

Voice Recognised Wheelchair with Inbuilt Mapping

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Abstract:- In this world of 7.8 billion population, near about 7.5 million population requires wheelchair for their movement. By any means if a person gets physically handicapped, then they are dependent upon others for their day to day maneuvering and their movement gets restricted until and unless someone helps them in moving their wheelchair. Patients having problems such as quadriplegic, cerebral palsy and multiple sclerosis are dependent on others and due to this they don't have the freedom of mobility and it sometimes become heart wrenching to see them in difficult situations.

Till now many technologies has been developed and are available in the market to overcome this problem. In our work, we have designed a voice activated wheelchair system for physically disabled persons which can be operated via simple voice commands with the help of mobile app [1] and assist them completely without any hassle to reach their destination in comfort in which a permanent mapping has also been done with the help of ATmega328P processor used in Arduino in which wheelchair user can reach it's destination on single command.

Keywords: Wheelchair, mapping, Arduino, ATmega328P, voice commands, quadriplegic, cerebral palsy

I. INTRODUCTION

Being handicapped not only effects the person's body internally but also affect him mentally which results in complete breakdown of person's health. In our research work we have developed our work in such a way, that it can act like complete automated wheelchair in known places where mapping has been provided in the Arduino [2] memory while in new places it will move as per the instructions given by the patient without any collision.

1.1 Motivation

Several researchers have shown their potential and have manufactured the independent mobility which consists of power wheelchair, manual wheelchair and walker with the access of benefit to both children and adults. Independent mobility reduces dependence on caregivers and family members and promotes feelings of self-reliance. Impaired mobility often results in decreased opportunities to socialize, which leads to social isolation, anxiety and depression. While the needs of many individuals with disabilities can be satisfied with traditional manual or power wheelchair, a segment of the disabled community finds it difficult or impossible to use wheelchairs independently. This population includes individuals with low vision, cognitive deficits, etc. The proposed voice-controlled wheelchair [3][4] along with inbuilt mapping would bring more convenience as well as safety to physically challenged people. Moreover the patients having

quadriplegic and cerebral palsy, lack of force, in which patient is near about completely handicapped can easily manoeuvre with the help of this voice controlled system. The technology can also enhance safety for users who use ordinary joystick-controlled powered wheelchairs, by preventing collisions with obstacles coming in path to it and provide mapping of the known places so that a next level of freedom can be provided to his movement.

1.2 Background

Previously researchers have developed various types of wheelchairs which include Sip and Puff Wheelchair, Head movement wheelchair and Joystick operated wheelchair which brings out the major way of mobility to the disabled people and provide them a way of self reliance and at last bringing a small smile in their face. It has definitely helped our society a lot and has helped us to think and develop things beyond that.

II. MATERIALS AND METHODS

The main aim of this project is to facilitate the movement of the disabled people and elderly people who cannot move properly so with this we can enable them to lead better lives without any problem. Voice recognition [5] is a key technology which can provide human interaction with machines for controlling a wheelchair. This project includes two parts which is software and hardware. It is realized that for input of human voice we are using Android phone as an intermediary. In this project, Arduino kit (Atmega328P) is used as controller to control the movement of wheelchair based on the human voice as an input. There are five basic movements of a wheelchair to be applied by the user. The Four operations perform by the wheelchair are described as following:

- I. Moving forward
- II. Moving backward
- III. Turning to the right
- IV. Turning to the left

Apart from this, we have also worked on providing a complete map of the location frequently used by the user, so that he can manoeuvre more easily with just providing the present location and the destination location at the mic of android phone which in result will even help him to give less instructions to the wheelchair, and all these instructions of movement of wheelchair will be stored in the Atmega328P processor of Arduino board.

