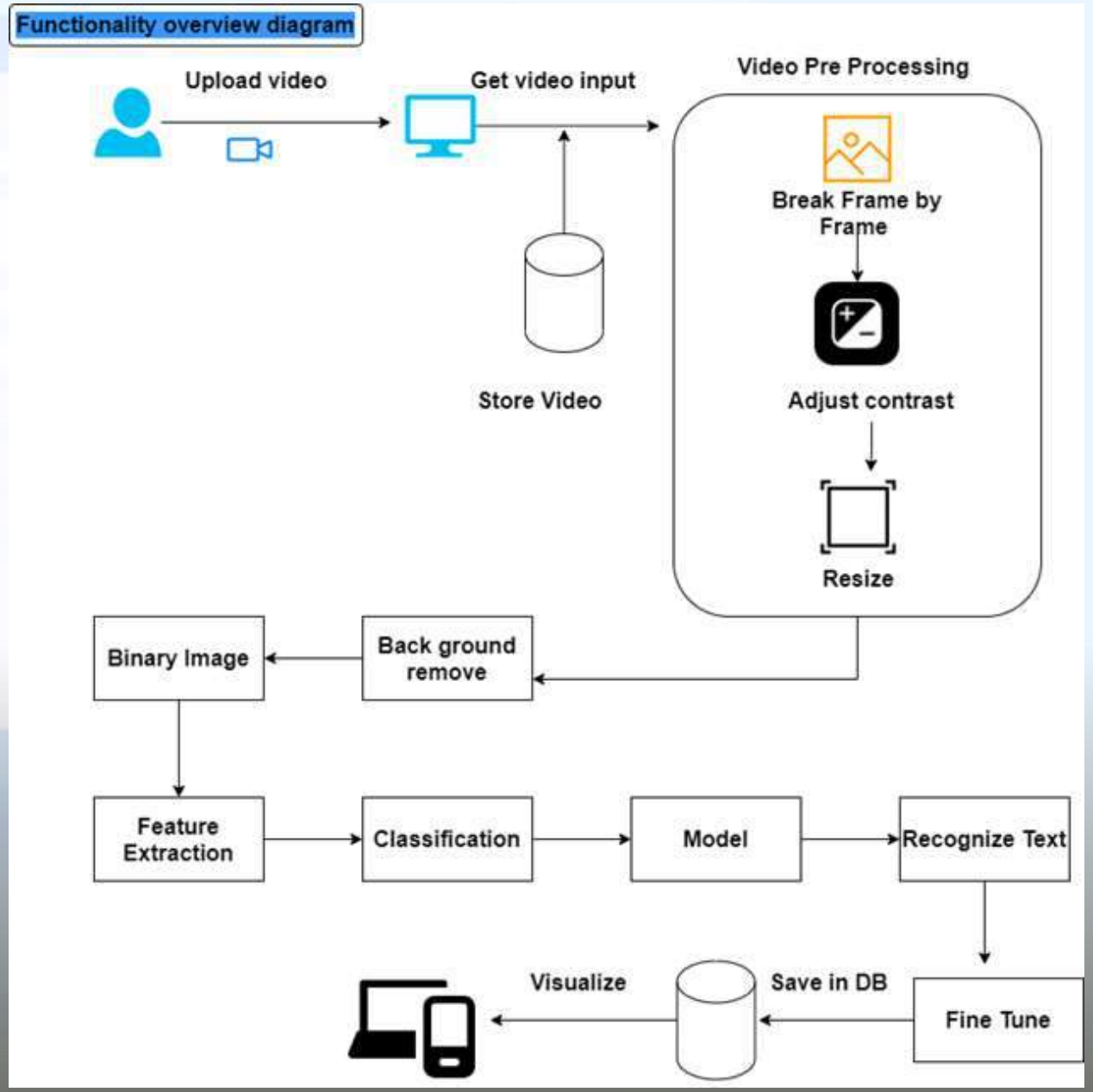
Main Objective

- 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 - Histogram of oriented gradients
- Classification - Stochastic Gradient Descent
- Training ML model data set from own dataset
- Recognize gestures text
- 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

- Flask
- React js

Tools

- For Video Processing– OpenCV
- For version controlling – GitLab
- Project Management – MS Planner

Test Results

My Video3.mp4

```
['when ', 'can ', 'help ', ' ?']
127.0.0.1 - - [15/Oct/2021 12:33:13] "POST / HTTP/1.1" 200 -
```

Health Question

when can help ?

Answer

My Video2.mp4

```
['how ', ' ', 'how ', ' ', 'how ', ' ', 'how ', ' ', 'drink ', ' ', 'dri
lp ', ' ', 'help ', ' ', 'help ', ' ']
['how',' ','can ','drink ','help ','?']
127.0.0.1 - - [15/Oct/2021 12:36:10] "POST / HTTP/1.1" 200 -
```

Health Question

how can drink help ?

Answer

Completion of the project

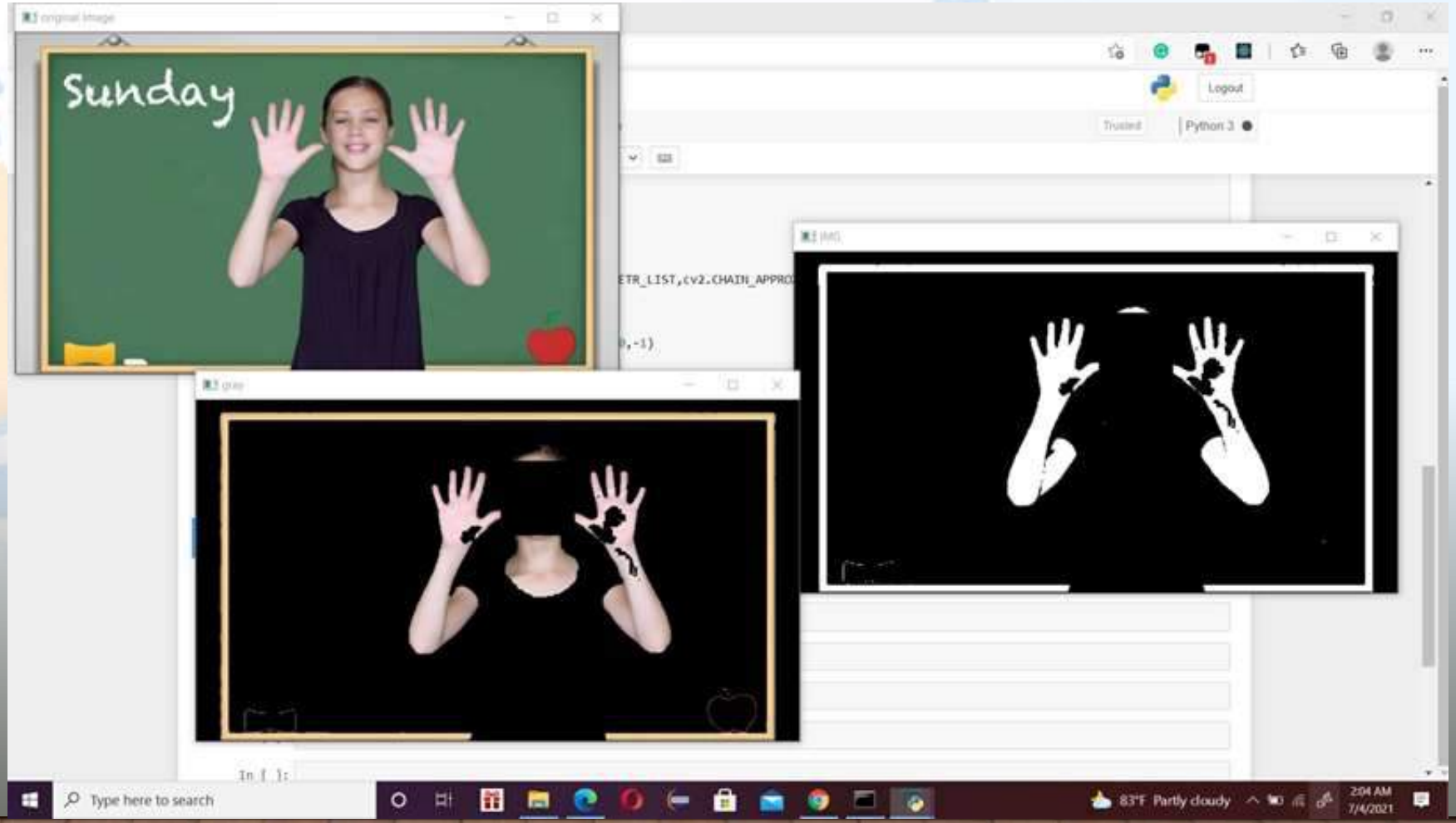
Pre processing

Resize Image

Find skin color area

Hide Face

Hide face



Failed attempts

- **MS ASL data set not accurate**

Model accurancy

In [180]:
```
cr = sklearn.metrics.classification_report(y_test,y_pred_test,output_dict=True)
pd.DataFrame(cr).T
```

