A Review: Sign Language Converter Using Hand Gloves

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Abstract - Most people in the world are not able to communicate with other people because of different levels of disabilities caused by work accidents or some diseases. They are facing a lot of problems while communicating. They use sign language to communicate with normal people. But there is a communication barrier between normal and mute people while communicating. Therefore, the paper proposes a smart glove to convert sign language into voice. This system consists of a flex sensor, accelerometer and touch sensor attached to the gloves. These are used to sense the different gestures made by the mute people and couple the analogy voltage to the Arduino. After that, it is converted into speech using the speaker. So, this system helps mute people to communicate with normal people.

***Key Words*:** Flex sensor, Bluetooth, Accelerometer

1. INTRODUCTION

Sign languages are the natural languages that are structurally different from the verbal language spoken on a day-to-day basis. Using hand movements, facial expressions, body posture and other movements is a form of communication. This form of communication is mainly used by hearing-impaired and mute people. It has an important role for people with speech disorders.

A speech-impaired person finds it challenging to comprehend normal people and vice versa when they try to communicate. To overcome the gap between people with hearing impairments and speech challenges, gesture recognition systems are being used. The study of gesture recognition is quite active. Sign language is not considered a global language and varies from country to country.

Sign language detection has been the subject of many research works, for example, American Sign Language (ASL) in the US, British Sign Language (BSL) in the UK and Japanese Sign Language (JSL) in Japan. There are around 137 sign languages are used around the world, with several nations having more than one native sign language, according to the 2013 edition of Ethnologue. The majority of nations utilize American Sign Language. In India, we are using Indian Sign Language.

2. LITERATURE SURVEY

Veeraprathap et al [1] have developed medical sensor networks to assist people with disabilities. Their system includes a glove-based sign-to-voice converter for American Sign Language, which synthesizes and adapts speech signals for English and various Indian languages. Additionally, they propose a sensor-controlled wheelchair that can navigate, detect obstacles and move automatically using Gesture and Ultrasonic Sensors to create Ad-hoc sensor networks. This technology can improve mobility assistance for people with physical impairments or elderly individuals.

Nikhita et al [2] have developed a smart glove for interpreting sign language, which can recognize the ten letters of the English alphabet. The glove uses LED-LDR pairs on each finger to detect hand gestures, which are then converted into digital signals by a microcontroller. These signals are transmitted wirelessly over ZigBee and translated into ASCII characters for each letter. When a message is received, a computer plays the corresponding audio and displays the letter on the screen. This innovative system has potential applications for improving communication between people who are deaf or hard of hearing and those who do not know sign language.

Jie et al [3] proposed a 3D convolutional neural network for automatically extracting spatial-temporal information from unprocessed video streams. The network uses multiple channels of video feeds, including trajectory, depth, color, body joint locations and depth hints, to enhance its performance. The authors tested their model on a dataset acquired using Microsoft Kinect and found that it outperformed traditional methods that rely on hand-crafted features. This approach has potential applications in various fields, including video analysis, action recognition and human-computer interaction.

John et al [4] developed a technique for converting sign language into text using neural networks. They used a data glove that measured 18 angles of different finger joints to capture hand gestures. The authors compared the performance of various neural network models, such as back-propagation and radial-basis functions, in recognizing the gestures. Some models achieved up to 100% accuracy across multiple test scenarios. This recognition system has the potential to be used for virtual reality applications, where sign language can control program execution.

Vishal et al [5] developed a smart glove interpretation system that can help people with physical disabilities communicate with others. The wearable system includes a 16*2 LCD display, five flex sensors, a three-axis accelerometer and Bluetooth connectivity. The accelerometer and flex sensors collect data and send it to the processor, which compares it to previously saved data. If the data matches a predefined meaning, it is displayed on the LCD screen and transmitted via Bluetooth to an Android smartphone. An Android app can then convert text into spoken language, enabling swift communication through sign language. This technology has potential applications in improving communication for people with physical disabilities.

Jason et al [6] conducted research on 2-D image recognition, specifically recognizing using still images as input, the 24 static letters of the American sign language alphabet. They developed a two-layer feed-forward neural network that uses a wavelet-based feature vector. They employed two wavelet-based decomposition methods, with the first generating a real-valued S-element feature vector and the second generating an ls-element feature vector. They trained the neural network using Levenberg-Marquardt training with each set of feature vectors. The system achieved 99.9% accuracy in identifying occurrences of static ASL fingerspelling. The researchers highlighted the need to address some challenges before extending the corpus of ASL signs to be recognized.

