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Automated Wheelchair Using Node MCU

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Abstract—*A wheelchair is one of the most widely used assistive equipment for individuals with mobility challenges to move around independently or with the assistance of a caretaker, to improve their quality of life. The main focus of this paper is to operate the wheelchair using hand gesture control as well as through web control. The hand gesture control is enabled using an accelerometer attached to a hand glove. It will detect the movement of the hand and the wheelchair will move accordingly. NodeMCU is the microcontroller used ,which has an inbuilt wi-fi module. A web page is created through which the assisting person can control the wheelchair over the wi-fi range. The nodeMCU used has an open source platform based on ESP8266 ,which provide a wi-fi range uptoabout 300 meters. The MPU6050 is a 3 axis accelerometer with Micro Electro Mechanical (MEMs) technology detects the hand wrist movement in X , Y and Z axes. If any mode of operation of the wheelchair failures, the other mode can continue the control successfully. Furthermore this provides an opportunity for visually impaired persons to move from one place to another. This wheelchair is comparatively simpler in a sense that if any person can able to move their wrist only, then he/she can operate the wheelchair. This technique will have a great impact on society because of its easier use and cheaper price compared to other automated wheelchair designs.*

Keywords——NodeMCU, MPU6050.

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I. INTRODUCTION

Wheelchair is a gadget utilized by crippled and elderly individuals for their transportation reason. A few sorts of smart wheelchairs are available in market. Joystick controlled wheelchair is the most commonly used one.Along with the higher buying and maintenance costs, there are some other drawbacks to those types of wheelchairs.In a joystick based wheelchair,the cost of repairing and maintaining power wheelchair can be higher than a normal wheelchair and difficulty to move. The rapid movement given to the joystick will make the joystick weak and broken. High concentration needed and effort to move the joystick.Many research works have been presented since then and there are different versions with different technologies of wheelchairs.Voice controlled, tongue controlled, eye movement controlled wheelchair technologies are available.But it can't be applicable in real life due to some constraints.

In a voice-controlled wheelchair, the wheelchair is being operated by the voice command through a speech processing system. However, in a real-life environment, noise around the user may mix with the user's speech.Thus, it will create a problem to the person in the wheelchair. It is difficult to use in rush places and noisy places. This may make the operation of this device difficult in noisy environments.To control the wheelchair with the tongue the user has to wear a headset. Sensors that are being used to detect command of the user through tongue may have short longevity due to being continuously touched by saliva.For controlling the wheelchair through eye movement, there would be a screen always in front of the operator/patient.The receiving of ambiguous eyes gestures is a threat to the person in the wheel chair.

The proposed wheelchair is based on hand gesture control and web based control technology.NodeMCU is the microcontroller used.It has an inbuilt wi-fi module through which the wheelchair can be controlled using a web page.The hand gesture control is enabled using an accelerometer connected to the hand of the patient.It detects the direction of movement of the wheelchair.NodeMCU is an open source platform based on ESP8266.The power consumption by this device is less. The reasonable cost of production is useful for the handicapped persons and can easily be controlled by the hand gesture of his own. Moreover, if any difficulty occurs in one mode, the other mode can complete the action.Caretaker can easily communicate with the wheelchair.

II.RELATED WORKS

In this paper , an automated wheelchair is designed which can be controlled using web page as well as through hand gesture.In paper [1],proposed design of a hand gesture controlled wheelchair using Arduino based microcontroller and Node MCU. The main focus is to control the wheelchair with the movement of the hand-wrist movement. Besides hand gestures, the wheelchair can also be controlled via Bluetooth technology. If any

problem occurs during the hand gesture control, Bluetooth technology can help to control the wheelchair through assisting person.

With reference to [2], developed a bluetooth-based wheelchair which can be controlled by finger or hand gesture using an Android application. The device helps those deprived of motion in their day to day activities. Even though there is a tremendous leap in this field, there are no facilities for the user to control the wheelchair with less strain on their hands. So this prototype will be a great help for the differently abled users as they can control the wheelchair by just moving their fingers or hands on the touchscreen.