Out[180]:

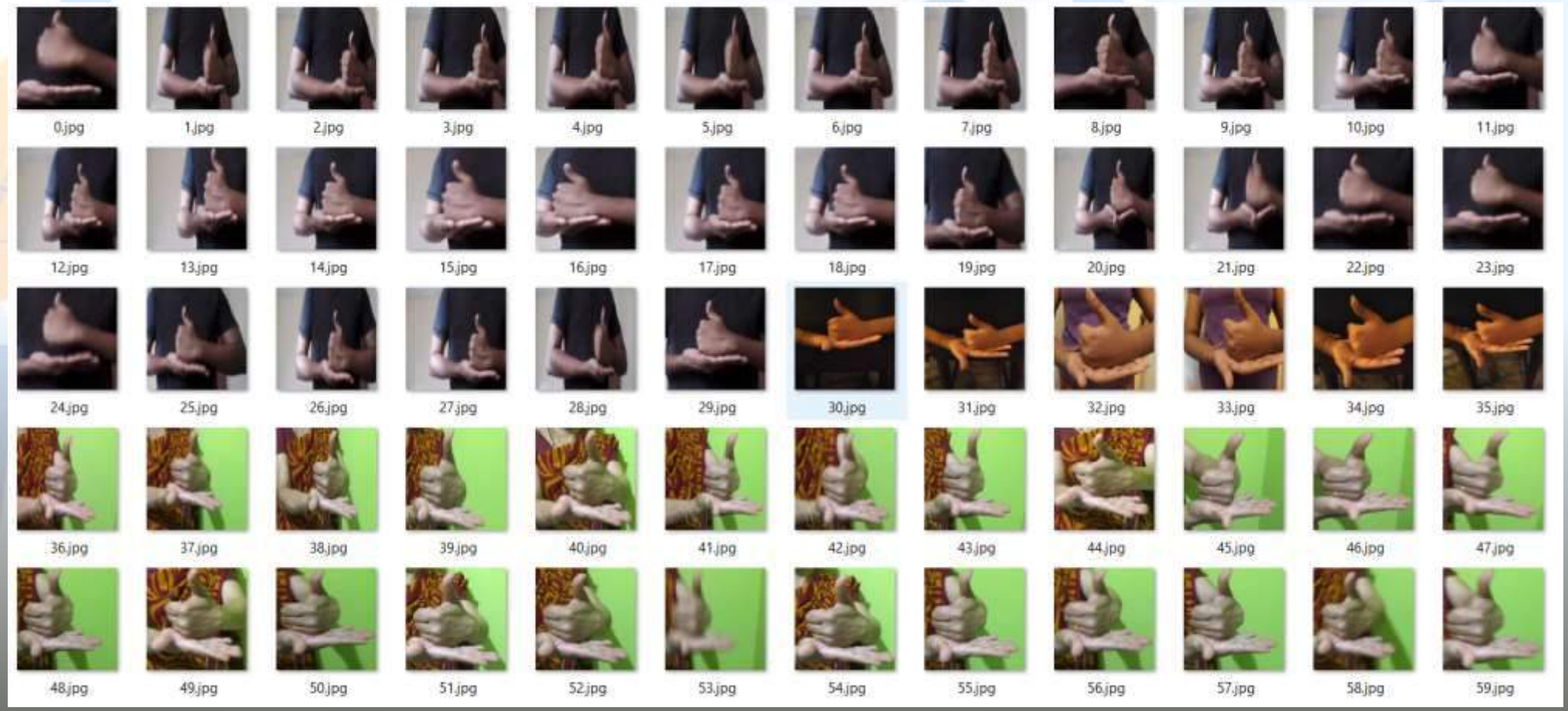
	precision	recall	f1-score	support
book	1.0	1.0	1.0	20.0
boring	1.0	1.0	1.0	17.0
easter	1.0	1.0	1.0	26.0
fail	1.0	1.0	1.0	21.0
germany	1.0	1.0	1.0	12.0
library	1.0	1.0	1.0	33.0
like	1.0	1.0	1.0	14.0
phone	1.0	1.0	1.0	31.0
signlanguage	1.0	1.0	1.0	23.0
accuracy	1.0	1.0	1.0	1.0
macro avg	1.0	1.0	1.0	197.0
weighted avg	1.0	1.0	1.0	197.0

In [179]:
```
metrics.cohen_kappa_score(y_test,y_pred_test)
```

Out[179]: 1.0

Completion of the project

Own dataset



Completion of the project

Labelling

```
In [21]: data['data'].shape

Out[21]: (486, 200, 200, 3)
```

```
In [22]: plt.figure(figsize=(12,6))
for i,c in enumerate(data['labels']):
    index=data['target'].index(c)
    img=data['data'][index]

    plt.subplot(3,10,i+1)
    plt.imshow(img)
    plt.xticks([]), plt.yticks([])
    plt.title(c)
plt.show()
```

Completion of the project

Model create and Training

Model Evaluation

In [41]:
```
cr = sklearn.metrics.classification_report(y_test,y_pred_test,output_dict=True)
pd.DataFrame(cr).T
```

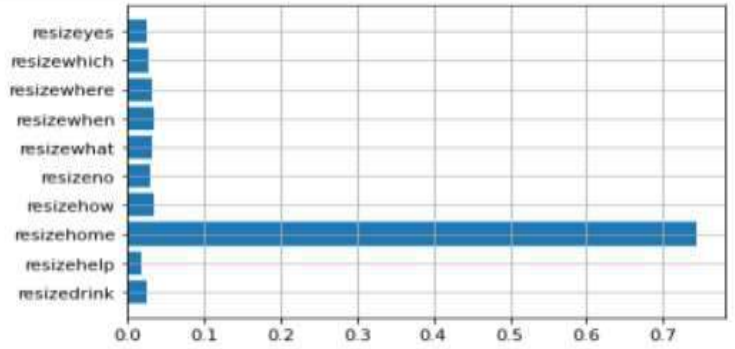
Out[41]:

	precision	recall	f1-score	support
resizedrink	1.000000	1.000000	1.000000	5.000000
resizehelp	1.000000	1.000000	1.000000	15.000000
resizehome	0.500000	0.200000	0.285714	5.000000
resizehow	0.750000	1.000000	0.857143	6.000000
resizeno	0.636364	0.700000	0.666667	10.000000
resizewhat	0.857143	0.923077	0.888889	13.000000
resizewhen	0.928571	0.866667	0.896552	15.000000
resizewhere	0.800000	0.800000	0.800000	10.000000
resizewhich	0.800000	0.923077	0.857143	13.000000
resizeyes	0.500000	0.333333	0.400000	6.000000
accuracy	0.826531	0.826531	0.826531	0.826531
macro avg	0.777208	0.774615	0.765211	98.000000
weighted avg	0.814644	0.826531	0.814130	98.000000

In [42]:
```
metrics.cohen_kappa_score(y_test,y_pred_test)
```

Out[42]: 0.8034218289085546

In [17]:
```
plt.barh(labels,prob_value)
plt.grid()
```



In [18]:
```
# top five probabilty values
top_5_prob_ind = prob_value.argsort()[::-1][:5]
```

In [19]:
```
top_5_prob_ind
```

Out[19]: array([2, 6, 3, 5, 7], dtype=int64)

