CAR PROJECT REPORT

Aim: Building a Wireless Remote Controlled Rechargeable Monster Truck.

Introduction:

Robotics is the study of robots. Robots are machines that can be used to do jobs. It helps to reduce the human efforts and provide them ease. These technologies deal with automated machines that can take the place of humans. Today, robotics is a rapidly growing field, as technological advances continue; researching, designing, and building new robots that serves various practical purposes.

A robot is a mechanical or virtual artificial agent, usually an electro-mechanical machine that is guided by a computer program or electronic circuitry. Robots can be autonomous or semi-autonomous and range from humanoids such as Honda's Advanced Step in Innovative Mobility (ASIMO) and TOSY's TOSY Ping Pong Playing Robot (TOPIO) to industrial robots, medical operating robots, patent assist robots, dog therapy robots, collectively programmed swarm robots, UAV drones such as General Atomics MQ-1 Predator, and even microscopic nano robots.

I have tried to create a WIFI controlled Monster Truck using widely used chip boards for embedded applications ex. Arduino and ESP boards. This car is designed to be controlled by a mobile application thereby reducing cost of developing a hardware remote. It has powerful geared motors which provide it high thrust and good speed. Body of the monster truck is custom designed for this application which makes it perfectly optimised for components used internally.

Members:

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Specifications:

- Height - 11 cm
- Length - 15 cm
- Breadth – 9 cm
- Ground clearance – 2.5 cm
- Weight - 2 kg
- Battery life – 1000 charge cycles

Features:

- High ground clearance
- 4 wheel drive and 2 wheel drive
- Splash proof
- Fast response
- Omni directional movement
- High torque
- Sufficient traction
- Suspension
- Wireless controlling by mobile application
- Speed controlling

Materials used:

- One Node MCU
- One Arduino UNO
- Two L298 motor controllers
- Four 12V Johnson DC geared motor with 500 rpm, stall torque 6kgcm, no load current 0.8A(max), load current 9A(max)
- Four 1:10 RC Monster Truck tires 12mm?
- Four 1/18 Metal shock absorbers 65mm?
- Custom designed metal chassis (having upper and lower parts for complete covering and splash proofing)
- One 14.8V 6600 mAH battery
- 15V 1A DC Adapter

Research for Alternatives:

- Arduino UNO + ESP 8266

  Problem - High delay and slow response

- Webmos D1 ESP8266 Development Board

  Problem -

- 1:10 RC model Rubber tires

  Problem - Low traction and inadequate ground clearance

- Commercially available chassis

  Problem - Does not meet our design requirements

- 12 V DC geared motor 300 rpm, 1.5 kg-cm

  Problem - Insufficient power and torque

- Blink pick and drop application

  Problem - Delayed response and connection problem

- Battery level indicator

  Problem - We tried to make our structure splash proof and attaching of battery level indicator would lead to many holes in upper chassis from where the water could seep into our circuit

Structure Designing:

Commercially available chassis did not meet following requirements :

- Splash proof body which can’t be achieved due to many unnecessary holes
- External axel shaft required so that shock absorbers can be attached
- So, we went to make our own customized chassis and axel which can be seen in the below photos

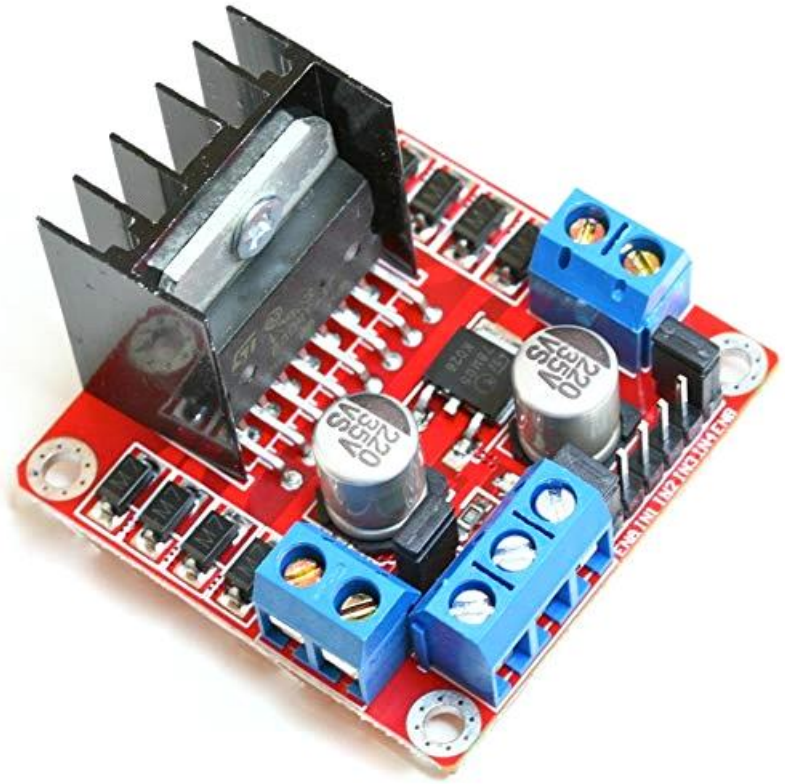
- Finally, the body was painted black to give its final appearance.
- The main problem with this chassis (that we realized after our car completion) is that it weighted too much and hence decreased the car's performance.