In this paper [3], designed a voice based automated wheelchair using wifi.The automated wheelchair is designed based on voice commands rather than gestures and buttons. The wheelchair uses NodeMCU microcontroller which has an inbuilt wi-fi module to control the wheelchair from anywhere.The main disadvantage is that it can't operate in crowded area .To operate in crowded area ,the system should be trained for high level voice recognition.

As in [5],"Tongue Dive System" is a tongue operated Assistive Technology (AT) developed for people with severe disability to control their environment. Tongue Drive consists of an array of Hall Effect magnetic sensors mounted on a mouthpiece to measure the magnetic field generated by a small permanent magnet secured on the tongue. Sensors that are being used to detect command of the user through tongue may have short longevity due to being continuously touched by saliva.

III.PROPOSED METHOD

1.Proposed System

The wheelchair system contains two parts, they are hand gesture control and web based control.To keep track of the command of the user of the wheelchair, the MPU6050 Gyro-accelerometer is used. It detects the position of the user's hand and the wheelchair executes the commands accordingly. NodeMCU module has its built-in setup to connect to the internet on its own.It is used to control the wheelchair using web.The basic block diagram of the system is shown in fig.1.

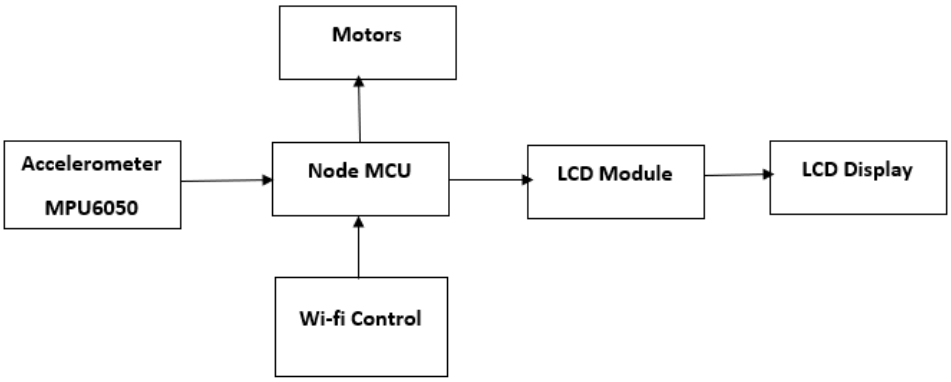

Figure1:Blockdiagram of the proposed system

Node MCU ESP8266 is the microcontroller used. It is interfaced with the accelerometer MPU6050.Two mode of operation is possible; Gesture mode and Web control mode. In gesture mode, the information data received from different movement of the wrist recorded by accelerometer is sent to the microcontroller. After receiving the input, the microcontroller executes the function as per the given instruction and as an output the wheelchair moves.In web control the input is from a web page available in the phone.

2.Circuit Diagram

Two motors are used to control the wheelchair. A toggle switch is employed inorder to switch between the hand gesture control and the web based control. Relays are used to control the motor. They are functionally identical to a magnetic motor starter. These are connected to the nodeMCU. A LCD display is connected using a driver.

