

Autonomous UV light Sanitizing System



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Project Objective :

Sanitizing highly contaminated zones such as schools, colleges, hospitals is a really tedious job, moreover, it's a highly precarious job. Therefore, the objective of the proposed project is to develop an Autonomous UV sanitization system using Raspberry Pi.

This project will aid them with a system which will automatically sanitize using UV light. Disinfection with the help of UV light makes the process much easier with better efficiency. This system will be equipped with a Human and object detection system using algorithms such as yolo v4 algorithm and darknet.

It will also be equipped with 4 Ultrasonic sensors placed all around this system for better accuracy for automation.

Motive behind the idea

- The motive behind using UV light is because it is an effective sterilization measure against a wide range of different microorganisms that are present within the environment. The use of UV sterilizing equipment is becoming more widespread, particularly in reaction to the ongoing COVID-19 pandemic.
- The main goal of the project is to obtain a product which collectively helps a person who risks his life into the highly contaminated zones.

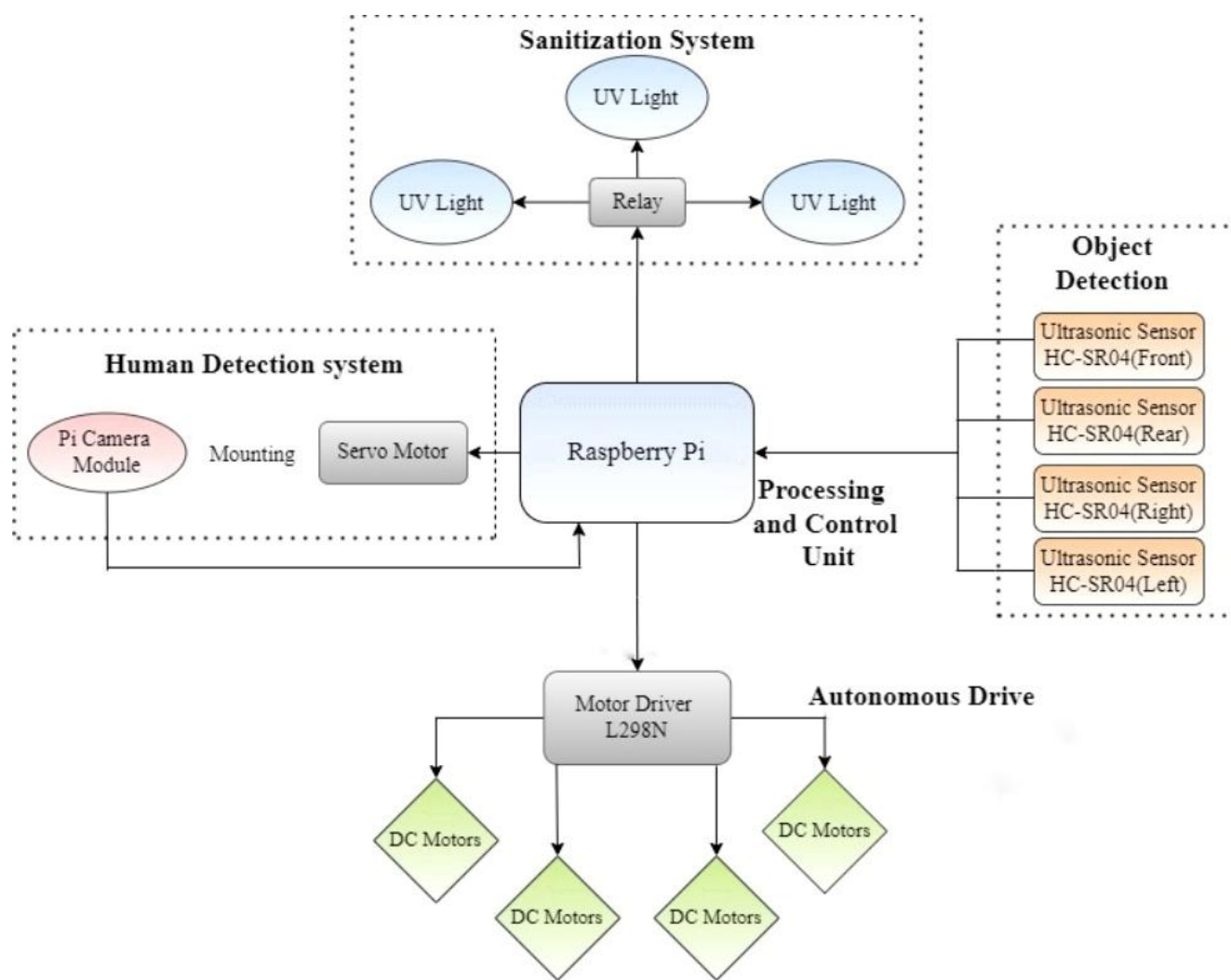


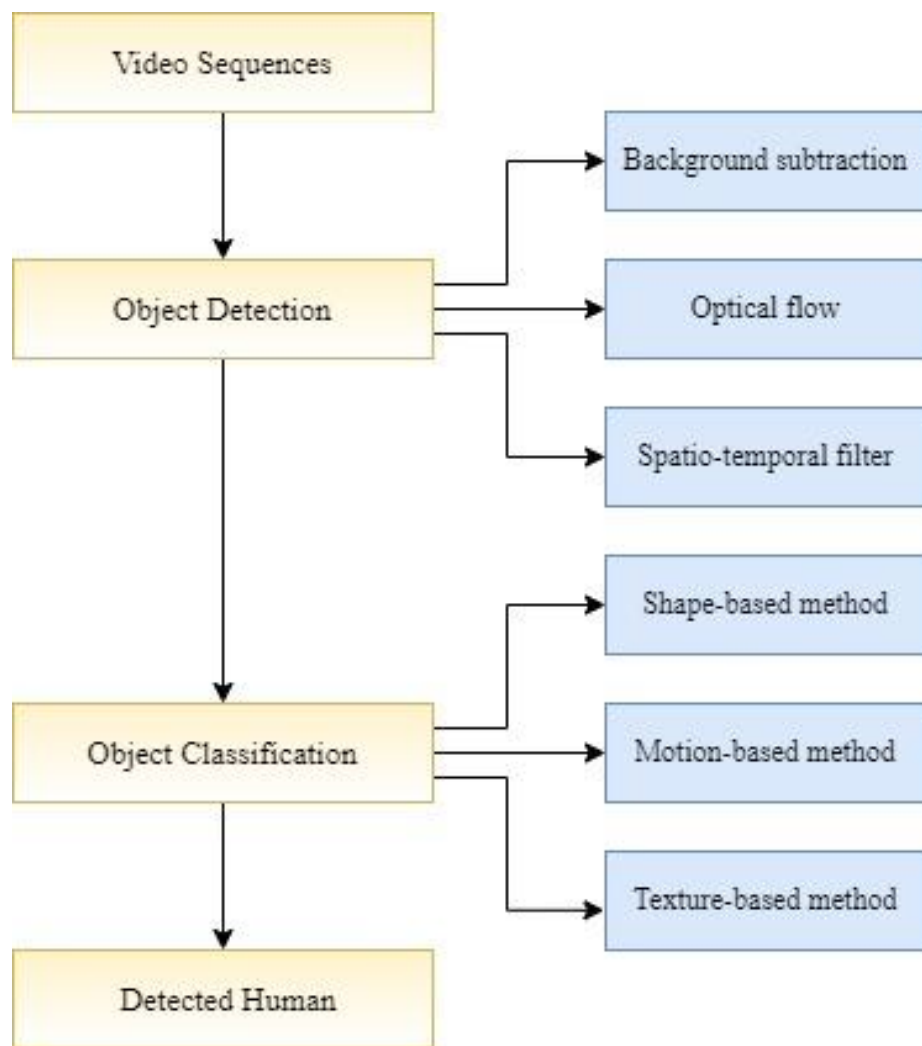
NOW LET'S TAKE A DEEP DIVE
INTO THE PROJECT!!



