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Design and Implementation of Smart Wheelchair using Arduino

Nandula Sri Manikya Sasank,G. Lakshmi Sowjanya, Bhyri Sai Shilpa, Rajana Divya,

Malla Hema Sai Kumar

Dept. of Electronics and Communication Engineering, Gayatri Vidya Parishad College for Degree and PG Courses, Visakhapatnam, Andhra Pradesh, India

ABSTRACT- People who are suffering from disabilities like handicapped, or paralysed, and those who cannot move often depend on others for their locomotion. A wheelchair can be used in these circumstances to move a person from one place to another. This proposal will increase the independency of an individual. In this proposal wheelchair consists of features like Hand gesture movement, Voice controlled mode, Obstacle detection, and a Heartbeat monitoring system. Hand gesture mode can be used for people who are dumb, deaf, and paralyzed. The voice-controlled mode can be used for those who cannot make any movement through the body. Obstacle detection can detect the object up to a certain range and avoid accidents. The heartbeat monitor system monitors the heartbeat and health condition of the individual. The individual can choose either the voice-controlled mode or hand gesture mode according to their disabilities.

KEYWORDS-Smart wheelchair, Gesture controlled, Voice command, Obstacle detection, Heartbeat monitoring

I. INTRODUCTION

As the population of the world increased day by day, especially in India, people with disabilities and handicapped persons increases. In such cases, wheelchairs are very useful for those who cannot move from one place to another place. Smart wheelchairs provide new opportunities to improve the mobility independence of people with disabilities. With the increasing demand for more efficient, safe, and cost-effective, mobility solutions, the development of smart wheelchairs has become a key focus of research in the fields of engineering. Wheelchairs have been an indispensable aid for those with mobility issues. However, traditional manual wheelchairs have limitations in terms of mobility and convenience. In recent years, the development of smart wheelchair technology has significantly improved the quality of life for people with disabilities. Smart wheelchairs are equipped with advanced sensors, controllers, and communication technologies that allow for greater independence and improved mobility.

Smart wheelchairs have the potential to provide users with greater control over their environment, as well as improved navigation and maneuverability. These devices are
capable of sensing and adapting to changes in the environment, such as obstacles, uneven terrain, and changes in slope.

With the increasing demand for assistive technologies, smart wheelchairs have the potential to transform the lives of millions of people with disabilities worldwide. As a result of their flexibility to accommodate unique user requirements and preferences, smart wheelchairs are growing in popularity. They may be programmed to respond to hand gesture control, avoid obstacles, and respond to voice commands, and heartbeat monitoring systems.

II. LITERATURE REVIEW

[1] According to one study, an Arduino-based smart wheelchair system includes a Voice command controlled and hand-gesture-controlled wheelchair. Voice commands are left, right, forward, and backward. As the same voice commands for hand gestures are controlled the gestures are like right, left, forward, and backward.
[2] According to the second study, Arduino-based gesture-controlled wheelchairs and convertible wheelchairs into a stretcher. In which the gesture commands may be left, right, forward, and backward. The wheelchair may move according to a specific direction, based on the gesture command.
[3] According to the third study, the wheelchair is automated with the feature of Voice controlled mode. In this study, people with disabilities like handicapped and paralyzed persons may be useful with this wheelchair.

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[4] In another study, an android phone controlled and touch screen-operated wheelchair is used in which, the voice commands are given by using an Android phone with the help of a Bluetooth module and Android application. In touch screen mode, the commands can be displayed on the display, and by clicking on any command, the wheelchair can be moved according to a particular direction.

III. METHODOLOGY

The methodology of this project had been divided into four parts

1) Hand Gesture controlled mode
2) Voice Command controlled mode
3) Obstacle detection mode
4) Heartbeat sensor module

3.1 Hand Gesture controlled mode

In Hand Gesture controlled mode, the wheelchair is a mode based on the gesture commands given by the person sitting in the wheelchair. In this mode, a hand glove is used to give the gesture commands. In this mode, there are two parts one is the Transmitter part and another one is the Receiver part.