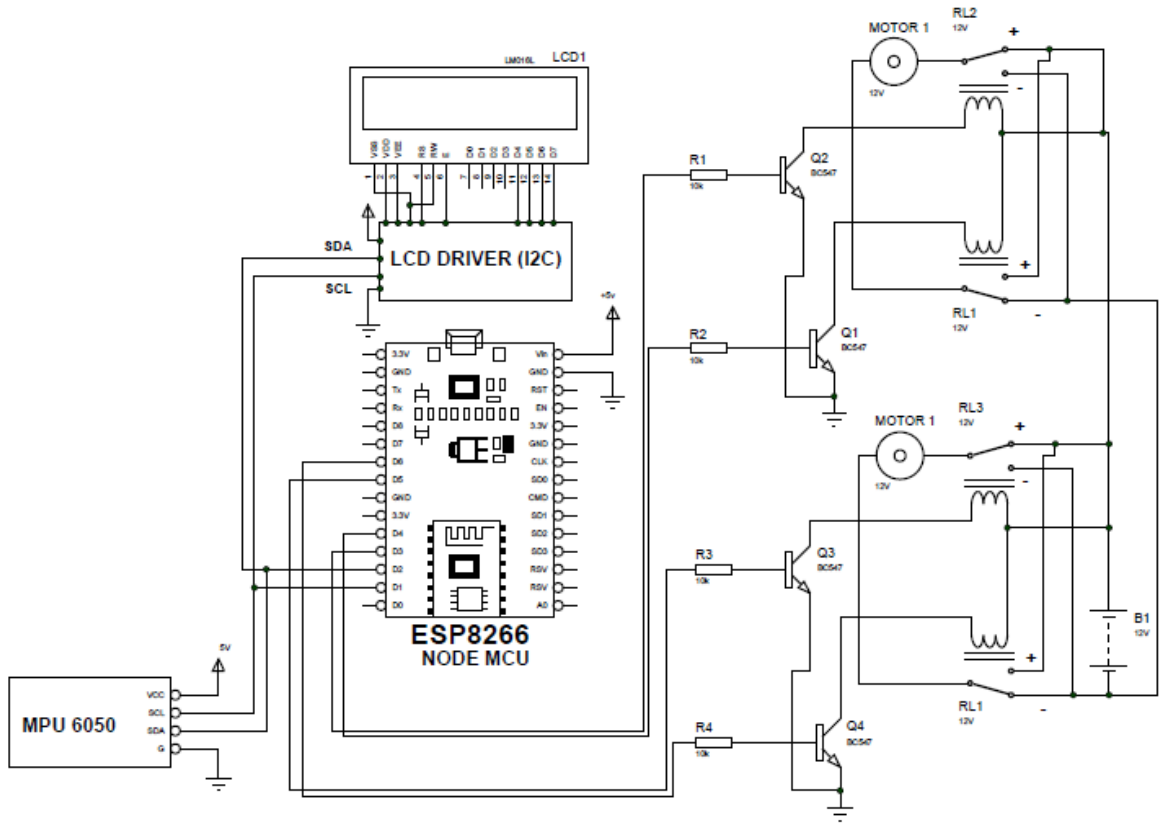

Figure2:Circuit diagram of the proposed system

2.1..*Control Strategy of motor*

Table 1:Movement controlling of the motor

Movement	Right motor	Left motor
FORWARD	Forward	Forward
REVERSE	Reverse	Reverse
LEFT	Forward	Stop
RIGHT	Stop	Forward

The accelerometer used is MPU6050,which is a 3 axis gyroscope and 3 axis accelerometer.For the operation of wheelchair, two axis are required for controlling forward,backward,left and right movement of the wheelchair.The accelerometer sends the x and y coordinate to the nodeMCU.We have four combination from acceleration sensor which we used to drive the motor in four directions.

***3.*Hardware Components**

Data is send to the nodeMCU from the accelerometer and the web page.The wheelchair can be controlled by two ways.The implementation of the proposed system requires the following components.

NodeMCU

NodeMCU is a popular and widely used development board based on the ESP-12E Wi-Fi Module that combines elements of easy programming with Arduino IDE (C++) and Wi-Fi capability.This microcontroller board can easily be programmed using the Arduino IDE programming software.

MPU6050

MPU6050 is a Micro Electro-Mechanical System (MEMS) which consists of a 3-axis gyroscope, 3- axis Accelerometer and a Digital motion processor integrated on a single chip. It works on the power supply of 3V-5V.The accelerometer is interfaced with the inputs of nodeMCU.Digital Motion Processor(DMP) module inside it is powerful enough to perform complex calculation and thus free up the work for Microcontroller.

