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Voice Controlled and Mobile Application Based Smart Wheelchair with GPS Tracking System

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ABSTRACT: In general, people with hands and legs impairment find it difficult to roam in the surroundings freely using a typical wheelchair. The proposed work is intended to help disabled people to use the wheelchair independently to wander around. A smart wheelchair is proposed which can be controlled through the user's voice as well as using the Blynk app on the user's mobile phone with a GPS tracking system. Moreover, there is also an automatic detection module to stop the wheelchair instantly whenever an obstacle blocks the way for a wheelchair. For using the proposed system, the user's mobile phone and the Node MCU ESP8266 which is the main control unit, both these are connected to the same source of internet. The proposed wheelchair receives the voice command given by the user via Google Assistant, These commands are predefined according to the user's convenience using IFTTT(If This Than That) Application. The proposed system design Voice Controlled and Mobile Application based Smart Wheelchair with GPS Tracking System can provide easy and comfortable access for people with hands and legs disability and also gives an automatic protection from obstacle collision if the mistake of any voice command occurs.

Index Terms: *Node MCU ESP8266, Blynk App, Voice Command, GPS Tracker, obstacle collision.*

I. INTRODUCTION

Adaptive technology for flexible roaming in the surroundings includes wheelchairs, walking aids, support for lifting and other devices. This may include someone to push a wheelchair, to lift the person from wheelchair to bed, etc. Taking into consideration that fewer caretakers and increased number of older adults, there is a high demand of users for a wheelchair which can be controlled by themselves without depending on others. Recently, in 2019 ministry had issued a draft to provide a ramp in public bus for physically challenged persons. In particular, wheelchairs with voice control and GPS Tracking enable the individual to enjoy a better environmental access. wheelchair is provided to a person, it should be user-friendly and there is a need to improve the wheelchair which will not only enable improved quality of life but also gives social functioning.

In 1933 Harry C. Jennings, Sr. and his disabled friend Herbert Everest both were mechanical engineers, invented the first lightweight, steel, folding, portable wheelchair. Later the increasing technology led to many such wheelchairs which were based on head and hand gesture, image processing, EMG and EEG control and so on. However, many limitations like signal processing, cost, not well-equipped structure led to a most unsuitable wheelchair for a user to use. Vaish was the first person for designing India's first robot Manav which has now designed a wheelchair that operates on brain-control technology. The mechanism behind the innovative wheelchair was the mind is made of millions of neurons and they rouse electrical impulses to the adjacent neurons depending on the thought that has to be produced. The electrical signals that are produced by electrochemical reactions are then passed through the brain to the scalp in a very minute amount. Those impulses are sensed and detected by a device called an EEG sensor. Primarily the electrical signal is amplified and then filtered. Those signals are then sent to a system that calculates those electrical signals into useful data for future use or record purpose.

PrannahDey proposed a Smart Wheelchair integrating head gesture navigation system which helps elderly people and illiterate patients to control their wheelchair by simply navigating their heads in to which direction they want to go. LDR sensor is used for light detection if there is no enough light in the surroundings for user to roam.

SJG Taylor proposed A lightweight wheelchair propulsion dynamometer for improving user energy

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efficiency and mobility. It measures propulsion forces and measures the energy expenditure with three multi-axis load cells to produce real-time forces due to pushing. Anantha Krishnan D proposed Autonomous Indoor Navigation for Wheelchairs using Signboards in which the system uses a deep learning model to sense signboards from surroundings and Azure Text Analytics API is used to summarize the text from the signboard images. This system runs on a Raspberry Pi that needs to be installed on any powered wheelchair. In the proposed system, a smart wheelchair is designed and implemented in which the wheelchair can be controlled through voice and also through the virtual Keys on the mobile phone application. A GPS tracking system is also included in the system for navigation purposes and also for family members to know the user's location. The system is user-friendly and also cost-effective.

