International Scientific Journal of Engineering and Management ISSN: 2583-6129
Volume: 03 Issue: 04 | April – 2024 DOI: 10.55041/ISJEM01580
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

Sign Language Recognition Device

Krish Jawa, Anish Mhaske, Vedant Thorat

Krish Jawa, Electronics, Datta Meghe College Of Engineering
Anish Mhaske, Electronics, Datta Meghe College Of Engineering
Vedant Thorat, Electronics, Datta Meghe College Of Engineering
Prof. Dr. Prashant Wankhade, Datta Meghe College Of Engineering

---

Abstract - The "Sign Language Recognition Device" (SLRD) project stands as a beacon of hope for bridging the Deaf and Hard of Hearing have different communication styles. community and the hearing world. Sign language, a rich and complex means of expression, has long faced barriers to its widespread acceptance and integration into mainstream communication. The SLRD project is an ambitious endeavor, harnessing the power of cutting-edge technology to revolutionize communication for sign language users..

***Key Words*:** Gesture Recognition, Computer Vision, Feature Extraction, Machine Learning, Real-time Processing.

1.INTRODUCTION

Sign language recognition devices leverage cutting-edge technology to translate sign gestures into spoken or written language, enhancing accessibility for the deaf and hard of hearing. By integrating into mainstream platforms like smartphones and video conferencing software, these devices facilitate real-time communication and foster inclusivity. They empower users in education, employment, and social interactions, breaking down communication barriers and promoting a more inclusive society.

2. PROBLEM DEFINITION

Sign language recognition devices address critical Those who are deaf or hard of hearing encounter communication. The primary problem revolves around the limited recognition and understanding of sign language gestures by the general population, which hinders effective communication and inclusivity. This problem is especially pronounced in educational, professional, healthcare, and social settings, where the lack of accessible communication tools leads to misunderstandings, isolation, and limited opportunities for individuals who mostly communicate with one other using sign language.

Furthermore, existing communication tools often do not adequately support sign language users, resulting in a lack of equal access to information, services, and participation in various aspects of life. This disparity contributes to social exclusion, reduced educational and employment opportunities, and challenges in accessing essential services and support networks. Therefore, the problem definition of sign language recognition devices encompasses the urgent need for accurate, reliable, and efficient communication solutions that bridge the disparity between sign language learners and non-learners.

These devices must overcome barriers related to language recognition, cultural understanding, technological integration, and accessibility to ensure seamless and inclusive communication experiences for individuals with diverse communication needs.

3. MOTIVATION

The motivation for developing and advancing sign language recognition devices is deeply rooted in addressing the significant challenges faced by individuals with hearing loss. According to the World Health Organization, over 5% of the global population experiences disabling hearing loss, totaling more than 360 million people worldwide. For these individuals, sign language serves as a primary mode of communication, yet the limited recognition and understanding of sign language by the general population create substantial barriers to effective communication and social inclusion.

Sign language recognition devices offer a transformative solution by serving as a bridge between the Deaf and hearing communities. They enable real-time interpretation and transliteration of sign language movements into text or speech language, facilitating seamless communication and accessibility in various settings. This technology-driven approach enhances inclusivity by ensuring that individuals who use sign languages can participate fully in educational, professional, healthcare, and social contexts, breaking down longstanding communication barriers and promoting equal opportunities.

Moreover, the motivation for these devices extends beyond accessibility; it encompasses empowerment for the Deaf and hard of hearing individuals. Access to accurate and efficient communication tools empowers individuals to express themselves, advocate for their needs, and engage actively in decision-making processes. This empowerment fosters self-confidence, autonomy, and agency, leading to improved well-being and quality of life.

4. LITERATURE SURVEY

Priyanka C Pankajakshan and Thilagavathi B have evaluated that sign language is the preferred method of communication among the deaf and the hearing impaired people all over the world.Sign language is said to have a

ISSN: 2583-6129
DOI: 10.55041/ISJEM01580

structured set of gestures in which each gesture is having a specific meaning. [1]

H Muthu Mariappan and V Gomathi have evaluated that for recognising the signs, the Regions of Interest (ROI) are identified and tracked using the skin segmentation feature of OpenCV. The training and prediction of hand gestures are performed by applying fuzzy c-means clustering machine learning algorithms. [2]

Purva C. Badhe and Vaishali Kulkarni have evaluated that the algorithm first performs data acquisition, then the pre-processing of gestures is performed to track hand movement and recognition is done using template matching. [3]

R Srinivasan, R Kavita and M Kavitha have evaluated that hearing-impaired people cannot communicate with normal people easily. Most people are not aware of sign language recognition. To support this, machine learning and CV can be used to create an impact on the impaired. [4]

Aneesh Pradeep, Mukhammadkhon Asrorov and Muxlisa Quronboyeva have evaluated that Sign Language Recognition (SLR) handles the recognition of hand gestures and continues to generate a text or voice for the corresponding hand gesture. Static and dynamic hand motions are the two different categories. Although static hand gesture recognition is simpler than dynamic hand gesture recognition, both recognitions are essential for human communities. [5]

5. PROPOSED METHODOLOGY

1. Research and Understand Sign Language:
Familiarizing with sign language, its grammar, and commonly used gestures. Understanding the language is crucial for accurate recognition
.

