2024 10th International Conference on Advanced Computing and Communication Systems (ICACCS)

Arduino Based Voice Controlled Wheel Chair for Physically Challenged Persons

Ayisha S,
Assistant Professor,
Electronics and communication Engineering
Shree Venkateshwara Hi-Tech Engineering College,
Gobi,Erode-638455
Tamil Nadu, India
ayishaecesvhec@gmail.com

Kokila C,
Electronics and communication Engineering
Shree Venkateshwara Hi-Tech Engineering College,
Gobi,Erode-638455,
Tamil Nadu, India
ecekokila.ckokila@gmail.com

Bhuvaneswari M,
Electronics and communication Engineering
Shree Venkateshwara Hi-Tech Engineering College,
Gobi,Erode-638455,
Tamil Nadu, India
mbuvaneshwari0@gmail.com

Tamilarasi B,
Electronics and communication Engineering
Shree Venkateshwara Hi-Tech Engineering College,
Gobi,Erode-638455,
Tamil Nadu, India
tamilarsib532@gmail.com

Abstract— This paper presents the design of a Voice Controlled Wheelchair tailored for individuals with physical illnesses or disabilities. The system integrates Arduino, a microcontroller, and a Geetech voice recognition module to facilitate wheelchair movement. Additionally, a battery level indicator is incorporated to monitor battery status. The primary objective of this system is to assist individuals who face challenges in mobility due to physical limitations such as impaired hands, feet, or lower body functions. By utilizing speech recognition technology, the wheelchair offers a novel interfacefor human-machine interaction.The implementation involves the Arduino interpreting commands and driving the two motors of the wheelchair based on the specified direction. This design aims to empower individuals who rely on assistance for performing daily tasks, providing them with greater independence and autonomy in mobility.

Keywords: Arduino, Battery level indicator, Ultrasonic sensor, Voice recognition module.Gear motor,LCD,Battery ,Blutooth model.

1. INTRODUCTION

Wheelchairs serve as essential mobility aids for individuals unable to walk due to physical illnesses or disabilities. They come in various types to cater to diverse user needs. Numerous studies emphasize the importance of enabling independent mobility for disabled individuals, aiming to enhance their quality of life and reduce dependency on others.

The wheelchair described in this context is capable of movement in four directions: forward, reverse, left, and right, along with a stop function. Utilizing a voice recognition module, users can control the wheelchair's movement by issuing voice commands. Additionally, a battery level indicator ensures users are informed about the wheelchair's power status, enhancing reliability and convenience [2].Typically, communication with the wheelchair occurs through a parallel port, which receives electrical signals representing commands from the user [3]. The wheelchair features four wheels for stability, and car wiper motors are employed to control their movement.

Microcontroller-based control systems have been proposed in previous works to cater specifically to the needs of disabled individuals [4]. These systems leverage advanced technologies to provide tailored solutions for enhanced mobility and independence.

In summary, the development of advanced wheelchairs with features such as voice control and battery indicators represents a significant advancement in assisting individuals with disabilities, fostering independence and improving their overall quality of life.

II.PROPOSED SYSTEM

The speech recognition block comprises three submodules: the Voice Capture Module, Voice Customization Module, and Voice Recognition Module, as depicted in Fig. 1 of our proposed system. The Voice Customization Module is utilized for training the system to recognize specific voice commands. In our case, we customize five commands— FRONT, BACKWARD,

RIGHT, LEFT, and STOP—to direct the wheelchair's movement.

Upon receiving voice commands, the Voice Customization Module converts them into binary codes based on their speech frequencies. These binary codes are then compared with predefined commands stored in the microcontroller [5]. Additionally, in our project, the system is equipped to detect obstacles and calculate the distance from the wheelchair, triggering an immediate system shutdown if necessary. Furthermore, a battery level indicator is incorporated for user convenience.

One distinguishing feature of our proposed system compared to existing ones is our utilization of existing wheelchairs sourced from hospitals. By integrating voice recognition circuits into these wheelchairs and subsequently returning them to the hospital, we effectively reduce the overall cost of implementing such systems.

Moreover, in our wheelchair design, the two wheels on the left side are controlled by one motor, while the wheels on the right side are controlled by the second motor, ensuring synchronized movement and maneuverability.

