Second year Mini Project Report

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BACHELOR OF ENGINEERING IN COMPUTER ENGINEERING

By

Siddhi Vijay Awari 04

Sri Haritha Movva 44

Ananya Parthasarathy 48

Srushti Poriwade 52

Hainy Chughria 67

Supervisor

Prof. Nusrat Ansari

Department of Computer Engineering

Vivekanand Education Society's Institute of Technology

HAMC, Collector's Colony, Chembur,

Mumbai-400074

University of Mumbai

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CERTIFICATE

This is to certify that the Mini Project entitled **“**GesSpy**”** is a bonafide work of **Siddhi Vijay Awari (04), Sri Haritha Movva (44), Ananya Parthasarathy (48), Srushti Poriwade (52), Hainy Chughria (67)** submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of **“Bachelor of Engineering”** in **“Computer Engineering” .**

(Prof._____)

Supervisor

(Prof._____)

Head of Department

(Prof._____)

Principal

Mini Project Approval

This Mini Project entitled “GesSpy**”** by **Siddhi Vijay Awari (04), Sri Haritha Movva (44), Ananya Parthasarathy (48), Srushti Poriwade (52), Hainy Chughria (67)** is approved for the degree of **Bachelor of Engineering** in **Computer Engineering.**

Examiners

1……

(Internal Examiner Name & Sign)

2……

(External Examiner name & Sign)

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Abstract

GesSpy – smart way to detect gestures. It will provide a platform for sharing and understanding opinions of mute and deaf people. “GesSpy” is an interactive space for sharing, which makes day-to-day talks among sign language users and the broader community convenient. It translates the signs into words and conveys the correct message. Users can skip the need to learn Indian Sign Language and communicate with their family, friends, etc. This web application presents the design and implementation of a sign detector system that utilizes computer vision and natural language processing techniques to enable real-time interpretation and communication of sign language messages. The proposed system leverages image processing algorithms to detect and recognize various signs captured by a camera, converting them into corresponding textual or vocal representations. Once a sign is detected, the corresponding message is generated in text format using language processing algorithms.

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Sincerely,

Siddhi Vijay Awari

Sri Haritha Movva

Ananya Parthasarathy

Srushti Poriwade

Hainy Chughria

List of Abbreviations

1. SL : Sign Language
2. ISL : Indian Sign Language
3. CSL : Chinese Sign Language
4. ArSL : Arabic Sign language
5. CNN: Convolutional Neural Networks
6. OpenCV: Open Source Computer Vision Library
7. HMM: Hidden Markov Models
8. RGB: Red Green Blue
9. API: Application programming interface

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Introduction

1.1 Introduction

Language is a crucial tool for communication, allowing individuals to express themselves, connect with others, and lead a more harmonious life. With over 7000 languages spoken worldwide, the power of language cannot be underestimated. Visual languages such as sign languages make use of hand, body, and eye motions. SL is a special language used by impaired people to communicate. For people with disabilities to have a means of communication, sign languages are crucial. Specially abled people can express themselves, communicate with others, and share their feelings using sign languages. The disadvantage is that not everyone is familiar with sign languages, which restricts communication between those with disabilities and average people. Even for normal people, communicating with impaired people is difficult as they are not aware of sign language (SL), so here the sign language recognition system is used to translate sign language into voice or text, to establish communication between normal and impaired people. As it is not feasible to have a sign interpreter everywhere, using a sign language recognition system one can become independent of a sign interpreter. This pattern recognition system is designed to understand human gestures, and if machines can recognize and differentiate these patterns, the desired message can be recreated. Signers use one sign to refer to several synonymous 35 words, such as home, house, and apartment. Similar to spoken 36 languages, sign languages are diverse; several sign languages are used worldwide, such as the ASL, CSL, and ArSL. Sign language recognition systems can be categorized into three parts like fingerspelling, word level, and continuous sign. Fingerspelling is a way in which signers use fingers for the alphabet and number representation without any facial expression. Word level is a way in which signers use hand movement to form sign words. A single hand gesture can describe the whole sign word. The continuous sign is a way in which along with the hand movement facial expression is also considered. As a result, systems that recognise various signs and deliver information to ordinary people are required.

1.2 Motivation

The need to socially connect the deaf and mute individuals led to the development of such sign recognition systems. To provide them a platform to express their thoughts, feelings freely without any ambiguity to any person who knows or doesn't know sign language is highly essential. A better alternative for learning sign language is the real time sign detection system. To design an interactive way for understanding Indian Sign Language and increase awareness about the same and to increase the number of people knowing the sign languages.

