Faculty of Information Technology

IS 1900 Business Project

Object Detection Line Following Smart Toy Car

Final Report

Group No: 22

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1. Introduction

As the world gets more connected through technology, each and every field is stepping and must step to a higher level. Toy industry is also one of the major industries that should grow and be revolutionized in the modern society.

Children are eager to learn about the world around them. Every new colour, texture and shape is a learning experience for them. Use of toys are one of the best ways to entertain a child. Not only for entertainment but also, they can discover and explore the world around them through toys. As everything in the world is connected through IOT (Internet of things), everything has become digitalized, smart and automated. So, the children's toys also should become smart and automated with this technological development.

Now a days almost all the parents are busy with their career lives. So, their children get isolated. Use of a smart toy is an excellent way to compensate the isolation and the lack of communication when no one is around the child. Smart toys can also improve the analytical power and the imaginary power of a child as they enter to a digital world. With the same old toys and games children become disappointed and bored. Traditional entertainment methods are not enough for them.

So toys should become smart and the functions that can be done using a toy should become enhanced. There are some toys that have unique functionalities but with few or more bugs. Toy cars are a type of toy that is prominent among kids, teenagers as well as some adults .There are various types of toy cars. Majority of them are controlled manually. Some can be controlled remotely but they are not able to ascertain objects. Furthermore, those toy cars must be controlled every single second while playing. These cars are unable to function automatically.

So in this project we are designing a multifunctional, interactive smart toy car called, 'Object Detection Line Following Smart Toy Car'.

2. Literature Survey

Toys are the objects that are most popular among age groups below 12 years. Children use these toys, just to pass time while enjoying those, as small children do not have much to do other than play or cry. Among all the types of toys, there are various types of toy cars with or without specified functions for them.

Nowadays, there is a variety of toy cars in the market for higher prices. Some of them are controlled manually, some can be controlled remotely and the user can drive the toy car in any direction as they wish.

There are cars that can detect the obstacles and stop functioning [1]. There are some toy cars that can follow a unique color line so that the car is able to go on that line [2].

Our project is different from those cars as it is a multifunctional and interactive smart toy car. In our project, the toy car will move on a black color line. If any obstacle is identified, a buzzer will ring informing the child to remove that object from the path. This toy car is also able to control remotely through a mobile phone using a mobile application. Moreover, a LED will be switched on when the car is turning to a side as signal lights of normal vehicles.

3. Aim and Objectives

3.1 Aim

The main aim of this project is to design and develop a smart, automated and multi-functional toy car that can be used as an entertainment medium for children, which will also help them to explore the world around them and develop their creativity.

3.2 Objectives

- To make the car be able to follow a line automatically.
- To alert the user if there are any obstacles in the path of the car.
- To indicate the turning of the car.
- To work as a remotely controlled car using a mobile phone.

4. Analysis and Design of the System

Mainly this car will be able to follow a black line drawn by the child in a white paper or any white colour surface, with the use of two IR sensors. To make the car move, go forward, backward, left and right, four servo motors will be used for the four wheels. A motor driver will be used to drive the four motors. When the car turns left or right LEDs will work as signal lights, indicating the turning directions.

This toy car will also be able to detect objects in its path (on the black line), with the use of an ultrasonic sensor. If an object is detected on the black line, the car will be automatically stopped and a buzzer will ring, alerting the child to remove the object from the path. Once the object is removed car will start moving along the line again.

Aside from the automatic line following and object detection function, this car will also be able to use as a remotely controlled car, by the mobile phone with the use of a Bluetooth module.

Block diagram of the system with the above mentioned functionalities and the components are shown below.

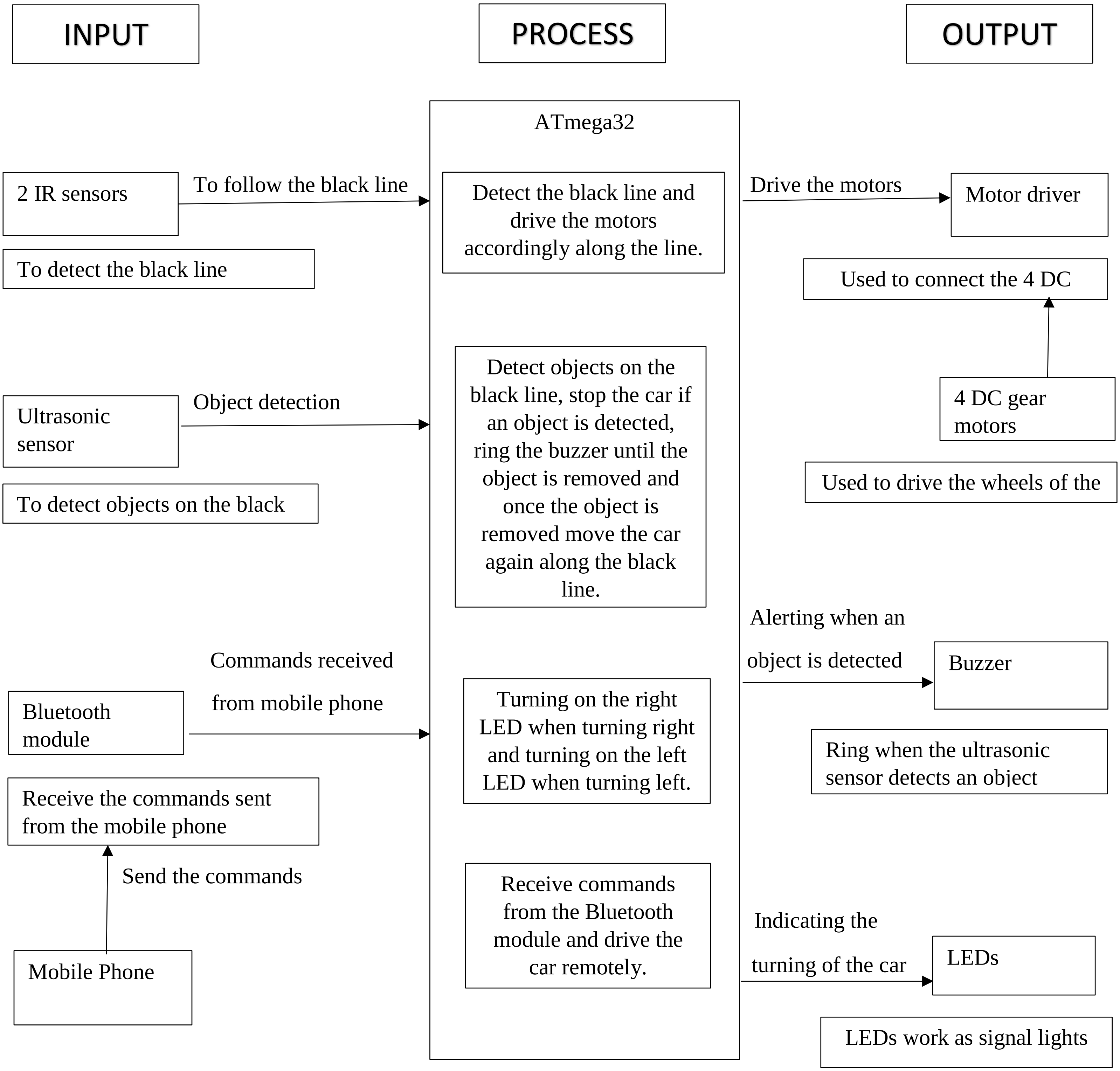

Figure 1 Block Diagram of the System

Full schematic diagram of the system is shown below.

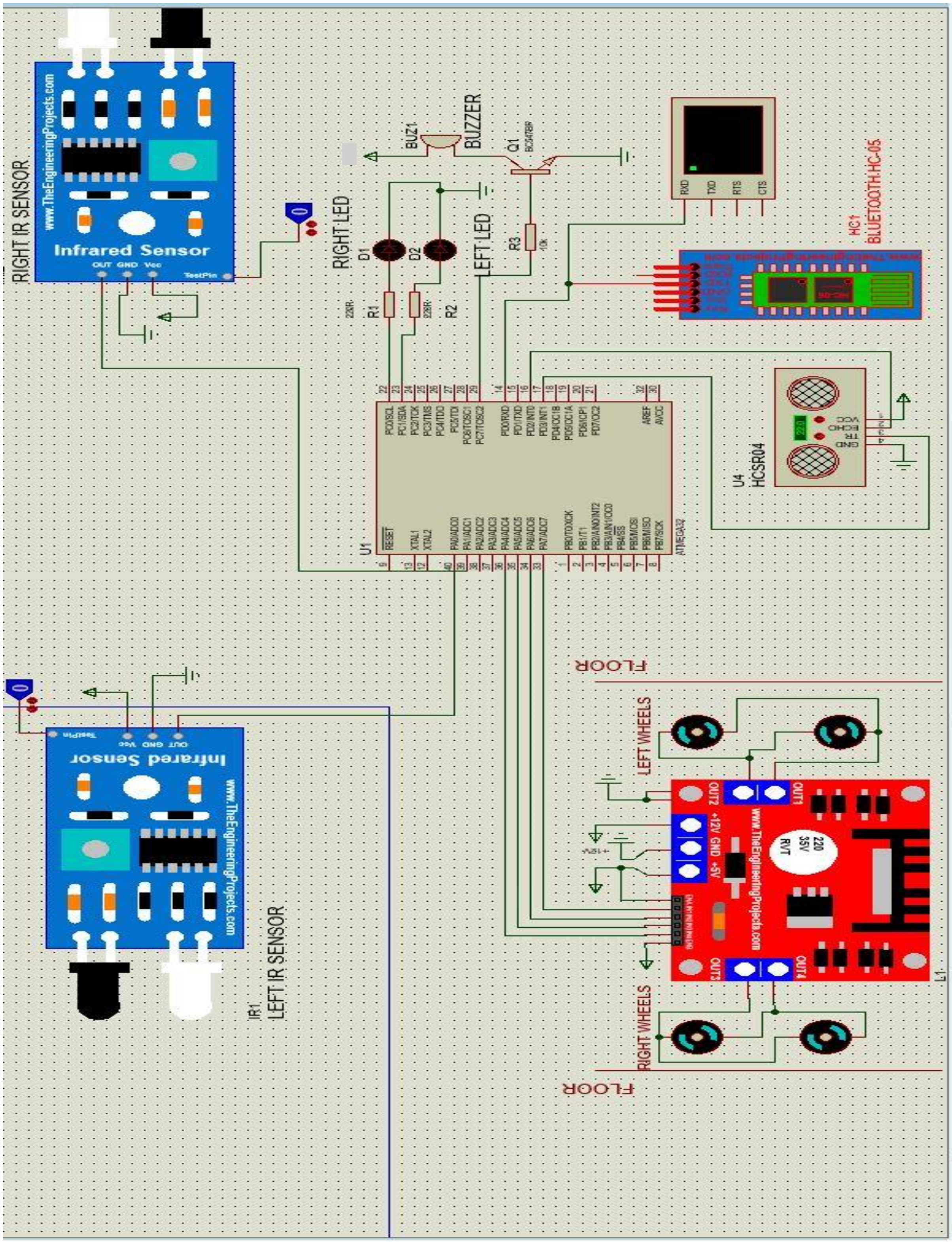

Figure 2 Full Schematic Diagram of the System

3D design of the Object Detection Line Following Smart Toy Car is shown below.

