Jordan University of Science and Technology

Faculty of Computer and Information Technology

Department of Computer Engineering

CPE: Graduation Project Final Report [Self Drive Car]

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Abstract

In the recent past there are approximately +100,000 traffic accidents resulting in approximately +10,000 injured and +700 deaths in Jordan due to several factors, including poor infrastructure, old cars and lack of concentration of the driver while driving.

We are seriously considering reducing and avoiding traffic accidents as much as possible to maintain human growth and not lose many lives as a result of such accidents.

In this project we will talk about self-driving cars or Autonomous car that help solve one of these problems of poor design and lack of safety in cars.

The design used reduces the accident rate and helps to drive safely because it contains a tracking follower sensor and motor drives at a constant speed and a ultrasonic sensor that helps to stop the car completely if the sensor senses a nearby object at a specified distance.

The usage and production of these cars has become a leading industry in almost every area of the world. The world's car stock exceeded 80 million after the Second World War, then more than 90 million in 1960. Five years later this number was 130 million, 291 million in 1980, 419 million in 1990, and 731 million in 2011. According to the forecasts, it will reach two billion by 2020 . Over the years and centuries, this industry has gone through enormous development, as the first vehicles were only powered by steam engine, then petrol and diesel came to public mind and currently it seems that the electric propulsion will be the future. Of course, with this development, faster and more useful vehicles can be produced, but in our accelerated world with more and more cars, unfortunately the numbers of accidents have increased.

In most cases, these accidents are the fault of the driver, therefore it could be theoretically replaceable with the help of self-propelled cars. Human presence is the most important part in transport at present, although there are many areas where you can use a tool or feature that helps people achieve greater efficiency. Some examples for these features are the autopilot on aircraft, the cruise control in cars, and many other tools that help decision-making. In this study, we will provide a brief summary about the development of self-driving or at least driver assisting devices and show how people are feeling about this.

We will detail the hardware components used in this system and the possibility of developing them in the future to preserve human lives as much as possible. [1]

I. Introduction

Autonomous cars are those vehicles which are driven by digital technologies without any human intervention. They are capable of driving and navigating themselves on the roads by sensing the environmental impacts. Their appearance is designed to occupy less space on the road in order to avoid traffic jams and reduce the likelihood of accidents. Although the progression is gigantic, in 2017, allowed automated cars on public roads are not fully autonomous: each one needs a human driver who notices when it is necessary to take back the control over the vehicle.

The dream of self-propelled cars goes back to the Middle Ages, centuries before the invention of the car. An evidence for this statement comes from sketches of Leonardo De Vinci, in which he made a rough plan of them. Later, in literature and in several science fiction novels, the robots and the vehicles controlled by them, appeared. The first driverless cars were prototyped in the 1920s, but they looked different than they are today. Although the "driver" was nominally lacking, these vehicles relied heavily on specific external inputs. One of these solutions is when the car is controlled by another car behind it. Its prototype was introduced in New York and Milwaukee known as „the American Wonder" or "Phantom Auto".

The future is ultimately unknowable but planning requires predictions of impending conditions and needs. Many decision-makers and practitioners (planners, engineers and analysts) wonder how autonomous (also called self-driving or robotic) vehicles will affect future travel demands, and therefore the need for roads, parking facilities and public transit services, and what public policies can minimize the problems and maximize the benefits of these new technologies. [2]

There is considerable uncertainty about these issues. Optimists predict, based on experience with previous technological innovations such as digital cameras, smart phones and personal computers, that autonomous vehicles will soon be sufficiently reliable and affordable to replace most human driving, providing huge savings and benefits. However, there are good reasons to be skeptical of such claims. [3]

Optimistic predictions often overlook significant obstacles and costs. Many technical problems must be solved before autonomous vehicles can operate reliably in all normal conditions.[4]

They will require years of testing and regulatory approval, and must become affordable and attractive to consumers. Motor vehicles are costly, durable, and highly regulated, so new vehicle technologies generally require decades to penetrate fleets. Autonomous driving can create new problems; a camera, telephone or computer failure may be frustrating but is seldom fatal; motor vehicle system failures can be frustrating and deadly to occupants and other road users. As a result, autonomous vehicles will probably take longer to develop and provide smaller net benefits than optimists predict.

This has important policy implications. Vehicles rely on public infrastructure and impose external costs, and so require more public planning and regulation than most other technologies. For example, many predicted autonomous vehicle benefits, including congestion and pollution reductions, require dedicated lanes to allow platooning (numerous vehicles driving close together at relatively high speeds), and autonomous vehicles can be programed based on user preferences, to maximizing traffic speeds and occupant comfort, or community goals, to minimize delay and risks to other road users. Policy makers must decide whether to build special autonomous vehicle lanes, how to price them, and how to regulate their operation in order to maximize total benefits. [5]

II. Professional Practice Constraints

There are of course limits to the performance of the system as a whole, issues that we are still figuring out how to deal with them. We are sure however that they can be solved, because there's a solution to every problem.

- **Manufacturability Constraints: Manufacturing must be to meet specific standards as the product must have the perfect shape, ideal weight and high quality of manufacturing.**
- **Economic Constraints: The product must be manufactured at the lowest possible cost as it is sold to people at a reasonable price, good and affordable.**
- **Sustainability: The product must be manufactured from very high quality components so that they are semi-permanent and low maintenance.**
- **Environmental Constraints: The product must be very safe for people and the environment by reducing environmental pollution.**
- **Health and Safety Constraints: The product should be safe in terms of manufactured materials so that they do not pose a risk to the user in terms of their safety and lack of impact on the environment.**
- **Ethical Standards Constraints The product should limit the unethical behaviors that result from some people who misuse this product.**
- **Social Values Constraints: The product must be scalable from the user's side according to the specific criteria in the law.**
- **Political Constraints: This product should be used under conditions that do not harm the interest of society and do not cause political harm in any society.**

III. System Architecture and Design

In the beginning, We will talk about all the components used in this project and explain the principle of each component working as detailed as possible and then it will be explained how the components were combined together.

Hardware Components:

1. **Arduino Nano V3.0.**
2. **Ultrasonic Sensor HC-SR04.**
3. **Ultrasonic Fixed Bracket Holder.**
4. **Infrared Line Tracking Sensor Module.**
5. **Dual H-Bridge DC & Stepper Motor Driver L298N.**
6. **DC Motor Gearbox Wheel & Tyre.**
7. **3.7V Li-ion Rechargable Battery 3800mA.**
8. **DC to DC Step Up Power LM2577s/XL6009.**
9. **Micro USB 5V 1A 18650 Lithium Battery Charger Module With Protection.**
10. **5V Magnetic Buzzer.**
11. **ON-OFF Power Switch 2 Pin.**
12. **Breadboard Mini 400 Tie-Point.**
13. **Car Chassis.**
14. **Male-Male & Male-Female Wires.**
15. **9V Battery.**
16. **9V Battery Connecter For Arduino.**

- **Arduino Nano V3.0**

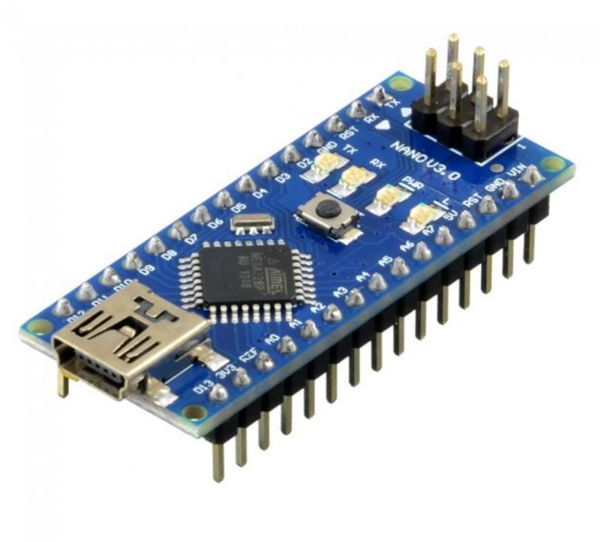

Figure 1: Arduino Nano V3.0

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.

Table 1: Arduino Nano V3.0 Properties.

Microcontroller	**ATmega328**
Architecture	**AVR**
Operating Voltage	**5 V**
Flash Memory	**32 KB of which 2 KB used by bootloader**
SRAM	**2 KB**
Clock Speed	**16 MHz**
Analog IN Pins	**8**
EEPROM	**1 KB**
DC Current Per I/O Pins	**40 mA (I/O Pins)**
Input Voltage	**7-12 V**
Digital I/O Pins	**22 (6 of which are PWM)**
PWM Output	**6**
Power Consumption	**19 mA**
PCB Size	**18 x 45 mm**
Weight	**7 g**

The board uses same type of Mini-B USB connector, same side connectors and 6-pin SPI connector, as well as the Atmel ATmega328P microcontroller in the 32-TQFP package. There are also 4 LEDs – Power LED, LED connected to digital output pin D13, and two LEDs showing status of the RxD and TxD communication lines.

To provide +5.0 V Vcc power supply, the board uses LM1117-5.0 SOT-223 linear stabilizer 5.0 V (compared to original UA78M05), with slightly higher current (800 mA vs. 500 mA of original UA78M05) and lower drop-out voltage (typ. 1.2 V vs. 2.0 V for UA78M05).

To facilitate the USB communication and to provide 3.3 V output, the board uses USB communication circuit CH340 in SOP-16 package (instead of FT232RL used on the genuine Nano R3 board), manufactured by several Chinese companies. The CH340 IC requires installation of driver software, which was covered and explained many times already, so I will not repeat this information. With installed driver, communication with Arduino (IDE) is clear and straightforward.

