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DEVELOPMENT OF A SIGN LANGUAGE TRANSLATOR BASED ON GESTURES-TO-WORDS USING IOT

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ABSTRACT

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 inability 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 NodeMCU 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 NodeMCU 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.

INTRODUCTION

Communication is a fundamental aspect of human interaction, enabling individuals to express thoughts, emotions, and needs. However, for speech and hearing- impaired individuals, communication becomes a significant challenge, especially when interacting with people who are unfamiliar with sign language. Sign language serves as a primary mode of communication for the deaf and mute community, using hand gestures, facial expressions, and body movements instead of spoken words.

In Malaysia, Malaysian Sign Language (MSL) is widely used by speech and hearing-impaired individuals. Despite its importance, 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.

This project aims to develop a gesture-to-word sign language translator based on Internet of Things (IoT) 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

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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.

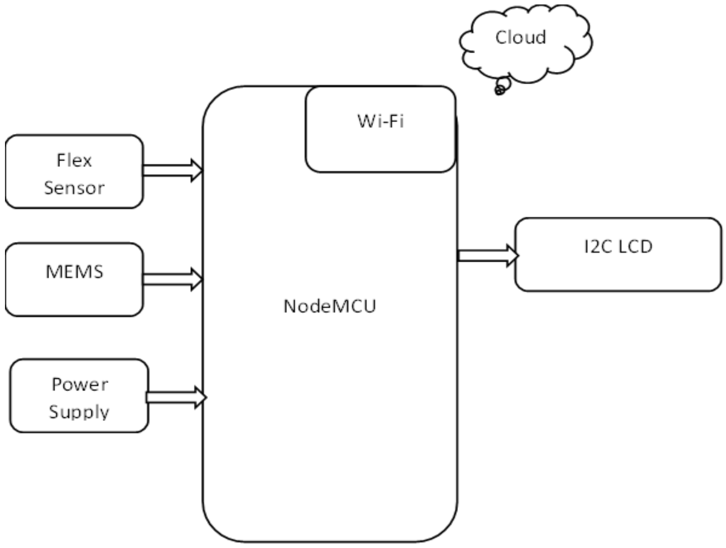

Figure.1 Block Diagram

LITERATURE SURVEY

Sign language is a crucial mode of communication for individuals with speech and hearing impairments, enabling them to express themselves using hand gestures and body movements. However, challenges arise when communicating with individuals who do not understand sign language. Various research efforts have been made to bridge this communication gap by developing sign language translation systems that convert hand gestures into text or speech.

Several 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 demonstrated 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.

PROPOSED SYSTEM

The proposed methodology uses flex sensors and an MPU6050 accelerometer- gyroscope for gesture recognition, with Node MCU ESP8266 enabling real-time IoT- based translation via a smartphone app. The system is programmed using Embedded C in Arduino IDE, displaying output on an I2C LCD and Blynk app, ensuring accessibility and accuracy.

Sign Language Translator System illustrates the flow of data from gesture detection to output display. It provides a clear representation of how different hardware and software components interact to achieve real-time sign

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language translation. The system primarily consists of sensors, a microcontroller (Node MCU ESP8266), an LCD display, and IoT connectivity for smartphone integration.

At the input stage, flex sensors are attached to the fingers to detect their bending positions, while the MPU6050 accelerometer-gyroscope module captures hand orientation and movement. These sensors generate analog and digital signals corresponding to different hand gestures. The collected data is then transmitted to the Node MCU ESP8266, which processes the signals and maps them to predefined sign language gestures.

The processing unit, Node MCU ESP8266, acts as the core of the system, converting raw sensor values into meaningful words. It is programmed using Embedded C in the Arduino IDE, ensuring efficient data handling and real-time translation. The microcontroller also enables Wi-Fi connectivity, allowing the processed data to be displayed not only on an I2C LCD screen but also on a smartphone via the Blynk application.