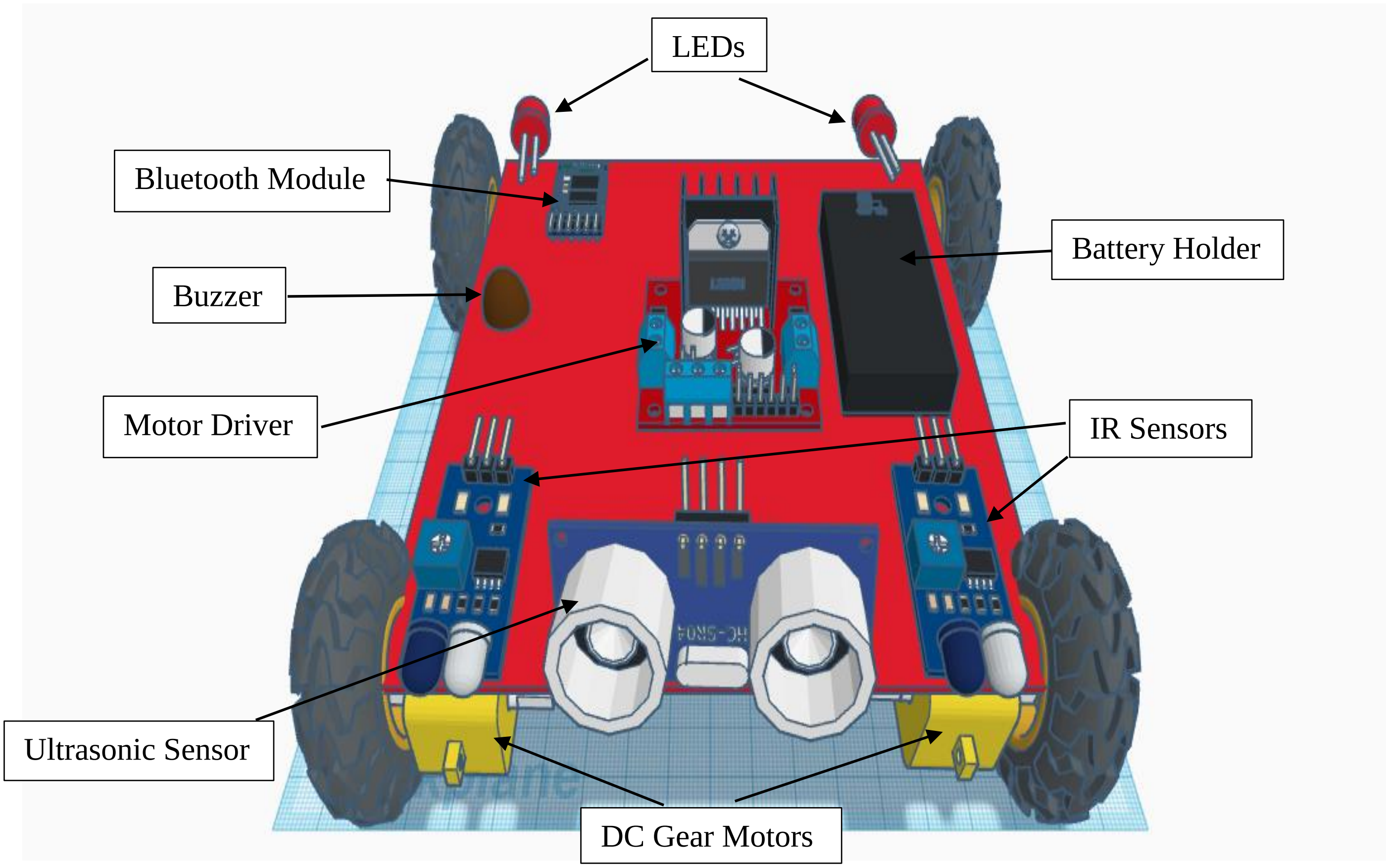

Figure 3 3D Diagram of Object Detection Line Following Smart Toy Car

5. Testing and Implementation

The components used in this project are IR sensors, HC-SR04 ultrasonic sensor, DC gear motors, L298N motor driver, HC-05 bluetooth Module, two LEDs and a buzzer. This project is simulated using the PROTEUS software, first individually and then as a whole.

The two IR sensors, are used to detect the black line (distinguishing between black and white colors). The two IR sensors are placed in the front left corner and the front right corner of the car. In this simulation one IR sensor is named as 'LEFT IR SENSOR' and the other is named as 'RIGHT IR SENSOR' for the easy identification. For simulation purposes, logic states are given to each of the IR sensors. The logic states of both IR sensors equal to zero means, the car is going forward on the black line correctly. Logic state of the LEFT IR SENSOR equals to one means, the car is going to the left, out of the black line (path) into the white surface. So when this happens the wheels of the car starts to turn right, bringing the car back to the black line (path). Logic state of the RIGHT IR SENSOR equals to one means, the car is going to the right, out of the black line (path) into the white surface. So when this happens the wheels of the car starts to turn left, bringing the car back to the black line (path). From the below diagram, left IR sensor, right IR sensor, logic states, right wheels and the left wheels can be identified.

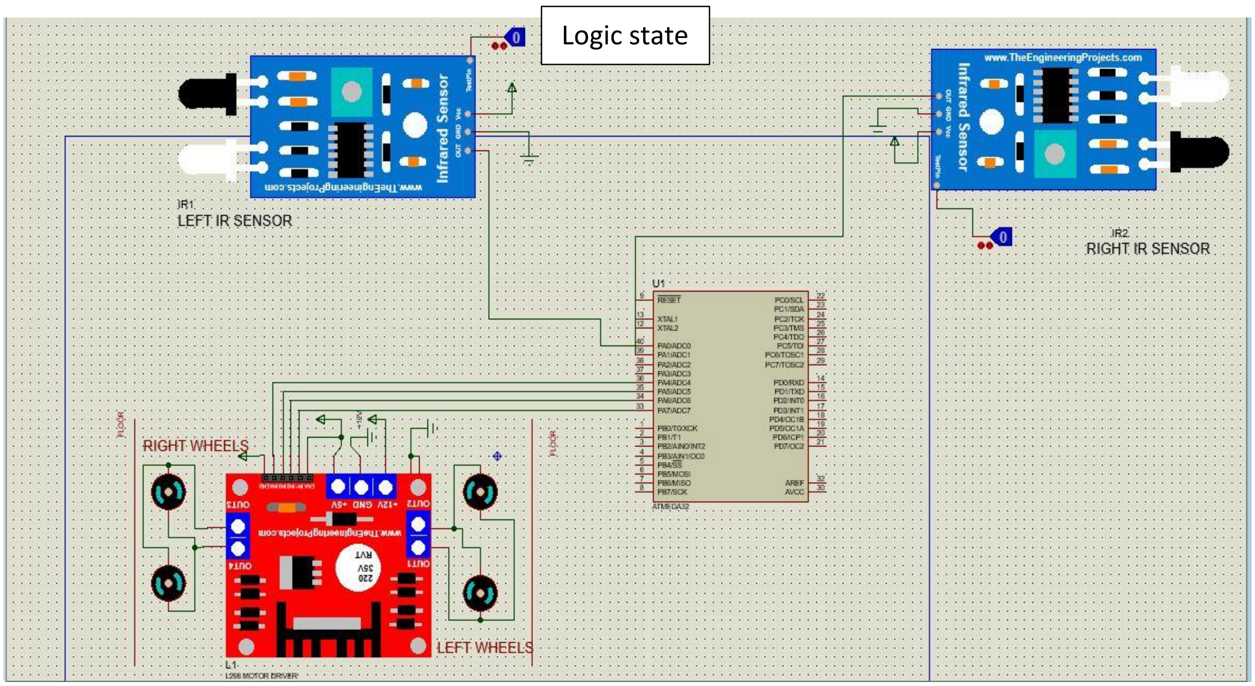

Figure 4 Left IR Sensor, Right IR Sensor, Logic States, Left Wheels and Right Wheels

HC-SR04 ultrasonic sensor is used to detect the objects on the black line. When the ultrasonic sensor detects an object on the black line within a distance of 20cm, wheels(motors) of the car will be stopped and the buzzer will start to ring. When the object is removed, buzzer will stop ringing and the wheels will start working again, allowing the car to go forward on the black line. Distance 20cm mean, 83 in timer value. This timer value 83 is used in the code and in order to identify 20cm = 83 in timer value, USART.h header file is used in the individual code and with the use of a virtual terminal, has identified that 20cm = 83 in timer value. Use of the virtual terminal can be seen from the below diagram.

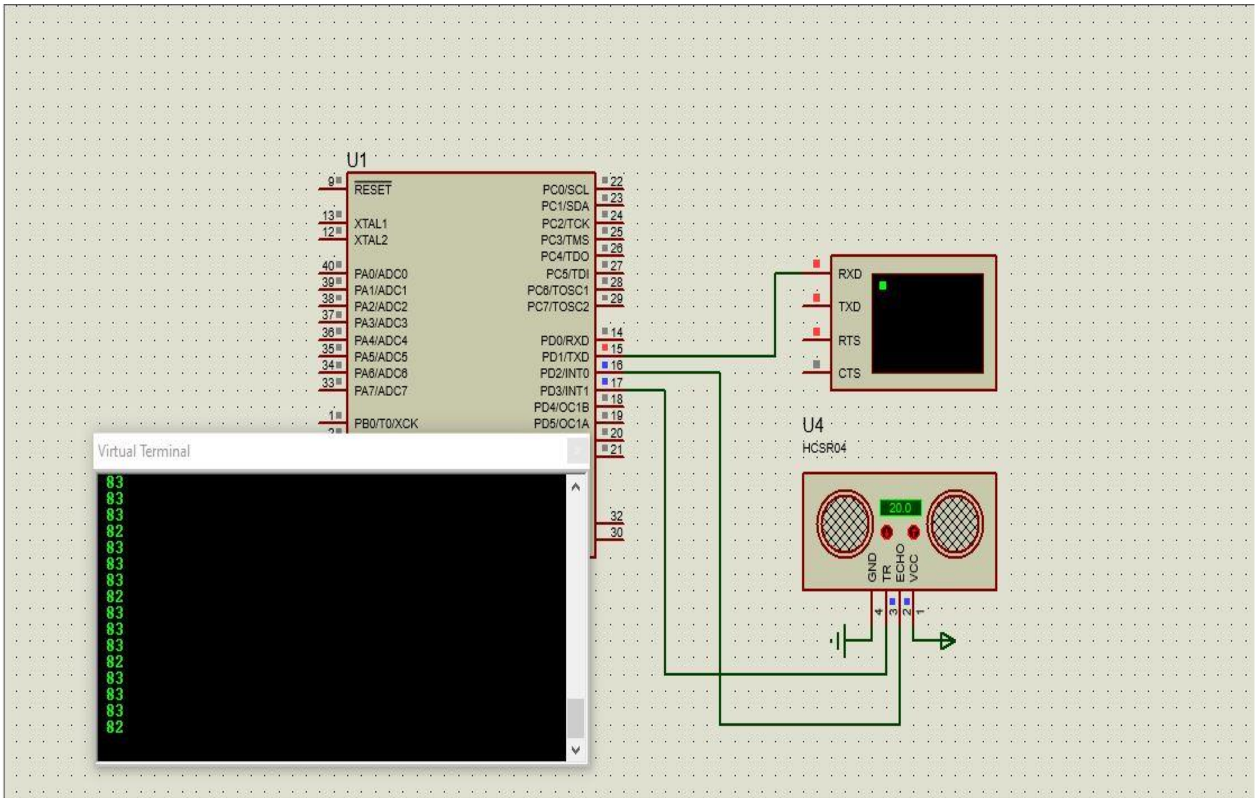

Figure 5 Use of the Virtual Terminal to identify what timer value is equal to 20cm

Four DC gear motors are used to move the toy car from one point to another point. The four motors are connected to the L298N motor driver with a parallel connection to use all the motors together. The motors can rotate forward, backward (reverse), left and right. These motors will be activated with the influence of other sensors connected to the toy car. The motors start to rotate when the logic states of both IR sensors are equal to one. The motors will turn left when the logic state of the left IR sensor equals one, and right when the logic state of the right IR sensor equals one. The car can also be moved with the commands given by a mobile phone using the Bluetooth module. The motors of the car will be stopped when the value of the ultrasonic sensor detects an object within 20cm.

LEDs are used as signal lights. When vehicle is moving left and right the relevant LED starts to blink. The LED also starts to blink with the commands given by the Bluetooth module. When we give the command R the Right LED starts to blink and when we give the command L the Left LED starts to blink. Buzzer is used to produce a beeping sound when Ultrasonic sensor detects and object on the black line. It will ring until the object is moved away from the black line. When the timer value is less than 83 that means ultrasonic sensor has detected an object within 20cm range. Then the buzzer will start to ring. Picture of the left LED switched on is shown below.