To switch between VIN power supply (6-12 V) and USB power supply, the board includes a Schottky diode with low forward voltage. Most of the boards I got seems to be using the Vishay Semi SD101CWS diode (Vf 0.6 – 0.8 V at 20 mA, S4 SMD marking code). [6]

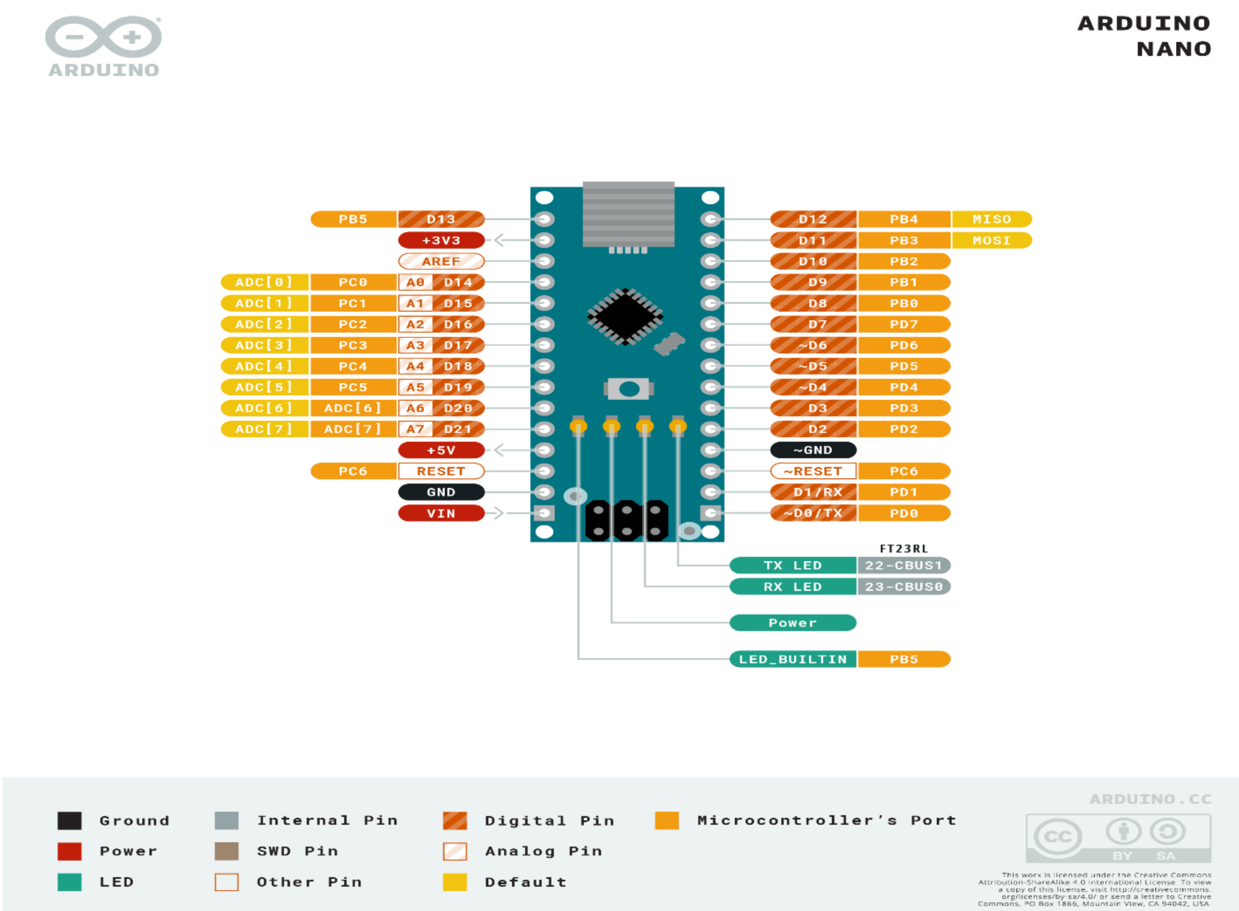

Figure 2: Arduino Nano V3.0 Pinout.

Table 2: Arduino Nano V3.0 PINOUT Description.

Pin Number	Name	Type	Description
1-2 , 5-16	D0-D13	I/O	Digital input/output
3 , 28	RESET	Input	Reset (Active Low)
4 , 29	GND	PWR	Supply Ground
17	3V3	Output	+3.3V Output (From FTDI)
18	AREF	Input	ADC Reference
19-26	A0-A7	Input	Analog Input Channel
27	+5V	I/O	+5V Output, +5V Input external Supply
30	VIN	PWR	Supply Voltage

- **Ultrasonic Sensor HC-SR04.**

Figure 3: Ultrasonic Sensor HC-SR04.

Table 3: Ultrasonic Sensor HC-SR04 Pin Configuration.

Pin Number	Pin Name	Description
1	**Vcc**	**The Vcc Pin Power the Sensor, Typically with +5V**
2	**Trigger**	**Input Pin, this Pin has to be kept high for 10us to initialize measurements by sending Ultrasonic Waves**
3	**Echo**	**Output Pin, this pin goes high for a period of time which will be equal to the time taken for the Ultrasonic Wave to return back to the sensor**
4	**GND**	**This Pin is Connected to the Ground of the system**

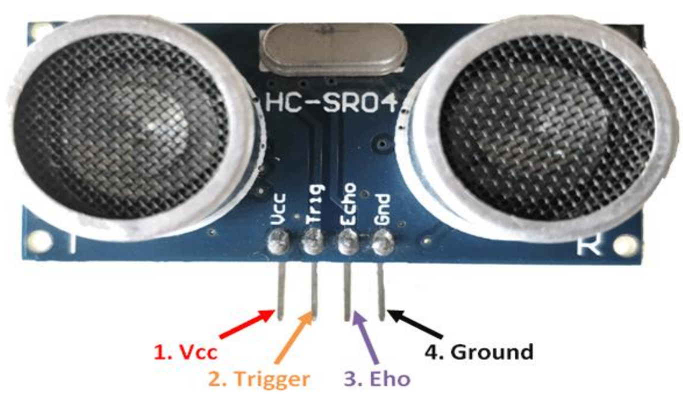

Figure 4: Ultrasonic Sensor HC-SR04 Pinout.

Table 4: Ultrasonic Sensor HC-SR04 Pin Features.

Operating System	**+5 V**
Theoretical Measuring Distance	**2 cm – 450 cm**
Practical Measuring Distance	**2 cm-80 cm**
Accuracy	**3 mm**
Measuring Angle Covered	**<15**
Operating Current	**<15 mA**
Operating Frequency	**40 Hz**

As shown above the HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that

Distance = Speed × Time

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module as shown in the picture below

Figure 5: Ultrasonic Sensor HC-SR04 Working.

Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor.

HC-SR04 distance sensor is commonly used with both microcontroller and microprocessor platforms like Arduino, ARM, PIC, Raspberry Pie etc. The following guide is universally since it has to be followed irrespective of the type of computational device used.

Power the Sensor using a regulated +5V through the Vcc ad Ground pins of the sensor. The current consumed by the sensor is less than 15mA and hence can be directly powered by the on board 5V pins (If available). The Trigger and the Echo pins are both I/O pins and hence they can be connected to I/O pins of the microcontroller. To start the measurement, the trigger pin has to be made high for 10uS and then turned off. This action will trigger an ultrasonic wave at frequency of 40Hz from the transmitter and the receiver will wait for the wave to return. Once the wave is returned after it getting reflected by any object the Echo pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor.

The amount of time during which the Echo pin stays high is measured by the MCU/MPU as it gives the information about the time taken for the wave to return back to the Sensor. Using this information the distance is measured as explained in the above heading.

- **Ultrasonic Fixed Bracket Holder.**

Figure 6: Ultrasonic Sensor HC-SR04 Fixed Bracket Holder.

This Component is used to install the ultrasonic sensor HS-SR04 on Car Chassis.

- **Infrared Line Tracking Sensor Module.**

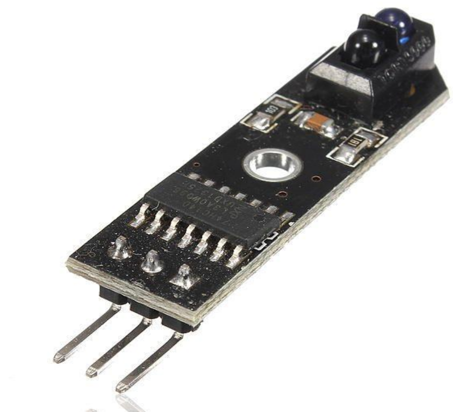

Figure 7: Infrared Line Tracking Sensor Module.

This sensor is for line tracking purpose. It differentiate white and black color, and it outputs via TTL signal. Utilizing it enable your mobile robot to have intelligent such as line following, or anti collision, or anti-edge falling. Good performance if the object have reflective surface. There is a variable resistor on-board for user to tune the threshold of white and black color. You can even combine several sensors to meet your specific requirements.

The sensor come with 3 pins, respectively is VCC, OUT and GND. The VCC and GND is the power for the sensor to operate. The OUT is the digital output signal from the sensor.

When sensor detected obstacle or white surface, the OUT will be LOW. It can be interface with any microcontroller with digital input such as PIC, SK40C, SK28A, SKds40A, Arduino series for line sensing, or even short distance obstacle detection. Also, not to forget, interface with Relay module offer non-contact switch.

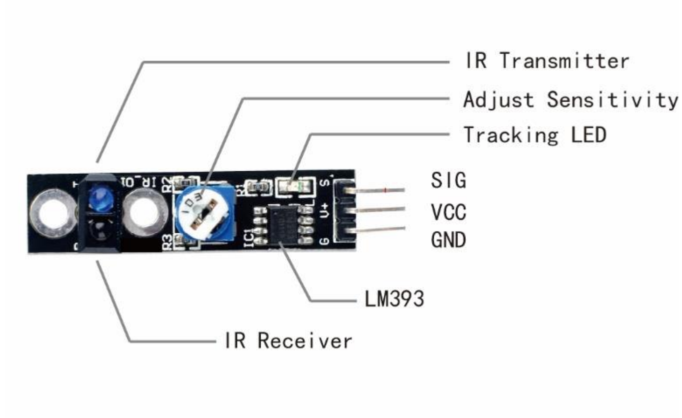

Figure 8: Infrared Line Tracking Sensor Module Pinout.

Table 5: Infrared Line Tracking Sensor Module Features.

