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Robot Sterilizer

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Graduation Project
Faculty of Computers and Artificial Intelligence
Submitted for the degree of Bachelor of Computer Science (B.CS.)

CONTENTS

Statement of Originality

Dear Sir,

In accordance with the course requirements for the Bachelor of Computer Science, I respectfully submit my thesis entitled

"Robot Sterilizer"

I declared that all work and picture illustrations in this thesis are my own and presented to the best of my knowledge and belief original, unless otherwise acknowledged in the text. This thesis has not been previously submitted for a degree at the University of Cairo, Faculty of Computers and Artificial Intelligence (FCAI) or any other institution.

ABSTRACT

PROBLEM DEFINITION

If you asked anyone about the most big problem in the life nowadays his reply will be the Corona Virus (COVID-19). The COVID-19 is considered one of the main disasters that kills tons of people all over the world.

The Coronavirus crisis also caused a reduction in the number of working hours globally by 8.8 percent, which exceeded the decline in the number of working hours during the global economic crisis in late 2008.

The UN reports in this regard indicated that looking at only the abolition of jobs reduces "to a large extent" the actual damage to the global economy due to the epidemic.

It also warned that the economic recovery is still surrounded by uncertainty, despite the hopes pinned on anti-Coronavirus vaccines to help the economy return to pre-Coronavirus levels of performance. The countries and world leaders try to solve this problem using the outreach, social distance, masks and alcohol to prevent the existence of the virus over the different surfaces.

MOTIVATION

Now the technology has created a good environment of solutions that there is no chance to have a human error, so the thinking of using robots for the outreaching people and sterilizing stuff have been increased this year according to the current situation of COVID-19.

As the robot can not be affect or effected by the virus and takes a lot of work and never gets bored and Robots may be effective in disinfection operations, measuring vital signs of disease, providing food to patients, as well as providing medicine at the times designated for it, especially in periods of global epidemics.

PROJECT OBJECTIVE

The main objective of the robot is to sterilize the floor from the corona virus and the other viruses and germs by using effective alcohol with concentration ratio 70%. This specific concentration is required to get rid of these aliments. The robot detects if there are obstacles or not by the help of Ultrasonic Sensor which detects if the front distance is less than a limit of 15cm.

The servo motor turns left and right to detect the longest distance or route to cover as much space of the room as possible. The second case is that if there is a front obstacle and in the right side as the servo will detect it, so the robot will turn to the left. The third case is that if there is a front obstacle and in the left side as the servo will detect it and the robot will turn to the right. The last case if there is a front, right and left obstacle the robot will calculate the right and left distances and tries to sterilize the floor

between them as the robot acts go-back-and-forward till covering all space of the floor.
Then the liquid spray phase as the main purpose of the project is to spray the floor with alcohol.
This phase is parallel with detecting the obstacles by the help of the Bump as it takes the liquid alcohol as an input from the pottle as give it as an output in a transparent cilicon pipes to be sprayed.
As it goes down from the specified hole in the robot design and the pipe is round all over the down and have some small holes to let the liquid pass through it in some calculated directions to have an equalized pressure from the bump and the quantity of the liquid.

To sum up the last point, if we considered there is an round cilicon pipe and have some holes but in such order that there is a balance in the quantity of the input liquid and the output quantity of the liquid such as three holes in front of the cilicon pipe and other three holes in the left and another three holes in the right of the pipe and lastly three in the back of the pipe.
Now it has such a balanced spray system to use it to sterilize the floor.

OVERALL DESCRIPTION

This section will give an overview of the whole system. The system will be explained in its context to show how the system interacts and introduce the basic functionality of it.

It will also describe what type of stakeholders that will use the system and what functionality is available.

At last, the constraints and assumptions for the system will be presented and it is as follows.

The Robot Sterilizer consists of some components such as Arduino Uno, Hbridge, Ultrasonic, Servo, bump and Vcc power source.

First of all, the robot as mentioned in many sections of this documentation sterilize the floor by using alcohol with concentration 70%.

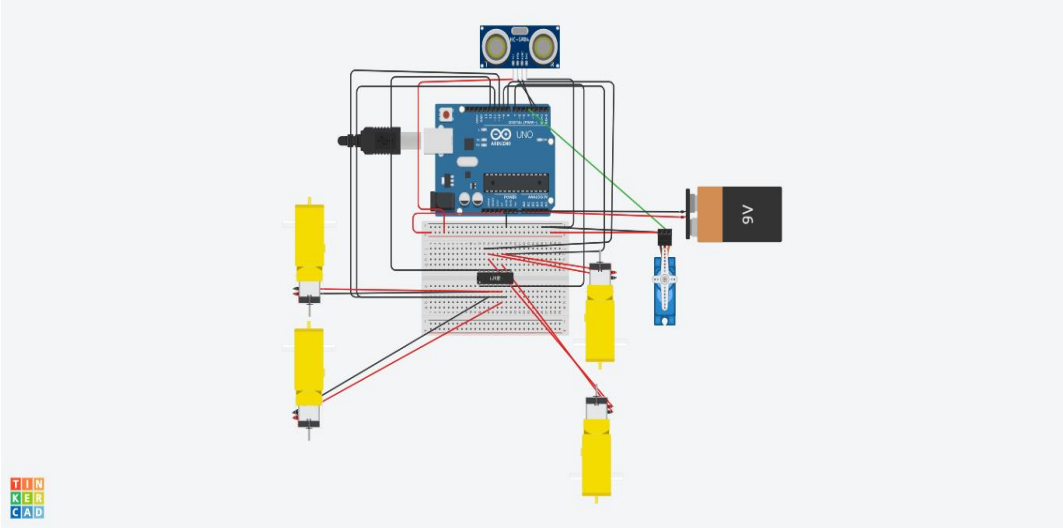
The robot moves straight by using the function of go_straight() as it turns on the four DC motors to move in one direction the front direction.

It continues applies go_straight() function till it finds an obstacle within 15-0 cm then it stops by using motor_reset() function to prevent hitting the obstacle and checks the distance of the left and the right as the in the case of checking the right distance it uses the turn_right() function to turn the servo motor to the right to let the ultrasonic sensor calculate the distance by using the_distance() function and the left distance it uses the turn_left() function to turn the servo motor to the left to let the ultrasonic sensor calculate the distance by using the_distance() function and check if the right distance is lower than 30 cm and the left distance is lower than 30

cm then it goes back by using the move_back() function or it checks if the distance in one direction is larger than the distance in the other direction then it goes to the direction of the largest range.

As if the range is right it uses go_right() function to let the robot goes to the right direction and if the range is left it uses go_left() function to let the robot goes to the left direction.

ENGINEERING DESIGN



We used Tinker CAD to simulate the project with it's available components.