3.1.1 Transmitter Circuit

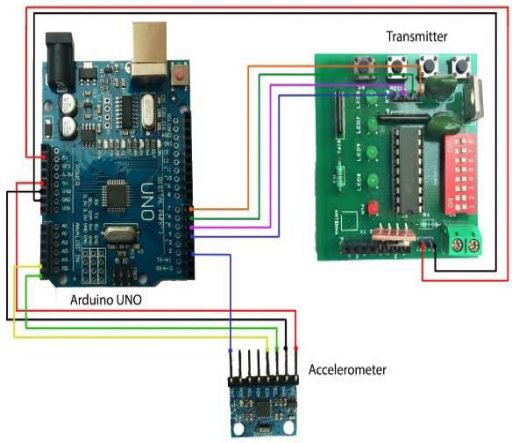

Figure 3.1 Transmitter Circuit

3.1.2 Receiver Circuit

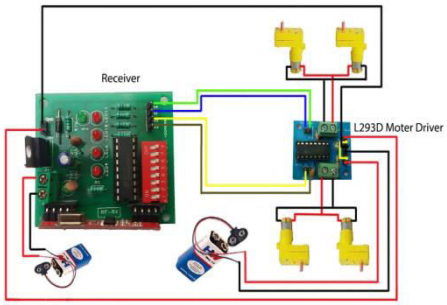

Figure 3.2 Receiver Circuit

3.2 Voice Command controlled mode

In this mode, the wheelchair is moved according to the voice commands given by the person sitting in the wheelchair. In this mode mainly used component is the HC-05 Bluetooth module. With the help of this component, voice commands are given by connecting with the mic or mobile application.

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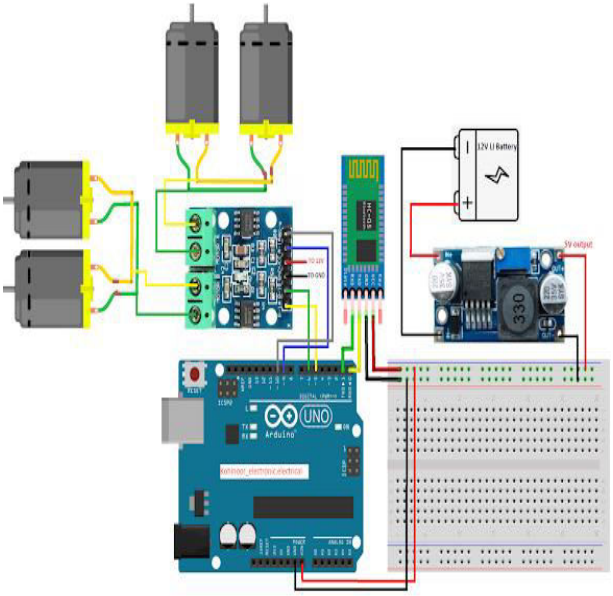

Figure 3.3 Circuit diagram for Voice controlled mode

3.3 Obstacle Detection Mode

In this mode, the wheelchair can detect obstacles and move according to the object's position. In this mode, mainly used components are Ultra Sonic Sensor and Servo motor. The ultrasonic sensor is used to detect the object and the Servo motor is used to move left or right when an object is detected.

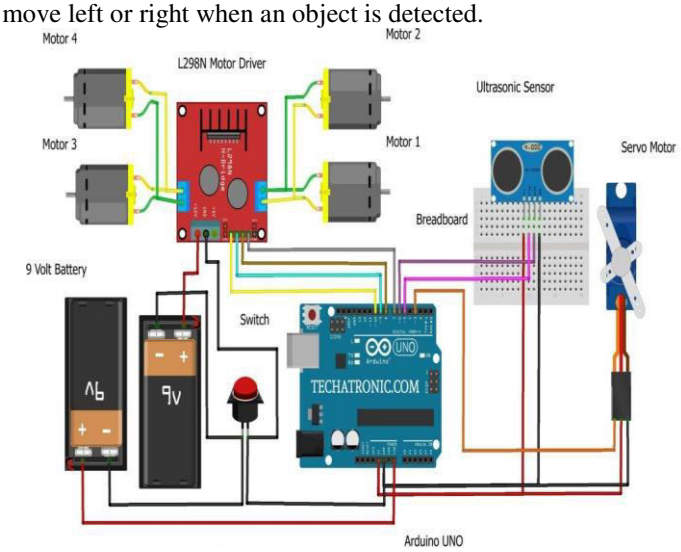

Figure 3.4 Circuit for Obstacle Detection Mode

3.4 Heartbeat Sensor Module

The heartbeat sensor module is used to monitor the health condition of the person sitting in the wheelchair. In this module, the heartbeat sensor and LCD are used as the main components. A heartbeat sensor is used to monitor the heartbeat and an LCD is used for displaying the heartbeat.