Detection Distance	**1.5 cm (tested with white paper)**
Power Supply	**3.3 – 5 V**
Operating Current	**18 – 20 mA**
Operating Temperature range	**0 C ~+ 50 C**
Wire Output Interface	**3**
Output	**Black Line = Logic Low, White Line = Logic High**

- **Dual H-Bridge DC & Stepper Motor Driver L298N.**

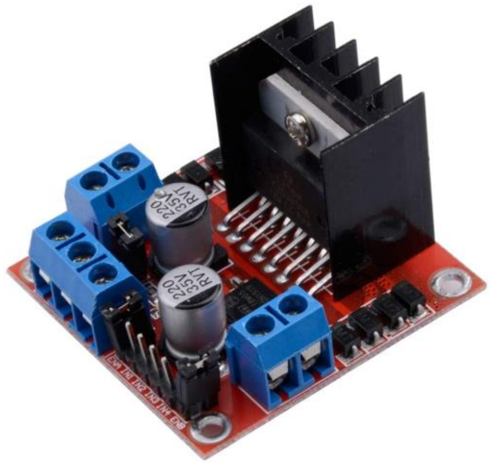

Figure 9: Dual H-Bridge DC & Stepper Motor Driver L298N.

In order to have a complete control over DC motor, we have to control its speed and rotation direction. This can be achieved by combining these two techniques.

1. **PWM – For controlling speed**
2. **H-Bridge – For controlling rotation direction**

The speed of a DC motor can be controlled by varying its input voltage. A common technique for doing this is to use PWM (Pulse Width Modulation)

PWM is a technique where average value of the input voltage is adjusted by sending a series of ON-OFF pulses.

The average voltage is proportional to the width of the pulses known as Duty Cycle.

The higher the duty cycle, the greater the average voltage being applied to the dc motor(High Speed) and the lower the duty cycle, the less the average voltage being applied to the dc motor(Low Speed).

Below image illustrates PWM technique with various duty cycles and average voltages.

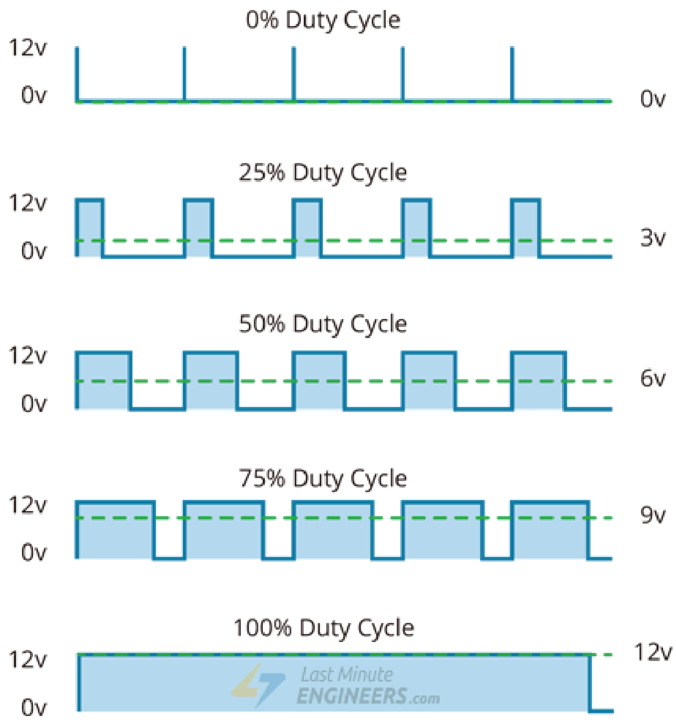

Figure 10: Pulse Width Modulation (PWM) Technique

The DC motor's spinning direction can be controlled by changing polarity of its input voltage. A common technique for doing this is to use an H-Bridge.

An H-Bridge circuit contains four switches with the motor at the center forming an H-like arrangement.

Closing two particular switches at the same time reverses the polarity of the voltage applied to the motor. This causes change in spinning direction of the motor.

At the heart of the module is the big, black chip with chunky heat sink is an L298N.

The L298N is a dual-channel H-Bridge motor driver capable of driving a pair of DC motors. That means it can individually drive up to two motors making it ideal for building two-wheel robot platforms.

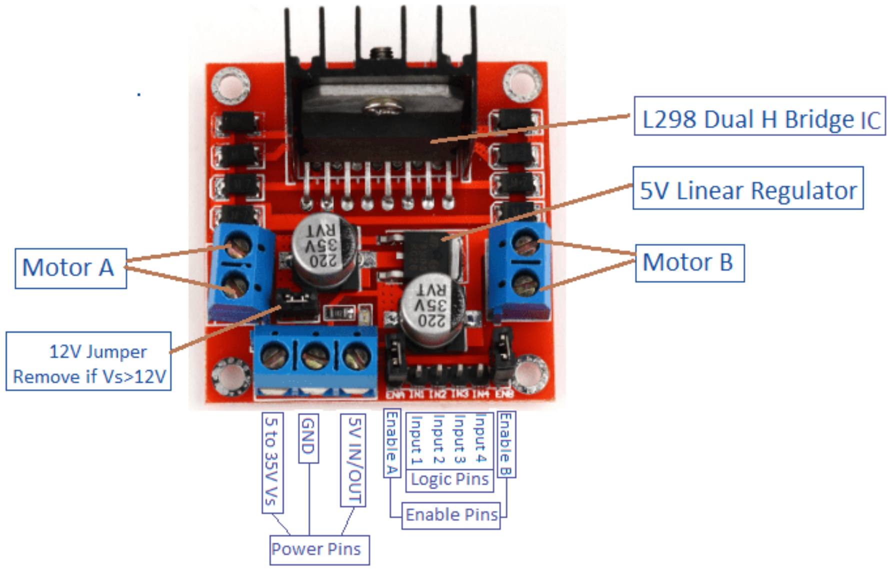

Figure 11: Dual H-Bridge DC & Stepper Motor Driver L298N Pinout.

- **DC Motor Gearbox Wheel & Tyre.**

Figure 12: DC Motor Gearbox Wheel & Tyre.

DC geared motor with rubber wheel suitable for your Arduino® vehicle based/robotics applications. Also a suitable replacement for the 2WD (KR-3160) and 4WD (KR-3162) car chassis.

Table 6: DC Motor Gearbox Wheel & Tyre Features.

Voltage	**3-6 V**
Current	**80-150 mA**
No Load Speed	**3V-125 rev/min , 5V-200 rev/min , 6V-230 rev/min**
Load Speed	**3V-95 rev/min , 5V-160 rev/min , 6V-175 rev/min**
Output Torque	**3V-0.8kg.cm5V-1.0kg.cm6V-1.1kg.cm**

- **3.7V Li-ion Rechargable Battery 3800mA.**

Figure 13: 3.7V Li-ion Rechargable Battery 3800mA.

✓ **Features:**

18650 3.7V Rechargeable Lithium Battery
3800mA large capacity, Blue classic color
rechargeable Battery, eco-friendly and environmental friendly
No memory effect, recharge up to 1000 cycles
100% Q.C. of every battery

✓ **Descriptions:**

Manufactured by Hi-Capacity power products.
Suitable for torch, remote controller, etc.
Exquisite workmanship provides great user experience.

According to different conditions, Battery capacity can be divided into actual capacity, theoretical capacity, also called rated capacity.
Battery capacity refers to the battery storage capacity.
The unit is "mA", 1A = 1000mA, so there are some differences between rated capacity and actual capacity in Li-ion Battery.
It is normal and reasonable.

- **DC to DC Step Up Power LM2577s/XL6009.**

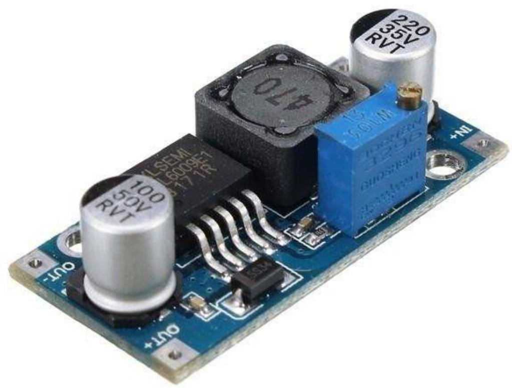

Figure 14: DC to DC Step Up Power LM2577s/XL6009.

- ✓ **Features: IN-IN+ input Positive input Negative! Positive output OUT + OUT-output negative , Test comparison sample reference: input 3W output 12V 0.4A 4.8W input 5V output 12V 0.8A 9.6W input 7.4V Output 12V1.5A 18W input 12V output 15V2A 3OW input 12V Output 16V2A 32W input 12W output 18V 1.6A 28.8W input 12V Output 19V 1.5A28.5W input 12V Output 24V 1A 24W.**

- ✓ **Vin * Ilin * Efficiency = Vout * lout Vin: Input Voltage lin: input current Vout: Output Voltage lout: output current , DSN60094A is a high-performance step-up switching current (BOOST) module. The module uses the second generation of high-frequency switching technology Xl6009e1 core chip performance than the first generation technology LM2577. Xl6009 boost module at a lower cost, superior performance, LM2577 module is about to be eliminated.**

- ✓ **Wide input voltage 3W - 32V, optimum operating voltage range is 5 - 32V , Wide Output voltage 5V-35W , Built-4A efficient MOSFET switches enable efficiency up to 94%; (LM2577 current is 3A) , high switching frequency 400KHz, can use a small-capacity filter capacitors that can achieve very good results, the ripple smaller and smaller. (LM2577 frequency only 50 KHz).**

- ✓ **Model Specification: DSN6009 boost module , Module Properties: Non-isolated boost (BOOST) , Rectification , Non-Synchronous Rectification , input Range: 3V - 32V , Output Range 5V - 35V**
- ✓ **It's brand new, good quality & high performance. ** PLS PAY ATTENTION the accurate size & voltage rate before placing order in order to avoid buying wrong thing. Free Shipping & the deliver time to USA is approx. 10-18 days after the shipment date.**

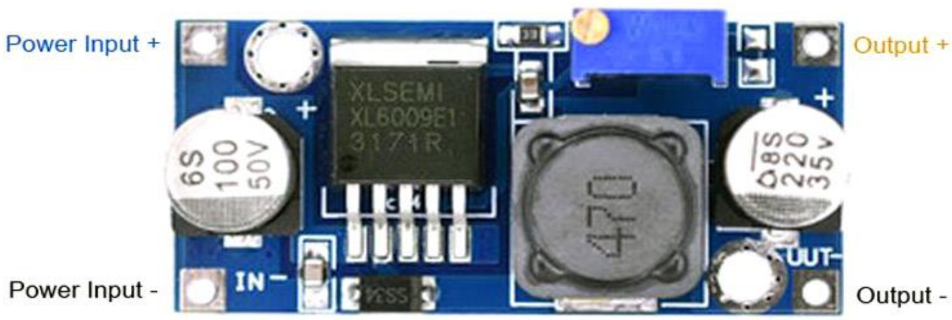

Figure 15: DC to DC Step Up Power LM2577s/XL6009 Pinout.