Overview of Project:

1. CHASSIS
2. SOFTWARE
 - Human Detection System and Object Detection system.
3. HARDWARE
 - UV Light
 - Pi Camera Module
 - Raspberry Pi
 - Servo Motors
 - Ultrasonic Sensors
 - LiPo Battery





CHASSIS

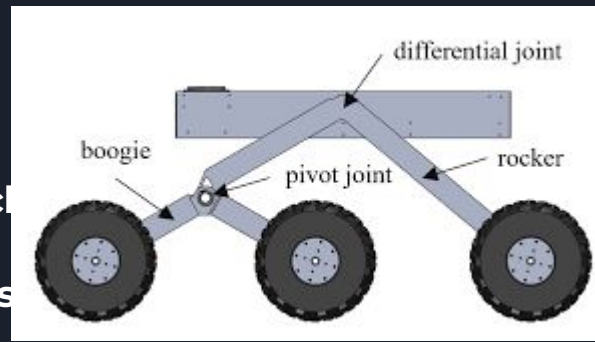
Chassis being used for our project is **Rocker Bogie Mechanism**

Rocker Bogie suspension system is a **passive springless mechanism**.

It is a **6 wheeled rover** capable of traversing **rough terrain** using an efficient **high degree of mobility and suspension system**.

Primary feature of Rocker Bogie:

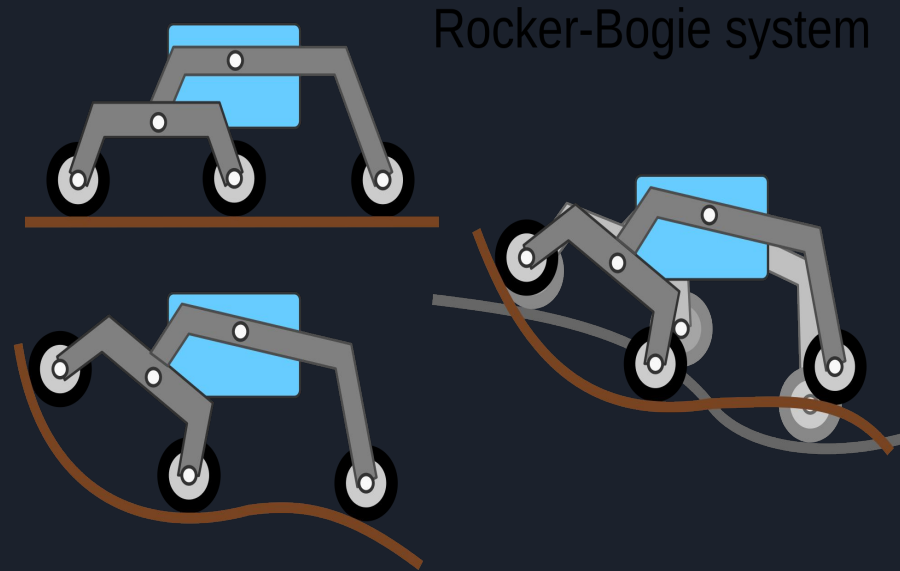
- Simple and Reliable design
- Capable of climbing over obstacles that are up to twice the size of the wheel diameter
- Completely made from PVC to increase its capacity to withstand shocks, vibrations, and mechanical failures



Advantages and purpose of ROCKER BOGIE MECHANISM

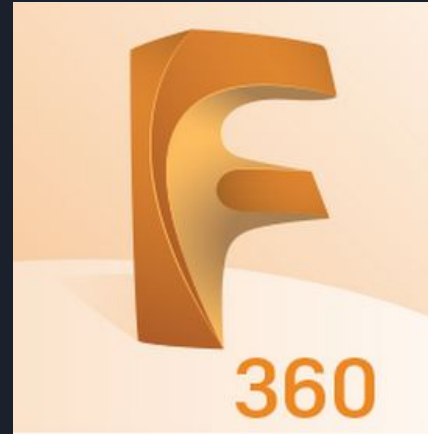
- The load is equally distributed on all wheels.
- Takes consideration of unevenness of the surface it is driving on.
- No suspension is required.
- Near to negligible reduction in speed due to obstacles (in our case Stairs)