In this research work we have used sensors we have used

2.1 Arduino UNO

Arduino Compiler Arduino is a tool for making devices that can sense and control more of the physical world than desktop computers. It is a microcontroller development board for writing software for the hardware circuitry. It consists of an ATmega328P microcontroller. The Atmel Atmega25328P is a low-power CMOS 8-bit microcontroller based on AVR enhanced RISC architecture. The complete mapping of the path is stored in this processor. By executing powerful instructions in a single clock cycle, the Atmega328P achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

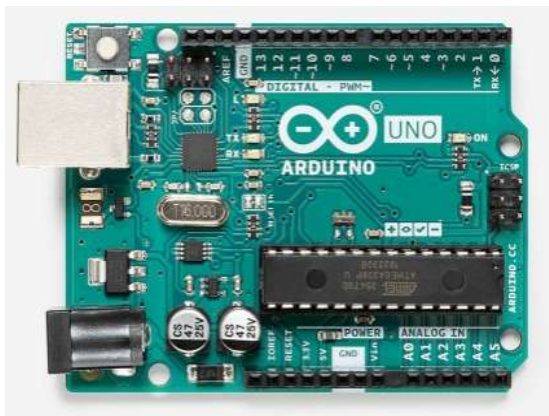


Figure 1: Shows the Arduino Uno board.[6]

2.2 L293D Motor Shields

Motor driver L293D IC The most common method to drive DC Motors in 2 directions under control of computer is with an H-Bridge motor driver. The L293D is an integrated circuit motor driver that can be used for simultaneous, bi-directional control of 2 small motors. It is used to drive two DC motors simultaneously, both in forward and reverse direction



Figure 2: Represents 293D motor shield.[7]

2.3 Bluetooth Module HC-05

It is used for many applications like wireless headset, game controllers, wireless mouse, wireless keyboard and many more consumer applications. It has range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions. It is IEEE 802.15.1 standardized protocol, through which one can build wireless Personal Area Network (PAN). It uses frequency-hopping spread spectrum (FHSS) radio technology to send data over air. It uses serial communication to communicate with devices. It communicates with microcontroller using serial port (USART).

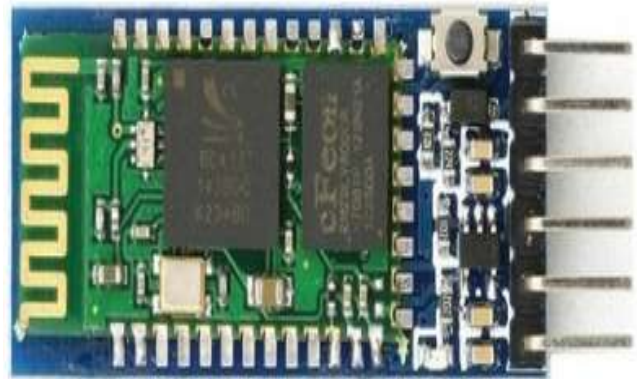


Figure 3: Representing Bluetooth module HC-05.[8]

2.4 Ultrasonic Sensor HC-SR04

Ultrasonic Sensor They are commonly used for a wide variety of distance measuring applications, non-contact presence, and proximity. These devices typically transmit a short burst of ultrasonic sound toward a target, which reflects the sound back to the sensor. The system then measures the time for the echo to return to the sensor and, computes the distance to the target using the speed of sound in the medium. Ultrasonic sensors work on a principle similar to Radar or Sonar, which evaluate attributes of a target by interpreting the echoes from radios or sound waves respectively. It is used as the obstacle detector in the hardware in reverse direction.



Figure 4: Represents ultrasonic sensor HC-SR-04.[9]

2.5 Wheel chair chassis (robotics chassis for miniature model)



Figure 5: Displays robotics chassis. [10]

2.6 Battery 12 volts

Two 12 volts replaceable battery has been used to reduce the project cost and to provide constant power during project time. But instead of it a rechargeable battery can also be used in order to provide adequate power supply for long time.



Figure 6: Shows 12V battery. [11]

2.7 DC Motors (12v 200 rpm)

It is a simple motor which uses electricity and a magnetic field to produce or which turns the motor. It comprises of 2 magnets of opposite polarity & an electric coil, which acts as an electromagnet. The repellent and attractive electromagnetic forces of the magnets provide the torque that causes the DC motor to turn. They are used them for the wheels of wheelchair.