As we can divide the whole project to 6 parts:

The Ultrasonic sensor: it has 4 pins the Vcc, Echo, Trig, and GND

Vcc is connected to the 5v.

Trig is connected to pin 2 of the Arduino.

Echo is connected to pin 3 of the Arduino.

GND is connected to the ground(GND).

The Servo motor: it has 3 outputs Vcc, GND, and Signal

Vcc is connected to the 5v.

GND is connected to the ground(GND).

SGNALI is connected to the pin 4 of the Arduino.

The Hbridge: it has 4 input pins, 2 enables, 7 output ports

Input1 is connected to pin 11.

Input2 is connected to pin 10.

Input3 is connected to pin 9.

Input4 is connected to pin 8.

Enable A is connected to pin 7.

Enable B is connected to pin 12.

Motor A1 is connected with the +ve of the R1 motor and -ve of the R2 motor.

Motor A2 is connected with the -ve of the R1 motor and +ve of the R2 motor.

Motor B1 is connected with the +ve of the L1 motor and -ve of the L2 motor.

Motor B2 is connected with the -ve of the L1 motor and +ve of the L2 motor.

The bump: it is submarine bump which it dives in the liquid and has one input and one output.

The input of the bump is the liquid and it is absorbed by the fans of the motor inside the bump.

The output of the bump is the absorbed liquid and it goes through cilicon transparent tiny pipes and do its functionality.

USED TOOLS

SOFTWARE TOOLS

ARDUINO IDE

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals – has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

TINKER CAD

I think every maker's been there: you finally finish that project you've been working on for so long. Everything is functioning just fine, but yet you feel like something is missing and then it hits you.

More often than not, pre-made project enclosures won't quite do the job. That is where this guide to Tinkercad will come in handy! It will teach you how to design and manufacture a custom case that looks great and will protect your project for many years without requiring any knowledge of complicated CAD software.

Tinkercad is a browser-based 3D design and modeling program created to provide a way for a variety of users (beginners to experts) to create projects.

Conventional CAD software options are not only expensive, but they're also often quite complicated to learn. These programs often have many features, that you won't even use for something as simple as a custom case. While they are great for professional users, makers will more likely be happy with Tinkercad, which I regularly use. It's not only free but also very easy to learn and to use.

HARDWARE TOOLS

ARDUINO MEGA 2560

The Arduino MEGA 2560 is designed for projects that require more I/O lines, more sketch memory and more RAM. With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the recommended board for 3D printers and robotics projects. This gives your projects plenty of room and opportunities
maintaining the simplicity and effectiveness of the Arduino platform.

H BRIDGE L298

L-298 is an Integrated Circuit (IC) available in two type of packages now a days which will be given later. L 298 is a dual full bridge driver that has a capability to bear high voltage as well as high current. It receives basic TTL (Transistor Logic) logic levels and is able to operate the different loads such as DC motors, stepper motors, relays etc. You should also have a look at Introduction to L23D.L-298 has two enable input to control any device by enabling or disabling it. L 298 IC is most commonly used to make motor drivers or motor controllers. These motor controllers can be controlled by any micro

controller e.g Arduino, PIC, Raspberry Pi etc. They receives input from micro controllers and operate the load attached to their output terminals correspondingly. L-298 motor driver (H-Bridge) is able to control two different DC motors simultaneously. While it can control a single stepper motor as well. L 298 has two Pulse Width Modulation (PWM) pins. PWM pins are used to control the speed of the motor. By changing the voltage signal's polarity at its input we can rotate the motor in either clockwise or counter clockwise direction. It has a lot of real life applications e.g robotics, doors lock systems, CNC machines etc.

ULTRASONIC SENSOR HC-SR04

It is an ultrasonic sensor, also known as an ultrasonic transducer that is based on a transmitter and receiver and mainly used to determine the distance from the target object. The amount of time it takes to send and receive waves will determine how far the object is placed from the sensor. It mainly depends on the sound waves working on “non-contact” technology. The required distance of the target object is measured without any damage, giving you accurate and precise details.

This sensor comes with a range between 2cm to 400cm and is used in a wide range of applications including speed and direction measurement, wireless charging, humidifiers, medical ultrasonography, sonar, burglar alarms, and non-destructive testing.

ULTRA-FIRE BATTERY 18650 3.7V

is a typical Lithium Ion rechargeable battery in cylindrical shape that offers 1100mAh actual capacity (although it is labelled 3000mAh by the OEM). It is a very low cost DC supply solution (low discharge rate), hence suitable in electronic projects or small mobile robots that do no require high discharge current. Also, it comes with an integrated protection PCB to prevent over-charged or over-discharged condition. The LI-3.7-1100 battery is 18650 sized with 18 mm in diameter and 67.5 mm in length. Its nominal voltage of a is 3.7V (will be at about 4.2V when fully charged). Hence, users can combine 2 units or 3 units of them to provide nominal voltage 7.4V or 11.1V.

DC MOTORS

A DC motor (Direct Current motor) is the most common type of motor. DC motors normally have just two leads, one positive and one negative. If you connect these two leads directly to a battery, the motor will rotate. If you switch the leads, the motor will rotate in the opposite direction.

SWITCH

Switch is an electrical component which can make or break electrical circuit automatically or manually. Switch is mainly works with ON (open) and OFF (closed) mechanism. Numerous circuits hold switches that control how the circuit works or actuate different characteristics of the circuit.

The classification of switches depends on the connection they make. Two vital components that confirm what sorts of connections a switch makes are pole and throw.

WATER PUMP 5V 120L/H

This is a low-cost mini submersible type water pump that works on 3-6V DC. It is extremely simple and easy to use. Just immerse the pump in water, connect a suitable pipe to the outlet and power the motor with 3-6V to start pumping water. Great for building science projects, fire-extinguishers, fire fighting robots, fountains, waterfalls, plant watering systems etc.

SERVO MOTOR SG90

Micro Servo Motor SG90 is a tiny and lightweight server motor with high output power. Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos.

BACKGROUND

We have been developing a sterilization robot since the emergence of the emerging corona virus, which in turn sterilizes public facilities, operating rooms and patient rooms with the virus, and this precisely prevents the virus from transmitting quickly between people. But the advent of this technology has its pros and cons.

Pros; as we have mentioned, is that it prevents the spread of infection, and we will mention later that it is used as a substitute for soldiers, doctors and most fields in which humans are present, It performs its work quickly, performs well, and also does not need rest during its work.

Cons; working-class people face heightened risks of losing their jobs to automation throughout the economy during deep recessions as companies seek ways to save on costs, There must be errors during its programming, and if this actually occurs, it may lead to severe losses.