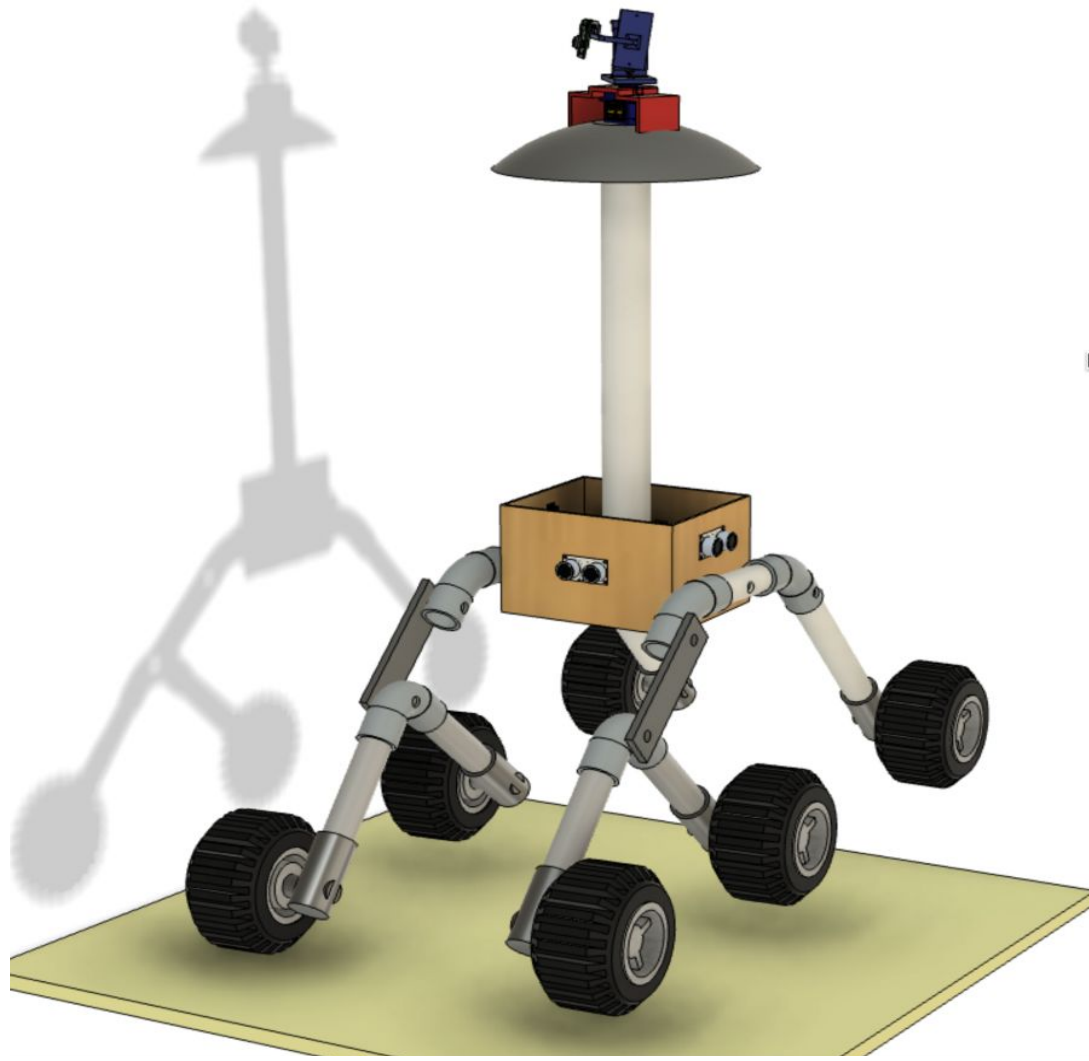
This system has been used, so that it can easily climb the stairs, not affect its maneuverability, and can sanitize the stairs area.

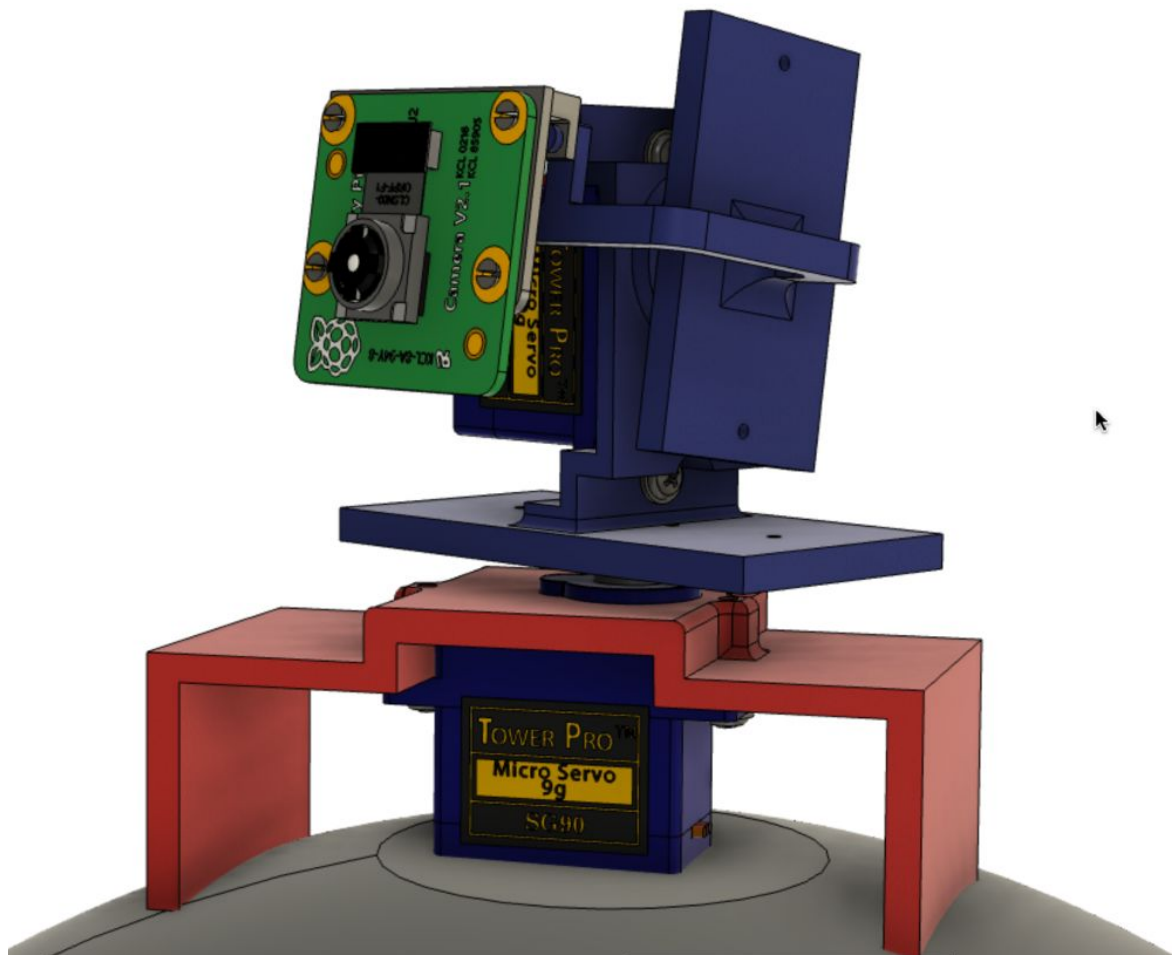


CAD MODEL

- CAD Model is made by using SOLIDWORKS and FUSION 360 softwares
- The model is even rendered using FUSION 360 software