Figure 7: Represents DC motor of 200rpm. [12]

2.8 Android phone with Android Bluetooth Voice Controller (App)

Tutorial link app has been used here for best connection of the android phone with the proposed wheelchair model.

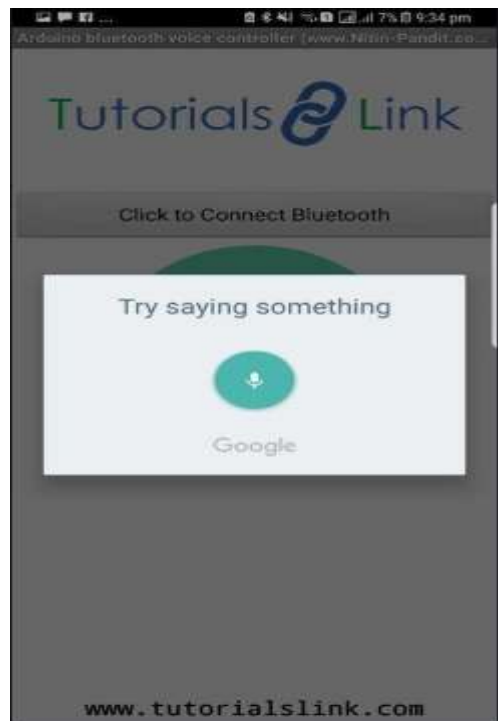
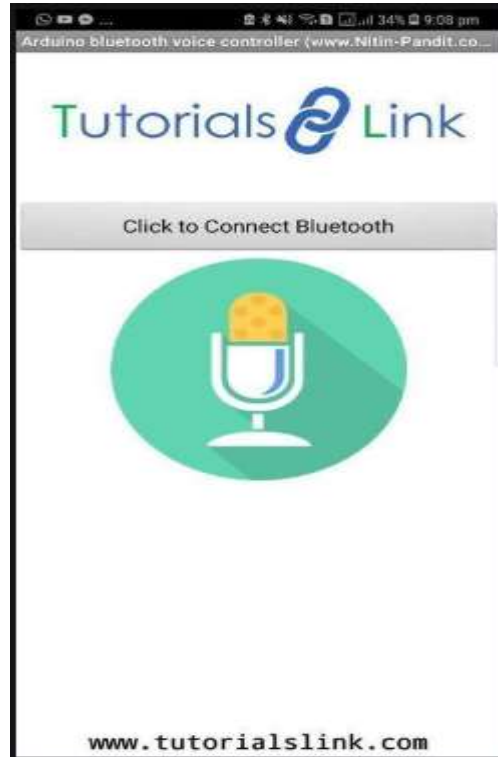


Figure 8: Representing the Android app used in our work. [13]

2.9 Breadboard

Small breadboard is used here for effective connection without and loose connection in order to enhance it's durability.