Circuit Designing:

Circuit design can be understood with the following points :

- We had a heavy duty dc geared motor with stall torque 6kgcm for pulling heavy weight RC car even on the inclined planes, ditches with ease. Although it provided max load current of 9A but we did a laboratory test which concluded that we need not more than 2A.

- That's why we used two L298N H-bridge motor drivers which provided 2A per bridge maximum current, 25W max power consumption per board . One board can drive two motors. It could provide direction control, speed control through PWM. It can provide 5v output voltage that we used as power supply for Arduino UNO. it could be powered using 5V-35V power supply.



- To power this powerful monster RC car we used one 14.6v 6600Mah Li-ion battery consisting of 12 cells each having 3.7 volts. It has long-life upto 1000 charging cycles. It is provided with inbuilt charging and discharging protection circuit.

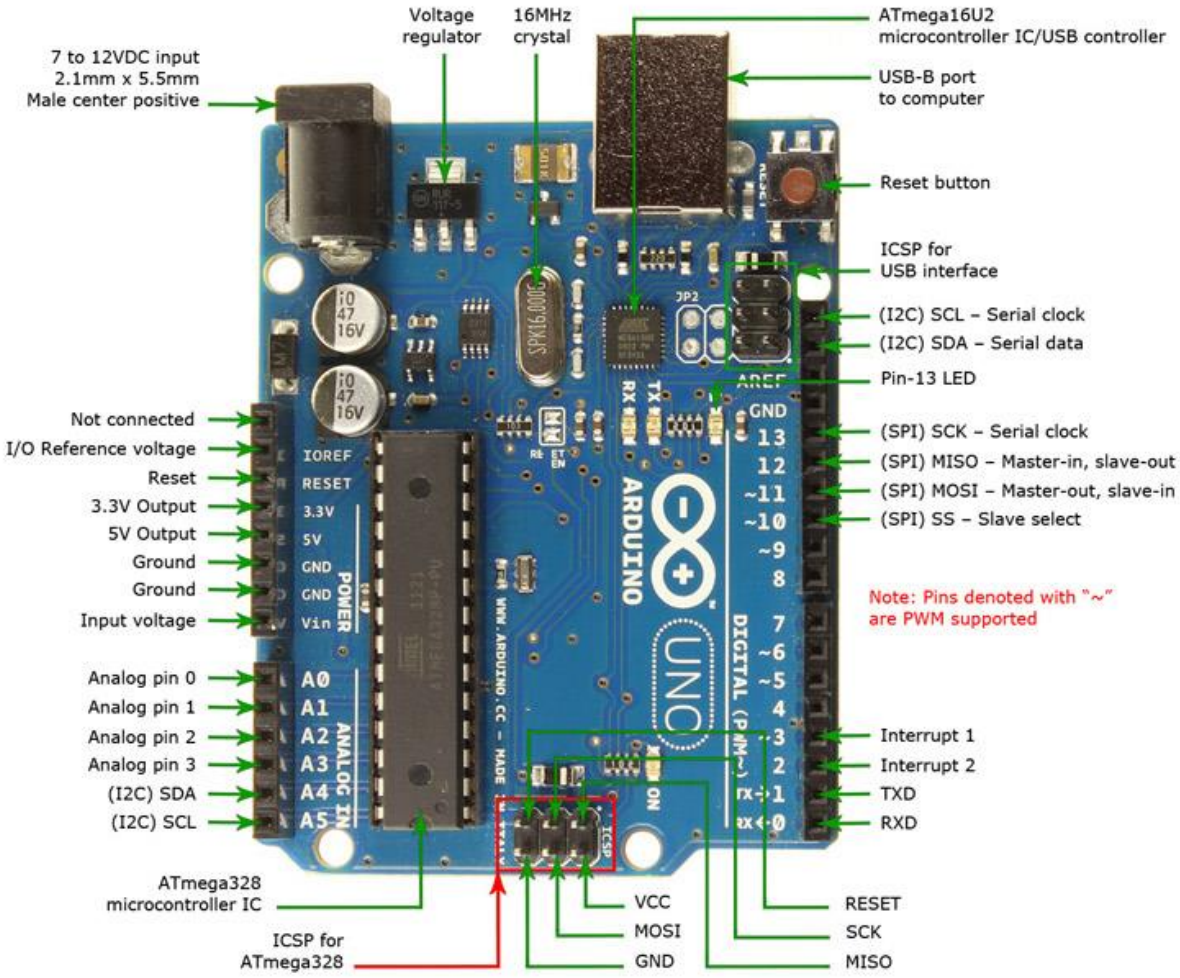
Specifications of Battery

- **Very Small in size and weight compared to Ni-Cd, Ni-MH and Lead Acid Batteries**
- **Discharge current up to 13.2A**
- **Long life with full capacity for up to 1000 charge cycles**
- **Charging current 2A**
- **12 X Li-ion 3.7V 2200mAh cells (4S3P)**
- **Compatible charger: 15V 1A/2A Smps with DC jack**
- **Low maintenance**
- **Inbuilt charge protection circuit**

- To control this whole set up we used Arduino UNO as controlling unit. The specifications of Arduino UNO is given below.

Microcontroller	ATmega328P – 8 bit AVR family microcontroller
Operating Voltage	5V
Recommended Input Voltage	7-12V
Input Voltage Limits	6-20V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	32 KB (0.5 KB is used for Bootloader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz

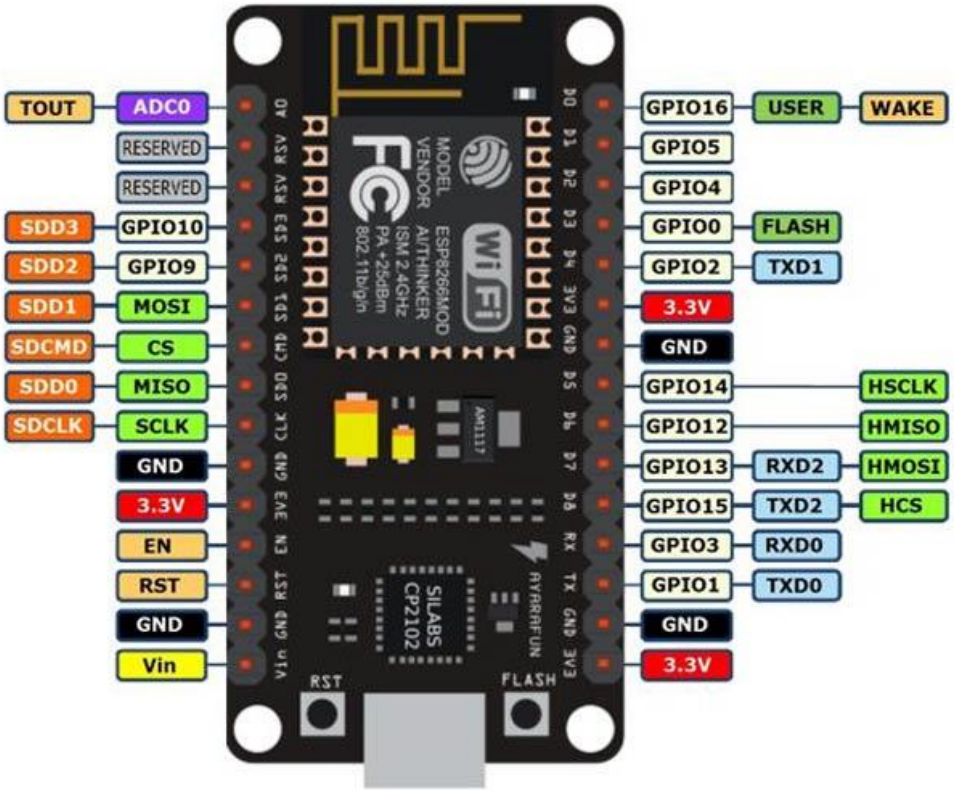
- The pin diagram is shown below.