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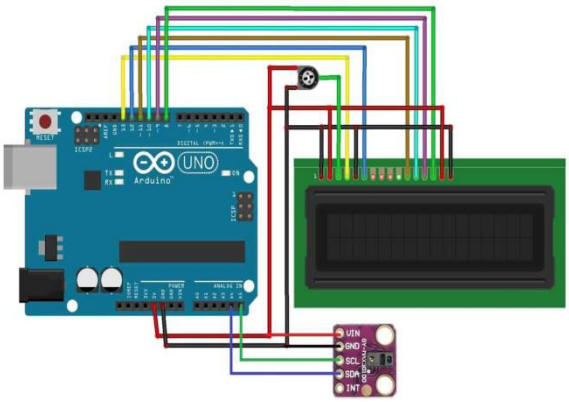

Figure 3.5 Heartbeat sensor module

IV. BLOCK DIAGRAM

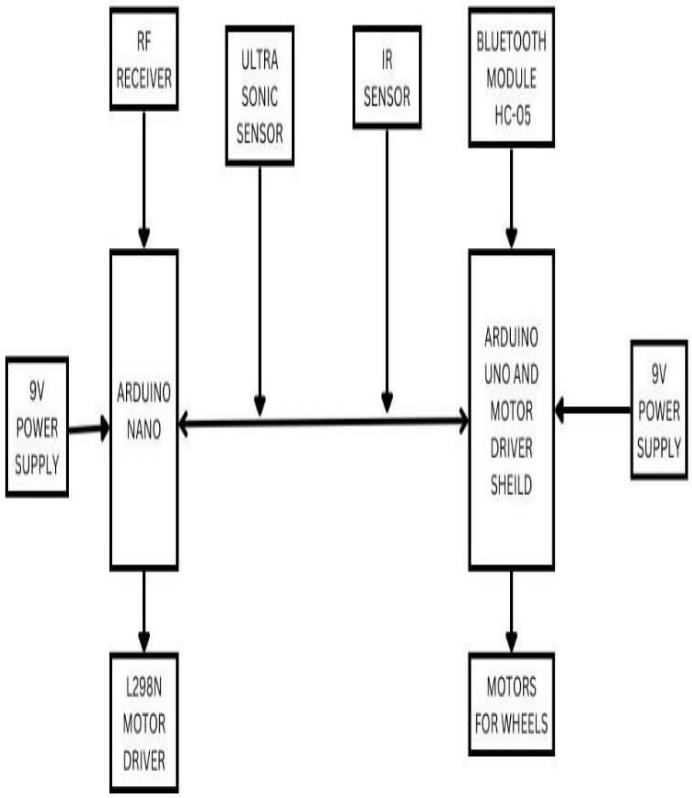

Figure 4.1 Block diagram

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V. HARDWARE REQUIRED

5.1 MPU6050

The MPU6050 IMU has both a 3-Axis accelerometer and a 3-Axis gyroscope integrated on a single chip. It helps to measure acceleration, orientation, displacement, and many other parameters of a system.

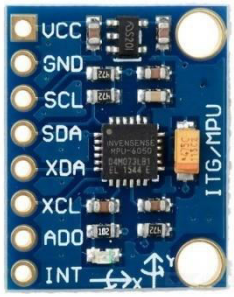

Figure 5.3 MPU6050

5.2 ARDUINO UNO

Arduino UNO is a low-cost, flexible, and easily programmable open-source microcontroller board that can be integrated into various electronic projects. Arduino programming is mainly based on C++ programming language. It has a large user community, free and broad ranges of libraries of codes, and relatively low-cost components. Arduino programming consists of mainly functions, values, and structure.