- **Micro USB 5V 1A 18650 Lithium Battery Charger Module With Protection.**

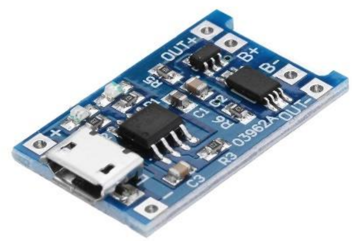

Figure 16: Micro USB 5V 1A 18650 Lithium Battery Charger Module With Protection.

- ✓ **Micro USB lithium battery charging board with overcharge, over discharge and overcurrent protection.**
- ✓ **On-board micro USB and soldering joints 5V input port and charging status indicator(red indicator is charging, blue indicator is full charged.**
- ✓ **Input Voltage: DC 5V, Charging Cut-off Voltage: 4.2V Maximum Charging Current: 1A.**
- ✓ **Current: 3A, Board Size: 26 X 17mm/1.02 X 0.67inch(L*W).**

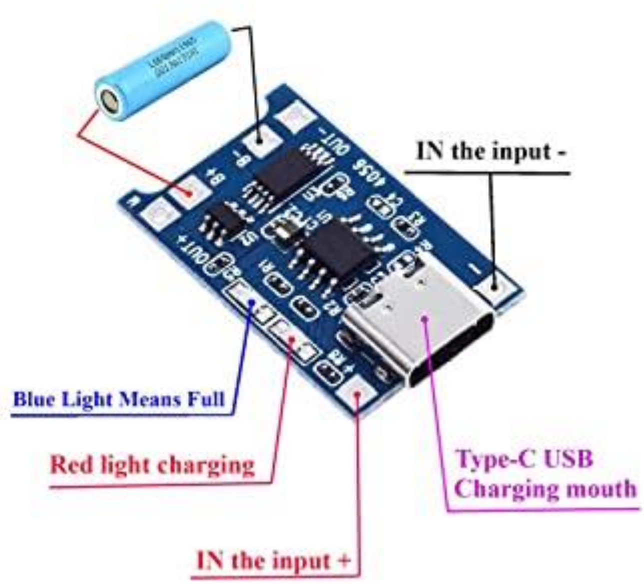

Figure 17: Micro USB 5V 1A 18650 Lithium Battery Charger Module With Protection Pinout.

- **5V Magnetic Buzzer.**

Figure 18: 5V Magnetic Buzzer.

5V continuous tone buzzer output frequency approximately 2300Hz. Diameter 10mmpositive lead is slightly longer.

Figure 19: 5V Magnetic Buzzer Pinout.

Table 7: 5V Magnetic Buzzer Configuration.

Pin Number	Pin Name	Description
1	Positive	Identified by (+) symbol or longer terminal lead. Can be powered by 6V.
2	Negative	Identified by short terminal. Typically connected to the ground of system.

- **ON-OFF Power Switch 2 Pin.**

Figure 20: ON-OFF Power Switch 2 Pin.

16 mm Diameter small round boat switch red mini round, red 2 pin On-OFF rocker switch.
3A/250V, 6A/125V Rocker Switch.
Seesaw Power Switch.

- **Breadboard Mini 400 Tie-Point.**

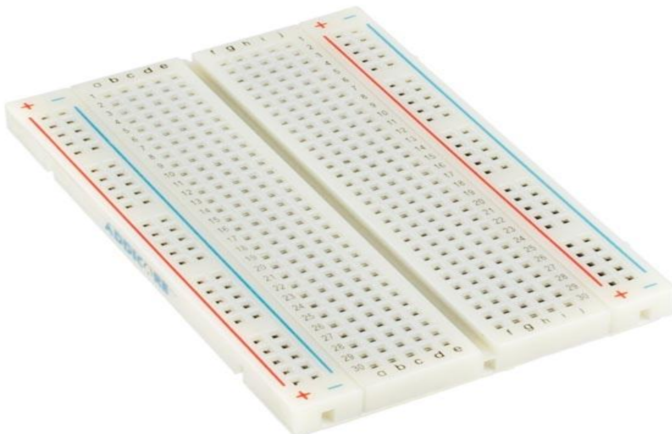

Figure 21: Breadboard Mini 400 Tie-Point.

- ✓ **400 tie-points,2 power lanes**
- ✓ **Size: 5.5×8.2×0.85cm, Vertical: A-J**
- ✓ **Breadboard Material ABS**
- ✓ **300V/3-5A, Horizontal: 1-30**
- ✓ **Works great with Arduino**

- **Car Chassis.**

Figure 22: Car Chassis.

- ✓ **Feature:**

  Smart car chassis tracing car Robot car chassis with code disk Ideal for DIY Mechanical structure is simple, it is easy to install This car is the tachometer encoder With a 4 AA battery box (batteries not included) Can be used for distance measurement, velocity Can use with other devices to realize function of tracing, obstacle avoidance, distance testing, speed testing, wireless remote control Size: 20 x 14cm (L x W) Wheel size: 6.5 x 2.7cm (Dia. x H) Note: Motor power supply is 3V ~ 6V. All the parameter above is tested without load. The car Chassis is transparent, you need to tear out protective paper.

- **Male-Male & Male-Female Wires.**

Figure 23: Male-Male & Male-Female Wires.

- ✓ **Male to Female, Male to Male AWG 26 Solderless Ribbon Jumper Wires for Breadboard Prototyping**
- ✓ **Color Coded with 10 Colors and 4 Wires of the Same Color in Each Length**
- ✓ **Insulated Wire Casing with 2.54 mm Pitch DuPont-Compatible Connectors**
- ✓ **For Use in Development and Prototyping with Arduino, Raspberry Pi, Single Board Computers, Love RPi Kits, and more**

- **9V Battery.**

Figure 24: 9V Battery.

These batteries are NOT rechargeable.

- **9V Battery Connecter for Arduino.**

Figure 25: 9V Battery Connecter for Arduino.

Hardware Design.

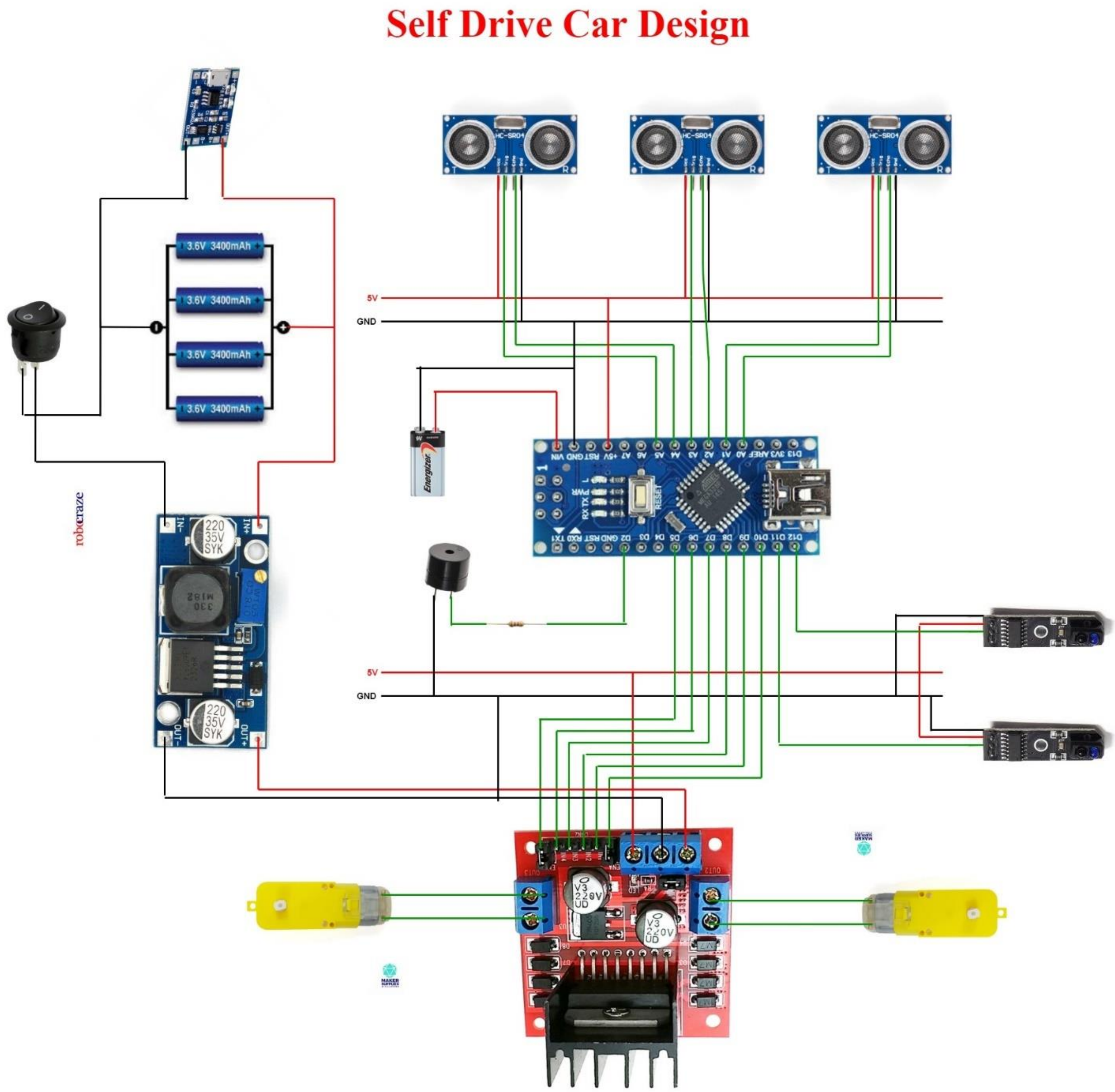

Figure 26: Self Drive Car Hardware Design.