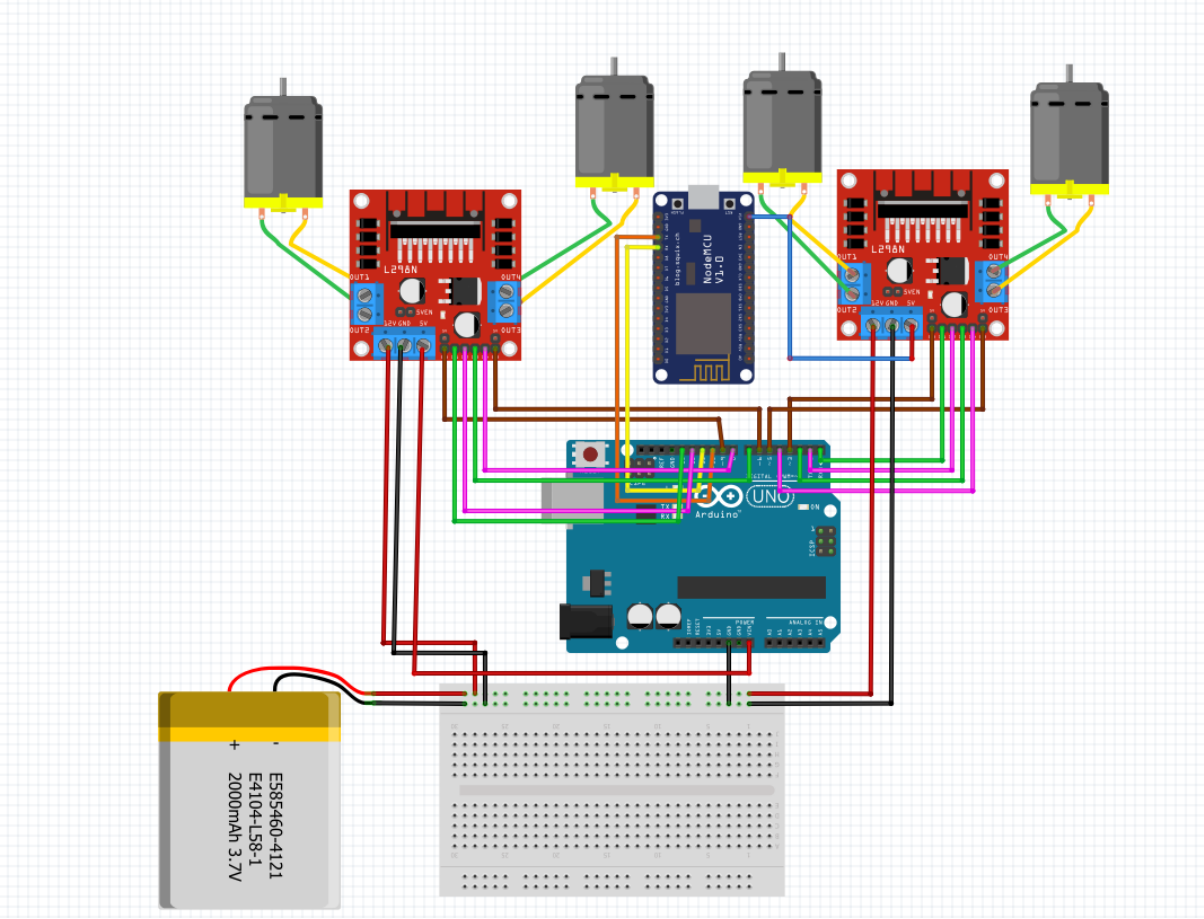
- For communication with the mobile app Nodemcu board was used. It uses Wi-Fi for communication. The specifications are mentioned below.

1. Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
2. Operating Voltage: 3.3V
3. Input Voltage: 7-12V
4. Digital I/O Pins (DIO): 16
5. Analog Input Pins (ADC): 1
6. UARTs: 1
7. SPIs: 1
8. I2Cs: 1
9. Flash Memory: 4 MB
10. SRAM: 64 KB

11. Clock Speed: 80 MHz

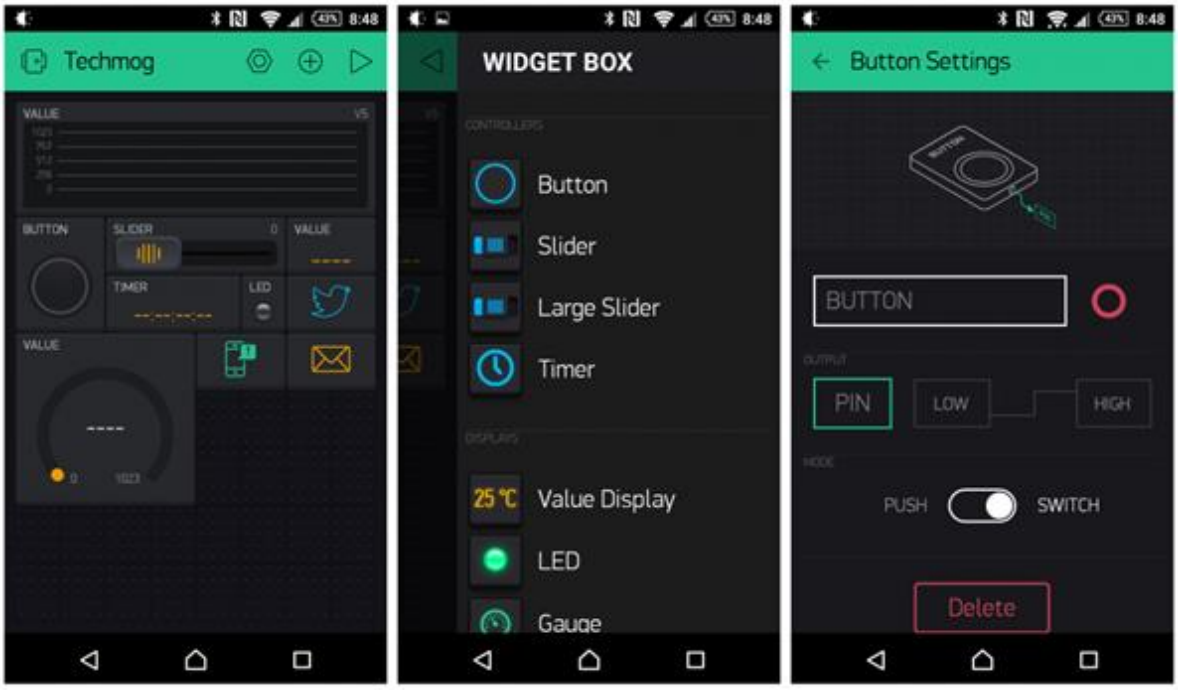


Circuit Diagram:



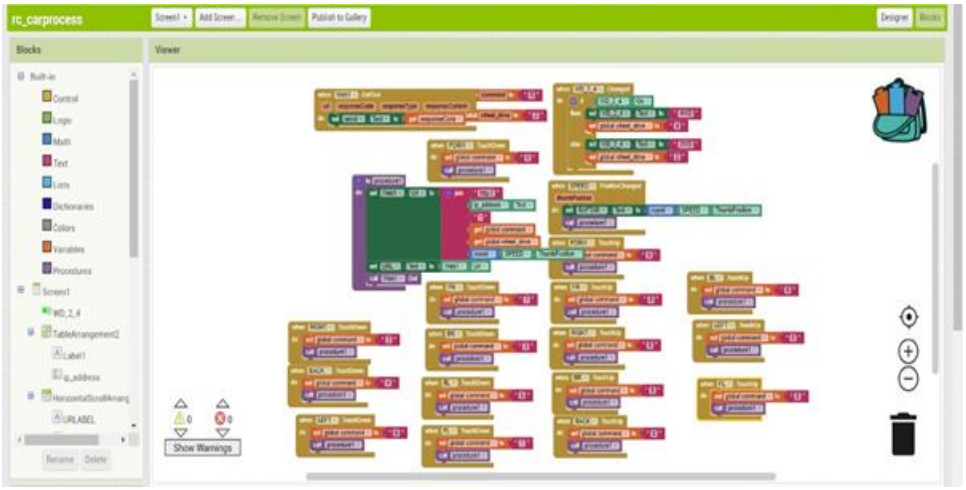
Wifi Remote Control:

- For the purpose of controlling car initially Blynk app was used because of its simplicity to use. Blynk is an iot app in which widgets buttons can be inserted easily via drag and drop method. It can easily work with Arduino and Wifi boards like Esp8266. But it gave delay of about 3-4 seconds which was totally undesirable.

