Abstract

The outside world is filled with fear of covid-19 as is it spreading through public spaces which restrict the common lifestyles of the people. Our project hopes to accomplish complete sanitization of the surrounding without any spread of corona. The major part of the sanitizing robot which we are building has an obstacle avoidance robot as its base model and on top of it, we have a spraying mechanism to spray sanitizer in almost vapor form to eliminate sputum carrying over to the public foreign object. So, in simple terms, the robot is designed to change path when it detects an object In Front of it which helps to avoid a crash and helps to navigate through unknown terrain or room filled with movable objects (people and pets). In parallel, it is equipped with a sanitizing module that enables the sanitizing of the environment. The Arduino UNO R3 is used as the control unit which provides the input from ultrasonic sensor to avoid obstacles and from IR sensor to control the sanitizing range. The robot can be used in any small-scale environment. The software used here is tinker cad for simulation and solid works for the designing of the model and stress test.

Keywords: Arduino UNO R3, sanitizing module, Tinker CAD

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CHAPTER 1
INTRODUCTION

The project's main aim and purpose have been explained briefly, now let's understand the base concept of the model. By now the purpose is clear, that is to autonomously sanitize an area. We are going to disinfect the area by spraying the sanitizer towards the object. We use fluid sanitizer rather than UV rays to disinfect the area. The robot manoeuvres the work area by the active feedback given by the ultrasonic sensor which in turn gives the signal to the motor driver L298N that drives the motor.

Figure 1.1 Image of sanitizing bot

The robot moves in the backward direction and deviates its path by pre-set degree angle and continues this process till the path has no obstacle. In a scenario where there are no obstacles In Front, the robot moves forward with a considerable speed. Parallelly the robot is equipped with a

disinfectant system that includes an IR sensor, a storage container, and a sprayer nozzle mechanism which allows the robot to disinfect only when the object Is in its work volume.

Figure 1.2 Image of sanitizing bot

1.1 Scope

The disinfectant sanitizing spray is in high demand and urgency as the world is desperate to make the situation back to normal so that the people of their respective countries can have the liberty to move freely in the open/public space. The major advantage of the disinfectant robot is not only to disinfect the area but also makes a huge impact and gives immense confidence to the people visiting the particular area so that they can enjoy it to their fullest without fear of getting infected by the virus.

The robot is a major plus for the small-scale as well as major-scale retailers in the mega mall environment. It can cover the whole area and

sanitize autonomously without any manpower and also it is possible at regular intervals to avoid getting in contact with people.

The environments where the bots are present change the atmosphere and give a boost to the business as more people feel safe in their commercial areas. The bot can not only sanitize the small area but a group of bots can effectively cover the whole mega mall. The idea behind the bot is not to disinfect the objects but the whole surfaces present near the bot. The world outside is recovering from the impact of the surprising but deadly virus which took over the world in the blink of the eye

1.2 Problem statement

The problem throughout the world is the covid -19 pandemic. The world was shocked to the core as their whole routine of life of the human civilization was at a still, Making the whole cycle of social interactions was missed throughout the world. The people missed going to public places like malls, amusement parks, and small retail shops. The people are afraid to come out of their houses in fear of transmitting the virus through surface contact. As the corona can transmit from any surface and travel through it causing the person to lose his health drastically. This is a major health concern as the saying goes “health is wealth”. We don't want anyone to get seriously affected by the corona.

The problem faced in public places is a lack of consistency and regularity. The places are cleaned but it is a huge work as first it requires a man for the job then he has to walk around the place spraying 24/7 within a gap of maximum half hour. For an average human being, this task is tiring and Risky. The person wants to stop the spread so if he doesn't take care of

himself, he might be the person affected and a transmitter. To stop the problem, we need a device that sanitizes the whole room at regular intervals and does not be the host for the virus. That's where most mobile robots come into the picture.

Designing and prototyping a concept is a big task and challenges are the learning part of it. We had to go through many challenges and learn many things in the process. The first thing we learned is the synchronization of the motors' importance. Before the start of the project, we had no clue about the concept. but as we proceeded, we observed that different motors have different speeds. That's when we learned that all similar components have a difference in performance due to many factors. Another major issue faced was the motor selection as we had a quite heavy load compared to other mobile robots. We needed motors to handle the weight and have enough torque to move. the selection and the chassis stress analysis helped a lot in understanding the basic concepts of designing a robot. Not all simulations are made with real-time-based components in mind. In short, to explain that statement the simulation was done on the computer using software, and doing it in real life has a huge difference in code, component, and design.

1.3 Introduction to Tinker CAD

Tinker CAD is an online user-friendly software to create and simulate digital circuits by connecting simpler components such as Arduino, sensors, actuators, and as well as to create 3D Design models with components, also lets users share and edit/modify others work.

1.4 Circuit for design and development of the disinfectant system

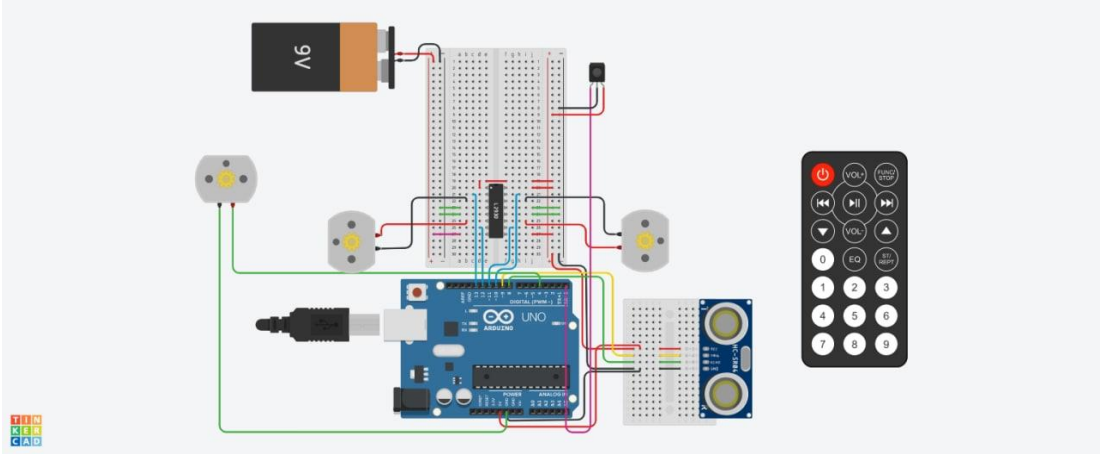

Figure 1.3 TinkerCAD simulation

1.5 Code

```
int TP=9; //TRIGGER PIN  //defining respective pins for spray and obstacle avoidance mechanism

int EP=8; //ECHO PIN

int A=10;//rb

int B=11;//rf

int C=12;//lb
```

```
int D=13;//lf

long duration, distance; //introducing 2 long variables



void setup() {

  Serial.begin(9600); //system will start communicating with arduino at
9600 baud rate

  pinMode(A, OUTPUT);

  pinMode(B, OUTPUT);

  pinMode(C, OUTPUT);

  pinMode(D, OUTPUT);

  pinMode(TP, OUTPUT); // signal transmission

  pinMode(EP, INPUT); // reciver

}



void loop(){

  digitalWrite(TP, HIGH); //start transmitting ultrasonic signals

  delayMicroseconds(1000);
```

```
  digitalWrite(TP, LOW); //after transmission reciever will wait for bounced back signal

  duration=pulseIn(EP, HIGH); //time taken by the reciver to recive transmitted signal

  distance=(duration/2)/29.1; //to calculate distance durattion should be divided by 2 then resultant by 29.1 to convert the distance into centimeters

  Serial.print(distance);//resultant distance will be printed on serial monitor with cm as unit

  Serial.println("cm");

  delay(1000); //value will be refreshed every 1 second



  if (distance>100){  //when distance is greater than 100cms; for forward movement

    digitalWrite(A, LOW); //pin 10 low

    digitalWrite(B, HIGH); //pin 11 high

    digitalWrite(C, LOW); //pin 12 low

    digitalWrite(D, HIGH); //pin 13 high

    delay(100); // hold for 1 second
```

```
}
else{ // distance less than 100,
  digitalWrite(A, LOW);  // all pins low
  digitalWrite(B, LOW);
  digitalWrite(C, LOW);
  digitalWrite(D, LOW);
  delay(1000); //delay of 1 second
  digitalWrite(A, HIGH); //for return motion
  digitalWrite(B, LOW);
  digitalWrite(C, HIGH);
  digitalWrite(D, LOW);
  delay(5000); //bot will move back for 2 seconds
  digitalWrite(A, LOW);  //again hold for 2 seconds
  digitalWrite(B, LOW);
  digitalWrite(C, LOW);
  digitalWrite(D, LOW);
```

```
    delay(2000);

    digitalWrite(A, HIGH); //will take a left turn and stay in same
direction until unless new object detected

    digitalWrite(B, LOW);

    digitalWrite(C, LOW);

    digitalWrite(D, HIGH);

    delay(2000);

  }

}
```

1.6 Introduction to solid works

Solid work is a software program that is used for modeling, plotting, visualized ideas virtually, designing, etc. It can also be used for mechanical, electrical, and civil purposes.