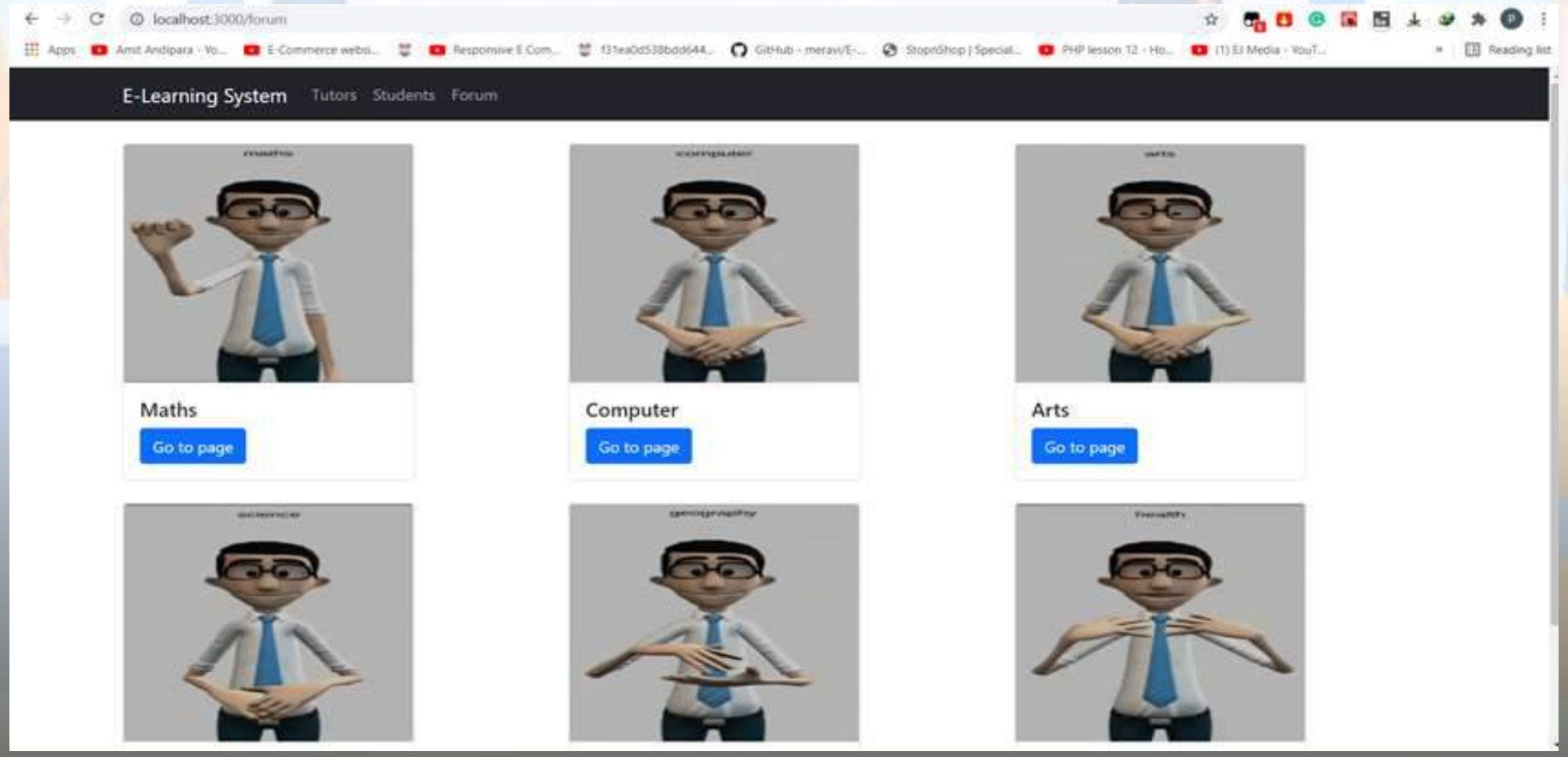
In [20]:
```
top_labels = labels[top_5_prob_ind]
top_prob = prob_value[top_5_prob_ind]
```

In [21]:
```
top_prob,top_labels
```

Out[21]:
```
(array([0.74374656, 0.03406137, 0.03361478, 0.03219125, 0.03138241]),
 array(['resizehome', 'resizewhen', 'resizehow', 'resizewhat',
        'resizewhere'], dtype='<U11'))
```