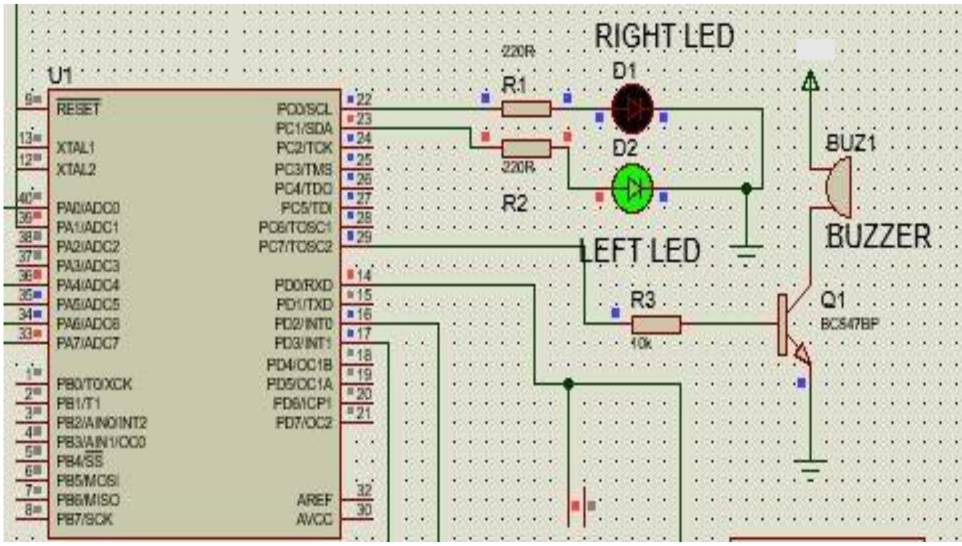

Figure 6 LEFT LED Switched On

Hc-05 Bluetooth module is used to control the car remotely, especially if the car is not on a black line. When doing the simulation through Proteus software, virtual serial port was created in order to communicate with the Bluetooth module and a software called "Serial Lab" is used to transmit the relevant characters. As for our project, Upper case F,B,L,R, and S are sent to move the car forward, backward, left, right and to stop accordingly.

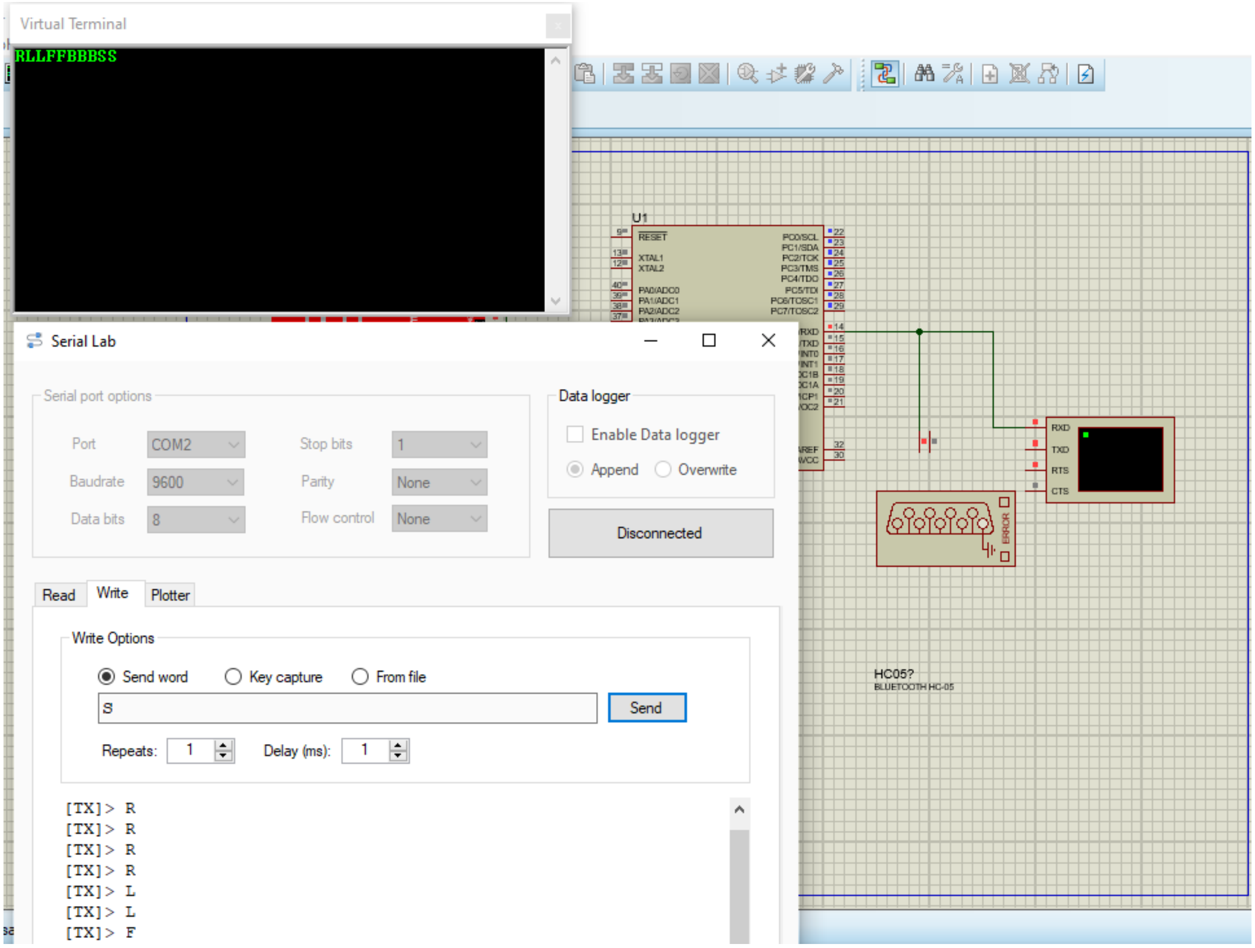

Figure 7 Giving Commands Using Serial Lab Software to Control the Car

6. Estimated Cost and Expenditure

Table 1 Estimated Cost and Expenditure

Components	**Price**
2 IR sensors	Rs.320.00
Ultrasonic sensor	Rs.300.00
Bluetooth module (HC-05)	Rs.850.00
L298N motor driver	Rs.360.00
4 DC gear motors	Rs.2800.00
Buzzer	Rs.150.00
LEDs	Rs.500.00
4 Rubber wheels	Rs.1400.00
12V 18650 Li-on battery pack	Rs.1000.00
Micro controller (Atmega32)	Rs.600.00
Total cost	Rs.8280.00

7. Further Work

As for further work and improvements to the object detection line following smart toy car, a robotic arm can be added to the car. Functionality of this arm is, when the ultrasonic sensor detects an object and the car stops, the child has to switch on the robotic arm attached to the car and the robotic arm will locate the object correctly and remove it from the path of the car.

8. References

[1]“Obstacle Avoiding Robot using Arduino”. [Online]. Available: https://www.electronicshub.org/obstacle-avoiding-robot-arduino/. [Accessed: 30-Nov.-2021].

[2]“Arduino Line Follower Robot”. [Online]. Available: https://www.electronicshub.org/arduino-line-follower-robot/. [Accessed: 30-Nov.-2021].

[3]“IR Sensor Module Pinout, Features & Datasheet”. [Online]. Available: https://components101.com/sensors/ir-sensor-module. [Accessed: 30-Nov.-2021].

[4]“Ultrasonic Ranging Module HC - SR04 - Product features”. [Online]. Available: https://cdn.sparkfun.com/datasheets/Sensors/Proximity/HCSR04.pdf. [Accessed: 30-Nov.-2021].

[5]“DC Motor - Definition, Working Principle, Types, Uses, FAQs”. [Online]. Available: https://byjus.com/physics/dc-motor/. [Accessed: 30-Nov.-2021].

[6]“HC-05 Bluetooth Module Pinout, Specifications, Default Settings ...”. [Online]. Available: https://components101.com/wireless/hc-05-bluetooth-module. [Accessed: 30-Nov.-2021].

[7]“Buzzer : Working, Types, Circuit, Advantages & Disadvantages”. [Online]. Available: https://www.elprocus.com/buzzer-working-applications/. [Accessed: 30-Nov.-2021].

[8]“5mm Round LED”. [Online]. Available: https://components101.com/diodes/5mm-round-led. [Accessed: 30-Nov.-2021].

9. Appendix – Individual Contribution

9.1 205032R – Gunasinghe H.G.C.A

In our project I was responsible for interfacing the two Infrared sensors with the ATmega 32 Microcontroller. Basically the two IR sensors are used to follow the black colored line. Both the sensors are placed on each sides of the toy car. I also designed the full schematic circuit diagram of our system, block diagram and the 3D diagram.
Specifications of IR sensor is as follows [3].

Table 2 Specifications of IR Sensor

Operating Voltage	3.3V to 5V
Operating Current	20 mA supply current
Detection Range	2 cm to 30 cm (Adjustable using potentiometer)
Active output level	The output is 0 (Low) when an obstacle is detected

In this project we are using two IR sensors to detect the black line (distinguishing between black and white colors). IR sensor is a simple electronic device that emits and detects IR radiation in order to find out certain objects/obstacles in its range. IR Sensor Module has a built in IR transmitter and IR receiver that sends out infrared light and looks for reflected infrared light to detect the presence of any obstacle in front of the sensor module. There are three pins in the IR sensor, VCC, GND and OUT.

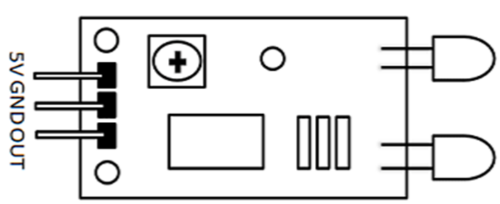

Figure 8 Pinout Diagram of IR Sensor

Circuit diagram of how the pins of two IR sensors should be connected to the MCU is shown below.

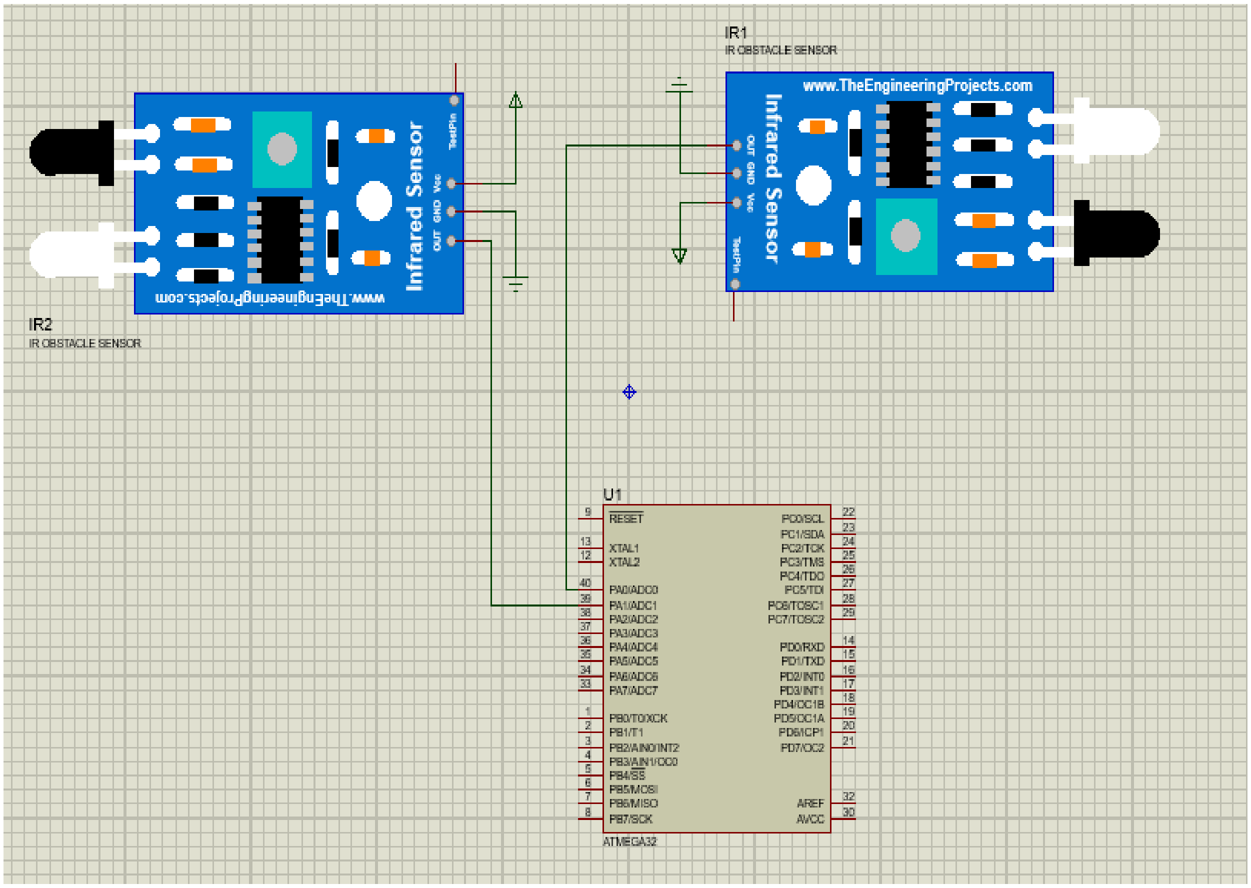

Figure 9 Schematic Diagram of IR Sensors

PCB design for the two IR sensors are shown below.