2. Selecting Hardware Components:
Selecting the necessary hardware components such as Raspberry Pi (preferably Raspberry Pi 4 for better performance), a camera module (like Raspberry Pi Camera Module), and any additional sensors if needed.

3. Install Operating System and Libraries:
Installing Raspbian or any other compatible operating system on the Raspberry Pi.
Installing libraries and dependencies like OpenCV, TensorFlow, or PyTorch for image processing and machine learning tasks.

4. Data Collection:
Collecting a dataset of sign language gestures. You can either create your own dataset by recording different gestures or use existing datasets like ASL Alphabet Dataset.

5. Preprocessing:
Preprocessing the collected data to enhance its quality. Steps may include resizing images, converting to grayscale, and normalizing pixel values.

6. Model Selection and Training:
Choosing a suitable machine learning model for sign language recognition such as convolutional neural networks (CNNs) or recurrent neural networks (RNNs).

7. Optimization:
Optimizing the model for deployment on the Raspberry Pi. Techniques like quantization, pruning, or model compression can be used to reduce the model size and inference time.

8. Integration with Raspberry Pi:
Writing Python scripts to capture video frames from the camera module connected to the Raspberry Pi. Preprocessing the frames and pass them through the trained model for inference.

9. Feedback System:
Implementing a feedback system to display recognized gestures. This could be through text output on a display or audio feedback.

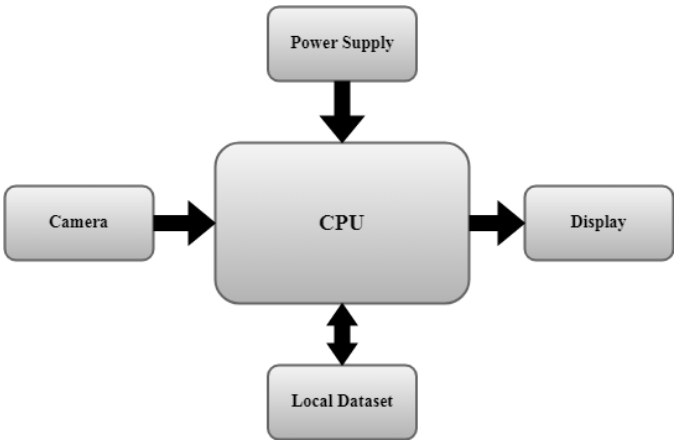
10. Testing and Evaluation:
Testing the device with different sign language gestures to evaluate its accuracy and performance. Collect feedback and iterate on the model and system design if necessary.

11. Deployment:
Once satisfied with the performance, then deploying the sign language recognition device in the desired environment.

12. Continuous Improvement:
Keep updated and refining the system based on user feedback and new advancements in technology.

This methodology provides a structured approach to develop a sign language recognition device using a Raspberry Pi, combining elements of hardware setup, software development, machine learning, and testing.

6. HARDWARE BLOCK DIAGRAM



International Scientific Journal of Engineering and Management
Volume: 03 Issue: 04 | April – 2024
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata
ISSN: 2583-6129
DOI: 10.55041/ISJEM01580

CPU :- The Central Processing Unit (CPU) is the brain of the device. It analyzes the data that the camera records. The block diagram shows a Raspberry Pi which is a minicomputer that can be used for various purposes including image processing.

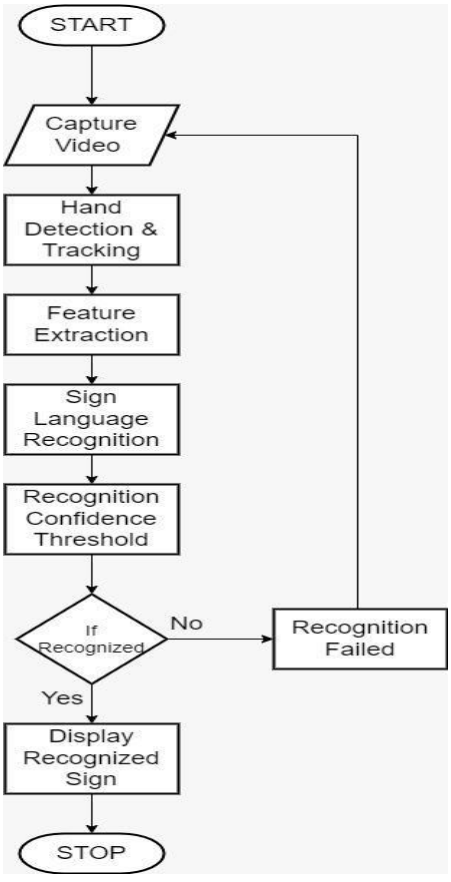
Camera :- The camera captures the video footage of the user signing. In this case, the block diagram specifies a Raspberry Pi Camera which is a high-definition camera module that can be plugged into a Raspberry Pi.