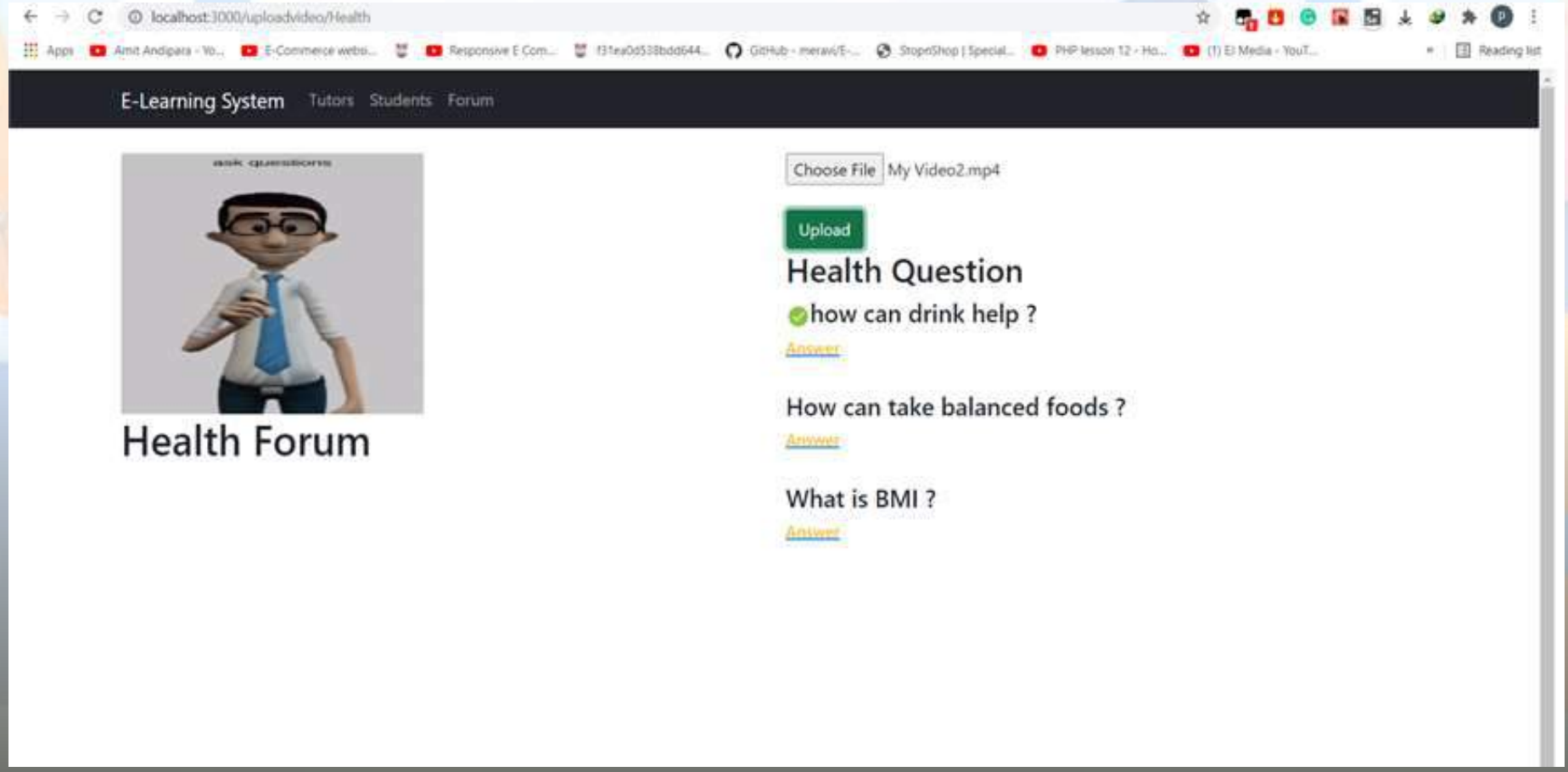
Completion of the project

Website using Flask uploading image



Completion of the project

Website using Flask uploading Video



Achievement

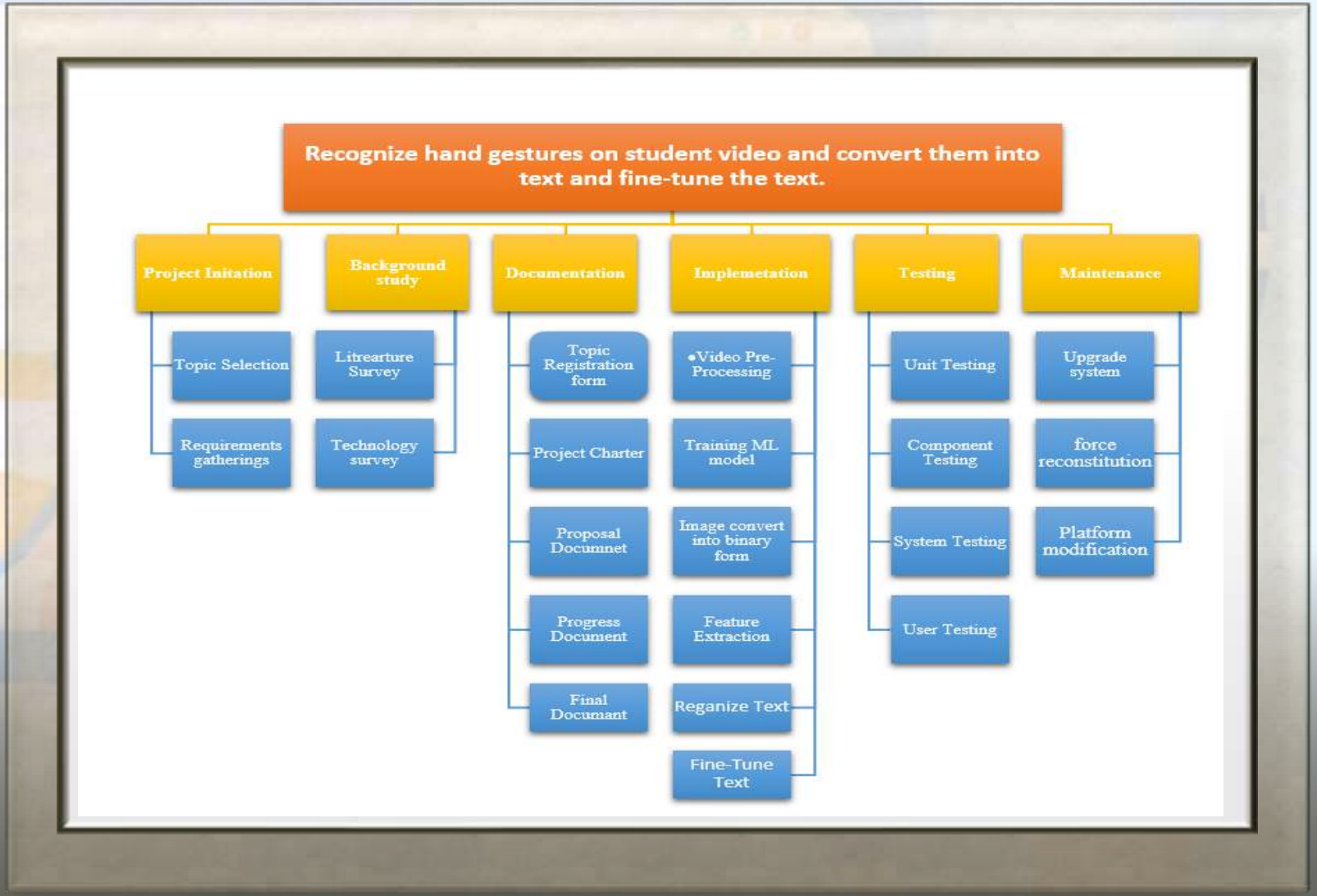
Completion

- Detect video sign language into text
- Identify hands gestures irrespective of skin color, background.
- Backend and Frontend

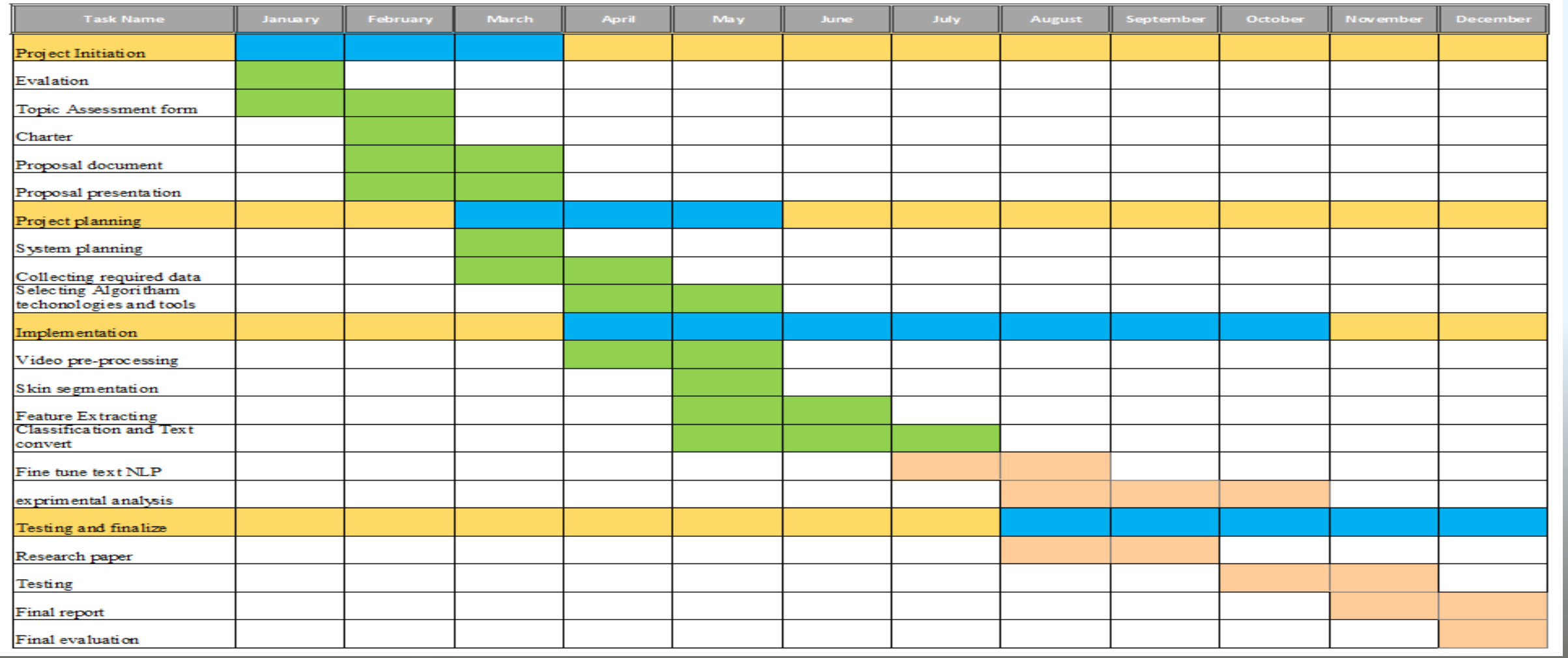
On going

- More testing and Bug Fixing!!

FUNCTION WORK BREAK DOWN



Gantt Chart - Function



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

Reference

[1] https://www.youtube.com/watch?v=iGWbqhdjf2s
[2] https://www.analyticsvidhya.com/blog/2019/09/feature-engineering-images-introduction-hog-feature-desc
[3] https://www.freecodecamp.org/news/how-to-build-a-web-application-using-flask-and-deploy-it-to-the-cloud-3551c985e492/
[4] https://towardsdatascience.com/image-pre-processing-c1aec0be3edf
[5] https://www.mygreatlearning.com/blog/introduction-to-image-pre-processing/
[6] https://flask.palletsprojects.com/en/2.0.x/
[7] https://analyticsindiamag.com/image-feature-extraction-using-scikit-image-a-hands-on-guide/

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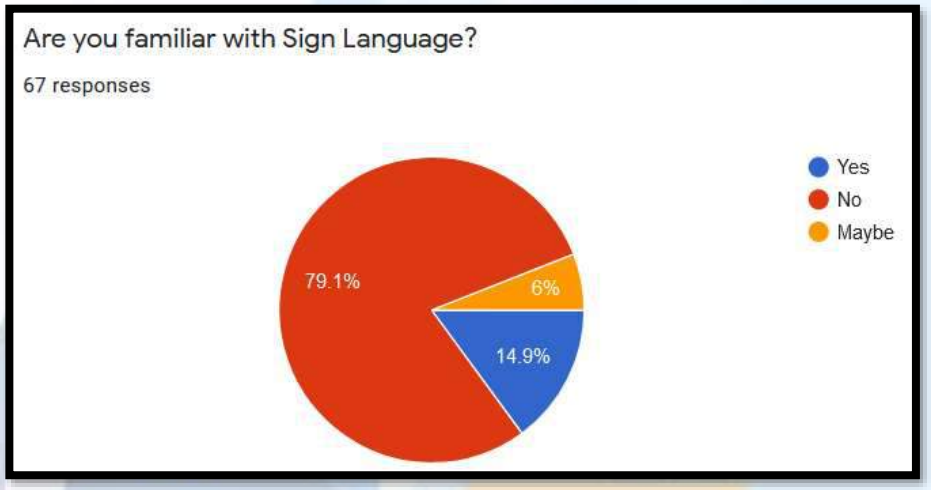
IT18152074 – Sangeeth Raj A