You can simulate a model, check the element's elasticity by using stress analysis features, and many more.

This is the mechanical model we created using solid works which consist of chassis, wheels, and sanitizing tank which represents our basic idea of how the real model will look like also with accurate dimensions and look.

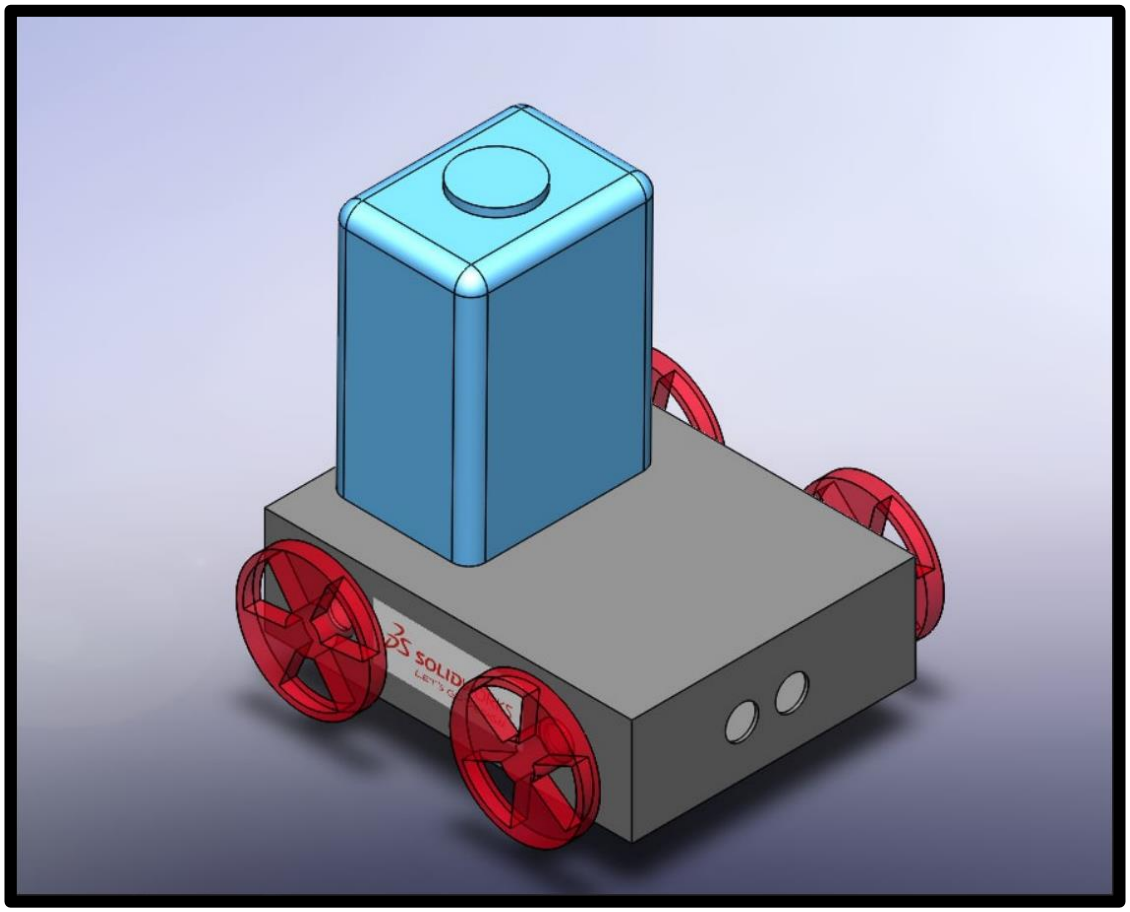

Figure 1.4 Solidworks Modelling

1.7 Stress test

We have conducted the stress test for the chassis whether the chassis can handle the load or not and we have done it through the solid works software. We mentioned the respected conditions.

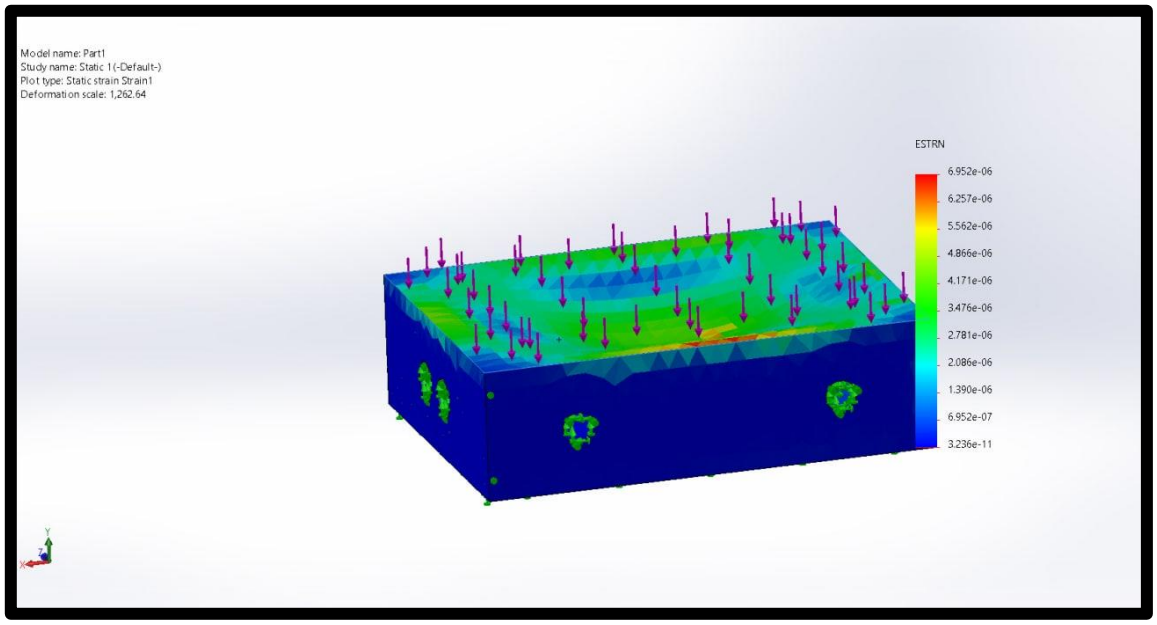

Figure 1.5 SOLIDWORKS STRESS ANALYSIS (A)

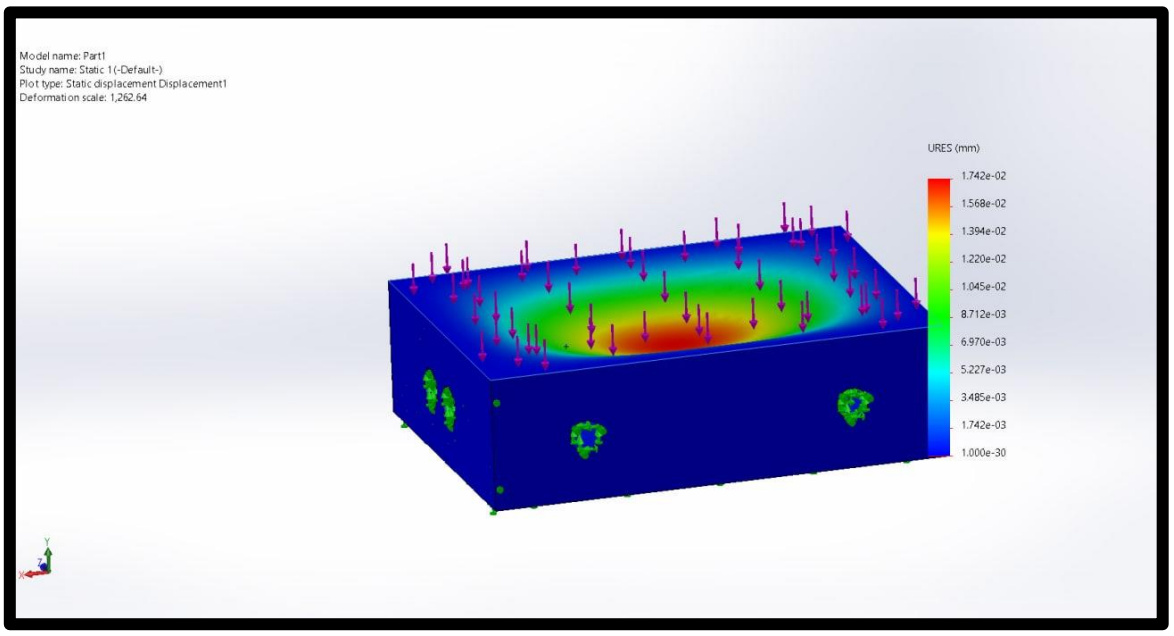

Figure 1.6 SOLIDWORKS STRESS ANALYSIS (B)