Robot technology has appeared in many ages such as:-

1. The age of pandemics:

   Robots served humans to protect them from hazards tasks. The first industrially successful robot, ”Unimate”, began operation at a General Motors plant in New Jersey, performing automated tasks dangerous for humans.
   Another examples are mobile robots aiding firefighters in environments with restricted visibility, robots mimicking hand and arm movements conducted by a human at a safe distance to reduce health risks for vulnerable workers, for example, in nuclear environments, and robotic aid in mountain rescue. The new

COVID-19 virus poses a number of risks and limitations to our society. During pandemics, healthcare professionals are at the front lines of the war and a specialist community with high vulnerabilities.

2. The surgical environment:
   Surgical treatment is the backbone of any healthcare system, with both elective and emergency procedures contributing to the population's wellbeing.

   Because of the urgency of management, the presence of several staff, and high-risk operations, operating rooms may be high-risk areas for transmission. Several surgical societies have issued safety recommendations during procedures Supplementary as a result of the significant risk to surgeons during COVID-19. The ultimate aim of robotic integration is to reduce interaction between the patient and healthcare provider at each phase, which can be divided into pre-operative treatment, anaesthesia, the surgical process, and post-operative care.

METHODS

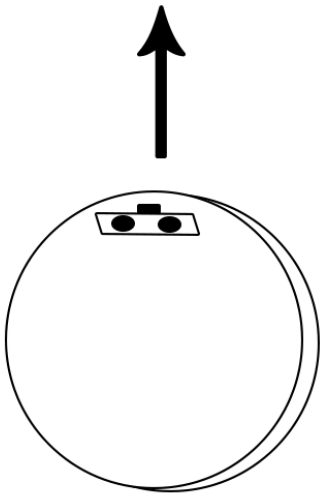
We have developed lots of optimized functions or methods to establish the Robot Sterilizer functionality such as move in one of the appropriate directions, turning the ultrasonic sensor to check the distance of the current path by rotating the servo motor and we will discuss all the functions.

1. motor_reset:
   the main goal of this function is to turn off the motors of the Robot the two left and right motors by using digitalWrite() as the following lines of code is the implementation.

```
void motor_reset()
{
  digitalWrite(motor_L1, LOW);
  digitalWrite(motor_L2, LOW);
  digitalWrite(motor_R1, LOW);
  digitalWrite(motor_R2, LOW);
}
```

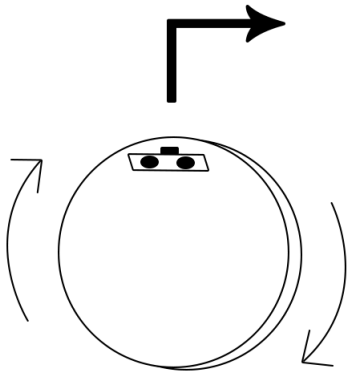
2. go_straight:
   the main goal of this function is to move forward in one direction as there is no obstacles in front of the Robot detected by turning on the motors of the Robot the two left and right motors by using digitalWrite() as the following lines of code is the implementation.

```
void go_straight()
{

  digitalWrite(motor_L1, HIGH);
  digitalWrite(motor_L2, LOW);
  digitalWrite(motor_R1, HIGH);
  digitalWrite(motor_R2, LOW);
}
```



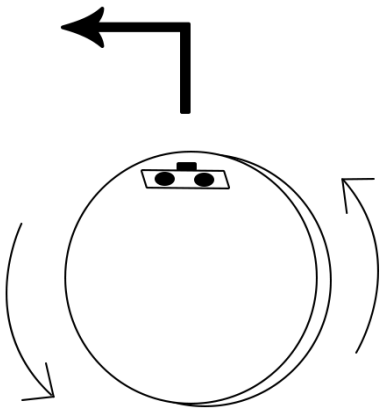
3. go_right:
   the main goal of this function is to move right as there is an obstacle in front of the robot and after calculating the distances in the left and right the right was better as it is the longest path by turning on the motors of the Robot the two left and right motors as the right motors will move back in reverse mode and the left motors will move forward to have a wide and speed rotation and delay() to put some delay for the motors to turn to the target path as the following lines of code is the implementation.

```
void go_right()
{
  motor_reset();
  digitalWrite(motor_L1, HIGH);
  digitalWrite(motor_L2, LOW);
  digitalWrite(motor_R2, HIGH);
  digitalWrite(motor_R1, LOW);
  delay(600);
  digitalWrite(motor_L1, LOW);
  digitalWrite(motor_R2, LOW);
}
```



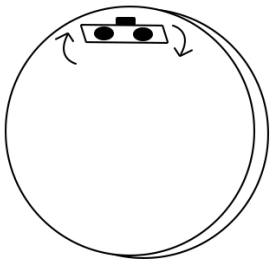
4. go_left:
   the main goal of this function is to move right as there is an obstacle in front of the robot and after calculating the distances in the left and right the left was better as it is the longest path by turning on the motors of the Robot the two left and right motors as the left motors will move back in reverse mode and the right motors will move forward to have a wide and speed rotation and delay() to put some delay for the motors to turn to the target path as the following lines of code is the implementation.

```
void go_left()
{
  motor_reset();
  digitalWrite(motor_R1, HIGH);
  digitalWrite(motor_R2, LOW);
  digitalWrite(motor_L2, HIGH);
  digitalWrite(motor_L1, LOW);
  delay(600);
  digitalWrite(motor_R1, LOW);
  digitalWrite(motor_L2, LOW);
}
```



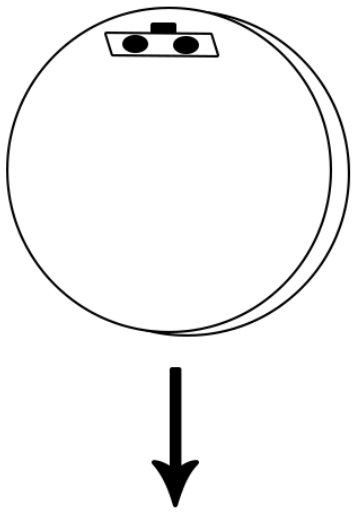
5. the_distance:
   the main goal of this function is to calculate the distances in the left and the right paths by turning the servo motor 90 degree to let the ultrasonic sensor to calculate the left distance and 180 degree to let the ultrasonic sensor to calculate the right distance by using digitalWrite(), pulseIn() functions as the following lines of code is the implementation.

```
void the_distance()
{

  digitalWrite(trig, LOW);
  delayMicroseconds(2);
  digitalWrite(trig, HIGH);
  delayMicroseconds(10);
  digitalWrite(trig, LOW);
  // Measure HIGH pulse width at echo pin.
  time = pulseIn(echo, HIGH);

  range =  time*0.034/2;
}
```