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

Functionality – Teaching American Sign language

Introduction

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



Research Gap & Problem

Research Problem

- There is no LMS on teaching sign language.
- The sign language tutors are lack of knowledge in teaching online platform.
- Lack of dataset for sign language.
- 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

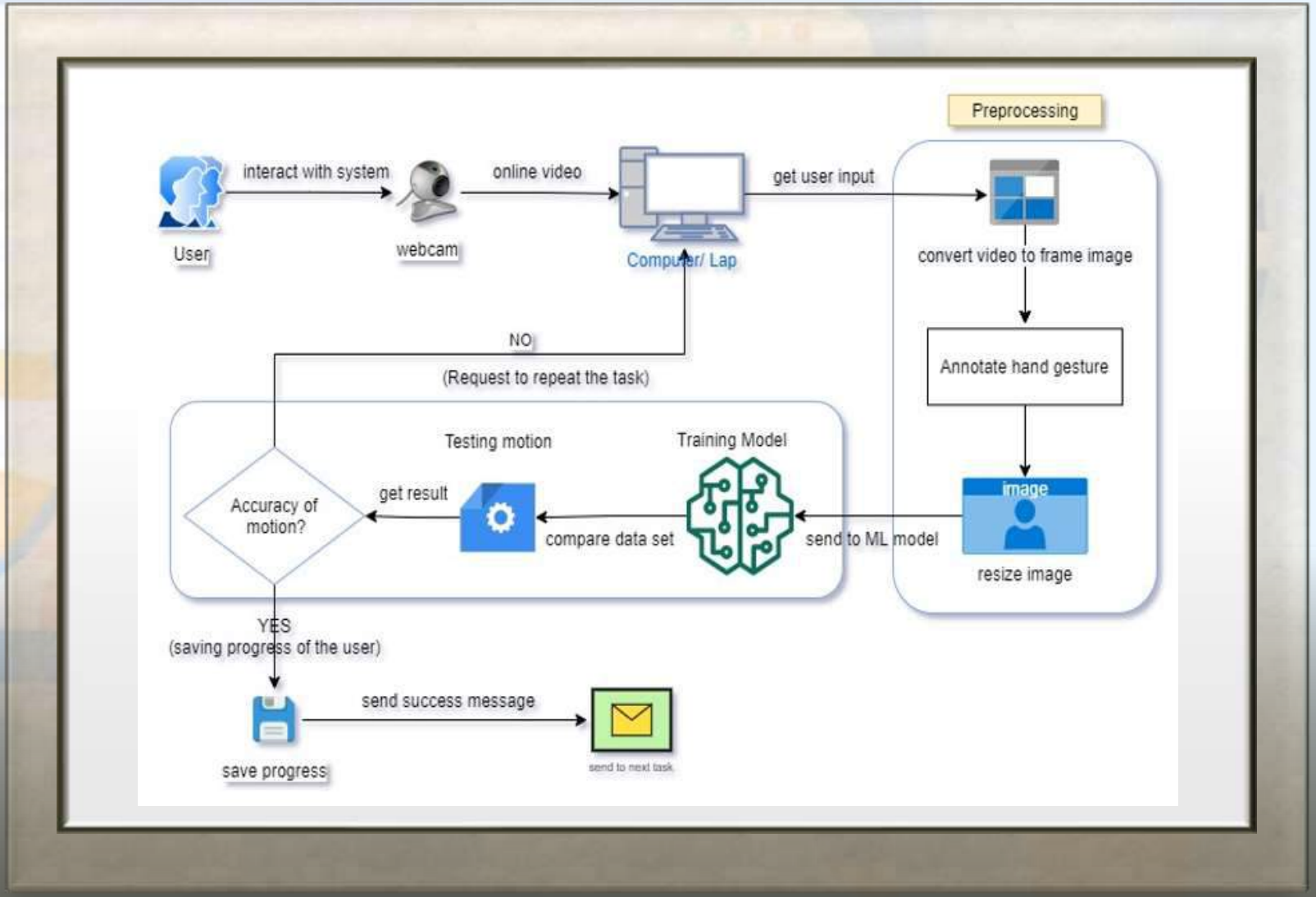
Main Objective

- 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.

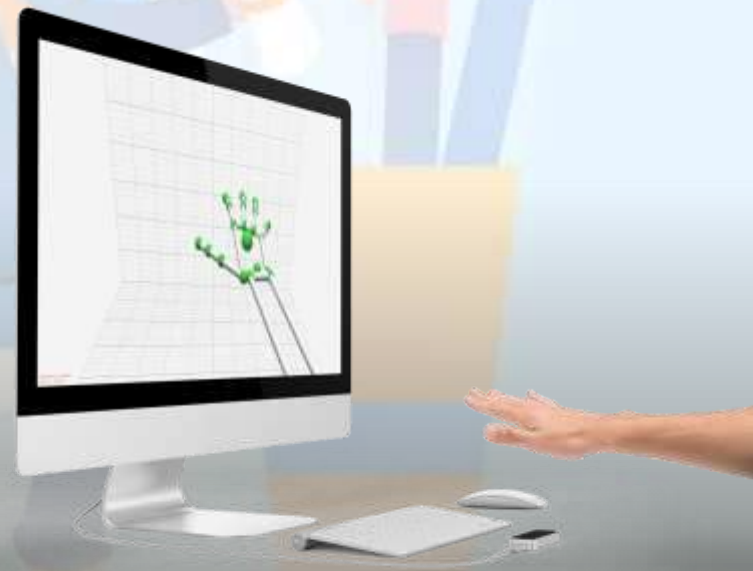
Function Overview



Methodology

Image Classification

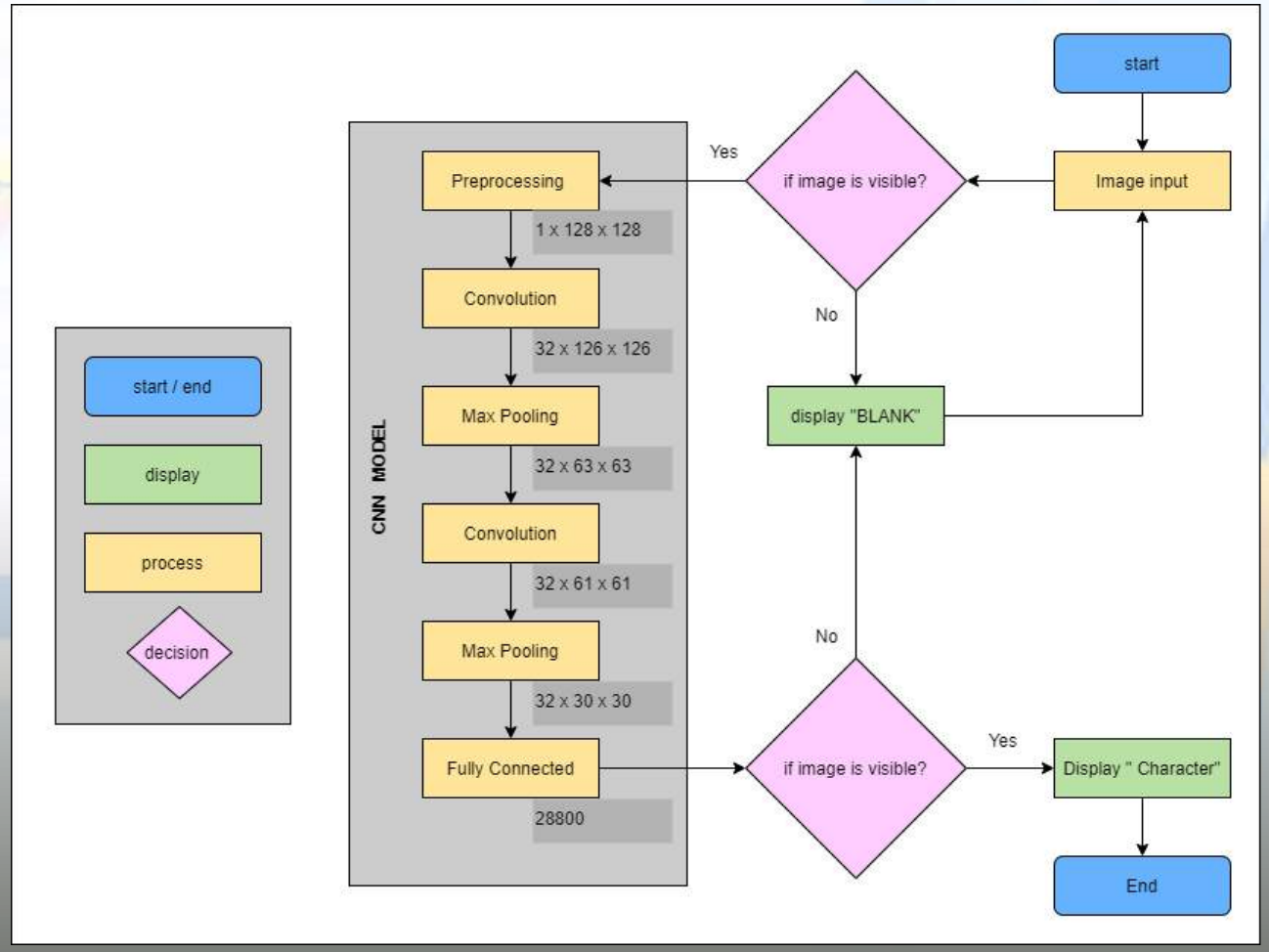
- **Implement ML model with Convolutional Neural Networks(CNN).**
- **Using ‘Keras' library to build a CNN model.**
- **Dataset alphabet of American sign language.**
- **Minimum 100-200 images per class to train.**
- **Image going through different stage in CNN classifier**
  1) Convolutional Layer
  2) Pooling Layer 1
  3) Convolutional Layer
  4) Pooling Layer 2



