

SMARTPHONE-BASED VEHICLE CONTROL SYSTEM FOR SPECIALLY ABLED INDIVIDUALS

Submitted in partial fulfillment of the requirements for the award of
Master of Technology degree in Medical Instrumentation

by

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DEPARTMENT OF BIOMEDICAL ENGINEERING

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SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A++" by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **PAVITHRA G.S (42440004)** who carried out the project entitled "**Smartphone-Based Vehicle Control System for Specially Abled Individuals**" under our supervision from June 2023 to April 2024.

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ABSTRACT

Specially abled individuals face unique challenges in their daily lives, including mobility limitations. To address this issue and enhance their independence, a smartphone-based vehicle control system is proposed in this work. This system leverages the capabilities of Arduino, an HC-05 Bluetooth Module, L298N Motor Driver, DC Motors, an Ultrasonic Sensor, Vibrators, a GSM Module, and an Android app developed using MIT App Inventor to create a user-friendly and efficient solution.

The primary objective of this work is to design a cost-effective and user-friendly system that allows specially abled individuals to control a motorized vehicle via a smartphone app.

Keywords: *Arduino, HC-05, DC Motors, MIT App, Ultrasonic Sensor.*

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LIST OF ABBREVIATIONS

AC	Alternating Current
ACPMS	Association Components & Parts Manufacturers Section
AOO	Apache Open Office
AREF	Analog Reference
AUTOSAR	Automotive Open System Architecture
BCM	Body Control Module
BLE	Bluetooth Low Energy
CAN	Controller Area Network
CPU	Central Processing Unit
DC	Direct Current
EEPROM	Electrically Erasable Programmable Read-Only Memory
GND	Ground
GSM	Global System for Mobile Communications
GUI	Global Competitiveness Index
I/O	Input/Output
ICSP	In-Circuit Serial Programming
IDE	Integrated Development Environment
IOREF	Input/Output Reference
IOS	iPhone Operating System
IOT	Internet Of Things
IR	Instruction Register
LCD	Liquid Crystal Display
MATLAB	Matrix Laboratory
MPU	Microprocessor Unit
OS	Operating System
PC	Personal Computer
PWM	Pulse Width Modulation
RPM	Revolutions Per Minute
SCA	Available Short-Circuit Current
SDA	Serial Data
SMS	Short Message Service
SOC	Security Operating Center

SPI	Serial Peripheral Interface
SPP	Serial Port Protocol
SRAM	Static Random Access Memory
SWC	Speedy Web Compiler
TI	Texas Instruments Incorporated
TTL	Transistor-Transistor Logic
UART	Universal Asynchronous Receiver/Transmitter
UNO	United Nations Organization
UPS	Uninterrupted Power Supply
USB	Universal Serial Bus
VCU	Vehicle Control Unit
WI-FI	Wireless fidelity

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CHAPTER 1

INTRODUCTION

The smartphone-based vehicle control system for specially abled individuals represents a groundbreaking technological solution aimed at enhancing the mobility, independence, and quality of life for those with mobility impairments. Mobility is a fundamental aspect of daily life, enabling individuals to access education, employment, and social opportunities. However, traditional mobility aids and vehicles often fall short in meeting the diverse and unique needs of specially abled individuals (Akshay S. et al., 2020). This work introduces an innovative approach that combines the power of Arduino, Bluetooth technology, motor control, ultrasonic sensors, and smartphone app development using MIT App Inventor to create a comprehensive and user-friendly solution. By addressing the limitations of existing systems, this project seeks to empower specially abled individuals, allowing them to control their vehicles effortlessly, navigate safely, and lead more independent and fulfilling lives.

As everyone is aware, smartphones are among the most potent and quickly evolving devices in the world today. This is largely due to their powerful CPU chips and connectivity capabilities. We also used Bluetooth, one such communication technology, in our investigation. In 1994, a telecom vendor for Ericsson developed this technology (Smruthi K.M et al., 2020). Bluetooth enables file transfer communication between devices. Its power allows it to connect to nearly seven devices at once and transfer data at the same time. It is ideally suited for a domestic setting because of its operating area's 8–10 m range. This explains why cell phones have become so capable in recent years, turning them into multipurpose portable devices (Kashevnik. A et al., 2019). Research into using an Android phone as a hub for human-robot communication is already rather active. with multiple chances.

High-tech equipment and automated systems that have substantially aided in ease, quick reaction times, and high reliability have become hallmarks of modern health services. Microelectronics' high processing power, portability, and affordability have led to the development of several gadgets, such as tablets and

smartphones, that are used to communicate with people in both their personal and professional lives. Advanced telecommunication technology has facilitated the widespread development of smart phone applications across multiple domains, including gaming, smart homes, and industry applications. Medical professionals, healthcare providers, and other skilled users have a wealth of opportunities to enhance their performance by fully utilizing rich data for sound decision-making in the rapidly expanding field of information technology and intelligent healthcare (Bor-Shing Lin et al., 2017). Not only will the development of this new information technology and intelligent mobile health trends benefit medical therapy and computer-assisted diagnosis, but it will also improve the mobility and safety of those with motor disabilities. In actuality, increasing mobility is a significant public health concern, particularly for elderly and disabled individuals who live alone. Significant advancements in technology have been made in the field of disabled people's mobility assistance.

The area of computer science that focuses on programming computers to act like people. These days, the most advanced computer chess algorithms can defeat human players. Neural networks are the hottest topic in artificial intelligence right now. They are working well in many fields, including natural language processing and speech recognition (Sajid. M. -U. A et al., 2020). It is possible to use devices that detect brain waves and translate them into mechanical movements to control prosthetic limbs, robots, and video games. The Brain Driver, on the other hand, is an automobile that runs solely on your thoughts and doesn't need any mechanical work from you. There are several different kinds of vehicles that use brain-controlled technology, including cars, bikes, and bicycles. With the use of this technology, a driver might change gears, accelerate, and mentally adjust their pace.

Autonomous vehicles, one of the most exciting technological developments in the automotive sector, are anticipated to have a big influence on future advancements in transportation efficiency and traffic safety. As a result, both industry and academia have shown a tremendous deal of interest in autonomous vehicles. Generally speaking, the autonomous car combines planning, automatic driving, and environmental observation (Warif. N. B. A et al., 2020). In accordance with

the planning module's specifications, the automatic driving module controls the necessary actuators to ensure that the vehicle travels along the intended path and speed profile. Therefore, the autonomy of the vehicle and its stability depend heavily on how well the automated driving control system performs (Mukhopadhyay. D et al., 2018). Both longitudinal and lateral controllers are part of the autonomous driving control system. The lateral controller works with the steering wheel to track the trajectory of the vehicle, while the longitudinal controller controls the vehicle's speed.

The rise in popularity of smartphones and the advancement of information technology have led to an increased demand for more convenient lifestyles. Without a doubt, the future directions for wireless communication technology development will be reduced power consumption and increased transmission speeds (Onyine Ikpeze et al., 2022). Ultra-low power consumption in the peak, average, and idle modes, low cost, and improved communication range are the salient advantages. Because Bluetooth low energy usage is significantly lower than standard Bluetooth, a button cell can power the gadget for several years. There will be more applications for Bluetooth 4.0 technology in the areas of home and automobile entertainment, sports and fitness, and health care.

The use of automobiles rises with the number of people on Earth. Due to a lack of parking spaces and the increasing number of cars, this circumstance has resulted in parking issues. Parking spaces are quite important, especially in shopping centers where it might be difficult to locate parking (Chaudhry. A et al., 2019). These could raise people's tension and frustration levels, in addition to causing car traffic congestion in parking spots. The available parking that visitors see at the main gate won't be available when they get to the parking place because the information can only be modified for a limited period of time. In contrast, the other existing parking system makes use of GSM and only delivers information in response to an SMS request from the user requesting a new parking lot assignment (Borat et al., 2013). When compared to existing technology, this will result in an extra bill charge each time the consumer uses the device, and SMS processing time for message sending and receipt will increase.

Everyone wants items that can multitask due to the rapid improvements in technology. Many robotic automobiles have been designed to carry out specific jobs in the past (Wang. Z et al., 2019). This project integrates a variety of capabilities into a single military autonomous vehicle concept. It's the robot that performs pick-and-place tasks, explosion detection, video surveillance, and autonomous obstacle detection ahead of it. For detection, it makes use of temperature, gas, and flame sensors. In addition to actively searching for fire, gas, and temperature, the robot can move around freely thanks to controls provided by a smartphone. Numerous sensors are installed on the car for this reason (Rahul. A Narhare et al., 2021). The robot can alert the IOT site when it detects an obstruction. The objective of this project is to build a functional prototype of a smartphone-operated, multifunctional robot car. This will enable the creation of a highly capable and adaptable robot with minimal hardware requirements. All other components in this project are interfaced with the Arduino UNO, which serves as a central component.

CHAPTER 2

LITERATURE SURVEY

Akshay S. et al. (2020) Design of smartphone-based dashboards for vehicles developed dashboards in automobiles for smart city applications. This system uses a microcontroller and wireless communication to detect the vehicle's status and helps the driver monitor fuel consumption, engine temperature, etc. for careful and safe driving. It collects the vehicle parameters and displays them on the smartphone for the owner. It uses a specially designed Android or iOS app to stop the engine, entertainment, weather, etc. with voice commands. It enables the user to operate the vehicle on his own smartphone and the owners to operate the vehicle with their voice. This program has voice control features.

Bhandari. R et al. (2018) Road safety is a major issue worldwide. Mobile devices are advantageous for detecting hazards and providing timely feedback on potential hazards. This approach focuses on the issue of accidents occurring more frequently in developing nations. Buses, for instance, might go forward or stop a short distance from the stop when they arrive at a bus stop rather than coming to a complete stop. People waiting at the bus stop and those getting on and off the bus are hurt in such an incident. It has been established that GPS and inertial sensors fall short of the micro-requirements to identify safety risks brought on by bus stops. Fullstop helps you drive and park by using a smartphone camera mounted on the windshield to view the front of the car. When the rolling stop is moved laterally, a fullstop powered by a smartphone using optical flow vectors can accurately detect the environment of stopping. Fullstop created algorithms to recognize two hazardous situations using an optical flow sensor and a smartphone camera mounted on a windshield.

