University of Southern California

Department of Aerospace and Mechanical Engineering

AME 554

Additive Manufacturing Technologies

PROJECT PROPOSAL:

COVID-19 Killer

A Smart Alcohol Sanitizing Robot

Group Members:

Chih-Yi Wu chihyiwu@usc.edu

Jiaoran Wang jiaoranw@usc.edu

Yaan Wang yaanwang@usc.edu

1. Introduction

1.1 Background

The COVID-19 pandemic continues to spread. To date, the global death toll from COVID-19 exceeded 900,000 and the number of confirmed cases has exceeded 27.7 million. The United States is still one the most severely affected countries in the world, with more than 190,000 deaths and 6.3 million confirmed cases.

1.2 Motivation

The public's demand for anti-epidemic products is increasing nowadays. Alcohol can effectively kill the new coronavirus, but there is a lack of household alcohol spraying equipment on the market. Therefore, we plan to develop a smart alcohol sanitizing robot.

1.3 Objectives

(1) Robot design

We decided to use the existing intelligent obstacle avoidance robot as the main body. Moreover, we plan to integrate the robot with a fully automatic electric disinfectant spraying device and a 3D printed trailer-mounted alcohol bin.

(2)Programmable route

The robot is equipped with a route recognition device, which can automatically identify the existing route to achieve route cruise spraying. The spraying route is completely customized by the user so that the robot can work in different environments.

(3)Automatic obstacle avoidance

The robot has an environment recognition function, which can automatically identify obstacles in the surrounding environment, and make route adjustment feedback to the obstacles. The angle of the route adjustment is customized by the user, and the speed of the obstacle avoidance recognition is also controllable.

(4)Rotatable multi-angle nozzle

We plan to use plastic hoses to connect the spray nozzle, suction nozzle and water pumps. The spread nozzle will be fixed to the roadblock identification device so that the spraying angle will be remote controllable and can rotate with the ultrasonic sensor module.

(5)USB rechargeable design and long battery life

The 18650 lithium battery will be used for the power supply of the robot. The cycle life of the battery can reach more than 500 times in normal use, which is more than twice that of ordinary batteries. Moreover, the battery has high safety performance, no explosion, no combustion, no toxicity, and no pollution. In addition, a 5V2A-10 watt USB charger will be integrated with the robot to ensure charging efficiency and maintainability in the future.

2. Design Approaches and Tools

2.1 Module Design

Design tools: Solidworks 2019/2020, AutoCAD2016

2.2 Module Manufacturing

Additive Manufacturing method for structure fabrication

2.2.1 Material

We plan to use two kinds of materials for different component manufacturing. The red, flexible one would be used for a bumper in the front of the robot car. The black PLA material will be used as the main material for constructional component manufacturing.

Fig.1 3D printing material

2.2.2 3D Printer

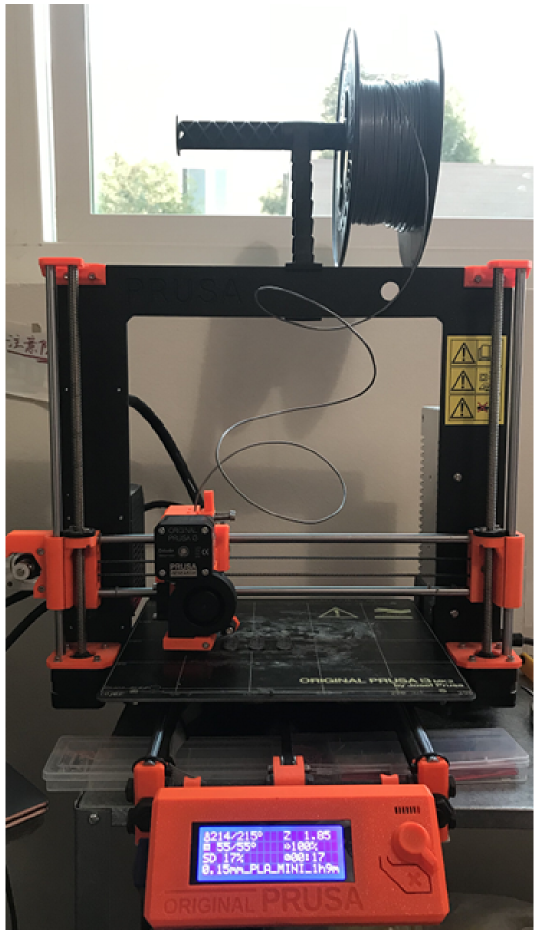

Fig.2 PRUSA i3

The brand of our 3D printer is PRUSA i3. The acceptable file type is .3mf and .amf.