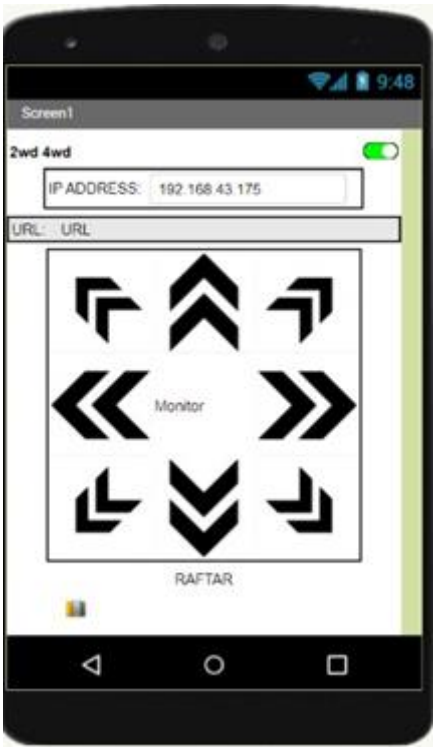


A Representative image of Blynk app

- To avoid the delay problem, we designed a totally new app with the help of MIT app inventor is a web tool developed by MIT for developing apps through blocks of code that can be easily dragged and dropped. It is free to use for everyone. The app that we developed using it solved the problem of delay. App can be downloaded in any mobile phone. For use one has to connect the RC Monster truck and mobile phone to same WIFI and thus they can communicate with each other.



Code behind application



User Interface of app

Documentation of application can be found in GitHub repository

https://github.com/RushilVerma/Wifi-Monster-Truck

Working:

Working of the RC car can be understood in the following point:

Mobile Application UI:

- Top right toggle switch toggles between 2-wheel drive and 4-wheel drive
- IP Address text Box: Input for the text box is IP address of the car could be changed but most of times remains as default.
- URL: It is the HTTP request going out to Nodemcu module is visible in this View Bar
- Arrows defined moves the car in a specified direction.
- Bottom last Defined the speed of the motors by a slider which is of scale 0 to 255.

Mobile Application Communication:

- Mobile application is used to operate the RC car.
- It has 8 buttons that provide it flexibility to move in 8 possible directions.
- The controller and the car should be in same Wi-Fi network to be operated.
- The controller sends a connect signal by sending an empty packet through https protocol address to IP address of the car Wi-Fi module.
- After the connection status is verified it sends the request to car module by a adding a subnet address after IP address in format:

EX: https://192.168.43.175/0000

- End four digits represent 2WD or 4WD information, arrow key pressed and speed adjustment switch data.

Embedded System:

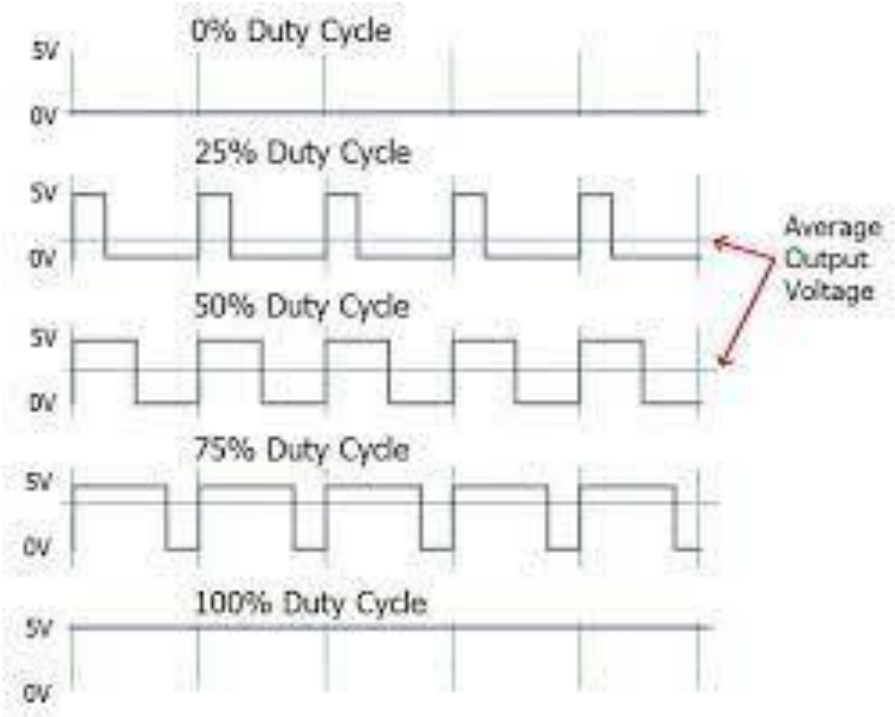
- The Nodemcu connected to same Wi-Fi network receives the http request.
- It separates the Ip addresses and task code (last four or five digits of message) stores in string
- The Nodemcu process string splitting and stores in array data then send the task code given to Arduino.
- Arduino sends the task code to the selected Motor controller by Digital and PWM signal through digital and Analog pins of Arduino board.

