PROSTHETIC HAND FOR PHYSICALLY CHALLENGED PEOPLE

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Introduction:

1. The loss of a limb significantly affects an individual's ability to perform daily activities, reducing independence and quality of life. Prosthetic hands are designed to restore basic functionalities; however, most commercially available prosthetic devices are expensive and inaccessible to economically weaker sections.
2. This creates a need for affordable and efficient alternatives. Recent advancements in embedded systems and sensor technologies have enabled the development of intelligent prosthetic devices.
3. Flex sensors and microcontrollers allow detection of human gestures and translation into mechanical movements. By integrating such technologies, it is possible to design a low-cost, user-friendly prosthetic hand.
4. This project focuses on developing a prosthetic hand using flex sensors and an Arduino-based control system. The system mimics natural hand movement by detecting finger bending and converting it into corresponding motor actions.
5. Additionally, Bluetooth control provides flexibility for manual operation.The proposed system aims to bridge the gap between functionality and affordability, making assistive technology accessible to a wider population, especially in rural and low-income areas.

Objectives:

1. To design and develop an affordable prosthetic hand system.
2. To restore basic hand functionalities such as gripping and holding.
3. To implement flex sensor-based gesture control.
4. To design a lightweight and user-friendly system.
5. The prosthetic to integrate a microcontroller-based control system for accurate and real-time movement of hand.

Methodology:

1. The project begins with **input acquisition** using flex sensors attached to the fingers, which detect bending motion and generate analog signals. These signals are sent to the Arduino Uno microcontroller for processing.
2. A **Bluetooth module (HC-05)** is integrated to provide wireless control through a smartphone. This acts as an alternative input method for the system.
3. The Arduino processes the input signals by filtering noise and mapping sensor values to predefined motion ranges. Based on this data, control signals are generated for actuators.
4. **Servo motors** are used for finger movement, controlled using PWM signals to achieve smooth and precise motion. A **DC motor**, controlled via an H-Bridge driver, is used for wrist or gripping actions.
5. The system includes a **power management unit** to provide stable voltage to all components. All modules are integrated to ensure coordinated real-time operation.
6. Finally, the system undergoes **testing and calibration**, where sensor sensitivity, motor angles, and response accuracy are optimized to achieve natural hand movement.

Result and Conclusion:

Figure1: Design and Structural Configuration of the Prosthetic Hand

The developed system successfully demonstrates a functional prosthetic hand prototype capable of performing basic hand movements. Flex sensors accurately detect finger bending and convert it into corresponding mechanical actions. Servo motors provide smooth and precise movement, closely resembling natural hand motion. The integration of Bluetooth control enables flexible operation through a smartphone. During testing, the system showed stable performance, and proper calibration improved accuracy and minimized errors.

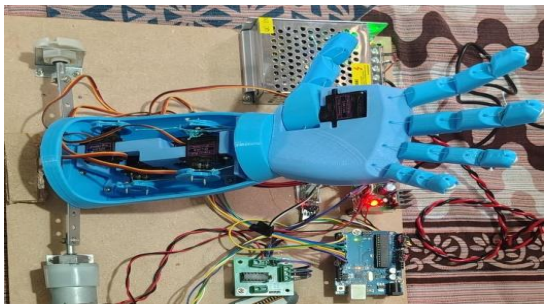

Figure 2: Prosthetic Hand

In conclusion, the project proves that a low-cost prosthetic hand can be effectively developed using simple and easily available components. The system achieves reliable and efficient performance while maintaining affordability and ease of use. This approach makes prosthetic technology more accessible, especially for economically weaker sections. Overall, the project contributes towards improving independence and quality of life for physically challenged individuals.

References:

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Future Scope:

The future scope of this project includes:

1. Upgrade the system by replacing flex sensors with EMG-based control for more accurate and natural hand movements.
2. Enhance functionality by developing a mobile app for Bluetooth control and customization of hand movements.
3. Improve the prototype by making it more compact, lightweight, and energy-efficient for comfortable long-term use.
4. Integrate advanced sensors such as pressure or touch sensors to provide feedback and improve gripping accuracy.
5. Implement AI or machine learning techniques to enable adaptive control based on user behavior and improve overall performance.