Borat et al. (2013) have developed a secure vehicle tracking and control system to deal with increasing vehicle theft. With this, the user can control the vehicle through an Android-based smart phone. This is done through a secure GSM network between the smartphone and the vehicle. Using their smartphone, the owner can lock, unlock, and monitor the vehicle. If a GSM network is not available, the Bluetooth channel will be used instead. The ignition lock and door lock

functions can be remotely controlled in a secure manner. Since it is connected to the GSM network, it has no limitations. The vehicle owner is also provided with theft alerts and location information in case of an intrusion. All this is done using a smartphone, which makes the system smaller and easier to use.

Bor-Shing Lin et al. (2017) It helps the visually impaired reduce the risk of colliding with obstacles in an unfamiliar environment. A smartphone-based guidance system helps visually impaired people navigate from one place to another effortlessly while avoiding hazards. By fusing a smartphone app with a computer picture recognition system, they have produced a guiding system. When the computer starts operating, a back-end server employs a quick convolutional neural network technique to collect the scenes in front of the smartphone user. The outcome is sent to the smartphone. The system notifies the user of obstacles via voice notification. This makes it possible for people who are blind to learn about their environment quickly.

Chaudhry. A et al. (2019) attempt to control robots by human voice to control the robot's movements by issuing daily voice commands. Android is used as a medium to send human commands to the microcontroller. By connecting the controller to the Bluetooth module via UART, the speech is received by the Android application and used by the voice module. The microcontroller processes the text and takes appropriate action to regulate the robot. It uses an ATmega Arduino board in hardware and embedded C in the Arduino IDE in software. Such robots are very helpful to humans when they help them do the work. Its main purpose is to control devices using voice commands.

Ghorbel. A et al. (2018) A mobile computing system in healthcare for people with reduced mobility requiring special care and equipment such as electric wheelchairs. Accidents happen frequently to disabled people, so they designed a new cloud-based wheelchair to support disabled people. Developed an android-based application to monitor disabled people with a human-machine interface developed in mobile SOC to efficiently control the wheelchair. It ensures control through a multimedia 3D interface and an internet connection. This wheelchair can be remotely monitored using an Android device. The main objective is to create a modern, technological wheelchair for the disabled.

Kashevnik. A et al. (2019) developed a system for driver support in the vehicle cabin based on the determination and recommendation of hazardous situations. In this, they analyze images from the smartphone's front-facing camera and information from sensors to monitor or determine dangerous situations. Drowsiness and distraction have been identified as two risk factors for road accident prevention. A warning system is set up and monitored to notify the driver of drowsiness and distraction. Since the driver's attention must be on the road, it keeps the driver awake by communicating with the driver using a speech-based computer interface. This program helps drivers operate the vehicle by protecting them from drowsiness and distraction.

Kengale. V et al. (2021) Many people with disabilities are unable to perform daily tasks. They can do some routine exercises or work with useful gadget technology. The main purpose of wheelchairs is to assist people who cannot walk due to physical disability or damage. Smart wheelchairs are technologically helpful for the elderly and frail who are unable to move. Electric wheelchairs equipped with PCs and sensors enable safe handling for consumers and watchmakers alike. Such smart wheelchairs are used for a variety of disabilities. Smart wheelchairs can be used autonomously indoors but require supervision from friends or relatives for safety in open spaces. It helps in the advancement of machines and sensors.

Mukhopadhyay. D et al. (2018) The internet of things (IOT) has been governing the electronics era. Cloud services have always dominated electronics product segments. So, a system has been developed to protect the vehicle from theft using IOT for the safety of vehicles and passengers. A system proposes a new security system based on wireless communication. GSM is used to send messages. The user can control the engine or ignition and turn it off if needed. Controls the opening of the security locker door and the wearing of seat belts using a password through the computer keypad. The IR module or sensor detects the obstacle and sends the signal to the microcontroller. It is connected to a Bluetooth module and an alarm. This alert signal is sent to the user's mobile phone. It shows that the IOT vehicle system can provide realistic and automatic theft control. This IOT-based vehicle system ensures user safety with a

mandatory seat belt and keyless locking and unlocking system. It is useful for car users.

Onyine Ikpeze et al. (2022) can make learning complex and simple for robotics enthusiasts to inspire youth interest in the fields of science, technology, engineering, and mathematics. IKPEZE Robot is a cost-effective mobile robot developed. The knowledge gathered from this method can be applied to all types of robotics. IKPEZE robots have additional vision and audio capabilities. It monitors the immediate environment. This method can be used not only in education and research but also in other applications. A mobile robot is developed by developing and implementing a Raspberry Pi-programmed chassis in the C language using a Debian Linux-based OS. The mobile application is developed with an easy-to-use user interface (GUI) on an Android smartphone. Captured footage is wirelessly sent to the Android phone via Wi-Fi and stored in the smartphone's local memory. A smartphone robot is capable of capturing live streaming images and recording audio and video events. A smartphone-controlled robot can find applications in various areas.

Rahul. A Narhare et al. (2021) designed a voice-controlled automobile this time. This machine operates using speech for a disabled person who cannot drive on their own. The car is designed to move using simple voice commands such as left, right, forward, and backward. Connectivity is used for car and human voice commands via Bluetooth HC-05 Android. Arduino UNO is designed to analyze voice commands and respond accordingly. It was developed to identify the car with the Arduino UNO, Raspberry Pi, and Arduino. However, real-time detection and avoidance of the bottleneck are achieved by using Arduino. In this mode, the car slows down and stops immediately when it detects an obstacle. In this, the communication between the car and the app is connected via Bluetooth, and ultrasonic sensors are used to prevent the car from getting into an accident.

Sajid. M. -U. A et al. (2020) Advances in biomedical technology and smart technology impact smart devices. Smart chairs are one of them. It is a smart device that operates a wheelchair through a hand gesture device and a smartphone. It is developed for the differently abled, who cannot walk or use others without assistance. A Bluetooth control module is used automatically using

a gyro sensor and accelerometer. The wheelchair moves forward, backward, left, and right by moving the hand while wearing a gesture system on the user's hand. A microcontroller-based wheelchair is compared by using Arduino Mega and Arduino Nano as controllers. This wheelchair works with 50 degrees less angle for forward and backward movement and 30 degrees less angle for left and right movement. A sonar sensor is used to prevent safe movement. This wheelchair is specially designed using SolidWorks. For this, an Android app has been created. Its main feature is controlling the wheelchair. A wheelchair cannot track any moving objects other than stationary objects. Sensitivity to hand movement is also essential. Its main objective is to usher in a new era of wheelchair development.

Sandhya A. et al. (2013) aimed to develop a germ-powered car for the physically challenged. This car integrates signals from various sensors like video, weather monitoring, and anti-collision; as such, cars only rely on what individuals think. It has a system that automatically turns on in case of emergencies. It's a great advance that technology will make the disabled able. This technology allows you to change gears and control speed and acceleration. This way, drivers can control the vehicle faster than with conventional methods. When braking, signals from the human nervous system save the time it takes to brake. This is helpful in the event of a sudden accident. With this technology, even the disabled can be made capable.

Smruthi K.M et al. (2020) The program is developed for the advancement and application of robotics and smartphone technologies. Robotics services are on the rise, according to statistics. The objective was to design an Android application that controls autonomous vehicles. It talks about the impact of integrating mobile phone and robotics technologies and their existing status. It provides a vehicle access system through a real-time smartphone app. It provides the user with controls such as locating the car in a crowded parking lot, remotely using the cellular signal to unlock and lock the car doors, and tracking the car in case of theft. A similar Mbrace app is available in Mercedes cars. The OnStar mobile app provides the user with options such as car battery, fuel economy, and reminders to charge the car. The remote start system provides options to start the car remotely, unlock and lock doors, etc.

Wahlstrom. J et al. (2017) describe the first ten years of smartphone-based vehicle telematics research. Focuses on user-friendliness and the challenges that arise due to the mobility of smartphones. Aspects related to sensors, energy consumption, and human machines are explored. They have reviewed the state of the art in smartphone-based traffic classification, ad hoc vehicle networks, cloud computing, and road condition monitoring. The idea of tying common physical objects to current Internet infrastructures is known as the "Internet of Things" (IOT). Two significant advantages come from this combination. IOT performs its work based on monitoring devices and their surroundings. Generate and send real-time status reports for connected devices. Actions can be taken based on the orders received from it. IOT provides large amounts of data. It helps in the analysis of behavior patterns, environmental conditions, and device performance. Smartphones have played an important role in the development of IOT. A smartphone application is used to integrate the capabilities of computers with cellular phones.

Wang. L. Xu et al. (2014) Technologies for autonomous vehicles that are essential include path monitoring and driver safety design. The driver control design describes longitudinal and lateral restraints for the Quafu - II autonomous vehicle. Both simulation testing and on-road vehicle testing are used to assess the performance of this control system architecture. It gives the autonomous vehicle a control system. Longitudinal and lateral controls make up the driver control system. In this, the vehicles' travel time is tracked using the longitudinal controller, while the wheels are tracked using the lateral controller. Through simulation and road testing, the effectiveness of this driver control system is assessed.

Wang. Z et al. (2019) Vehicle control is a problem for pure electric vehicles. The AUTOSAR standard describes control system software for a pure electric vehicle. Each control state is modeled by MATLAB/Simulink. A vehicle control unit (VCU) with a master slave is designed. It uses a Freescale MPC5606B microcontroller. Finally, the VCU helps to check and control the AOO-class prototype car. This model uses Simulink to implement Power On/Off SWC, Driver Determination SWC, and other SWCs by breaking the vehicle control strategy down into various

modules. An AOO-class electric vehicle is used to verify the vehicle control system. This AOO-class prototype meets normal driving standards.

Warif. N. B. A et al. (2020) The number of vehicles is rising as more people use them. Due to this, they find it difficult to park for free in congested places, especially in shopping malls. In all applications in today's society, IOT technology has the capacity to transport data via a network without requiring human involvement. It has created an Android-based mobile application for car parking monitoring called ACPMS to locate parking spaces. The parking issue is resolved by ACPMS by allowing the user to track the location of the vehicle using the parking sensor. ACPMS is created utilizing a database, mobile applications, and hardware connectivity, among other things. For the database, OOOwebhost is used. The ACPMS makes it simple for consumers to find their parking place on a mobile device.

Xia Kun et al. (2013) developed a smartphone platform for a Bluetooth 4.0-based vehicle control system. Apple iPhone 4s with CC2540 to support BLE specification; TI uses CC2540 and BCM vehicle real-time. The CC2540 also collects peripheral information from the vehicle via CAN. On the other hand, using BLE technology, the smartphone connects to the CC2540 to drive the vehicle and show information on the smartphone interface. This control system performs well and offers a variety of applications for short communications. The iPhone 4s is believed to be able to use this internal Bluetooth 4.0 system to start the vehicle, unlock the doors, and access information without a key.