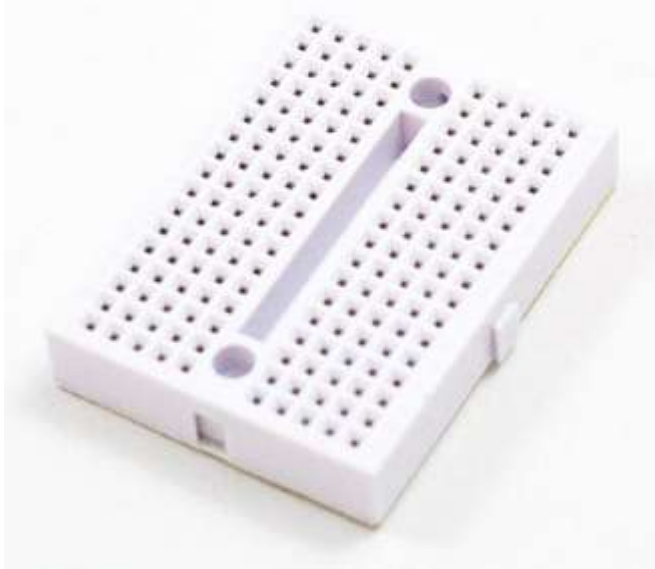
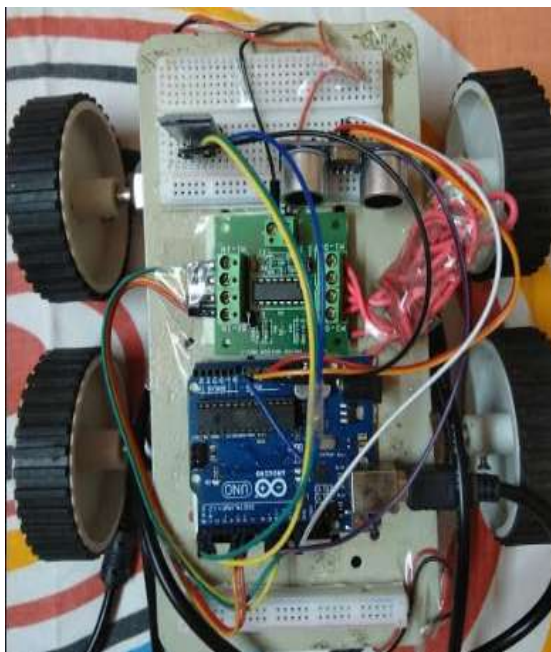


Figure 9. Shows the breadboard being used in the work. [14]

2.9 Proposed Model

It is the final working proposed model that we have designed which is completely working as per our designed algorithm.