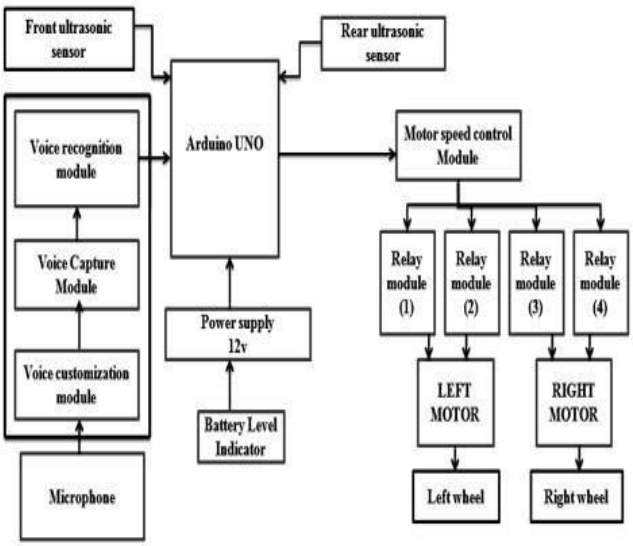


Fig1.Block diagram of the proposed system

the voice recognition module. It extracts and analyses voice features of human delivered to a machine or computer through the microphone.

Working Principle of voice recognition module is that HM2007 (fig. 2) is a single chip CMOS voice recognition module.

1) FEATURES OF VOICE RECOGNITION MODULE

- Voltage:4.5-5.5V
- Current:<40mA
- Digital Interface: 5V TTL level UART interface
- Analog Interface: 3.5mm mono-channel microphone connector + microphone pin interface
- Size: 30mm x 47.5mm
- Recognition accuracy: 99% (under ideal environment)

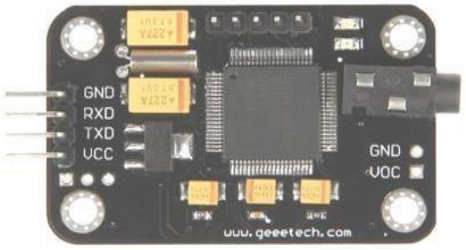


Fig. 2. Geetech voice recognition module

B. ARDUINO

The Uno has the difference that it does not use the FTDI USB-to-serial driver chip. No additional programmer is required for programming board.

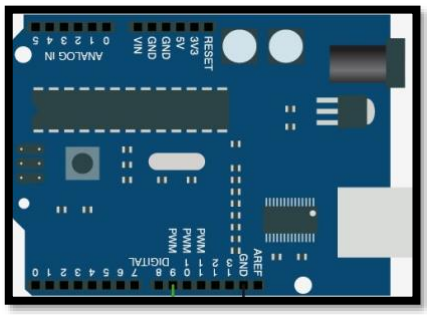


Fig. 3. Arduino

1) Technical specifications

- Microcontroller: AT Mega 328 □ Operating voltage: 5V □ Input voltage (Recommended): □ 7-12 V

- Input voltage (Limits): 6-20 V
- Digital I/O pins: 14 □ Analog input pin :6
- Flash memory :32 KB of which .5KB used by boot loader
- SRAM :2KB
- EEPROM :1KB
- Clock Speed :16 MHz

C. Relay H-Bridge

To drive DC motors with different voltages and currents we can design a h-bridge with a relay board. This control logic is really smart, a short circuit will never happen, even during a transition state. For control a dc motor we need an h-bridge.it is the only way to drive motor forward, stop and reverse. Each pin of individual motor is connected to a relay and if the logic status is 1 it is connected to positive power if logical status is 0 it connected to ground. The term H Bridge is the typical graphical representation of the circuit. In simple words, the term H Bridge is derived from the flow of current in the circuit which you will understand completely with the help of the following example. An H bridge can be made using four switches, MOSFET's or Relays.

