ISSN 2319-5991 www.ijerst.com

Peer Reviewed, Referred & Indexed Journal

Research Paper

A GLOVE THAT CONVERTS SIGN LANGUAGE INTO TEXT AND SPEECH

G.Anitha Chowdary, Y. Harshitha Reddy, S .Anji, S. Deepika , S. Ganesh

Associate professor ,UG Student, Department of Electronics and Communication Engineering

TKR College Of Engineering and Technology ,Medbowli,Meerpet ,Balapur,Hyderabad,

Telangana 500097,India

--******--

Abstarct - Sign language is one of the world's languages, but instead of using speech or voice, it communicates by hand signals and other body parts. Speech and hearing-impaired people need to be able to communicate in sign language. A speech impaired person is someone who is unable to talk due to a reluctance or in ability to speak. A person who has been hearing-impaired since birth or loss may develop later. Malaysian Sign Language (MSL) will be used by Malaysians speech and hearing-impaired population to communicate, but it will be an obstacle as they need to converse with normal people. Currently, sign language translators are mostly focused on general sign language and American Sign Language (ASL). This project aimed to develop a sign language translator system based on MSL with Node MCU ESP8266, flex sensors and MPU6050 accelerometer gyroscope sensor module that would enable speech and hearing-impaired people to communicate with regular people who are unfamiliar with sign language. It used a data glove approach method that can convert a hand gesture into words. In this context, the flex sensors defined the sensor values based on finger bending, meanwhile, the accelerometer gyro sensor module defined the hand position. This project implements IoT technology to display the meaning of sign language gestures on a smartphone. A Node MCU ESP8266 module was also used as a source IoT platform by integrating with the Blynk application in the smartphone to display the output of the system.The integration of the NodeMCU ESP8266 makes the system capable of transferring data via Wi-Fi. The data captured from the sensors is processed, and the gesture's meaning is displayed on a smartphone screen via the Blynk app, offering a real-time translation of the sign into text. This IoT functionality is crucial as it allows the system to be portable, user friendly, and flexible for various use cases, especially in everyday situations where a smartphone can easily be used to read the translation.

1. INTRODUCTION

Communication is an essential aspect of human interaction, allowing individuals to express thoughts, emotions, and needs. However, for speech and hearing- impaired individuals, communication becomes a significant challenge, mainly when interacting with people who are unfamiliar with sign language. Sign language is used as a primary mode of interacting for the deaf and mute community, using hand gestures, expressions, and body movements instead of spoken words. In Malaysia, Malaysian Sign Language (MSL) is widely used by speech and hearing impaired individuals. many people outside the community do not understand MSL, creating a communication gap that hinders daily interactions, education, and employment opportunities. Current technological advancements have introduced sign language recognition systems, but most focus on general sign language or American Sign Language (ASL), leaving a need for localized solutions tailored to specific regional sign languages like MSL. The aim is to develop a gesture-to-word sign language translator based on Internet of Things technology to bridge this communication gap. The system utilizes a data glove approach embedded with flex sensors and an MPU6050 accelerometer-gyroscope sensor module to capture and interpret hand gestures. The flex sensors detect finger bending, while the accelerometer and gyroscope measure hand orientation and motion. The collected gesture data is processed using Node MCU ESP8266, which transmits the recognized signs to a smartphone interface via the Blynk IoT platform, displaying the translated words in real time.

2. LITERATURE SURVEY

Sign language is a crucial mode of interaction for individuals with speech and hearing impairments, enabling them to express themselves using hand gestures and body movements.It helps to convey their emotions and information to people around them. However, challenges arise when interacting with individuals who do not understand sign language. Multiple research have been made to bridge this communication gap by developing sign language conversion systems that convert gestures into text or speech. Various studies have explored different technologies and methodologies for translating sign language into text. Early systems relied on image processing and computer vision techniques, where cameras captured hand movements, and machine learning algorithms recognized gestures. However, these systems had limitations such as lighting dependency, complex background processing, and high computational costs. To overcome these challenges, researchers shifted towards wearable sensor-based approaches, such as data gloves embedded with flex sensors, accelerometers, and gyroscopes. These sensor-based systems provide higher accuracy in gesture recognition, as they can precisely track finger bending and hand orientation. For example, studies have illustrated that flex sensors can effectively detect the degree of finger bending, while MPU6050 accelerometer and gyroscope modules can determine hand movements and orientation in 3D space. In recent years, IoT-based solutions have gained prominence in sign language translation. Systems integrated with Wi-Fi-enabled microcontrollers like the NodeMCU ESP8266 allow real-time data transmission to smartphones or cloud platforms. Researchers have successfully implemented IoT platforms like Blynk and Firebase to display translated text on a mobile application, making the system more accessible and user-friendly.

