CSE1905- TARP

OBJECT DETECTING BLUETOOTH CONTROL ROBOTIC VEHICLE

PROJECT REPORT

By

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Submitted to

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Certified that this project report entitled "**OBJECT DETECTING BLUETOOTH CONTROL ROBOTIC VEHICLE**" is a bonafide work of **Lokesh Kanna – 19MIA1014, Nithya Sharma – 19MIA1028, Yuvashree R – 19MIA1053, K Niharika Samyuktha – 19MIA1083** who carried out the TARP project under my supervision and guidance. The contents of this Project work, in fullor in parts, have neither been taken from any other source nor have been submitted to any other Institute or University for award of any degree or diploma and the same is certified.

Dr. Manjula D,
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ACKNOWLEDGEMENT

We wish to express our sincere thanks and deep sense of gratitude to our project guide, **Dr. Manjula D**, Professor Higher Academic Grade, School of Computer Science Engineering, for his consistent encouragement and valuable guidance offered to us in a pleasant manner throughout the course of the project work.

We express our thanks to our HOD **Sivabalakrishnan M** for his support throughout the course of this project.

We also take this opportunity to thank all the faculty of the school for their support and their wisdom imparted to us throughout the course.

We thank our parents, family, and friends for bearing with us throughout the course of our project and for the opportunity they provided us in undergoing this course in such a prestigious institution.

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1. ABSTRACT

Bluetooth technology has evolved over the years. It helps in establishing connections between devices. This project focuses on developing a robotic vehicle that uses Bluetooth for communication between the vehicle and mobile, which is used to control the movement of the robotic vehicle. These commands are sent from the Android mobile to the Bluetooth. An additional feature has been included, where the robotic vehicle detects obstacles present in its way. Here we have used a Bluetooth module to control the car, and it is also an android based application. A Bluetooth module is used to receive commands from an android phone and Arduino UNO is used for controlling the whole system. Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. Arduino uses an ATmega328 microcontroller. Bluetooth controlled car move according to the button touched in the android Bluetooth mobile app. This project aims on developing a vehicle that is well suited for storage management purposes. In subsequent sections, we have elaborated the procedure of this framework.

2. INTRODUCTION

The traditional methods of human-machine interaction have been significantly altered by smartphones. A person's life now revolves around their smartphone. Android is a mobile device software platform that consists of an operating system, middleware, and important apps. An operating system that is safe and secure is Android. Software known as the SDK, or Software Development Kit, contains all of its necessary tools. We are aware that automated mechanical processes have completely supplanted all manual processes.

Our major goal is to create a robotic vehicle that can be controlled remotely using a touch screen display unit connected via bluetooth, can identify impediments in its path, and can warn the user of such difficulties.The hardware in smartphones has also advanced significantly. So, it stands to reason that Android smartphones will be very useful for business, industrial, and other general-purpose applications. Due to their high power, noise-free operation, compact design, durability, and low maintenance and cost, DC motors are frequently used to provide variable speed drive systems in industrial applications such as automation, electrical traction, military equipment, and fixed disc drives. These days, a variety of communication technologies are in use, including GSM, GPRS, Wi-Fi, WLANs, and Bluetooth. Each method has its own unique qualities and applications. Among these wireless connections, Wi-Fi and Bluetooth technology are frequently required.

In this project, we propose a robotic vehicle which functions based on Arduino, motor driver and Bluetooth module. Arduino is an open source prototyping platform, it uses an ATmega328P microcontroller. Since robotics has become a major part in our daily life and also in the engineering field, it plays a vital role in the development of new technology.This is a very simple remote control car, where the ordinary micro-controller has been replaced by Arduino and IR sensors have been replaced by a Bluetooth module. The remote will be the android cell phone. The Bluetooth module is used to receive commands from an android phone and Arduino UNO is used for controlling the whole system.

The Bluetooth communication module-equipped controller makes up the system hardware. It will be connected to the robotic car's motors and alternative parts. When the robot app is activated and Bluetooth connectivity is established with the existing system, one can control the vehicle by sending wireless commands from the app using the functionalities that have already been configured in the app.The car will go in the four directions that have been given: left, right, front, and back. Both motors will travel in the same direction when moving forward, and they will move in the opposite direction when moving backward. Either motor will revolve for left and right movements, and both motors will halt for a stop. The user instructs the motors using the smartphone application.

2.1. OBJECTIVES AND GOALS

- To construct a robotic vehicle that can be operated with the help of a touch screen display unit for remote operation.
- To establish a Bluetooth connection between the robotic vehicle and a mobile application.
- To perform obstacle detection
- To alert the user when an obstacle is detected in the vehicle's way.

2.2. BENEFITS:

- Reduces the workload of manpower.
- Low cost to design the system.
- Easier detection of obstacles with the help of a suitable sensor.
- Can be used in storage management units.