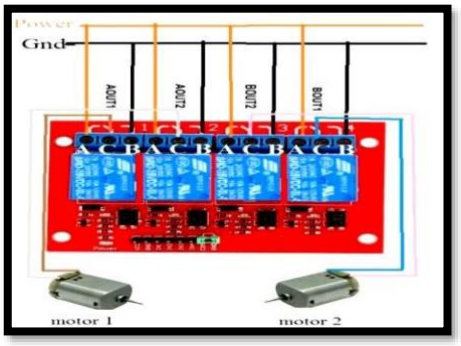


Fig. 4. Relay H-Bridge

D. Wiper motor

In order to move wiper motor it needs a power source. The different power sources are the batteries, voltages, current (minimum of 1.6 amps at 70 rpm; 1 amps at 41 rpm), computer batteries (12volts output) and other battery supplies that do not exceed the limit of 12 volts otherwise the motor is bound to overheat. In this project we use 2 wiper motors of 12v.

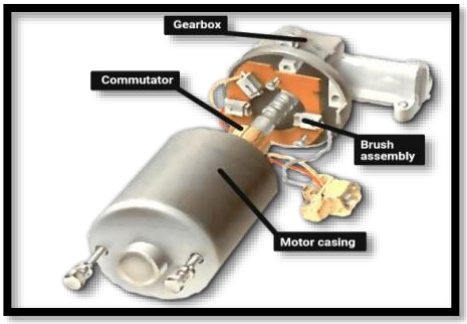


Fig. 5. Wiper motor

E. Ultrasonic Sensor

Ultrasonic sensors work by emitting sound waves at frequency too high for human beings to hear. They then wait for the sound to get reflected back, calculating. Ultrasound is reliable in any lighting environment and can be used either inside or outside. Ultrasonic sensors can handle collision avoiding mechanism for a robot, and being move often, as long as it isn't too fast.

These sensors are widely used and they can be implemented in water level sensing, drone applications and sensing cars at your local drive-thru restaurant or bank. Ultrasonic rangefinders are commonly used to detect a collision.

Distance = product of Time and Speed of Sound in Air (340 m/s))/2

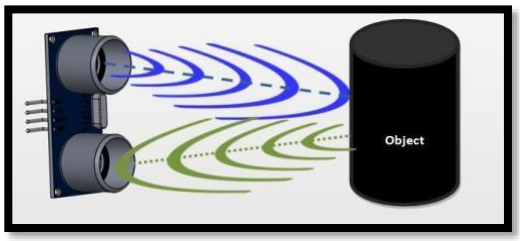


Fig. 6. Ultrasonic sensor

1) Advantages

- Can operate in many environment.
- Ultrasonic sensors work in smoke filled environment.

F. Battery level indicator

The heart of our battery level indicator circuit is LM3914
IC. This IC takes input voltage and drives 10 LED's linearly according to the input analog voltage. In this circuit LED's (D1D10) displays the capacity of the battery display mode. This mode is chosen by the external switch sw1 which is connected to 9th pin of IC. 6th & 7th pins of IC are connected to ground through a resistor. This resistor controls the contrast of LED's. Here resistor R3 and POT RV1 forms potential divider circuit connection. Here pot RV1 is used for calibration of circuit. There is no need of any external power to this circuit.

circuit is designed to monitor 10V -15V DC supply. The circuit will work even if the battery voltage is having 3V. The operating voltage of this IC is about 3v to 25v DC. LM3914 drives LED's, LCDs and vacuum fluorescents. The IC contains adjustable reference and accurate 10-steps dividers. This IC can also act as sequencer in the indicator.

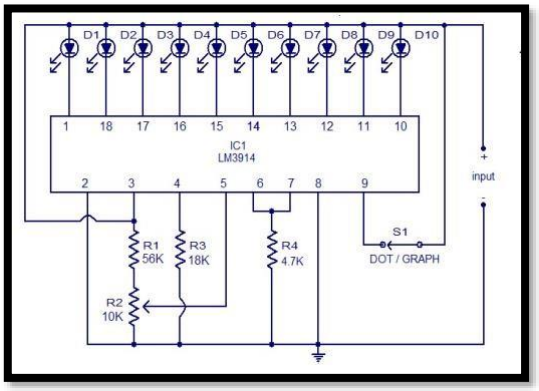
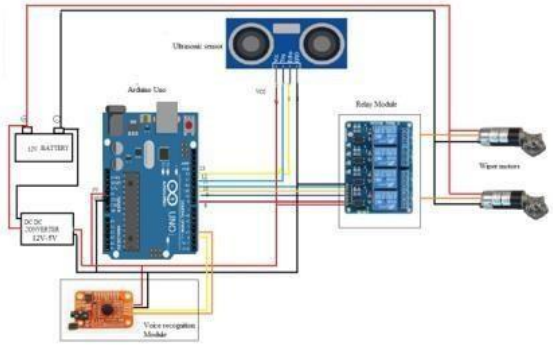