CHAPTER 3

AIM AND SCOPE

3.1. AIM

The aim of a smartphone-based vehicle control system for specially-abled individuals is to provide an accessible and user-friendly interface, allowing them to control and navigate vehicles using their smartphones. This technology aims to enhance independence and mobility for individuals with disabilities, enabling them to operate vehicles with ease and safety.

3.2 EXISTING SYSTEM

The current solutions for addressing the mobility needs of specially abled individuals often involve a combination of manual wheelchairs, mobility scooters, and modified vehicles. Manual wheelchairs offer basic mobility but can be physically demanding, limiting users' ability to traverse long distances or navigate challenging terrain independently. Mobility scooters provide powered mobility but may lack the flexibility to adapt to various environments effectively. Modified vehicles, such as wheelchair-accessible vans, offer more comprehensive transportation solutions but tend to be expensive and may require specialized infrastructure for accessibility.

Furthermore, existing mobility aids and vehicles typically do not incorporate modern smartphone-based control systems. Users with mobility impairments often rely on physical controls, which can be cumbersome and less intuitive. Safety features such as obstacle detection and avoidance are also often lacking in conventional mobility devices and vehicles.

While there are some smartphone-controlled wheelchairs and mobility scooters available, they are often costly and may not be widely accessible. Additionally, these solutions may lack customization options to accommodate diverse user needs. Overall, the existing mobility solutions for specially abled individuals have limitations in terms of cost, adaptability, ease of use, and safety, leaving room for innovation and improvement.

3.2.1 Disadvantages

- Modified vehicles such as wheelchair-accessible vans can be expensive.
- Vehicles generally do not incorporate modern smartphone-based control systems.

3.3 PROPOSED SYSTEM

The proposed system aims to revolutionize the mobility and independence of specially abled individuals by introducing a smartphone-based vehicle control system that leverages cutting-edge technology and user-friendly design. This innovative system will utilize a combination of hardware components and a custom Android app to create a comprehensive and adaptable solution.

The proposed system addresses several critical issues present in the existing mobility solutions for specially abled individuals. It offers a cost-effective alternative to expensive specialized vehicles, making independent mobility more accessible. Additionally, the smartphone-based control system enhances ease of use and customization options, as users can tailor the app's interface to their specific needs.

Ultimately, this project's innovative approach provides specially abled individuals with a safer, more affordable, and highly adaptable solution for their mobility needs. It not only improves their independence but also empowers them to participate more actively in education, employment, and social activities, thereby enhancing their overall quality of life.

3.3.1 Advantages

- It is useful for lower body disabilities.
- It will be very easy to handle.
- It helps obstacles and navigate around them.

3.4 SCOPE

The system should be adaptable to different types of vehicles, allowing a wide range of specially-abled individuals to benefit, including those using wheelchairs or other assistive devices. The scope extends beyond the technology itself to

consider the holistic impact on the lives of specially-abled individuals, promoting independence, accessibility, and improved quality of life.

CHAPTER 4

MATERIALS AND METHODS

4.1 BLOCK DIAGRAM

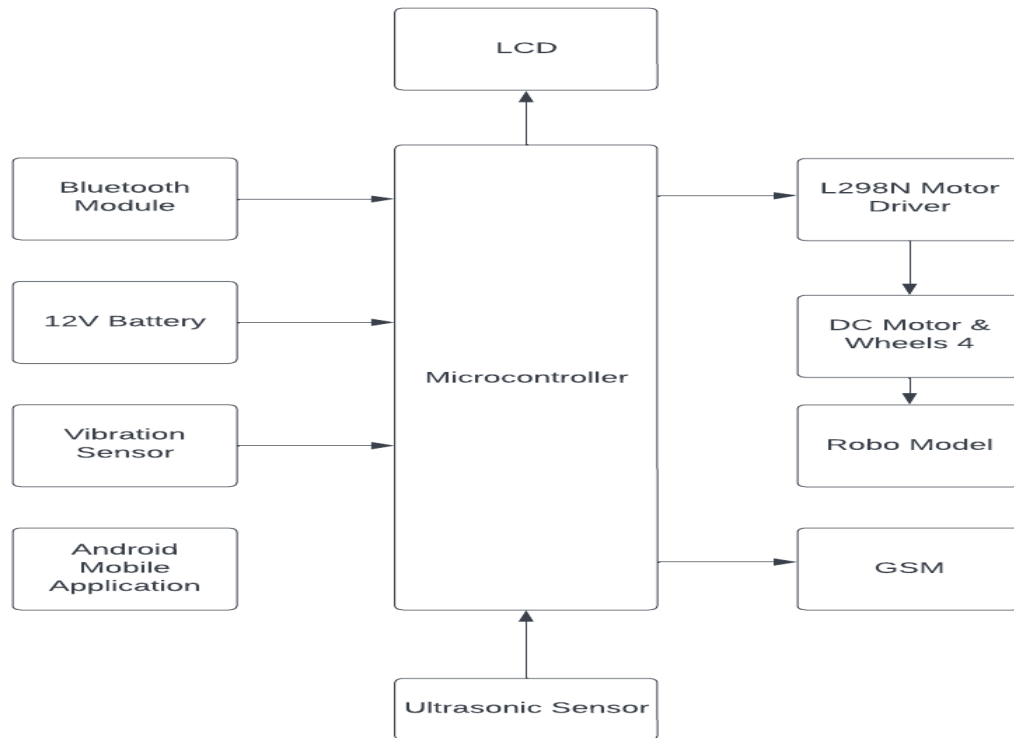


Fig:4.1 : Block Diagram of Car Model

At the heart of the proposed system, as shown in Fig. 4.1, is a block diagram of hardware, an Arduino microcontroller, which serves as the central processing unit. It will be equipped with an HC-05 Bluetooth module for wireless communication with a smartphone. This integration allows specially abled users to control the system through a user-friendly Android app developed using MIT App Inventor. The app will feature an intuitive interface, providing straightforward commands for controlling the vehicle's movement.

To ensure safe and obstacle-free navigation, an ultrasonic sensor will be incorporated into the system. This sensor will continuously scan the surroundings,

sending real-time feedback to the smartphone app, thus helping users identify obstacles and navigate around them.

The L298N motor driver and DC motors will enable precise control over the vehicle's movement, including direction. This fine-grained control will enhance the user's ability to maneuver in various environments.

The vibration Sensor Detects sudden impacts or collisions, indicating potential accidents or collisions. When a significant vibration is detected, the Arduino can interpret it as a potential accident and trigger an alert sequence.

GSM Module enables the vehicle to send SMS to predefined numbers, such as relatives or emergency services, in case of an accident. The GSM module requires a SIM card and allows the vehicle to communicate over cellular networks.

4.2 CIRCUIT DIAGRAM

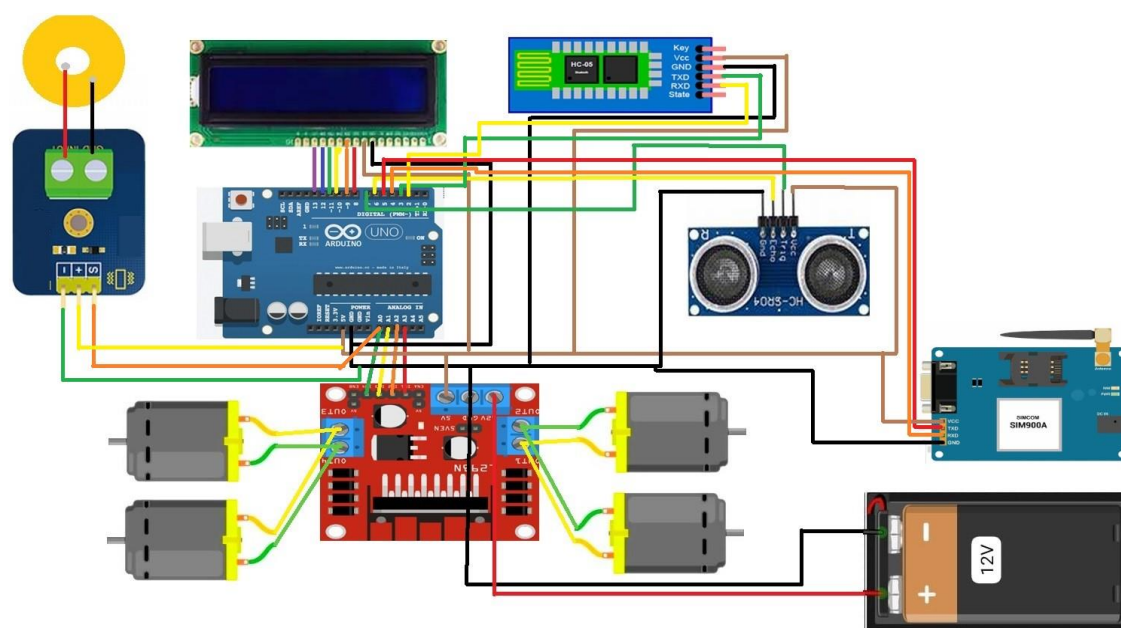


Fig:4.2 : Hardware Circuit Diagram

Fig. 4.2 shows that the D7 pin of the LCD display is connected to pin 13 of the Arduino UNO. The D6 pin is connected to pin 12 of the Arduino UNO. D5 is connected to the 11th pin of the Arduino UNO. D4 is connected to the -10th pin of the Arduino UNO. D3 is connected to the 9th pin of the Arduino UNO. D2 is

connected to the 8th pin of the Arduino UNO. The LCD displays that the D1 pin is connected to the Arduino UNO 5V positive terminal. The LCD displays that the D0 pin is connected to the GND of the Arduino UNO. The 7th pin of the Arduino UNO is connected to a triangulation of an ultrasonic sensor. The 6th pin of the Arduino UNO is connected to the echo of an ultrasonic sensor. The GND of the ultrasonic sensor is connected to the Arduino UNO GND. A0 of the Arduino UNO is connected to IN4 of the L298N motor driver. A1 of the Arduino UNO is connected to IN3 of the L298N motor driver. A2 of the Arduino UNO is connected to IN2 of the L298N motor driver. A3 of the Arduino UNO is connected to IN1 of the L298N motor driver. The 5V current of the L298N motor driver is connected to the positive terminal of the 5V Arduino UNO. The GND of the L298N motor driver is connected to the negative terminal of the Arduino UNO GND. A 12V battery positive terminal is connected to the L298N motor driver's 12V current terminal, and a negative terminal is connected to the GND of the Arduino UNO. The motor driver L298N is connected to the motor driver with out1, out2, and out3 and out4 pins. The vibration sensor positive terminal is connected to the 5V current of the Arduino UNO, and the negative terminal is connected to the GND of the Arduino UNO. The S pin is connected to the A0 of the Arduino UNO. GSM Module GND is connected to the Arduino's GND, and VCC is connected to the 5V current supply of the Arduino. TXD is connected to pin 5 of the Arduino, and RXD is connected to pin 6 of the Arduino. Bluetooth sensor VCC is connected to Arduino UNO's 5V, and Bluetooth sensor GND is connected to Arduino UNO's GND. TXD is connected to pin 3 of the Arduino UNO, and RXD is connected to pin 2 of the Arduino UNO.