II. LITERATURE REVIEW

In 2016, Romil Chauhan and Harsh Agarwal[1] proposed a model based on Artificial Intelligence for operating the wheelchair using Raspberry Pi and USB microphone is used for voice input. Here,also the problem of tracking the location of patient was not solved.

In 2018, Sumet Umchid and PitchayaLimhaprasert[2] proposed Voice Controlled Automatic Wheelchair. In this system, the wheelchair is operated by simple voice commands and ultrasonic sensor is used for automatic obstacle detection but it did not overcome the problem of tracking the location of patient.

In 2019, NasrinAktar and IsratJaharr[3] came with a Voice Recognition based Intelligent Wheelchair and GPS Tracking Wheelchair. In this system, all problems were overcomed like patient can control the wheelchair using voice commands and also through mobile app, location of patient was tracked using GPS module and automatic obstacle detection was included. But the proper positioning of hardware was a major concern.

In 2019, Ranjith Kumar and K.Sumathi[4] proposed Smart Assistance Library System for the Disabled: AnIoT based User-Friendly Wheelchair in which the impaired people are helped to easily navigate and read the book and translate into the language needed by combining reader and navigation system. Still, it is a dedicated application and cannot be used on general basis.

In 2019, PrannahDey and Md. Mehedi Hasan[5] proposed Smart Wheelchair Integrating Head Gesture Navigation system in which there was an involvement of head gesture for navigation can make the user feel dizzy and uncomfortable after long use.

III. SYSTEM ARCHITECTURE

The schematic block diagram of Voice Controlled and Mobile Application based Smart Wheelchair is presented in figure 1. The Node MCU is the main control unit of the proposed system having inbuilt Wi-Fi Chip ESP8266. The Voice command is received by Google Assistant which is predetermined. This received voice command is proceed towards Node MCU through

IFTTT(Webhooks) and blynk server. According to the given commands the wheelchair will drive in respective direction. The GPS Module is used for precise Location Detection and IR sensor is used for Obstacle Detection. The H-Bridge is the link between Node MCU and the Motors. The entire system works on 12V power supply and on the same source of internet.

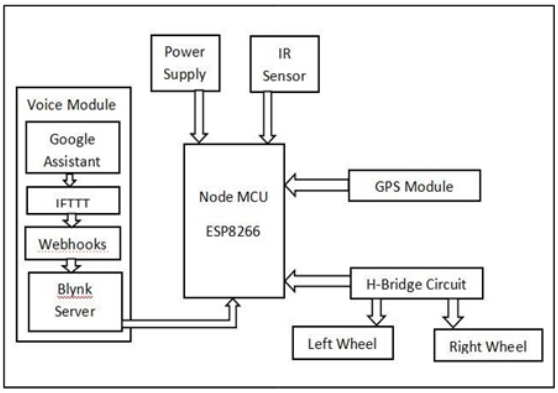

Fig. 1 Schematic Block Diagram of Voice Controlled and Mobile Application based Smart Wheelchair

A . Node MCU ESP8266

It is an open-source IoT platform which runs on ESP8266 System-On-Chip Wi-Fi which is the main control unit of the system. It is an 8-bit microcontroller unit that runs on the IEEE 802.11b standard. It operates only on 3.3V. The operating current is 80mA. It uses ISM 2.4 GHz bytes and provides a flash memory of 4MB. It is reliable for IoT applications. It is the main processing unit of the proposed system.

B. Ublox NEO-6M GPS Module

It includes a ceramic patch antenna with a UART TTL socket. It also provides the facility of power backup and baud rater storing configuration settings. It operates on 3.3V. The navigation update rate is 1Hz. The baud rates can be configured from

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4800 to 115200. It is having high sensitivity for indoor applications.
In the proposed system, GPS module is used to track the location of the wheelchair receiving the co-ordinates from satellites. The location is tracked by emitting radio signals from satellites.