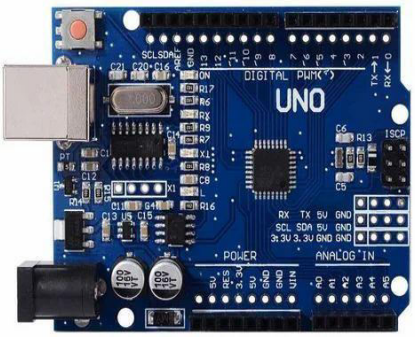

Figure 5.2 Arduino UNO

5.3 SERVO MOTOR

A servo motor is used to control the speed. It converts electricity into precisely controlled motion by the use of negative feedback mechanisms. Another name for a servo motor is a controlled motor

Figure 5.3 Servo Motor

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5.4 RF TRANSMITTER AND RECEIVER

The RF Transmitter and Receiver serial data and transmits it wirelessly through its RF antenna. RF transmitter receiver serial data and transmits to the receiver through an antenna. The transmission occurs at the rate of 1Kbps – 10Kbps. The RF frequency is 433MHz

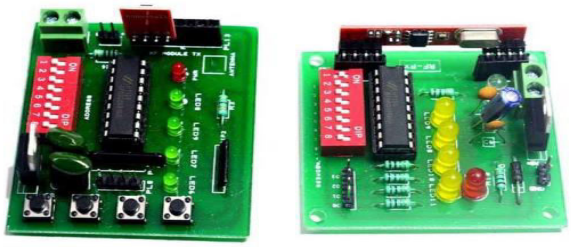
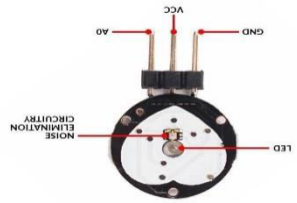


Figure 5.4 RF Transmitter and Receiver

5.5 HEART PULSE SENSOR

A heart pulse sensor is based on the principle of photoplethysmography. It measures the change in the volume of blood through any organ of the blood which causes a change in the light intensity through that organ.
Figure 5.5 Heart Pulse Sensor



5.6 HC-05 BLUETOOTH MODULE

HC-05 is a class 2 Bluetooth module designed for transparent wireless serial communication. The HC-05 Bluetooth module is used as UART serial converter module and can easily transfer the UART data through wireless Bluetooth.

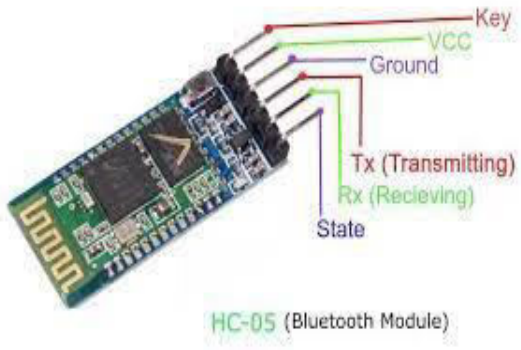


Figure 5.6 HC-05 Bluetooth Module

5.7 ULTRASONIC SENSOR

The ultrasonic sensor is an electronic device used to measure distances. Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing.

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Figure 5.7 Ultrasonic Sensor

VI. SOFTWARE REQUIREMENT

6.1 ARDUINO IDE

The Arduino IDE is open-source software, which is used to write and upload code to Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment.

