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Hand Gesture Recognition for Deaf and Specially-Abled using ML and AI

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Abstract: *Millions of people have hearing loss on a global scale. This high figure emphasises how important it is to develop a system that can distinguish sign language and translate it into text, making sign language simpler to understand without the aid of a translation. There has been talk of a CNN algorithm based on sign language. We use hand gestures and sign language, which is a language unto itself, to communicate with those who are mostly deaf and dumb*

Keywords: Convolutional Neural Network, Sign Language, Machine Learning, Alphabet predictions

I. INTRODUCTION

AI refers to the utilization of computer-based artificial intelligence, which enables systems to learn and improve autonomously without explicit programming. The focus of AI lies in the development of computer programs that can gather information and use it to make decisions on their own. In the field of motion recognition, the integration of Gestural Control in the Human-Computer Interaction has been extensively studied. Within the broader context of pattern recognition, human motion recognition plays a significant role. It comprises the Description and Decision Cycles as integral components. The description phase converts raw numerical data into a structured format aligned with the decision-making process, allowing for data aggregation. The acquisition process and the interpretation cycle are additional components of the Signal Recognition System. These cycles convert real signals into numerical data and provide a representation of the image sequence, respectively. Any distinct hand gesture consists of four elements: hand posture, movement, direction, and location. These gestures can be categorized as staticor dynamic movements. According to the World Health Organization (WHO), over 5% of the global population, which equates to 360 million individuals, including 32 million children and 328 million adults, experiences some form of hearing impairment. Individuals with hearing disabilities commonly use sign language as a means of communication. However, most individuals with normal hearing have limited knowledge of sign language. Given the significant number of people affected by hearing loss, there is an increasing need to facilitate communication between hearing and hearing-impaired individuals through sign language recognition systems. The primary goals of such systems include reducing costs and improving accuracy. Developing an AI-based sign language recognition system for seamless communication and translating sign language into text can greatly assist hearing individuals in interacting and understanding those with hearing impairments. The proposed system utilizes images from a local source or frames captured by a webcam as input. It describes and analyzes the images, ultimately generating the desired output.

II. METHODOLOGY

2.1 Problem Definition:

Defined the problem statement: to develop a hand gesture recognition system for deaf and specially-abled individuals. Specified the goals and objectives of the project, such as achieving high accuracy in gesture recognition and real-time processing.

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2.2 Literature Review

- Conducted an extensive review of existing research papers, articles, and projects related to hand gesture recognition and machine learning techniques.
- Identified the state-of-the-art approaches, algorithms, and technologies used in this domain.

2.3 Data Collection and Preparation:

- Identified and collected a comprehensive dataset of hand gesture images.
- Determined the types of gestures needed for effective communication with deaf and specially-abled individuals.
- Split the dataset into training and testing sets, ensuring an adequate distribution of samples for each gesture class.

2.4 Feature Extraction:

- Explored different feature extraction techniques suitable for hand gesture recognition.
- Extracted relevant features from the pre-processed dataset, such as hand shape, finger positions.
- Experimented with feature engineering methods to enhance the discriminative power of the extracted features.

2.5 Model Selection and Training:

- Evaluated various machine learning algorithms suitable for gesture recognition, such as convolutional neural networks (CNNs), recurrent neural networks (RNNs), or support vector machines (SVMs).
- Chose the most appropriate algorithm based on the project requirements and the characteristics of the dataset.
- Designed and implement the chosen model architecture, considering factors like network depth, layer types, and activation functions.
- Trained the model using the prepared dataset.

2.6 Model Evaluation:

- Evaluated the trained model's performance using appropriate evaluation metrics, such as accuracy, precision, recall, and F1 score.
- Assessed the model's robustness and generalization ability by testing it on unseen data, including real-time gesture input.
- Compared the results with existing approaches and highlight the strengths and limitations of the developed model.

2.7 System Integration

- Developed a user-friendly interface for the hand gesture recognition system, considering the needs and limitations of deaf and specially-abled users.
- Implemented real-time processing capabilities to provide immediate feedback on recognized gestures.
- Ensured the system's compatibility with different devices, such as cameras.

2.8 Testing and Validation

- Conducted extensive testing of the integrated system, involving deaf and specially-abled individuals as end-users.
- Collected feedback and suggestions to refine the system's performance, usability, and accessibility.
- Validated the system's effectiveness in facilitating communication and improving the quality of life for the target user group.

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2.9 Documentation and Reporting

- Prepared detailed documentation of the project, including the methodology, algorithms used, experimental setup, and implementation details.
- Provided clear instructions for deploying and using the developed system.
- Summarized the project's achievements, lessons learned, and future directions for improvement.

2.10 Project Presentation and Demonstration

- Created a comprehensive presentation highlighting the project's objectives, methodology, results, and contributions.
- Demonstrated the working system to the project committee, explaining its functionality and benefits.
- Addressed any questions or concerns raised by the committee and receive feedback forpotential enhancements.

III. MODELING AND ANALYSIS

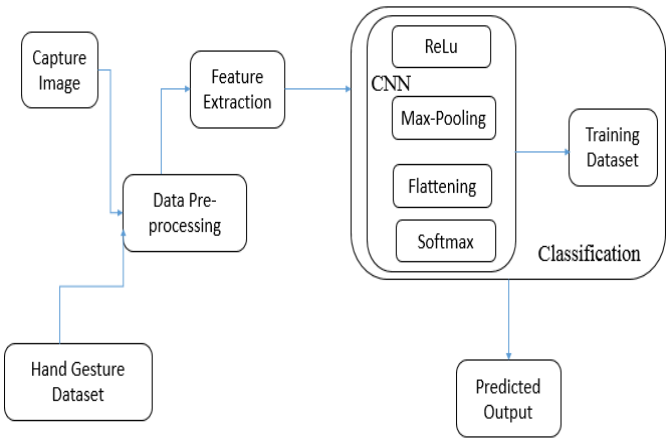

Figure 1: 3D view of building.

IV. CONCLUSION

The CNN algorithm, which the technology uses to recognize hand motions, will provide us the best results in the recommended framework. The Hand Gesture Recognition system will enable two-way communication and make it simpler for individuals with disabilities to engage with those who are not disabled by recognizing the alphabets or numbers a person desires to say. As a consequence, the implementation system can interpret Sign Language and predict letters.

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