In this part we will talk about the design of the project using the pieces already mentioned.
The main component in this project is the Arduino Nano, a Microcontroller that controls all the components by programming them and connecting all the components on them in a way that is not random but by following the terms, rules and information to reach the high quality of the design

Table 8: Arduino Nano Connections.

Pin Name	Connected Component
Vin	Positive Pin of 9V Battery (Input)
GND	Negative Pin of 9V Battery (Input), Ground Line in Breadboard (Output)
+5V	Vcc Line in Breadboard (Output)
A0	Echo Pin for left Ultrasonic Sensor
A1	Trigger Pin for left Ultrasonic Sensor
A2	Echo Pin for center Ultrasonic Sensor
A3	Trigger Pin for center Ultrasonic Sensor
A4	Echo Pin for right Ultrasonic Sensor
A5	Trigger Pin for right Ultrasonic Sensor
D2	5V Buzzer
D5	Enable A Pin for L293N H-Bridge
D6	Enable B Pin for L293N H-Bridge
D7	Input 1 Pin for L293N H-Bridge
D8	Input 2 Pin for L293N H-Bridge
D9	Input 3 Pin for L293N H-Bridge
D10	Input 4 Pin for L293N H-Bridge
D11	OUT Pin for right Infrared Sensor
D12	OUT Pin for left Infrared Sensor

The voltage of all the components is taken from the Arduino , which in turn takes its voltage from the 9V battery and also the ground from the Arduino . As for the L293N H-Bridge, it has two inlets, one with a power of 5 volts and the other 12 volts, and the ground is common to the two voltages. For the 12 volts, we generated voltage and electric current using rechargeable lithium batteries. To generate 12 fixed volts, we used the DC To DC Step Up Power so that it had variable resistance that allowed for customized voltage generation and then we connected the exit to the L293N H-Bridge. A Battery has been connected to Micro USB Charger to recharge the batteries, so we keep the batteries as continuous as possible.
The use of the L293N H-Bridge is to control the wheels of the car that rotate using the motors in terms of speed and direction.

IV. Software Implementation

The main focus of the project is to control the vehicle in terms of walking in a straight line and avoiding collisions with objects. Therefore, by means of sensitivity, the goal of the project can be reached using two essential components, which is Infrared Sensor and Ultrasonic Sensor.
Based on what has been mentioned, the car will enter in several cases depending on its position and location and everything surrounding it, the cases have been divided as in the following table:

Table 9: Code Description.

<table>
<tr><th>Case Number</th><th>Ultrasonic Read</th><th>Infrared Read</th><th>Flag Value</th><th>Status</th></tr>
<tr><td>1</td><td>Left || Center || Right = LOW
(No Nearby Object)
(Distance > 6 cm)</td><td>Right = HIGH
Left = HIGH</td><td>1</td><td>The vehicle drives forward
(Two Wheel is rotate)</td></tr>
<tr><td>2</td><td>Left || Center || Right = LOW
(No Nearby Object)
(Distance > 6 cm)</td><td>Right = HIGH
Left = LOW</td><td>1</td><td>The vehicle drives Left
(Only Right Wheel rotate)</td></tr>
<tr><td>3</td><td>Left || Center || Right = LOW
(No Nearby Object)
(Distance > 6 cm)</td><td>Right = LOW
Left = HIGH</td><td>1</td><td>The vehicle drives Right
(Only Left Wheel rotate)</td></tr>
<tr><td>4</td><td>Left || Center || Right = LOW
(No Nearby Object)
(Distance > 6 cm)</td><td>Right = LOW
Left = LOW</td><td>1</td><td>The vehicle Stop.
(No Wheel rotate)</td></tr>
<tr><td>5</td><td>Left || Center || Right = HIGH
(Nearby Object)
(Distance <= 6 cm)</td><td>Right = HIGH
Left = HIGH</td><td>0</td><td>The vehicle Stop.
(No Wheel rotate)
(Buzzer ON)</td></tr>
<tr><td>6</td><td>Left || Center || Right = HIGH
(Nearby Object)
(Distance <= 6 cm)</td><td>Right = HIGH
Left = LOW</td><td>0</td><td>The vehicle Stop.
(No Wheel rotate)
(Buzzer ON)</td></tr>
<tr><td>7</td><td>Left || Center || Right = HIGH
(Nearby Object)
(Distance <= 6 cm)</td><td>Right = LOW
Left = HIGH</td><td>0</td><td>The vehicle Stop.
(No Wheel rotate)
(Buzzer ON)</td></tr>
</table>

As we saw in the previous table, the greatest reliance was on the Ultrasonic so that the value of the flag changes depending on the value of the Ultrasonic, so that if the value is equal to 1 then the car will move, but if it is 0 then the car will never move.

Spot Lighting.

Mechanical Car Drive Advantages:

1. **Better handling in dry conditions - accelerating force is applied to the rear wheels, on which the down force increases, due to load transfer in acceleration, making the rear tires better able to take simultaneous acceleration and curving than the front tires.**

2. **More predictable steering in low traction conditions (ie: ice or gravel) because the steering wheels maintain traction and the ability to affect the motion of the vehicle even if the drive wheels are slipping.**

3. **Less costly and easier maintenance - Rear wheel drive is mechanically simpler and typically does not involve packing as many parts into as small a space as does front wheel drive, thus requiring less disassembly or specialized tools in order to replace parts.**

4. **No torque steer.**

5. **Even weight distribution - The division of weight between the front and rear wheels has a significant impact on a car's handling, and it is much easier to get a 50/50 weight distribution in a rear wheel drive car than in a front wheel drive car, as more of the engine can lie between the front and rear wheels (in the case of a mid-engine layout, the entire engine), and the transmission is moved much farther back.**

6. **Steering radius - As no complicated drive shaft joints are required at the front wheels, it is possible to turn them further than would be possible using front wheel drive, resulting in a smaller steering radius.**

7. **Towing - Rear wheel drive puts the wheels which are pulling the load closer to the point where a trailer articulates, helping steering, especially for large loads.**

8. **Weight transfer during acceleration. (During heavy acceleration, the front end rises, and more weight is placed on the rear, or driving wheels).**

9. **Drifting - Drifting is a controlled skid, where the rear wheels break free from the pavement as they spin, allowing the rear end of the car to move freely left and right. This is of course easier to do on slippery surfaces. Severe damage and wear to tires and mechanical components can result from drifting on dry asphalt. Drifting can be used to help in cornering quickly, or in turning the car around in a very small space. Many enthusiasts make a sport of drifting, and will drift just for the**

sake of drifting. Drifting requires a great deal of skill, and is not recommended for most drivers. It should be mentioned that front wheel drive and four wheel drive cars may also drift, but only with much more difficulty. When front wheel drive cars drift, the driver usually pulls on the emergency brake in order for the back wheels to stop and thus skid. This technique is also used for 'long' drifts, where the turn is accomplished by pulling the e-brake while turning the steering wheel to the direction the driver desires. With drifting, there is also the importance of 'counter-steering' - where while temporarily out of control, the driver regains it by turning the wheel in the opposite direction and thus preparing for the next turn or straight-away.

Mechanical Car Drive Dis-Advantages:

1. **More difficult to master - While the handling characteristics of rear-wheel drive may be more fun for some drivers, for others having rear wheel drive is less intuitive. The unique driving dynamics of rear wheel drive typically do not create a problem when used on vehicles that also offer electronic stability control and traction control.**

2. **Decreased interior space - This isn't an issue in a vehicle with a ladder frame like a pickup truck, where the space used by the drive line is unusable for passengers or cargo. But in a passenger car, rear wheel drive means: Less front leg room (the transmission tunnel takes up a lot of space between the driver and front passenger), less leg room for center rear passengers (due to the tunnel needed for the drive shaft), and sometimes less trunk space (since there is also more hardware that must be placed underneath the trunk).**

3. **Increased weight - The drive shaft, which connects the engine at the front to the drive axle in the back, adds weight. There is extra sheet metal to form the transmission tunnel. A rear wheel drive car will weigh slightly more than a comparable front wheel drive car, but less than four-wheel drive.**
4. **Higher purchase price - Due to the added cost of materials, rear wheel drive is typically slightly more expensive to purchase than a comparable front wheel drive vehicle. This might also be explained by production volumes, however. Rear drive is typically the platform for luxury performance vehicles, which makes read drive appear to be more expensive. In reality, even luxury performance front drive vehicles are more expensive than average.**

5. **More difficult handling on low grip surfaces (wet road, ice, snow, gravel...) as the car is pushed rather than pulled. In modern rear drive cars, this disadvantage is offset by electronic stability control and traction control.**

Self Drive Car Advantages:

1. **Decreased the number of accidents Autonomous cars prevent human errors from happening as the system controls the vehicle. It leaves no opportunity for distraction, not just like humans who are prone to interruptions. It also uses complicated algorithms that determine the correct stopping distance from one vehicle to another. Thereby, lessening the chances of accidents dramatically.**

2. **Lessens traffic jams Driverless cars in a group participate in platooning. This allows the vehicles to brake or accelerates simultaneously. Platoon system allows automated highway system which may significantly reduce congestion and improve traffic by increasing up the lane capacity. Autonomous cars communicate well with one another. They help in identifying traffic problems early on. It detects road fixing and detours instantly. It also picks up hand signals from the motorists and reacts to it accordingly.**

3. **Stress-free parking Autonomous cars drop you off at your destination and directly heads to a detected vacant parking spot. This eliminates the wasting of time and gas looking for a vacant one.**

4. **Time-saving vehicle As the system takes over the control, the driver has a spare time to continue work or spend this time catching up with their loved-ones without the having the fear about road safety.**

5. **Accessibility to transportation Senior citizens and disabled personnel are having difficulty driving. Autonomous vehicles assist them towards safe and accessible transportation.**

Self Drive Car Dis-Advantages:

1. **Expensive High-technology vehicles and equipment are expensive. They prepare a large amount of money for research and development as well as in choosing the finest and most functional materials needed such as the software, modified vehicle parts, and sensors. Thus, the cost of having Autonomous cars is initially higher. However, this may lower down after 10 years giving way for the average earner people to have one.**

2. **Safety and security concerns Though it has been successfully programmed, there will still be the possible unexpected glitch that may happen. Technologies are continuously updating and almost all of this equipment may have a faulty code when the update was not properly and successfully done.**

3. **Prone to Hacking Autonomous vehicles could be the next major target of the hackers as this vehicle continuously tracks and monitors details of the owner. This may lead to the possible collection of personal data.**

4. **Fewer job opportunities for others As the artificial intelligence continues to overcome the roles and responsibilities of humans, taxi, trucks, or even co-pilots may be laid off as their services will no longer be needed. This may significantly impact the employment rate and economic growth of a certain country.**

5. **Non-functional Sensors failures often happened during drastic weather conditions. This may not work during a blizzard or a heavy snowfall.**

   Our technology still continues to develop and to be tested. Autonomous cars may provide a significant comfort we needed. However, we need to bear in mind that there are still disadvantages affiliated with it.

