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Design a Compact Robotic Car Based on Microcontroller

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Abstract: ***The proposed product aims to design a compact robotic car which can be remotely controlled by a keyboard. The detailed information on the research, design and construction of a real-time remote control robotic car. The command to the robotic car will be given remotely through a keyboard. A comparative study has been implemented on the major components to be used in this project. They include microcontrollers, propulsion, sensors, power supplies, etc. The basic prototype which can be remotely controlled to move forward, reverse and change direction. The prototype consists of Atmel microcontroller, AT89C2051, based transmitter and receiver. The transmitter acts as a remote control which sends command to the receiver. The receiver is mounted on a chassis with motors and wheels attached. Received signals are decoded to control the movements of the motors. C / C++ programming language are used to create the interface within the receiver and transmitter. The prototype is compact, portable and operates like a normal car. It will be able to turn left, turn right, forward and reverse. All movements of the prototype are remotely controlled via the transmitter. Traction or speed control is achieved through generation of Pulse Width Modulation (PWM) codes. The PWM codes will vary the rotational speed of the motor.***

Keywords: robotic car, Atmel microcontroller, C/C++programming language ,Dc motor, PWM

1. Introduction

Modern day technology has seen the development of different types of robotic used in our everyday lives. So, what is a robot? A robot is an automatically guided machine which is able to do tasks on its own, almost always due to electronically-programmed instructions. These instructions are stored in microcontrollers.

A common application of robots is for use in places that are deemed too hazardous for humans to go. Industries where nuclear materials are used often make use of robots so that human workers are not exposed to the dangerous effects of radioactive materials. By implementing this system it can be used to assist in a number of purposes such as in search and rescue missions. If guided by a computer or laptop with the use of a video camera, this robot can go into dangerously polluted environment such as chemical spill or radioactive "hot zones" in nuclear power plants. By upgrading it can explore areas with extreme radiation that would highly lethal to human.

This project aims to design a compact robotic car based on microcontroller. The instructions to control the vehicle will be stored in the microcontroller, which will be the "brain" of the robotic car. The robotic car will be remotely controlled via a keyboard.

2. Objectives of the Project

- The main objective of this project is to create a prototype robotic remote control car which can be remotely controlled to move forward, reverse and change direction
- To use C/C++ language for developing program and system optimization**.**
- To know the microcontroller its features and its operation can analyze the data and operate properly.
- To know the technology of embedded system design

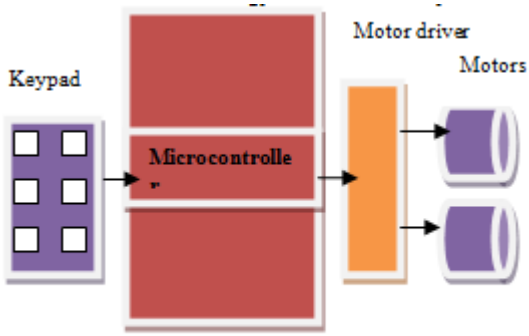


Figure 1: Block Diagram of the system

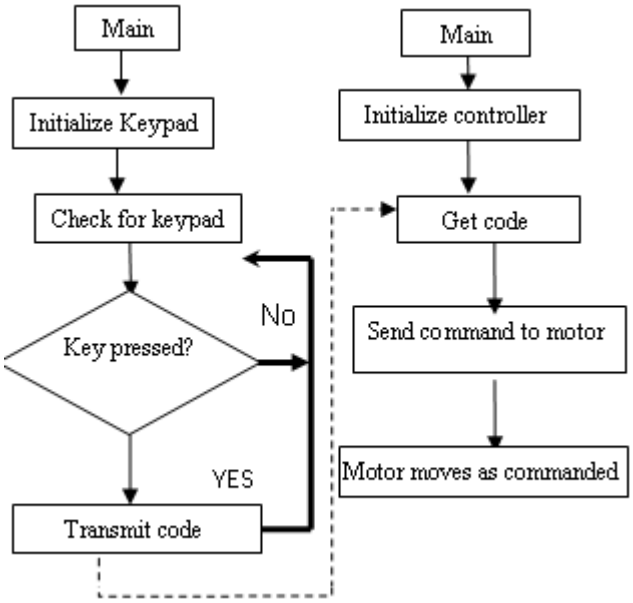


Figure 2: Robotic Car Algorithm Flowchart

Figure 2 shows the robotic algorithm flowchart. Briefly, upon power-up, both the keypad and controller will be initialized. The keypad will enter a loop to check for the key pressed. When a key is detected, the code corresponds to the