2.3. FEATURES:

- This robotic vehicle uses ultrasonic sensor which measures the distance to an object with the help of sound waves for the detection of any obstacles present
- Proteus 8 Professional simulation shows significant results and the hardware prototype shows promising output.

3. LITERATURE SURVEY

Arpit Sharma, Reetesh Verma, Saurabh Gupta, Sukhdeep Kaur Bhatia[1] have configured an android smartphone which can control a robot via Bluetooth technology. The phone uses motion sensors and records the gestures sent via an android mobile phone. It also has an inbuilt accelerometer and Bluetooth module for controlling the movements of a robot.

Jorge Kazacos Winter [2] has developed android controlled robot automation. Main aim of his project was the transfer of information wirelessly between a smartphone and the robot and developing the robot and its communication system underneath a low price and open source philosophy. He used 3D design techniques to style the structure of the robot with the facilitation of parametric modelling software. The style, when fed to the 3D printer can print the parts of the robot in a layered manner one by one and can then use these parts to assemble the robot simply. He has used an Arduino microcontroller and Wi-Fi technology in this robot.

According to *Rajesh Bhatt,Tashi Rapden Wangchuk and Subankar Roy* [3], “Wireless control is one of the most important basic needs for all people all over the world. But unfortunately the technology is not fully utilized due to a huge amount of data and communication overheads". Generally many of the wireless controlled robots use RF modules. But this project for robotic control makes use of Android mobile phones which are very cheap and easily available.They used Bluetooth communication to interface Arduino UNO and android. Arduino can be interfaced to the Bluetooth module though UART protocol. According to commands received from android the robot motion can be controlled.The available control commands are more than RF modules.

Selvaraj, Vijayalakshmi and M, Archana,[4] developed an Android controlled temperature sensing RoboCar. The work is based on Android OS, Arduino, L298N motor, DC motor driver, temperature sensor-DHT11 and Bluetooth module. The Arduino code is simulated on software and interfaced with the hardware. The device can be controlled by any smart device with android. AirDroid is an app exclusive to Android which enables you to connect your device to PC through a Wi-Fi controller or wireless network.It is used to connect the mobile camera to view in our pc .It also used to view the location of the car. The Robotic car senses the temperature to be viewed by the mobile app. All the controls of the vehicle on the app on that device. It is used to sense the environment of the military force before doing some of the process. It is used for sensing the environment of the system.

Manish Kumar Tiwari , Deepak Rasaily , Anup Neopany[5] developed a robot car that is controlled by a cell phone using DTMF. The robot is controlled by a mobile phone that makes a call to the mobile phone attached

to the robot. In the course of a call, if any button is pressed, a tone corresponding to the button pressed is heard at the other end of the call. This tone is called "Dual Tone Multiple-Frequency" (DTMF) tone. The robot perceives this DTMF tone with the help of the phone stacked on the robot. The received tone is processed by the microcontroller with the help of DTMF decoder. The microcontroller then Tran -Smits the signal to the motor driver ICs to operate the motors and the robot starts moving.

M. Muthukumaran, M. Kannusamy, M. Kanagaraj, A. Guru Eswaran 4,[6] presents the design and implementation of a low cost but yet flexible and secure cell phone based home automation system. The design is based on a standalone Arduino BT board and the home appliances are connected to the input/ output ports of this board via relays. The communication between the cell phone and the Arduino BT board is wireless. This system is designed to be low cost and scalable allowing a variety of devices to be controlled with minimum changes to its core. Password protection is being used to only allow authorized users from accessing the appliances at home.

R.Piyare and *M.Tazil* research work provided full functionality to remotely control home appliances via wireless communication between the Arduino BT and cell phone using Bluetooth technology. The Arduino BT board was connected with a home appliance and it was controlled by a Symbian OS cell phone application. Similarly, another study presented a home automation system using Bluetooth and an android application. However, this was designed only for 4 lights and it was not feasible to control more than 4 Home appliances. In another research project, XBee based home automation system was introduced for handicapped and elderly people. XBee transceivers were used for wireless communication between the master control panel board and the remote control device.A home monitoring and automation system was also studied, it was implemented by using Arduino Uno and Digilent chipKIT. Although this system is mentioned as a low cost system, it is much more expensive than the Bluetooth base home automation system. A low cost and wireless controlled automation system was designed by researchers. Bluetooth technology was used to provide remote controlled wireless access to users[7].

Dr. Deepak Sonker, Dr. Vishal Khatri, Dr. Ranjeeta Kaur, Ms Ambooj Yadav[8] developed a Bluetooth Car Controlled Using Arduino.It is through efficient electronic programming that a computer can control a robot, hence a robot can be thought of as an Electromechanical machine. Some of the essential characteristics that a robot must have are - sensing, movement, energy, intelligence. It performs a task using control systems, various power supplies and software all working together. We developed an Android application which uses remote buttons to guide an RC car’s motion. Hence, the mobile device harboring the Android application acts as the car’s remote control. Bluetooth is the basis of communication between the controller and Android, using the USART protocol.