Fig 7. Battery level indicator

4. Circuit Diagram



8. Circuit Diagram

5. Working of Voice Controlled Wheelchair

Input is taken through microphone. Speech signal is processed using with the help of speech recognition module and is transfer to the Arduino. Arduino converts these instructions into commands that can be recognized by the motors. This controls the movement and direction of wheel chair through motor driver. Arduino decides the operation of the two DC motors depending on the given instruction. Firstly, voice module is trained with four commands. After that the voice command is send by the person whose voice has being drained. The Arduino is used to check the signal associated with this command and compare it with the stored commands and performs the task related to this command.

COMMANDS	OUTPUT
Front	motor 1 and motor 2 moves forward
Back	motor 1 and motor 2 moves backward
Left	only motor1 moves forward and rotates to left
Right	only motor 2 moves forward and rotates to right

Fig 10. Directions

When the voice is detected, the wheel chair can be controlled to move in that direction by giving commands to the wheel chair, these commands are transferred using electrical signals which are used to drive the left or right motor of the wheel chair. There are two motors connected to the left and right wheels of the wheel chair, the electrical signals are transferred to these motors using some hardware ports, called the communication port is the parallel ports. Four wheels are used in the wheel chair for proper balancing. The movement of wheels is controlled by DC motors which are attached to the wheel chair. Two wheels located on the left side of the wheelchair are controlled by one motor and similarly the wheels on the right side are controlled by the other motor.

6. Conclusion

Voice controlled wheelchair has the key functionality of following voice commands. Along with the normal methods of operations such as joystick/keypad, a novel way of controlling the chair using a web application, will also be made available. This provides user the ability to control the wheelchair while sitting in some corner of the house.

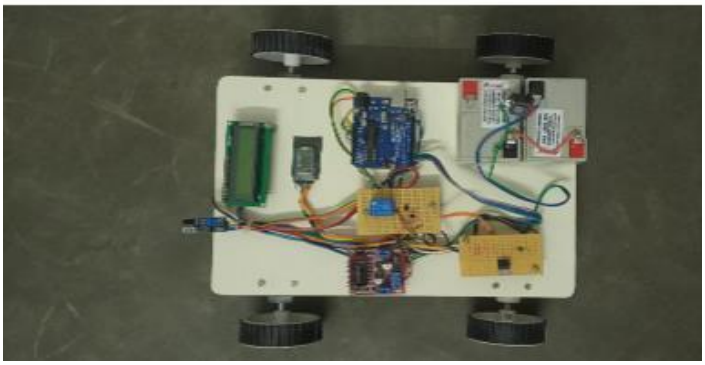
The proposed model uses advanced hardware which not only processes the voice but also controls the motors, thus, reducing the number of hardware used and decreasing the cost.

However, there is also a disadvantage that it does not distinguish between a normal conversation and a command. The problem of the recognition of commands by another person is minimized in a situation where the user is wearing a dynamic microphone with a narrow filed of sound, which also partially removes the background noise and enhances the change in the color of pronounced commands by the user. This does not have a larger effect on the quality of the recognition.

7. Future Scope

- Further advancement is possible by automatically charging battery with any renewable source of energy.
- Stair climbing mechanism can be implemented in future using voice command.

8. RESULT



voice operated wheelchair is the modified version of the manual wheelchair. It is operated on the joystick of patient (i.e. commands such as forward, left, right, stop, etc.) and voice of the patient .The wheelchair does not require any person to move it as it is automated with motors. Voice of an independent speaker is send through the android app,which is paired to HC-05 and interfacing of the Arduino and HC-05 converts the voice signals and with the help of L298D Driver motors are driven and hence the wheelchair moves in the direction directed from the independent speaker.

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