C. H-bridge circuit

H-Bridge circuit act as an intermediate between the Node MCU and the DC Motors as Node MCU cannot be directly interfaced with motors because it doesn't provide enough power and current required to drive DC Motors. H-Bridge circuit is used for controlling DC motors to and fro. It consist of L298N double H-Bridge Drive chip to accept the standard TTL logic level for DC motors. It is having an inbuilt 7805 voltage regulator which operates on 2.5V. When the drive voltage is greater than 12V, an external 5V logic supply is used to protect the chip from damage. One H-bridge can control two DC motors at a time. Its power consumption is 25W and the operating current is 3A.

D. IR sensor

IR sensor is used for automatic obstacle detection. It shows output 0v (low) if any obstacles come in the way, 5V (high) otherwise. Its sensitivity range is 800nm to 1100nm. It's operating frequency is 35KHz to 41KHz. Its power consumption is 3-5V DC and the operating current is 3mA.

E. DC Motors

Two 12V DC 500 RPM motors are used. The operating voltage is 6-18V. It provides a torque of 1kgm-cm. It gives a load current of 900mA. They are used to drive the wheelchair.

F. External Battery

This is 12V- 1.3A per hour battery. It is used to provide voltage to the entire proposed system.

G. Blynk App

It is an open-source platform with IoS and Android app to control hardware like Arduino, Raspberry Pi, Node MCU using the Internet. It is a digital dashboard where one can build a graphic interface for the project by simply dragging and dropping widgets. This application is used for interfacing Google Assistant and Node MCU as they cannot be directly connected.

H. IFTTT(If This Then That) app

It serves as a mobile app and website both. It is used to connect all services together so that all tasks are automatically accomplished. In the proposed system, IFTTT is used to interface Node MCU, Blynk app and Google Assistant.

I. Google Assistant

It is a natural language technology where the users can easily find answers to their questions and get things done through speech or voice. The best example is Alexa. Google Assistant is used by the user for giving commands for driving the wheelchair.

J. Arduino IDE Software

ESP8266 is the core for Arduino IDE and it is one of the best and leading software development platform for various boards. It is an open source platform where one can easily write and upload the codes. The codes are usually written in C and C++. For uploading the code to the ESP8266 and use the serial console, the micro USB cable is connected to ESP8266 Board and the other side to is connected to the computer's USB port.

IV. METHODOLOGY

A. Interfacing through Voice

The proposed wheelchair is intended to receive the voice command by the user's mobile phone via Google Assistant. This input voice command is forwarded to the IFTTT server which further passes it to Node MCU through the Blynk Server. The Node MCU gives respective instruction for Motor's movement through H-Bridge. These instructions are configured as Program in Arduino IDE Software.

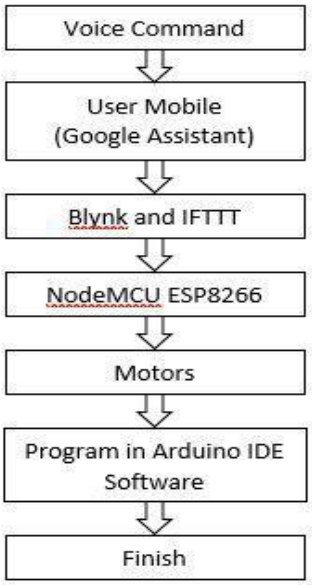

Fig.2: Flowchart of Voice Module

B Navigation using Keys

For the proposed system to function using keys there is a need for Installing the Blynk app on the user's mobile phone. For the user's interface, the

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Blynk app with custom-designed keys is used to facilitate monitoring and controlling the motors. Appropriate commands are predetermined to each keys. The predetermination of command is accomplished through program register in Arduino IDE Software.

Fig. 3: Navigation using Keys

C Interfacing GPS Module

For the proposed system to display the location of the wheelchair, the Blynk app is installed on the user's mobile phone. Google Map is integrated in the Blynk app which tracks the location of wheelchair on the map itself receiving the coordinates from the satellite. The GPS Module works according to the program written in the Arduino IDE Software.