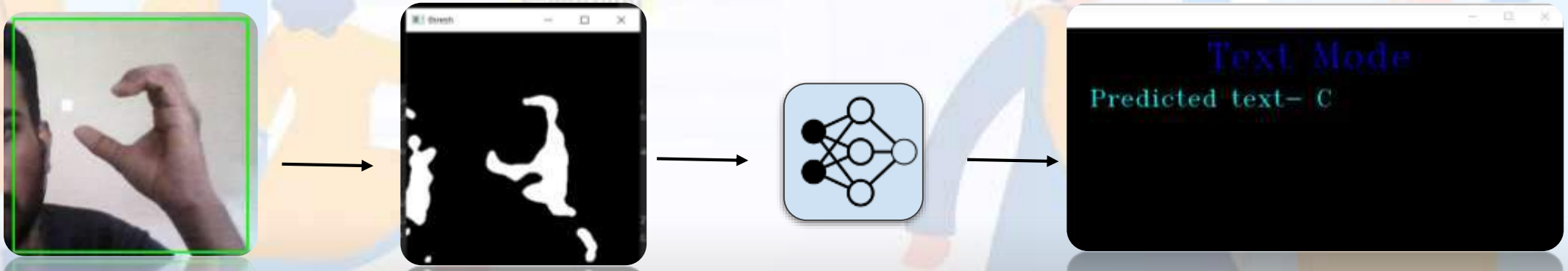
Methodology

CNN Model

- **Model trained with alphabet and digits**
- **Test with random sign in low light environment with webcam**(USB2.0 VGA UVC)



Methodology



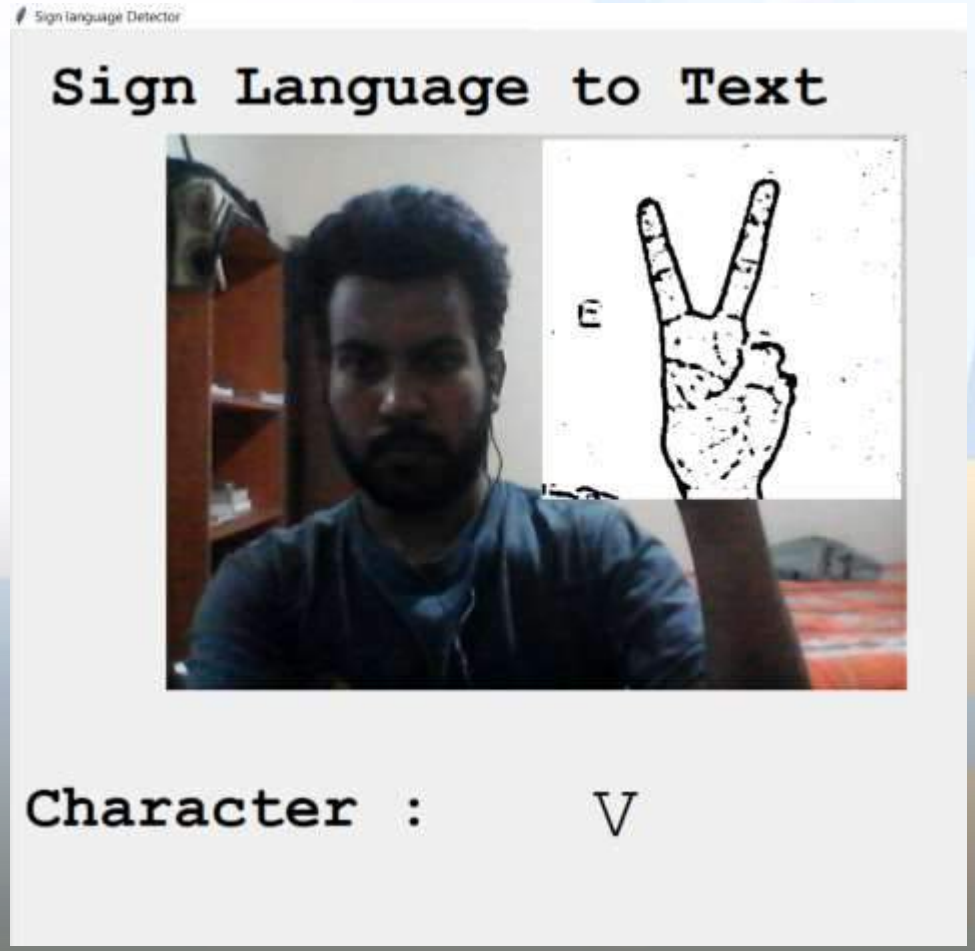
Hand Gesture → Threshold → CNN → Identified Symbol