Vaibhav Malav, Raushan Kumar Bhagat, Rahul Saini, Udit Mamodiya [9]developed and designed a Home automation using Arduino with Bluetooth module. Home automation system gives a simple and reliable technology with Android application. Home appliances like fan, Bulb, AC, automatic door lock are controlled by Home automation system using Arduino Uno with Bluetooth module. The paper mainly focuses on the monitor and control of smart home by Android phone and provides a security based smart home, when the people do not present at home. This paper motive is controlled home appliances in smart homes with user friendly, design at low cost, simple installation.

Arun Francis G, Arulselvan M, Elangkumaran P, Keerthivarman S, Vijaya Kumar J [10] Radio Detection and Ranging (RADAR), a device that can be used to monitor a distinct area continuously. It is a detection system which utilizes radio waves to decide the range, angle or velocity of objects. The presence of aircrafts, ships, spacecraft and weather formations. The main intent of this project is to help our fishermen who are caught by the neighbouring country's Navy. They are getting caught while fishing near the neighbouring country's border. This project helps the fishermen to escape from them by raising an alert message. The alert message will be exhibited in the shade. While seeing the alert note, they can get alerted and move away from the place immediately. The location and the distance of the object is also measured and indicated to the people. This system has an Arduino which is connected to an Ultrasonic Sensor which is attached to a DC Motor.

4. DESIGN

4.1. BLOCK DIAGRAM

The main features of the basic block diagram are the Microcontroller used – (ATMEGA328P), Bluetooth module, Motor driver, a couple of motors for driving the car , an ultrasonic sensor and a buzzer.

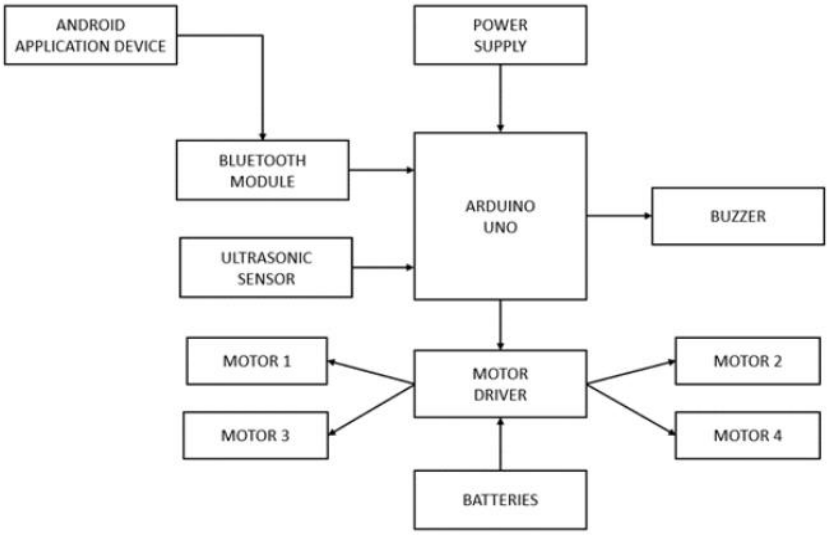

Figure 1: Block Diagram of the system

The block diagram was drawn so as to give a vivid explanation of how the system works at a glance. As shown in (Figure 1), it can be seen that the main heart of this Bluetooth controlled vehicle system is Arduino. Ultrasonic sensor, Bluetooth 8 module and buzzer are connected to the digital pins of the Arduino along with the motor driver. For all inputs given from the android application through the Bluetooth module to the Arduino, the Arduino sends commands to the motor driver accordingly. The motors are activated depending on the input from the motor driver. The motors can move either forward or backward. The Bluetooth controlled car can turn activating motor 2 and 4. It can turn right by activating the motors 1 and 3. Whenever an obstacle is detected, the ultrasonic sensor becomes high and the buzzer buzzes for 2 seconds and moves backward. Then, the command is reset to user inputs.