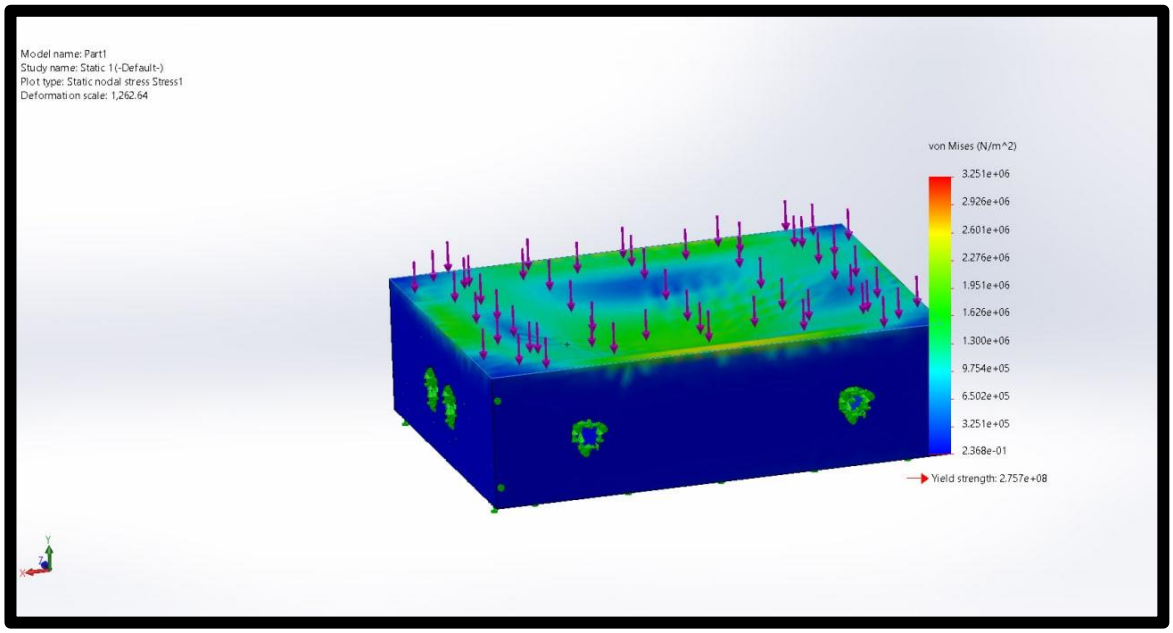

Figure 1.7 SOLIDWORKS STRESS ANALYSIS (B)

CHAPTER 2
LITERATURE REVIEW

The literature review was created after studying 9 papers of distinct mechanisms. Each consists of a different objective and way of approach towards the goal.

1) SANITIZATION ROBOT

Authors: Apeksha Wadibhasme, Yedhu Bhooshan M M,

Kaushik Moolya, Shireen Farhath, Dipti Darade, Sumana Hati

We learned all the components like ultrasonic sensors, motor drivers,

Arduino UNO ETC, their usage and basic idea of creating the system.

2) Obstacle Avoidance Robot Using Arduino

Author: Pavithra A C and Subramanya Goutham V

Learned the mechanism of obstacle avoiding design and working

3)Obstacle Avoidance system

Author: Faiza Tabassum, Susmita Lopa, Muhammad Masud Tarek

& Dr. Bilkis Jamal Ferdosi.

Learning the mechanism of obstacle avoiding design

4)Autonomous Navigation and Obstacle Avoidance Vehicle.

Author: Kyuhyong You

Learning the mechanism of obstacle avoiding design

5)International Journal of Soft Computing and Engineering

Author: Vivek Hanumante Sahadev Roy Santanu Maity.

Learning distance measurement and working principle.

6) Intelligent tracking obstacle avoidance wheel robot

Author: Elsevier B.V

Learning distance measurement and working principle

7)Design of Disinfection Robot for Livestock Breeding

Author:Qing Chun Feng

We understood the mechanism of spray Nozzle and system structure

8)H Bridge DC Motor Driver Design and Implementation with Using dsPIC30f4011

Author: Tolga Özer , Sinan Kıvrak , Yüksel Oğuz

learned the working of h-bridge motor driver

9)Design a nd Simulation Study of Small Four-Wheel Vehicle Chassis for Single Driver

Author: M. Z. A Rashid, M. F. Abdul Latif , M. Nur Othman & Marizan Sulaiman

Learned the steps to design and test a chassis

2.1 Who has the problem?

Covid 19 has already affected the daily lives of people all over the globe.

This virus is highly communicable and spreads at a faster rate in highly denser or populated areas due to which humans are getting highly affected.

It is not humanly possible or rather tiresome to sanitize huge places at frequent intervals.

2.1 Manual Sanitizing

2.2 What is the solution?

To prevent or reduce the spread of the virus we need to sanitize at regular intervals on highly touched surfaces.

2.3 Where is the problem occurring?

This problem generally occurs where a high number of people get interacted at public places such as train coaches, shopping malls, general stores, etc.

2.4 Why is it important to address?

It's important to sanitize the environment at regular intervals to prevent the spread of the virus. The virus has made people get locked in their homes for a long time. Which had a devastating impact on their social life. People need to get back to their normal life, which is a major issue for business owners and for entertainment parks. People need to go out into the world without any fear of the virus ever affecting the public spaces.

CHAPTER 3
CALCULATIONS

3.1 Load calculation

Total wheel drive = 02

Load = 4kg

Safety factor = 1.5

Total payload = 4 x 1.5

= 6kg

Load on each wheel = 6/2

= 3kg

Radius of wheel = 4cm

Formula available for torque of wheel:

T_w = TTE(kg) x R_w(cm) x RF

T_w: torque of wheel

TTE: total tractive effort (load)

R_w: radius of wheel

RF: resistance factor

T_w = 3kg x 4cm x 1

= 12 kg-cm

RPM of motor = 45

Total distance covered in 1 min = RPM x circumference

= 45 x 2 x π x r

= 45 x 2 x 3.14 x 4

= 1130.4 cm

= 11.304 m

= 11m (approx.)

3.2 Sanitization mechanism

Total tank capacity= 1500ml

Total continues spray time= 26 min= 1560sec

Liquid dispensed per second= 1500/1560

= 0.9615 ml/s

= 1ml/s (approx.)

3.3 Object detection mechanism

Distance =(duration/2)/29.1

duration= time taken by the receiver to receive the transmitted signal

CHAPTER 4
METHODOLOGY

The Methodologies involved in this project to achieve the objective is of two goals,

Primarily Objective - OBSTACLE AVOIDANCE SYSTEM is a base objective that will be involved in the mobility of robots inside the workspace autonomously that is without any involvement of human contact.

Secondary Objective – SANITIZER SPRAYING MODULE Involves in the spraying of the liquid sanitizer stored in a tank on the surfaces which IR sensors detect for a specific time.