Methodology

Analysis Object

Image Classifier

- Gaussian
- Rectified Linear Unit
- Max Pooling Layer
- Dropout Layers



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

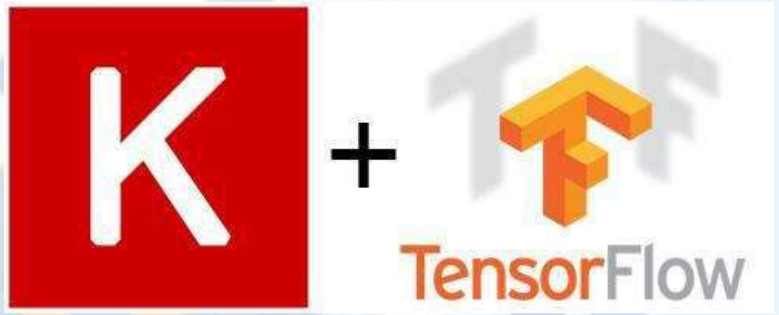
User Requirements

- Personal computer / Laptop
- Webcam
- Internet connection

Technology & Tool Selection

Technologies

- Preprocessing
- Image Classifier



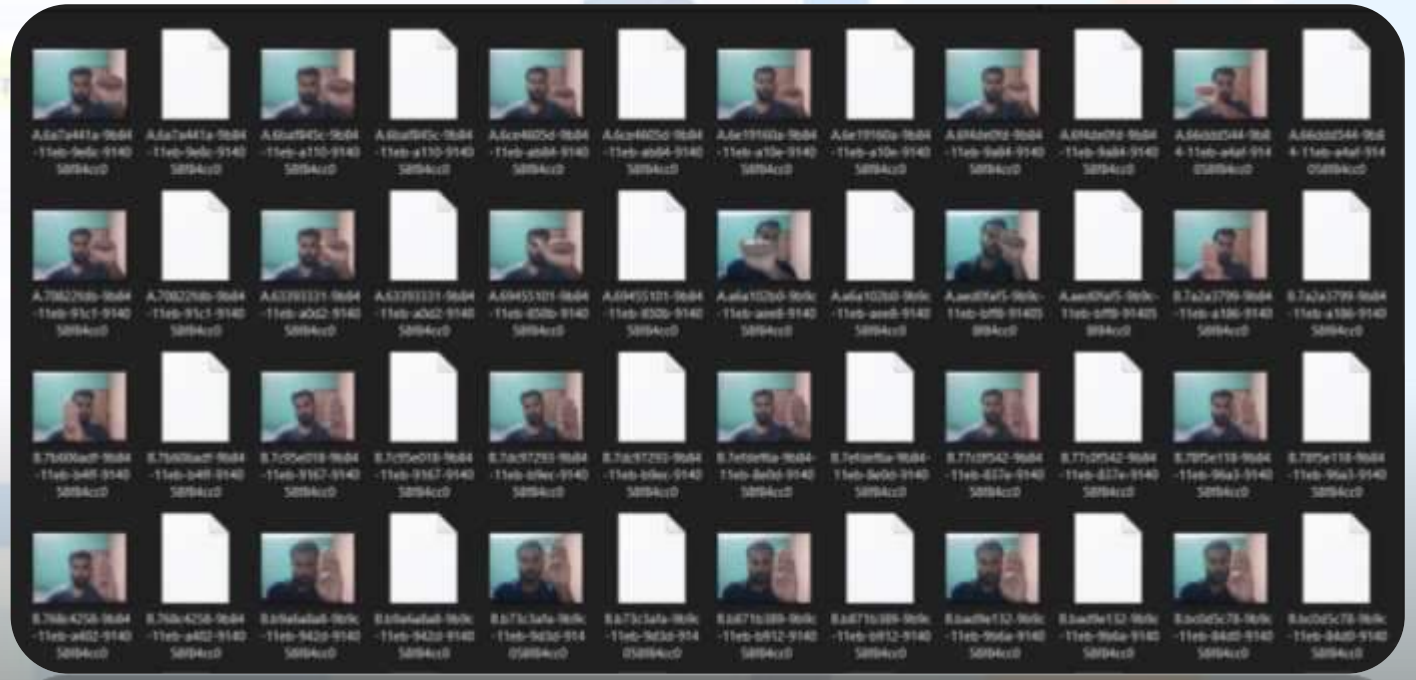
Tools

- Preprocessing– OpenCV, Gaussian filter
- Image Classifier – CNN, Keras, TensorFlow
- For version controlling – GitLab
- Project Management – MS Planner

Completion of Project

Failed Attempts

- **Build model using TensorFlow tf2_detection_zoo, and train model with own dataset.**



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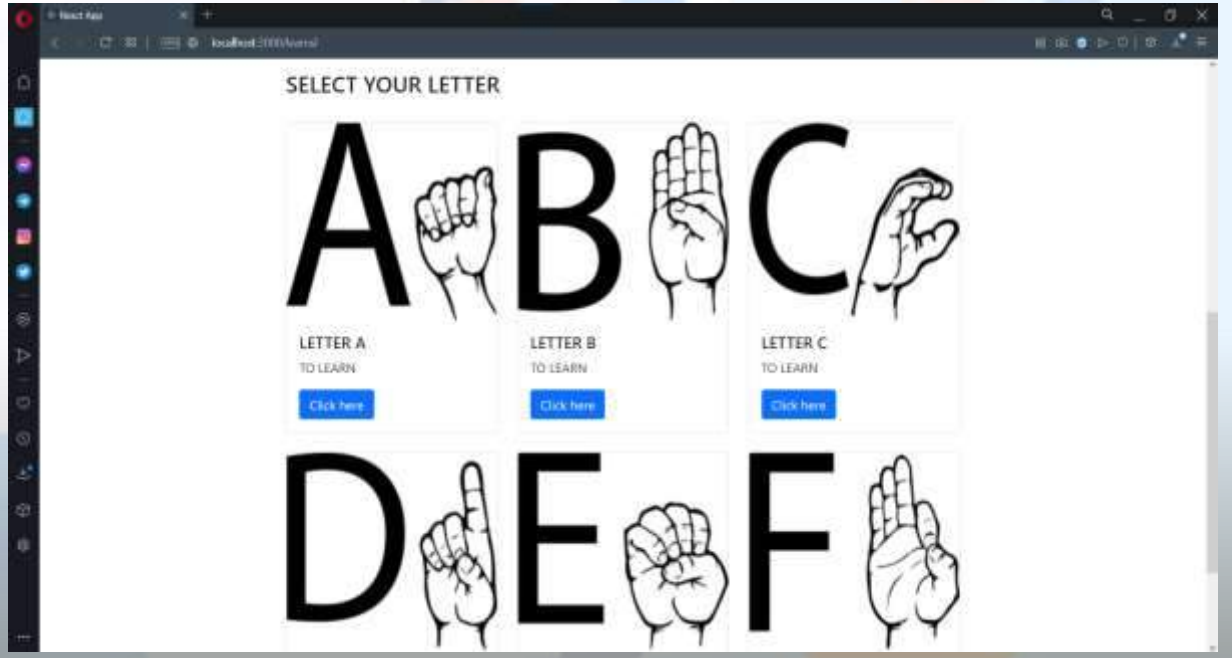
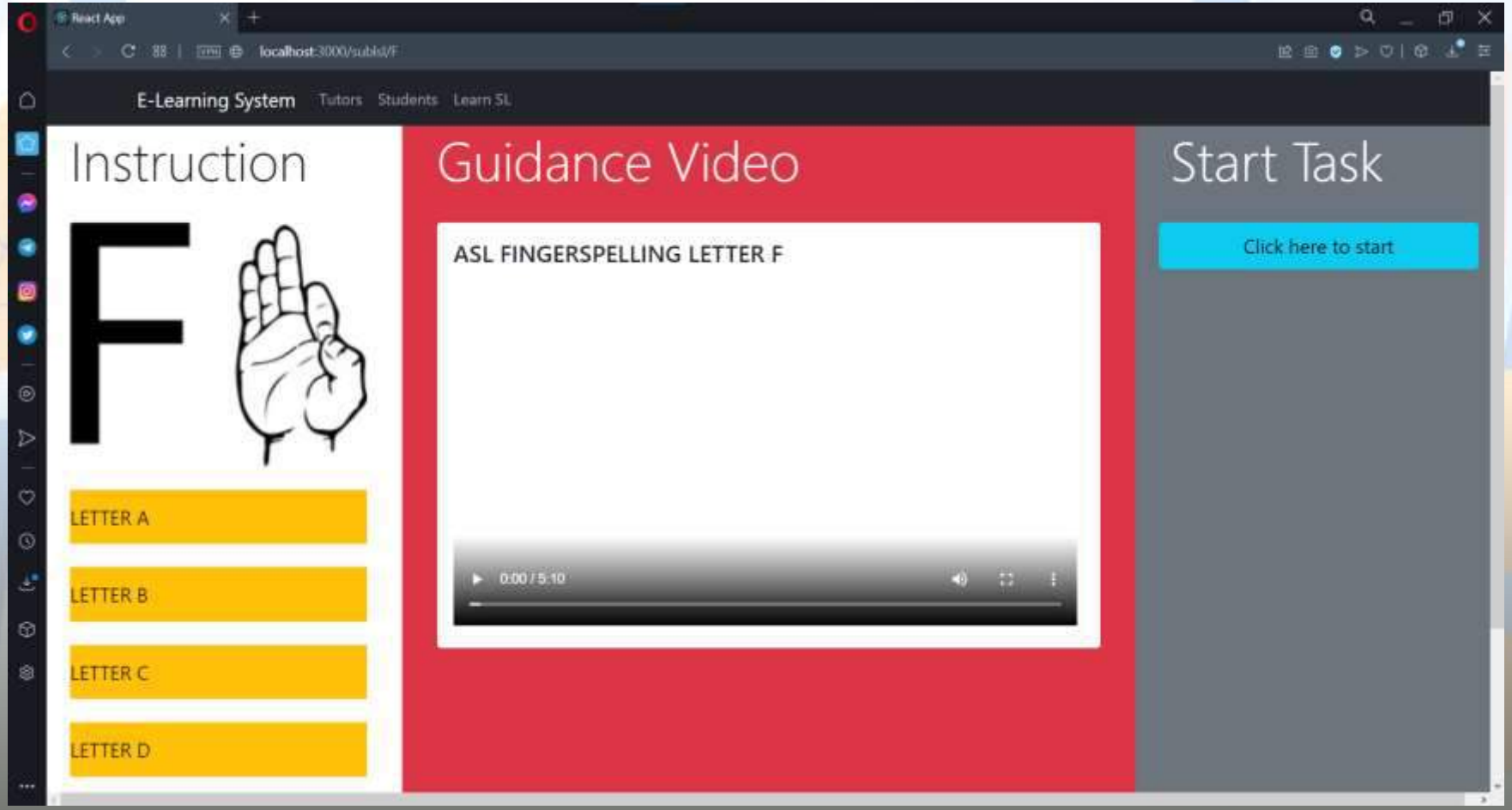
Completion of Project

