SMART GESTURE GLOVE FOR WHEELCHAIR NAVIGATION AND COMMUNICATION

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Introduction:

Mobility and communication are fundamental aspects of human independence and interaction. For individuals with physical impairments, particularly those with limited mobility or speech disabilities, performing everyday tasks and conveying their needs can be challenging. In recent years, assistive technologies have emerged to bridge this gap, promoting accessibility and inclusion. Among them, wearable devices offer a compact and user-friendly solution to enhance autonomy The Smart Gesture Glove for Wheelchair Navigation and Communication is an innovative project designed with this vision. It is a multifunctional wearable device that captures intuitive hand gestures and translates them into commands for controlling a motorized wheelchair, and also enabling communication through audio feedback. This dual functionality empowers users not only to move independently but also to express themselves effectively. This project is particularly relevant in a society that is moving toward inclusive technological solutions. It aims to improve the quality of life for individuals with mobility impairments by offering them greater control, confidence, and connectivity. With an intuitive design and real-time feedback, the Smart Gesture Glove represents a step forward in assistive technology, bridging the gap between physical limitations and independent living.

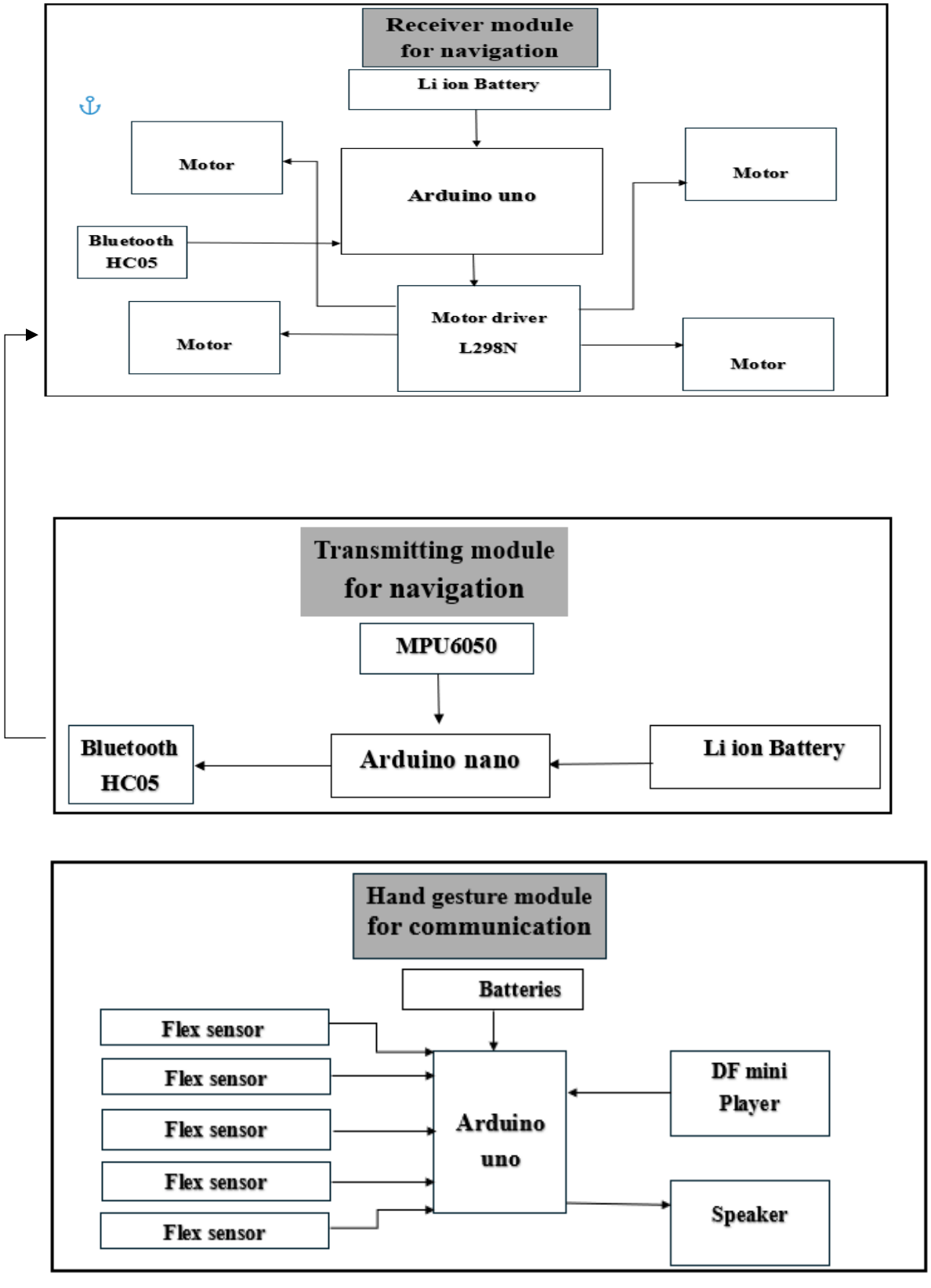
Objectives:

- To develop a smart glove that enables users with physical impairments to control a wheelchair using intuitive hand gestures for smooth and independent movement.
- To integrate voice output features that translate gestures into audio, helping users express their needs effectively and interact with their environment.
- To facilitate communication between individuals with mobility impairments and their caregivers, family, and friends helping users stay socially connected.
- Design a device that is easy to use, customizable, and meets individual needs.