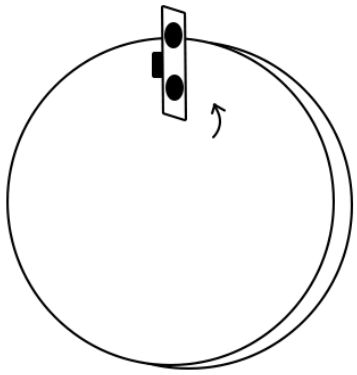
6. move_back:
   the main goal of this function is to turn on the reverse mode in all the motors to go back by using digitalWrite() function as the following lines of code is the implementation.

```
void move_back()
{
  digitalWrite(motor_L2, HIGH);
  digitalWrite(motor_L1, LOW);
  digitalWrite(motor_R2, HIGH);
  digitalWrite(motor_R1, LOW);
}
```



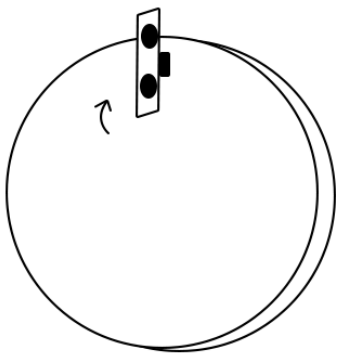
7. turn_left:
   the main goal of this function is to turn the servo motor to the left to let the servo do its function (calculating the distance) as it has two round ports one for transmitting the ultrasonic waves and the other is the receiver and it is basically the functionality of the ultrasonic sensor by using servo.write(degree) function as the following lines of code is the implementation.

```
void turn_left()
{
  myservo.write(180);              // tell servo to go to position in
variable 'pos'
  delay(1000);
  the_distance();
  myservo.write(90);              // tell servo to go to position in
variable 'pos'
}
```



8. turn_right:
   the main goal of this function is to turn the servo motor to the right to let the servo do its function (calculating the distance) as it has two round ports one for transmitting the ultrasonic waves and the other is the receiver and it is basically the functionality of the ultrasonic sensor by using servo.write(degree) function as the following lines of code is the implementation.

```
void turn_right()
{
  myservo.write(0);              // tell servo to go to position in
variable 'pos'
  delay(1000);
  the_distance();
  myservo.write(90);              // tell servo to go to position in
variable 'pos'
}
```



RELATED WORKS

CODI BOT UGV

New CoDI BOT UGV developed for the first time by Marakeb Technologies for Abu Dhabi Airports to be deployed at Abu Dhabi International Airport. it was the first use of CoDI BOT UGV to limit risk of COVID-19.
Robot is designed for the disinfection of spaces, limiting risk of contamination or human exposure to viruses including COVID-19.

The BOT has three central functions:

- Targeting of virus strains on surfaces with controlled bursts of germicidal UV rays.
- Screening of individual through thermal infrared monitoring.
- Disinfection of areas using liquid cleaning agents.

CoDI BOT UGV uses MAP IR3 System which do:

- Scan high traffic areas to identify and track feverish people.
- The MAP IR3 System is high-sensitivity dual-thermal camera coupled with intelligent identification and tracking of feverish people. The built-in sophisticated algorithm identifies and captures images of subjects with fever and issues real-time audible alerts upon detection.

TMIROB SERIES - INTELLIGENT STERILIZATION ROBOT (ISR)

The TMiRobot disinfection robot series is designed specifically for application in hospital and clinical environment for disinfecting environmental air and subject surface, via automatic robot with ultra-violet (UVC) light, hydrogen peroxide and filtering. The next generation is undergo R&D for general office disinfection.

Product Highlight:

Autonomous Movement: A floor plan map can be import into the robot or via autonomous discovery mode.

The clinical user can also configure the system via user configurable disinfection mode, positional control, automatic routing, automatic home return and recharge.

Highly Efficient:

The robot can maximizing the cleaning efficiency by exploring the map and minimize disinfection time.

Multiple Disinfection:

Ultra-Violet C (UVC), hydrogen peroxide (H2O2) and other disinfection media, with 0.3um air filtering (HEPA)

Precise: 360 disinfection spray head

ISR is clinically and field tested and verified to kill 99.99% of all bacteria and disinfect in 10 mins (5m x 5m area). Rapid mode also available to obtain a 95% disinfection rate under 6 mins.

Compliance:

UVC: WS/T 367 - A.3.1.2, GB19258

Hydrogen Peroxide Sprayhead: WS/T 367 - 11.2.1.5

Air Filter: GBT 18801-2015-5 / HEPA

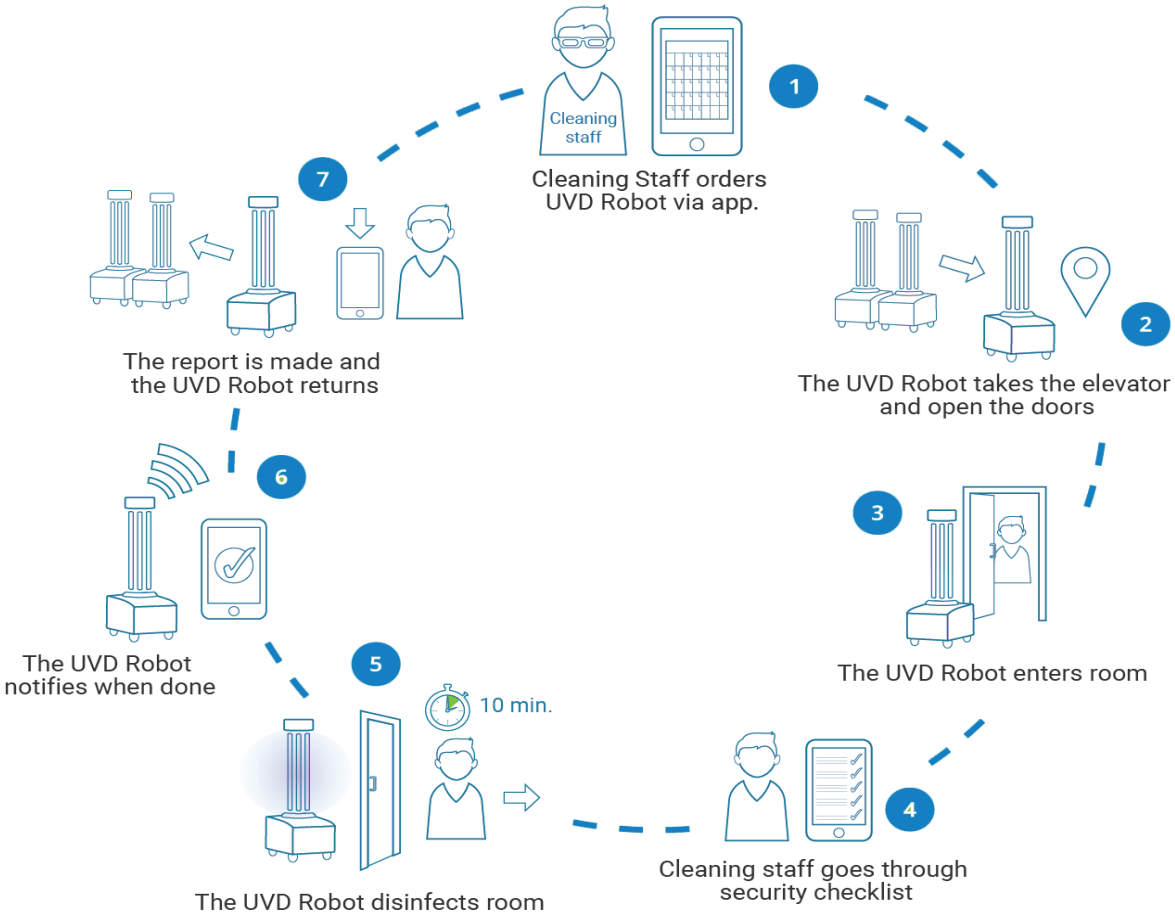
UVD ROBOTS

UVD Robots, a subsidiary of Blue Ocean Robotics, are able to disinfect patient rooms and operating theaters in hospitals. The robots consist of a mobile base equipped with multiple lidar sensors and an array of powerful short wavelength ultraviolet-C (UVC) lights.

The operators deploy the robot using a computer. The robot scans the environment using its lidars and creates a digital map. The operator can then annotate the map indicating all the rooms and points the robot should not disinfect. After that, the robot relies on simultaneous localization and mapping (SLAM) to navigate.

The robot then drives autonomously around hospitals while emitting 20 joules per square meter per second (at 1-meter distance) of 254-nanometer light to eliminate bacteria and other harmful microorganisms. As a result, hospitals can guarantee a 99.99 percent disinfection rate – reducing the risk for patients, staff and relatives of contracting dangerous infections.

In May 2020, Frost & Sullivan awarded Blue Ocean Robotics the Best Practice Award for „2020 European Professional Service Robots Product Leadership“ for their virus-killing UVD robots. In 2019, the company received an Innovation and Entrepreneurship Award in Robotics and Automation (IERA).



TECHNICAL SPECIFICATIONS

- Max Speed: 5.4 km/h
- Battery Charging Time: 3 hours
- Total Weight: 140 kg
- Dimensions: L: 93 x W: 66 x h: 171 (cm)
- Operating Time: 2-2.5 hours (disinfects 9-10 rooms)

- Disinfection Coverage: 360 degrees
- Disinfection Time: 10-15 min. pr. room
- Connectivity: Wireless (Wi-Fi based)
- UV-Wavelength: 254 nm (UV-C rays)
- Charging Requirements: 220-240 VAC, 50 Hz, 6 Amps
- Safety: Software & Sensors Based ,Emergency Stop Button

XENEX DISINFECTION SERVICES

San Antonio-based Xenex Disinfection Services LLC makes full-spectrum UV Germ-Zapping Robots to eliminate harmful bacteria, viruses and spores that can cause healthcare-associated infections (HAIs).

Unlike most single spectrum low-intensity UV (UVGI) devices, Xenex' LightStrike uses a xenon lamp to generate bursts of high intensity, full germicidal spectrum (200-315 nanometers) UVC light that is more intense than sunlight. According to the company, its robot is the only pulsed xenon UV device of its kind, while other companies manufacture mercury UV devices.

Studies, published in nearly three dozen different peer-reviewed journals, have shown reductions of 53 to 100 percent of infections acquired in hospitals. In a recent test, performed at the Texas Biomedical Research Institute, the LightStrike robot destroyed SARS-CoV-2 in two minutes achieving a four-log (99.99 percent) reduction in that time.


GERM-ZAPPING ROBOTS
XENEX

TMIROB

Shanghai's TMI Robotics has developed a robot that moves completely autonomously, fulfilling the task as pre-programmed with the layout and topography of the hospital or department. It will set off systematically disinfecting nearby air and all surfaces in any given area, and even return itself to a docking station when it requires a recharge.

The robot integrates three disinfection modes: ultraviolet, ultra-dry vaporized hydrogen peroxide, and air filtration to meet the demanding disinfection requirements in the healthcare sector. UV alone, at the optimal distance, can achieve 99.99 percent bacterial kill - including antibiotic-resistant bacteria and viruses. When combined with air-filtration, it forms a highly effective method of disinfecting and cleansing the surrounding air, in addition to achieving surface disinfection of surrounding walls, furniture and fixings.

Any combination of these methods can be applied depending on the space or departmental rooms to be disinfected. The robot also automatically calculates the disinfection time according to the space and fixings and ensures no 'dead spots'.

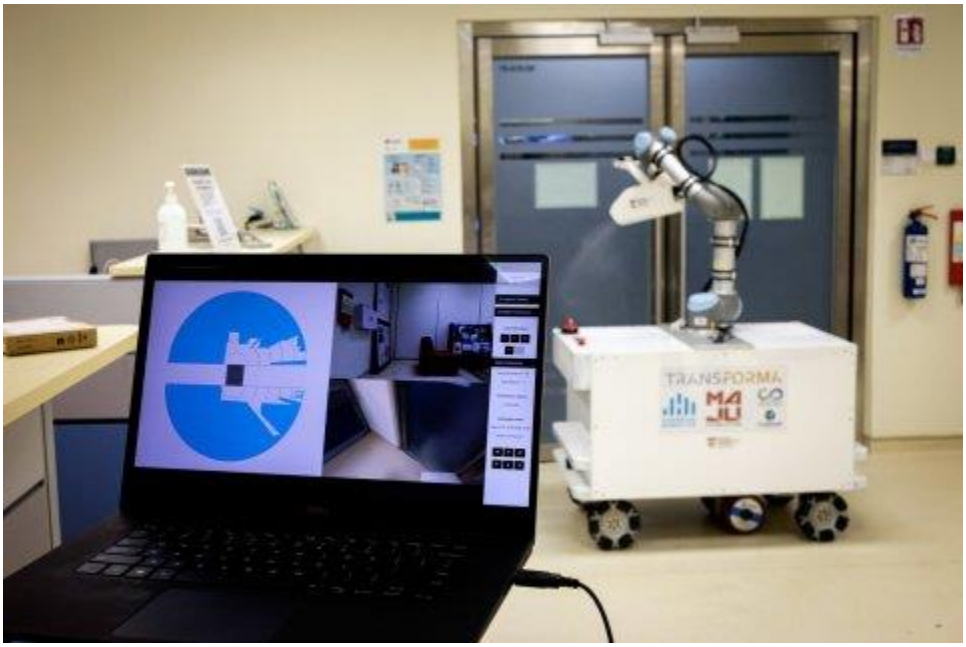
XDBOT

Researchers from Nanyang Technological University, Singapore (NTU Singapore), have developed a semi-autonomous robot that can disinfect large surfaces quickly. XDBOT, or 'eXtreme Disinfection roBOT', can be wirelessly controlled via a laptop or tablet. That removes the need for cleaners to be in contact with surfaces, thereby reducing the risk of picking up the virus from potentially contaminated areas.