matrix will be transmitted to the controller circuit. When the code is received, it will be decoded and command the motor to move.

3. Hardware Design

3.1 Power Supply Circuit

The two power supply circuits are required; one for the transmitter module and the other for the receiver module. In both circuits, the LM7805A regulator is used to provide a constant step down voltage of 5V (maximum current: 1A) to different components.

A standard 9V alkaline battery provides the power requirements of the transmitter circuit. The 9V input is regulated by the LM7805A to provide a constant 5V power supply to the RF transmitter and the Atmel Microcontroller IC (AT89C2051). The transmitter's power supply circuit is shown in Figure 3

A 10 cells 1.2 alkaline battery-pack will provide 12 volts input to the receiver circuit. Similarly, the 12V input is regulated by the LM7805A to provide a constant 5V power supply to the RF receiver and the Atmel Microcontroller IC (AT89C2051). The 12V input is used to drive the motors via the L293D motor driver. The receiver's power supply circuit is shown in Figure 4

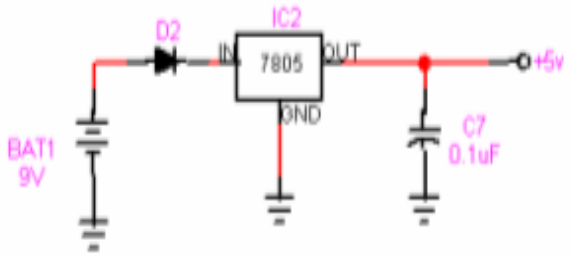


Figure 3: Transmitter power supply Circuit

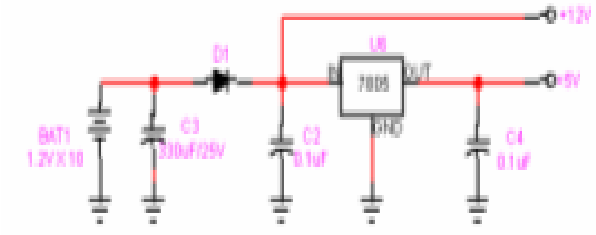


Figure 4: Receiver power supply Circuit

3.2 The Atmel AT89C2051 Microcontroller

In this project, the main application requirement of the microcontroller is to provide motor control function, which require relatively low signal rate of 50 to 100 milliseconds. Since the speed of processing is not critical in this project, an 8-bit microcontroller will be sufficient. The most popular choice of microcontrollers for such an application would be Atmel AT89C 2051.

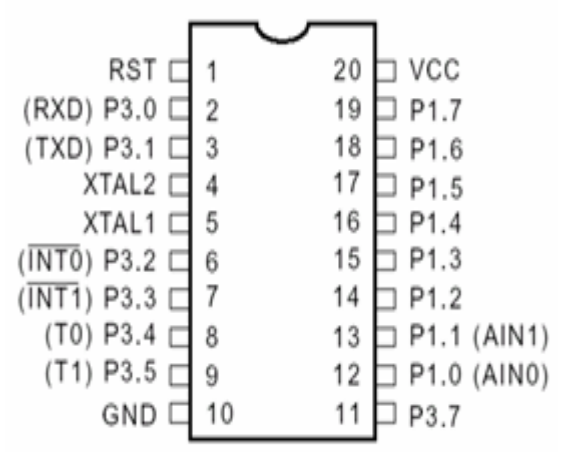


Figure 5: Pin Layout for Microcontroller AT89C2051

3.3 The Transmitter Circuit

The schematic of transmitter circuit is shown in Figure 6:

A 3x2 matrix keypad - They are configured to provide left, right, forward, backward, speed increase and decrease functions. Wireless transmitter module, TX1-433.92MHz. – This is connected to an antenna for the transmission of user input to the receiver module. It has a maximum range of 100 feet at 4800 bps data rate.