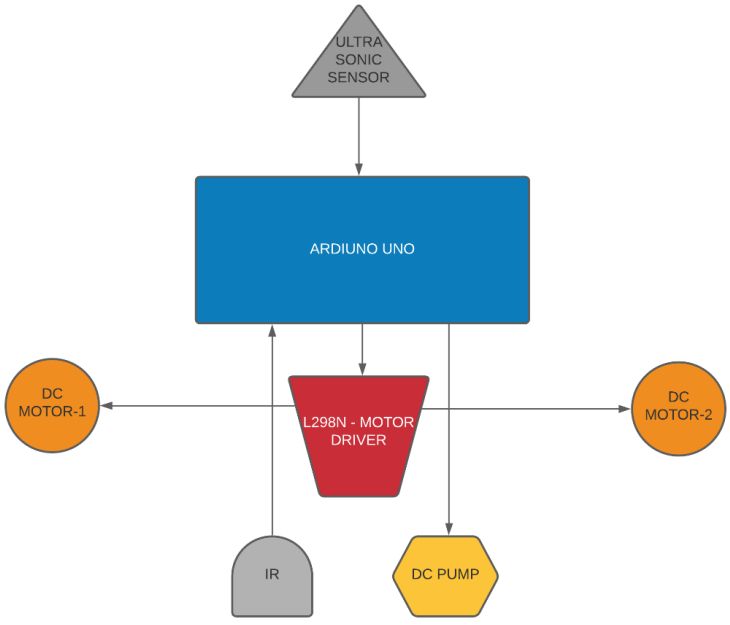

Figure 4.1 block diagram

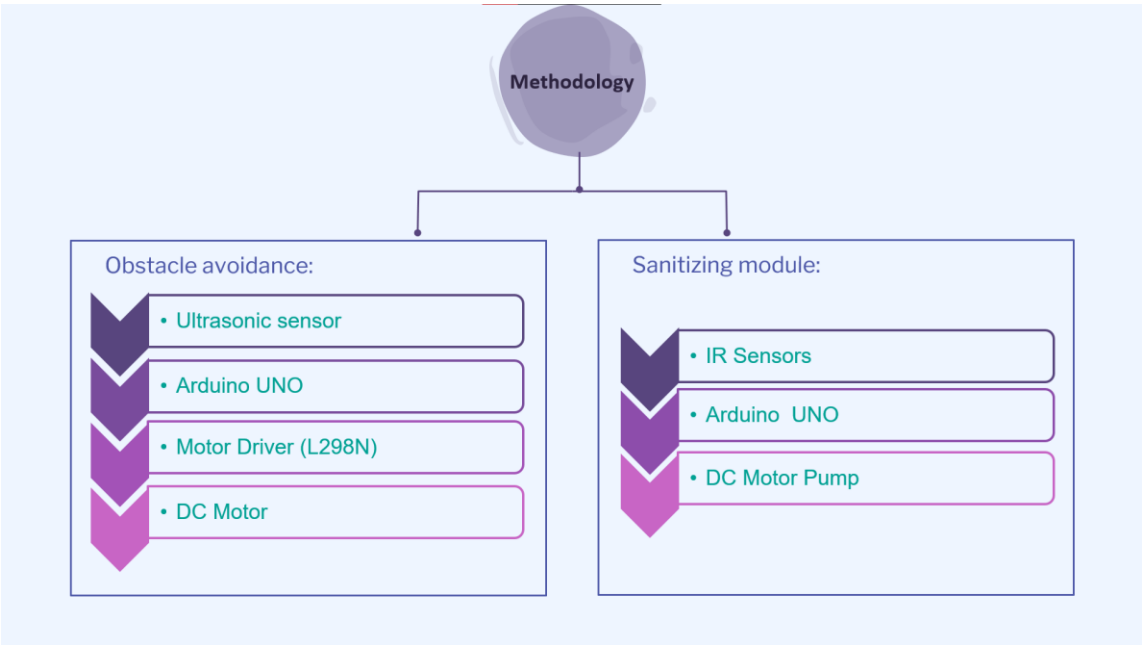

Figure 4.2 flowchart

4.1 Component Selection

4.1.1 Arduino UNO R3

Figure 4.3 Arduino UNO R3

Its comes with ATMega328 IC on board which is replaceable too, it is powered by USB port plus a 12v input post also available on board, the

board contains other components like PWM pins, timers, external interrupts or internal interrupts, using USB interface it enables the board to act as a serial device. On board pins are capable of providing constant power supply of 5v.

Arduino UNO Specifications:

ATmega328p microcontroller is used.

5V is the operating voltage.

7-12V input voltage can be used

I/O digital It has 14 pins in (of which **3,5,6,9,10 and11** are PWM output pins)

Working on 16 MHz clock speed

Weight: 25 g, Width: 4 mm, Length :6

VOLTAGE REGULATOR:

. Its principal function is to regulate the voltage level. Even if the regulator's input supply voltage fluctuates, the output voltage remains stable and close to +5V. It acts a stable source of power.

RESET BUTTON:

This button is used to reset the microcontroller. It flashes the controller when used.

0-13 DIGITAL PINS:

Pins 0-13 on the Arduino UNO board are digital input/output pins.

It works in two states only SIGNAL HIGH (1) and SIGNAL LOW (0).

ANALOG PINS:

Arduino UNO contains 6 analog pins with ANLOG TO DIGITAL CONVERTER.

PWM PINS:

Digital pin **3,5,6,9,10 and11 are PWM pins.**

It modulates analog value on a digital signal.

GROUND PINS:

There are 5 ground pins on ARDIUNO UNO

4.1.2Motor driver (L298N):

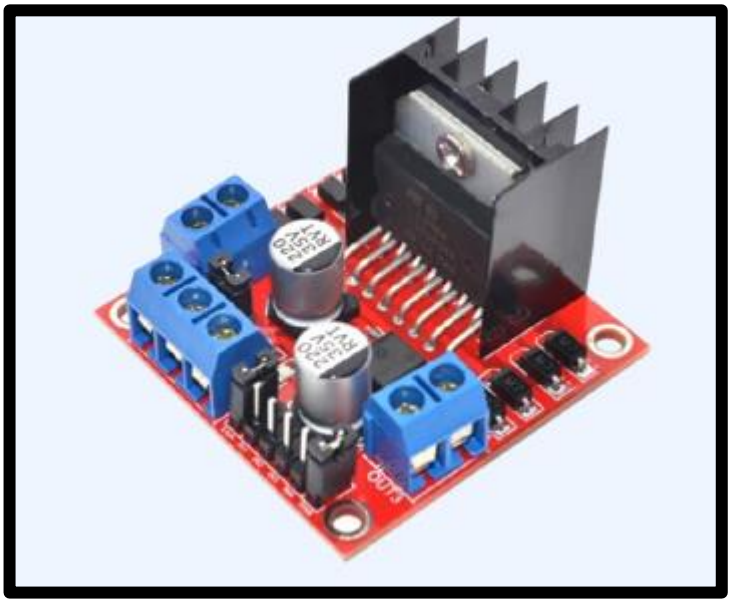

Figure 4.4 Motor Driver L298N

Advantage of using this motor drive is that it supports high torque motors i.e., it is capable of drawing high ampere of current as compared

to other motor drivers. Moreover, it can withstand up to 46v of supply and it comes with a heat sink for excessive heat dissipation.

4.1.4 Motors:

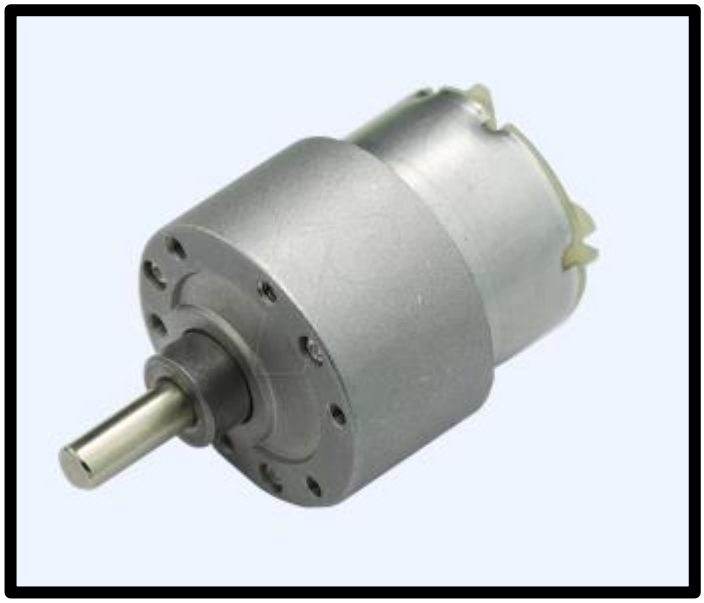

Figure 4.5 DC Motor

In this project we are using 12v geared DC motors that are capable of providing torque of 12 kg-cm and these motors are of 45 RPMs for steady movement of robot.