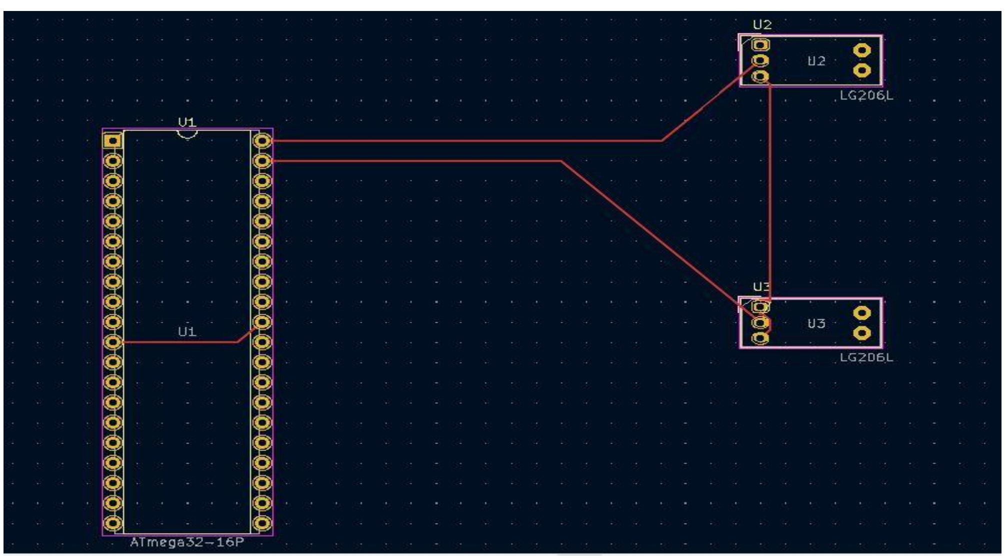

Figure 10 Silk Screen of IR Sensor PCB design

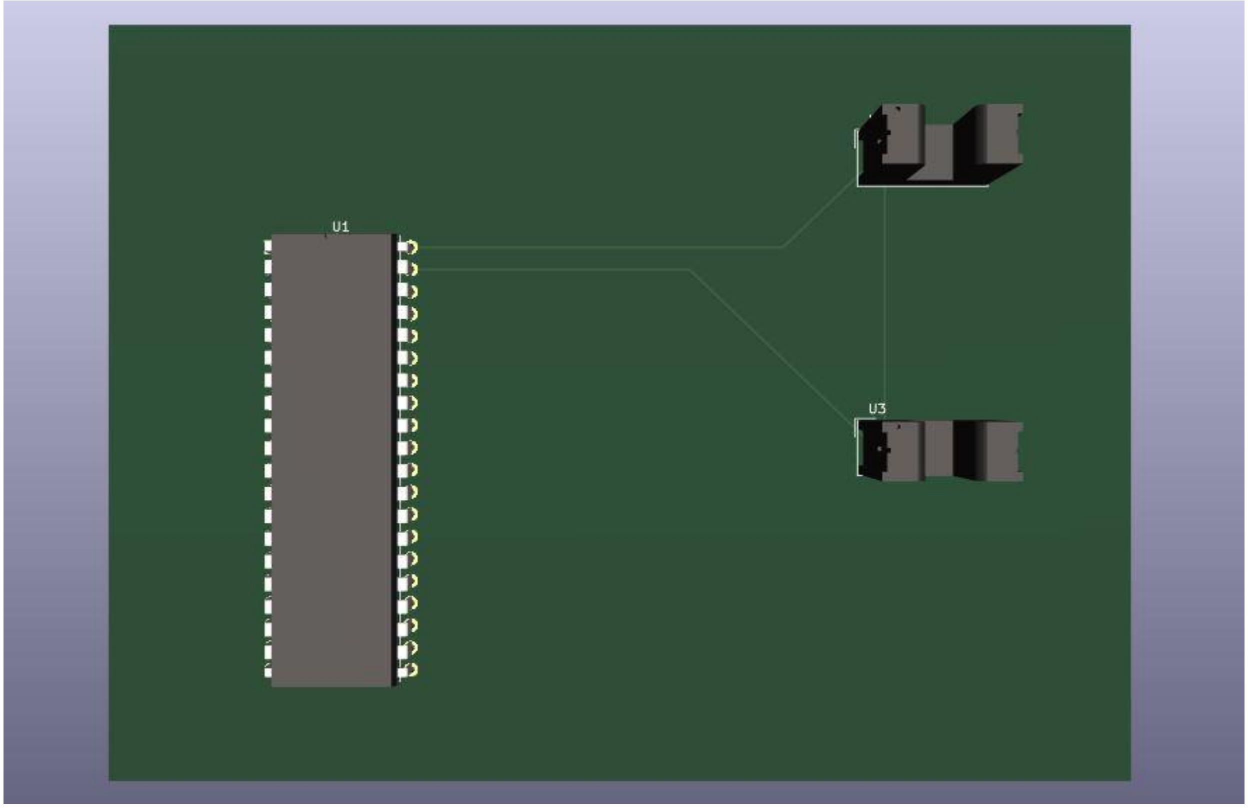

Figure 11 Component View of IR Sensor PCB design

Coding part for the IR sensors are shown below

```
#define F_CPU 8000000
#include <util/delay.h>
#include <avr/io.h>
#include <avr/interrupt.h>

int main(void)
{
	/*IR Remote*/
	DDRA&=~((1<<0)|(1<<1));//ir as input
	DDRA|=(0b1111<<4);//motor


	while (1)
	{
		if (PINA&(1<<0))
		{
			PORTA=(PORTA&0x0F)|(0b0110<<4);//right
		}
```

```
else if((PINA&(1<<1)))
		{
			PORTA=(PORTA&0x0F)|(0b1001<<4);//left
		}

		else
		{
			PORTA=(PORTA&0x0F)|(0b0101<<4);//go
		}
	}
}
```

Figure 12 Coding Part of IR Sensors

9.2 205047R – Kalyanapriya K.B.V.T.R

I was responsible for interfacing the HC-SR04 Ultrasonic sensor with the ATmega32 microcontroller. In this project Ultrasonic sensor is used to detect objects on the black line.
I also did report writing along with another member and designed the full PCB board.

Specifications of Ultrasonic sensor is as follows [4].

Table 3 Specifications of HC-SR04 Ultrasonic Sensor

Operating Voltage	5V
Operating Current	15mA
Operating Frequency	40KHz
Max Range	4m
Min Range	2cm
Ranging Accuracy	3mm
Measuring Angle	15 degree
Trigger Input Signal	10µS TTL pulse
Dimension	45 x 20 x 15mm

In this project ultrasonic sensor is used to detect objects on the black line within 20cm. Ultrasonic sensor measures the distance to an object using ultrasonic sound waves. The ultrasonic sensor uses a transducer, (a device that converts energy from one form to another) to send and receive ultrasonic pulses that relay back information about an object's proximity (nearness of an object). There are four pins the Ultrasonic sensor. VCC, TRIGGER, ECHO and GND.

Figure 13 Pinout Diagram of HC-SR04 Ultrasonic Sensor

Circuit diagram of how the Ultrasonic sensor should be connected to the MCU is shown below.

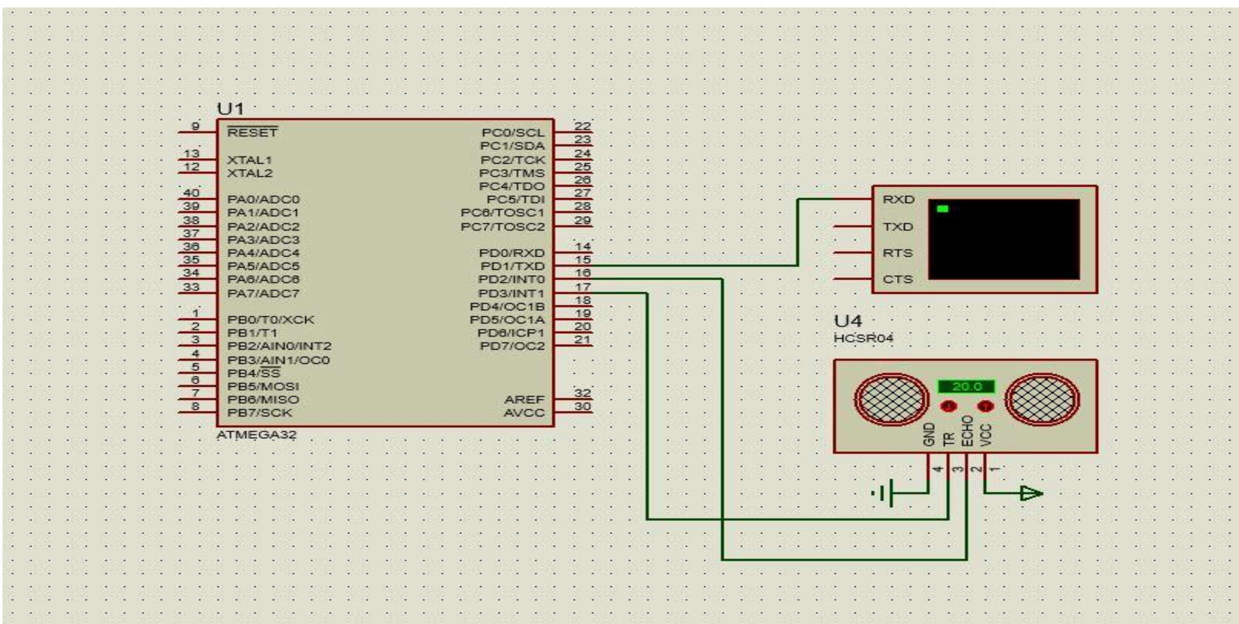

Figure 14 Schematic Diagram of HC-SR04 Ultrasonic Sensor

PCB design for the HC-SR04 ultrasonic sensor is shown below.