The AT89C2051 microcontroller – Acts as an interface between the keypad and the RF transmitter. LM7805 voltage regulator will provide 5V regulated power to the circuit.

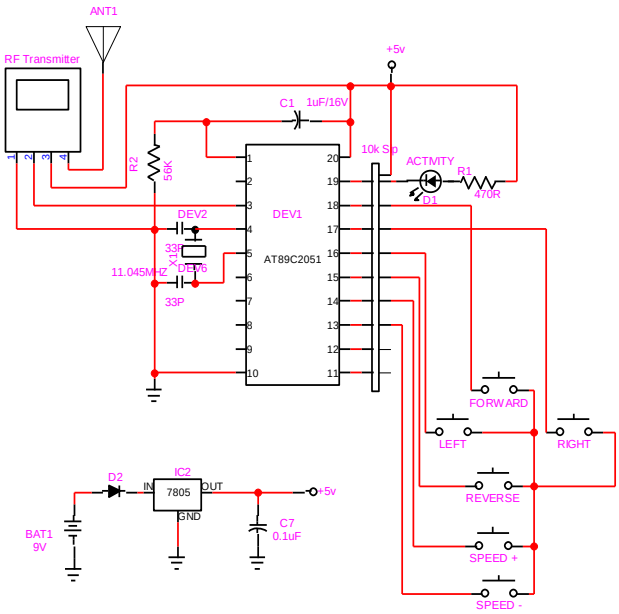


Figure 6: Schematic transistor circuit

3.4 The Receiver Circuit

The schematic of receivercircuit is shown in figure 7:
Wireless receiver module, RX-433 which is connected to an antenna for the reception of the transmitted signal. The received signal is then send to the microcontroller for processing. The AT89C2051 microcontroller will receive the transmitted codes. The L293D motor drivers are

quadruple high-current half-H drivers, Figure 8. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. This device is designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. The clamping diodes are built into the chip which prevent the back EMF generated by the motors to harm the H-bridge. the bidirectional DC motor control for M1, can be provided by pin 1 to pin 7 of L293D. This control is shown in Figure 9

