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# EMG-CONTROLLED LOWER LIMB EXOSKELETON STIMULATOR FOR HEMIPLEGIC PERSON

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**Abstract**: This project presents the development of an EMG-controlled lower limb exoskeleton designed to aid individuals with hemiplegia in regaining mobility and enhancing rehabilitation outcomes. Utilizing an Arduino microcontroller, EMG sensors, and a DC motor, the exoskeleton responds to muscle signals, enabling intuitive control that mimics natural leg movement. An accelerometer sensor is incorporated for gesture recognition and fall detection, providing an added layer of safety by monitoring unintended movements and potential falls.

**Keywords:** EMG-sensors, Arduino UNO, H-Bridge, Hemiplegia.

## I. INTRODUCTION

An EMG-controlled lower limb exoskeleton stimulator for hemiplegic individuals is a device designed to aid in rehabilitation and mobility by using electromyography (EMG) signals to control the movement of the exoskeleton. Hemiplegia, often caused by conditions like stroke or traumatic brain injury, results in partial or complete paralysis on one side of the body, limiting the ability to perform daily activities. Traditional rehabilitation methods focus on physical therapy exercises to retrain movement, but these can be limited in effectiveness, particularly for long-term recovery.

## II. METHODOLOGY

The EMG-controlled lower limb exoskeleton operates by translating muscle activity into movement through a combination of sensors, a microcontroller, actuators, and communication modules. The process begins with signal acquisition, where an EMG sensor is placed on the user's muscle to detect electrical activity generated by muscle contractions. This activity is sent to an Arduino microcontroller, which then moves to the signal processing and interpretation stage.

The Arduino analyzes the EMG signals to identify specific patterns corresponding to the user's movement intentions and adjusts the system's response accordingly. The system activates a DC motor based on the intensity of the EMG signals, providing proportional assistance to facilitate natural, user-initiated movements. This actuation ensures that the motor responds to the muscle signals, allowing the exoskeleton to assist in walking or rehabilitation exercises by working in coordination with the user's muscle efforts.

To further enhance safety and functionality, the exoskeleton integrates an accelerometer for gesture and fall detection, continuously monitoring the orientation and acceleration of the user's limb to detect any falls or abnormal movements. In such events, an alert is triggered to notify the user or caregivers. The exoskeleton also provides real-time feedback via an LCD, displaying critical information like device status, battery levels, and movement mode indicators, enabling the user to monitor its operation. Additionally, a remote monitoring and notification system, utilizing a NodeMCU module, allows caregivers to receive emergency alerts through Telegram in case of a fall or other emergencies, ensuring prompt assistance and added safety.

  

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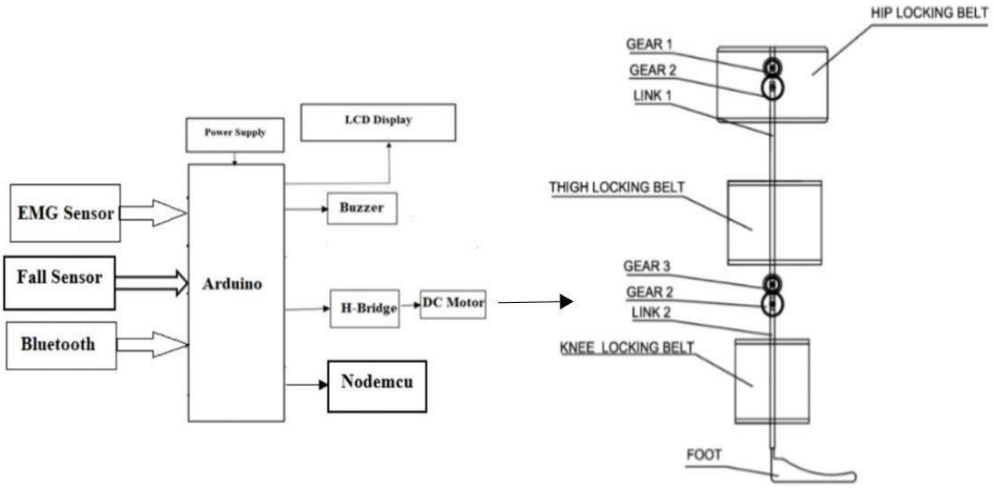


Figure 1: Block Diagram of EMG controlled lower limb exoskeleton stimulator for hemiplegic person