1.3 Problem Statement & Objectives

The problem we aim to address in the field of sign language identification involves the accurate recognition and interpretation of various sign language gestures. Not everyone in the hearing community can understand sign languages, which can lead to communication barriers between deaf and hearing individuals. Feeling isolated due to communication barriers and societal misconceptions can lead to feelings of frustration. In some educational settings, there might be a lack of qualified sign language teachers or resources, which can impact the quality of education for deaf students. In Spite of growing technology there are still apps that are not as fast. All of these factors contribute to problems with mental health and communication.The objective of the project is to develop a user friendly web application to detect the signs used by the signers for communicating and recognize them with their corresponding english language text with that particular image sign and displaying it as the output.

1.4 Organization of the Report

Our project emphasizes on the conversion of signs used by the users in their day to day life to communicate into their equivalent text in real time. The need to make the life of deaf and mute individuals a bit easier and to boost the awareness of sign language. Our objective is accurate sign language recognition and interpretation of various sign language gestures. We aim to eliminate the inequalities faced by the specially abled community.

The major limitation encountered is the detection of a limited set of hand gestures. Also some signs are similar in gesture but differ in facial expressions which cannot be detected by the system. And the other external environmental barriers can pose a drawback of the system. Our mini project contributes in this field by providing deaf individuals with the tools they need to communicate effectively, sign language detection systems promote empowerment, inclusion, and the breaking down of communication barriers.

We propose a novel approach to trying to tackle the limitations by enabling real time sign language recognition. The process goes as follows, our system after being activated is employed to capture the hand gestures and by evaluating to the correct result with the help of the dataset available displays the result in the form of text. We have utilized a web camera, laptop or computer for the hardware part and for the software we made use of python, visual studio code, cnn, flask, firebase.

This project can be expanded by providing a wide variety of datasets, overcoming environmental challenges and enabling more accurate recognition. It is an innovative way to translate signs into text.

Literature Survey

2.1 Survey of Existing System

1. Sign language recognition using template matching technique by Soma Shrenika, Myneni Madhu Bala

   The system proposed here aims at solving this problem. The implementation of the system is by using OpenCV Python. The system uses various libraries. Acquiring the images,converting to grayscale images. Track the edges by using canny edge detection. Detecting pattern using template matching, output as text. The implementation of the system is using image processing techniques. This system is for people who cannot use gloves, sensors and other highly refined equipment. If the image is blurry or poorly lit, it may result in inaccurate recognition. It may not be able to accurately interpret dynamic gestures or signs that involve movement.

2. Real-Time Sign Language Detection by Sangeeta Kurundkar, Arya Joshi, Aryan Thaploo, Anish Awalgaonkar, Sarthak Auti

   A system was developed in which 26 American sign language letters were categorized using a CNN classifier. Collect correct and precise data. With the help of the Keras library, convolution layers machine learning was implemented. Here, the input image was passed through a CNN to produce a convolutional feature map and train them using Keras. Kears was only allowed to report accuracy numbers as it is a classification problem. It utilizes Tensorflow technology to recognize sign language and the python and open cv were used for data acquisition. Systems cannot work in various lighting and background conditions. The range of dataset used is not very effective.

3. Towards Multilingual Sign Language Recognition by Sandrine Tornay Marzieh Razavi, Mathew Magimai Doss

   It introduces a multilingual approach that derives hand movement information independently of the target sign language. A combination of data collection, feature extraction, subunit derivation using HMM’s, model training. It finds a performance gap between language-dependent and independent approaches, which is mitigated when combined with hand shape information. There's limited discussion on the potential challenges or nuances of applying this approach across different sign languages.

4. A Systematic Review on Systems-Based Sensory Gloves for Sign Language Pattern Recognition: An Update From 2017 to 2022

   The data glove-based approach achieves higher accuracy, fast reaction, and good mobility. The sensor is the most important component in measuring hand gestures such as bending (curve), motion, rotation, and orientation. There are various sensors used to detect hand bending, such as flex sensors. Since sign language gestures consist of hand and wrist movements, the accelerometer sensor's features include the capacity to recognize hand direction and rotation. The glove was customized with ten Accelerometer sensors. Challenges that are related to the hardware are pertaining to the cost, sensor issues, and power issues. Sensors that are highly sensitive, with the flex sensor technique showing a considerable number of errors.