Local Dataset :- This block stores the sign language data used by the CPU to recognize the signs being captured by the camera. This data is likely a collection of images or videos of signs and their corresponding text or code.

Display :- The display shows the output of the CPU. In this case, it's a 1.3 inch OLED display which is an organic light-emitting diode display known for its high contrast and low power consumption.

Power Supply :- This block provides the electrical power to run the entire device. It consists of Lithium Ion Batteries and a Charging Module. The batteries store the electrical charge and the charging module regulates the incoming current to safely charge the batteries

7. FLOW CHART



8. SOFTWARE AND HARDWARE

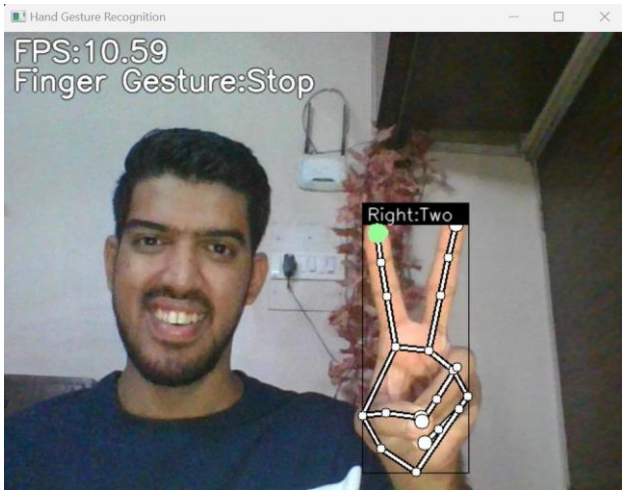
8.1 - Hardware Requirements :

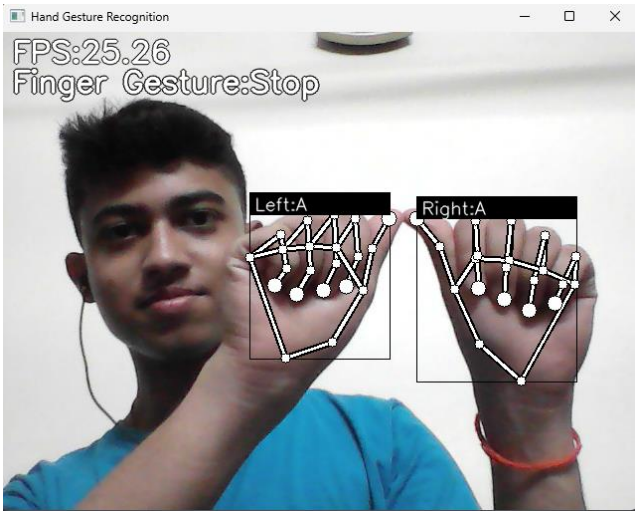
1) Raspberry Pi 4 model B
2) Raspberry Pi Camera
3) 1.3-inch I2C OLED Display
4) 18650 Li-ion Battery
5) TP4056 Charging Module
6) MP1584 Step-down Converter
7) DPDT Relay

8.2 - Software Requirements :

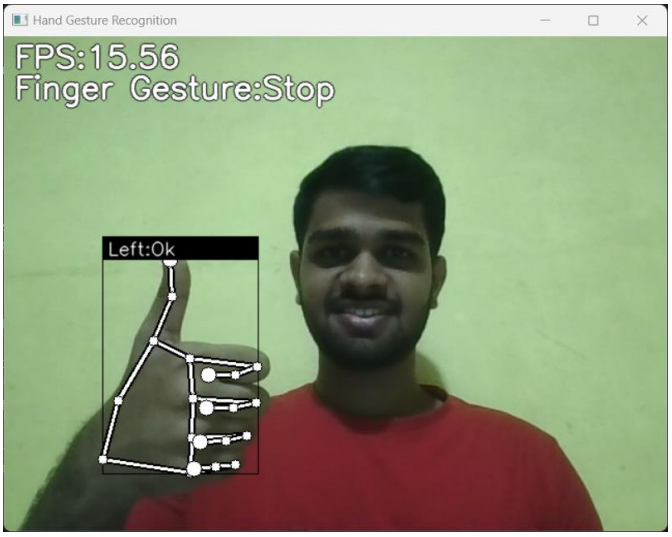
1) Python
2) OpenCv
3) Tensorflow
4) Sklearn
5) Matplotlib
6) MediaPipe
7) Tf-Nightly