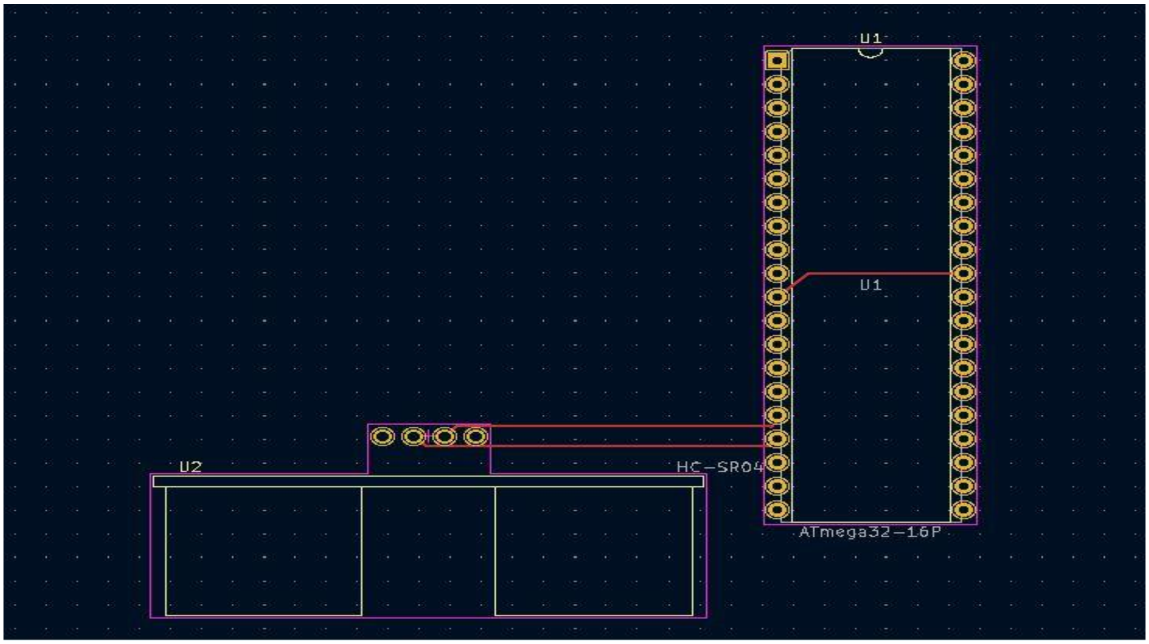

Figure 14 Silk Screen of HC-SR04 Ultrasonic Sensor PCB Design

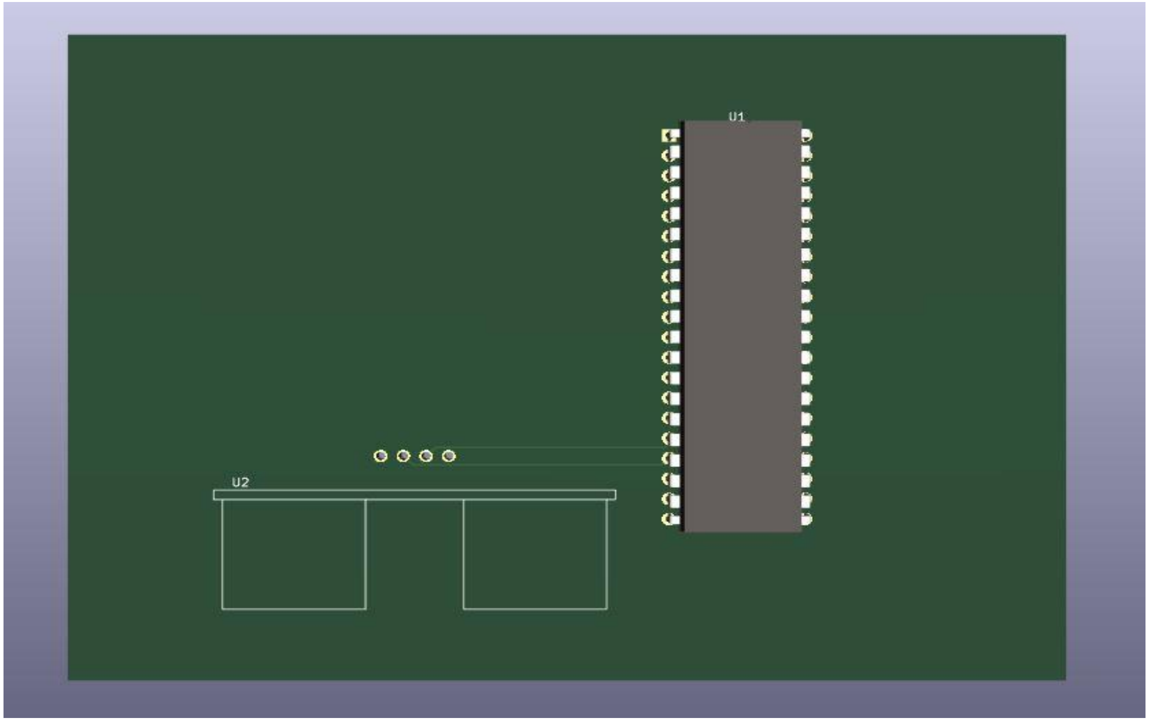

Figure 15 Component View of HC-SR04 Ultrasonic Sensor PCB Design

Coding part of the HC-SR04 ultrasonic sensor is shown below.

```
#define F_CPU 8000000
#include <avr/io.h>
#include <avr/interrupt.h>
#include <util/delay.h>
#include <stdio.h>
#include <stdbool.h>
#include <stdint.h>
#include "USART virt.h" //This header file is used to find what value is 20cm. It is
found that 20cm is equal to 83. (header file downloaded)

char txdata[20];
volatile uint16_t TimerCal=0;// variable to collect echo data
uint16_t ultraINT0=0;
DDRC=0xFF;//led and speaker (full port c defined as output)
DDRA|=(0b1111<<4);//motor


int main(void)
{       USART_Init(9600);

        /*Ultrasonic Timer Part*/
        DDRD|=(1<<3); //define pinD3 as output
        TCCR0|=(1<<WGM01);//Enable Compare match mode
        TCCR0|=(1<<CS11);//Start timer  prescaler =8
        TCNT0=0;
        OCR0=10;
        /*register value= time*(clock speed/prescale)
        register value=0.000001*(8000000/1)
        register value=10*/
        TIMSK|=(1<<OCIE0);//enable timer Compare inturrept
        sei();

    while (1)
    {
               PORTD&=~(1<<3);//TRIG pin low
               _delay_us(50);//wait 50 micro sec
               PORTD|=(1<<3);//TRIG pin high
               _delay_us(50);//wait 50 micro sec
               PORTD&=~(1<<3);//TRIG pin low

               while(!(PIND&(1<<2)))//while echo pin is not high
               TimerCal=0;//rest timer
               while((PIND&(1<<2)))////while echo pin is high
               ultraINT0=TimerCal;//copy timer value
               sprintf(txdata," %u\r\n",ultraINT0);
               USART_TxString(txdata);

               if (ultraINT0<83)
               {
                      PORTC|=(1<<7);//buzzer start ringing
                      PORTA=(PORTA&0x0F)|(0b0000<<4);//car stops
               }
```

```
            else
            {
                  PORTC&=~(1<<7);       //buzzer stop
                  PORTA=(PORTA&0x0F)|(0b0101<<4);//car moves again
            }

            _delay_ms(100);

      }
}

ISR(TIMER0_COMP_vect){//ultrasonic
       TimerCal++;
       TCNT0=0;
```

Figure 16 Coding Part of HC-SR04 Ultrasonic Sensor

9.3 205070F - Nimesha M.K.B

I was responsible for the two LEDs and the buzzer. In this project LEDs are used as signal lights. When the vehicle turns right the right side LED starts to blink and when it turns left the left LED starts to blink. This automated toy car is able to detect the objects in its path (on the Black line) and when an object is detected the car will stop and at the meantime the buzzer starts to ring until the obstacle is removed from that place. I also designed the full schematic circuit diagram of our system, block diagram and the 3D diagram.

Specifications of the buzzer is as follows [7].

Table 4 Specifications of the Buzzer

Frequency Range	3300Hz
Operating Temperature	– 20° C to +60°C
Operating Voltage	3V to 24V
Sound Pressure Level	85dBA or 10cm
Supply Current	below 15mA

In this project a buzzer is used in order to produce a beeping sound when the toy car detects an obstacle on the black line by using an ultrasonic sensor. The buzzer starts to produce a beeping sound until the object is removed. The buzzer is a sounding device that can convert audio signals into sound signals. It is usually powered by DC voltage.

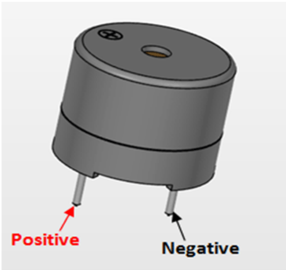

Figure 17 Pinout Diagram of the Buzzer

Specifications of the LED is as follows [8].

Table 5 Specifications of the LED

Forward Current (IF)	30mA
Forward Voltage (VF)	1.8V to 2.4V
Reverse Voltage	5V
Operating Temperature	-30℃ to +85℃
Storage Temperature	-40℃ to +100℃
Luminous Intensity	20mcd

In this project LEDs are used to indicate the turning of the car. When the car turns left the left LED will blink and when the car turns right, the right LED will blink. A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. It has two pins, ANODE and CATHODE.

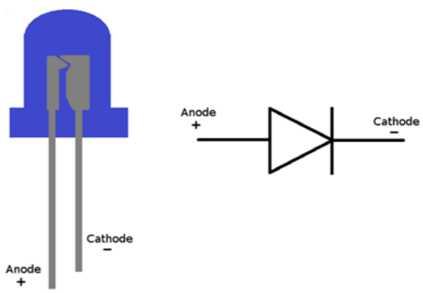

Figure 18 Pinout Diagram of the LED

Circuit diagram of how the buzzer and the LEDs should be connected to the MCU is shown below.

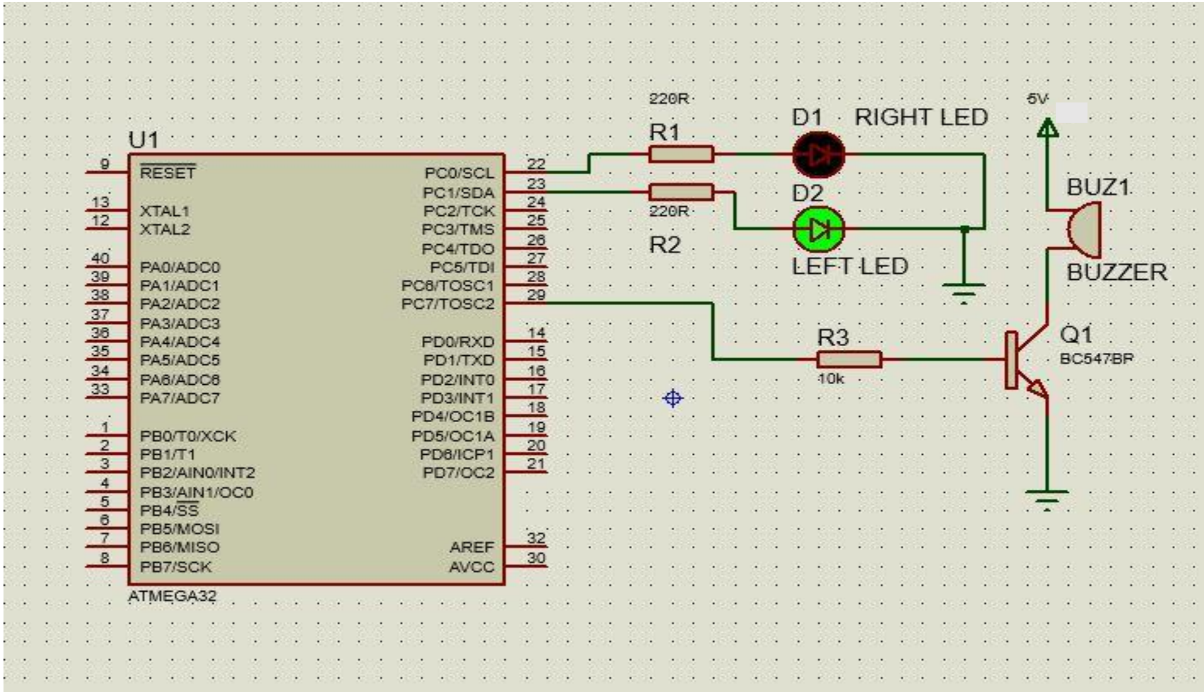

Figure 19 Schematic Diagram of LED and the Buzzer

PCB design for the LEDs are shown below.