5. Conversion of Indian Sign Language to Speech by Using Deep Neural Network Sonali Patil, Shivam Gulave, Vaibhav Gawai, Prashant Gode, Prathamesh Mudme

   To interpret the meaning of sign language an interpreter is needed and to eliminate the need of an interpreter a system is proposed using a neural network. The gestures of the user are captured in real-time. The predicted word is converted into relevant voice by using Google text to speech API. A system is implemented to interpret Indian sign language to text and then to speech. The system deals with both types of hand gestures like static and dynamic. Unmatched gestures and speech can lead to improper grouping of letters and words.

2.2 Limitation Existing system or research gap

1. One of the major limitations is that the system detects a limited number of gestures.Most of the previous systems can only read alphabets excluding j and z (because they are not static images).
2. Sign language systems may have signs that look similar but have different meanings, this can lead to misinterpretations by the detection system. This also creates problems in reading/ detecting continuous statements.
3. Achieving real-time sign language detection and translation can be computationally intensive and may require powerful hardware, limiting accessibility as not all the users have access to the necessary technology or internet connectivity to use the system effectively.
4. External noise or if the image is blurry or poorly lit, it may result in inaccurate recognition and can affect the accuracy of sign language detection systems, especially in public spaces.

2.3 Mini Project Contribution

Sign language detection systems contribute significantly to improving the lives of individuals who use sign language as their primary means of communication. By providing deaf individuals with the tools they need to communicate effectively, sign language detection systems promote empowerment, inclusion, and the breaking down of communication barriers. This system tries to achieve a recognition system and make it more user - friendly. In emergency situations, sign language detection systems can help first responders and emergency personnel communicate effectively with deaf individuals to ensure their safety and well-being. This web application will provide a real time static sign detection system. This system contributes to the goal of reducing inequalities through advancing inclusive technology and fostering effective communication through real-time sign language recognition.

Proposed System

3.1 Introduction

The field of sign language detection holds vast potential for improvement, and we're committed to exploring several avenues for future development. This includes expanding our system to support multiple sign languages, enabling real-time translation capabilities, and refining gesture recognition for greater accuracy.The need to make the life of deaf and mute individuals a bit easier and to boost the awareness of sign language. Therefore, in order to facilitate communication between normal and disabled individuals, a sign language recognition system is utilized to translate sign language. This system contributes to the goal of reducing inequalities through advancing inclusive technology and fostering effective communication through real-time sign language recognition. Emphasizing on the conversion of signs used by the users in their day to day life to communicate in real time. Our proposed system aims to seamlessly convert hand gestures into signs in real-time, facilitating smoother communication between sign language users and non-users. This technology has practical applications in education, healthcare, and customer service, promising to empower deaf or hard-of-hearing individuals to interact more effectively with the wider community. By continually advancing sign language detection technology, we aim to foster inclusivity and accessibility across various sectors, ultimately creating a more connected and understanding society.

3.2 Architecture/ Framework

1) The dataset was prepared for model training by collecting around 100 images for 10 different ISL sign gestures.
2) This customized dataset was used to train the CNN model for real time sign language detection.
3) The model was then evaluated by the testing dataset. It tests and assures the accuracy of the working of the project.
4) This trained and tested model was deployed on a flask server for creating a real-time sign detector web application.
5) The input frames collected from the web application were preprocessed to pass it to the deployed model.
6) The prediction results of the model consisting of the accurate label for the gesture and the accuracy score are processed to display it to the user in real-time.