User Interface



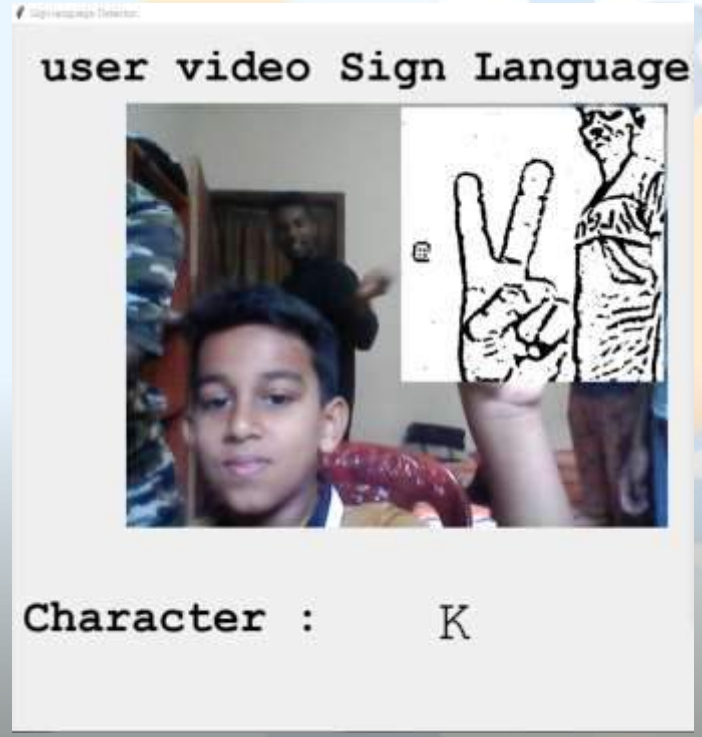
Completion of Project

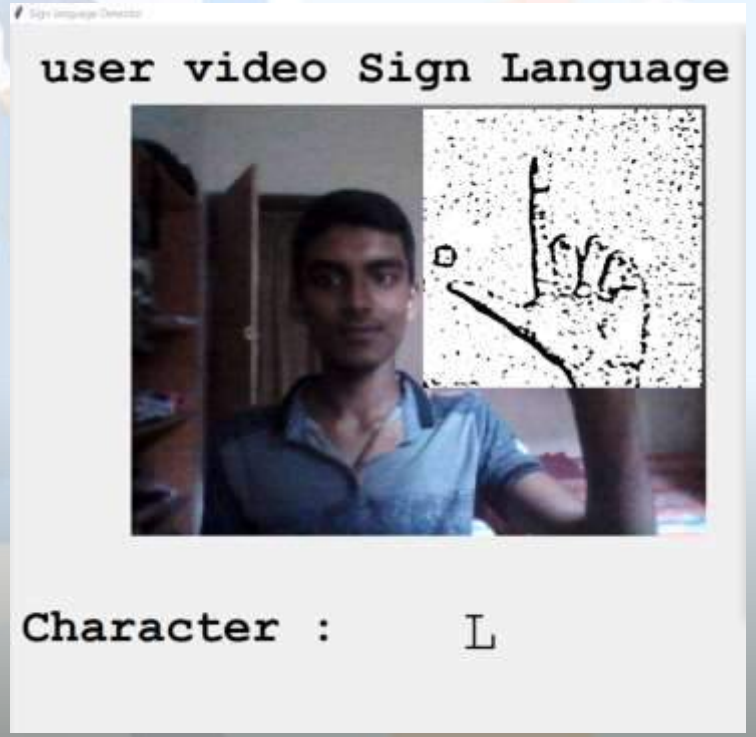
User Interface



Completion of Project

Model Testing





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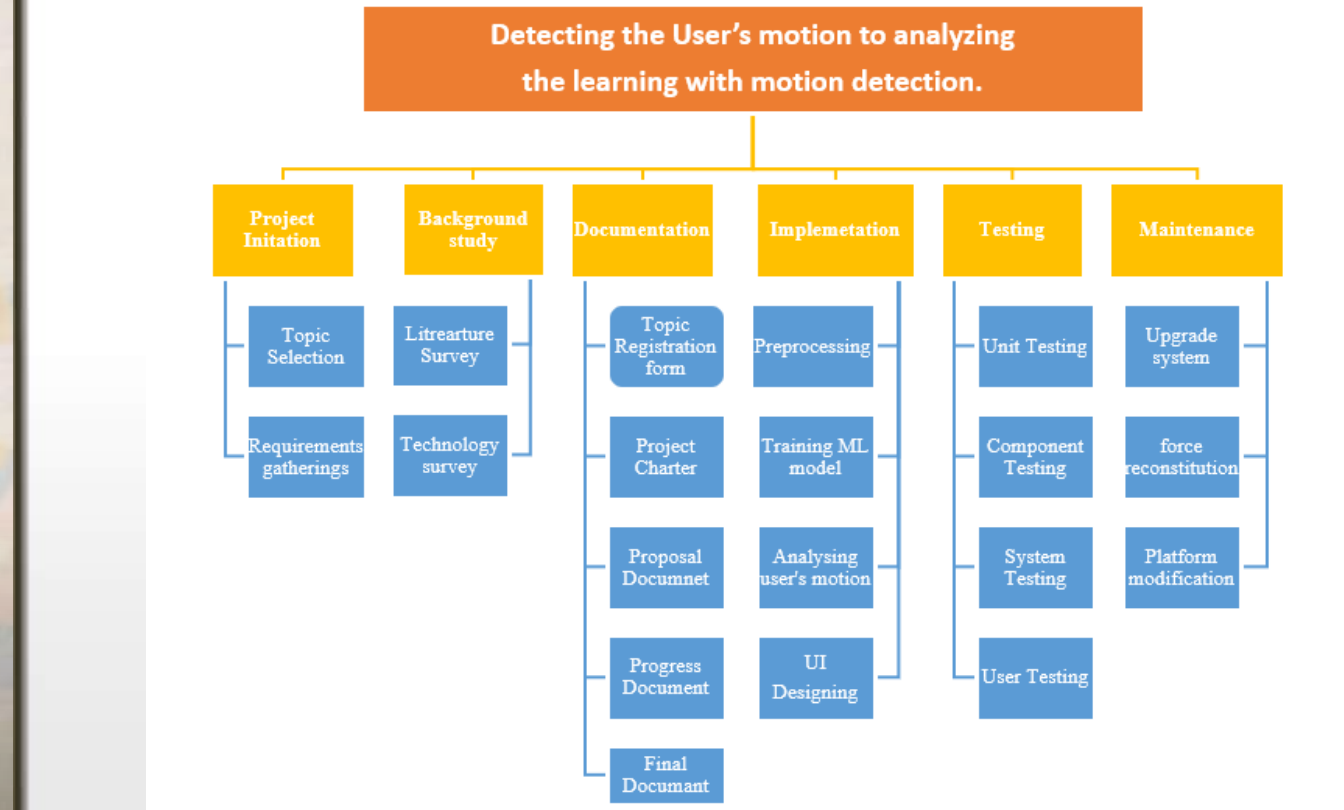
Gantt Chart - Function

FUNCTION WORK BREAK DOWN



Achievement

Completion

- Detect images in real-time
- Identify hands gestures
- UI Designing

On going

- More testing and Bug Fixing!!

Reference

1. https://www.python.org
2. https://pysource.com/object-detection-opencv-deep-learning-video-course/
3. https://opencv.org
4. https://tensorflow-object-detection-api-tutorial.readthedocs.io/en/latest/install.html
5. https://keras.io/guides/training_keras_models_on_cloud/
6. https://www.machinecurve.com/index.php/2020/04/13/how-to-use-h5py-and-keras-to-train-with-data-from-hdf5-files/
7. https://blog.roboflow.com/computer-vision-american-sign-language/
8. https://github.com/tensorflow/models/blob/master/research/object_detection/g3doc/tf2_detection_zoo.md

THANK YOU

ANY QUESTIONS?