DC Motor
A geared DC Motor has a gear assembly attached to the motor.The gear assembly helps in increasing the torque and reducing the speed.It has higher starting torque, quick starting and stopping, reversing, variable speeds with voltage input and they are easier and cheaper to control.
Voltage: 24 Volt DC.
Output: 250 Watt.

Power Source
To provide the power to the entire system, we have used two rechargeable Li-Po (Lithium Polymer) battery each of 12 volts. The main reason behind using two 12volt batteries is to control each DC geared motor seperately, as it consumes more power.

LCD Module
The movement of the wheelchair is shown on the LCD display.It is connected to the nodeMCU using an I2C module.It is an inbuilt PCF8574 I2C chip that converts I2C serial data to parallel data for the LCD display.

4.Program Algorithm

The NodeMCU Development Board can be easily programmed with Arduino IDE since it is easy to use. Programming nodeMCU with the Arduino IDE will hardly take 5-10 minutes. A toggle switch is used to switch between the WEB mode and the GESTURE mode. There are five inputs from the web page; stop, forward ,backward, right and left. The input from the webpage is accessed by the nodeMCU and the motor is controlled accordingly. The gesture mode includes the mpu6050.Two axis are selected for the controlling of the wheelchair. The x and y values are noted from the movement of the hand. A toggle switch is a type of electrical switch that is actuated by moving a lever back and forth to open or close an electrical circuit. It make or break electrical connections in a circuit by the closing or opening electrical contacts. If the toggle switch is OFF ,the web mode is switched on otherwise, the gesture mode. The wheelchair has five inputs; right ,left, forward, backward and stop. The input is given by a bystander using the web page.

If the toggle switch is switched ON, the gesture mode is intialised. The accelerometer MPU6050 has three axes, X, Y and Z. It records the value according to the movement of the patient's hand since the sensor is attached to his/her hand. In the program ,X and Y axis are selected for the controlling. Limits are set for different directions of movement as shown in the flowchart.