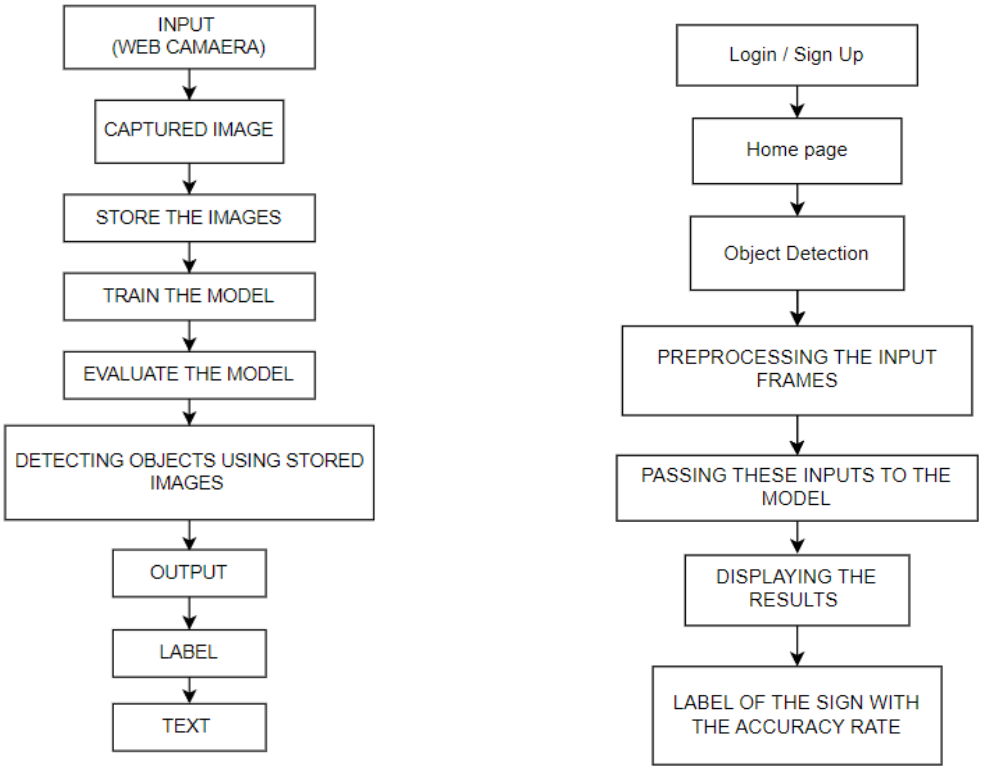

Fig 1: Framework

3.3 Algorithm and Process Design

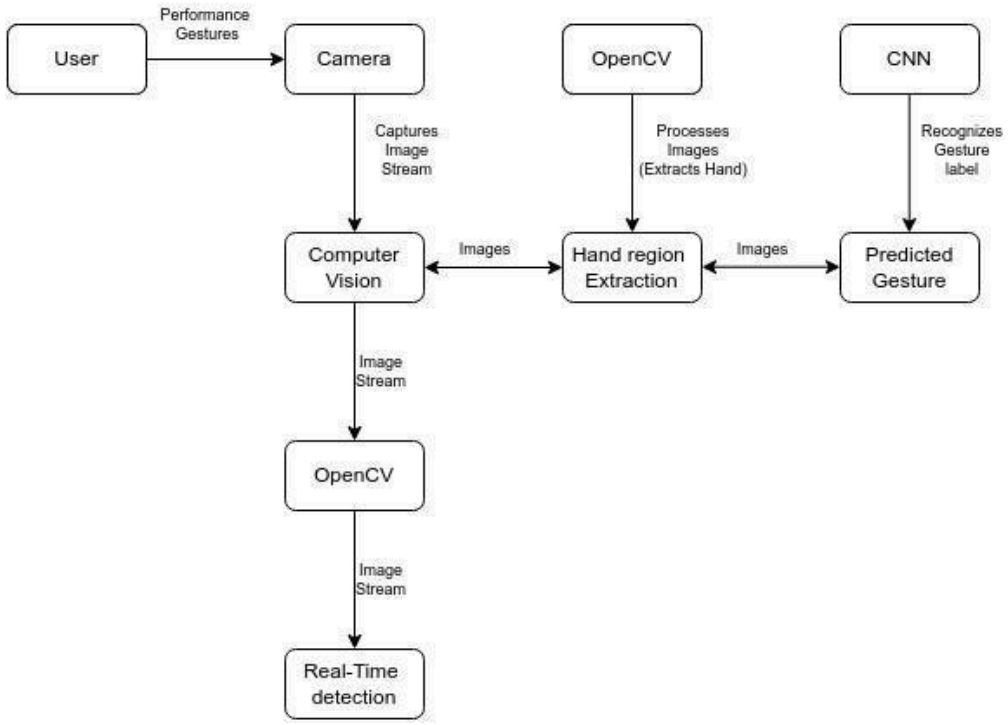

Fig 2: Block Diagram

1) User Authentication: The user is prompted to either sign up or log in to the application. This step ensures that the system knows who is using it and can personalize the experience if needed.
2) Gesture Conversion: After authentication, the user can select the option for real-time sign language detection.
3) Camera Activation: Once the user selects the gesture conversion option, the camera is activated. This allows the application to access real-time video input from the user's device.
4) Real-time Sign Detection: The camera captures the user's hand gestures in real time. This involves continuously processing the video stream to detect and track the position and movements of the user's hands.
5) Comparison with Dataset: The captured sign is then compared with a pre-existing dataset of known sign language gestures. This dataset contains information about the visual features of various signs and their corresponding textual translations.
6) Translation and Display: If a match is found in the dataset, the corresponding translation in text is retrieved.