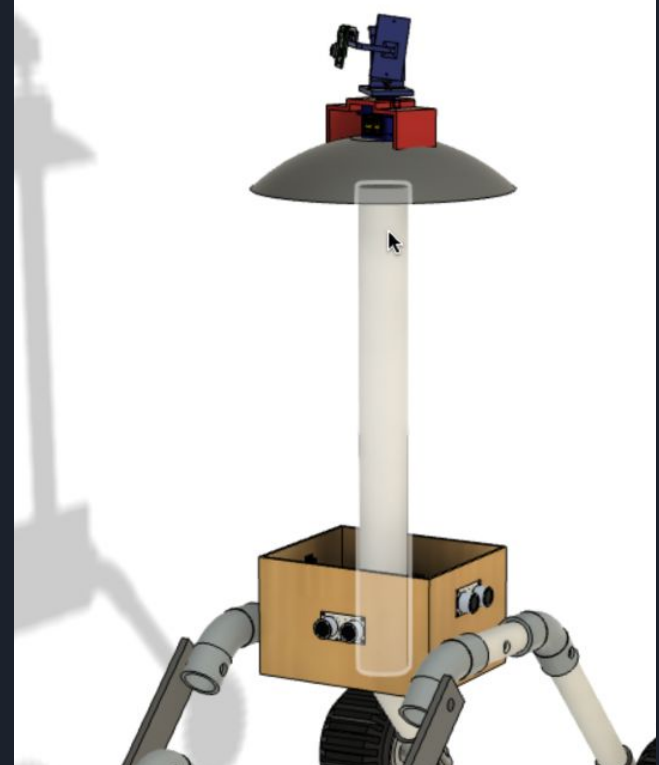
The SolidWorks logo, featuring a stylized 'S' icon followed by the word 'SOLIDWORKS' in a bold, sans-serif font.

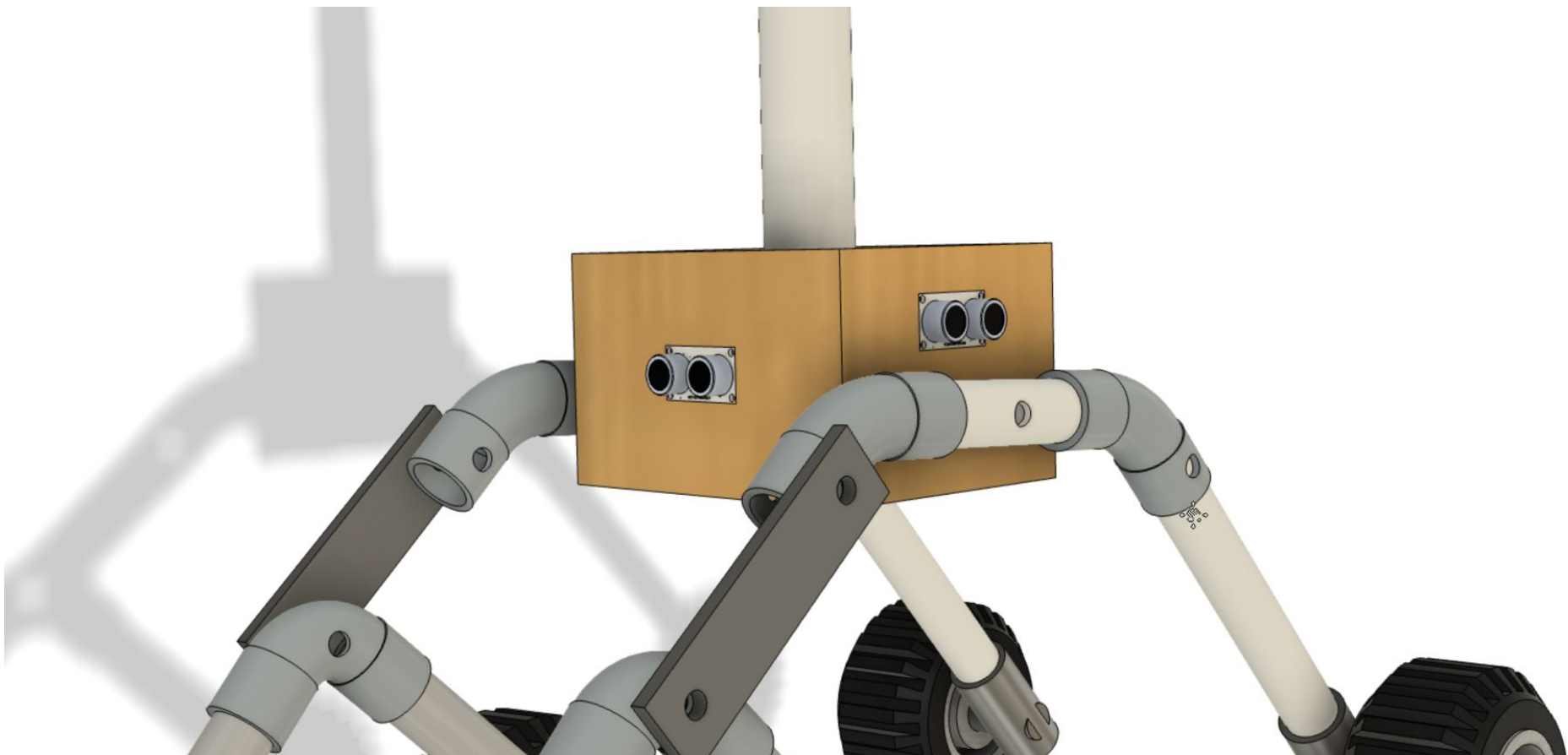




Vertical Rod and Dome

- Chassis consists of a vertical rod and dome which will be helping for sanitization.
- UVC lights are spiraled with the support of the vertical rod.
- Entire vertical rod is wrapped with the silver foil paper for increasing the range of the UVC light radiation for better and effective sterilization.
- On the top of the vertical, there is present a dome which helps to spread the UVC radiations more evenly and increases the range.