4.3 HARDWARE REQUIREMENTS

- Arduino UNO Board
- LCD Display
- Bluetooth Module
- L298N Motor Driver
- DC Motor
- Ultrasonic Sensor
- 12 Volt Battery
- GSM Module

- Vibration Sensor
- Android Mobile Application

4.3.1 Arduino Uno Board

An Arduino Uno board is shown in Fig. 4.3, which is basically a microcontroller board based on the AT Mega 328P microcontroller. The Arduino boards are used to read inputs from sensors and turn them into outputs, such as turning on a light or motor. The Arduino boards were created by David Cuartielles and Massimo Banzi at the Interaction Design Institute in Ivrea, Italy, in 2005. The Arduino software is based on the Arduino Integrated Development Environment (IDE). The IDE is used to write and upload programs to Arduino using C and C++.

The central processing unit is responsible for controlling the system. Arduino IDE writes, compiles, and uploads the code to the Arduino microcontroller. It uses three main things: Sensors and switches are connected to the controller to provide information.

This microcontroller board has 14 digital I/O pins out of which 6 can be used as PWM output, 6 analog inputs, 16MHz ceramic resonator, a USB Connection, a power jack, an ICSP header and a reset button. Communications can be done using UART, I2C and SPI. Power supply connector used in Arduino UNO board is Barrel plug. USB serial processor used in Arduino UNO is ATmega16U2 16MHz.

The AT mega 328P is an 8-bit microcontroller from Microchip. It has 32 KB flash memory, 2KB SRAM, 1 KB EEPROM, 32 registers and 10-bit analog to digital converter. It is based on the RISC architecture. It consumes low power and low cost. Hence this type microcontroller is used in Arduino boards. Arduino boards are inexpensive when compared to microcontrollers. Arduino software can run in almost all operating system such as Windows and Linux. The Arduino software (IDE) is flexible and easy to use.

4.3.1.1 Types of Arduino Board

- Arduino UNO

- Red Board
- LilyPad Arduino
- Arduino Mega
- Arduino Leonardo

4.3.1.2 Advantages

- Open source.
- User friendly.
- Cost effective.
- Portable.
- Easy to learn programming.
- simplified program language to execute.
- Low power consumption.

The Arduino Uno board can be powered either by USB or by an external power supply. The power source is assigned automatically. External (non-USB) power can be supplied either by an AC-to-DC adapter (wall-wart) or a battery. A 2.1mm center-positive plug should be inserted into the circuit board's power connector to connect the adapter. The GND and Vin pin headers of the power connector can be fitted with battery leads. An external supply between 6 and 20 volts can power the board. However, if less than 7V is supplied, the 5V pin may supply less than five volts, causing the board to become unstable. When more than 12V is applied, the voltage regulator may overheat and damage the board. The suggested range for Arduino UNO is 7 to 12 volts.

The power connectors are as follows:

- Vin is the voltage applied to the Arduino board when it is powered by an external source (as opposed to 5 volts from the USB connection or other regulated power sources). The pin involved can be utilized for both providing and receiving voltage, provided that it is obtained through the power jack.
- 5V pin receives a controlled 5V from the board's regulator. The board can be powered by the DC power jack (7 - 12V), the USB connector (5V), or the VIN

pin on the board (7-12V). Using the 5V or 3.3V pins to supply power bypasses the regulator and may cause damage to your board.

- The on-board regulator generates a 3.3Volt supply, which is 3V3. Max current draw is 50 mA.
- GND refers to the pins that are connected to the ground.
- IOREF, the voltage reference with which the microcontroller runs, is provided by this pin on the Arduino board. The IOREF pin voltage can be read by a correctly constructed shield, which can then select the right power supply or enable voltage translators on the outputs to function with 5V or 3.3V.

Using the `pinMode()`, `digitalRead()` and `digitalWrite()` functions in Arduino programming, the 14 digital input/output pins can be used as input or output pins. Each pin operates at 5 volts and can deliver or receive a maximum of 40 milliamperes. It also contains a 20-50kOhm internal pull-up resistor that is unplugged by default. Some of the 14 pins have specific roles, which are detailed below:

- Serial Pins 0 (Rx) and 1 (Tx): TTL serial data is received and transmitted via the Rx and Tx pins. They're linked together using the ATmega328P USB to TTL serial chip.
- External Interrupt Pins 2 and 3 can be set to cause an interrupt on a low value, a rising or falling edge or a value change.
- PWM Pins 3, 5, 6, 9 and 11: Using the `analogWrite()` method, these pins give an 8-bit PWM output.
- SPI Pins 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK): SPI communication is carried out using these pins.
- LEDs built-in Pin 13: This pin is connected to an integrated LED; when pin 13 is HIGH, the LED is turned on; when pin 13 is LOW, the LED is turned off.

There are 6 analog input pins in addition to the 14 digital pins, each of which has a resolution of 10 bits or 1024 possible values. They measure from 0 to 5 volts, but by using the AREF pin with the `analogReference()` function, this limit can be raised. Wire library also uses analog pins 4 (SDA) and 5 (SCA) for TWI communication. There are few more pins on the Arduino Uno, which are listed below:

- With the `analogReference()` function, AREF is used to provide a reference voltage for analog inputs.
- The microcontroller is reset by setting this pin to LOW.

A serial monitor is included in the Arduino software, allowing simple textual data to be transferred to and from the Arduino board. Any of the Uno's digital pins can be used for serial communication using this library.

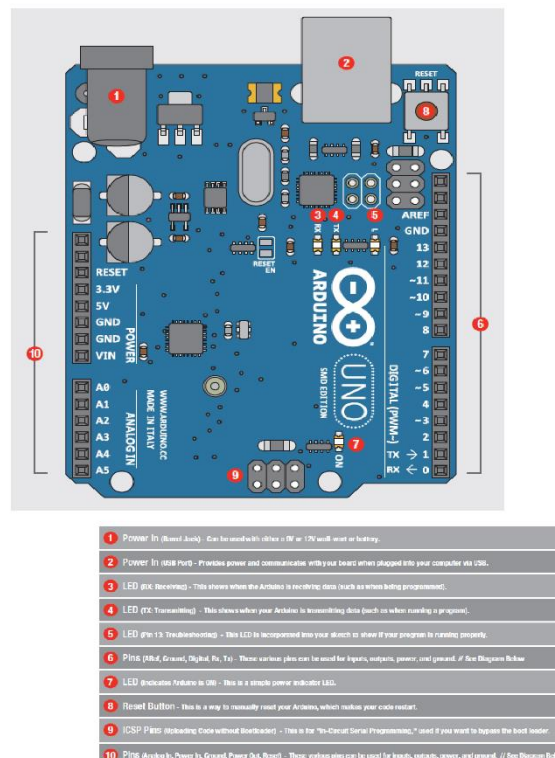


Fig:4.3 : Arduino UNO Board

4.3.2 LCD Display

The LCD display shows in Fig. 4.4 that the page turns right, left, forward, backward, etc. The liquid crystals do not emit light directly; instead, they use a backlight to produce images in color.

The LCD display module is integrated with an LSI controller, which includes two 8-bit registers: a data register (DR) and an instruction register (IR). The address information for the character generator (CGRAM) and display data RAM (DDRAM),

as well as instruction codes (such as screen clear and cursor shift), are stored in the IR. Only the MPU has the ability to write the IR.

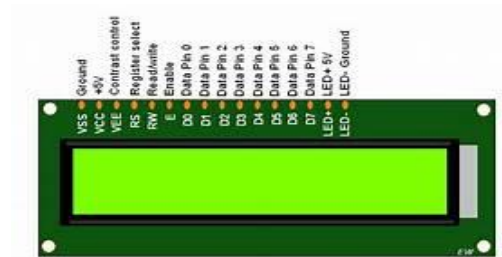


Fig:4.4 : LCD Display

4.3.3 Bluetooth Module

The system implements the Bluetooth communication protocol shown in Fig. 4.5 between the smartphone app and the HC-05 Bluetooth module to establish a wireless connection between the Arduino and the smartphone.

The HC-05 operates in two different modes: data mode, which allows it to send and obtain data from other Bluetooth-enabled equipment, and AT Command mode, which allows you to modify the device's default settings. By using the key pin, we are able to use the gadget using either of either of these modes, as detailed in the pin descriptions.

The HC-05 module uses the Serial Port Protocol (SPP) to operate, which makes pairing it with microcontrollers fairly simple. All you need to do is power the module up with +5V along with connect its Rx pin to the MCU's Tx and its Tx pin to the MCU's Rx, as seen in the image below. If the key pin is left unground on power-up, it will automatically enter data mode. However, it can be connected to enter command mode.

4.3.3.1 HC-05 Default Settings

- Default Bluetooth Name: "HC-05"
- Default Password: 1234 or 0000
- Default Communication: Slave
- Default Mode: Data Mode

- Data Mode Baud Rate: 9600, 8, N, 1
- Command Mode Baud Rate: 38400, 8, N, 1
- Default firmware: LINVOR

4.3.3.2 Applications

- Wireless communication between two microcontrollers
- Communicate with Laptop, Desktops and mobile phones
- Data Logging application
- Consumer applications
- Wireless Robots
- Home Automation

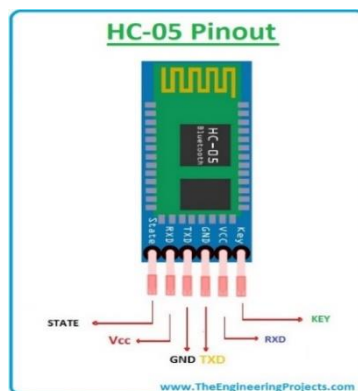


Fig:4.5 : HC-05 Bluetooth Module

4.3.4 L298N Motor Driver

To control the DC motors and manage their speed and direction. The drive module integrates the two L298N chips; it can drive four DC motors. DC and stepper motors can be driven by this high-power motor driver module, as shown in Fig. 4.6 of the L298N. An L298 motor driver integrated circuit and a 78M05 5V regulator make up this module. With direction and speed control, the L298N module can operate two or up to four DC motors. The L298N Motor Driver module consists of an L298 Motor Driver IC, a 78M05 Voltage Regulator, resistors, capacitors, a

power LED, and a 5V jumper in an integrated circuit. The placement of the jumper is the only way to activate the 78M05 voltage regulator. In the event that the power supply is 12V or less, the voltage regulator will power the internal circuitry, and the microcontroller can be powered by the 5V pin as an output pin. When the power source is more than 12V, the jumper shouldn't be inserted; instead, the internal circuitry should be powered separately by 5V applied through the 5V port.