Addition Provided by Self Drive Car:

Although current Advanced Driver-Assistance Systems (ADAS) provide important safety functions such as pre-collision warnings, steering assistance, and automatic braking, self-driving vehicles take these technologies to the next level by completely removing the need for a driver.

ABS & EBS Systems:

the EBS Electronic Braking System EBS includes the ABS anti-lock braking system and ASR traction control system components.

Anti-lock braking system (ABS)

- ✓ **The ABS uses sensors to detect the speed of every wheel during braking and adjusts the brake pressure individually at each wheel.**
- ✓ **Wheels are prevented from blocking.**

Vehicle directional stability and maneuverability remain assured even for emergency braking on a slippery roadway.

ABS Benefits:

- ✓ **Braking with the physically maximum possible brake force in a short response time and therefore a reduction in the stopping distance before the pedal is fully pressed down**
- ✓ **Controlled braking with high driving stability and maneuverability even for emergency braking and therefore ultimate braking reliability even on roadways with different friction conditions**
- ✓ **Conservation of tyres, as tyre wear is evenly distributed over the circumference.**
- ✓ **Improved traction on a slippery surface such as ice, snow, gravel or wet cobblestones**
- ✓ **Increased driving safety: Rear end does not skid at sudden loss of traction**
- ✓ **Wear-intensive tyre spin is prevented.**

Spot lighting on our Project.

In this project we have studied the advantages of both mechanical driving and self-driving which help us to develop a car far removed from the disadvantages of mechanical and self-driving.

For power, we generate to power supply to both Arduino and L298N chip. The Arduino power supply is a 9V battery that make sure to work perfect without any problem. The L298N chip power supply is four lithium battery in parallel that supply 3.7V, but this voltage is not enough to work the L298N chip, so we use the DC to DC step up power to generate 12V from these batteries to be able to turn on the L298N chip. But we have problem, the current that generated from the batteries is not enough to work the DC motors although we used the best type of battery in Jordan. To solve this problem, we use 9V battery as extra power supply for L298N chip, then the DC motor work successfully.

At first we had some problems with driving in terms of speed, responsiveness, speed and downtime. Since the ratio of the wheel rotation speed of the car was different the speed of the car's right wheel relative to the speed of the car's left wheel. To solve this problem, we have used an ABS-like system through programming where it is possible to control the speed of the motor's rotation as I want. There for I studied the difference between the speed of each wheel in terms of the relationship of the revolution per minute and therefore i found that the speed of the right wheel of the car precedes the speed of the car wheel left by 1.14%. So you controlled the speed of the right wheel of the car and its capacity of 223 rev/min, but the car's left wheel has a capacity of 255 rev/min so that the number of cycles for each of the wheels of the car is equal.

And we use ABS system when car turn left or right. When turn right, the right wheel decreases the speed to half relative to the left wheel. And so on, when turn left, the left wheel decreases the speed to half relative to the right wheel.

Due to the estimated weight of the car estimated at 1175 grams, several speeds were handled to achieve an equality between the speed and weight of the vehicle.
The speed of the car is calculated by a program using center ultrasonic sensor which calculates the time the car travels after a certain distance.
To apply this, the car was placed 10 meters from the wall and made the car move, as the time needed to travel this distance was 24.6 seconds.
So, by saying that the (speed = distance / time), the speed of the car is estimated at 1.44 kilometers/hour.

To determine stop distance from any object front the car, to start decrease the speed of the car the distance like to be 72Cm from the object. So the speed is 40 Cm/S and the distance from object is 72Cm, then the car decreases the speed to 20Cm/s to get the distance 10Cm, then decrease the speed to 10Cm/s to get the distance 5Cm, and then the car stops at 5Cm from the object.

In this project we have sought to achieve all the rules and conditions in this world to extract a product of a high level of manufacturing quality and high accuracy in achieving the objectives of this product and reach a high degree of safety for the driver and the world at large and reduce the environmental pollution resulting from mechanical driving.

Bibliography

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[3] Johnston and Walker 2017; Keeney 2017; Kok, et al. 2017

[4] Knight 2020

[5] Papa and Ferreira 2018; Speck 2017

[6] Arduino, a vše kolem

Appendix A

Here, we include the physical project as figures to clear understand.

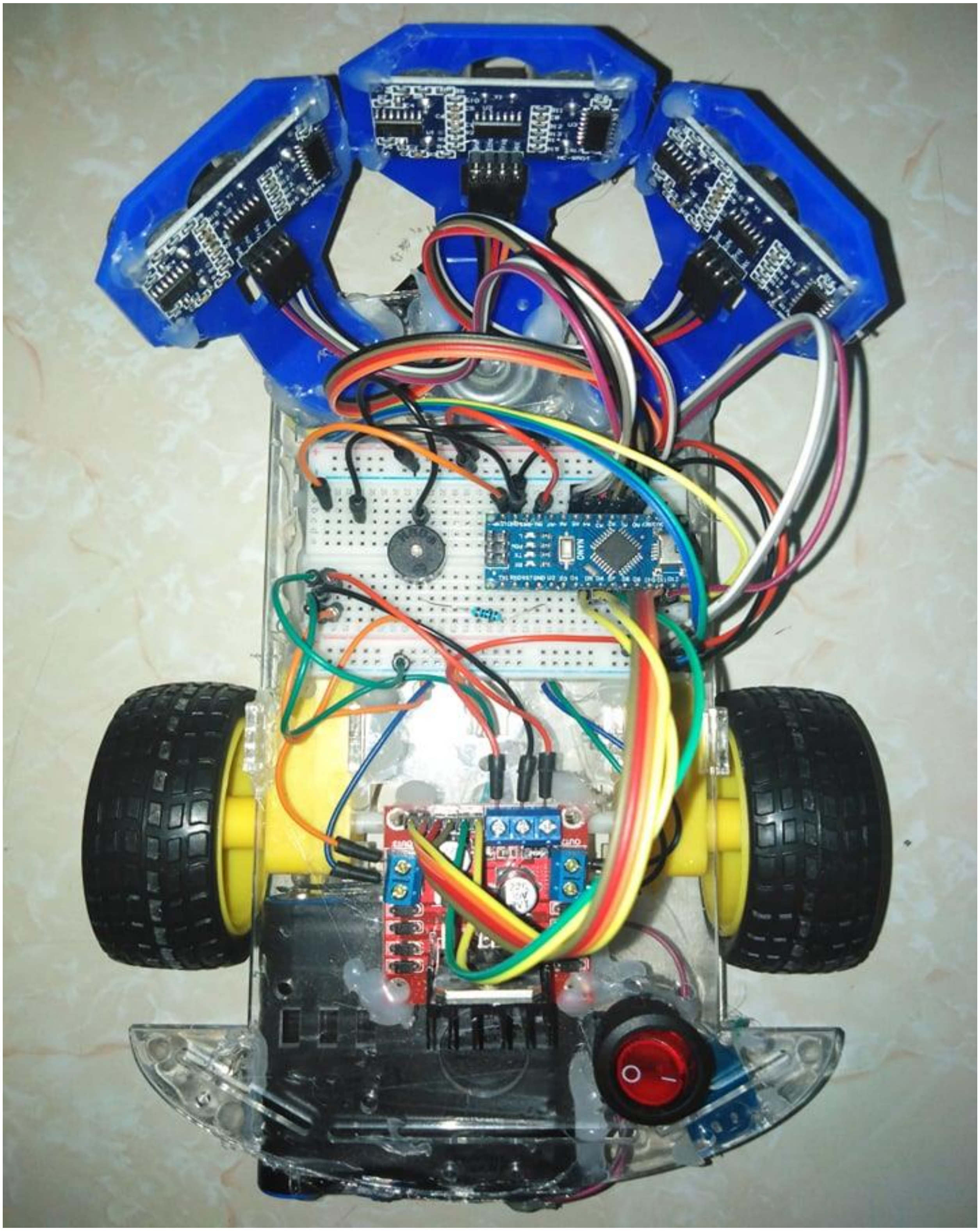

Figure 27: Physical Design.