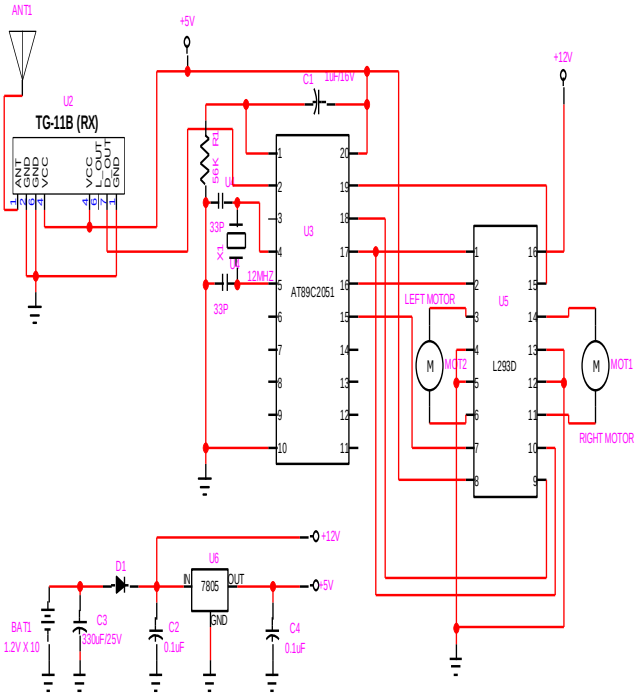


Figure **7:** Receiver Circuit

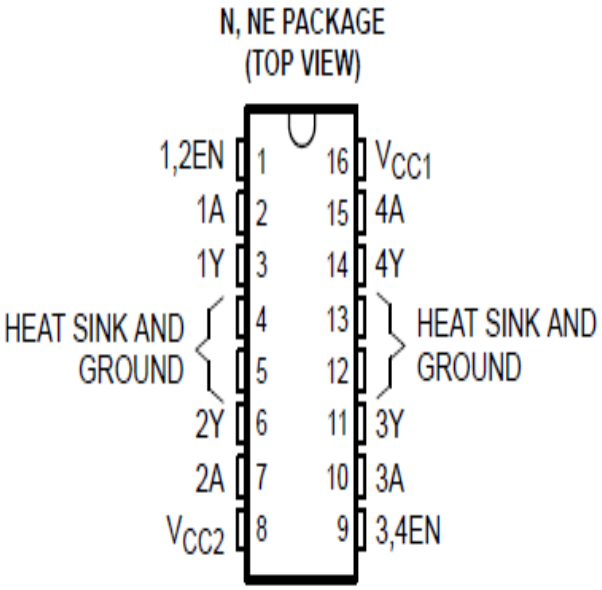
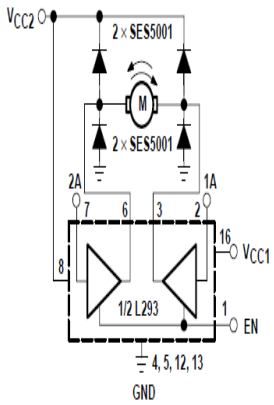


Figure 8: Pin Configuration of L293D Quadruple High-Current Half-H Drivers



EN	1A	2A	FUNCTION
H	L	H	Turn right
H	H	L	Turn left
H	L	L	Fast motor stop
H	H	H	Fast motor stop
L	X	X	Fast motor stop

L = low, H = high, X = don't care

Figure 9: Bidirectional DC Motor Control

4. Software Design and Algorithm

The software design of his project consists of two programs: the transmitter program and the receiver program. The transmitter program is responsible for decoding the user's input from the keypad while the receiver program is responsible for receiving this input. Thereafter, the receiver program will decode this input before sending it to command the motor driver.
The following coding is required in both sets of program to configure the UART serial channel.

```
/*-------------------------------------------
Configure the serial port to run at 300 Baud.
-------------------------------------------*/
 TMOD = 0x20;/* timer 1, mode 2, 8-bit reload */
 SCON = 0x50; /* mode 1, 8-bit uart, enable receiver */
TH1 = 0xA0; //Baud rate 300
TR1 = 1; /* start the timer */
```

The following codes describe the ports declaration in the transmitter program.

```
sbit led=P1^7; //define ports
sbit front=P1^4;
sbit back=P1^1;
sbit left=P1^3;
sbit right=P1^2;
sbitspeedp=P1^6;
sbitspeedm=P1^5;
```

The following codes describe the ports declaration in the receiver program.

```
sbit enm1=P1^5; //Motor1 Enable pin
sbit pm1=P1^6; //Motor1 Positive pin
sbit mm1=P1^2; //Motor1 Negative pin
sbit enm2=P1^3; //Motor2 Enable pin
sbit pm2=P1^4; //Motor2 Positive pin
sbit mm2=P1^7; //Motor2 Negative pin
```