Methodology:

The project mainly consisting of two gloves, one for controlling the wheel chair using hand gesture and other for enabling communication through a smart gloves. For wheelchair navigation, an sensor such as the MPU6050 is mounted on the user's dominant hand to detect hand movements. These movements are processed in real-time using a Arduino, which interprets specific gestures such as tilting the hand forward, backward, left, or right. Each gesture is mapped to a particular command that controls the direction of the wheelchair. These commands are then used to drive the wheelchair motors through a motor driver module like the L298N. To enhance mobility and flexibility, a wireless module such as Bluetooth is used to transmit commands from the glove to the wheelchair system.

On the other hand, the communication glove is worn and is equipped with flex sensors on each finger. These sensors detect finger bends of finger gestures, each of which corresponds to a pre-defined message. A separate microcontroller processes the sensor inputs and recognizes the gesture being made. Once identified, the gesture can trigger a response through speech module like DF Mini Player, allowing the user to audibly communicate the message.


Receiver module for navigation
Li ion Battery
Motor
Arduino uno
Motor
Bluetooth HC05
Motor driver L298N
Motor
Motor
Transmitting module for navigation
MPU6050
Bluetooth HC05
Arduino nano
Li ion Battery
Hand gesture module for communication
Batteries
Flex sensor
Flex sensor
Flex sensor
Flex sensor
Flex sensor
Arduino uno
DF mini Player
Speaker

Result and Conclusion:

The smart gesture glove was successfully built and tested for both navigation and communication. Flex sensors and the MPU-6050 sensor detected hand gestures accurately. The Arduino processed the signals and sent commands wirelessly to the wheelchair. Four main gestures controlled the wheelchair: forward, backward, left, and right. The glove responded quickly, making real-time movement smooth and reliable. The DF Player Mini and speaker gave voice output based on hand signs. Common phrases like “hello” and “I need help” were played clearly. The design was lightweight, wearable, and comfortable for long use. In conclusion, the Smart Gesture Glove will meet its objectives by providing both mobility control and communication assistance. It shows strong potential for real-life use, especially for individuals with physical or speech disabilities. Future improvements can include adding more gestures, advanced voice responses, and better battery life.

Project Outcome & Industry Relevance:

The Smart Gesture Glove project successfully demonstrated how wearable technology can be used to assist individuals with physical disabilities. The system provides a reliable and intuitive way to control a wheelchair and communicate using hand gestures, enhancing both mobility and independence. This project has strong potential for real-world application in healthcare, rehabilitation centres, and assisted living environments. It can be especially beneficial for patients with spinal cord injuries, muscular disorders, or speech impairments. The integration of wireless communication and gesture recognition makes it suitable for modern smart healthcare systems. Industries focusing on assistive devices and medical wearables can adopt this technology for commercial use. Its low cost, ease of use, and adaptability make it scalable for mass production. Additionally, it contributes to the growing field of human-computer interaction and accessible design, aligning well with industry trends toward inclusive technology.

Working Model vs Simulation/study

This project is developed as a working model. A working model involves the physical construction and real-time implementation of the system, allowing for direct interaction with hardware components such as sensors, microcontrollers, motors, and

communication modules. The gesture-based control system and the communication glove are built, tested, and demonstrated in real-life scenarios, making it possible to evaluate their performance, accuracy, and usability.

Project Outcomes and Learnings:

The project successfully resulted in the creation of a smart glove capable of controlling a wheelchair using hand gestures and enabling basic voice-based communication. It achieved the core goal of improving mobility and interaction for users with physical impairments. We learned how to integrate various components like flex sensors, MPU-6050, and DF Player Mini effectively. Working with Arduino helped us understand real-time data processing and wireless communication. We gained practical experience in hardware design, coding, circuit connections, and troubleshooting. Testing with different users gave us insight into user experience, comfort, and response time. Additionally, we understood the importance of designing inclusive technology that meets real-world needs. Overall, the project enhanced our skills in embedded systems, teamwork, problem-solving, and innovation.

Future Scope:

The future scope of this project includes:

1. Add GPS functionality to assist in outdoor navigation for wheelchair users.
2. Support gesture customization through a companion mobile app for personalized control.
3. Enhance battery life and energy efficiency for extended daily use.
4. Include health monitoring features like pulse or temperature sensors in future versions.
5. Enable two-way voice communication to assist users with both mobility and speech challenges.
6. Add feedback systems like vibration motors for gesture confirmation or alerts.
7. Improve the user interface with a real-time gesture display on a connected mobile device.
8. Expand the number of detectable gestures for more advanced wheelchair commands.
9. Explore commercial production and partnerships with medical and assistive tech industries for large-scale deployment.