P. Subha et al [7]. proposed a method wherein 32 binary 'UP' & 'DOWN' symbols are defined to represent the five fingers' positions. The right hand's palm side is depicted in the photos, which are loaded dynamically at runtime. During the method's development and testing phases, a single user was taken into consideration. The pre-processed static photos were created using the feature point extraction approach and each sign's training set consists of 10 images. By recognizing the fingertip position of static images using image processing techniques, the images are transformed into text. The suggested method can recognize the signer's photos that are dynamically taken during testing. The test results demonstrate that the suggested Sign Language Recognition System can identify images with 98.125% accuracy with 160 images after 320 images were taught and tested.

Ravikiran et al [8] developed an algorithm to detect the number of fingers extended in American Sign Language gestures. Their approach relies on Finger Tip Detection and Boundary Tracing to detect fingers without requiring any special markers or gloves on the hand and without needing the hand to be precisely aligned to the camera.

Oinam et al [9] describe two techniques for hand gesture recognition: vision-based and data-based. The vision-based approach uses MATLAB software to process input images and decision-making is done without any dataset, resulting in accurate results compared to other techniques. However, it only detects static hand gestures. On the other hand, the data-based approach uses a glove with five flex sensors attached to an Arduino Uno board, MATLAB software and a speaker. According to the paper, the vision-based technique achieves 100% accuracy in bright lighting conditions with a white background, while the data glove-based technique achieves an accuracy of 86%.

Abdullah et al [10] developed the Hand Talking System (HTS), which uses a sewing controller and a few sensors. A smartphone, an accelerometer, an Arduino and flex sensors are included in the HTS. The system uses an Android app for user interaction and to store multi-language data in an SQLite database. The HTS allows users to speak in letter-formed words or to use hand gestures to represent common words used in daily communication. In both American Sign Language (98.26%) and Arabic Sign Language (99.33%), the researchers achieved high accuracy rates. The overall average accuracy rate for both sign languages was 98.795%.

Manisha et al [11]. They developed a sign language recognition system using an image processing technique. This paper reviews various strategies for lowering communication barriers by creating aid for deaf-mute people. In this, they collect the images using a webcam and they used a leap motion controller it detects the hand movement and converts that signal into computer commands.

Mahesh et al [12] developed a portable sign language recognition system was developed using accelerometers, gyroscopes and flex sensors embedded in a glove to record the user's movements in real-time. The data is processed by an Arduino nano microcontroller and transferred to a computer via Bluetooth. A support vector machine algorithm is then used for classification to identify the sign language motions and anticipate the corresponding word. The system was tested with both Indian sign language and American sign language, showing promising results for facilitating communication for mute individuals and promoting language learning

Chhaya et al [13] proposed a real-time sign language-to-speech conversion system using image processing and machine learning. The system collects images using a webcam, which is then analyzed using image processing techniques like the OTSU method. A linear classification algorithm is used for the classification of the gestures, which are stored in files with 120 copies of each gesture. The authors found that storing more copies of gesture images can improve the accuracy of the system. The system uses histograms to record image gestures, providing a promising approach for facilitating communication for individuals who use sign language.

Honggang et al [14] developed a system for recognizing American sign language gestures using multi-dimensional Hidden Markov Models (HMMs). The system extracts hand gestures from a motion tracker for birds and a cyber-glove sensory glove. The motion tracker data characterize the trajectory of hand movement, while the glove's strain gauges determine the shape of the hand. These data are then processed through an HMM processor for recognition of the 26 alphabets and 36 basic handshapes in American sign language. The approach shows promise for recognizing American sign language gestures, with the potential for facilitating communication for individuals who use sign language.

Tushar et al[15] aimed to design and implement a low-cost wired interactive glove for sign language recognition that interfaces with a computer running MATLAB to identify gestures with high accuracy. The glove uses bend sensors, hall effect sensors and an accelerometer to map hand and finger alignment and an automated repeat request error-controlling protocol is employed to transmit the data to a computer. The technology has the potential to translate sign language into more understandable formats like text messaging, providing a useful tool for facilitating communication for individuals with disabilities.

3. CONCLUSIONS

According to the literature review, the glove-based technique produces more accurate results than the vision-based method. This approach of converting sign language into voice is based on the glove-based approach. This smart glove approach is intended as a prototype to verify the feasibility of recognizing sign languages with smart gloves. As a result, this system aims to eliminate the communication barrier between normal and speech-impaired individuals. Due to the fact that this is a portable device, it can be used in a wide variety of communication situations.

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