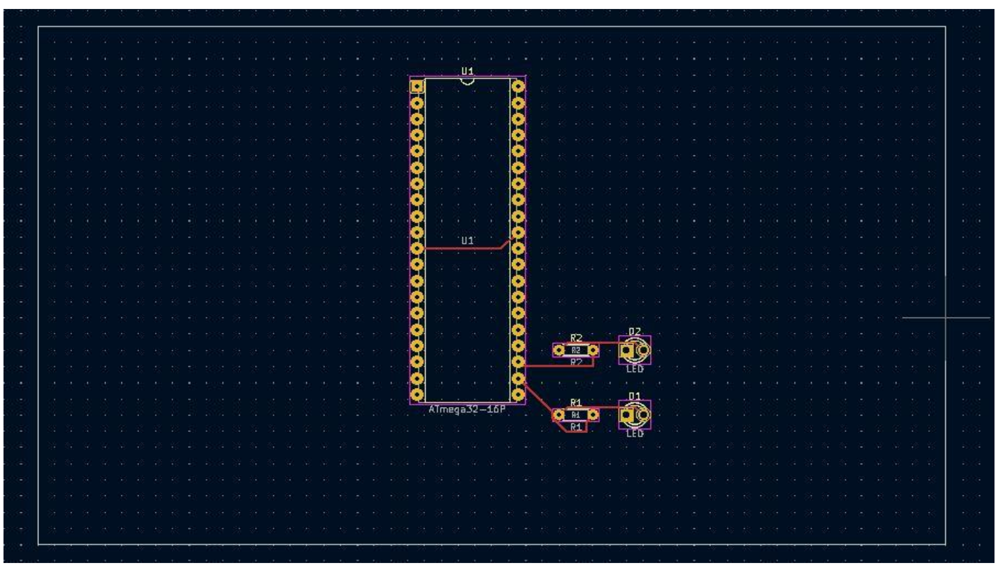

Figure 20 Silk Screen of the LED PCB Design

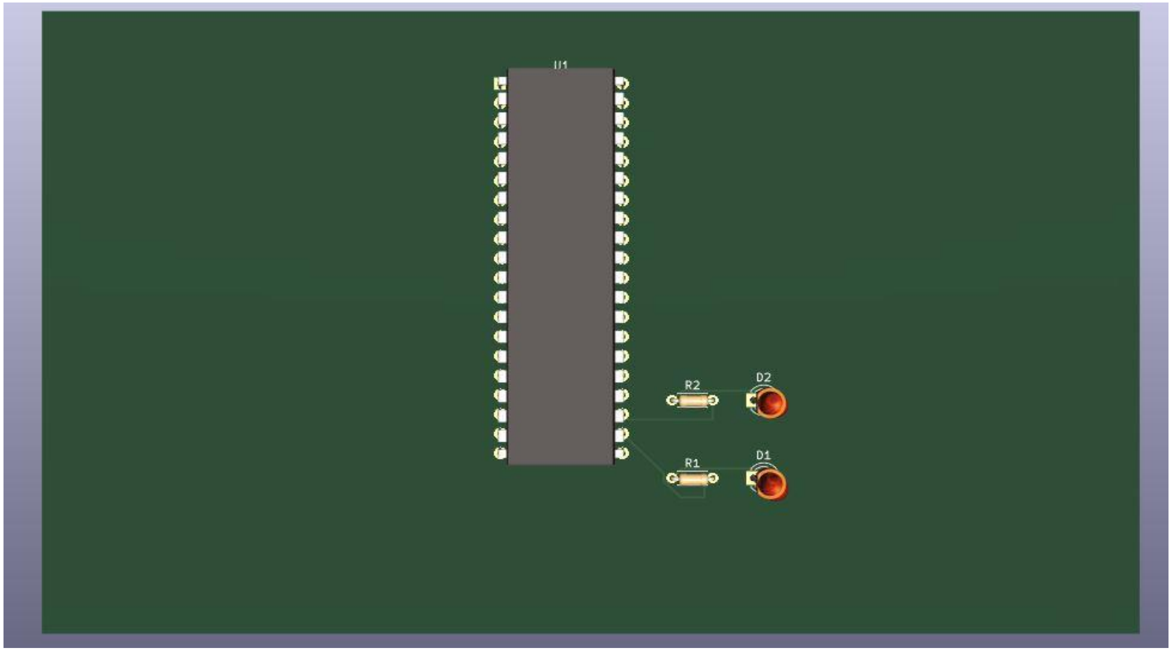

Figure 21 Component View of LED PCB Design

PCB design of the buzzer is shown below.

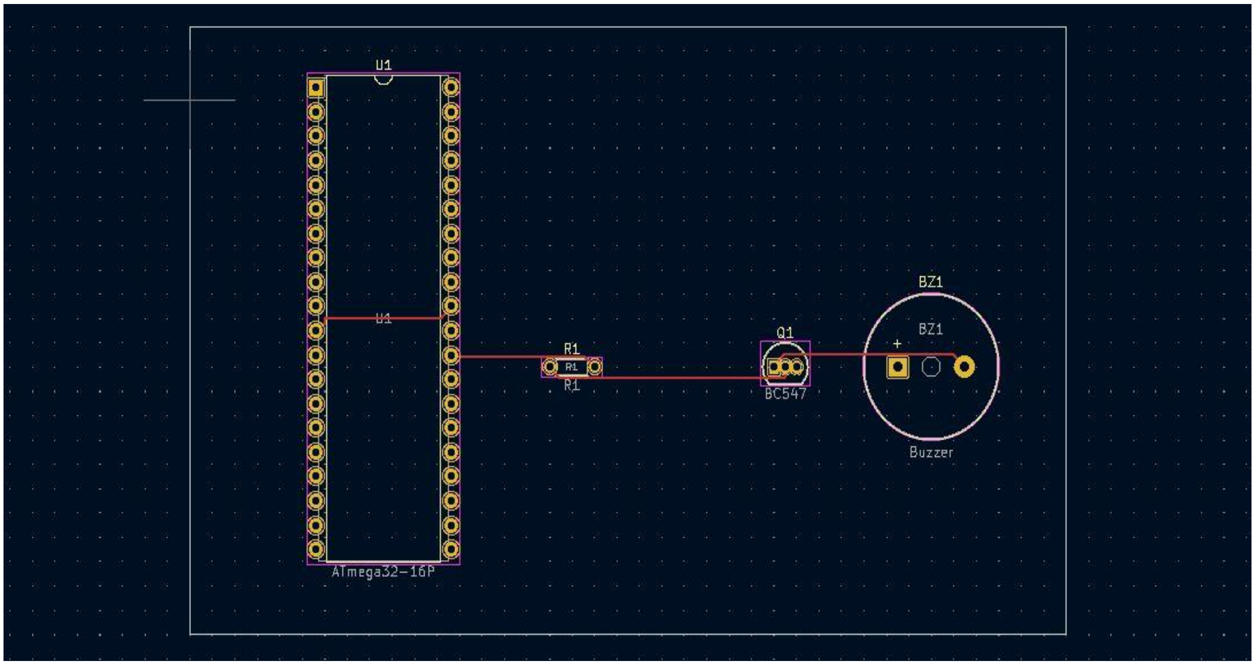

Figure 22 Silk Screen of the Buzzer PCB Design

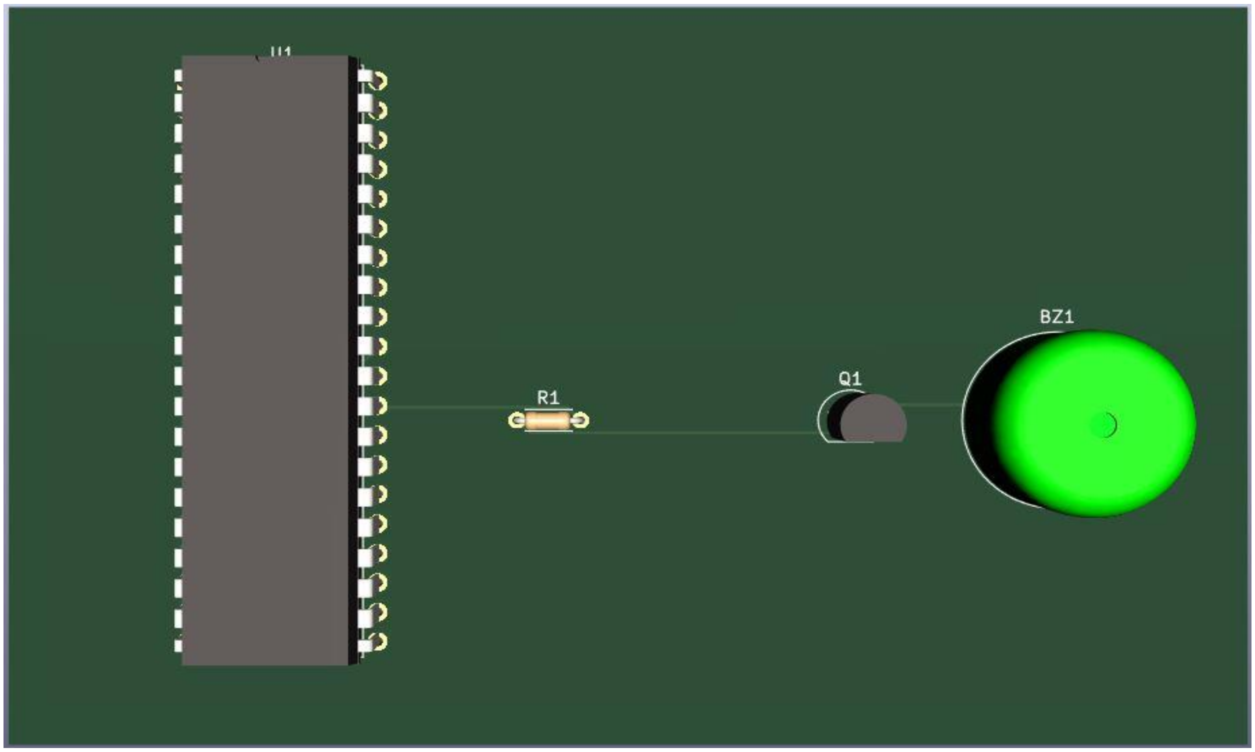

Figure 23 Component View of Buzzer PCB Design

Coding part of the buzzer and the LEDs are shown below.

```
#define F_CPU 8000000
#include <util/delay.h>
#include <avr/io.h>


uint16_t ultraINT0=0;

int main(void)
{
	DDRC=0xFF;
	PORTC=0xFF;
	
	DDRA|=(0b1111<<4);//motor
	
	while (1)
{
		if (ultraINT0<83) /*ultraINT0 means the timer value,
		if the timer value is less than 83 means, the ultrasonic sensor has
detected a object within 20cm range.
		So now the buzzer should start ringing. How the timer value taken is
done by the person who does ultrasonic sensor.
		So in this individual part buzzer won't ring as the value to the
```

```
		{
			PORTC|=(1<<7);//buzzer start
		}

		else
		{
			PORTC&=~(1<<7);		//buzzer stop
		}

		if (PORTA==(PORTA&0x0F)|(0b0110<<4))/* Car turning right, then right led
will blink as the right signal light.
		car turning right coding part is done by the person who does motor
driver & motors */

		{
			PORTC^=(1<<0); //right led blinking (right signal light)
		}

		else if (PORTA==(PORTA&0x0F)|(0b1001<<4)) /* when car is turning left,
*/

		{
			PORTC^=(1<<1); //left led blinking (left signal light)
		}

		else/* when car is not turning anywhere */

		{
			PORTC&=~(0b11<<0); //both signal lights off
		}
	}
}
```

Figure 24 Coding Part of LEDs and Buzzer

9.4 205107D - Thathsaranee K.T

In our hardware project, I was assigned to connect DC gear motors for the toy car. The purpose of the DC gear motor is to move the toy car. The toy car uses four wheels to move from one point to another point. In order to operate four wheels, each wheel should have a DC gear motor. But gear motor is not able to connect with the microprocessor directly. Gear motors are connected to the microcontroller using the L298N motor driver. I also did report writing along with another member and designed the full PCB board.

Specifications DC gear motor 200 RPM is as follows [5].

Table 6 Specifications of DC Gear Motors

Operating Voltage	3V~6V
Operating Current	150mA +/- 10%
Min. Operating Speed (3V)	90+/- 10% RPM
Min. Operating Speed (6V)	200+/- 10% RPM
Stall Torque (3V)	0.4kg.cm
Stall Torque (6V)	0.8kg.cm
Gear Ratio	1:48
Body Dimensions	70 x 22 x 18mm
Wires Length	200mm & 28 AWG

In this project, four DC gear motors are used to move the toy with the aid of a motor driver. A gear motor is an all-in-one combination of a motor and gearbox. The addition of a gear head to a motor reduces the speed while increasing the torque output. The most important parameters in regards to gear motors are speed (rpm), torque (lb-in), and efficiency (%). In order to have complete control over the DC gear motor, we have to control its speed and rotation direction. This can be achieved by combining these two techniques. (PWM, H-Bridge).

The L298N is a dual-channel H-Bridge motor driver capable of driving DC motors. That means it can individually drive up to two motors making it ideal for building two-wheel robot platforms. Here, 4 motors will be connected with a parallel connection so that it is able to connect all the 4 motors to one L298N module. Pins of L298N Motor driver are VCC, GND, 5V, ENA pins, IN pins and OUT pins. DC gear motors are connected to the L298N module. Then L298N module is connected to the Atmega32.