Figure 6.1 Arduino IDE

VII. CIRCUIT DIAGRAM

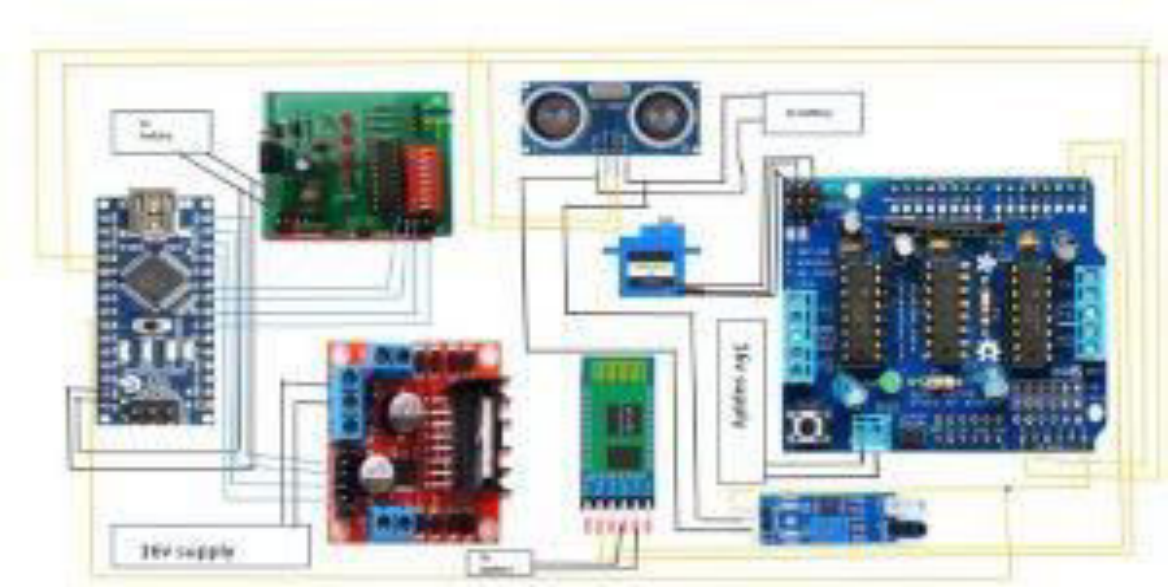

Figure 7.1 Circuit diagram

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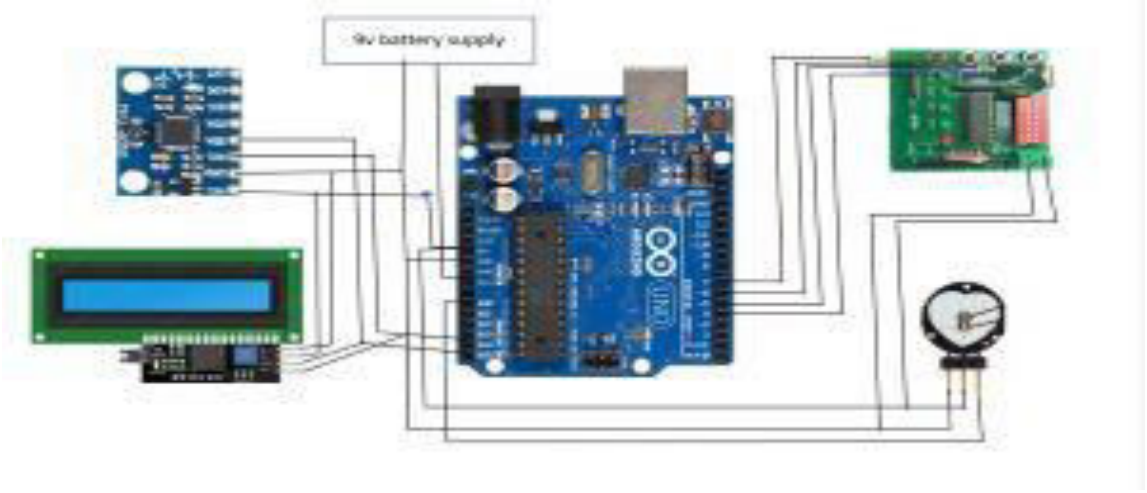

Figure 7.2 Circuit diagram

VIII. RESULT

Figure 8.1 Prototype

IX. CONCLUSION

The smart wheelchair is a highly advanced and innovative mobility device that aims to provide a safe, convenient, and comfortable way for individuals with mobility issues to move around their environment. The combination of these features creates a comprehensive solution that offers users the independence and peace of mind they need to carry out their daily activities with ease. The heart-beat sensing feature adds an extra layer of safety and well-being, allowing users to monitor their health while on the move. This advanced wheelchair represents a significant step forward in the development of mobility aids, and it holds great promise for improving the lives of people with mobility challenges.

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