4.2. REQUIRED EQUIPMENTS

- ATMEGA328P
- Ultrasonic sensor
- Bluetooth Module
- Motor Driver

- DC motors
- Wheels
- Chassis
- Buzzer
- Mini breadboard
- 9v Batteries
- Serial cable
- Jumper cables

5. METHODOLOGY:

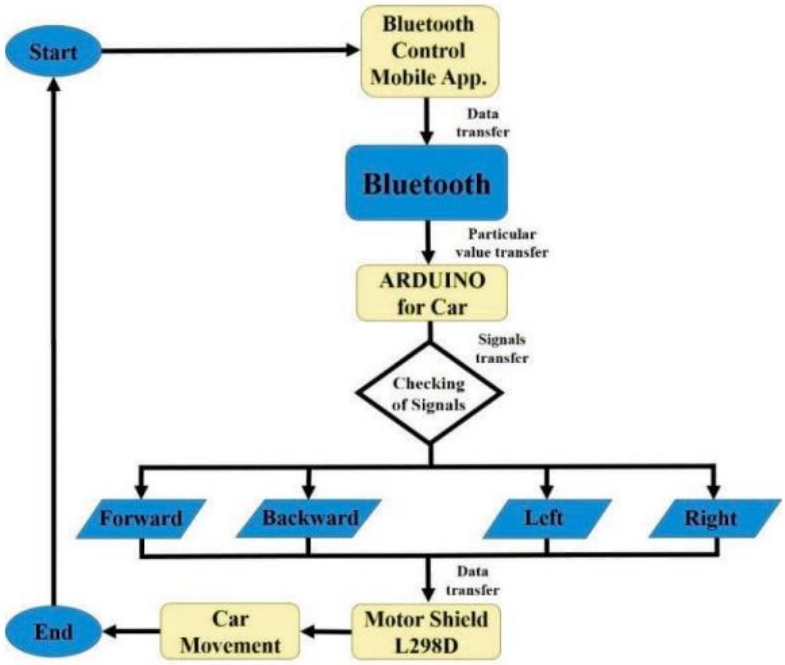

Figure 2 UML Diagram to depict the process of the car controls from the mobile app used

6. HARDWARE ANALYSIS

6.1. ARDUINO UNO:

Figure 3 Arduino NOTE: From Arduino, Wikipedia [11]

Arduino UNO, shown in (Figure 3), is an open-source microcontroller board based on the microchip ATmega328P microcontroller. It has 5 analog input pins, 14 digital input/output pins from which 6 pins can be used as PWM outputs, a USB connection port, a power jack, a reset button and an ICSP header. In this project the digital pins 0,1,5,6,7,8,9,10,11,12 are used. Arduino consists of both, a physical programmable circuit board and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. Using Arduino IDE, the Arduino UNO is programmed based on bluetooth controlled car code implemented to it.

6.2. L298N MOTOR DRIVER

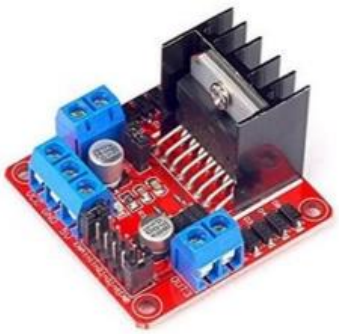

Figure 4 L298N Motor Driver NOTE: From Hajare Electricals Engineer L298N Motor Driver Module, IndiaMART [12]

The L298N is a dual H-Bridge motor driver which controls directions and speed of two DC motors at the same time. The peak current is up to 2A and it can drive the DC motors voltages from 5V to 35V. The speed of the DC motors can be controlled by varying its input voltage and with the use of PWM pins. The input and the enable pins of the motor driver are connected to six digital output pins in the arduino.[13]

6.3. ULTRASONIC SENSOR HC-SR04

Figure 5 Ultrasonic Sensor HC SR04 NOTE: From Omatom Power Ultrasonic Sensor HC SR04 Module, IndiaMART[14]

The ultrasonic sensor is a device that is used to measure the distance to an object with the help of sound waves. The HC-SR04 Ultrasonic distance sensor consists of two ultrasonic transducers. The one acts as a transmitter which converts electrical signals into 40 KHz ultrasonic sound pulses. The receiver listens for the transmitted pulses. If it receives them, it produces an output pulse whose width can be used to determine the distance the pulse travelled. There are only four pins on the HC-SR04: VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground). The sensor is small, easy to use and offers excellent non-contact range detection between 2 cm to 400 cm with an accuracy of 3mm.[15]

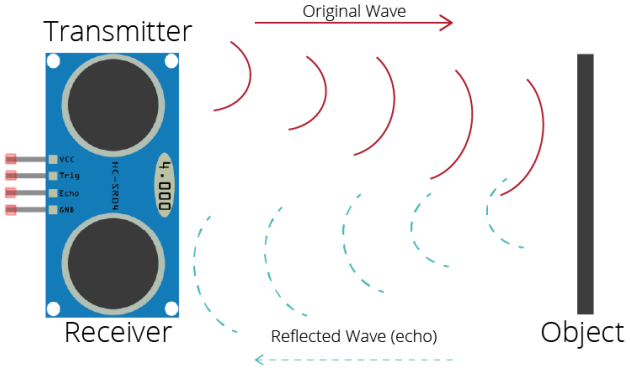

Figure 6 Ultrasonic sensor detecting the object using sound waves

6.4.HC-05 BLUETOOTH MODULE

Figure 7 HC-05 Bluetooth Module

NOTE: From Bluetooth HC-05 Module, IndiaMART[16]

HC-05 Bluetooth Module is an easy-to-use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with a controller or PC to receive and send data when connected with other Bluetooth devices.HC-05 Bluetooth module provides switching mode between master and slave mode which means it able to use neither receiving nor transmitting data. You just need to connect the rx and tx to the controller or serial converter and give a 5 volt dc regulated power supply to the module.