7) Accuracy and Recognition: The system relies on accurate recognition to ensure that the correct sign is being captured and translated.
8) Display to User: The translated text is displayed on the user's screen in real time. This allows the user to receive immediate feedback on the accuracy of their sign.

3.4 Details of Hardware & Software

Hardware :

i) Web camera - For capturing images for detection,

ii) Internet Connection

Software :

i) Python - High level programming language for model training and creating web application.

ii) Tensorflow - Object detection {The TensorFlow Object Detection API is an open-source framework built on top of TensorFlow that makes it easy to construct, train and deploy object detection models.}

iii) CNN: Convolutional Neural Network efficient for real-time object detection model

iv) Flask: A light-weight python framework for building efficient web application.

Tools : Visual studio code

Constraints :

i) Web camera Error

ii) Internet connection

3.5 Experiment and Results

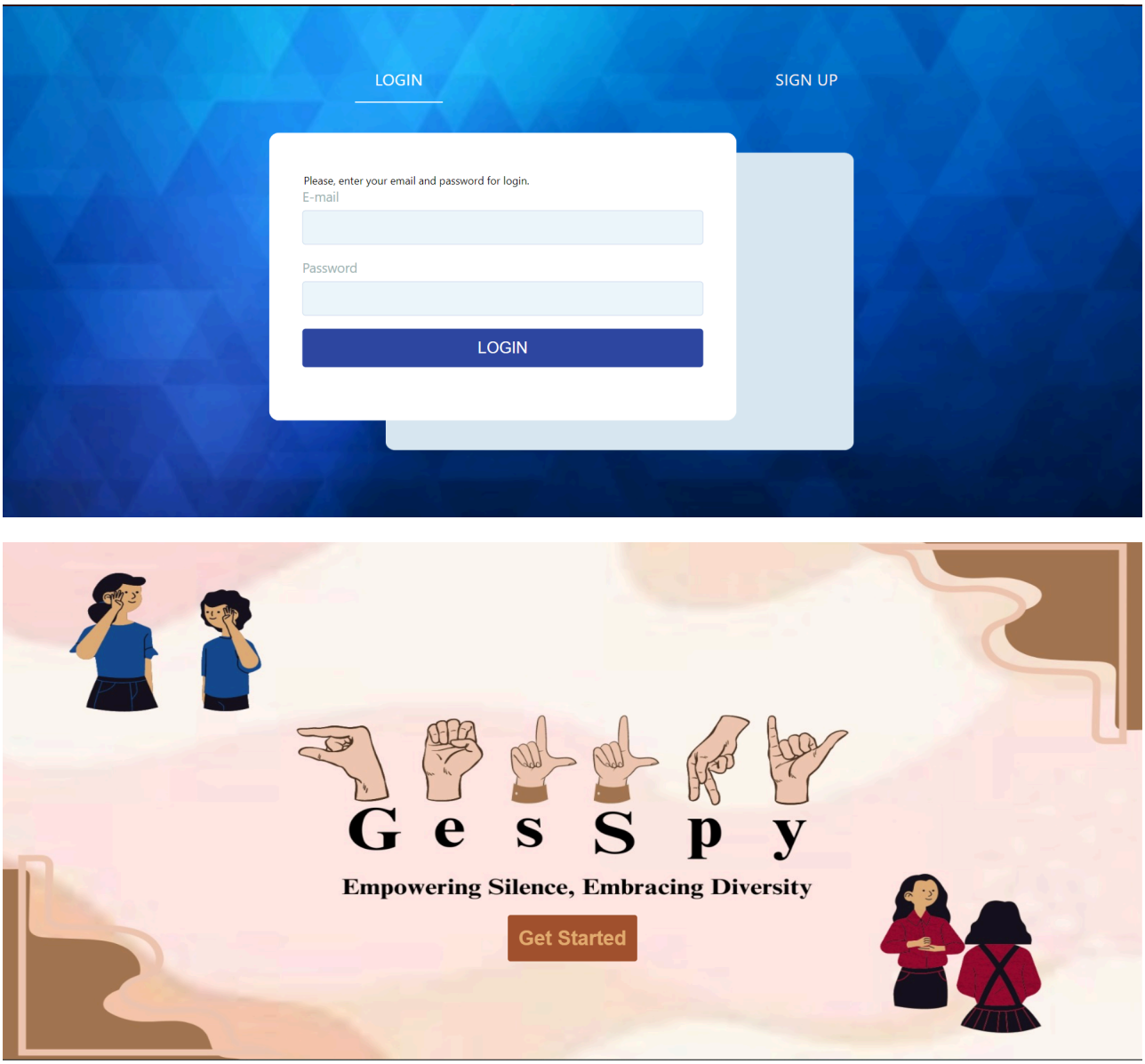

Fig 3: Web App Layout

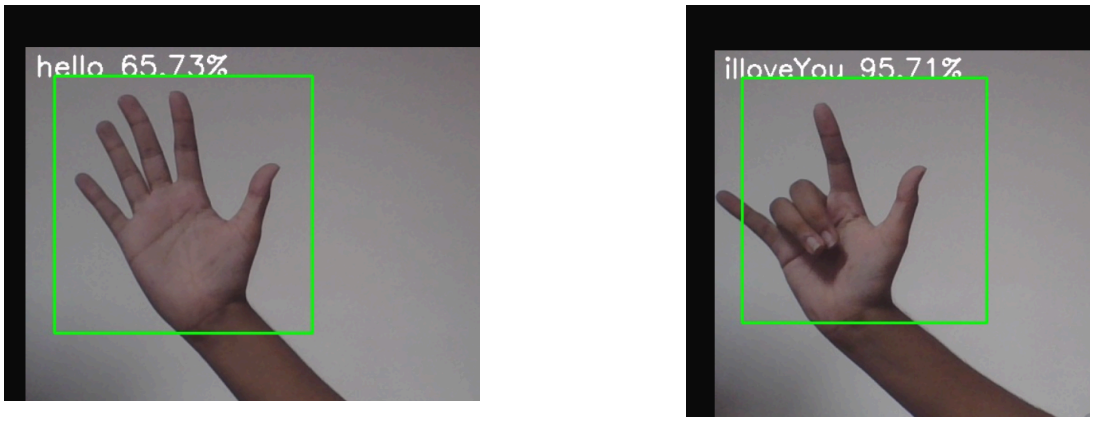

Fig 4: Camera window

3.6 Conclusion and Future work.

TensorFlow, with its reputation for adaptability and robustness in deep learning applications, serves as the backbone of our system, excelling particularly in tasks like image recognition and natural language processing. Think of it as the powerhouse behind the scenes, providing a solid framework for building and enhancing neural networks. In contrast, sci-kit acts as a reliable ally, ideal for simpler machine learning tasks and rapid implementations. When tackling complex neural networks on a large scale, TensorFlow steps up, while