XDBOT can navigate semi-autonomously in any environment using LIDAR (Light Detection and Ranging) and high-definition cameras, while its arm is controlled by a human operator – like a tank with a rotating turret. Currently, the operator can control the robot from up to 30 meters using a laptop/tablet, which can be increased to 50 meters or

further with more antennas installed on XDBOT.

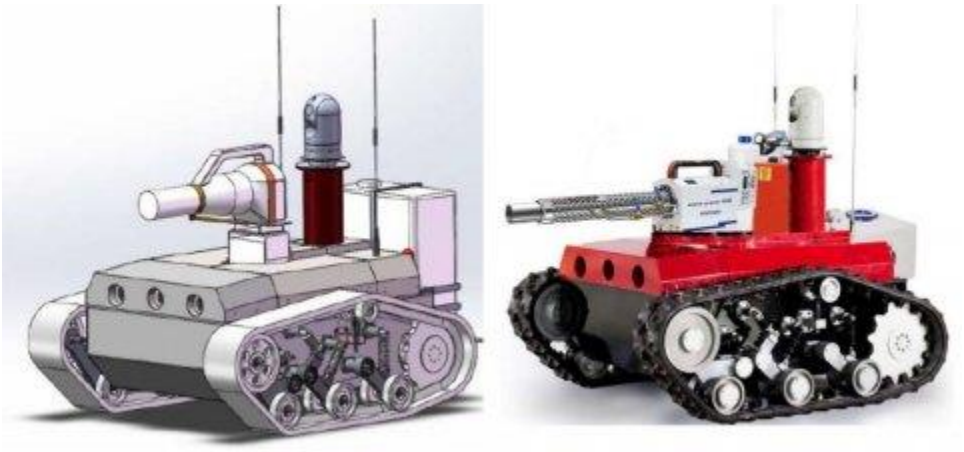
Rather than a conventional pressure-spray nozzle, it uses an electrostatic-charged nozzle to ensure a wider and further spread of the disinfectant, behind and over hidden surfaces. Unlike typical nozzles, XDBOT's nozzle discharges chemicals with a positive electrical charge. These disinfectants will then be attracted to all negatively-charged surfaces. Surfaces already covered with the disinfectant will then repel the spray, making this method very efficient. This concept of charge attraction is similar to how positive and negative poles of magnets are drawn to each other.



SIEMENS / AUCMA

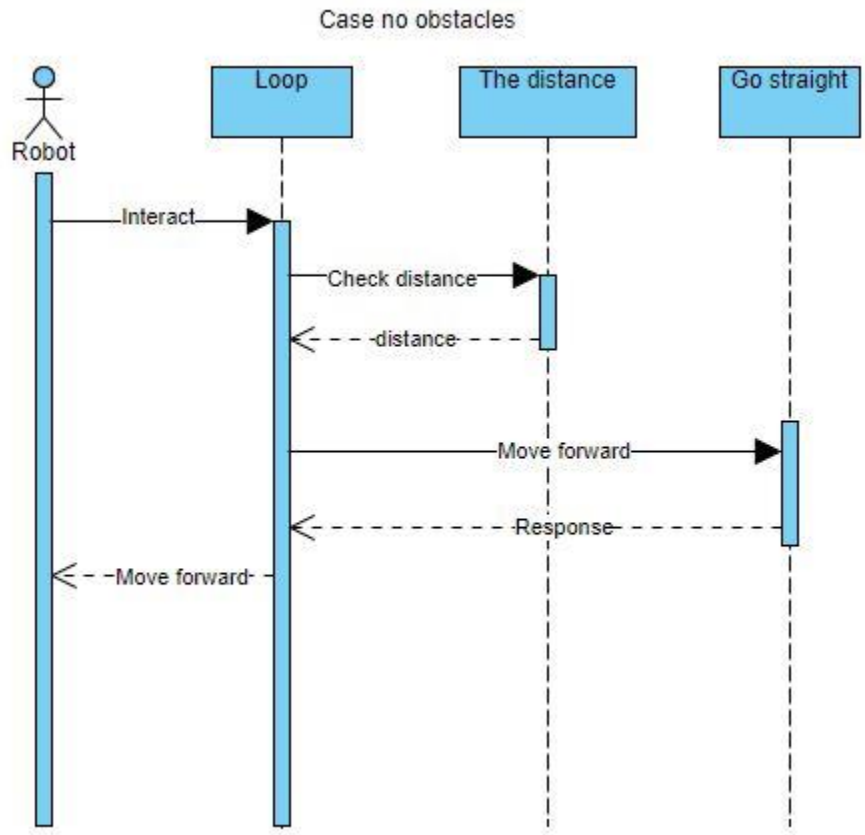
Engineers at Siemens and Aucma Co. Ltd have developed an intelligent disinfection robot to battle against the coronavirus and other viruses in hospitals. Most disinfection robots combine a petrol-driven moisturizer gun with an electric chassis. However, on-site refueling of robots is neither clean nor convenient. The team therefore decided to develop purely electric disinfection robots to better cater to the needs of hospitals. Powered by a lithium battery, the robot can disinfect up to 36,000 square meters in one hour.

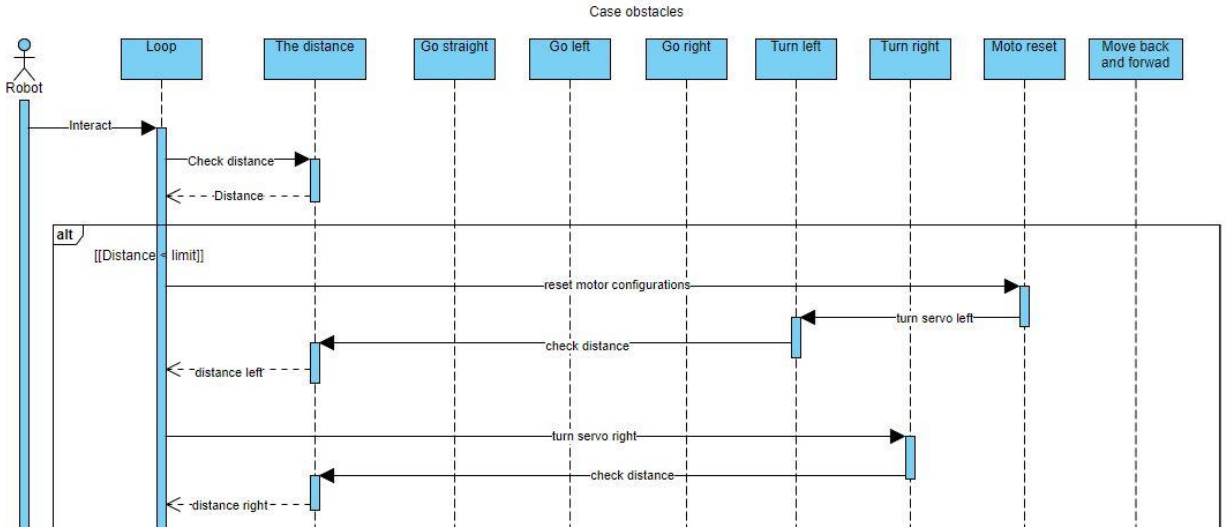
To make the robots operate easily on various road surfaces, the team adopted a caterpillar chassis instead of wheels to improve their ability to surmount obstacles surmounting and climb slopes. A 360-degree camera platform on the top transmits videos and information in real time, coupled with an intelligent vision algorithm that allows the operator to remotely locate affected areas and prevent the spread of infectious diseases at low cost.

