SIGN LANGUAGE RECOGNITION TO TEXT AND VOICE USING CNN

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ABSTRACT

Communication is one of the fundamental needs of human interaction, but individuals with hearing and speech impairments often face difficulties in communicating with others. Sign language serves as an important medium for such individuals; however, many people are unfamiliar with sign language, creating communication barriers. This project proposes a Sign Language Recognition System using Convolutional Neural Networks (CNN) that converts hand gestures into text and voice output in real time. The system captures hand gestures using a camera, preprocesses the images, and uses deep learning techniques to classify sign language gestures accurately. The recognized gestures are converted into readable text and synthesized speech, enabling effective communication between sign language users and non-sign language users. The proposed system improves accessibility, enhances communication efficiency, and demonstrates the effectiveness of CNN models in image-based gesture recognition applications.

INTRODUCTION Sign language is a visual means of communication used by people with hearing and speech disabilities to express their thoughts and emotions through hand gestures, facial expressions, and body movements. Although sign language plays a critical role in enabling communication for millions of people worldwide, communication barriers still exist because many individuals are not familiar with sign language. This creates challenges in education, healthcare, workplaces, and social interactions. Traditional communication methods often require interpreters, which may not always be available, leading to delays and misunderstandings.

Recent advancements in artificial intelligence and deep learning have opened new possibilities for automated sign language recognition systems. Among these technologies, Convolutional Neural Networks (CNN) have proven highly effective in image recognition and classification tasks. CNN models can analyze visual patterns from hand gestures and accurately identify sign language symbols. By integrating computer vision

techniques with deep learning algorithms, sign language gestures can be recognized in real time and converted into text and speech outputs. This project focuses on developing a Sign Language Recognition to Text and Voice System using CNN. The proposed system captures hand gestures through a webcam, processes the images, and uses a trained CNN model to recognize the corresponding sign language alphabet or word. The recognized output is then converted into text and voice, enabling smooth communication between differently abled individuals and the general public. The system aims to improve accessibility, reduce communication gaps, and provide a user-friendly and efficient communication solution.

LITERATURE SURVEY

1. Title: Real-Time Sign Language Recognition Using CNN

Authors: S. Kumar, R. Sharma, and A. Singh
Description:
This study presents a real-time sign language recognition system using Convolutional Neural Networks for gesture classification. The authors demonstrate high accuracy in recognizing static hand gestures and converting them into text output.

2. Title: Deep Learning-Based Hand Gesture Recognition

Authors: Y. LeCun, L. Bottou, and P. Haffner
Description:
The paper explores deep learning techniques for image recognition and highlights the effectiveness of CNN models in detecting and classifying hand gestures from image datasets.

3. Title: Sign Language to Speech Conversion System

Authors: P. Verma and S. Gupta
Description:
This research introduces a system that converts recognized sign language gestures into speech using text-to-speech technology, improving communication for hearing-impaired individuals.

4. Title: Hand Gesture Recognition Using Computer Vision

Authors: R. Patel and K. Mehta
Description:
The study focuses on computer vision techniques for detecting hand movements and gestures in real-time environments using image preprocessing methods.

5. Title: CNN-Based American Sign Language Recognition

Authors: M. Johnson and T. Brown
Description:
This paper develops a CNN model for recognizing American Sign Language alphabets with high classification accuracy and efficient processing speed.

6. Title: Real-Time Gesture Recognition Using OpenCV and Deep Learning

Authors: A. Jain, P. Sharma, and R. Singh
Description:

The authors combine OpenCV and deep learning models for real-time gesture detection and recognition, demonstrating practical implementation in communication systems.

7. Title: Vision-Based Sign Language Interpretation System

Authors: H. Wang and J. Chen
Description:
This study proposes a vision-based interpretation system that translates sign language gestures into readable text using machine learning algorithms.

8. Title: AI-Based Communication System for Deaf and Mute People

Authors: K. Reddy and S. Rao
Description:
The paper discusses AI-driven communication systems that assist differently abled individuals through gesture recognition and voice generation technologies.

