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Review on Design & Fabrication of Android-based Wheelchair

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ABSTRACT

The use of powered wheelchairs with high navigational intelligence is one of the great steps towards the integration of severely physically disabled people. Driving a wheelchair in domestic environments is a difficult task even for a normal person and becomes even more difficult for people with legs impairments.

A wheelchair is used by aged people or people having leg injury or specially-abled people. Different wheel chairs have been made, problem with most of them is that they require an attendant to address the needs of the patient. It also requires human efforts to move the wheelchair.

This project addresses the problems faced by the patient and the attendant and makes it easy to operate the wheelchair by integrating a smartphone with the wheelchair. The system is wireless. The user can send the command to the wheelchair using a Bluetooth mobile application. For this purpose, we have used Arduino Mega, Bluetooth Module (HC-05), monster motor shield, geared high torque dc motor with gearbox and 12V DC power supply. This wheelchair is made to provide mobility solution to patients within their home or inside hospitals, so that they can move freely without need of an attendant to push the wheelchair. So the dependency of the patient reduces.

Key words: Arduino Mega, Bluetooth Module, DC Motor, wheelchair, smartphone

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INTRODUCTION

Patients who could not walk be it any reason need wheelchair so that they can move from one place to another. A wheelchair is a chair fitted with wheels. The rear wheels are larger in diameter, generally rear wheels are used by the patient to operate the wheelchair. Front wheels are castor wheels with bearings which adjust themselves as per the movement of rear wheels.

Smart wheelchair is something which makes it easy for the patient to access things they need and reduces their dependency on another person.

Smartphone is nowadays like heartbeat of people and available with every individual. Smartphone is like a minicomputer which can perform a wide range of operations using application available on the Play Store. Various wearables are nowadays becoming wireless. This is possible with the help of Bluetooth available in our smartphone. We can send commands to the other Bluetooth devices using our smartphone Bluetooth signal.

In this project, we have integrated a smartphone with a wheelchair. We have used Bluetooth Module HC-05 and Arduino Mega and programmed the Arduino to control DC Motors with the Monster Motor Shield. The prototype smart wheelchair is able to perform basic movement operations like Front, Left and Right. Also, there are 4 speed variations provided.

There are 3 different positions provided for the patient's comfort: sitting, sleeping and resting. The patient could be easily transferred to bed by switching the wheelchair to the sleeping position.
The aim of this project is:

- to eliminate human effort to move a wheel chair
- to reduce dependency of a patient on another person
- to provide comfort to the patient operating the wheelchair
- to provide easy transfer to bed from wheelchair

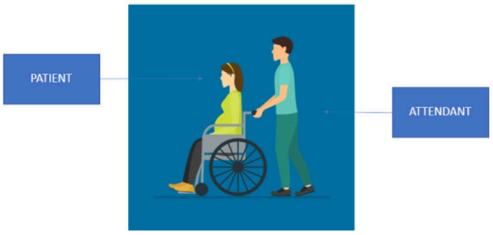

Fig. 1 Patient & Attendant

LITERATURE REVIEW

Before starting the project work, we have done some literature review to find out what others work have been done in similar field. Most of them were IOT based, some have done similar work that we have planned, yet our project unique in its own way.
[1] has made a smart wheelchair which allows disabled to move on his own by operating a joystick. This wheelchair also senses humidity and temperature and opens an umbrella sensing chance of rain. They have used temperature sensor, Ultrasonic Proximity sensor, Microchip PIC16F88 microcontroller for simultaneous control of speed and direction. [2] has used Arduino Uno and its software platform, accelerometer, L298 dual Motor driver, ESP8266 Wi-Fi Module to make a wheelchair for Quadriplegia patients. [3] has also used IOT in making wheelchair to help Cerebral Palsy patients. This system also monitors patient's health parameters and shows it in a mobile application. [4] aims at developing an inexpensive smart wheelchair by integrating a microcontroller-based health monitoring system to a regular wheelchair, to detect any cardio vascular abnormality using heart rate. [5] have designed and tested a prototype of a smart wheelchair with multiple operating modes which can be toggled using a switch as per user requirement. The hand gesture control mode allows the user to control the wheelchair with the help of the movement of the hand captured by the accelerometer. also, the user can even use voice control mode which takes the user's commands as input and performs the desired action.