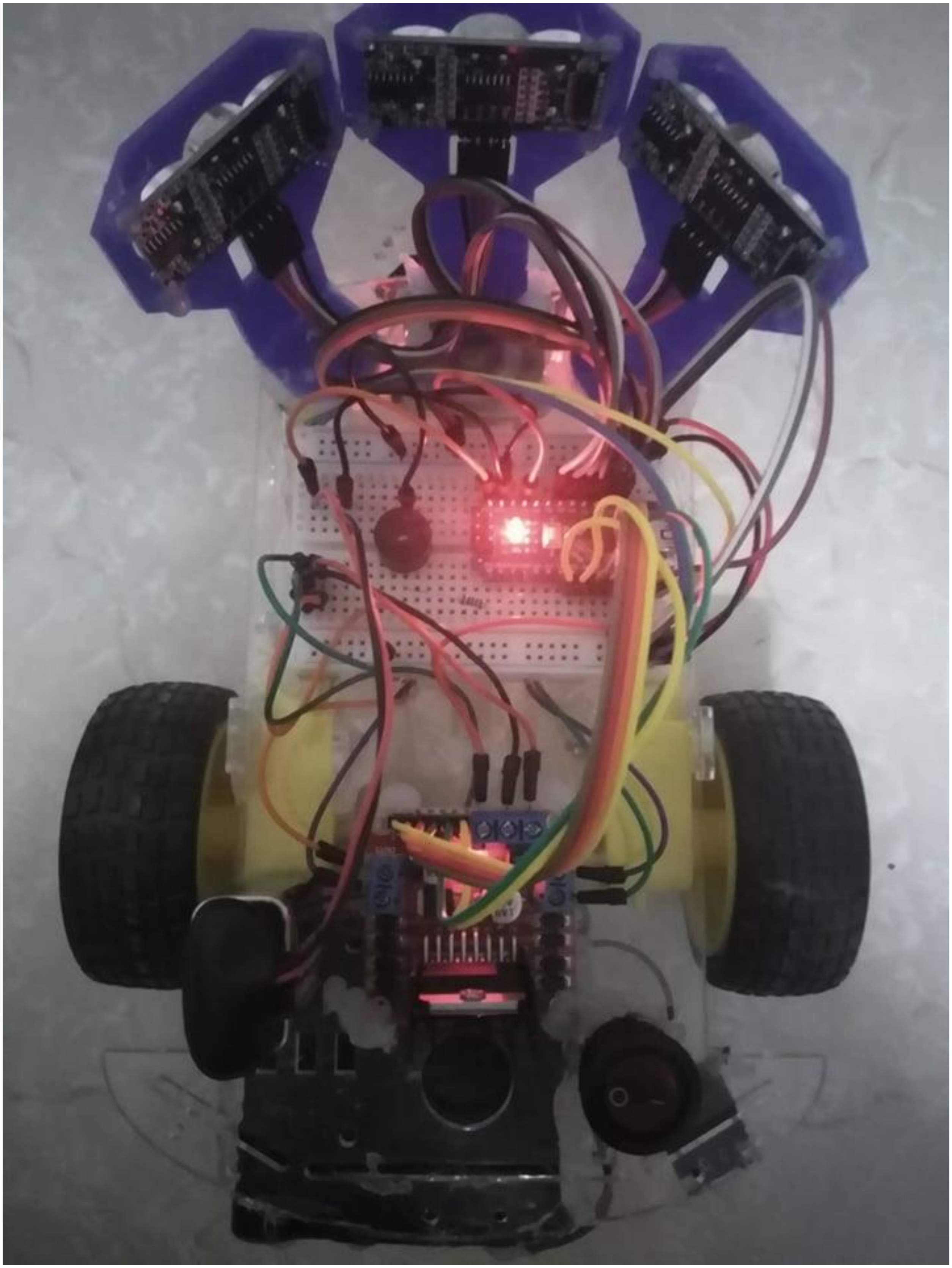

Figure 28: Physical Design.

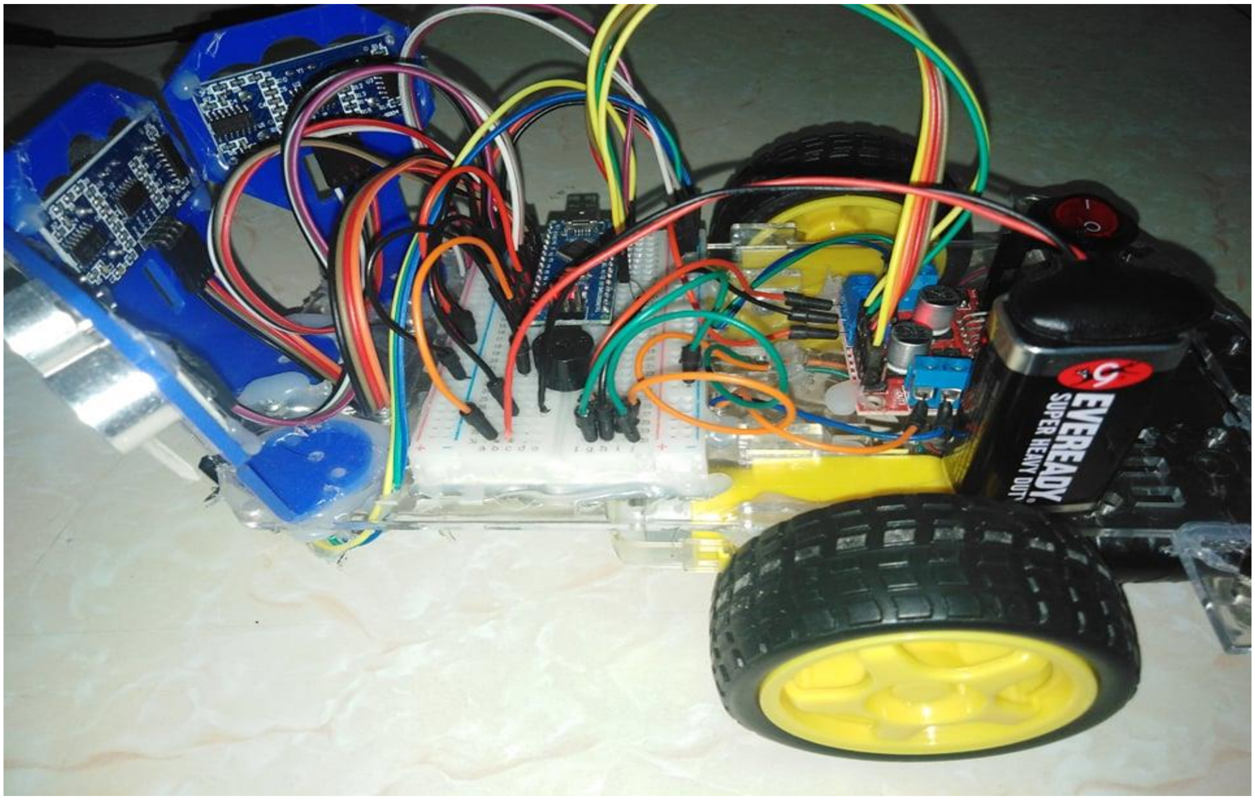

Figure 29: Physical Design.

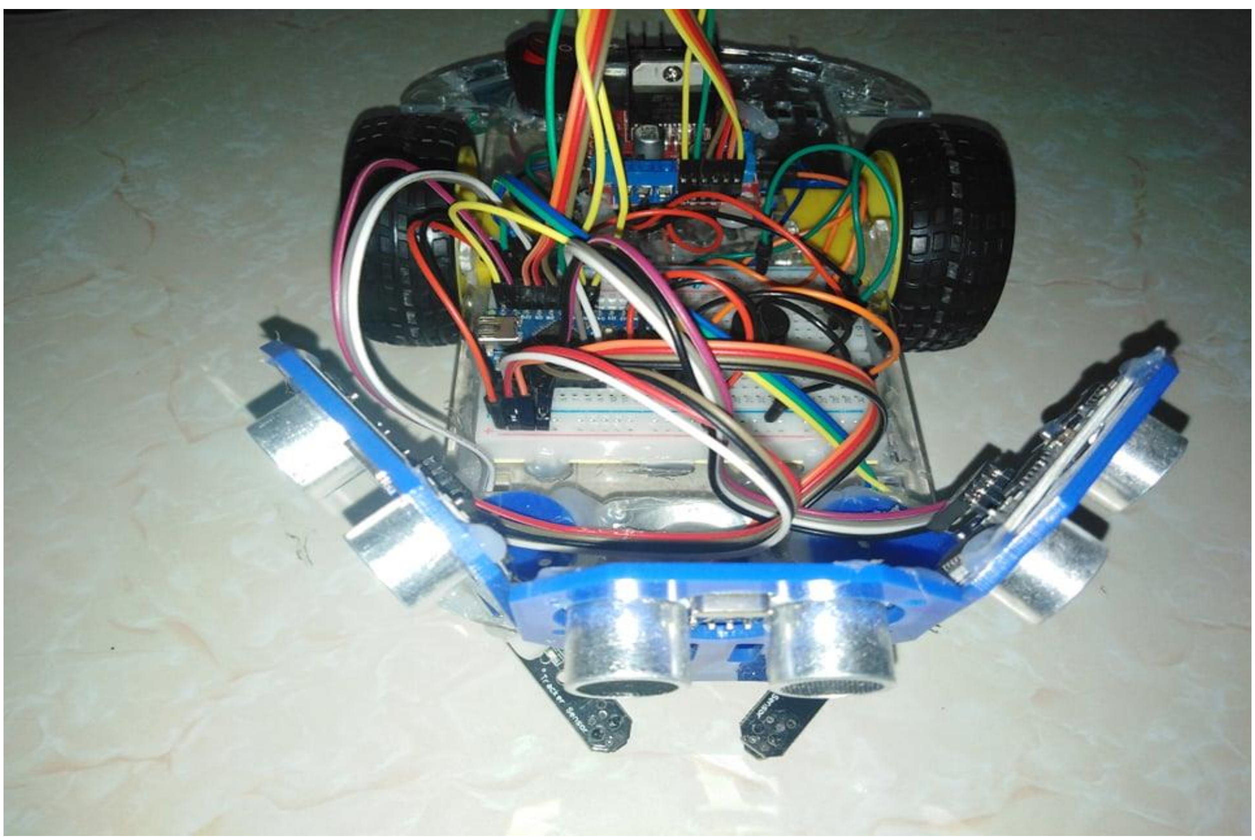

Figure 30: Physical Design.

Figure 31: Physical Design.