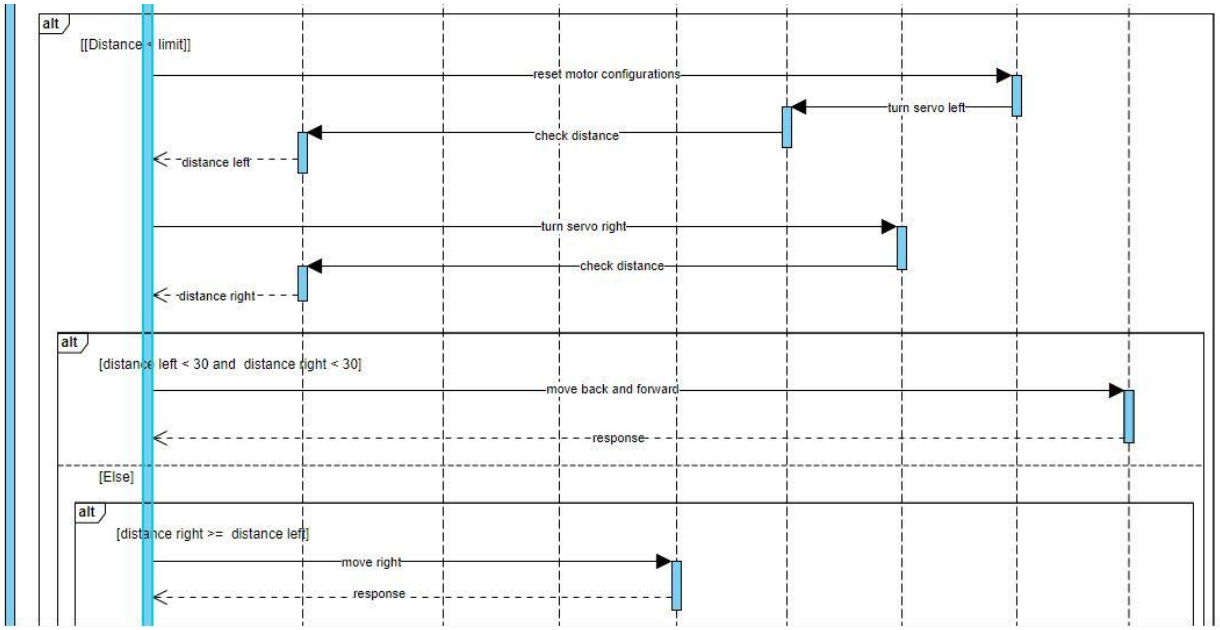


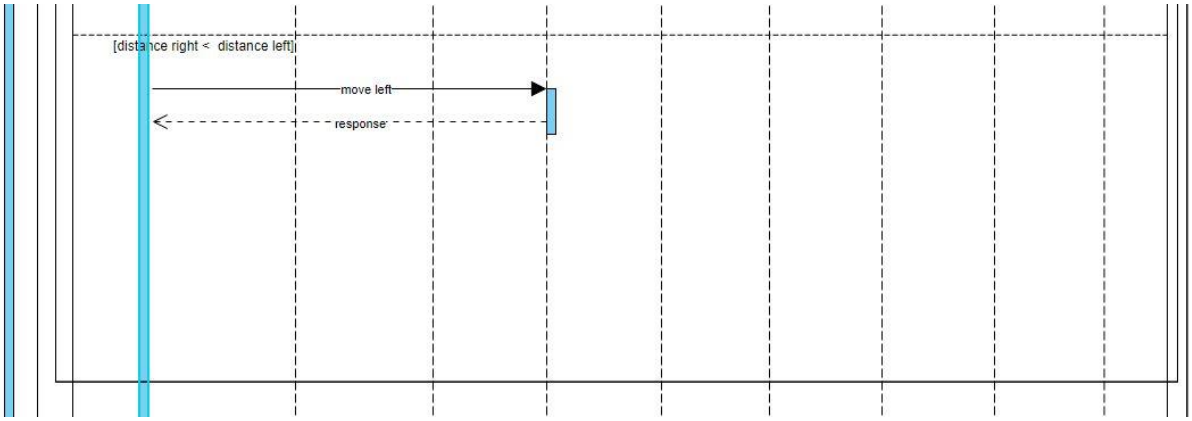
PROJECT SPECIFICATIONS

SEQUENCE DIAGRAM




Case obstacles
Robot
Loop
The distance
Go straight
Go left
Go right
Turn left
Turn right
Moto reset
Move back and forwad
Interact
Check distance
Distance
alt
[[Distance < limit]]
reset motor configurations
turn servo left
check distance
distance left
turn servo right
check distance
distance right


alt
[[Distance < limit]]
reset motor configurations
turn servo left
check distance
distance left
turn servo right
check distance
distance right
alt
[distance left < 30 and distance right < 30]
move back and forward
response
[Else]
alt
[distance right >= distance left]
move right
response

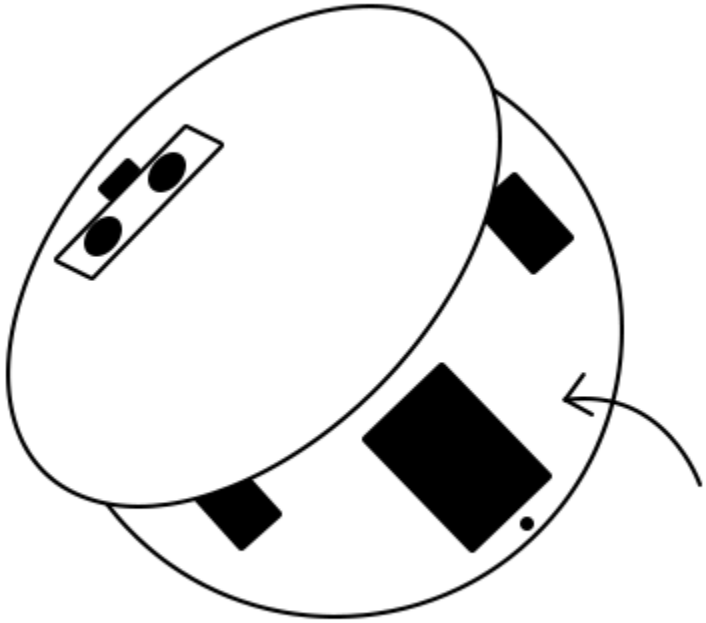

[distance right < distance left]
move left
response

FUTURE WORKS

Till now this project is under the name of “Demo” and it has some extra features and it ready to be up-and-ready.
Such as the size of the alcohol tank, the bump rate of bumping, and the spray optimizers.