METHODOLOGY

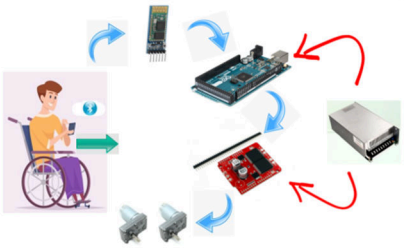

Fig. 2 Schematic Diagram

The wheelchair system consists of an Arduino Mega microcontroller which serves as the wheelchair 's memory, Bluetooth Module HC-05 to connect wirelessly with smartphone. Motor driver circuitry which is responsible for controlling the 12-volt DC motors attached to the wheels, and a smartphone which controls the wheelchair 's motion using a Bluetooth joystick application. The microcontroller communicates through Bluetooth signal sent from smartphone. The hardware is designed in such a way that the wheel chair easily moves on a plane surface. The two DC motors provide necessary torque required to move flawlessly with 10 kg load. The motors are synced such that they both rotate at equal rpm to move the wheelchair in a straight line. To move the wheelchair to the right or left their respective motor rotates the wheel and the direction is easily and safely changed by the user. The motors are powered by a 12V 40A

SMPS, which could be replaced easily with a 12V battery. The SMPS also provides necessary power to the electronics of the project. A single Arduino Mega is the brain of the smart wheel chair. It connects the Bluetooth and the motor driver circuits. The shaft of the motor is connected directly to the wheels to make power transmission and wheelchair design as easy as possible.

WORKING & CONSTRUCTION

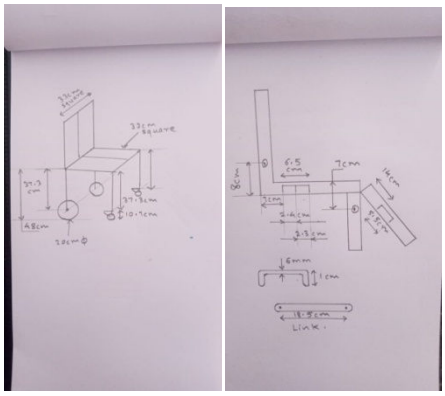

Fig. 3 Dimensions of the wheelchair

The implementation of the smart wheelchair was divided into two halves, software and hardware. The hardware consists of the wheelchair itself, DC motors and battery. The software part is composed of programming and PCB designing.
The programming was done in Arduino software. The hardware is designed in such a way that the wheel chair easily moves on a plane surface. The two DC motors provide necessary torque required to move flawlessly with 10 kg load. The motors are synced such that they both rotate at equal rpm to move the wheelchair in a straight line. There are 4 speed variations provided. To move the wheelchair to the right or left their respective motor rotates the wheel and the direction are easily and safely changed by the user.
The motors are powered by a 12V 40A SMPS. The SMPS also provides necessary power to the electronics of the project. A single Arduino mega is the brain of the smart wheel chair. It connects the Bluetooth and the motor drive circuits. We are using Arduino Joystick application (uncia Robotics) available on Play store as mobile phone interface to control the circuitry and wheelchair.

RESULT & DISCUSSION

The prototype wheelchair has been tested and results have been found on 10kg load including the external weight. The wheelchair is designed to travel straight, left and right direction. To travel backward one has to take a 360-degree left or right turn then move straight forward. This has been done because the VNH3ASP30 does not allow rotation of wheels in reverse direction. Overall, the functioning of the wheelchair is smooth and efficient on flat surface.

Fig. 4 Three comfortable positions

CONCLUSION

This prototype wheelchair makes it easy for a user to handle the wheelchair. The application interface is much similar to video game joystick. Thus, the whole system is user-friendly. The motors were successfully controlled as per the

commands. The 3 modes of wheelchair provide comfort to the user and allows easy chair to bed transportation. Real life implementation of this project will help disabled patients to feel free in terms of mobility.

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