6.5.DC MOTORS

Figure 8 Dual Shaft BO motor

NOTE: From Constflick Technologies dual shaft BO motor, Electronicscomp [17]

Bo motor (Battery Operated) is a lightweight DC geared motor. It has great torque and rpm at low voltages. It is suitable to operate lightweight robotics vehicles. The DC motor converts electrical energy into mechanical energy. The shaft is set in a way such that it helps to increase torque and reduce the speed of the motor.

6.6.BUZZER

Figure 9 Buzzer

NOTE: From Mini Piezo Buzzer Mini, pcboard.ca[18]

The buzzer converts audio signals into sound signals. It is usually powered by DC voltage. Piezo buzzers are simple devices that can generate basic beeps and tones. They work by using a piezo crystal, a special material that changes shape when voltage is applied to it.

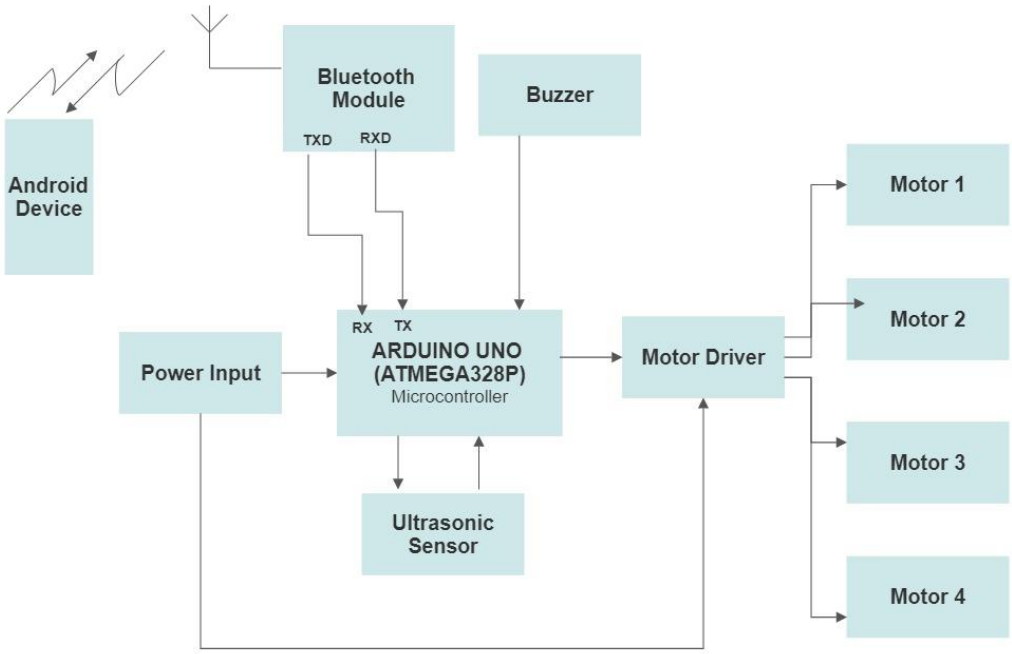

Figure 10: Architecture Diagram of the Hardware Component

7. IMPLEMENTATION

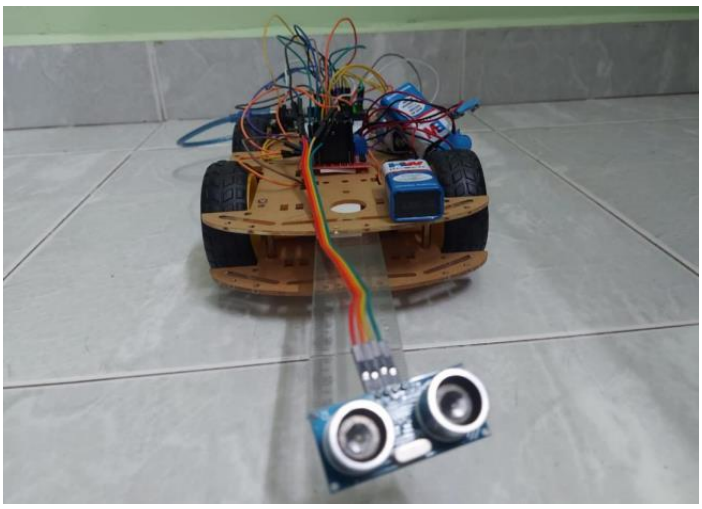

Figure 11.(a) Hardware implementation

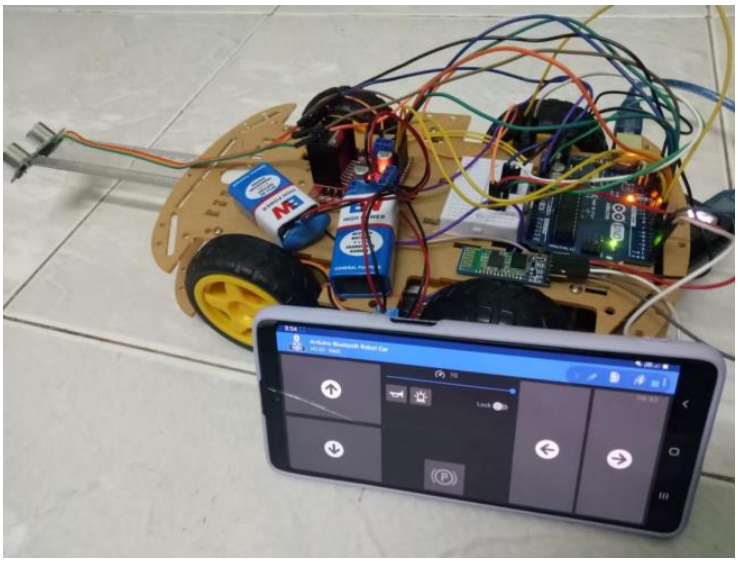

Figure 11.(b) Hardware implementation

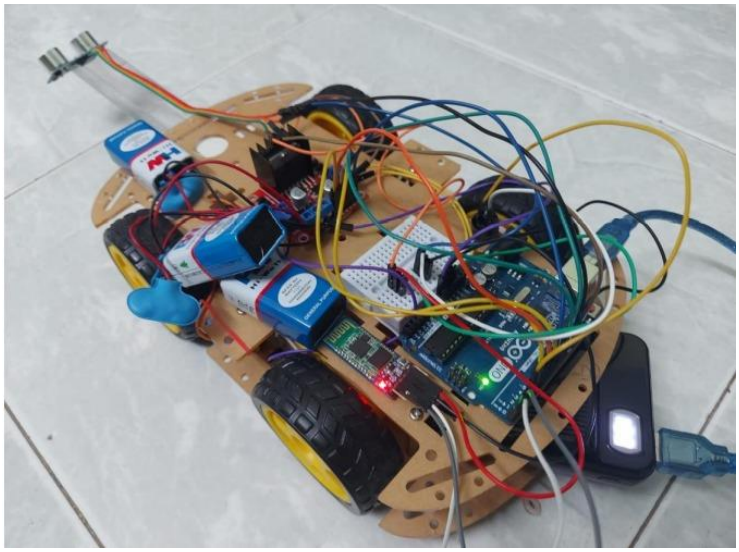

Figure 11.(c) Hardware implementation

The motor driver is connected to the Arduino to drive the car. The input pins of the driver are connected to digital Arduino pins. Here we have used four DC motors to drive the car. The battery is used to power the motor driver to drive the motor. The Bluetooth module's tdx and rdx pins are directly connected to the Arduino's rx and tx pins. Also, the vcc and ground pins of the Bluetooth module are connected to +5 volts and Arduino ground. The Android Bluetooth mobile app is used to move the Bluetooth-enabled car. To run this project first, we need to download the Bluetooth app (Arduino Bluetooth Robot Car) from the Google Play store. The Arduino connects to the Bluetooth module to provide connectivity and it also connects to the motor driver to control the motor speed. The robot car moves according to the instructions given by the user via the Android app. The RC module is the main working unit of this system. The unit consists of an Arduino chip, a motor driver (L298N), an ultrasonic sensor, and a Bluetooth module connected to the circuit. The L298N motor driver is used to control the 4 dc motors. The center of the unit is the Arduino Uno. The Arduino Uno is responsible for communicating with the android smartphone using the Bluetooth module and controls the 4 dc motors using the motor driver. The RC unit is powered by a 9V battery connected to the Arduino chip. An Arduino program contains instructions that mediate between the Android controller and the Arduino car. The proposed Arduino car will contain the Arduino microcontroller with basic mobility functions.