At the output stage, the translated words are displayed on an LCD screen, providing instant feedback. Simultaneously, the Blynk app on a smartphone receives the translated text, making it accessible for communication with non-sign language users. This IoT-based approach enhances usability, as the system can be remotely monitored and updated.

The power supply unit ensures continuous operation by providing the necessary voltage to all components. The system undergoes rigorous testing and calibration to improve accuracy, response time, and user experience. The block diagram thus represents a seamless integration of sensors, microcontrollers, and IoT technology, enabling efficient and accessible communication for speech and hearing-impaired individuals.

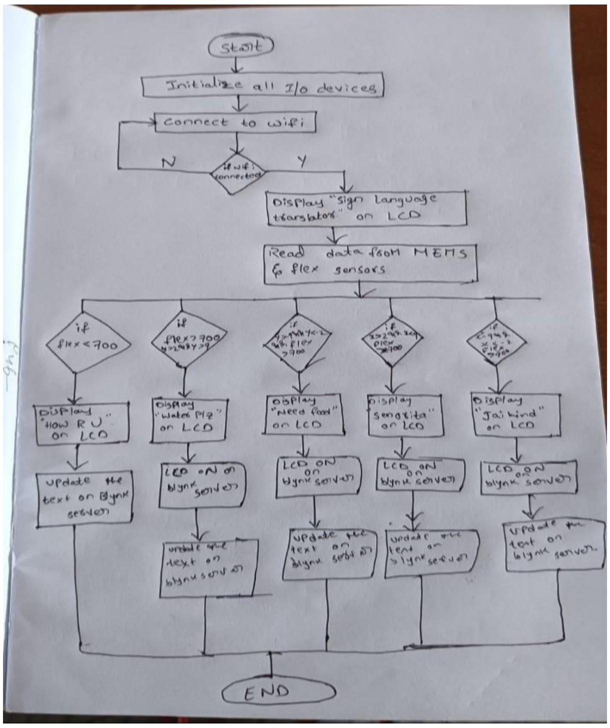

Figure.2 Flow Chart

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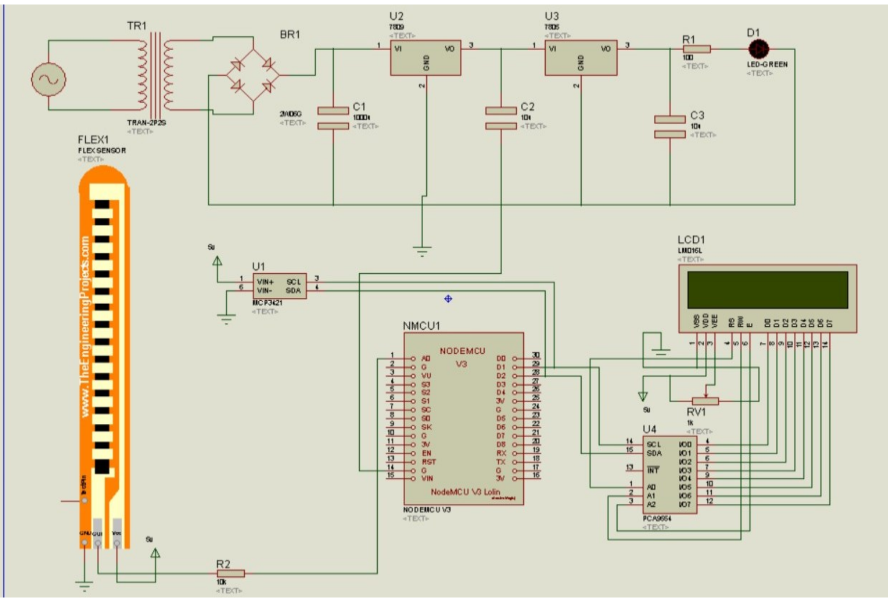

Figure.3 Schematic Diagram

RESULTS

The developed Malaysian Sign Language (MSL) translator system successfully converts hand gestures into corresponding words, facilitating communication between speech and hearing-impaired individuals and those unfamiliar with sign language. The system effectively utilizes flex sensors to measure finger bending and an MPU6050 accelerometer gyroscope sensor to determine hand positioning. This combination enables accurate gesture recognition, ensuring precise interpretation of MSL gestures into readable text.