4.1.5 Ultrasonic sensor

Reason behind using this sensor for detecting obstacles in path is that it can be used in dark environment, it is not affected by colour or transparency of object and it is costs less.

Range Specified: 150cms

HC-SR04 Ultrasonic Sensor comprises of 4 pins.
PIN 1 – It supplies +5V power to module.

PIN 2 (TRIGGER PIN) – It’s an input pin that is used to initiate the measuring process by emitting ultrasonic waves for 10 seconds.

PIN 3(ECHO) - This is an output pin that goes high for a set amount of time, which corresponds to the time it takes the wave to return to the sensor. It acts as a input to controller.

PIN 4 – It’s for Ground. (GND)

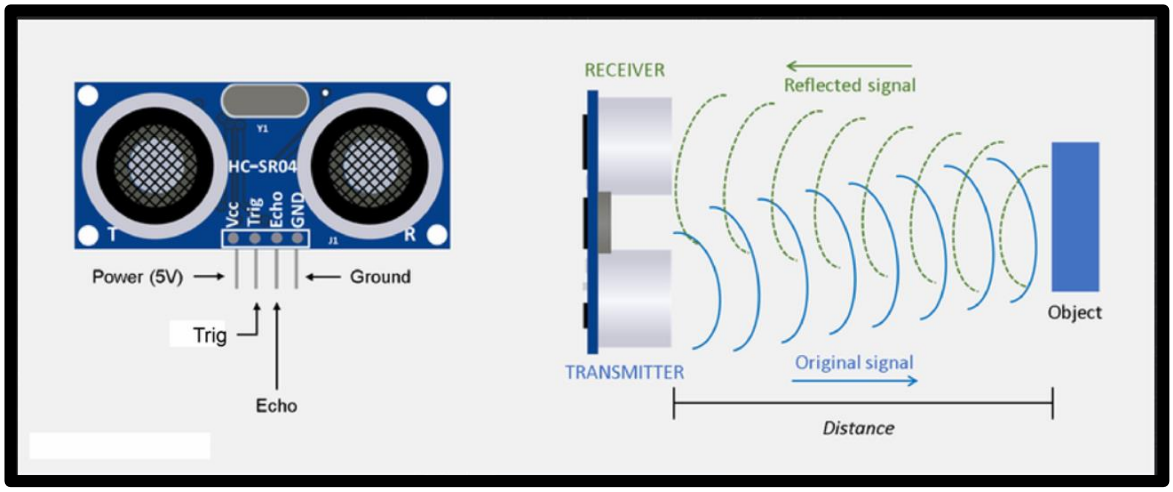

Figure 4.6 Ultrasonic sensor

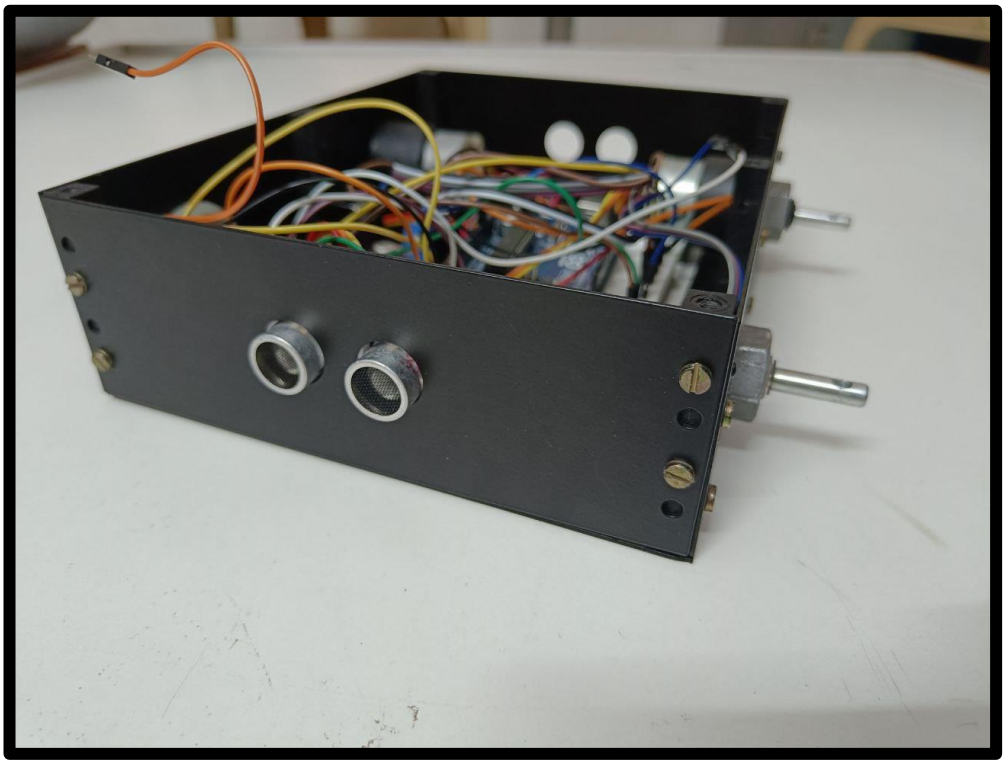

Figure 4.7 mounted ultrasonic sensor

4.1.6 IR sensor:

It is used for detecting surfaces to be sprayed with sanitizer, its range is 30cm at most.

PIN 1 (VCC) – It supplies +5V power to module.
PIN 2 (GND) – Grounds the module.
PIN 3 (OUT) – Active OUTPUT to microcontroller.

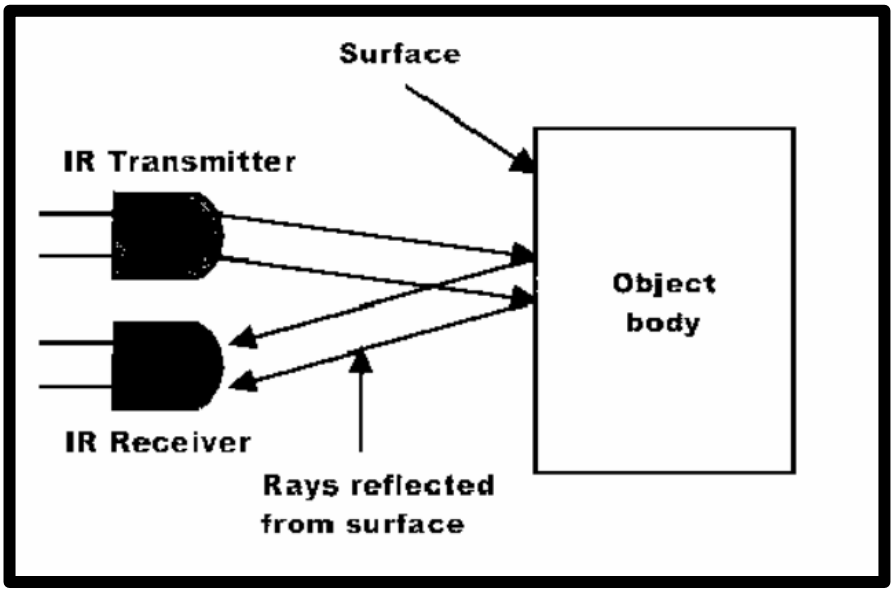

Figure 4.8 IR sensor

4.1.7 DC water pump:

Figure 4.9 DC Pump

The pump used is capable of drawing 1ml sanitization liquid per second through a spray nozzle which sprays up to the distance of 30 cm and covers an area of 150cm^2.

4.1.8 Battery:

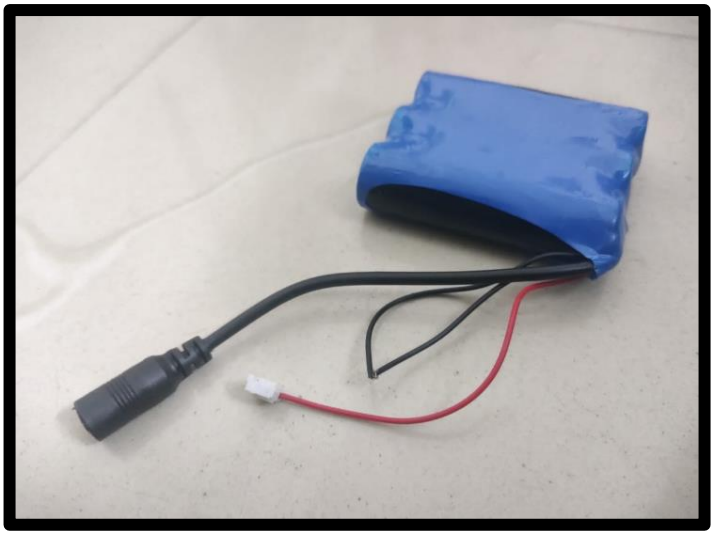

Figure 4.10 Battery

A battery packet of 2000mAh lithium polymer is used with 3 cells, the battery is re-chargeable. The battery will withstand for 45 mins once fully charged.