3. EXISTING SYSTEM

Existing methodologies for sign language translation are primarily divided into vision-based, sensor-based, and hybrid systems. Each approach offers unique benefits but also comes with certain limitations in terms of cost, accuracy, and usability.

1. **Computer Vision-Based Approach**:

This method uses cameras to capture hand gestures and body movements. Advanced deep learning models such as Convolutional Neural Networks (CNNs) are applied to process the captured images or video frames. The system identifies patterns in hand shapes, positions, and motion to translate them into text or speech. While this approach is non-invasive and user-friendly, it is highly dependent on environmental conditions such as lighting, background noise, and camera quality. It may also struggle with complex gestures or occlusions.

2. **Wearable Sensor-Based Approach:**

In this approach, users wear gloves embedded with sensors such as flex sensors, accelerometers, and gyroscopes. These sensors detect finger bending, hand orientation, and movement. The collected data is processed to recognize specific gestures. This method provides higher accuracy compared to vision-based systems and is less affected by environmental conditions. However, it can be expensive and less comfortable due to the need for wearable hardware..

3. **EMG (Electromyography)-Based Approach**:

EMG-based systems use sensors placed on the skin to measure electrical signals generated by muscle activity. These signals are analyzed to interpret hand gestures based on muscle contractions. This approach can detect even subtle movements and works well in situations where visible motion is limited. However, it requires precise sensor placement and can be sensitive to noise, making it complex and costly.

4. **Hybrid Approach (Sensor + Vision Based)**:

Hybrid systems combine wearable sensors and computer vision techniques to improve overall performance. By integrating both physical movement data and visual information, these systems achieve higher accuracy and reliability. However, the combination increases system complexity, computational requirements, and cost.

5. **AI-Based NLP Integration**:

For Gesture Translation Modern systems incorporate Artificial Intelligence and Natural Language Processing (NLP) to convert recognized gestures into grammatically correct and meaningful sentences. Instead of simple word-by-word translation, NLP enables contextual understanding, improving communication quality. The downside is increased computational complexity and the need for large datasets for training.

4. PROPOSED SYSTEM

The proposed system focuses on a cost-effective, accurate, and real-time solution using wearable sensors and IoT technology. It combines hardware and software components to translate sign language gestures into text and speech efficiently.

1. **Sensor-Based Gesture Recognition:**

The system uses flex sensors to detect the bending of fingers and an MPU6050 accelerometer-gyroscope to capture hand motion and orientation. These sensors continuously generate data corresponding to different gestures. The collected signals are processed to identify predefined sign language gestures accurately.

2. **IoT Integration with Node MCU ESP8266**

The Node MCU ESP8266 acts as the central controller and communication module. It processes sensor data and transmits it wirelessly to a smartphone using Wi-Fi. This enables real-time communication and eliminates the need for wired connections, making the system portable and user-friendly.

3. **Embedded System Development**

The entire system is programmed using Embedded C in the Arduino IDE. The microcontroller reads sensor inputs, applies decision logic, and maps them to specific gestures. Efficient coding ensures fast processing speed and minimal delay in translation, which is essential for real-time communication.

4. **Real-Time Display and User Interface**

The translated output is displayed on an I2C LCD screen for immediate feedback. Simultaneously, the data is sent to a smartphone application (such as the Blynk app), where it can be displayed as text or converted into speech. This dual-output system improves accessibility for both hearing and speech-impaired individuals as well as normal users.

5. **System Testing and Performance Evaluation**

The system undergoes multiple levels of testing, including unit testing (individual components), integration testing (combined modules), and user testing (real-world usage). Parameters such as accuracy, response time, reliability, and user comfort are evaluated. Based on feedback, necessary improvements are made to optimize system performance.