8. SOFTWARE ANALYSIS

8.1.ALGORITHM

1. Start
2. Define necessary pins with suitable name
3. Define motors pins joined with arduino board
4. Define pins in write or read type and define functions to run the rc car.
5. Non return function such as forwardMove(), reverseMove(), leftMove(), rightMove(), stop() and special function to stop using ultrasonic sensor is defined o.r objectdetected() in which each motors are digitally written to high or low according to the direction.
6. Start loop function, for perception of distance ultrasonic module calculation is given with invoking "trigger" and "echo pin'' for transmitting and receiving.
7. Invoke if-else case to check if the prompted distance received from the ultrasonic sensor passes or falls short of the limit. If an object falls under the limit distance, pin Buzzer is set high and a special function objectdetected() is invoked with a delay of 2s.
8. For the bluetooth controlled direction, the input is read through Serial.read() and if-else is invoked to compare with user-defined commands and run the functions if matches.
9. End

8.2.SOURCE CODE:

```
#define trigPin 12
#define echoPin 11
#define buzz 4
#include <SoftwareSerial.h>
SoftwareSerial blue(0, 1);
char Incoming_value = 0;
long duration, distance;
char t;
int enA = 10;
int in1 = 9;
int in2 = 8;
```

```
// motor two
int enB = 5;
int in3 = 7;
int in4 = 6;
void setup()
{// set all the motor control pins to outputs
 Serial.begin(9600);
 pinMode(enA, OUTPUT);
 pinMode(enB, OUTPUT);
 pinMode(in1, OUTPUT);
 pinMode(in2, OUTPUT);
 pinMode(in3, OUTPUT);
 pinMode(in4, OUTPUT);
 pinMode(13, OUTPUT);
 pinMode(trigPin, OUTPUT);
 pinMode(echoPin, INPUT);
 pinMode(buzz, OUTPUT);
}
void forwardMove()
{ //forward
 digitalWrite(in1, HIGH);
 digitalWrite(in2, LOW);
 analogWrite(enA, 200);
 digitalWrite(in3, HIGH);
 digitalWrite(in4, LOW);
 analogWrite(enB, 200);
}
void reverseMove()
{
 //reverse
```

```
 digitalWrite(in1, LOW);
 digitalWrite(in2, HIGH);
 analogWrite(enA, 200);
 digitalWrite(in3, LOW);
 digitalWrite(in4, HIGH);
 analogWrite(enB, 200);
}
void leftMove()
{
 digitalWrite(in1, LOW);
 digitalWrite(in2, LOW);
 digitalWrite(in3, HIGH);
 digitalWrite(in4, LOW);
 analogWrite(enB, 200);
}
void rightMove()
{
 digitalWrite(in1, HIGH);
 digitalWrite(in2, LOW);
 analogWrite(enA, 200);
 digitalWrite(in3, LOW);
 digitalWrite(in4, LOW);
 analogWrite(enB, 200);
}
void stopp()
{
 digitalWrite(in1, LOW);
 digitalWrite(in2, LOW);
 digitalWrite(in3, LOW);
 digitalWrite(in4, LOW);
```

```
}
void objectDetected()
{
 digitalWrite(in1, LOW);
 digitalWrite(in2, LOW);
 digitalWrite(in3, LOW);
 digitalWrite(in4, LOW);
 delay(1000);
 digitalWrite(in1, LOW);
 digitalWrite(in2, HIGH);
 analogWrite(enA, 200);
 digitalWrite(in3, LOW);
 digitalWrite(in4, HIGH);
 analogWrite(enB, 200);
}
void loop() {
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance = (duration/2) / 29.1;
if(distance < 5 )
{ digitalWrite(led,HIGH);
objectDetected();
}
else{digitalWrite(buzz,LOW);}
Serial.print(distance);
Serial.println(" cm");
```

```
 if (Serial.available() > 0)
 {
 Incoming_value = Serial.read();
 Serial.print(Incoming_value);
 Serial.print("/n");
 if (Incoming_value == 'F')
 {
 forwardMove();
 }
 else if (Incoming_value == 'B')
 {
 reverseMove();
 }
 else if (Incoming_value == 'R')
 {
 rightMove();
 }
 else if (Incoming_value == 'L')
 {
 leftMove();
 }
 else if (Incoming_value == 'S')
 {
 stopp();
 }
 }
}
```

8.3.SIMULATION:

Circuit Simulation in proteus platform:

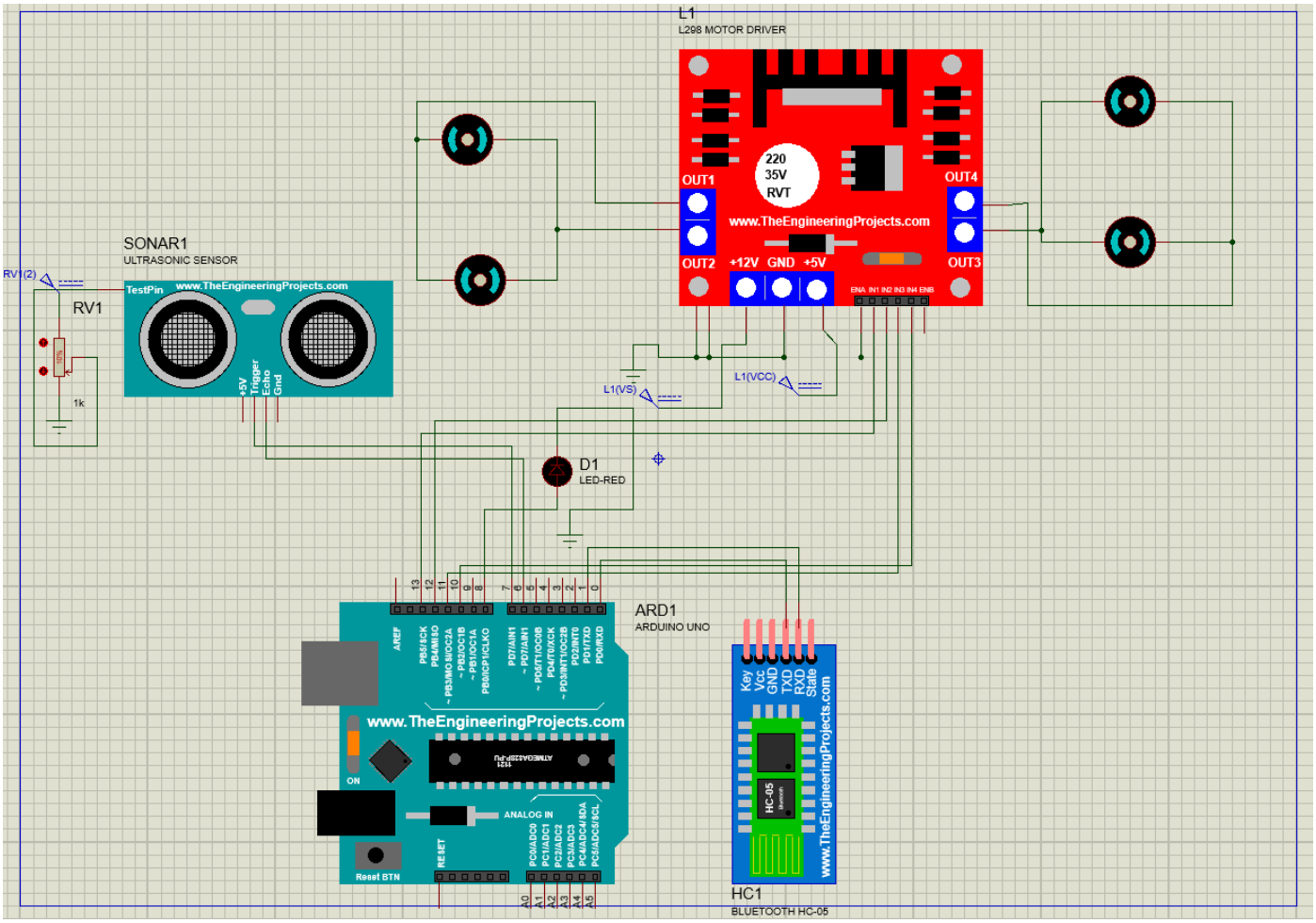

Figure 12: Software Diagram

9. CONCLUSION AND FUTURE WORK

9.1. RESULT

We have implemented a Bluetooth controlled robotic vehicle that uses an Ultrasonic sensor to detect obstacles around its surroundings. The buzzer helps to notify the user of the presence of obstacles and the vehicle automatically moves back to redirect the path. The communication is established between the vehicle and the app through the Bluetooth module.

9.2. INFERENCE

It can be observed from the hardware implementations that the Bluetooth control vehicle can detect any obstacle that comes in the radius of 15 cm. The vehicle stops immediately for 2 seconds and goes in reverse to diverge away from 24 the path with the obstacle. The controls are set back to user input. All the commands from the app are sent to the vehicle without any delay. The vehicle can move in different directions: forward, backward, right and left.

9.3. CONCLUSION

Main objective of this project is to ease the human effort through mechanical help. This project works as a smart object as the remote-controlled car can be used wireless with a Bluetooth module so the user can control it with more freedom. The project work has been studied and implemented a complete working model of using Arduino uno board which comprises ATmega328p microcontroller. The programming and interfacing of the Arduino board with project components has been mastered during the project implementation. The project can move packages around small places and micromanage storage facilities with less human interaction. Therefore, such systems are very much useful when implemented on a large scale and can bring significant changes in the storage facilities as with added advantages such as simple circuit implementation and flexibility in design.

9.4. FUTURE WORK

As the advancement of technology is taking place at a fast pace. Project can be improved in the future in many ways. Usage of robotic cars in military purposes, using it as metal detectors to do recon on land mines. It can also be used in Mining area to sense poisonous gases or to search for someone who is missing in the place of mining.

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