sci-kit shines in quick and efficient model deployments.While TensorFlow and scikit-learn are powerful tools for general machine learning tasks, CNNs stand out as the preferred choice for image-related tasks such as real-time sign language detection. They work on labeled datasets additionally possessing the capability to extract the features of the inputs needed for performing the task automatically thus facilitating efficient model training and precise prediction results. Our system's effectiveness is gauged by its ability to accurately identify sign gestures, visualized by neatly bordered signs with translated text displayed precisely above. With an accuracy range of 70-90%, our system's performance varies based on various parameters and implementation nuances. Thus CNN model was integrated in the web application for an interactive real-time gesture detection experience. Looking ahead, we envision incorporating dynamic signs to enhance flexibility and adaptability for diverse applications.

Looking forward, we aim to enhance sign language recognition by refining accuracy and usability. We plan to expand the system's vocabulary, including regional variations, and explore practical applications like integrating it into video conferencing software and mobile apps. Speed and scalability are also priorities to ensure real-time performance, empowering the deaf and hard-of-hearing community and fostering connection in an inclusive world.

References

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3. Sign Language Recognition using Template Matching Technique Soma Shrenika and Myneni Madhu Bala.

4. Towards Multilingual Sign Language Recognition by Sandrine Tornay, Marzieh Razavi, Mathew Magimai Doss