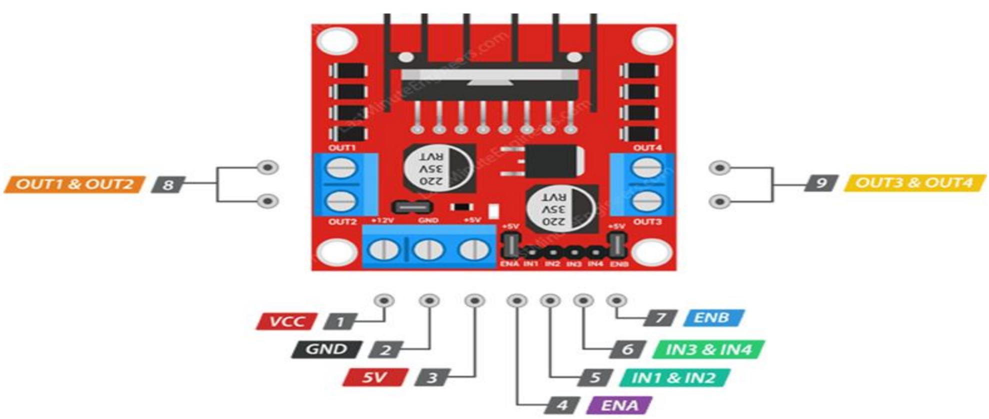

Figure 25 Pinout Diagram of L298N Motor Driver

Circuit diagram of how the DC gear motors and the L298N Motor driver should be connected to the MCU is shown below.

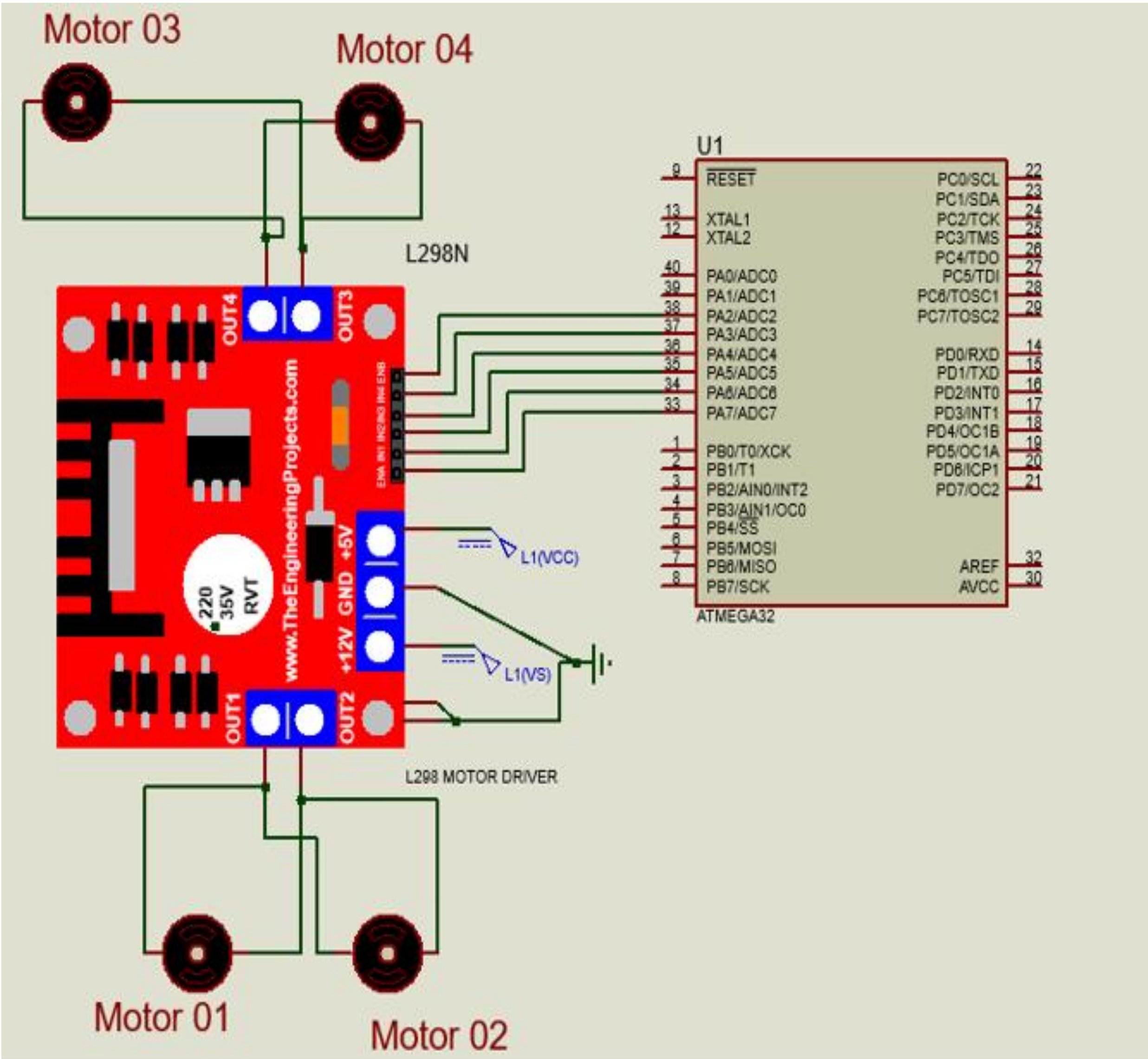

Figure 26 Schematic Diagram of Motor Driver and the DC Gear Motors

PCB design for the motor driver and the DC gear motors are shown below.

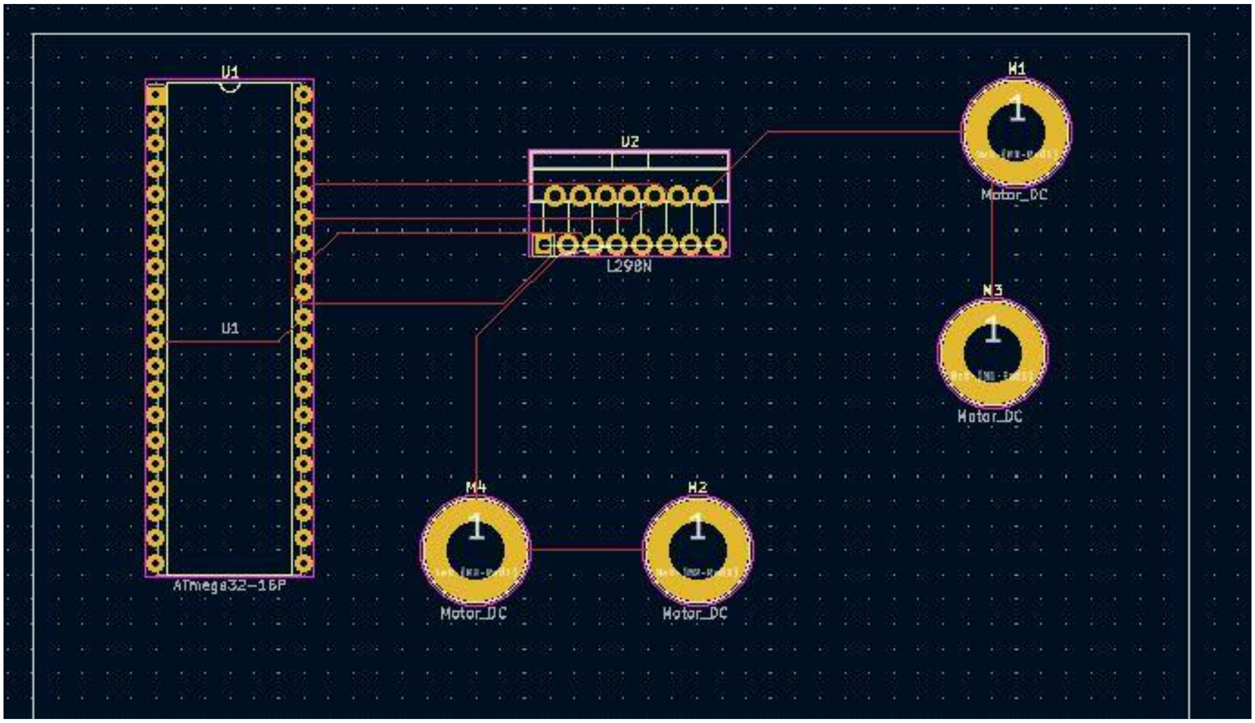

Figure 27 Silk Screen of Motor Driver and DC Gear Motors PCB Design

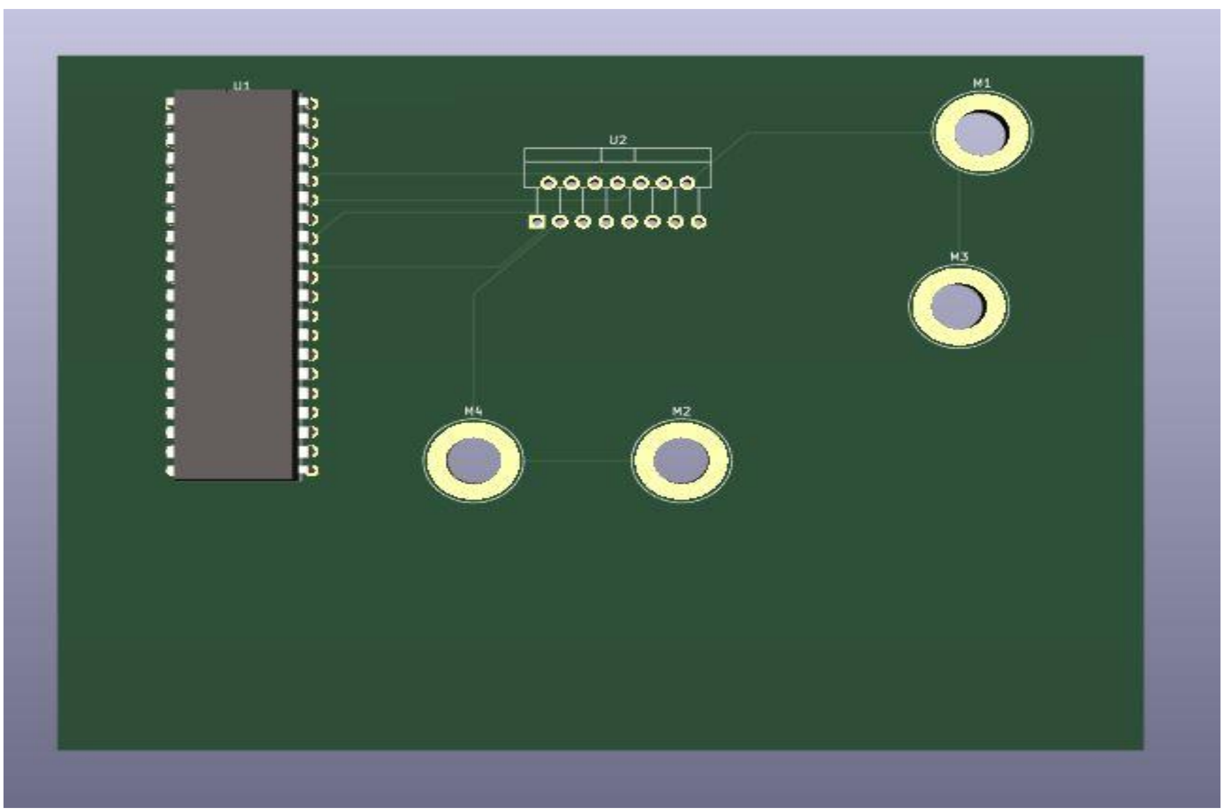

Figure 28 Component View of Motor Driver and DC Gear Motors PCB Design

Coding part of the DC gear motors and the motor driver is shown below.

```
#define F_CPU 8000000
#include <avr/io.h>
#include <util/delay.h>


int main(void)
{
	DDRA|=(0b1111<<4);
	
	PORTA=(PORTA&0x0F)|(0b0101<<4);//forward
	_delay_ms(2000);
	PORTA=(PORTA&0x0F)|(0b1010<<4);//reverse
	_delay_ms(2000);
	PORTA=(PORTA&0x0F)|(0b1001<<4);//left
	_delay_ms(2000);
	PORTA=(PORTA&0x0F)|(0b0110<<4);//right
	while (1)
	{
	}
}
```

Figure 29 Coding Part of Motor Driver and DC Gear Motors

9.5 205124C - Sandamini M.D.R

In this project, I was responsible for interfacing the Bluetooth module with the Atmega 32 microcontroller. Basically, in this project Bluetooth is used to control the car remotely. My task is to get the commands from the mobile phone in order to control the car. I also did the animation video showing the functionality of our project and designed the full PCB board.

Specifications of HC-05 Bluetooth Module is as follows [6].