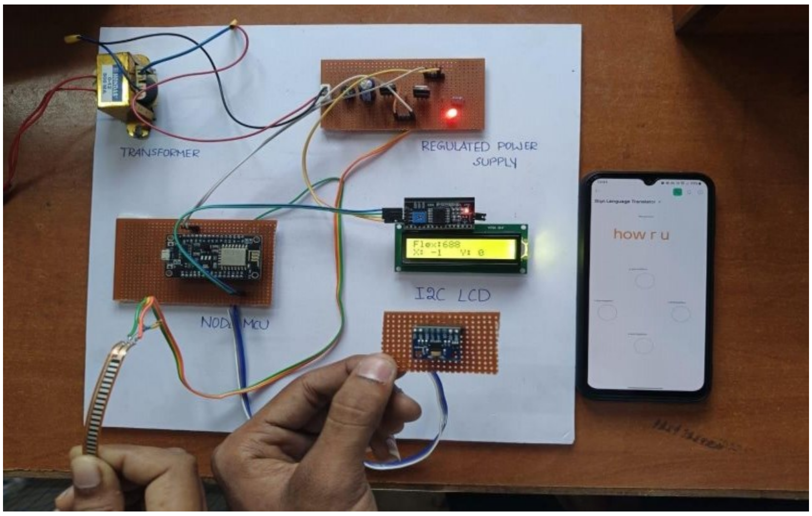

Figure.4 Flex detection

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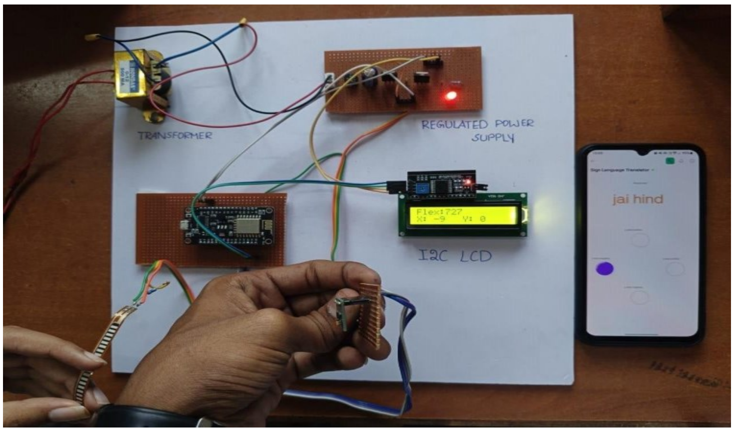

