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Real-Time Hand Gesture Detection using Deep Learning

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Abstract: Around the world, thousands of individuals with hearing loss use sign languages which come in a variety of regional variations to communicate daily. Therefore, it is believed that strengthening communication and inclusion for this group of people requires the automated translation of sign languages. But this is challenging research subject due to a number of issues. Developing a consistent system is impractical due to the regional variations in sign language. This is one of the key obstacles. Still, sign language recognition technology holds promise for improving deaf community services by assisting in communication gaps and enhancing the general well-being of society. The goal of the" Real-Time Hand Gesture Detection for Sign Language Recognition using Python" project is to create a system that can instantly translate sign language movements into text. The system tracks and detects hand movements using computer vision techniques, and then classifies the gestures using machine learning algorithms. The classes" Ok, Open Hand, Peace, thumbs up Thumbs down and alphabets A-Z" can be detected by our suggested system. Python programming and the OpenCV library will be used to carry out the project's computer vision tasks. In our suggested system, we create two distinct sections: the first uses the Exception architecture model to recognize hand motion photographs and forecast outcomes, while the second uses OpenCV to detect in real time using a webcam. With the help of the Exception architectural model, our suggested solution was able to achieve 90.34% training accuracy and 90.00% validation accuracy. A dataset of hand motions that were recorded with a webcam will be used to train the hand gesture identification model. The finished system will include an intuitive user interface to let people who don't use sign language communicates with others who do. In a variety of contexts, including public areas, workplaces, and classrooms, it may enhance inclusivity and communication for individuals with speech or hearing impairments.

Keywords: Hand Gesture, Segmentation, Random Forest, OpenCV, TensorFlow, Keras, CNN, Deep learning, Scikit learn.

I. INTRODUCTION

The urgent need for automated sign language translation to improve inclusion and communication for people with hearing loss is addressed by the" Real-Time Hand Gesture Detection for Sign Language Recognition using Python" project. Although regional differences in sign languages make consistency difficult, sign language identification technology has the potential to improve societal well-being and bridge communication gaps.

The goal of our project is to create a system that can translate sign language movements into text instantaneously. The system uses computer vision techniques to track and detect hand movements, then classifies the data using machine learning algorithms. It does this by leveraging Python programming and the OpenCV package. Our suggested approach achieves high training and validation accuracies for hand motion identification by using the Exception architecture model. Our technology helps those who use sign language and those who do not, promoting inclusivity in public spaces, workplaces, and educational institutions alike. It does this by integrating an intuitive user interface.

II. RELATED WORK

This study compares accuracy in hand gesture recognition of a single viewpoint set-up with proposed two viewpoint set-up for different classification techniques. The efficacy of the presented approach is verified practically with various image processing, feature extraction and classification techniques. Two camera system make geometry learning and three-dimensional (3D) view feasible compared to a single camera system. Geometrical features from additional viewpoint contribute to 3D view estimation of the hand gesture. It also improves the classification accuracy. Experimental results demonstrate that the proposed method show escalation in recognition rate compared to the single camera system, and also has great performance using simple classifiers like the nearest neighbour and decision tree. Classification within 1s is considered as real-time in this study (7).

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We use the gesture control board to combine with gesture image recognition methods to perform the double authentication gesture recognition. Raspberry Pi is the control centre to integrate the intelligent light bulb. HUE makes a gesture recognition system. The results explain that the accuracy rate of the gesture recognition proposed is 90%. Meanwhile, it is higher than the SVM method (6).

Proposed framework is integrated in our physical human robot interaction library OpenPHRI. This integration complements OpenPHRI by providing successful implementation of the ISO/TS 15066 safety standards for ”safety rated monitored stop” and ”speed and separation monitoring” collaborative modes. We validate the performance of the proposed framework through a complete teaching by demonstration experiment with a robotic manipulator. Keywords: Physical Human-Robot Interaction, Safe Collaborative Robotics, Convolutional Neural Networks, Real-time Vision, Transfer Learning (8).

