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An AI-Powered Companion for Deaf and Mute Communication

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Abstract: SLR seeks to translate gesture-based communication into text or voice to further elaborate on correspondence between the hard of hearing quiet people and other hearing people. Despite this action having a huge cultural impact, it is nonetheless quite difficult due to its complexity and wide variety of hand signals. Existing SLR methods utilize grouping models in consideration of hand-crafted features to handle communication via gestures developments. Lately, it is attempting to gather robust features that can adapt to the wide range of hand movements. We suggest a specific 3D convolutional neural network (CNN) to handle this problem

I. INTRODUCTION

These days, we do not need much complicated methods to perform tasks as most of them are automated thanks to technology. However, this automated environment does not seem to benefit the disabled much, and the deaf and dumb people have not been developed yet as they find it hard to interact with others. One of the significant reasons for this is because they talk differently than normal people and the technological advancement has not provided special consideration to individuals with disabilities. So that becomes one key reason to choose a project to benefit them. The HGRSLTV program, which translates to "Hand Gesture Recognition of Sign Language for Text and Voice Conversion," allows deaf and dumb people to communicate with one another by observing and tracing the movements of their hands. Hand motion detection is possible through a web camera.

II LITERATURE SURVEY

[1] "Two Way Communicator between Deaf and Dumb People and Normal People" proposed by Ahire, Prashant G. et al. The ability to speak one's mind by reacting to events is one of nature's precious gifts to the human race, but denied some, it widens the gap between privileged and ordinary people. This product allows easy communication through a system mapping ISL movements to speech from real-time video and animated natural language translation of ISL movements.

[2] "Orientation sensing for gesture-based interaction with smart artefacts" by Alois, F., Stefan, R., Clemens, H., and Martin, R Direction detection is an important resource for smart artifacts that are designed to provide embodied interaction based on position, orientation, and relevant features. We classify hand-worn, hand-carried, and hand-graspable objects, supporting research across these categories for artifacts subject to manual control. Our framework applies orienta -tion sensor-based gesture recognition, viewing orientation features as "signals" from a theoretical perspective.

[3] "Automated speech recognition approach to continuous cue symbols generation" by Ibrahim Patel and Dr. Y. Srinivasa Rao The research aims to help the deaf and mute population by translating spoken language into sign language, in this case, converting American Sign Language (ASL) into spoken signals. Using an ASL dictionary for words, fingerspell when a word cannot be found with the words in the model, while for vocal disability, images for prompts from the audio input is generated through HMM that converts the audio input.

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[4] “Finger Detection for Sign Language Recognition" by: Ravikiran, J., Kavi, M., Suhas, M., Sudheender, and S., Nitin, V. Computer identification of sign language provides the scientific challenge of improving communication with hearing-impaired individuals. This work introduces an efficient algorithm for counting fingers in American Sign Language gestures, using boundary tracing and fingertip detection, which does not require markers, gloves, or any specific hand alignment. The key terms involved in this include finger detection, image processing, boundary tracing, sign language recognition, and computer accessibility for the impaired.

III SCOPE AND METHODOLOGY

SCOPE

The project "An AI-Powered Companion for Deaf and Mute Communication" aims to create an advanced communication tool for individuals who are either deaf or mute. The system will apply the most advanced machine learning algorithms in interpreting and translating sign language into spoken or written text and vice versa, in real time. It also features speechto-text and text-to-speech conversion in order to make two-way communication seamless. Also incorporated into the project is lip-reading technology to augment the system in terms of accuracy and efficiency. Therefore, when integrated with other technologies, this AI assistant will certainly reduce the gaps between communications that exist currently with regard to social interactions as well as enhance quality of life.

METHODOLOGY

The system begins by capturing real-time images of hand gestures using a webcam, which serves as the primary input device, enabling an interactive process for gesture recognition in any environment. The captured images undergo pre-processing to enhance their quality by reducing noise and standardizing dimensions, ensuring that the dataset is ready for analysis and recognition. Unwanted elements or objects in the background are removed through segmentation techniques, isolating the hand as the primary candidate for accurate recognition. The processed images are then converted to their binary form, which represents the hand gesture in the form of a high-contrast, simplified shape; this reduces the complexity of computation and improves the recognition of gesture patterns. To process the gesture image into such a meaningful representation for later feed into recognition model, edges, contours, as well as the key points are picked up from the binary image, this representation serves as input into the model which then feeds this through a Convolutional Neural Network and multi-layered architectures to discern patterns in features and also classify gestures against pre-trained datasets. The CNN matches the input gesture with a pre-stored database of gestures, identifies a match, and attaches the corresponding text description or meaning to it. The recognized gesture is thus converted into text and further synthesized into speech, thereby facilitating effective, real-time verbal communication of the interpreted sign language gesture.