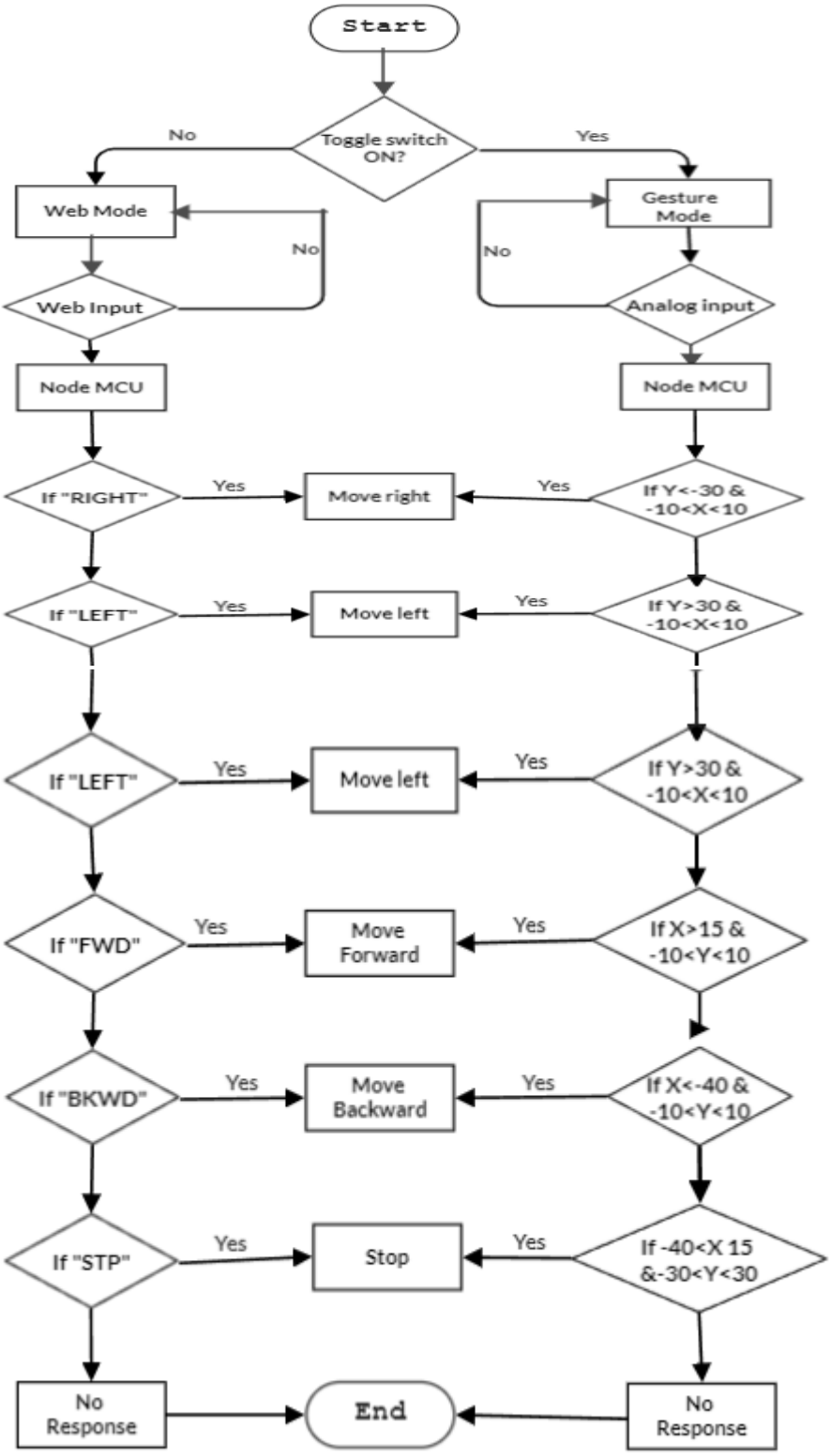

Figure 3.Flowchart showing the program algorithm of wheelchair.

IV.HARDWARE IMPLEMENTATION

The mechanical part of the wheelchair has been done using an old chair.The figure shows the mechanical setup of the wheelchair.

Figure 4:Mechanical part of wheelchair

The connections of the components are completed in the PCB.Four relay modules are used to control the motors.The LCD display is interfaced using an I2C module.

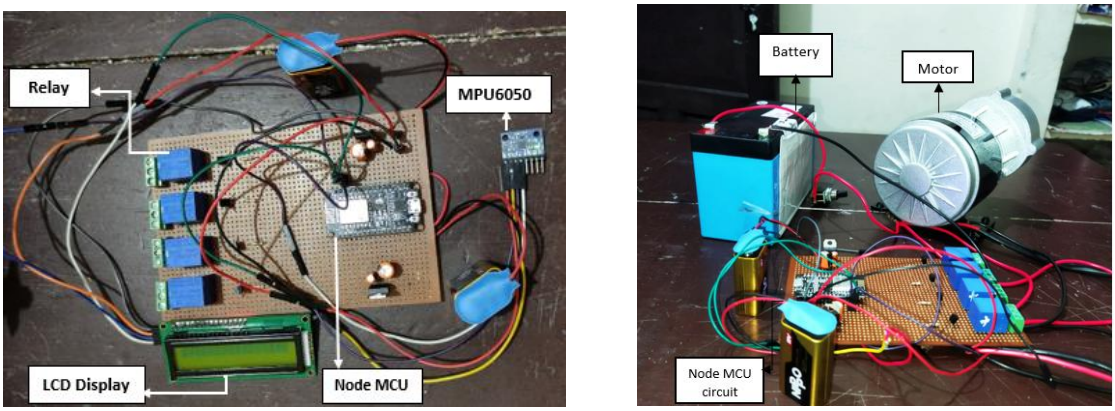

Figure 5:Interfacing of the hardware components

A 12 V 7Ah battery is used for powering the motor.The battery and motor is interfaced to the circuit.The connections are checked.After that the program will upload to the nodeMCU.Arduino IDE is used to program ESP8266.