Figure.5 MEMS Output updating On Blynk

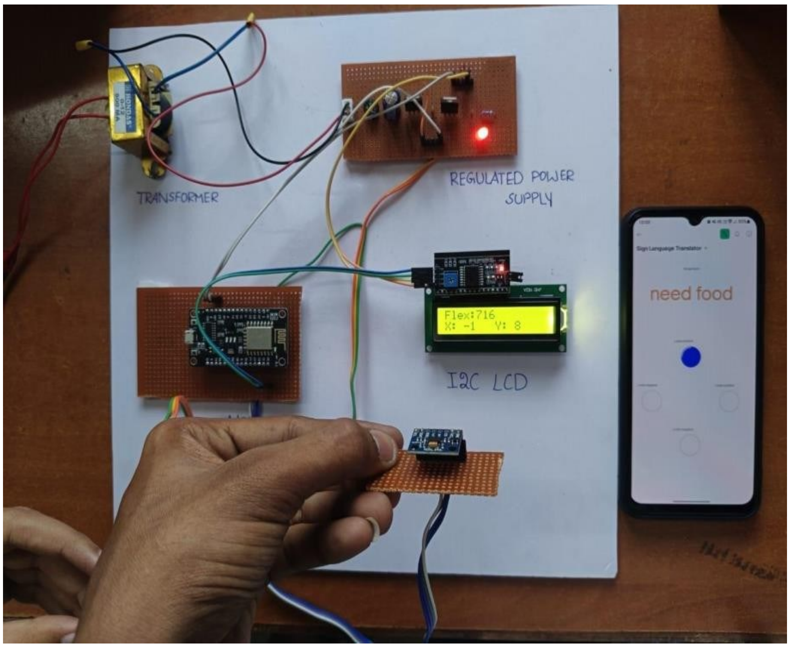

Figure.6 Forward direction Message

ADVANTAGES

1. **Bridging Communication Gaps –** Helps individuals with speech and hearing impairments communicate effectively with non-sign language users.
2. **Real-Time Translation –** Converts hand gestures into spoken or text-based words instantly.
3. **IoT Connectivity –** Enables remote communication via cloud platforms, mobile apps, or smart devices.
4. **User-Friendly Interface –** Simplifies communication through wearable sensors or camera-based gesture recognition.
5. **Portable and Wearable –** Can be implemented as a glove, wristband, or embedded device for easy mobility.

APPLICATIONS

- **Healthcare Communication –** Assists patients with speech disabilities in interacting with doctors and nurses.
- **Educational Institutions –** Supports students with hearing impairments in classrooms through seamless communication.
- **Workplaces & Offices –** Facilitates professional communication for differently-abled employees.
- **Smart Home Integration –** Allows users to control home appliances using sign language gestures.
- **Public Services –** Enhances accessibility in banks, airports, and government offices for the hearing-impaired.
- **Customer Service & Retail –** Helps deaf customers interact with store representatives and service providers.

CONCLUSION

In 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 NodeMCU 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 communication 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.

FUTURE SCOPE

- **Expansion of Vocabulary –** The system can be enhanced by incorporating a larger dataset of MSL gestures, enabling it to recognize a wider range of words and phrases for more effective communication.
- **Machine Learning Integration** – Implementing machine learning algorithms can improve the accuracy of gesture recognition by allowing the system to adapt and learn from different users' hand movements over time.
- **Speech Output Feature –** Adding a text-to-speech (TTS) function can enable the system to provide voice output for translated gestures, making communication even more seamless for hearing-impaired users.

REFERENCES

1. Sharma, R. Gupta, & P. Kumar – "IoT-Enabled Smart Glove for Sign Language Recognition", IEEE Transactions on Human-Machine Interaction, 2022.

ISSN 2454-9940
www.ijasem.org
Vol 19, Issue 1, 2025

2. M. Hossain, S. Rahman, & A. Farhan – "Real-Time Sign Language to Speech Conversion Using IoT", International Journal of Advanced Computing, 2021.
3. T. Patel & J. Singh – "Gesture Recognition Using Machine Learning for Sign Language Translation", Journal of Embedded Systems and IoT, 2023.
4. S. Zhang & Y. Wang – "Smart Wearable Solutions for Deaf and Mute Communication", Springer IoT Applications, 2020.
5. P. Kumar & A. Verma – "A Cloud-Based Approach for Sign Language Translation Using IoT", International Conference on Emerging Technologies, 2022.
6. Ramesh & K. Anand – "AI-Integrated Gesture Recognition for Speech-Impaired Individuals", Elsevier Internet of Things Journal, 2021.
7. Lee & M. Brown – "Neural Network-Based Hand Gesture Recognition for IoT Applications", ACM Computing Surveys, 2022.
8. Hernandez & J. Lopez – "IoT in Assistive Technology: Enhancing Communication for the Deaf", IEEE Sensors Journal, 2023.
9. R. Das & S. Roy – "Sign Language Recognition System Using Accelerometer and IoT", Proceedings of the International IoT Conference, 2021.
10. World Health Organization (WHO) – "Assistive Technologies for People with Disabilities", WHO Report, 2020.