UPGRADE ALCHOHOL TANK

The next phase of the project is to have a bigger tank which can hold up to 2000 ml which lets the robot sterilize the floor longer times without need to refill it again and again as our currently tank is 200 ml used for testing the concept of tank as it is hand made.



BUMP LARGER THAN 5V

The next phase of the project is to have a more powerful bump which an hold more voltages and give more pressure and bumping rate higher than the current bump as the it is 5v only but the target one is from 12v or higher.

This edit will affect positively on the project as it will sterilize better with high rate bumping of alcohol or any other liquid.

SPRAY OPTIMIZERS

The next phase of the project is to add real spray optimizers as we have created a solution but not better than the optimizers as we have made a calculated-distance tiny holes at the left, right, and front of the robot to do the same functionality of the spray optimizers.
But why can't e now use the optimizers? Because it needs more pressure from the liquid inside and this needs to have a good bumping rate with at least 12v which will be in the future work phases.

APPENDIX

Robot Sterilizer Code:

```
#include <Servo.h> //the servo library
Servo myservo;
int pos = 0;
//attaching the left motor to arduino pins
int motor_L1 = 8;
int motor_L2 = 9;
int enable_L = 7;
//attaching the right motor to arduino pins
int motor_R1 = 10;
int motor_R2 = 11;
int enable_R = 12;
//attaching the ultrasonic to arduino pins
const int trig = 2;
const int echo = 3;
//attaching the servo motor sinal to arduino pins
int servo_motor = 4;

int limits = 25;// the limit of available space of the obstacle
int i;
int x = 0;
unsigned long time;
int range;
int distance_left, distance_right;
int max_speed = 30;

void the_distance();
void go_straight(int way);
void go_left();
void go_right();
void move_back_and_forth();
void motor_reset();
void turn_right();
void turn_left();
```

```
void setup()
{
  Serial.begin(9600);
  myservo.attach(4);
  pinMode(trig, OUTPUT);
  pinMode(echo, INPUT);

  pinMode(motor_L1,OUTPUT);
  pinMode(motor_L2,OUTPUT);
  pinMode(motor_R1,OUTPUT);
  pinMode(motor_R2,OUTPUT);

  digitalWrite(enable_L, HIGH);
  digitalWrite(enable_R, HIGH);

  digitalWrite(motor_L1, LOW);
  digitalWrite(motor_L2, LOW);
  digitalWrite(motor_R1, LOW);
  digitalWrite(motor_R2, LOW);

  myservo.write(90);
  delay(500);
}

void loop() {
range = 0;
  the_distance();
  Serial.println(range);
  if (range > limits)
  {
    go_straight();
  }
```

```
  else
  {
    motor_reset();
    move_back();
    delay(300);
    motor_reset();
    turn_left();
    the_distance();
    distance_left = range;
    turn_right();
    the_distance();
    distance_right = range;
    if ( distance_right < 30 &&  distance_left < 30) {
      move_back();
      delay(1000);
      motor_reset();
      delay(1000);
      go_right();
    }
    else
    {
      if ( distance_right >=  distance_left)
      {
        go_right();
        delay(100);
      }
      if ( distance_right <  distance_left)
      {
        go_left();
        delay(100);
      }
    }
  }
}
```

```
void motor_reset()
{
  digitalWrite(motor_L1, LOW);
  digitalWrite(motor_L2, LOW);
  digitalWrite(motor_R1, LOW);
  digitalWrite(motor_R2, LOW);
}

void go_straight()
{

  digitalWrite(motor_L1, HIGH);
  digitalWrite(motor_L2, LOW);
  digitalWrite(motor_R1, HIGH);
  digitalWrite(motor_R2, LOW);
}

void go_right()
{
  motor_reset();
  digitalWrite(motor_L1, HIGH);
  digitalWrite(motor_L2, LOW);
  digitalWrite(motor_R2, HIGH);
  digitalWrite(motor_R1, LOW);
  delay(600);
  digitalWrite(motor_L1, LOW);
  digitalWrite(motor_R2, LOW);
}
```

```
void go_left()
{
  motor_reset();
  digitalWrite(motor_R1, HIGH);
  digitalWrite(motor_R2, LOW);
  digitalWrite(motor_L2, HIGH);
  digitalWrite(motor_L1, LOW);
  delay(600);
  digitalWrite(motor_R1, LOW);
  digitalWrite(motor_L2, LOW);
}

void move_back()
{
  digitalWrite(motor_L2, HIGH);
  digitalWrite(motor_L1, LOW);
  digitalWrite(motor_R2, HIGH);
  digitalWrite(motor_R1, LOW);
}

void the_distance()
{

  digitalWrite(trig, LOW);
  delayMicroseconds(2);
  digitalWrite(trig, HIGH);
  delayMicroseconds(10);
  digitalWrite(trig, LOW);


  // Measure HIGH pulse width at echo pin.
  time = pulseIn(echo, HIGH);

  range =  time*0.034/2;
}
```

```
void turn_left()
{
  myservo.write(180);              // tell servo to go to position in variable 'pos'
  delay(1000);
  the_distance();
  myservo.write(90);              // tell servo to go to position in variable 'pos'
}

void turn_right()
{
  myservo.write(0);              // tell servo to go to position in variable 'pos'
  delay(1000);
  the_distance();
  myservo.write(90);              // tell servo to go to position in variable 'pos'
}

void resetservo()
{
  myservo.write(90);
}
```

CONCLUSION

The overall objective from our project is to make sure that the floor of the place doesn't have any viruses or diseases like COVID-19.
So a Robot Sterilizer made to clean the floor with alcohol 70% concentration that responsible for getting rid of any disease or viruses as the robot tries to cover all the space of the place by checking with Ultrasonic sensor the front obstacles and deal with them. As if the obstacle in the front it will checks the right and left indices and choose the much larger space to cover as much as the space of the floor with an optimized time.

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