IV SYSTEM ARCHITECTURE

The system architecture for the AI-powered companion for deaf and mute communication integrates several components to ensure seamless interaction. At the core lies a robust data processing pipeline, collecting and preprocessing video, audio, and text inputs. The video input is passed into a CNN to identify and translate sign language gestures. At the same time, an RNN handles speech-to-text and text-to-speech conversion to ensure real-time communication. The model is extended with an integration of a lip-reading deep learning for lip movement videos to enable better interpretation of speech. The models are orchestrated by the central control unit, with proper data flow and synchronized outputs. The user interface layer caters to intuitive access and usage for users accessing the system via mobile applications and web interfaces. This interface will allow users to input sign language, speech, or text and receive real-time translations. The entire system is supported by a scalable backend infrastructure, ensuring high performance and reliability. This architecture ensures a cohesive, real-time communication tool that effectively bridges the gap for deaf and mute individuals.

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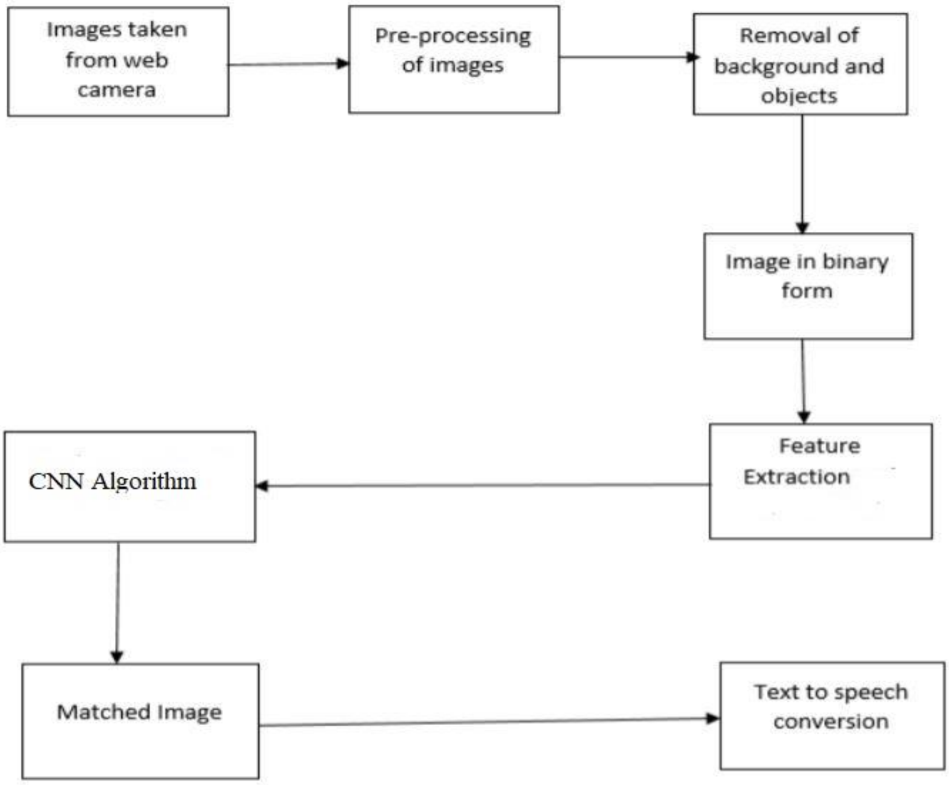

Fig : System Architecture

V. CONCLUSION

It's just a straightforward demonstration of the way CNN could be utilized to tackle issues in the world of PC vision with an extremely serious degree of accuracy. A finger spelling movement-based communication interpreter is gained which has 100% precision. The venture could then be stretched over other communications with signing by developing the correlating dataset and preparing the CNN.

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