4.1.9 Chasis:

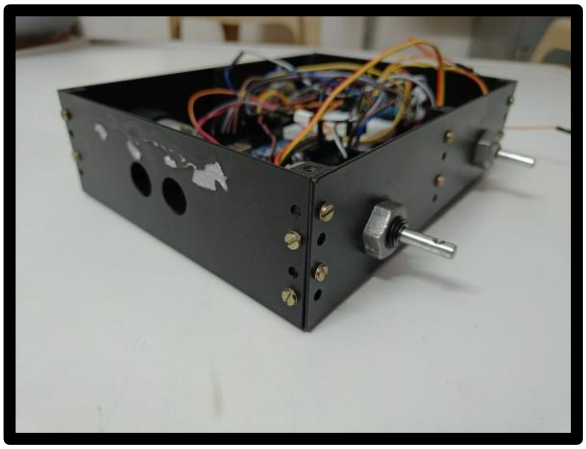

Figure 4.11 chassis

The chassis used is of mild steel which is capable of holding weight up to 6kgs. Length=22cm; width= 17cm; height= 6cm

4.1.10 Wheels:

Figure 4.12 Wheels

Wheels of 8cm radius is used to provide suitable torque and width of 1cm is used with rubber grip to gain proper traction for movement.

4.2 Obstacle avoidance robot:

The obstacle avoidance system involved in the mobility of the robot comprises 4 components HC SR04 ULTRASONIC SENSOR, ARDUINO UNO R3 Microcontroller, L298N MOTOR DRIVER.

- The Ultrasonic sensor is mounted on the facing side or front side of the chassis.
- Here we used it to detect a distant object on the track of the work area

- By emitting Ultrasonic sound waves and converting the reflected sound signal into an electrical signal.
- This Digital signal goes as input to the microcontroller.
- Depending on the feedback from the Ultrasonic sensor the microprocessor initiates the signal to the next driving component (L298N) motor driver.
- The robot is driven by 2 DC motors mounted in the rear end.
- The Data flow starts and moves as follows the Ultrasonic sensor, senses the obstacle and gives a feedback digital signal to the microcontroller; the microcontroller initiates the motor driver to drive the DC motors.
- Skid steering is a mechanism used in 4 wheels-based vehicles for a skid steer vehicle to turn steering because of multiple forces acting on the vehicle. This mechanism is used to make the robotic system to take turns in desirable directions.
- The motion of turn occurs when the two adjacent motors are operated at different speeds and it results the vehicle to change its path by skidding.

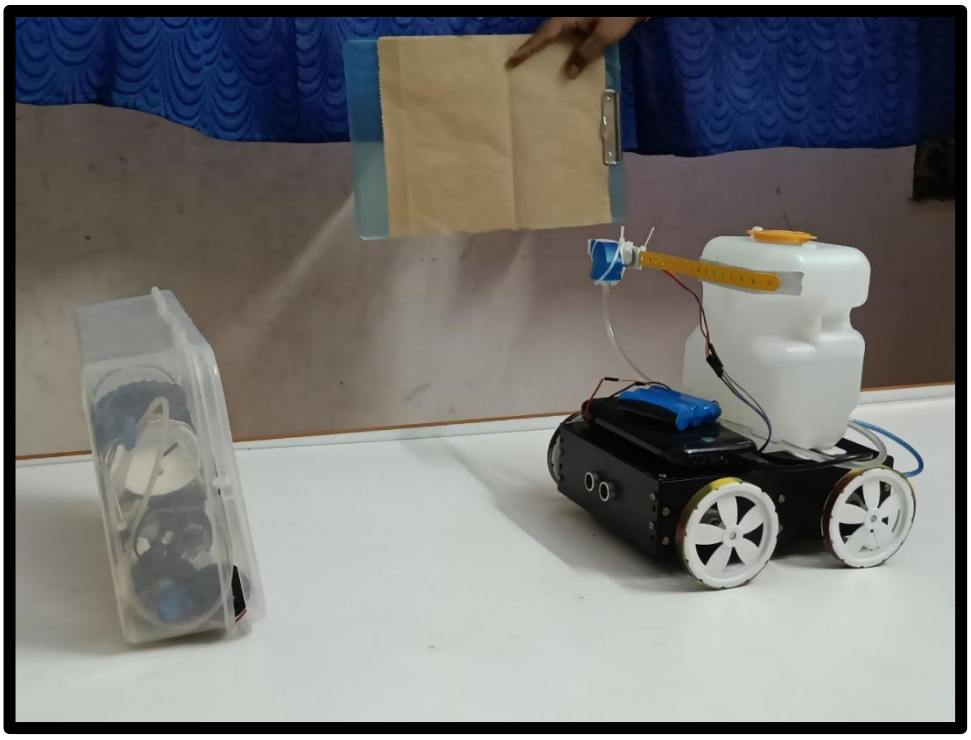

Figure 4.13 Obstacle avoidance

4.3 Sanitizing spraying module:

The sanitizer spraying module comprises two 3 components

IR SENSOR, DC PUMP, SPRAYING NOZZLE.

- The IR sensor is mounted at the center at 90 degrees.
- The Sanitizer storage container of 1500ml is fixed on top of the chassis, and the DC pump is mounted along with it.
- The spraying nozzle is fixed with a tube from the DC pump, which in turn is supplied from the container.
- The Data Flow starts when the IR sensor detects things and sends a signal to the microprocessor to initiate the DC pump.

- DC pump starts and the nozzle sprays the sanitizer through the work area.

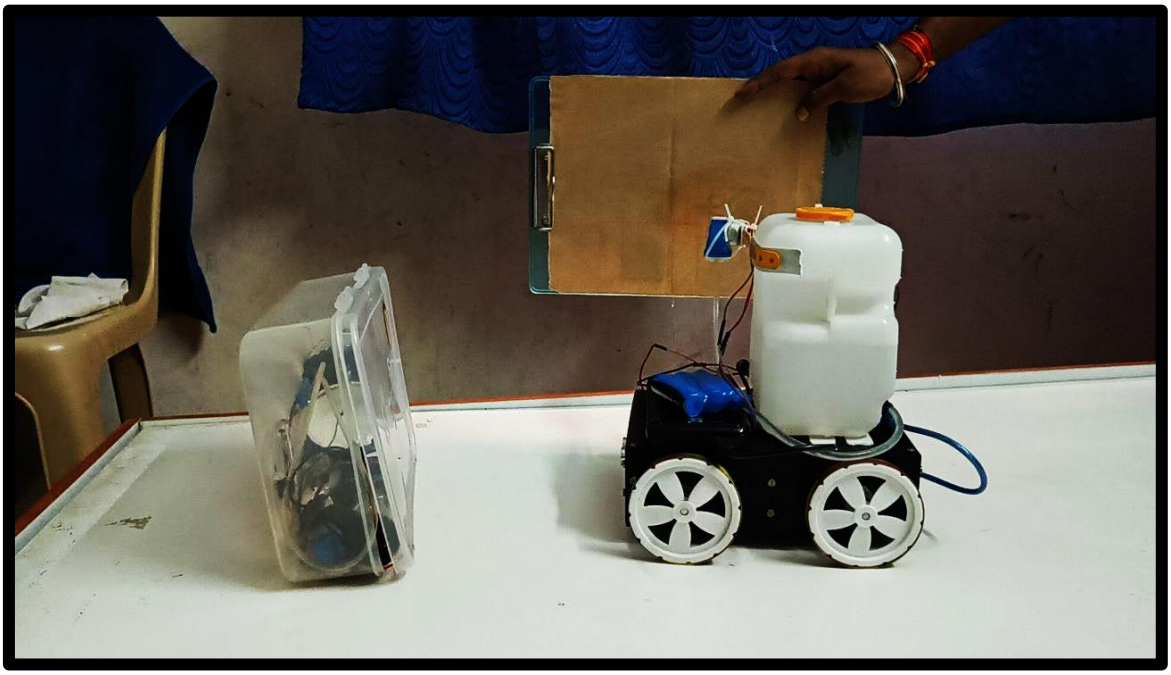

Figure 4.14 sanitizing spray

BOTH THE SYSTEM WORKS PARALLELLY TO ACHIEVE THE OBJECTIVE.