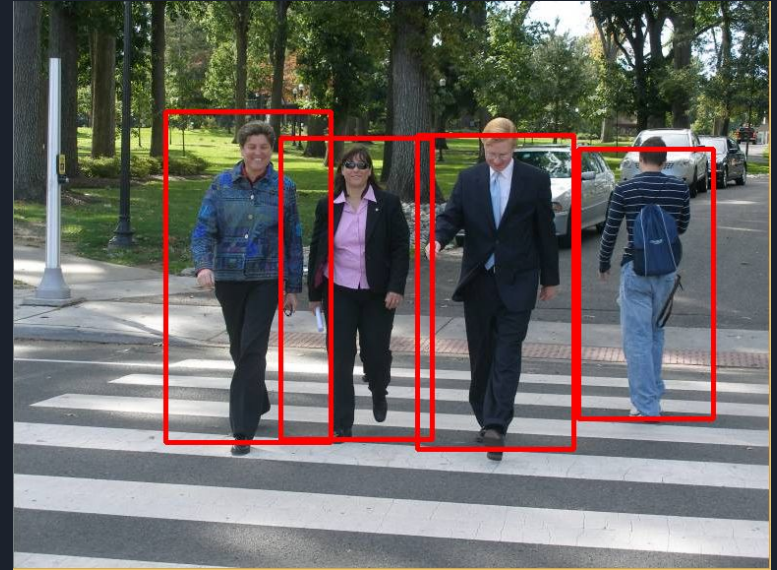






Software

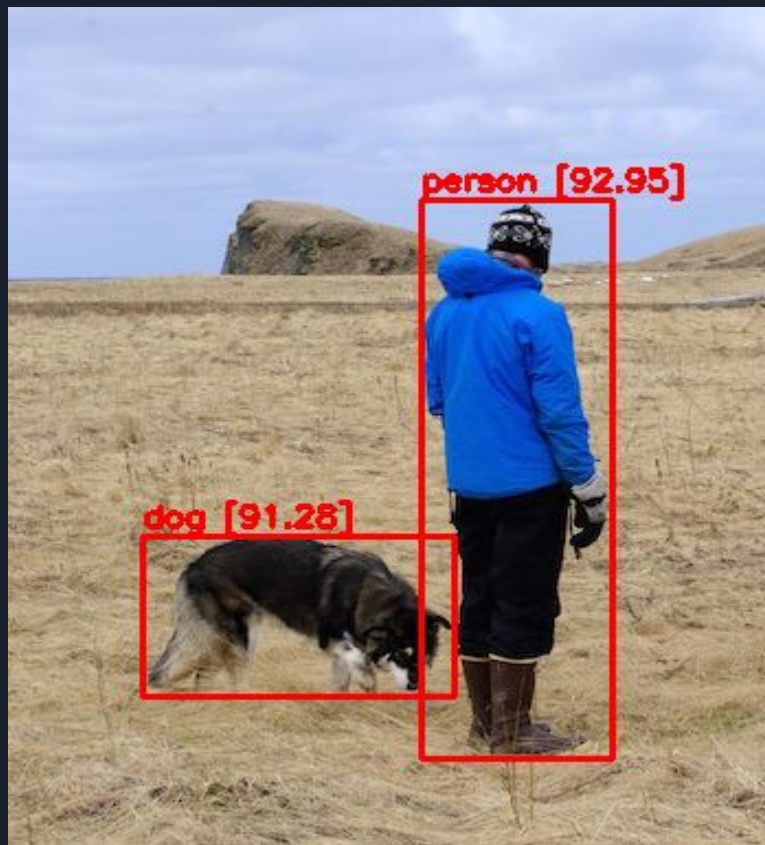
- Since UV light is used for sanitizing the surroundings and is harmful to human beings, human detection is done using OpenCV with the help of a camera module.
- The model will be trained using neural networks by showing many positive and negative images and increasing its accuracy for live human detection.
- As soon as this system detects any human, it will pass a signal to UV light and turn it off immediately.





We have subdivided the implementation of human and object detection into **3 parts/steps**

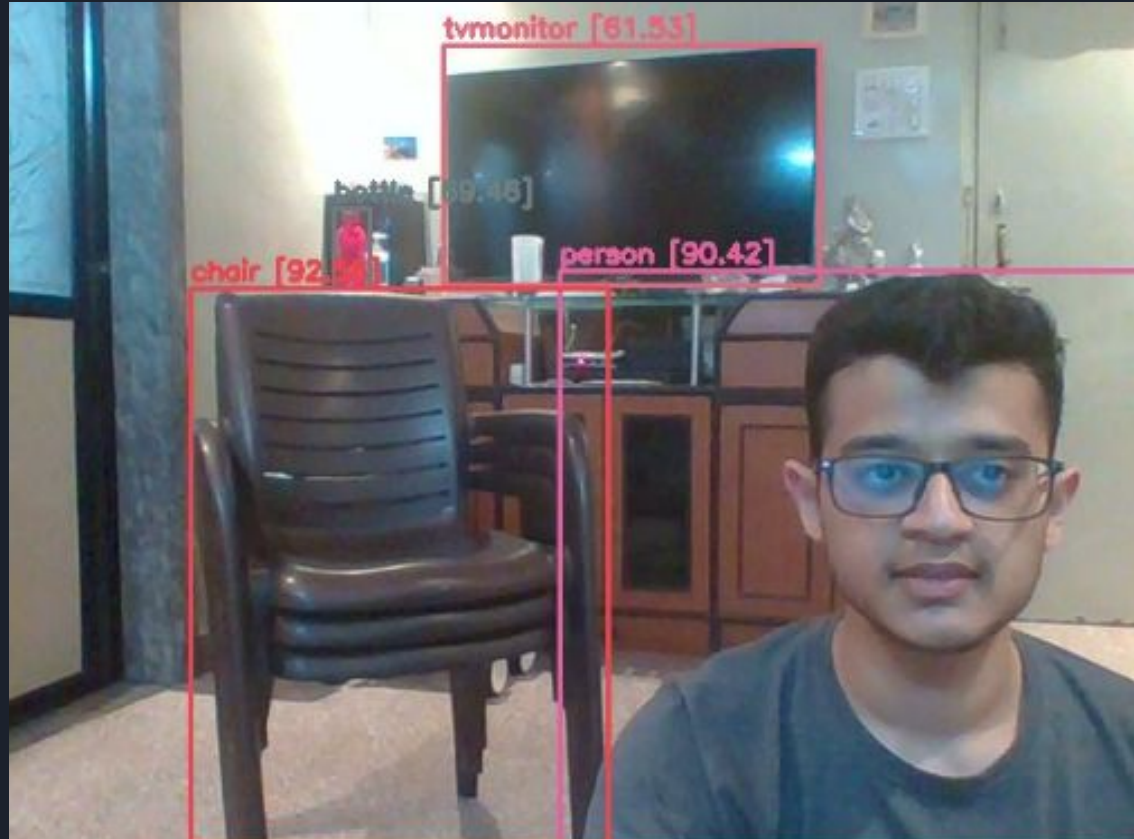
PART 1 : Testing detection using test images