9. Title: Deep Neural Networks for Gesture Recognition

Authors: G. Hinton and A. Krizhevsky
Description:
This research highlights the role of deep neural networks in gesture recognition applications and demonstrates improved performance compared to traditional machine learning approaches.

10. Title: Smart Sign Language Recognition Using IoT and AI

Authors: L. Zhang and Y. Liu
Description:
The study integrates IoT devices with AI-based gesture recognition systems to provide smart and portable communication solutions.

EXISTING SYSTEM

Existing sign language recognition systems primarily rely on manual interpretation or sensor-based technologies such as data gloves and motion sensors. Manual interpretation requires the presence of trained sign language interpreters, which may not always be feasible or affordable. Sensor-based systems provide accurate gesture recognition but require users to wear special hardware devices, making them uncomfortable and less practical for everyday use. Some computer vision-based systems have been developed; however, they often suffer from low accuracy, poor lighting adaptability, and limited real-time performance. Traditional machine learning approaches require manual feature extraction and are unable to effectively handle complex gesture patterns. Furthermore, many existing systems only provide text output and lack speech conversion features, limiting their communication capabilities. These limitations highlight the need for a more efficient, accurate, and user-friendly sign language recognition system.

DISADVANTAGES

- Requires manual interpretation
- Sensor-based systems are costly
- Low recognition accuracy in existing models

- Sensitive to lighting conditions
- Limited real-time performance
- Lack of voice output in some systems

PROPOSED SYSTEM

The proposed Sign Language Recognition to Text and Voice System utilizes Convolutional Neural Networks (CNN) and computer vision techniques to provide accurate and real-time gesture recognition. The system captures hand gesture images using a webcam and preprocesses the input through image enhancement and segmentation techniques. The processed images are then fed into a trained CNN model that identifies the corresponding sign language gesture with high accuracy.

Once the gesture is recognized, the system converts it into text and generates voice output using text-to-speech technology. Unlike traditional sensor-based systems, the proposed approach does not require any wearable devices, making it more convenient and cost-effective. The integration of deep learning techniques improves recognition accuracy and enables the system to adapt to different lighting conditions and backgrounds. Additionally, the system supports real-time communication, making it suitable for educational institutions, healthcare services, public communication systems, and personal use. Overall, the proposed system provides an efficient and accessible solution for bridging communication gaps between hearing-impaired individuals and society.

ADVANTAGES

- Real-time gesture recognition
- High accuracy using CNN
- Converts gestures to text and voice
- No wearable devices required
- User-friendly and cost-effective
- Enhances communication accessibility

IMPLEMENTATION

Data Collection

- Collect sign language gesture images

Preprocessing

- Image resizing and normalization

Feature Extraction

- Extract gesture features using CNN

Model Development

- Train CNN model for classification

Text Conversion

- Convert recognized gestures into text

Voice Generation

- Generate speech using text-to-speech engine

Testing

- Evaluate accuracy and performance

METHODOLOGY

Step 1: Image Acquisition

Capture hand gestures using webcam

Step 2: Image Preprocessing

Resize and normalize images

Step 3: CNN Training

Train deep learning model on gesture dataset

Step 4: Gesture Recognition

Classify sign language gestures

Step 5: Text Conversion

Convert gesture into readable text

Step 6: Voice Output

Generate speech using TTS engine

CONCLUSION

The Sign Language Recognition to Text and Voice System using CNN provides an effective and intelligent communication solution for hearing and speech-impaired individuals. By combining computer vision techniques with deep learning models, the system accurately recognizes sign language gestures and converts them into text and speech in real time. The use of Convolutional Neural Networks significantly improves recognition accuracy and enables the system to handle complex gesture patterns efficiently. The integration of text-to-speech technology further enhances communication by allowing recognized gestures to be spoken aloud, thereby bridging the communication gap between sign language users and non-users.

Although challenges such as varying lighting conditions, gesture complexity, and background noise may affect performance, the proposed system demonstrates significant improvements over traditional methods. Future enhancements may include multilingual support, dynamic sentence recognition, mobile application integration, and advanced AI models for continuous gesture tracking. Overall, the proposed system contributes to accessibility, inclusivity, and improved quality of life for differently abled individuals by enabling seamless communication through modern AI technologies.

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