## III. IMPLEMENTATION

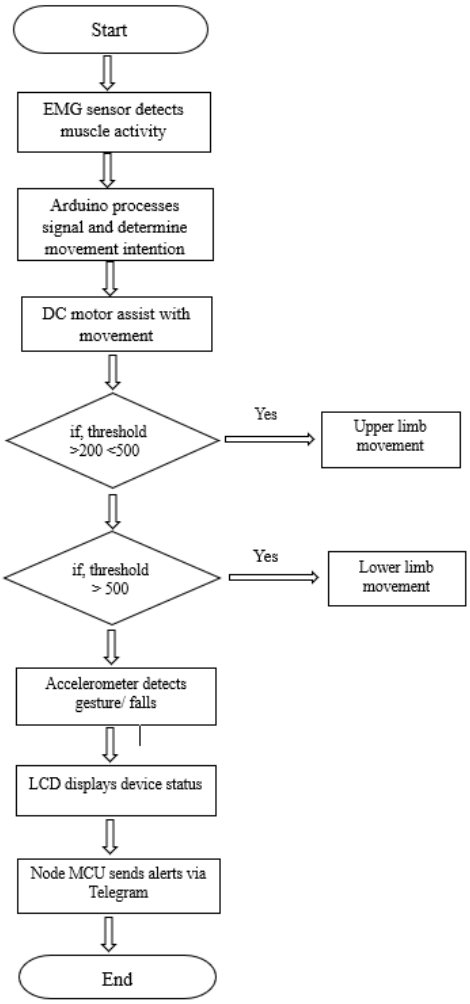


Figure 2: Implementation steps of EMG controlled lower limb exoskeleton stimulator for hemiplegic person

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## IV. RESULT

Figure 3 : Exoskeleton of Lower Limb

Figure 4: Movement of Lower and Upper limb of Exoskeleton

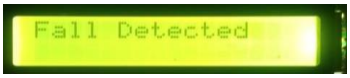


Figure 5: Display of Fall Detection in LCD

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Figure 6: Display of Gesture Detection in LCD

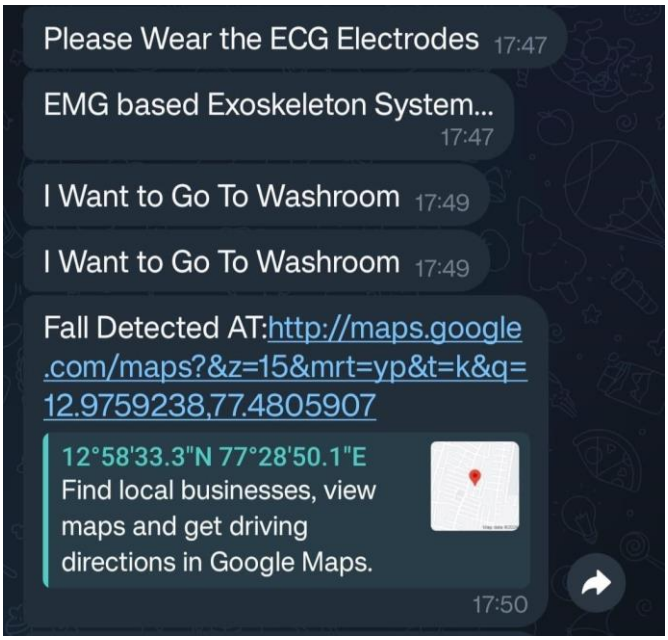


Figure 7: Message of Fall detection and Gesture detection to Care Take in Telegram

## V. CONCLUSION

This project successfully developed an EMG-controlled lower limb exoskeleton designed to assist hemiplegic individuals in regaining mobility and improving rehabilitation outcomes. By integrating an Arduino microcontroller, EMG sensor, accelerometer for gesture and fall detection, DC motor for actuation, and a Node-MCU module for remote notifications via Telegram, the exoskeleton provides a user centered approach to rehabilitation. The system allows intuitive, muscle-driven control, enhancing movement fluidity and enabling personalized rehabilitation in both clinical and home settings. Initial testing indicates that the exoskeleton responds effectively to muscle signals, facilitating natural leg movement and accommodating user-specific needs. The accelerometer sensor's fall detection capability adds a critical safety feature, while the real-time feedback on the LCD and Telegram alerts contribute to greater user confidence and remote monitoring.

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