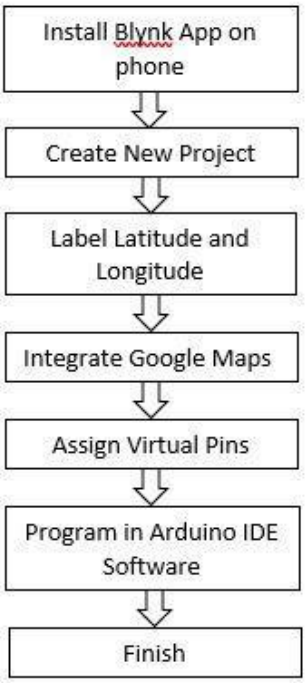

Fig. 4: Flowchart of GPS Module

D. DC Motors

Enable (ENA)	IN1A	IN2A	Action
0	-	-	Disable
1	Low	High	Clockwise
1	High	Low	Anticlockwise
1	High	High	Stop
0	Low	Low	Stop

Fig. 5: Truth Table for working of DC Motor

V. HARDWARE IMPLEMENTATION

Fig. 6(a) Hardware Implementation of System(Front View)

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Fig. 6(b) Hardware Implementation of System (Side View)

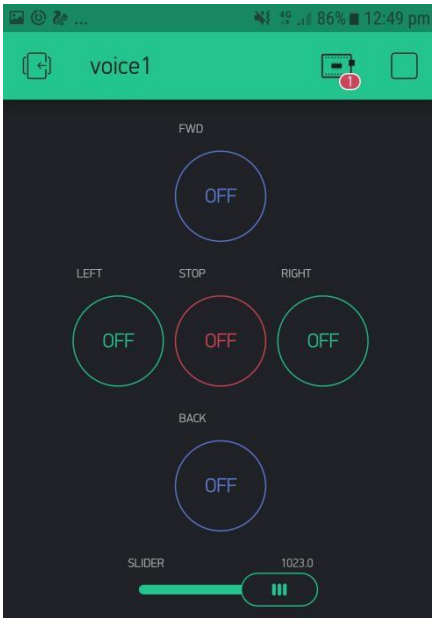

Fig. 7(a) Wheelchair control keys on Blynk App (Mobile Phone)

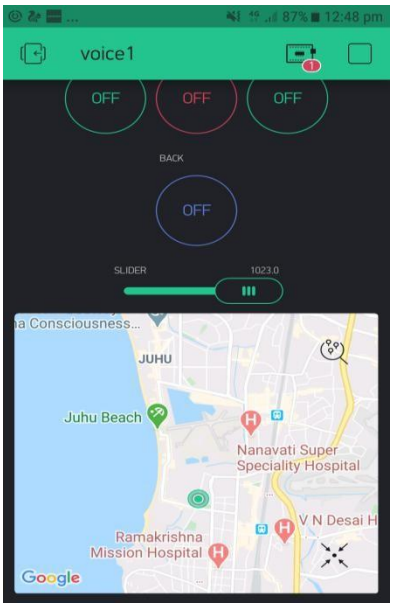

Fig. 7(b) Location of the Wheelchair on Blynk App(Mobile Phone)

VI CONCLUSION

In conclusion, the proposed voice-controlled and mobile application based smart wheelchair can be operated by the simple voice/mobile application commands given by the user to help people with physical disability who cannot control their movements especially with arms and hands more independent. The Infrared sensor will be included while developing the wheelchair for the automatic obstacle detection system in order to stop the wheelchair immediately when any obstacles suddenly come in the way of the wheelchair. Therefore, the proposed voice controlled and mobile application based smart wheelchair can provide easy access for people with a physical disability and also offer more safety due to automatic protection from obstacle collision. In the future, the wheelchair can be implemented for hilly regions and slope land because the wheelchair occupant or wheelchair pusher needs to give propulsion force to move the chair ahead.

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