4.4 Circuit Diagram:

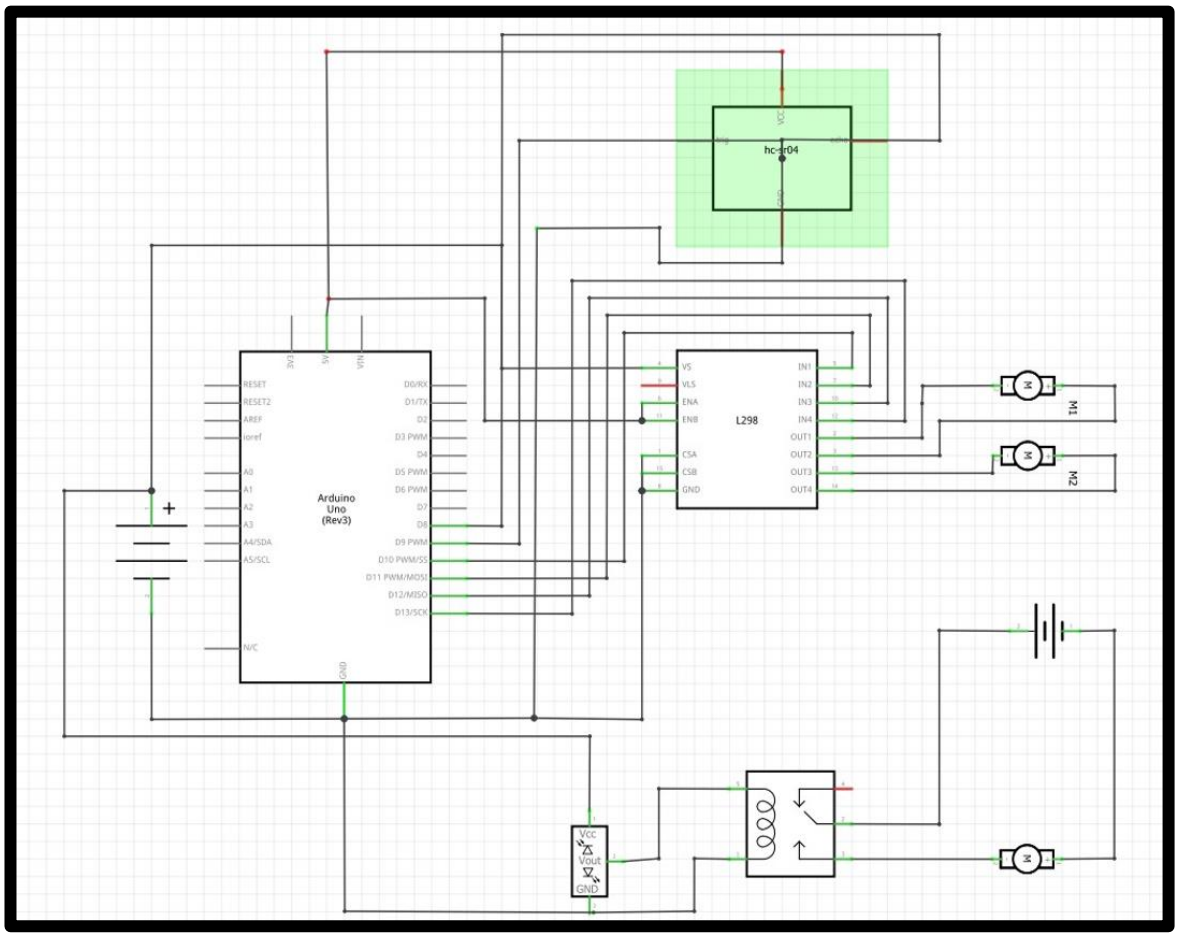

Figure 4.15 Circuit Diagram

- This Circuit contains Arduino UNO R3 connected to a power supply of 5v.
- Ultrasonic sensor is connected to Arduino through the digital pins to collect the input data.
- The dc motors are connected to the motor driver l298N, which drives the 2 rear motors depending upon the signal received from Arduino.
- Simultaneously, the IR sensor is connected to the vcc and gnd of

Arduino.

- The out pin is connected with relay directly. The relay provides the power supply to the dc pump.