4.3.4.1 Alternate Driver Module

- TMC2209,
- DRV8825,
- A4988,
- L9110S,
- DRV8711.

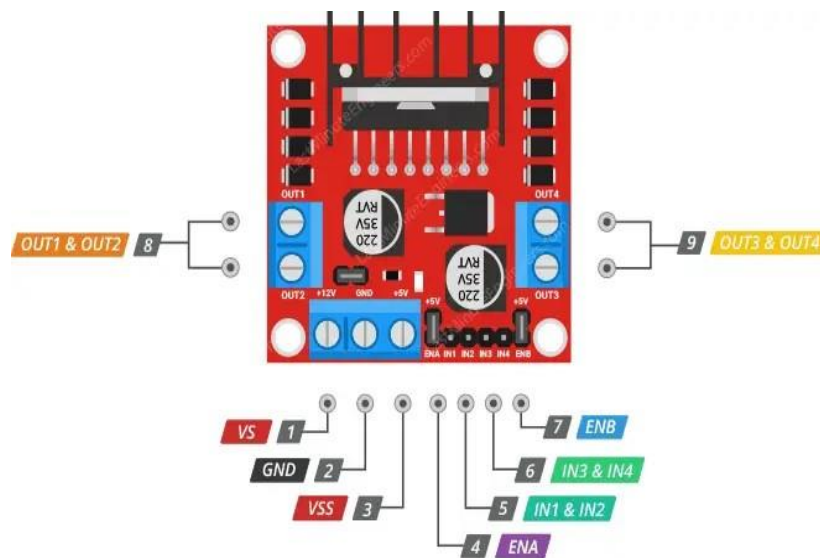


Fig:4.6 : L298N Motor Drive

4.3.5 DC Motors

In Fig. 4.7, which shows the two DC motor motions, the input electrical energy is the direct current. DC motors will be used to drive the vehicle's wheels. Electrical power is transformed into mechanical energy by a DC motor, which is then transformed into mechanical rotation. Fig. 4.8 shows the DC motor is used with a 30-rpm clamp gear motor. We use it to move heavy objects with less rpm.

The DC motor is often utilized by enthusiasts who begin to experiment with electronics, as its name implies. Because of this, using this motor is quite straightforward. Because this motor operates between 4.5V and 9V, you can use any standard 9V battery or even a 5V supply. Simply connect the battery's positive (+) side to one terminal and its negative (-) sign to the other end to start the motor moving. Simply swapping out the terminals will reverse both the motor's direction and speed. You must adjust the voltage that is delivered to the motor in order to control its speed. This can be accomplished most easily with a potentiometer. There are plenty of additional ways to accomplish this as well.

Additionally, keep in mind that the motor can draw up to 250 mA when it is loaded, so be sure you have a supply for it. Use a motor driver integrated circuit (IC) like the L293D or ULN2003 if you are controlling it with a microcontroller or digital integrated circuit. Additionally, these ICs will make it simple for you to control the motor's direction.

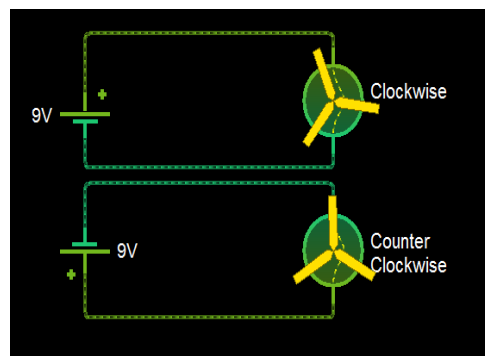


Fig:4.7 : DC Motor Motion

4.3.5.1 Applications

- Toy cars
- Windmill projects
- Basic Electronics Projects
- As robot wheels

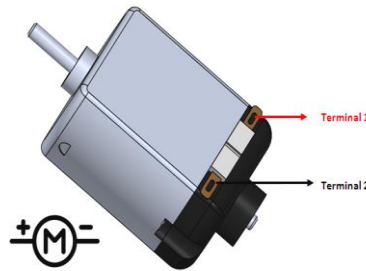


Fig:4.8 : DC Motor

4.3.6 Ultrasonic Sensor

Fig. 4.9 shows the ultrasonic sensor. This sensor will provide real-time obstacle detection and avoidance capabilities. An ultrasonic sensor is a kind of electronic device that uses ultrasonic sound waves to detect the distance between two objects and transforms the reflected sound into an electrical signal. Ultrasonic waves move quicker than audible sound. The range of ultrasonic detection is 180 degrees.

The pin names of the 4-pin module, which houses the HC-SR04 Ultrasonic (US) sensor, are Vcc, Trigger, Echo, and Ground, in that order. This widely utilized sensor is employed in numerous applications where object detection or distance measurement are necessary. The two projectile-like eyes on the front of the module comprise the ultrasonic transmitter and receiver. The sensor utilizes the straightforward high school concept that

$$\text{Time} \times \text{Speed} = \text{Distance}$$

As the ultrasonic wave is what we are employing, we are aware that the US wave's universal speed at room temperature is 330 m/s. The module's internal circuitry will determine how long it will take for the US wave to return and activate the echo pin for that identical period of time. In this manner, we can also determine the duration. Now all you need to do is use a microprocessor or microcontroller to calculate the distance.

Commonly used with microprocessor and microcontroller platforms like Arduino, ARM, PIC, Raspberry Pi, etc. is the HC-SR04-SR04ance sensor. The guidelines

that follow are universal in nature, as they must be adhered to regardless of the kind of computing equipment being utilized.

Table. 4.1 shows the sensor's ground and Vcc pins; a controlled +5V is used to power the device. Since the sensor uses less than 15 mA of current, the on-board 5V pins (if accessible) can power it directly. Since the trigger and echo pins are also I/O pins, they can be linked to the microcontroller's I/O pins. The trigger pin must be set high for 10 μ s before being switched off in order to begin the measurement. By doing this, the transmitter will produce an ultrasonic signal at a frequency of 40 Hz, and the receiving device will wait for the signal to return. The echo pin rises high for a certain period of time, which is the amount of time that it takes for the signal to return to the sensor after it has been reflected by any object.

The MCU, or MPU, measures how long the echo pin remains high since it provides information about how long it takes for the signal to come back to the sensor. As stated in the headline above, the distance between points is measured using this information.

Table 4.1: Ultrasonic Sensor Pinout Configuration

Pin Name	Description
Vcc	The Vcc pin powers the sensor, typically with +5V.
Trigger	The trigger pin is an input pin. This pin has to be kept high for 10 seconds to initialize measurement by sending a US wave.
Echo	An echo pin is an output pin. This pin goes high for a period of time, which will be equal to the time taken for the US wave to return to the sensor.
Ground	This pin is connected to the ground of the system.

4.3.6.1 Applications

- Used to avoid and detect obstacles with robots like biped robots, obstacle avoider robots, path-finding robots, etc.
- Used to measure the distance within a wide range of 2cm to 400 cm.
- Can be used to map the objects surrounding the sensor by rotating it.
- The depth of certain places, like wells, pits, etc., can be measured since the waves can penetrate through water.



Fig:4.9 : Ultrasonic Sensor

4.3.7 Battery

Fig. 4.10 shows that a battery is a device that stores chemical energy and converts it into electrical energy. Chemical reactions in a battery involve the flow of electrons from one material (an electrode) to another through an external circuit. The flow of electrons provides electricity that can be used to do work. It powers the system, including DC motors.

The inexpensive lead-acid used in it is mostly found in cars and other vehicles to power their lighting systems. In products where size, space, and weight are irrelevant, these are more desirable. These are typically seen as 2V, 6V, 12V, and 24V batteries and have nominal voltages ranging from 2V to 24V. Seven Wh/kg is its power density.

4.3.7.1 Advantages

- Cheap in cost
- Easily rechargeable
- High power output capability

4.3.7.2 Disadvantages

- Very heavy

- Occupies much space
- Power density is very low.

4.3.7.3 Applications

- Used in cars,
- UPS (uninterrupted power supply),
- robotics,
- heavy machinery, etc.



Fig:4.10 : Battery

4.3.8 GSM Module

The GSM module enables the vehicle to send SMS to predefined numbers. Fig. 4.11 shows that the that the GSM module also allows the vehicle to communicate over cellular networks using a SIM card. The European Telecommunications Standards Institute (ETSI) created the GSM (Global System for Mobile Communications, formerly Groupe Special Mobile) standard. With over 90% of the market and operations in over 219 countries and territories, it was developed to define the protocols for second-generation (2G) digital cellular networks, which are used by mobile phones. Today, it is the de facto global standard for mobile communications. The Global System for Mobile Communications (GSM) on 2G and 3G cellular communication systems offers packet-oriented mobile data services called General Packet Radio Service (GPRS). A chip or circuit used to establish communication between a mobile device or computer and a GSM or GPRS system is called a GSM or GPRS module. In addition to being a mobile phone with GSM modem functionality, a GSM modem can also be a specialized

modem device with a serial, USB, or Bluetooth connection. The GSM/GPRS module provides an example of how to use AT commands. Via a computer, they can do all of the features of a mobile phone, including sending and receiving SMS, MMS, and calls. GSM Example: GSM SMS Transmission.



Fig:4.11 : GSM Module

4.3.9 Vibration Sensor

The vibration sensor shown in Fig. 4.12 detects sudden impacts or collisions. When vibration is detected, the Arduino can trigger an alert sequence. A **piezoelectric sensor** is a device that uses a piezoelectric effect to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge. When a force is applied to a piezoelectric material, an electric charge is generated across the faces of the crystal. This can be measured as a signal or voltage proportional to the pressure.