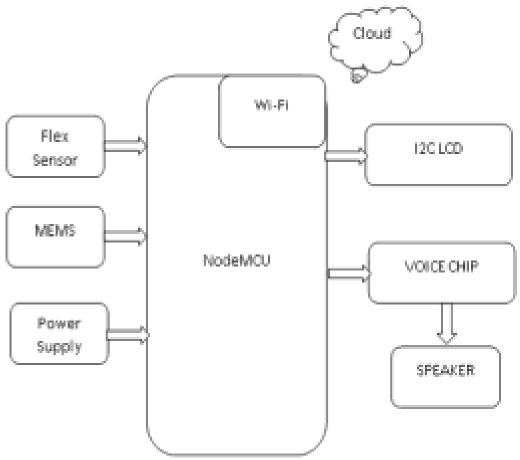

Fig: Block Diagram of Proposed System

5. RESULT ANALYSIS

Fig: Implementation of a glove that converts sign language into text and speech

6. CONCLUSION

This project successfully developed a Malaysian Sign Language (MSL) translator system using NodeMCU ESP8266, flex sensors, and the MPU6050 accelerometer gyroscope sensor module. By utilizing a data glove approach, the system effectively converts hand gestures into words, allowing speech and hearing impaired individuals to communicate with those unfamiliar with sign language. The combination of flex sensors for finger bending detection and an accelerometer gyroscope module for hand position tracking ensures accurate gesture recognition, making the system a reliable tool for real-time translation. Furthermore, integrating IoT technology into the project enhances its accessibility and usability. By using the Node MCU ESP8266 as an IoT platform and connecting it with the Blynk application, the translated gestures are displayed on a smartphone, providing a seamless and user-friendly experience. This innovation bridges the exchanging gap between the speech and hearing-impaired community and the general public, offering a practical solution for daily interactions. The system's wireless connectivity and real-time processing further improve its efficiency and convenience. Overall, this MSL translator system demonstrates a significant advancement in assistive technology for people with speech and hearing impairments. It not only contributes to improving their communication but also promotes inclusivity in society. Incorporating machine learning for more precise gesture recognition, and integrating speech synthesis for enhanced communication. This project lays the foundation for further research and development in sign language translation technology, ultimately fostering a more inclusive and connected world.

REFERENCES

1. Ahmed, M. A. et al., A Review on Systems-Based Sensory Gloves for Sign Language (2018). — comprehensive survey of glove sensors, signal processing, and prototypes.

2. Madhiarasan, M., A Comprehensive Review of Sign Language Recognition (2022, arXiv) — broad SLR review including modalities, datasets and models.

3. UCLA team — glove translating ASL to speech (Nature Electronics coverage / press release, 2020) — prominent real-time prototype and smartphone integration example.

4. ArXiv / Systematic review on custom data gloves (2024) — analysis of sensor choices, encumbrance, and standardization needs.

5. Ji, A. et al., Dataglove for Sign Language Recognition of People with ... (2023) / MDPI assistive glove papers (2023)

6. A. Kumar and R. Singh, "Design and Development of Sensor-Based Communication Glove for Speech Impaired People," International Journal of Engineering Research & Technology (IJERT), vol. 7, no. 5, pp. 234–238, 2018.

7. S. Sharma and R. Gupta, "IoT Based Assistive Communication System for Differently Abled Persons," International Journal of Innovative Technology and Exploring Engineering (IJITEE), vol. 8, no. 9, pp. 1124– 1128, 2019.

8. N. Singh and A. Chatterjee, "NodeMCU Based RealTime Emergency Communication System Using Firebase," International Conference on Smart Computing and Electronics Systems (ICSCES), pp. 456–460, 2020.

9. S. Banerjee, P. Das, and M. Roy, "Capacitive Touch Sensor Based Assistive Device for Non-

Verbal Patients," International Journal of Scientific & Technology Research, vol. 10, no. 3, pp. 89–93, 2021.

10. Google, "Firebase Realtime Database Documentation," Google Developers, 2023.[Online].Available:https://fihttps://firebase.google.com/docsrebase.google. com /docs

11. A. Reddy and K. Prakash, "IoT Based Smart Health Monitoring System," International Journal of Advanced Research in Computer and Communication.