It develops an improved segmentation and deep learning-based strategy for dynamic hand gesture recognition. The data is gathered from the ISL benchmark dataset that consists of both static as well as dynamic images. The initial process of the proposed model is the preprocessing, which is being performed by grey scale conversion and histogram equalization. Further, the segmentation of gestures is done by the novel Adaptive Hough Transform (AHT), where the theta angle is tuned. Once the segmentation of gestures is done, the optimized Deep Convolutional Neural Network (Deep CNN) is used for gesture recognition. The learning rate, epoch count, and hidden neurons are tuned by the same heuristic concept. As the main contribution, the segmentation and classification are enhanced by the hybridization of Electric Fish Optimization (EFO), and Whale Optimization Algorithm (WOA) called Electric Fish based Whale Optimization Algorithm (E-WOA). The training of optimized Deep CNN is handled by Dynamic Time Warping (DTW) for avoiding redundant frames, thus enhancing the performance of dynamic hand gestures. Quantitative measurement is accomplished for evaluating hand gesture segmentation and recognition, which portrays the superior behaviour of the proposed model (1).

III. OBJECTIVE

- Data Entry Converting a user-oriented description of the input into a computer-based system is called design. The purpose of this design is to prevent errors in the data input process and to provide management with the proper guidance for obtaining accurate information from the computerized system.

- To handle a huge volume of data, it is accomplished by designing user-friendly displays for data entry. Making data entering simpler and error-free is the aim of input design. The layout of the data entering page makes it possible to manipulate data in every way. It has record viewing capabilities as well.

- A validity check will be performed on the data upon entry. Screens can be used to help enter data. When necessary, appropriate notifications are sent to prevent the user from being lost in the moment. Therefore, the goal of input design is to produce an input layout that is simple to understand.

IV. RESULT

- The ”Real-Time Hand Gesture Detection for Sign Language Recognition using Python” project successfully achieved its goal of creating a system that can instantly translate sign language movements into text. The system utilizes computer vision techniques to track and detect hand movements, followed by classification using machine learning algorithms. The proposed system can detect gestures such as ”Ok”, ”Open Hand”, ”Peace”, ” Thumbs up”, ”Thumbs down” and alphabets A-Z.

- Python programming and the OpenCV library were employed for the project’s computer vision tasks. The system consists of two distinct sections: the first utilizes the Exception architecture model to recognize hand motion photographs and forecast outcomes, while the second uses OpenCV for real-time detection using a webcam.

- Through the use of the Exception architectural model, our proposed solution achieved high training and validation accuracies of 90.34% and 90.00%, respectively. A dataset of hand motions recorded with a webcam was utilized to train the hand gesture identification model.

- The finished system includes an intuitive user interface, enabling individuals who do not use sign language to communicate effectively with those who do. In various contexts, including public areas, workplaces, and classrooms, the system enhances inclusivity and communication for individuals with speech or hearing impairments.