4.3.9.1 Advantages

- One of the main advantages of piezoelectric sensors is their ruggedness. This makes them suitable for use in a variety of harsh environments.
- Piezoelectric sensors can be used at high temperatures. They can work up to 1,000°C.
- They are low-power devices since the output signal is generated by the piezoelectric element itself.
- The sensing element of a piezoelectric sensor is insensitive to electromagnetic interference and radiation.
- Piezoelectric sensors can be easily made using inexpensive materials

4.3.9.2 Applications

- They can be used in a wide range of industrial and aerospace applications where they'll be exposed to high temperatures and pressures.
- They are frequently used for measuring dynamic pressure, for example in turbulence, blast, and engine combustion. These all require fast response, ruggedness and a wide range of operations.
- Their sensitivity and low power consumption make them useful for some medical applications.

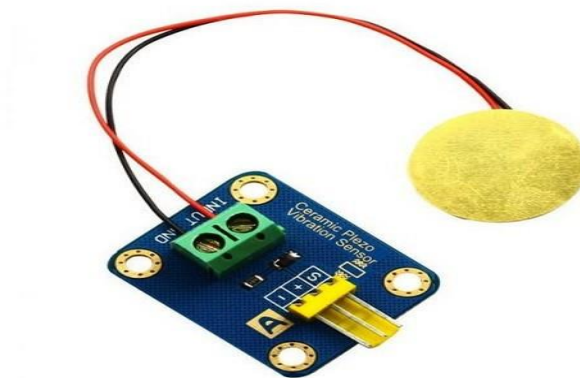


Fig:4.12 : Vibration Sensor

4.3.9 Android Mobile Applications

The smartphone is compatible with the Android app. It will be shown in Fig. 4.13. To install and use the control app, the smartphone must be running on Android. MIT App Inventor designs and develops user-friendly Android applications for vehicle control. Forward, backward, left, right, and stop buttons can be used to operate. When using these buttons, it will show us text in the comment box. You can also drive the vehicle using the buttons on the speech recognizer. While using the speech recognizer, the words we say through voice are displayed as text in the comment box for the driver in the app to verify the command we say.



Fig:4.13 : Android Mobile Applications

4.4 SOFTWARE REQUIREMENTS

- Arduino IDE
- MIT App Inventor
- Android Operating System
- Bluetooth Communication
- Programming Languages
- Development Tools
- Operating System
- USB Cable
- Bluetooth-Enabled Smartphone

4.4.1 Arduino IDE

To write, compile, and upload the code to the Arduino microcontroller. Arduino IDE is an open-source software that helps to write and upload the code to Arduino board.

4.4.1.1 To Download Software

Step 1: Open Internet Explorer and search for Arduino IDE.

Step 2: Click the link that appears on the top of the search page. (www.arduino.cc)

Step 3: Click Software on that website.

Step 4: Select Arduino IDE tab and choose the download options according to the system model.

Step 5: Click Just Download and it starts to download in background.

Step 6: Open the downloaded file location.

Step 7: Click the file and it starts to download.

Step 8: Give required permission and choose the storage path and install it.

4.4.1.2 To Create and Run Program

Step 1: Open Arduino IDE.

Step 2: Open file and click New Sketch.

Step 3: Open the Tools from the Menu bar and select Port as Arduino UNO.

Step 4: Enter the code in the working space and save it.

Step 5: Verify and compile the code.

Step 6: Select Serial plotter from Menu bar to view the Graphical representation and select Serial Monitor in Tools from Menu bar to view the values obtained as output.

4.4.2 MIT App Inventor

For designing and creating the user-friendly Android app that controls the vehicle. Web applications give novices the opportunity to learn computer programming and develop Android software applications.

- Visit the MIT App Inventor website. It was shown in Fig. 4.14 on the Create app page.
- Then go to create apps and customize the apps according to our needs.
- Then, according to our requirements, we have developed a user-friendly Android vehicle application using the user interface in Palette.

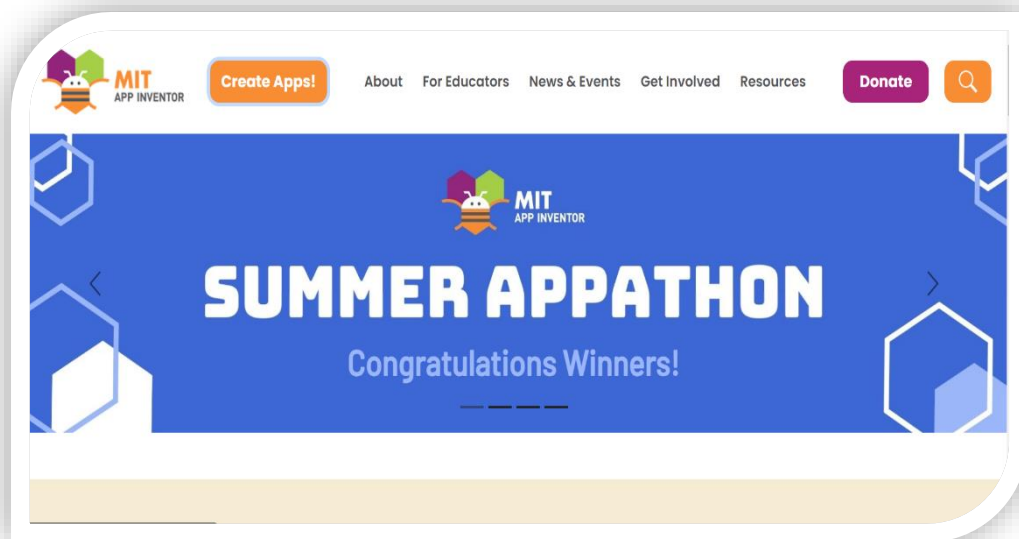


Fig:4.14 : Create Apps

- After going to build apps, it will show Fig. 4.15 project screen blocks, and then go to robotics, where it will show the designed application.

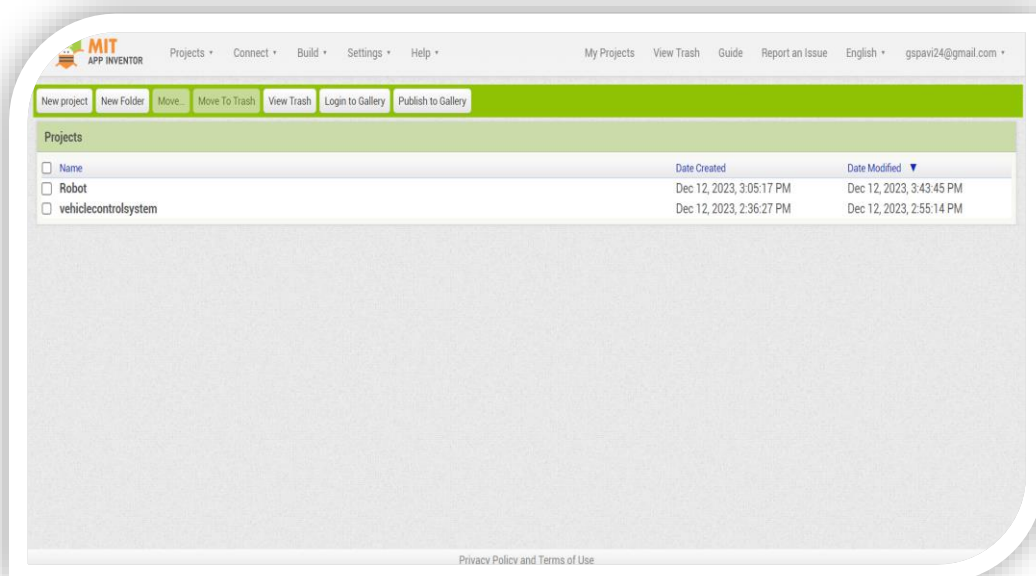


Fig:4.15 : Projects Screen

- Then the site shows Fig. 4.16, the first page of my application.
- Designed using user interfaces to build the app as per our requirements.

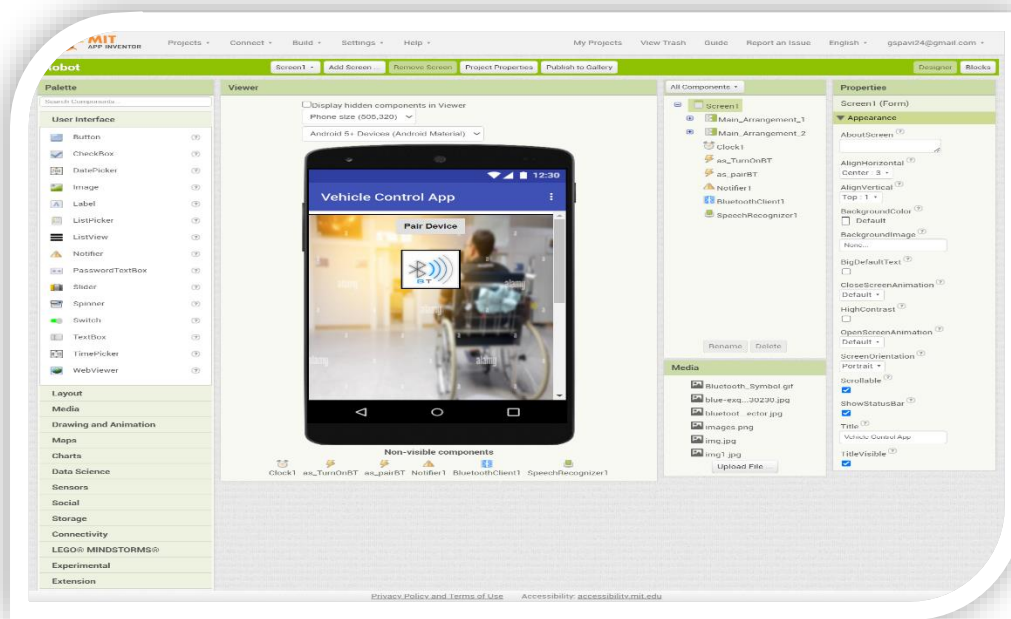


Fig:4.16 : Screen 1 Main Arrangement 1

- Touch the Bluetooth icon and connect the HC-05 to Bluetooth, as shown in Fig. 4.17.