PART 2 : Testing the detection on image captured from the webcam



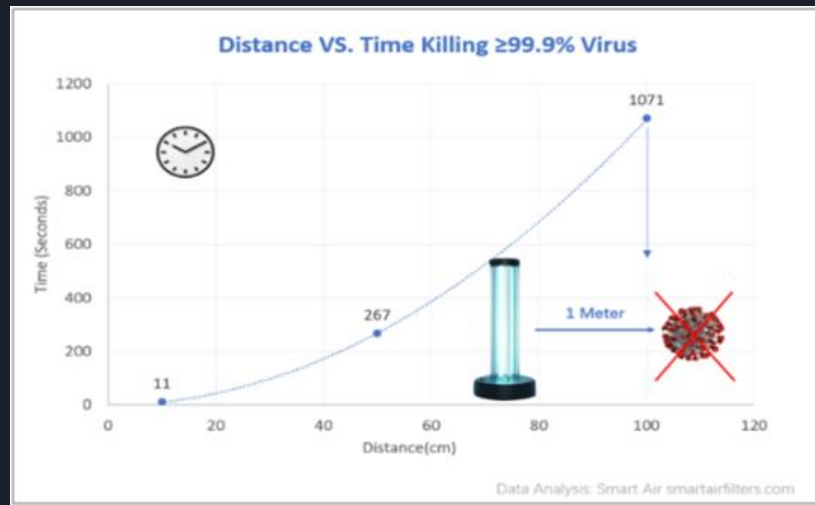
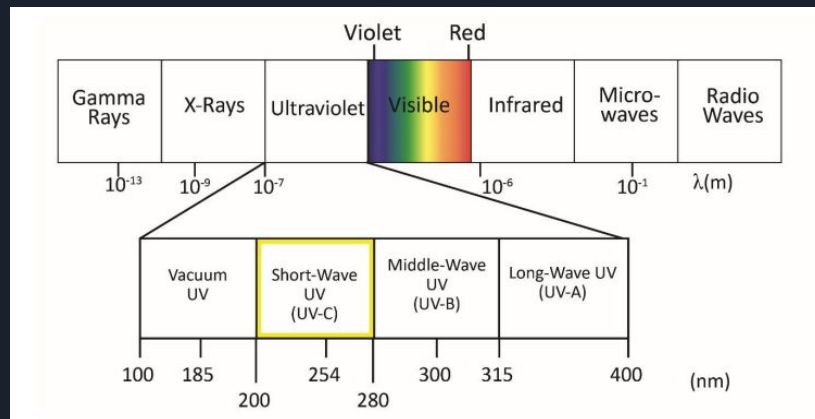
PART 3 : Testing the detection on the live feedback from the webcam



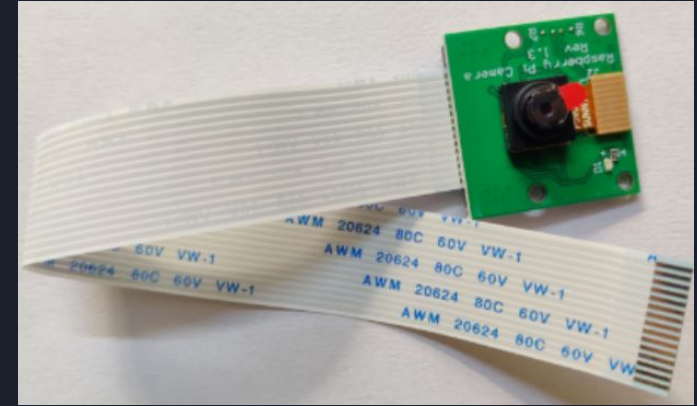
Hardware

UV light

- includes UV-C which operates at wavelengths between 200 - 300 nm.
- A single UV-C LED that is about 2.5W can output 99.9% irradiance over a 5cm surface.
- Far-UVC light is anticipated to have about the same anti-microbial properties as conventional germicidal UV light, but without producing the corresponding health effects.



- **Pi Camera Module** is a portable lightweight camera that supports Raspberry Pi. It is normally used in image processing and segmentation. It will be used for human and object detection.
- **Raspberry Pi** provides a set of GPIO (general purpose input/output) pins, allowing you to control electronic components for physical computing and explore the Internet of Things (IoT). It is 40 times faster than Arduino when it comes to clock speed. It is easier and faster way to use OpenCV for integration with Raspberry Pi rather than Arduino UNO.

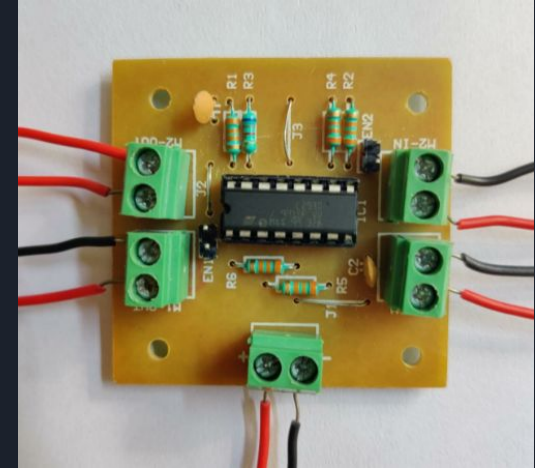


- **Ultrasonic Sensors** measure the distance to the target by measuring the time between the emission and reception. This will help us determine the distance between the obstacle and the system and make it fully autonomous. As soon as any obstacle comes under the threshold value of the Ultrasonic sensor, it will pass the signal to the motor controller/driver through Raspberry Pi and will change the motors directions to left or right accordingly.
- **Lipo Battery** the main advantages of LiPo battery cells are that they have about four times the energy density of nickel-cadmium or nickel-metal hydride batteries. This is the main reason for using the Lipo batteries instead of the normal batteries for the longer operation and optimal power supply to the system.



Motor Driver

- Motor drivers can be connected to the microcontroller to receive commands and run the motor with a high current.
- L298N Motor Driver Module consists of an L298 motor driver IC and a 78M05 5V regulator.
- L298N Module can control up to 4 DC motors, or 2 DC motors with directional and speed control.
- The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time.