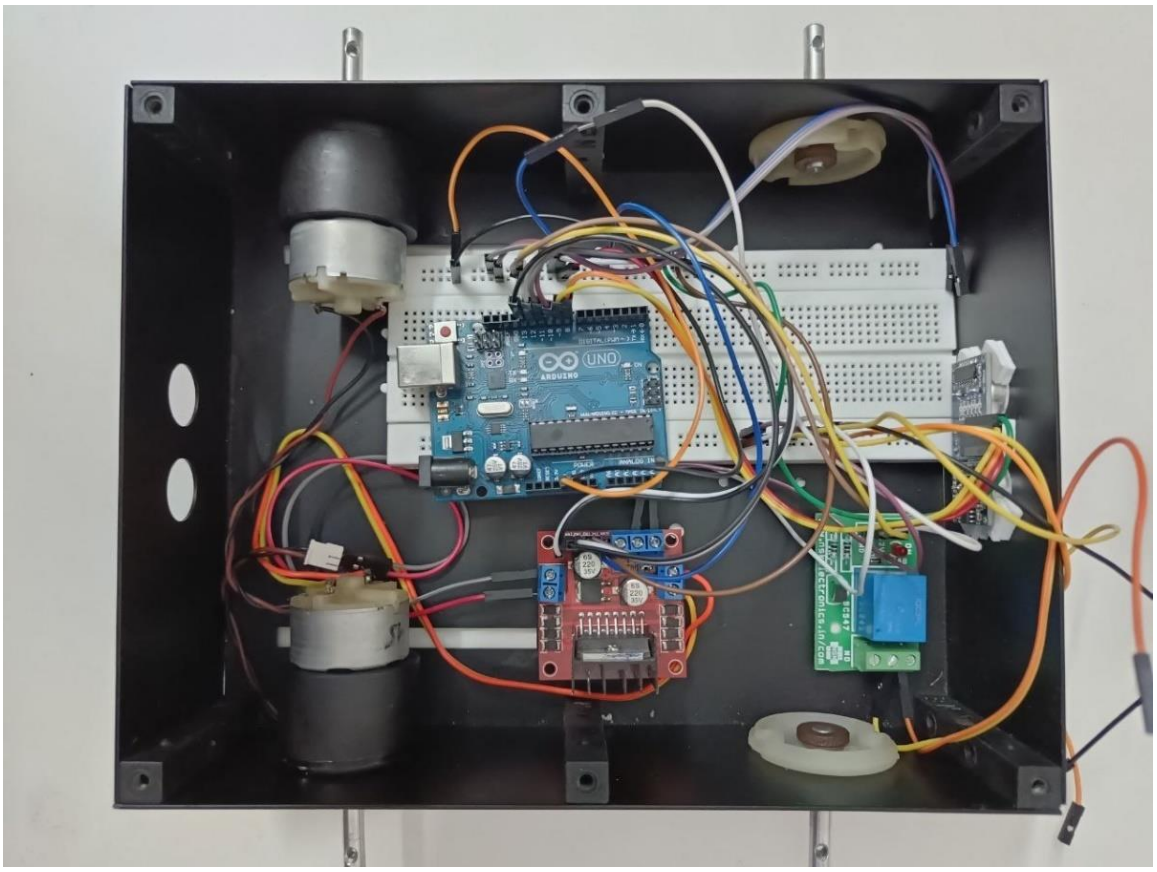

Figure 4.16 circuit

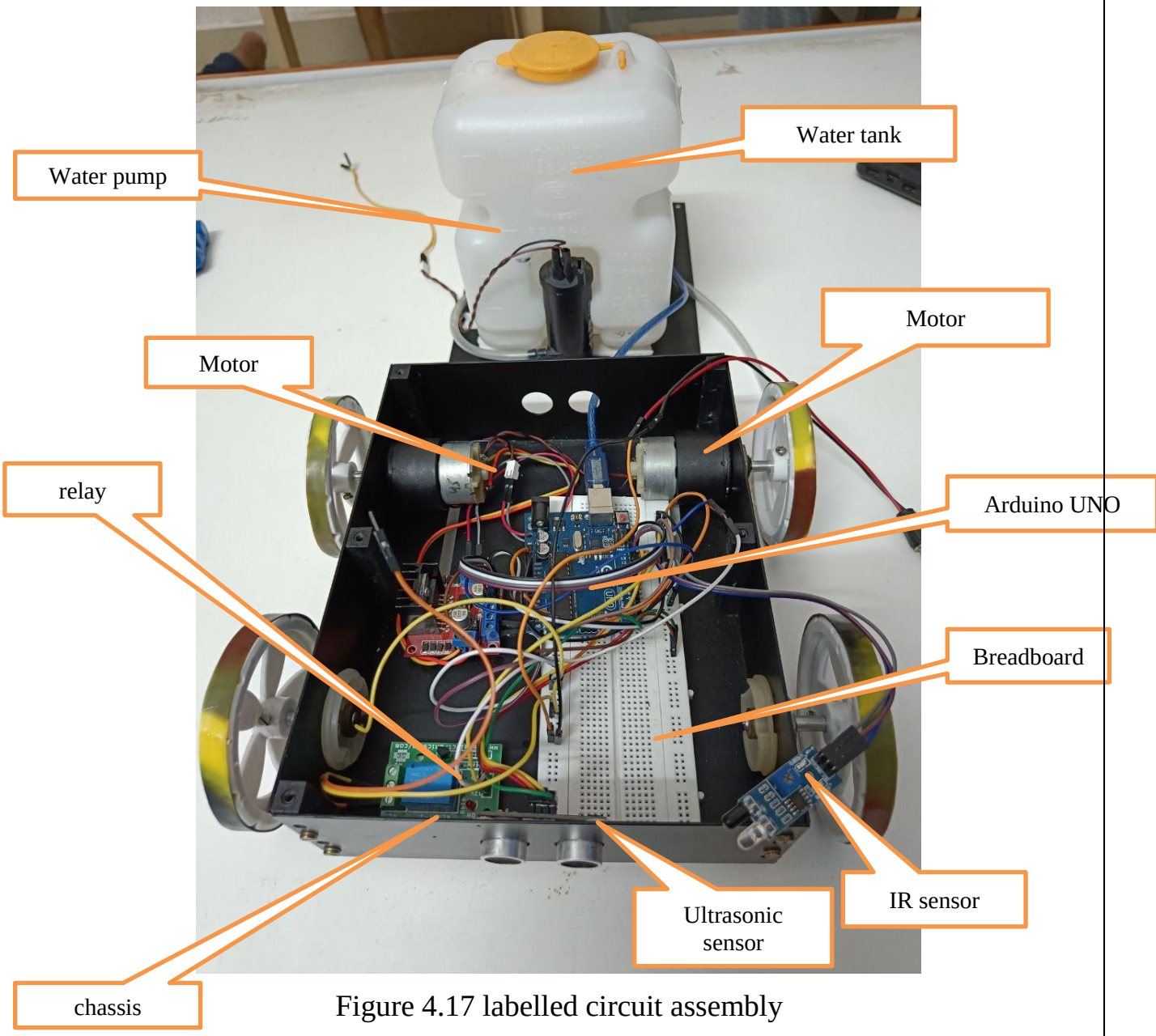

Figure 4.17 labelled circuit assembly

CHAPTER 5
SCOPE OF FUTURE PROJECT

In the future, the robot can be equipped with a smart navigation algorithm to make precise navigation Inside the workspace, also a Bluetooth module can be installed to control it manually as well and for spraying sanitizer, a robotic arm can be more effective and efficient. If simulated in ROS it can enable an accurate 360-degree work area. The future modifications are endless and are limited only by our imagination.

CHAPTER 6
CONCLUSION

- The robot has been designed and the obstacle avoidance function is successful.
- The parallel function of the sanitizing spray is successful.
- The simulation in software is successful. which is in solid works and some bit of proteus.
- The design of chassis and stress analysis is successful.
- The solid model in the solid works is successfully designed.
- The lessons learned from setbacks are the major learning for future projects.

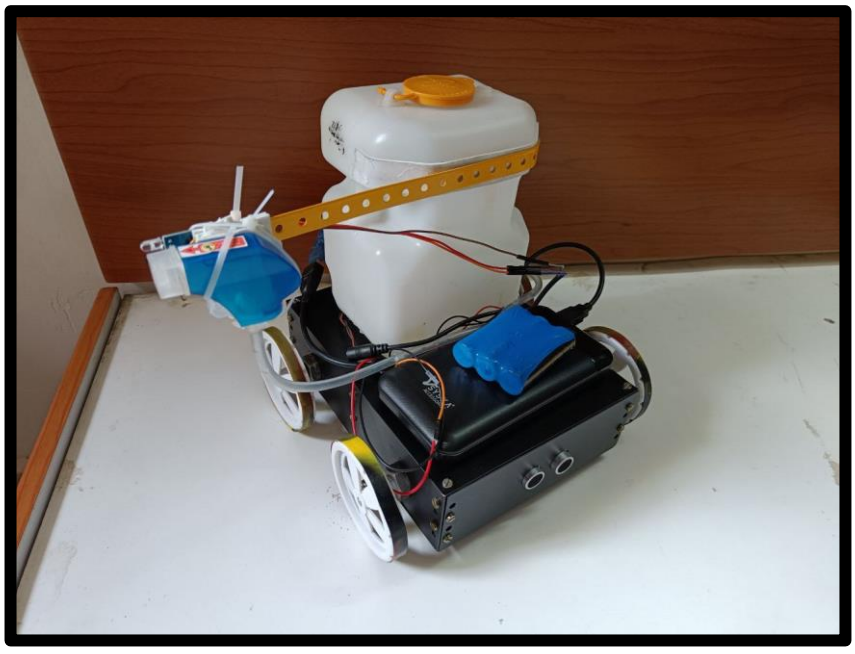

Figure 6.1 Final model image a

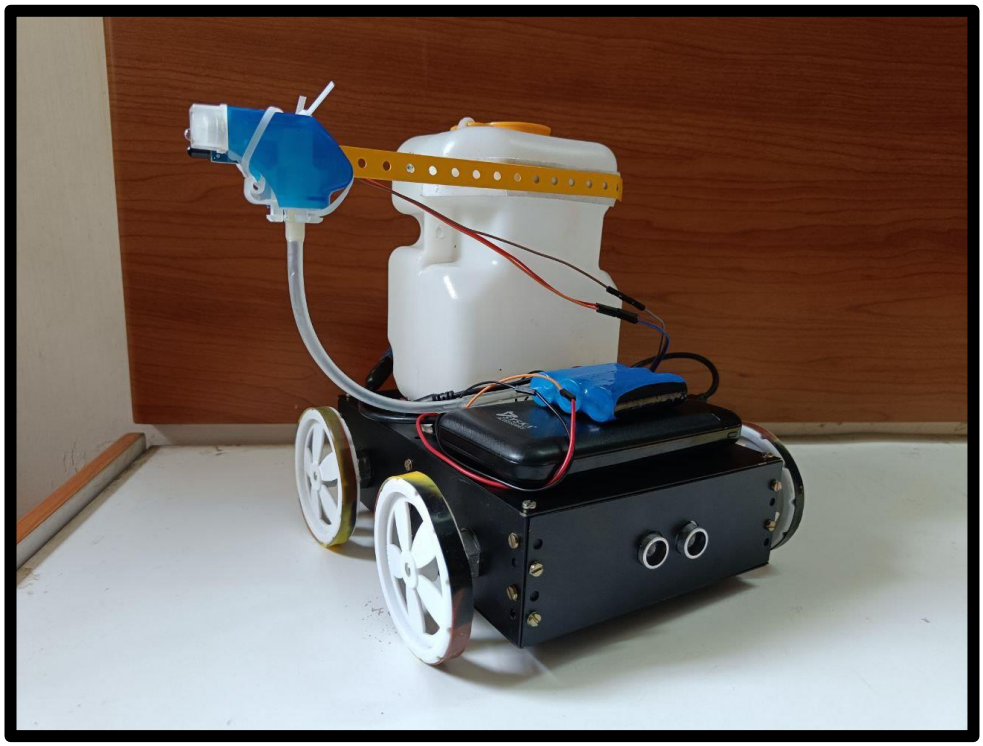

Figure 6.2 final model image (b)

CHAPTER 7
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