9. RESULT





International Scientific Journal of Engineering and Management
Volume: 03 Issue: 04 | April – 2024
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata
ISSN: 2583-6129
DOI: 10.55041/ISJEM01580



10. CONCLUSION

Our project aimed to create a portable sign language recognition device using Raspberry Pi technology, OpenCV, TensorFlow, and MediaPipe libraries for real-time interpretation. Despite challenges in optimization and user interaction, the device offers accurate sign language translation, enhancing communication accessibility for the mute community. Throughout the development process, we encountered various challenges, including optimizing the algorithm for real-time performance on the Raspberry Pi platform, fine-tuning model accuracy, and ensuring user-friendly interaction through the OLED display. Despite these challenges, our project represents a significant step towards bridging the communication gap for individuals with speech impairments. The compact and portable nature of our device makes it suitable for everyday use, allowing users to communicate effectively in various settings. Moving forward, further improvements could be made to enhance the device's accuracy, expand its vocabulary of recognized signs, and integrate additional features for improved user experience. Additionally, exploring opportunities for mass production and distribution could help make this technology more accessible to those who need it most. In summary, our sign language recognition device embodies the spirit of innovation and inclusivity, offering a practical solution to empower individuals with speech impairments and facilitate seamless communication in their daily lives.

11. FUTURE SCOPE

Enhanced Gesture Recognition: Further research and development can focus on improving the accuracy and robustness of the gesture recognition algorithm. This could involve training the model on a larger dataset of sign language gestures to recognize a wider range of signs with higher precision.

Expand Vocabulary: Expanding the vocabulary of recognized signs can make the device more versatile and useful in various communication scenarios. Collaborating with sign language experts and communities to identify additional gestures and their meanings can help enrich the device's vocabulary.

Gesture Translation: Integrating real-time translation capabilities can enable the device to not only recognize sign language gestures but also translate them into text or speech in multiple languages. This feature would enhance accessibility for users from diverse linguistic backgrounds.

User Interface Improvements: Enhancements to the user interface can improve the overall user experience. This could include implementing voice feedback, customizable settings for gesture recognition sensitivity, and intuitive navigation options on the OLED display.

Integration with Smart Devices: Integrating the sign language recognition device with other smart devices and platforms can further enhance its functionality. For example, connecting it to smartphones or smart home assistants can enable seamless communication across different devices and environments.

ACKNOWLEDGEMENT

An acknowledgement is meant to express our gratitude towards all the people who have lent support and help for the successful completion of the project. I take great pleasure in acknowledging Dr. D. J. Pete (Principal), Dr. G. S. Raghtate (Head of Department) and Mr. S.R.Jajoo (Major Project coordinator) of Datta Meghe College of Engineering, Airoli for giving us an opportunity to implement and build the project by ourselves.

We are extremely thankful to Prof. Dr. Prashant Wankhade (Major Project Supervisor) who gave us an opportunity to work in a highly esteemed organization with their ever-helpful guidance, motivation throughout the project period. His valuable support helped us to complete our task successfully. We have personally experienced the linkage between theoretical knowledge and its practical implication.

At last, we must express our sincere heartfelt gratitude to all the staff members, non-teaching staff members & our fellow classmates of the Electronics department who helped us directly or indirectly during this course of work.

REFERENCES

1) "Sign Language Recognition System", Priyanka C Pankajakshan, Thilagavathi B, International Journal of Innovative Research in Science, Engineering and Technology, August 2015

2)"Real-time Recognition of Indian Sign Language", H Muthu Mariappan, V Gomathi, International Journal of Innovative Research in Science, Engineering and Technology, October 2019

3)"Indian sign language translator using gesture recognition algorithm", Purva C. Badhe, Vaishali Kulkarni, International Journal of Innovative Research in Science, Engineering and Technology, April 2016

4)"Python And Opencv For Sign Language Recognition",R Srinivasan, R Kavita, M Kavitha, International Journal of Innovative Research in Science, Engineering and Technology, 2023

5)“Advancement Of Sign Language Recognition Through Technology Using Python And OpenCV”, Aneesh Pradeep, Mukhammadkhon Asrorov, Muxlisa Quronboyeva, 7th International Multi-Topic ICT Conference (IMTIC), 2023