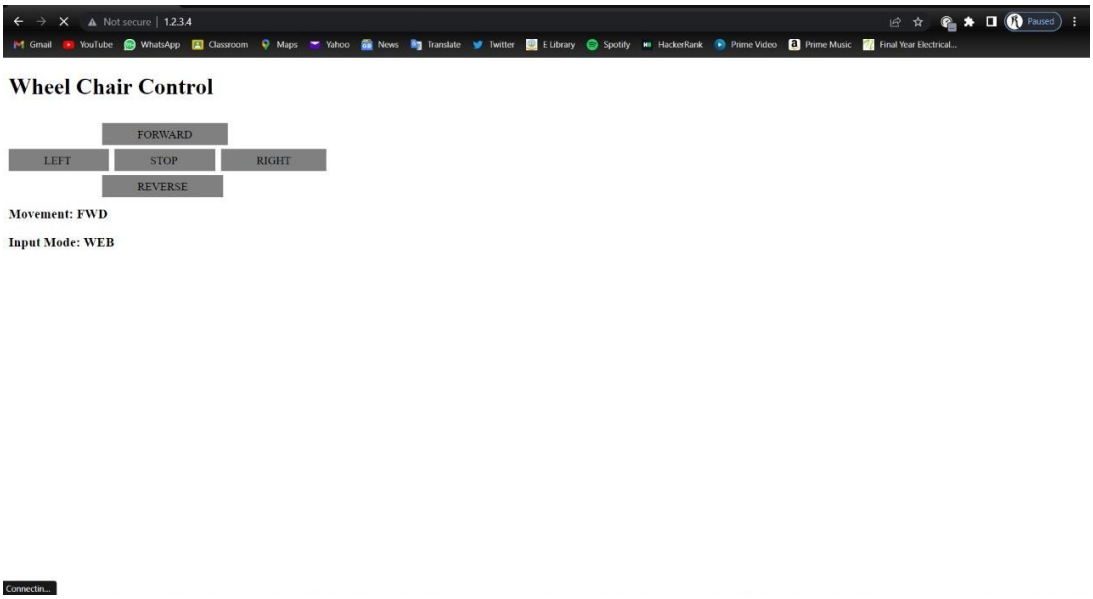

Figure 6:Web page showing the control of the wheelchair

After the completion of the code, connect the NodeMCU with the laptop and choose the board port correctly and then hit the Upload button. Open Wi-Fi settings in smartphone or laptop. There will be a Wi-Fi network with the SSID name and password that had given in the beginning of the code.A webpage will open as shown in the above diagram.We can control the wheelchair by changing the wheelchair movement options.

V.CONCLUSION

The wheelchair uses hand gesture controlled technology and web based control. The two mode of operation make it more efficient and user friendly. Node MCU has given this hardware a lift up in case of IoT technology. By using node MCU, the range of operation has increased. A person anywhere in the range of wi-fi can directly communicate with the wheelchair using his/her phone. The gesture control is based on the movement of the wrist of the patient. The accelerometer is connected in a hand glove. Any visually disabled or a partially paralyzed person can easily control the wheelchair .Therefore, the proposed system can reduce the complexities of other automated wheelchairs and improve the lifestyle of movement disabled people through easier techniques. Further details of the patient can also collect and record in the webpage.

VI.FUTURE WORK

In the future, many new features can be included in the system.Sensors to record the temperature,heartbeat and other health status of the patient can include and the data can be made available in the phone of the caretaker.It helps to keep a health record of the patient.Sensors to check the atmospheric temperature, humidity can also be integrated.Cameras and monitor is incorporated to entertain the patient and also to monitor him.

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