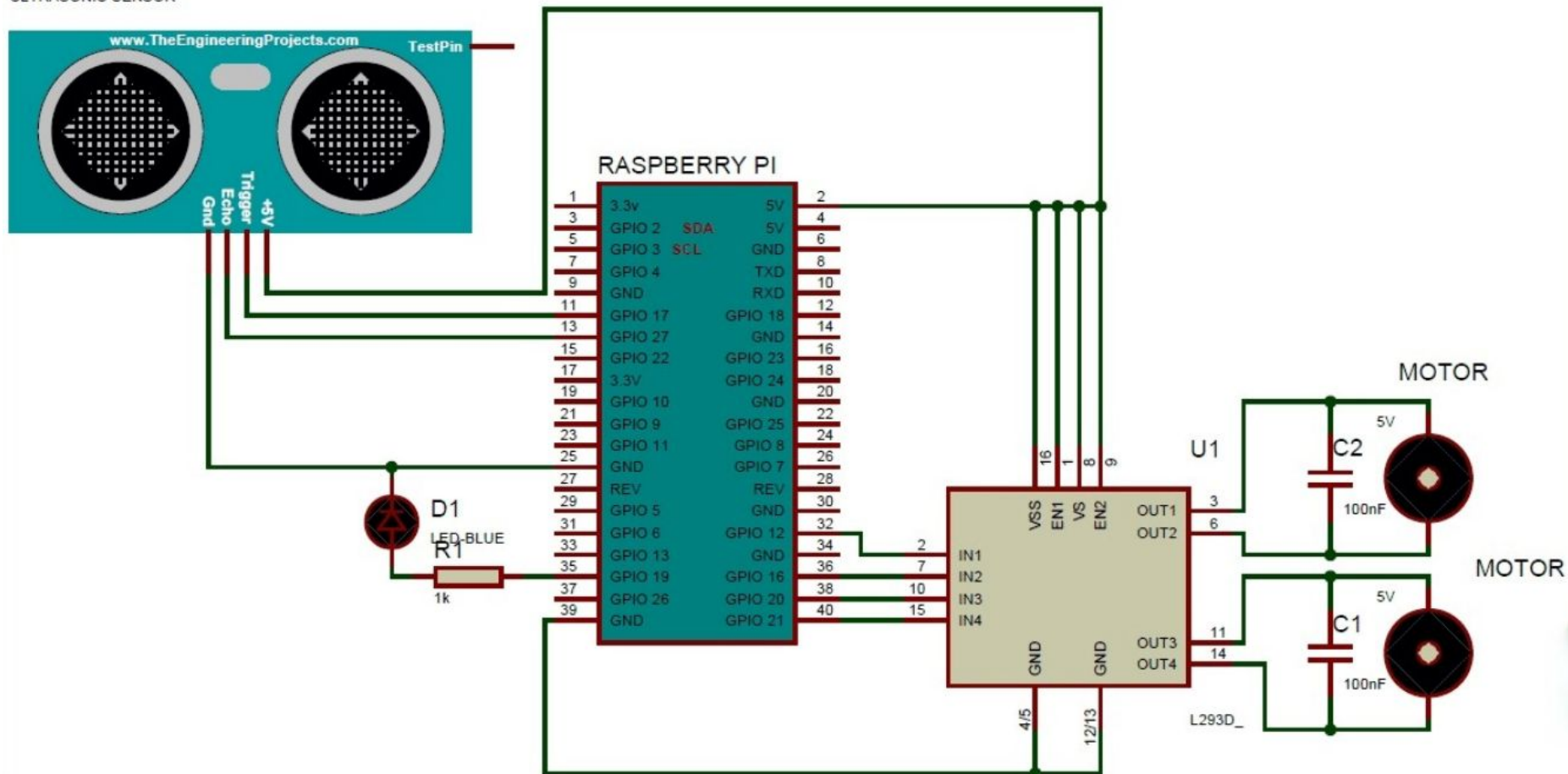


Schematic Diagram



SONAR1

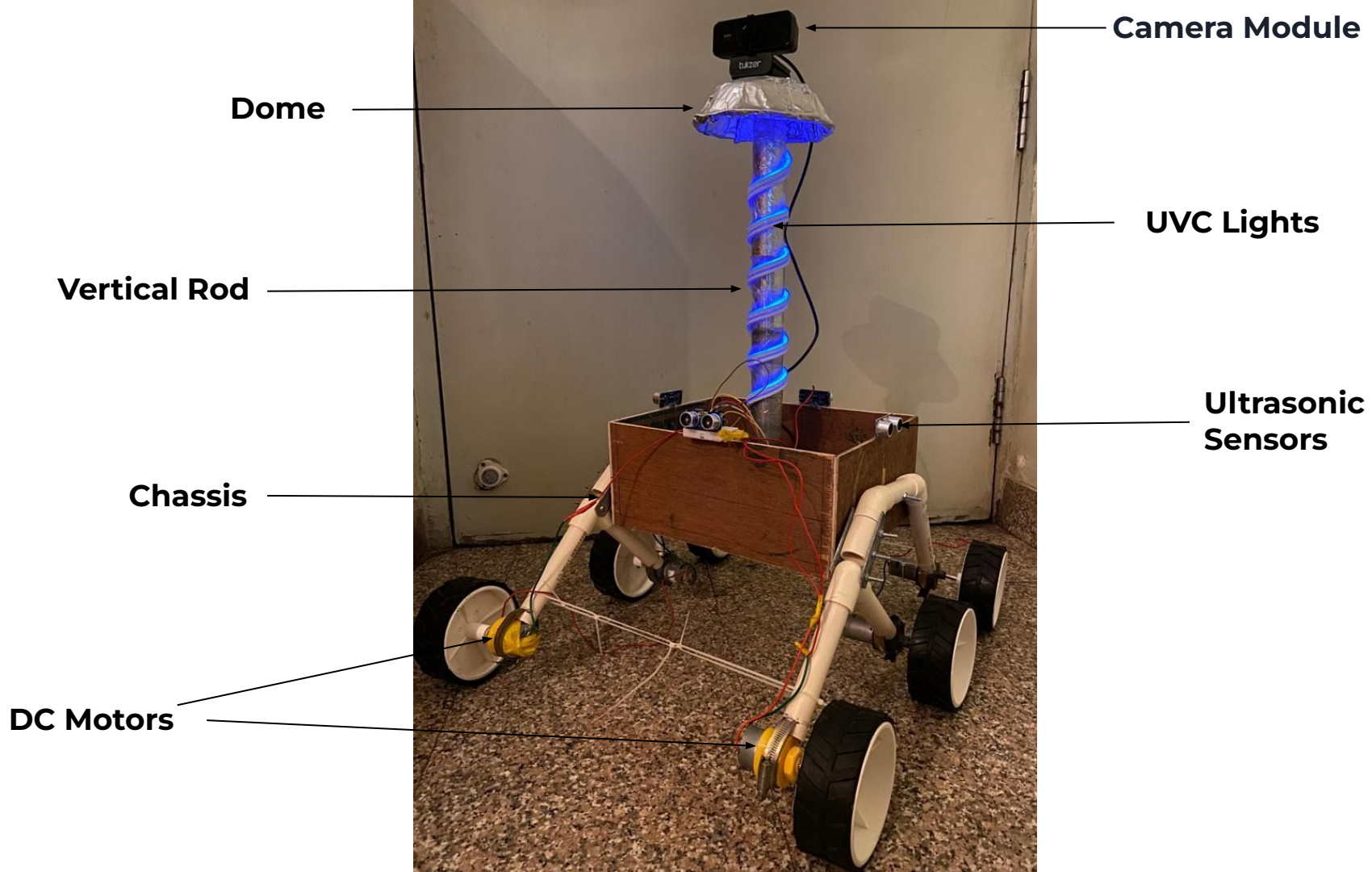
ULTRASONIC SENSOR



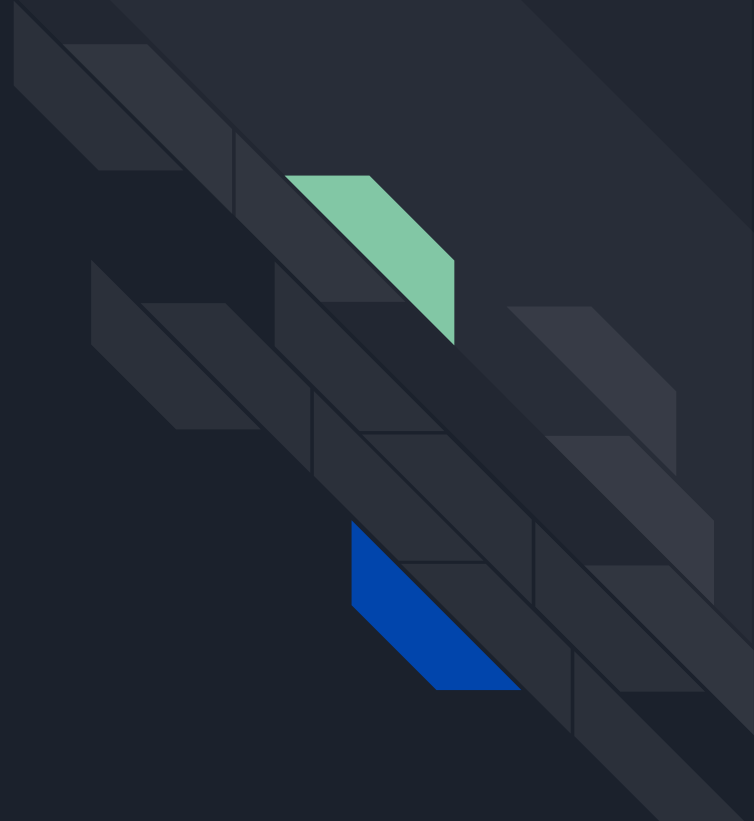
FINAL PRODUCT

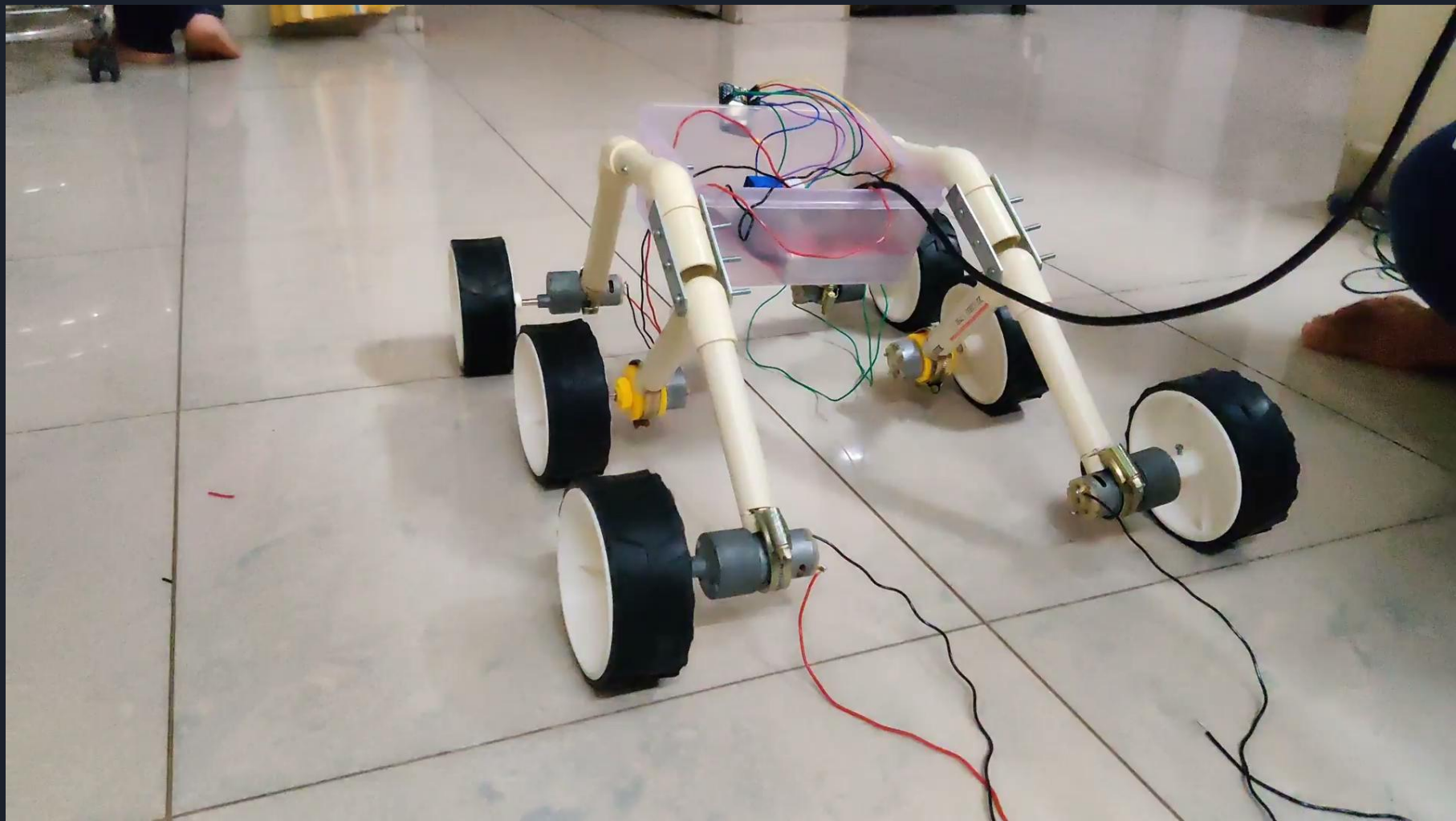






Working of the Robot







FUTURE SCOPE



- LIDAR Sensor.
- SLAM (Simultaneous Localisation and mapping) Technology.
- Better UVC light arrangements.
- Optimising the Rocker Bogie chassis



THANK YOU!