Note: Arduino only sends the message signal to motor controller for which message is specified. Other motor controller will work the same function if speed and 2WD or 4WD option is not toggled. Sometimes works to check there working

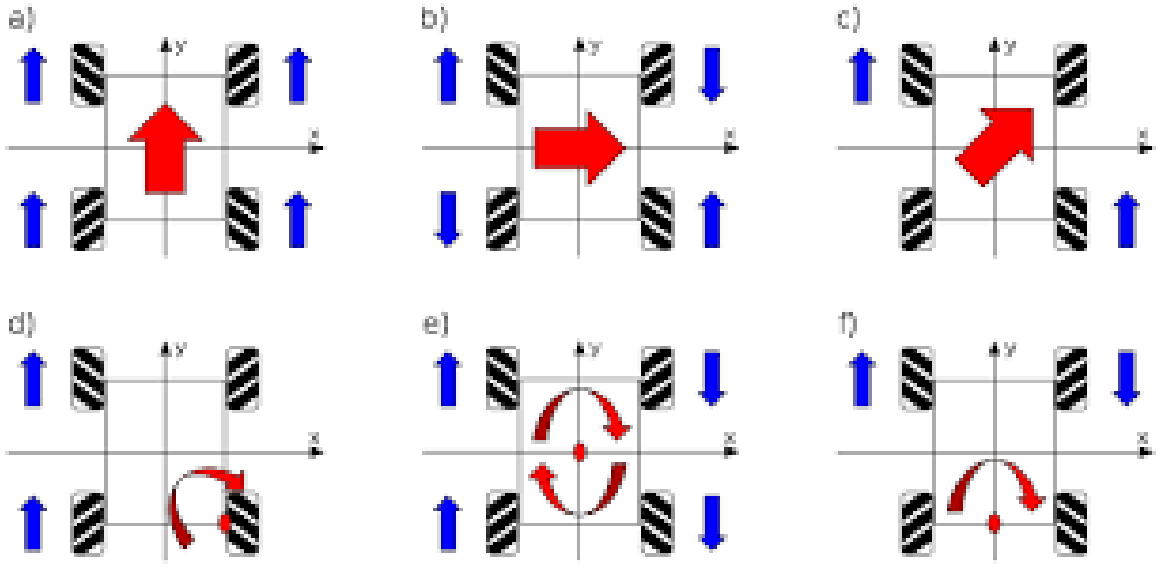
- Motor controller performs rotation of motor in direction and speed fed by Arduino signal.

Motor and Entire Car mechanics:

- As a combination of all steps the wheels of motor synchronised move according to the desire of operator.
- The speed is adjusted by the Duty cycle of the arduino signal provided to motor controller.



- The wheel combination are done as follows:



Conclusion:

Final look of the car can be seen in the below figure. It is a wireless RC monster truck. It is fully rechargeable with battery life up-to 6 hours thus making it idea for any truck race. Large tyres provide it sufficient ground clearance apart from a perfect grip on the surface. It comes with good suspensions making it ideal for imperfect tracks. It can be controlled via a mobile application that can be installed on any mobile phone. All these features make it a perfect fit for any of the car race competition.

Future work:

- Arduino+Esp8266/Nodemcu combination could be replaced by a single development board to provide less delay, less cost and less surface area
- Instead of using metal chassis, 3D printed chassis could be used to decrease weight and hence providing ease of movement.
- Required shaft and tyre hexagonal rings (commercially unavailable) could be 3D printed.

- Webpage to control the car which can be accessed by connection to car Wi-Fi.