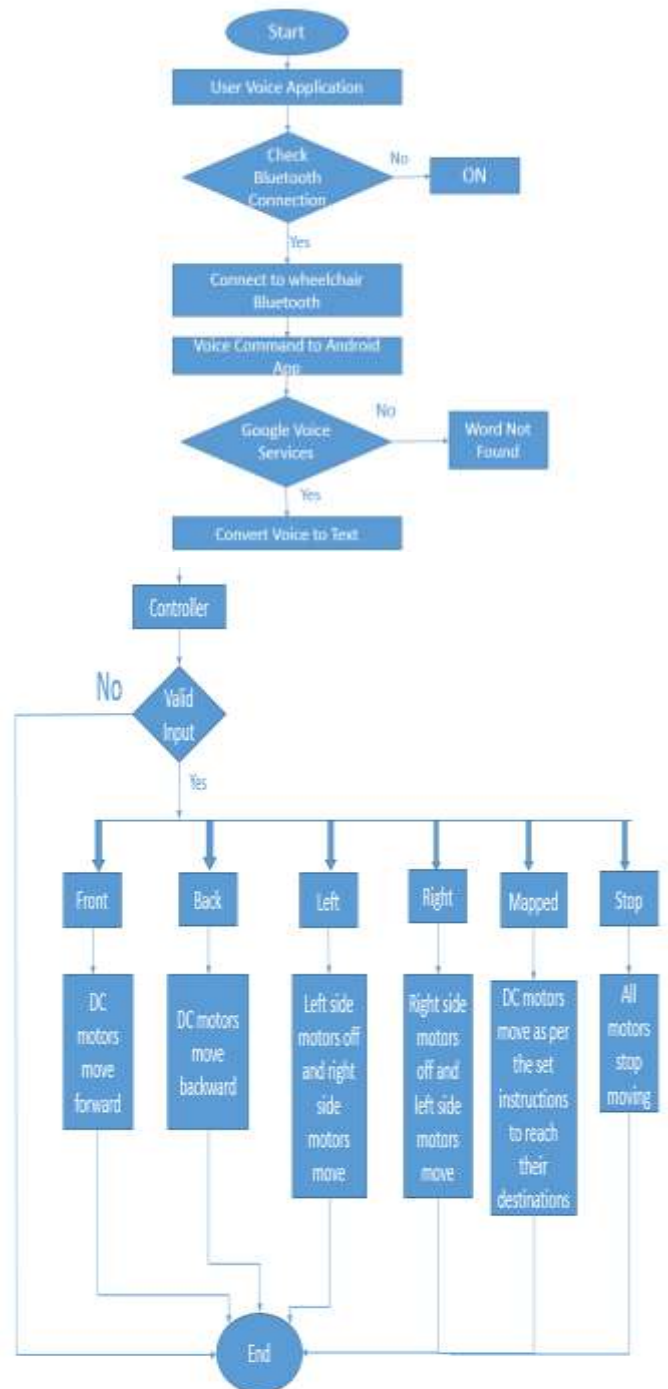


2.10 Software Requirement

1. Arduino IDE
2. Android Application

3. Coding language (java & C++)

2.11 Algorithm



III. RECOGNITION EXPERIMENT

To evaluate recognition performance, we experiment speech recognition test with 15 students. The target words are nine reaction commands and five verification commands as shown in table 1. This experiment is carried on in laboratory room.

There were some voices of other people in the recording environment in the circumference. As the results, we obtained successful recognition rates of 98.3% of reaction command and 97.0%.

3.1 Stopping experiment:

The action of this system executes until the next command is given. For example, a wheelchair goes straight until stop or turn command is input. Then, we tested the following three experiments to verify the operation of our system. From two experimental results of ex.2 and ex.3, the braking distance of about 2m occurred until it actually stopped after stop command was input. This is the reason why two seconds are necessary for the recognition processing and the display of the result. The running speed is 1.8km/h, and our system runs 2m in 2 seconds. This distance supposed with the specifications of the voice controlled wheelchair though it can be expected that the braking distance decreases by making improvement in the performance of the laptop and the low running speed. Here, the braking distance was about 50cm when button operation is used without using the voice input.

3.2 Running experiment

The next experiment is a running experiment. This experiment was carried out with same five persons of previous experiment. A running place was in the corridor of campus, and the width of the corridor was about 2 m, and one obstacle was put on the hall of the corridor. We set two courses A and B as shown in figure 8. The total distances of course A and B were about 16m and 13 m, respectively. The experimental running time, the number of basic reaction command and the number of short moving reaction command are shown in table 2. Because a little moving distance operation of the course B is more necessary than the course A, there is more input of the short moving reaction command in the course B. Though the person E is one of the authors and he is control the system in a practiced operation, every person is almost running at the same time.

IV. ADVANTAGES

The patients like quadriplegic and cerebral palsy, lack of force, can easily handle this voice controlled system.

The use of Arduino make the programming of the system easy and thus, reduced the software and hardware interfacing problems.

The system can be operated by giving synthetic voice commands.

The system is fully automated because of the use of Arduino and motor drivers.

4.1 Future Scope

Finding a way for automatically charging of the battery of the wheelchair with the help of its motion of the wheel chair like the present regenerating braking used in the car

With the implementation of gear box we can produce high speed moving wheelchair in more open space

Attachment of solar panel can also be done to charge the battery for power supply to the components required to drive the wheelchair.

4.2 Conclusion

- The design and implementation of a voice controlled wheelchair for disabled people using Arduino and voice recognition module for controlling the motion of a wheelchair is designed. The direction as well as the destination (if the path mapped inside processor) of the wheelchair now can be selected using the specified voice commands.
- The design not only reduce the manufacture cost compared with present market but also will give great competitive with other types of electrical wheelchair. The only thing needed to ride the wheelchair is the synthetic voice commands of the person.
- A system that can directly enhanced the lifestyle of a physically disabled person in the community is implemented. This project has many advantages like safety, comfort, energy saving, full automation etc.
- The technology can also enhanced safely for users who use ordinary joystick-controlled wheelchair, by preventing collision with walls, fixed objects, furniture and other people. Thus all the drawbacks of the joystick controlled wheelchair are overcome by this "voice controlled wheelchair".

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