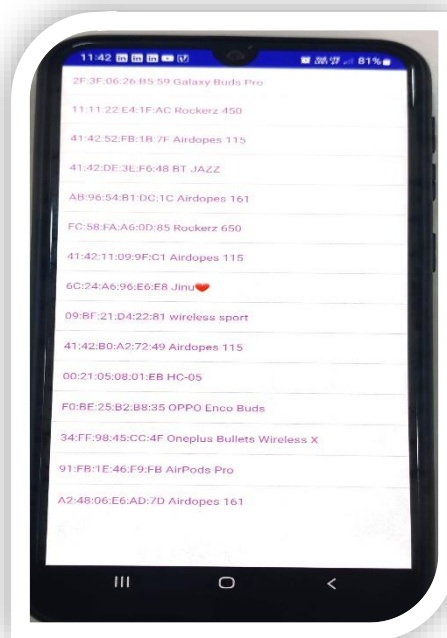


Fig:4.17 : Bluetooth Connection

- Then buttons are given to control the vehicle. It will show Fig. 4.18.
- Then go to the block button and program the blocks to design and use the application.

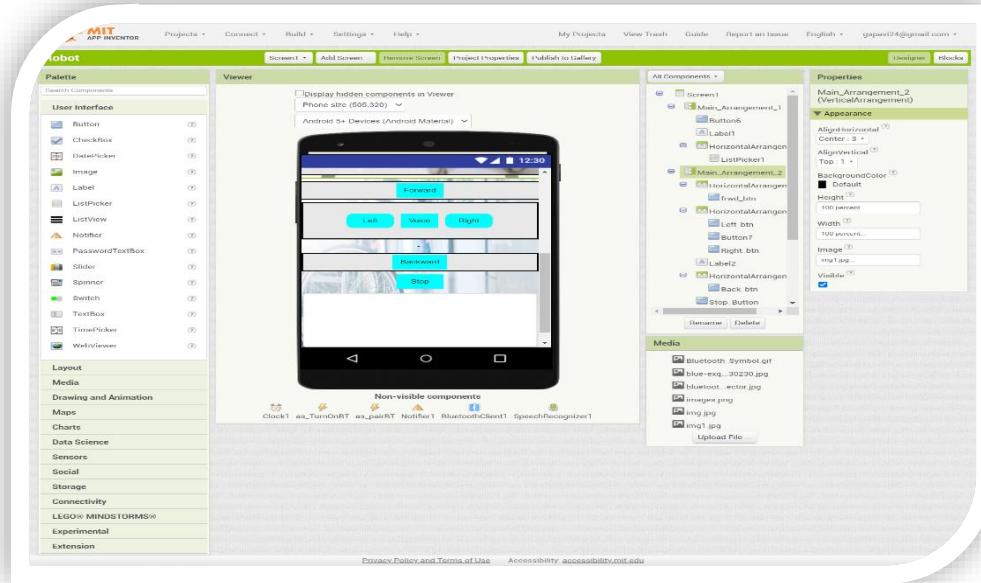


Fig:4.18 : Main Arrangement 2

4.4.2.1 Software App Blocks

- It provides details about the mobile program that runs the modules.
- As per my specifications, we have developed user-friendly software shown in Fig. 4.19 with details like Bluetooth connectivity, background images, text color, forward, backward, left, right, stop, object detection, a text box, sending SMS, etc. in the app for mobile devices.

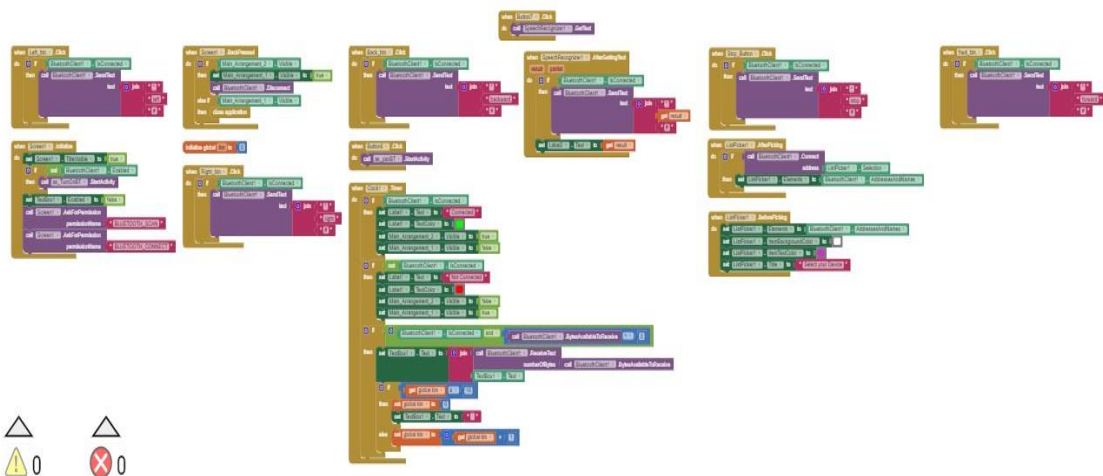


Fig:4.19 : Software App Blocks

4.4.3 Android Operating System

The smartphone should run on Android to install and use the control app.

4.4.4 Bluetooth Communication

The system should implement Bluetooth communication protocols between the smartphone app and the HC-05 Bluetooth module.

4.4.5 Programming Languages

Knowledge of programming languages like C/C++ (for Arduino) and block-based programming (for MIT App Inventor) is essential for coding and app development.

4.4.6 Development System

Text editors, development environments, and debugging tools as needed for coding and app development.

4.4.7 Operating System

The computer used for coding and development should be running a compatible operating system (e.g., Windows, macOS, Linux).

4.4.8 USB Cable

To connect the Arduino to the computer for programming.

4.4.9 Bluetooth-Enabled Smartphone

The smartphone used for testing and controlling the system should support Bluetooth connectivity.

4.5 SOFTWARE FLOW DIAGRAM

4.5.1 Work Flow

Fig. 4.20 represents the work flow of the software.

4.5.1.1 Initialization

- Specially-abled user launches the custom Android app on their smartphone.

4.5.1.2 Bluetooth Pairing

- The app establishes a Bluetooth connection with the Arduino microcontroller using the HC-05 Bluetooth module.

4.5.1.3 System Calibration

- The user calibrates the system settings through the app, adjusting parameters like speed, sensitivity, and control preferences.

4.5.1.4 Real-time Sensor Feedback

- The ultrasonic sensor continuously scans the surroundings, detecting obstacles.
- Real-time feedback from the sensor is transmitted to the smartphone app via Bluetooth.

4.5.1.5 User Commands

- The user interacts with the app, issuing commands for the movement and direction of the vehicle.

4.5.1.6 Motor Control

- The Arduino, equipped with the L298N motor driver, translates user commands into precise control signals for the DC motors.

4.5.1.7 Vehicle Movement

- The DC motors drive the vehicle according to the specified commands, allowing for smooth and controlled movement.

4.5.1.8 Obstacle Avoidance

- The system analyses the sensor feedback to identify obstacles.
- Based on this information, the system autonomously adjusts the vehicle's trajectory to avoid collisions.

4.5.1.9 Customization

- Users have the option to customize settings through the app, tailoring the system to their specific mobility needs.

4.5.1.10 Emergency Stop and Safety Measures

- The system incorporates emergency stop mechanisms triggered by the app or hardware to ensure user safety.

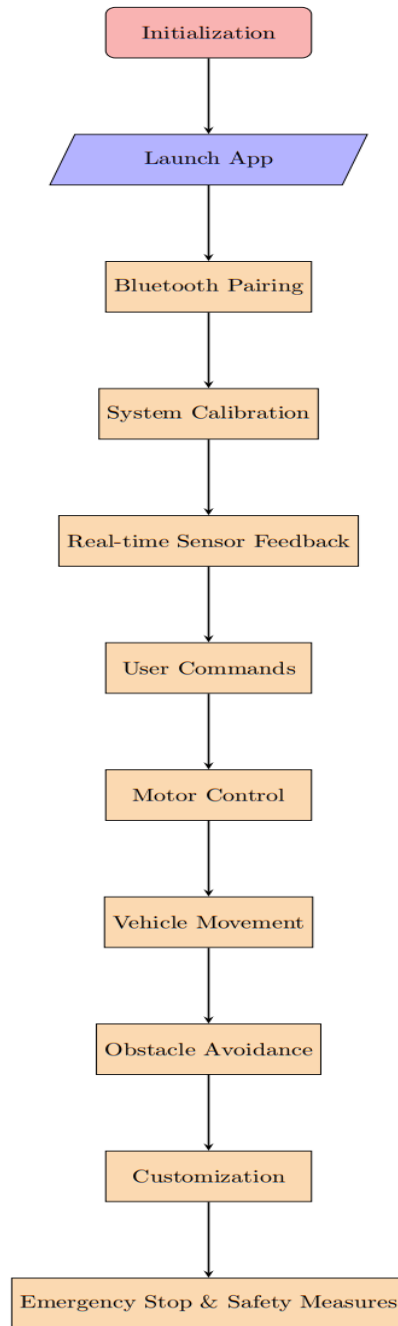


Fig:4.20 : Software Work Flow

CHAPTER 5

RESULTS AND DISCUSSION

The existing mobility solutions for specially abled individuals. It offers a cost-effective alternative to expensive specialized vehicles, making independent mobility more accessible. Additionally, the smartphone-based control system enhances ease of use and customization options, as users can tailor the app's interface to their specific needs. This project's innovative approach provides specially abled individuals with a safer, more affordable, and highly adaptable solution for their mobility needs. It not only improves their independence but also empowers them to participate more actively in education, employment, and social activities, thereby enhancing their overall quality of life.