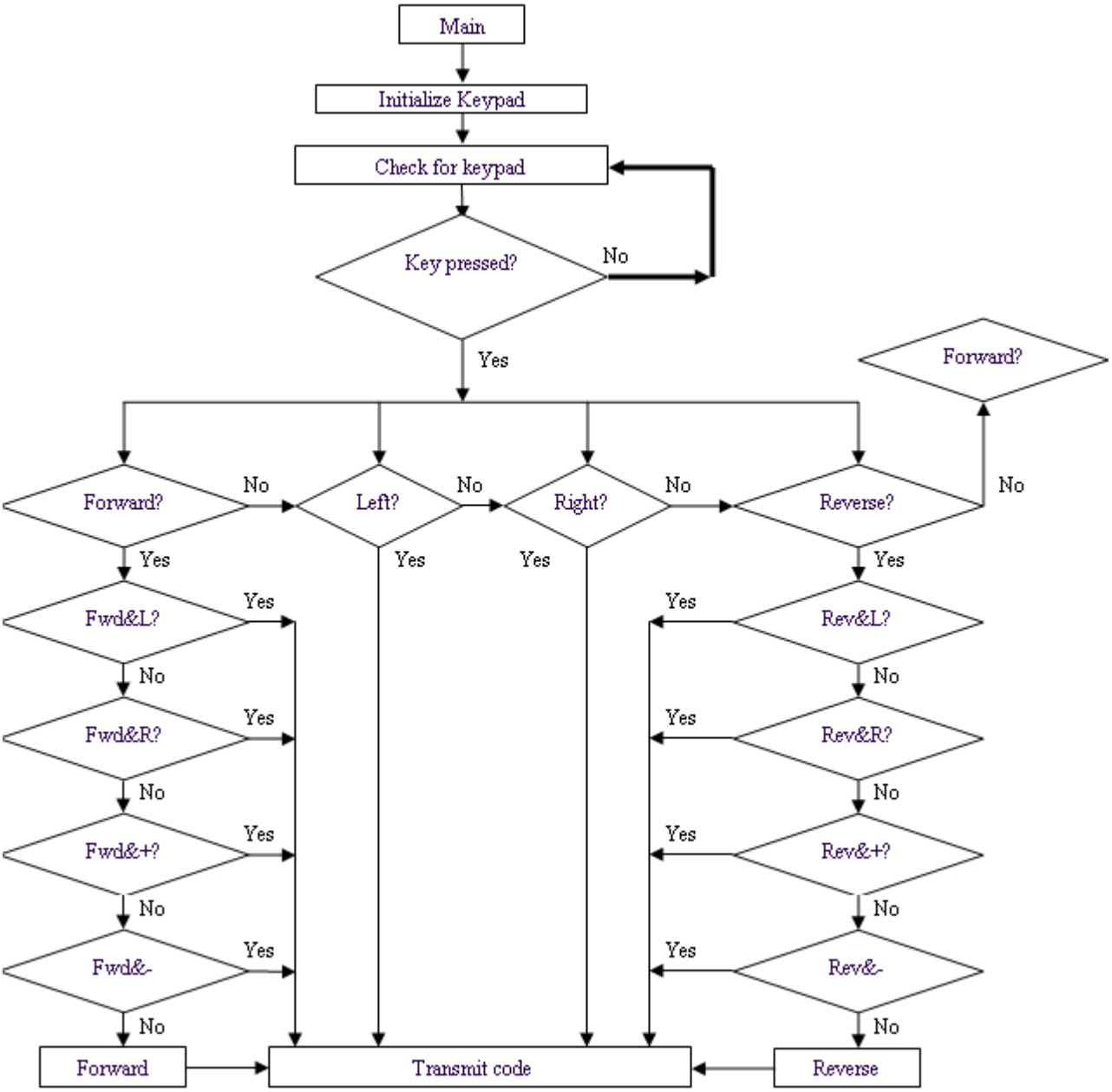


Figure 10: Transmitter Algorithm Flowchart

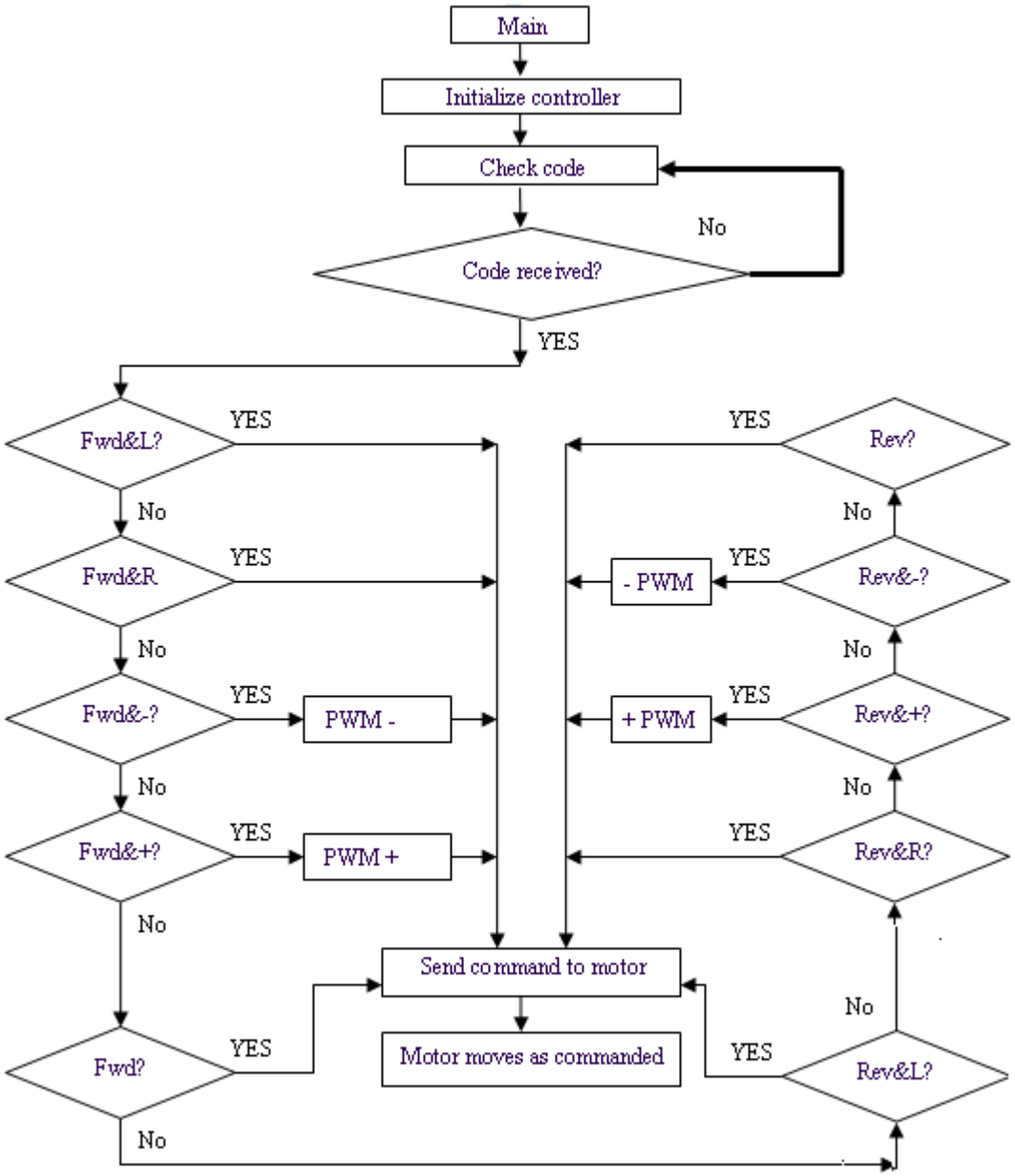


Figure 11: Receiver Algorithm Flowchart

5. Conclusions

This project has achieved the main objectives. This prototype was constructed around2Atmel AT89C2051 microcontrollers, which provide processing power on the transmitter and receiver. The transmitter is the remote control keypad which sends command to the receiver. The receiver is combined with the chassis, motors and wheels to form the robotic car. User's input on the keypad is processed by the microcontroller for transmission through the RF transmitter. This transmitted signal is then received by the RF receiver and further decoded by the microcontroller to control the movements of the motors through the L293D motor driver. On the robotic car, traction or speed control is achieved through generation of Pulse Width Modulation (PWM) codes. The PWM codes will vary the rotational speed of the motor.

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