

Hand Gesture Controlled Wheelchair With Obstacle Detection



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Introduction

The Hand Gesture-Controlled Wheelchair with Obstacle Detection project aims to address the challenges faced by individuals with physical disabilities, particularly those with limited upper body mobility. The hand gesture-controlled wheelchair system promotes user autonomy and reduces the reliance on caregivers or attendants for routine wheelchair operations. The hand gesture-controlled wheelchair system offers an alternative mode of control that does not require physical contact, eliminating the need for complex manual controls or joysticks. The system interprets specific hand gestures and translates them into corresponding wheelchair movements providing users with a natural and efficient means of controlling their mobility such by moving wrist of the hand of patient to the right, left, top, down, wheelchair can be moved to the right, left, backward and forward respectively. In this we have two circuits one which is gesture recognition circuit which is set on the hand of the operator which detects the gesture of the hand by accelerometer sensor and then transfers the data through wireless communication to the wheelchair moving circuit which is present at the wheelchair and then wheelchair moving circuit controls the motors using motor driver accordingly and for the obstacle detection we have used ultrasonic sensor at the wheelchair moving circuit which detects the obstacle and reports to the wheelchair moving circuit to stop the wheelchair. The hand gesture-controlled wheelchair system offers an alternative mode of control that does not require physical contact, eliminating the need for complex manual controls or joysticks.



Figure 1: Hand Movement

Technology Used

1. ESP32
2. Ultrasonic Sensor (HCSR-04)
3. Accelerometer Sensor (MPU6050)
4. ESP-NOW
5. Motor and Motor Driver
6. Lithium-ion Battery

Gesture Recognition Circuit

This is a gesture recognition circuit which deals with the detecting gestures of the hand and then this circuit send commands to the wheelchair moving circuit, Here, we need a sensor or a mechanism which can de-tect the gestures of the hand for that purpose we are using accelerometer sensor which deals with the measurements of the change in acceleration due to gravity done by itself. So if we put this on the hand of the operator we can easily detect the hand motion by measuring change in acceleration due to gravity made by itself. Here we are using MPU6050 sensor as accelerometer sensor and we are communicating with this via inter-integrated communication protocol.

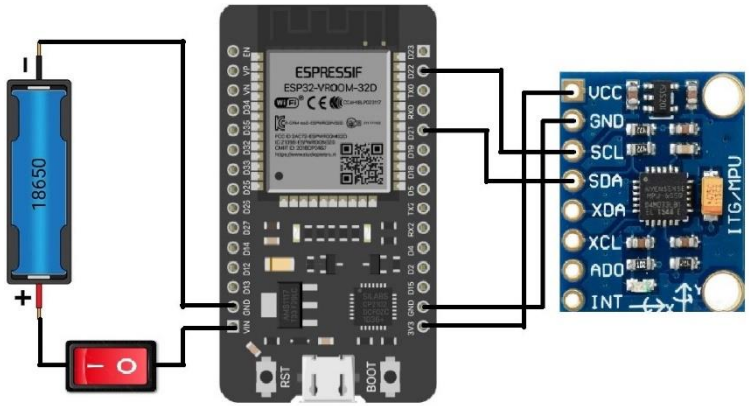


Figure 2: Gesture Recognition Circuit

For the wireless communication we are using ESP-NOW protocol developed by espressif which is a fast communication protocol that can be used to exchange small messages (up to 250 bytes) between ESP32 boards. ESP-NOW is very versatile and we can have one-way or two-way communication in different setups.

Wheelchair Moving Circuit

This section will respond to the signals received from the gesture recognition circuit, Here for the processing of the data and controlling of the motors where we need to move wheelchair both forward, backward, right and left for that we need motor controlling operation and for that we are using ESP32 microcontroller board.

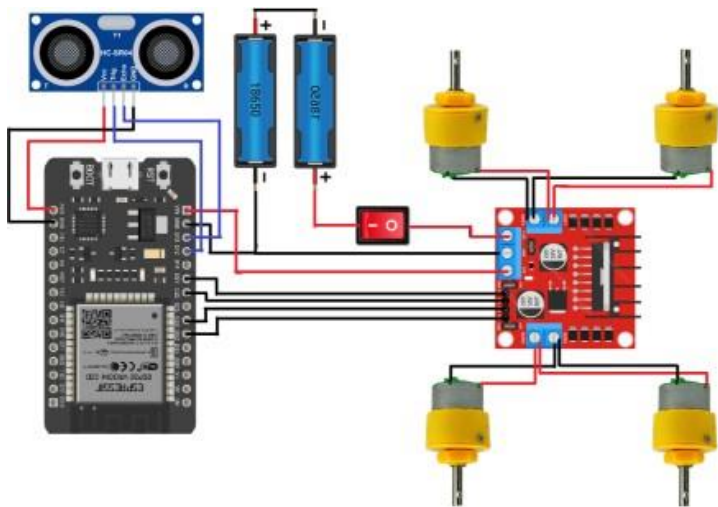


Figure 3: Wheelchair Moving Circuit

We need a motor for movement of the wheelchair for this project purpose we are using dc geared motors this kind of motors have high torque and low RPM which make them suitable for this application, here we also need a driver circuit which helps us in controlling the direction and speed of the rotation of motors for this we are using H-bridge motor driver which is L298N motor driver which can supply maximum of 2 amps of current and 40v of the voltage at the output on each side. In order to implement obstacle detection we are using ultrasonic sensor which uses ultrasonic waves for the detection of the obstacle.

Motor Movement

Movement of Motors According to Hand Gesture		
Direction of Hand Gesture	Movement of Left Motor	Movement of Right Motor
Downward	Forward	Forward
Upward	Backward	Backward
Right	Forward	Backward
Left	Backward	Forward

Result



Figure 4: Prototype



Figure 5: Prototype

Future Scope

Further by upgrading a motors, motor driver , batteries and structure of wheelchair, we can make this wheelchair capable of carrying human weight and also we can add different functionalities to improve the quality of chair.