



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

SMART GLOVES USING NODE MCU

Sanskar Dubey
Final year Btech(cse)

Avinash Pandey
Final year Btech(cse)

DR. S Prabakaran
Dept. of cse Galgotias University

Abstract

In an increasingly connected world, ensuring inclusivity through technological innovation is essential. Individuals with speech, hearing, or physical disabilities often face significant communication barriers. This research presents the design and implementation of a smart glove system that enables gesture-based communication using the Internet of Things (IoT) and NodeMCU ESP8266. The glove uses flex and LDR sensors to detect hand movements, which are encoded into messages and transmitted to a receiver via Wi-Fi. With the integration of APIs, OLED displays, and potential audio outputs, this system provides a low-cost, scalable solution for assistive communication. The study demonstrates its potential for use in healthcare, education, and smart home environments, and lays the foundation for further development in wearable assistive technologies.

1. Introduction

Communication is a fundamental human right, yet millions of people around the world face challenges due to speech or hearing impairments. Existing systems like sign language require human interpretation or advanced recognition technologies that are often cost-prohibitive and not universally accessible.[1][2]

Recent advancements in IoT, microcontroller platforms like NodeMCU, and sensor-based wearables provide promising avenues for assistive technology. This research aims to

bridge communication gaps through a smart glove that captures hand gestures and converts them into readable or audible messages, using a combination of IoT, embedded systems, and wireless communication technologies.

In a world increasingly reliant on seamless communication, individuals with speech, hearing, or physical disabilities continue to face significant challenges in expressing themselves. Traditional assistive methods such as sign language are limited by the need for a trained interpreter or complex vision-based recognition systems, which are often inaccessible in low-resource environments. This communication barrier not only affects daily interactions but also hinders access to education, healthcare, and employment opportunities.

The Objective of this paper

Design a wearable glove capable of recognizing up to 32 gestures using flex and light sensors.

Transmit gesture data wirelessly using NodeMCU.

Display messages on an OLED screen and/or through audio playback.

Provide a cost-effective, portable, and scalable assistive communication tool.

2. Literature Review

Two primary approaches dominate current gesture recognition systems:

Vision-based systems utilize cameras and image processing techniques to recognize hand signs. However, these systems are often hampered by environmental factors like lighting and background noise, and they lack portability.

Sensor-based systems, such as data gloves, offer a more reliable and real-time alternative. These gloves are embedded with sensors that capture physical hand movements, translating them into machine-readable data.

The integration of **NodeMCU ESP8266** into IoT applications has shown significant promise in recent years due to its low cost, built-in Wi-Fi module, and compatibility with Arduino IDE. Prior studies [4][6] have demonstrated the effectiveness of NodeMCU in real-time data transmission for various wearable technologies, making it an ideal choice for this project.

3. Methodology

3.1 Hardware Components

NodeMCU ESP8266: Microcontroller with built-in Wi-Fi for wireless data transfer.

Flex Sensors: Measure bending of fingers and send analog signals.

LDR Sensors: Used to detect finger placements based on light intensity.

OLED Display: Provides textual feedback of the detected message.

7809 Voltage Regulator: Converts 12V input to 9V for safe microcontroller operation.



3.2 Software Tools

Arduino IDE: For programming NodeMCU and sensor calibration.

Heroku and Postman: For testing and deploying RESTful APIs.

C/C++: Programming language for embedded logic.

Visual Studio Code: Code editing environment.

Google Chrome: For cloud platform access and API interface testing.

3.3 Circuit Design

Each finger of the glove is equipped with a flex or LDR sensor connected to analog and digital pins on the NodeMCU. The sensor readings are interpreted as binary values, enabling $2^5 = 32$ unique gesture combinations. The circuit is powered by a micro-USB cable and features an OLED display and optional audio output via a DF Mini Player module.

4. Results and Discussion

The smart glove successfully recognized and transmitted a range of 32 unique hand gestures, each mapped to a specific pre-defined message. The NodeMCU ensured low-latency communication over Wi-Fi to a connected device or cloud service.

4.1 Performance Metrics

Recognition Accuracy: ~92% accuracy in controlled lighting conditions.

Latency: Less than 2 seconds from gesture to display/output.

Power Efficiency: Operated continuously for 4–6 hours on a 2200 mAh battery.

4.2 Limitation

Assistive Communication: Individuals with speech impairments could convey messages to caregivers.

Smart Home Control: Future integrations could allow gesture-based control of appliances.

Healthcare Monitoring: Elderly users can use the glove to send help alerts via preset gestures.

Despite the promising results, challenges include:

Sensor Noise: Inconsistent readings due to glove positioning or external light.

Power Management: Short battery life in continuous operation.

Scalability: Adding more gestures requires additional sensors or complex encoding.

5. Conclusion

This paper presents a comprehensive solution for gesture-based communication using a smart glove embedded with IoT technologies. By combining NodeMCU with sensor arrays, the system delivers a cost-effective, portable, and highly functional wearable communication tool. Its potential for enhancing the lives of individuals with disabilities is significant, especially in low-resource settings.

Further enhancements could involve integrating machine learning for adaptive gesture recognition, expanding cloud connectivity for real-time monitoring, and improving battery life through low-power design optimization.

References

1. Robocraze.com. *Arduino vs NodeMCU*. <https://robocraze.com/blogs/post/arduino-vs-nodemcu>
2. Wikipedia. *Arduino*. <https://en.wikipedia.org/wiki/Arduino>
3. NodeMCU Documentation. <https://nodemcu.readthedocs.io/en/release/>
4. ResearchGate. *Use of NodeMCU in IoT Products*. <https://www.researchgate.net/publication/337656615>
5. Scribd. *NodeMCU ESP8266*. <https://www.scribd.com/document/729248314/NodeMCU-ESP8266>
6. Jetir.org. *IoT Glove Project*. <https://www.jetir.org/papers/JETIR2404707.pdf>