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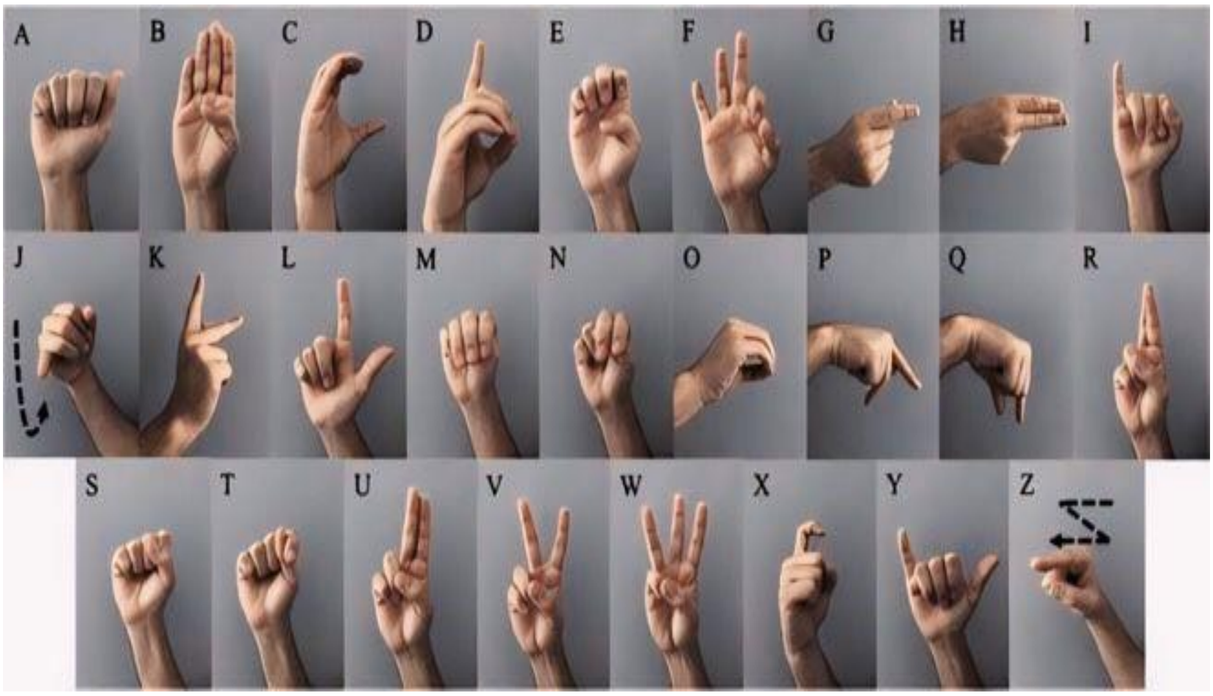

Fig. 1: American Sign Language

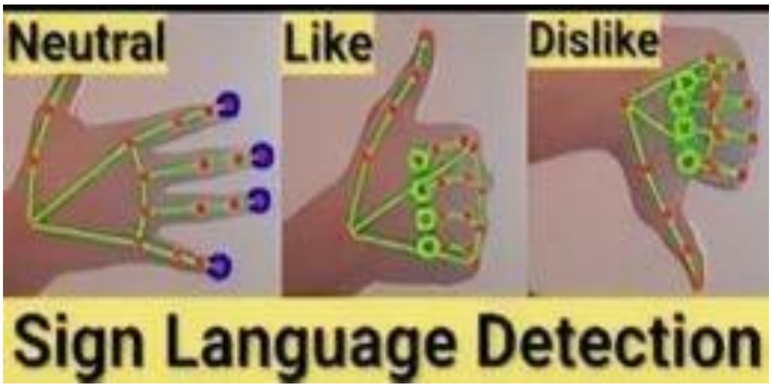

Fig. 2: Visualisation of Hand by computer vision

TABLE I
RESULTS OF THE ”REAL-TIME HAND GESTURE DETECTION FOR SIGN LANGUAGE RECOGNITION USING PYTHON” PROJECT.

Metric	Value (%)
Training Accuracy	90.34
Validation Accuracy	90.00

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V. CONCLUSION

The urgent need for automated sign language translation to improve inclusion and communication for people with hearing loss is addressed by the "Real-Time Hand Gesture Detection for Sign Language Recognition using Python" project. Although regional differences in sign languages make consistency difficult, sign language identification technology has the potential to improve societal well-being and bridge communication gaps. The goal of our project is to create a system that can translate sign language movements into text instantaneously. The system uses computer vision techniques to track and detect hand movements, then classifies the data using machine learning algorithms. It does this by leveraging Python programming and the OpenCV package. In particular, our suggested approach achieves high training and validation accuracies for hand motion identification by using the Exception architecture model. Our technology helps those who use sign language and those who do not, promoting inclusivity in public spaces, workplaces, and educational institutions alike. It does this by integrating an intuitive user interface.

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