Table 7 Specifications of HC-05 Bluetooth Module

Bluetooth protocol	Bluetooth Specification v2.0+EDR(Enhance Data Rate)
Frequency	2.4GHz ISM band
Modulation	GFSK(Gaussian Frequency Shift Keying)
Emission power	≤-84dBm at 0.1% BER

Speed	Asynchronous communication: 2.1Mbps(Max) / 160kbps, Synchronous communication: 1Mbps / 1Mbps
Security	Authentication and encryption
Profiles	Bluetooth serial port
Supply Voltage	+3.3V to 6.0 V
Supply Current	30mA
Working temperature	-20 ~ +75Centigrade
Dimension	26.9mm x 13mm x 2.2 mm

HC-05 Bluetooth module is a Bluetooth to serial converter that connects the microcontroller to other Bluetooth enabled devices(mobile phone).The Bluetooth module is used to control the car remotely using a mobile phone apart from its main functions, line following and object detection. Especially if the car is not on a black line, by using Bluetooth we are able to take it to the correct path. Bluetooth module has six pins. ENABLE, VCC, GROUND, TX(Transmitter), RX(Receiver) and STATE.

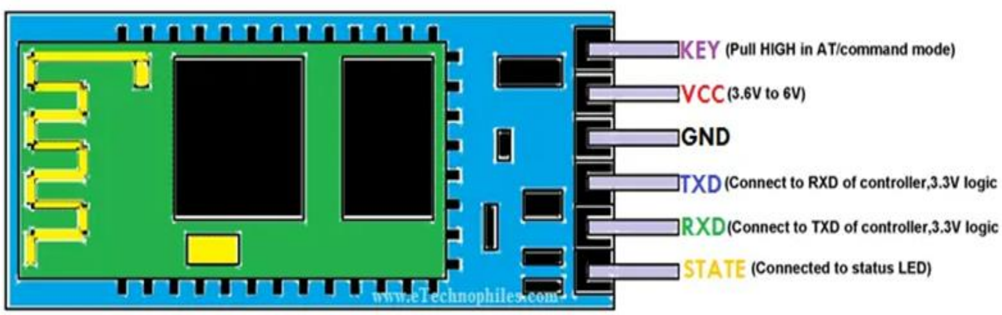

Figure 30 Pinout Diagram of HC-05 Bluetooth Module

Circuit diagram of how the HC-05 Bluetooth module should be connected to the MCU is shown below

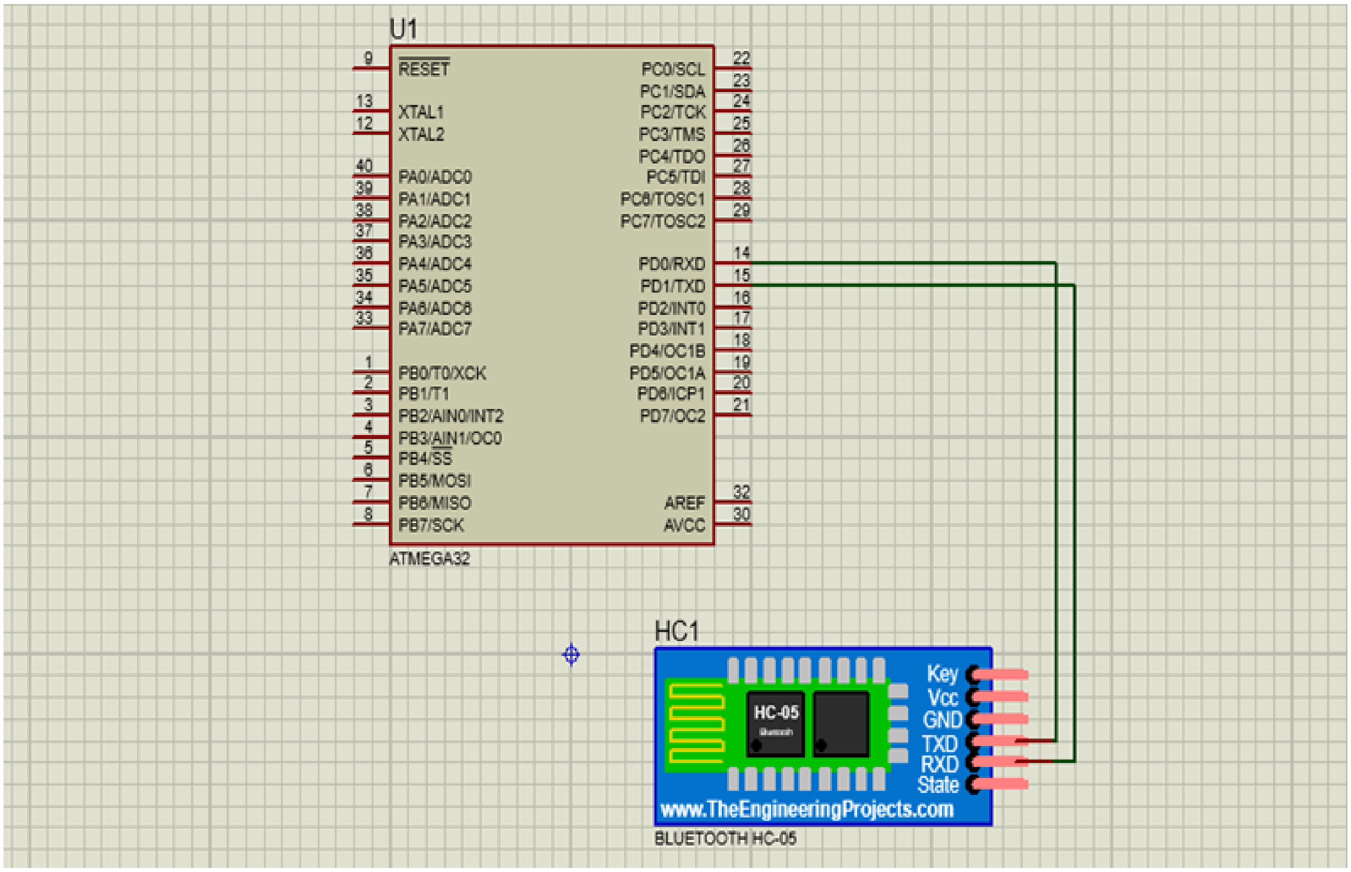

Figure 31 Schematic Diagram of HC-05 Bluetooth Module

PCB design of the HC-05 bluetooth module is shown below.

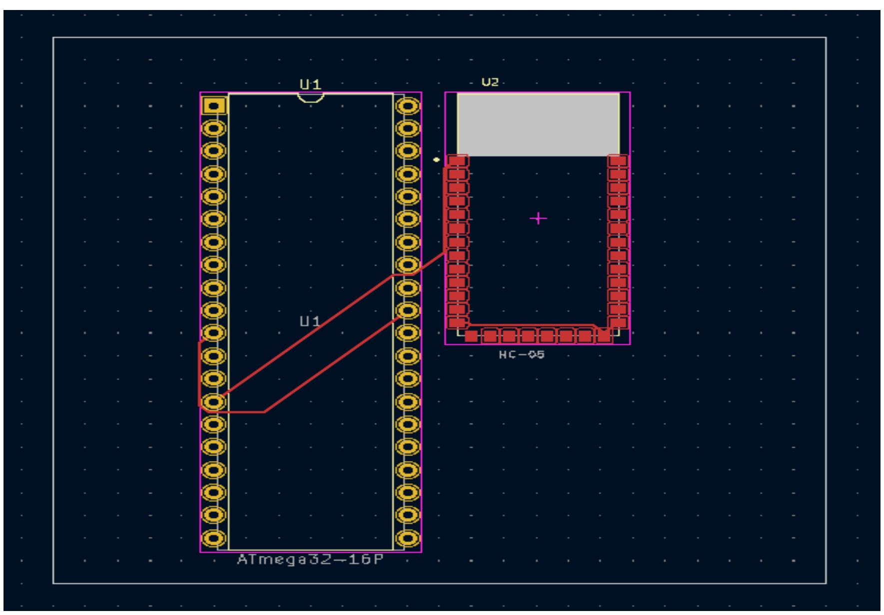

Figure 32 Silk Screen of HC-05 Bluetooth Module PCB Design

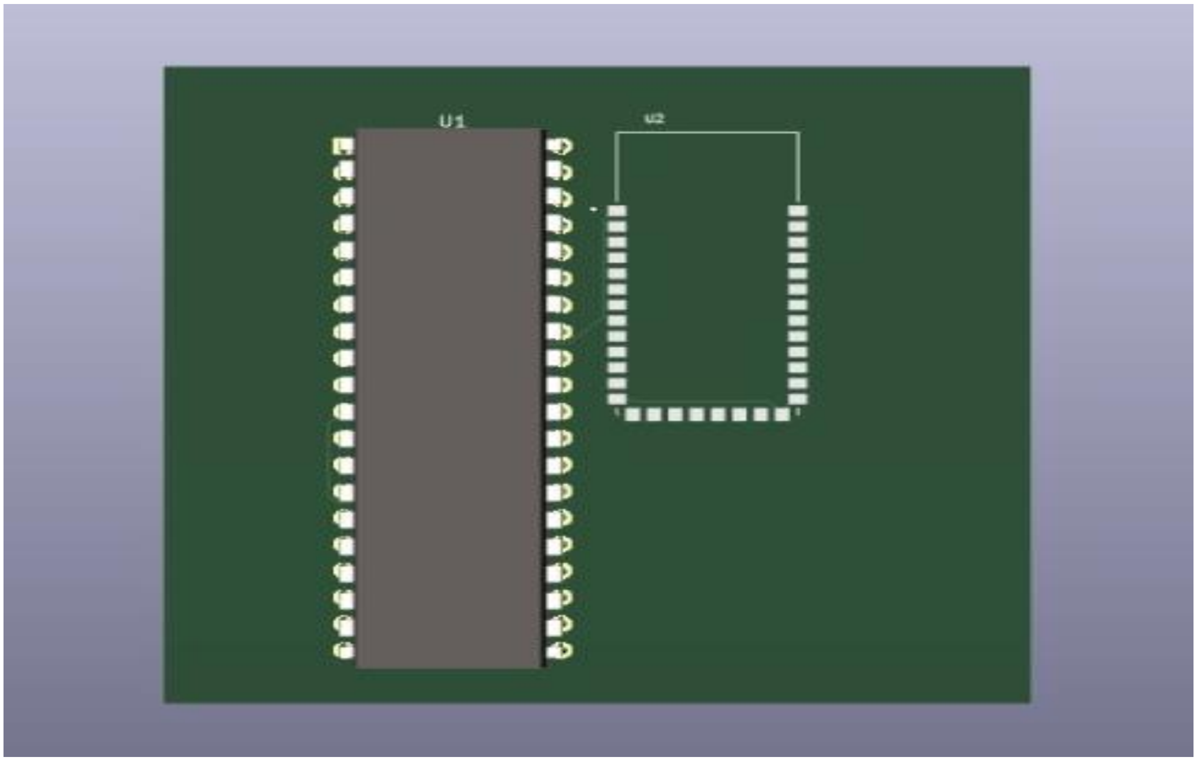

Figure 33 Component View of HC-05 Bluetooth Module PCB Design

Coding part of the HC-05 bluetooth module is shown below.

```
#define F_CPU 8000000
#include <util/delay.h>
#include <avr/io.h>
#include <avr/interrupt.h>
#include <stdio.h>

uint8_t rchar;

int main(void)
{
	DDRC=0xFF;
	DDRA|=(0b1111<<4);
	/*Set baud rate */
	UBRRH = (unsigned char)(51>>8);
	UBRRL = (unsigned char)51;
	/*Enable receiver and transmitter */
	UCSRB = (1<<RXEN)|(1<<RXCIE);
```

```c
	/* Set frame format: 8data, 1stop bit */
	UCSRC = (1<<URSEL)|(1<<USBS)|(3<<UCSZ0);
	sei();

	while (1)
	{
		if (rchar==107)
		{
			PORTC|=(1<<0);
			rchar=0;
		}
	}
}

ISR(USART_RXC_vect){//F B L R s

	rchar=UDR;
	if (rchar)
	{
		switch(rchar){
			case 70:PORTA=(PORTA&0x0F)|(0b0101<<4);break;//foward
			case 66:PORTA=(PORTA&0x0F)|(0b1010<<4);break;//back
			case 76:PORTA=(PORTA&0x0F)|(0b1001<<4);break;//left
			case 82:PORTA=(PORTA&0x0F)|(0b0110<<4);break;//right
			case 83:PORTA=(PORTA&0x0F)|(0b0000<<4);break;//stop
		}
		_delay_ms(100);
		rchar=0;
	}
}
```

Figure 34 Coding Part of HC-05 Bluetooth Module