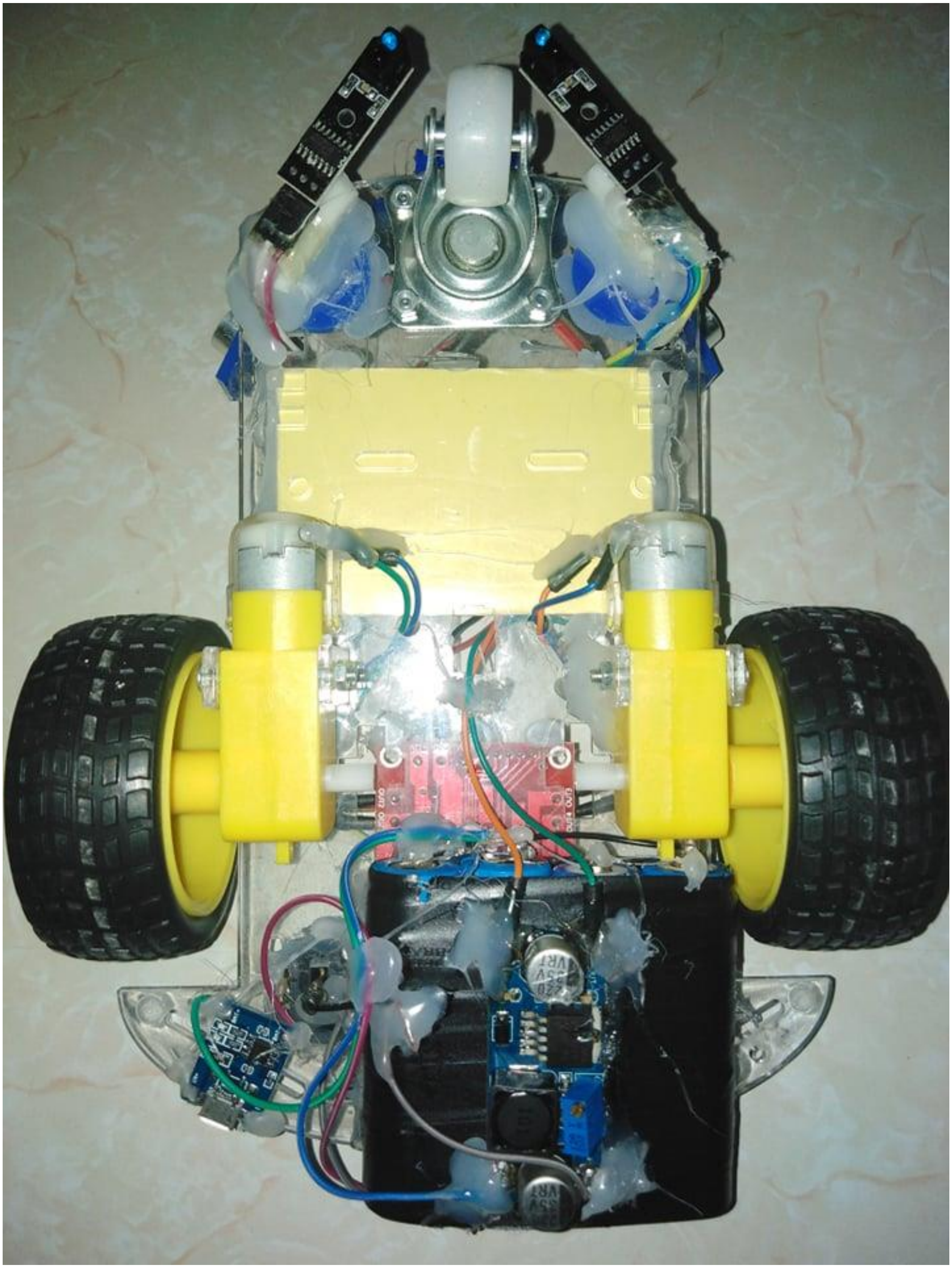

Figure 32: Physical Design.

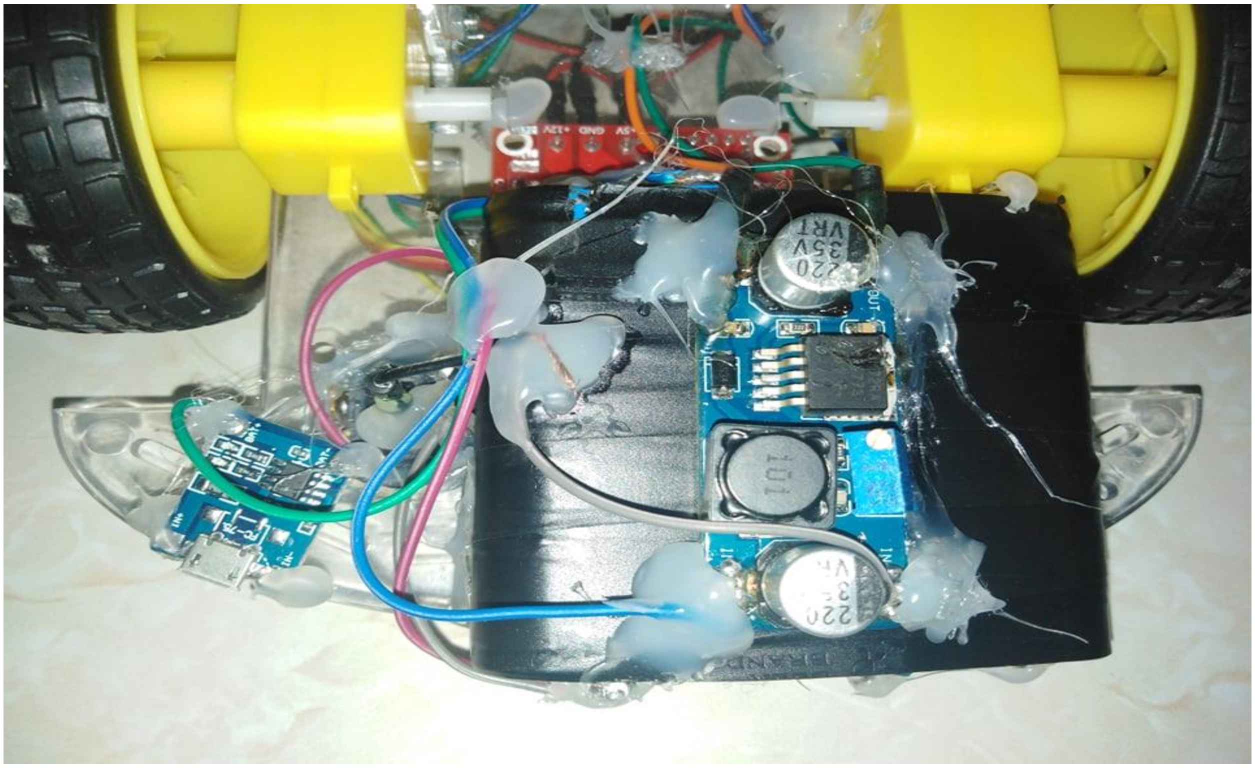

Figure 33: Physical Design.

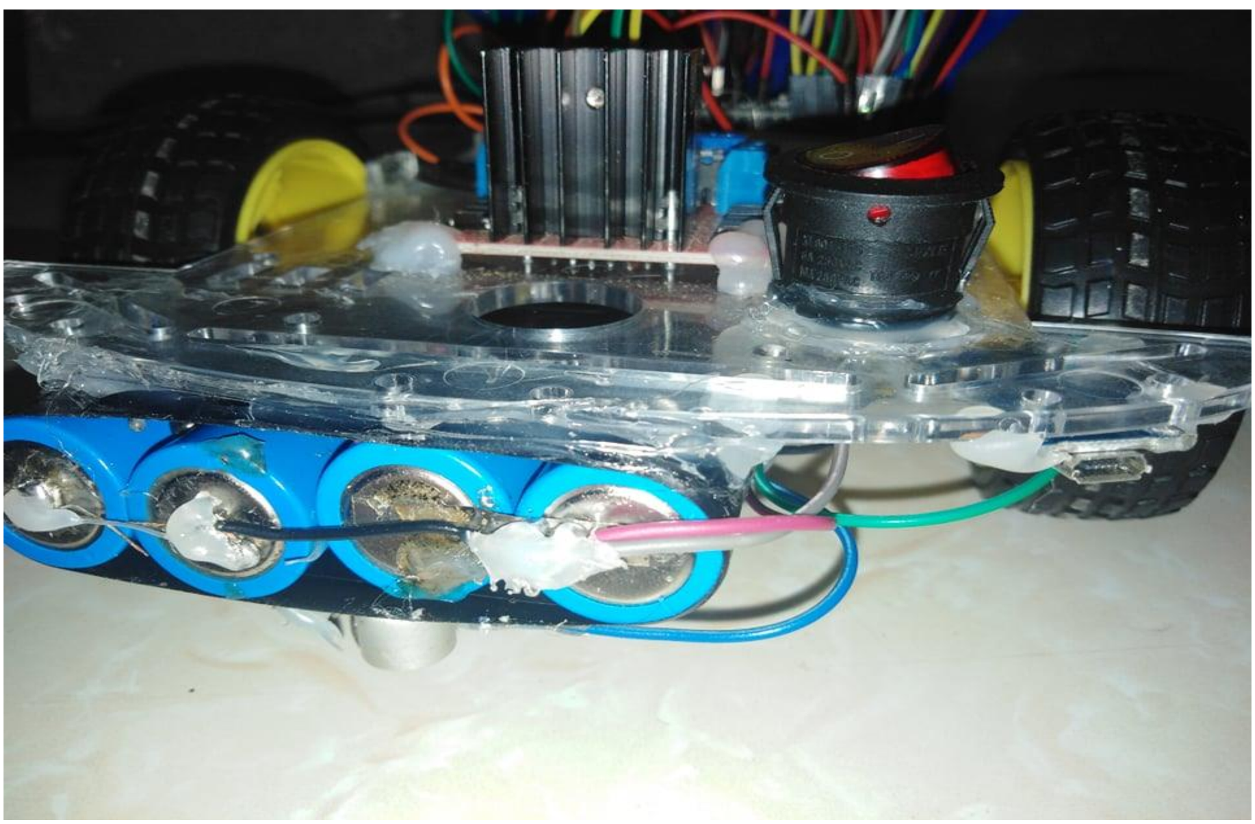

Figure 34: Physical Design.