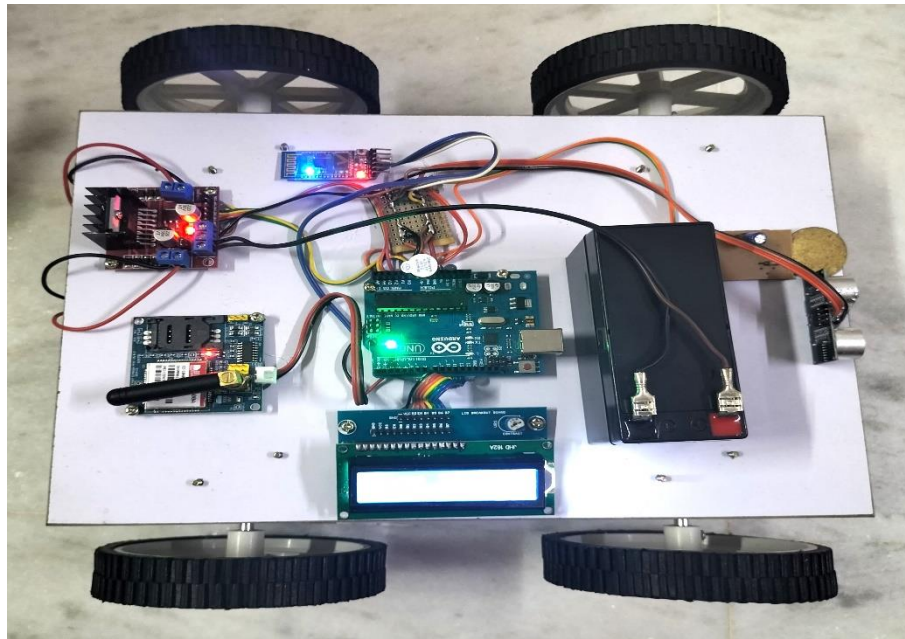


Fig:5.1 : Hardware Setup

Fig. 5.1 displays the hardware setup. Arduino UNO, LCD display, Bluetooth module, ultrasonic sensor, L298N motor driver, 12V battery, DC motors, gsm module, and vibrator for accident detection are used. Arduino UNO is used to process output for every input according to the customized program. The LCD display helps to display the direction in which the vehicle is moving through forward, backward, left, right, stop, and speech recognition. Bluetooth is used to pair the device with a mobile application. The ultrasonic sensor continuously scans the surroundings and sends real-time feedback to the smartphone app. This enables users to identify obstacles

and navigate around them. The L298N motor driver is used to control the DC motors and manage their speed and direction. The 12V battery is used to power the system and DC motor. The vehicle's wheels are powered by DC motors. The GSM module enables the vehicle to send SMS to predefined numbers, such as relatives or emergency services, in case of an accident. The vibrator vibrates the vehicle and provides information and alerts when the ultrasonic sensor is disabled. Vibrations that indicate possible accidents or collisions cause the Arduino to recognize a possible accident and trigger an alert sequence. It alerts the occupants of the car and their family members by sending SMS via GSM.

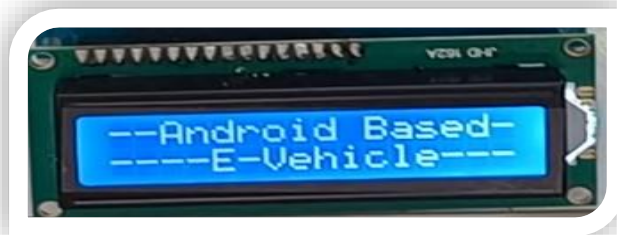


Fig:5.2 : Starting of LCD Display

In Fig. 5.2, the LCD starts to display the name of the device for 2 seconds.



Fig:5.3 : Initializing to Measures Ultrasonic Distance

Initializing to measure ultrasonic distance after a power supply is given, as shown in Fig. 5.3.



Fig:5.4 : Forward Direction

The motion of Android-based e-vehicles in the forward direction is shown in Fig. 5.4. A mobile app can be used to drive the car in a forward direction using buttons and also show the ultrasonic distance.

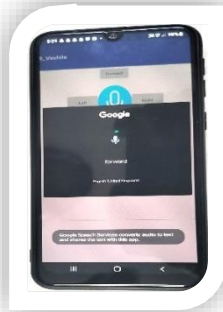


Fig:5.5 : Using Speech Recognizer to Forward

Fig. 5.5 shows using a speech recognizer to drive the E-vehicle forward. A mobile app can be used to drive the car forward using voice recognition.



Fig:5.6 : Backward Direction

The motion of Android-based e-vehicles in a backward direction is shown in Fig. 5.6. A mobile app can be used to drive the car backward using buttons and also show the ultrasonic distance.

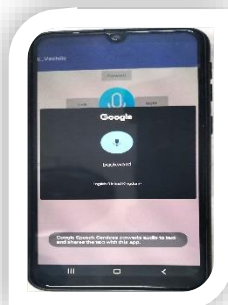


Fig:5.7 : Using Speech Recognizer to Backward

Fig. 5.7 shows using a speech recognizer to drive the E-vehicle backward. A mobile app can be used to drive the car backward using voice recognition.



Fig:5.8 : Turning Left

The motion of Android-based e-vehicles turning left is shown in Fig. 5.8. A mobile app can be used to drive the car on the left side using buttons and also shows the ultrasonic distance.



Fig:5.9 : Using Speech Recognizer to Turning Left

Fig. 5.9 shows using a speech recognizer to drive the E-vehicle on the left side. A mobile app can be used to drive the car on the left side using voice recognition.

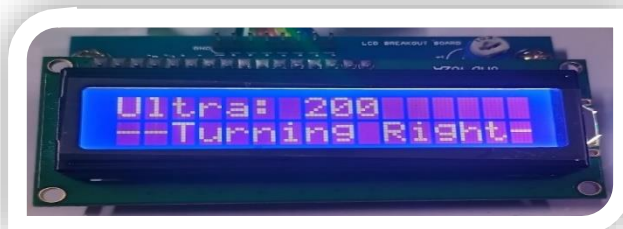


Fig:5.10 : Turning Right

The motion of Android-based e-vehicles turning right is shown in Fig. 5.10. A mobile app can be used to drive the car on the right-side using buttons and also shows the ultrasonic distance.

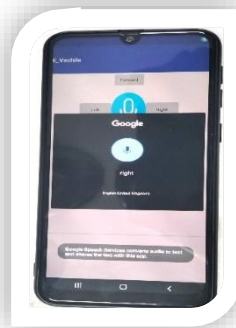


Fig:5.11 : Using Speech Recognizer to Turning Right

Fig. 5.11 shows using a speech recognizer to drive the E-vehicle on the right side. A mobile app can be used to drive the car on the right-side using voice recognition.



Fig:5.12 : Stop

That Android-based E-vehicles are stopped Is shown in Fig. 5.12. A mobile app can be used to drive the car to the stop using buttons and also show the ultrasonic distance.

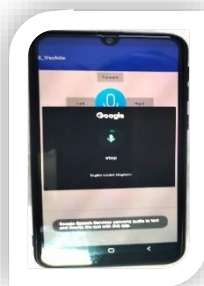


Fig:5.13 : Using Speech Recognizer to Stop

Fig. 5.13 shows using a speech recognizer to drive the E-vehicle stop. A mobile app can be used to drive the car to the stop using voice recognition.



Fig:5.14 : Object Detected

An Android-based e-vehicle is detected using an ultrasonic sensor, as shown in Fig. 5.14. The ultrasonic sensor detects the object in the distance and slows the car to a stop at a specified distance. It will display objects detected on the LCD display.



Fig:5.15 : Sending MSG

Fig. 5.15 displays the message sent to the predefined number. When an accident occurs, the vibration sensor vibrates the vehicle and sends an SMS to a predefined number.



Fig:5.16 : MSG Sent

The sent message is shown in Fig. 5.16. It shows that the message has been sent after sending the message.



Fig:5.17 : SMS and Link

Fig. 5.17 shows the sent message and connection. It shows in the message a mobile phone with a predefined number.

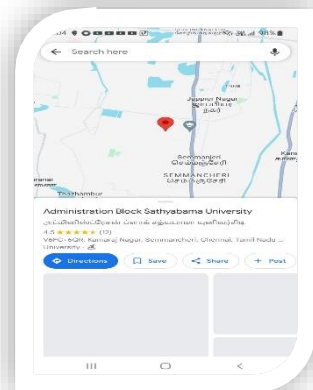


Fig:5.18 : Location of the Vehicle

The location of the vehicle is shown in Fig. 5.18. After sending an SMS, we can touch the link in the SMS, and it will show the location of the car to a predefined number of people.

CHAPTER 6

SUMMARY AND CONCLUSIONS

6.1 SUMMARY

With this e-vehicle, lower-body disabled people can drive the vehicle automatically with their own hands without the help of others. India has many people who depend on others to meet their basic needs. Part of it is our inability to go out alone for our own needs without the help of others. This vehicle has been brought in to fulfill this. In this vehicle, instead of the dashboard, you can operate the vehicle using a smart touch screen or mobile phone. In this way, you can operate the vehicle by touching the voice assistant and pronouncing forward and backward with your mouth. This makes it easier and safer for people with disabilities to go out without the help of others. This e-vehicle is designed with disabled-friendly safety systems, making it safe not only for the disabled but also for general use. This designed car is designed to detect any obstacle during its movement and stop the vehicle from a certain distance. Also, in case of an accident, the vehicle will send an SMS to a pre-defined number and show the location of the vehicle. Ultimately, it will be capable of supporting universal access and future security features. It is very useful and safe to move from one place to another without the help of others.

6.2 CONCLUSION

The smartphone-based vehicle control system offers a promising avenue for enhancing convenience, safety, and efficiency in the realm of transportation. Through this technology, users can remotely access and manage various functions of their vehicles, ranging from unlocking doors and starting engines to monitoring diagnostics and adjusting settings. One of the key advantages of this system is its accessibility and ease of use. With the ubiquity of smartphones, virtually anyone can harness the power of vehicle control at their fingertips. This accessibility democratizes vehicle management, empowering users with greater autonomy and flexibility in how they interact with their vehicles. Moreover, the smartphone-based control system enhances security by enabling users to remotely monitor their vehicles and take action in case of emergencies, such as locking doors or

activating anti-theft measures. This not only provides peace of mind to vehicle owners but also acts as a deterrent against theft and unauthorized access. Furthermore, the integration of smart features like real-time diagnostics and predictive maintenance alerts improves vehicle health management. By receiving timely notifications about potential issues or maintenance needs, users can proactively address them, thereby reducing the risk of breakdowns and prolonging the lifespan of their vehicles. However, it's essential to acknowledge certain challenges and considerations associated with smartphone-based vehicle control systems. Privacy and cybersecurity concerns must be addressed to safeguard sensitive data and prevent unauthorized access or tampering. Additionally, compatibility issues may arise with older vehicle models or disparate software platforms, necessitating careful integration and standardization efforts. In conclusion, the smartphone-based vehicle control system represents a significant advancement in automotive technology, offering unparalleled convenience, security, and efficiency. While there are challenges to overcome, the potential benefits for both users and manufacturers are substantial. With further innovation and refinement, this technology is poised to redefine the driving experience and shape the future of transportation.

6.3 FUTURE SCOPE

These future scopes represent potential directions for the evolution of smartphone-based vehicle control systems, driven by technological advancements, shifting societal trends, and evolving user expectations. As the automotive industry continues to innovate, these systems are likely to play an increasingly integral role in shaping the future of mobility.

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SCIENCES (NCMHS - 23)**

Coimbatore, India 4th November 2023

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