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SIGN LANGUAGE DETECTION USING CNN

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Abstract: Sign language detection is a revolutionary technology that enables automated recognition and interpretation of sign language gestures, bridging the communication gap between the deaf, dumb and hard of hearing community and rest of society. It developed using machine learning and computer vision techniques. Our innovative approach combines CNN- convolutional neural networks with advanced motion capture technologies to accurately identify a wide array of signs, taking into account that intricacies of hand shapes, movement. Detection: video/image capture >Hand tracking/feature extraction > ML model classification > text/speech output. In our experiments, the detection system demonstrated impressive accuracy rates, and maintained strong performance in real-world situations.

Keywords: CNN (Convolutional Neural Network), ML (Machine learning), Hand tracking.

I.INTRODUCTION

Sign language detection that uses Convolutional Neural Networks (CNNs) to recognize and interpret sign language gestures, specifically for spelling letters. The project aims to bridge the communication gap between the deaf and hard-of-hearing community and the wider society by utilizing advanced machine learning and computer vision techniques. The system is designed to accurately identify various hand shapes and movements in different environments, making it adaptable and efficient for diverse users. The abstract highlights that in experiments, the detection system demonstrated impressive accuracy rates and maintained strong performance in real-world situations. Key components of the system include video/image capture, hand tracking/feature extraction, ML model classification, and text/speech output. The project emphasizes the use of state-of-the-art technologies to improve communication accessibility for the deaf and hard-of-hearing community.

II.LITERATURE SURVEY

In today's busy, connected world, good communication is important for bringing different communities together. For people who are deaf or hard of hearing, sign language is a key way to communicate. But there are not enough automated systems to understand sign language, which makes it hard for them to talk with others who don't know it. Manual interpretation can be slow and not always accurate, making communication difficult. The Sign Language Detection project aims to solve this problem by creating a system that automatically recognizes and understands sign language using advanced technology. It uses special computer programs to detect sign language gestures by looking at hand shapes and movements. The system captures videos or images of sign language, tracks hand movements, identifies the gestures with a machine learning model, and then gives back the matching text or speech. This method greatly improves communication, offering a quick and effective way for sign language users to connect with others. The project has shown great accuracy and works well in real-life situations, showing its potential to improve communication in schools, workplaces, and social settings.

III.EXISTING SYSTEM

Current systems for detecting sign language mainly rely on human experts or simple gesture recognition. Some use fixed gesture databases that match hand movements to letters or words. While some tools use computer vision and machine learning to recognize gestures, they often have problems with accuracy, speed, and adapting to different sign languages. These systems may have difficulty with subtle hand shapes, complex movements, or changes in context, and they usually need a lot of manual input or training data to work well. This project aims to fix these issues by using advanced CNNs and motion capture technology to create a better, faster, and more adaptable solution for detecting sign language.

PROBLEM STATEMENT

- Limited Accuracy: Has trouble with small movements and shapes.
- Training Data Dependence: Needs a lot of labelled examples to learn.
- Environment Sensitivity: Affected by light, sounds, and viewing angles.
- Limited Real-Time Capabilities: Cannot recognize gestures in real-time.

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IV.PROPOSED SYSTEM

The Sign Language Detection activity uses advanced technologies like Machine Learning and Computer Vision to automatically recognize and understand sign language finger-spelling. It combines special types of computer programs with motion tracking to accurately see hand shapes and movements for interpreting letters. This system helps sign language users communicate better with others, providing a quick and easy way to turn finger-spelled signs into text or speech.

ADVANTAGES

- Reduces the need for manual interpretation.
- Makes sure there are no mistakes in translating gestures.
- Makes communication easier for sign language users.
- Works for different sign languages.
- Translates in real-time for quick communication.

V.MODULE DESCRIPTION

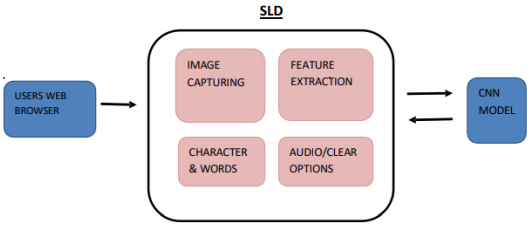

FIG 1: MODULE DESIGN

User web browser: This is the procedure of getting an image from a webcam, usually hardware, for processing an image. In our project, the web camera is the hardware source. This is the first step because we need an image to start processing. The image we get has not been changed in any way.

Image capturing: Function: This function finds and follows the position of hands and important features like shapes or points on the hand. Explanation: It uses computer vision methods to separate the hand features from the background. If using video, it tracks hand position and movement over time, allowing for gesture recognition.

Technologies: OpenCV, Media Pipe (for hand tracking)

Feature extraction: Function: This function uses a trained Convolutional Neural Network (CNN) to identify and classify hand signs. Explanation: The prepared image (or series of images) goes through the CNN model to find features that are specific to different sign language gestures. CNNs are good at learning patterns from images, making them suitable for recognizing sign language gestures.

Technologies: TensorFlow, Keras, PyTorch, and OpenCV.

Characters and words: Function: This function connects recognized gestures to their sign language symbols, words, or phrases. Explanation: Once the CNN classifies a gesture, the system matches it to a list of sign language symbols (like "A", "B", "Hello") or phrases. This helps turn the sign language gesture into something that people can understand.

Technologies: Python, NumPy.

Audio/clear options: In sign language detection using CNNs, AUC-ROC (Area Under the Receiver Operating Characteristic Curve) and CLEAR (Classification Error, precision, recall, and F1-score) are used to measure performance:

Auc-roc

AUC-ROC checks how efficient the model can tell apart positive and negative classes. A higher AUC-ROC score means good performance.

Clear metrics

CLEAR metrics include:

1.Classification Error: The rate of incorrectly classified samples.

2. Precision: The rate of true positives among all positive estimations.

3. Recall: The true positive rates among all actual positives rates.

4. F1-score: A balance of precision and recall. These metrics help check how well sign language detection models work, ensuring they recognize and classify signs accurately.

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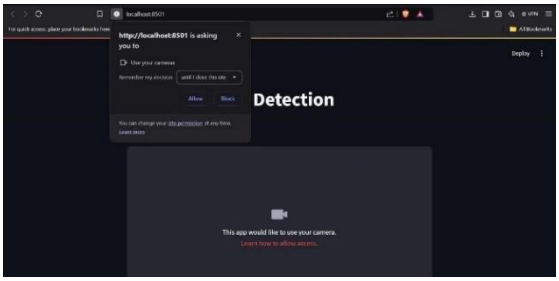
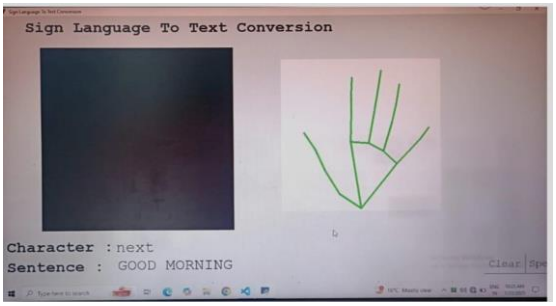
CNN model: CNN Model in Sign Language Detection a Convolutional Neural Network (CNN) is a class of deep learning model for recognizing sign language. Here's how it works:
1. Image Input: The CNN takes images or video frames of sign language gestures.
2. Feature Extraction: The CNN finds features like hand shapes, directions, and movements from the images.
3. Pattern Recognition: The CNN identifies patterns in these features to classify the sign language gestures.
Using CNNs, sign language detection models can be very accurate and effective for understanding and interpreting sign language.

VI. RESULT

Home page:



Live detection:



VII.CONCLUSION

The Sign Language Detection and Text-to-Speech project helps people who are deaf or hard of hearing communicate better by turning sign language gestures into spoken words. It uses computer technology to recognize these gestures and link them to letters or words. The system also uses text-to-speech tools to give immediate audio responses, making conversations easier in daily life. It can understand ongoing sign language and quickly respond with speech, which helps users talk to those who don't know sign language. The project uses advanced learning methods to ensure accurate translations and can adapt to different sign languages and complex gestures. This tool aims to improve communication for the deaf community, allowing them to connect more easily with others. By combining gesture recognition with speech, it provides a simple and effective way to enhance everyday interactions.

VIII.FUTURE WORK

Multi-Modal Fusion: Combining multiple modalities, such as vision and audio, to improve sign language detection.
Adversarial Training: Training CNNs to be robust to adversarial attacks and variations in sign language gestures.
Real-Time Sign Language Detection: Developing real-time sign language detection systems that can be used in practical applications.

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