To meet the balance of the structural strength and printing speed, the main large components will be printed with a 0.3mm-width filament, while the fine structure will be printed with a 0.15mm-width filament.The internal fill structure will be adjusted according to the external shape During the model slicing before turning it into G-code.

2.3 Module Analysis

Structural finite element analysis to improve design dimensions and positions

Design tools: COMSOL-Multiphysics 5.3a, ANSYS APDL2015 or Solidworks 2019 FEA modules.

2.4 Production Process Diagram

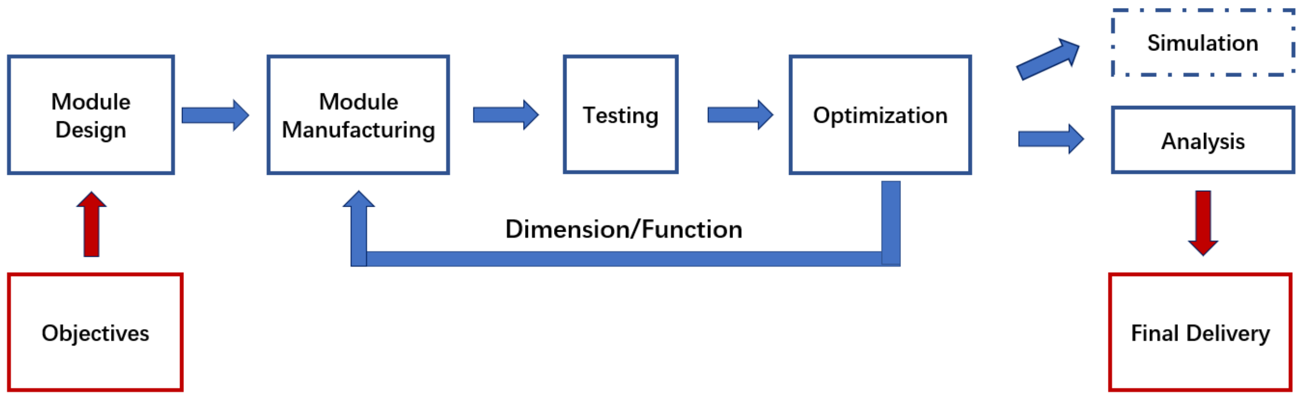

Fig.3 Design Diagram

3. Components

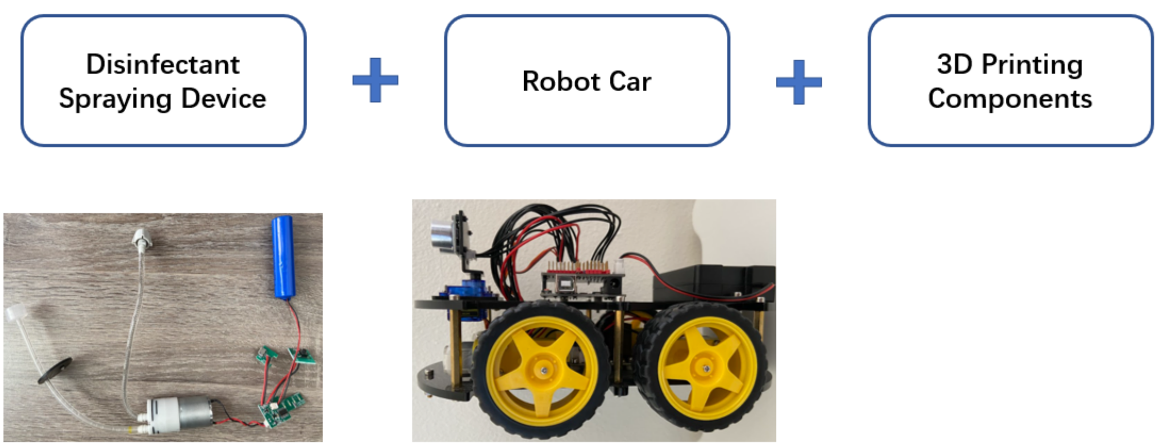

Fig.4 Main Modules

3.1 Disinfectant Spraying Device

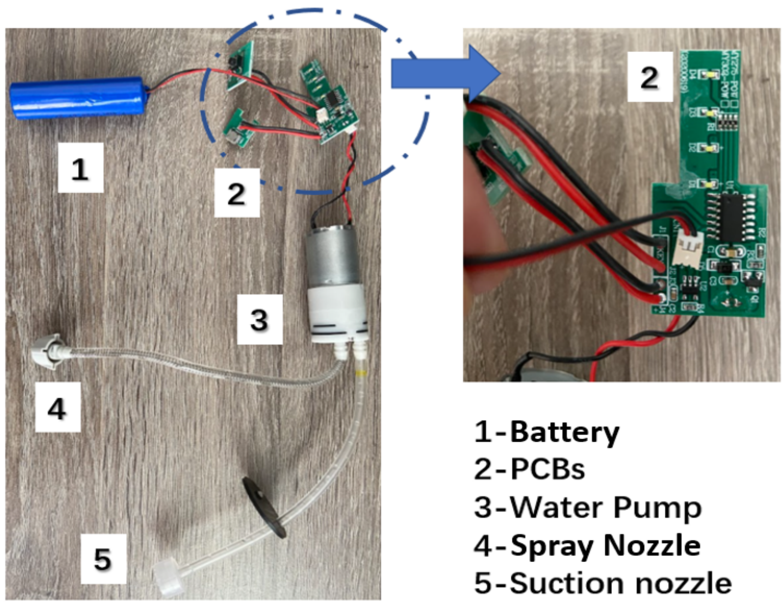

Fig.5 Disinfectant Spraying Device

3.2 Robot Car

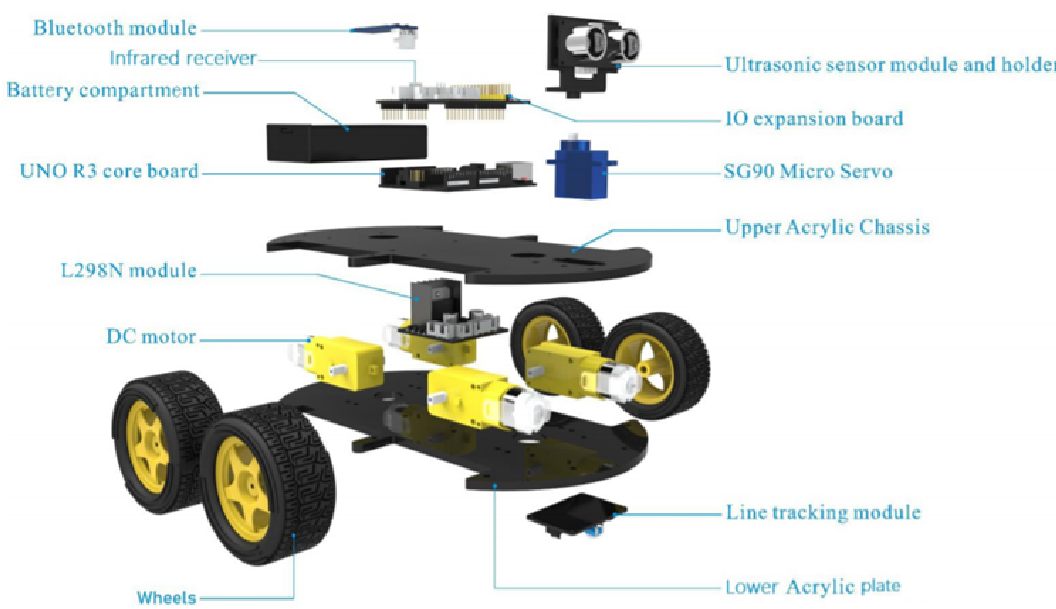

Fig.6 Robot Car Components

3.3 Overall Schematic Diagram

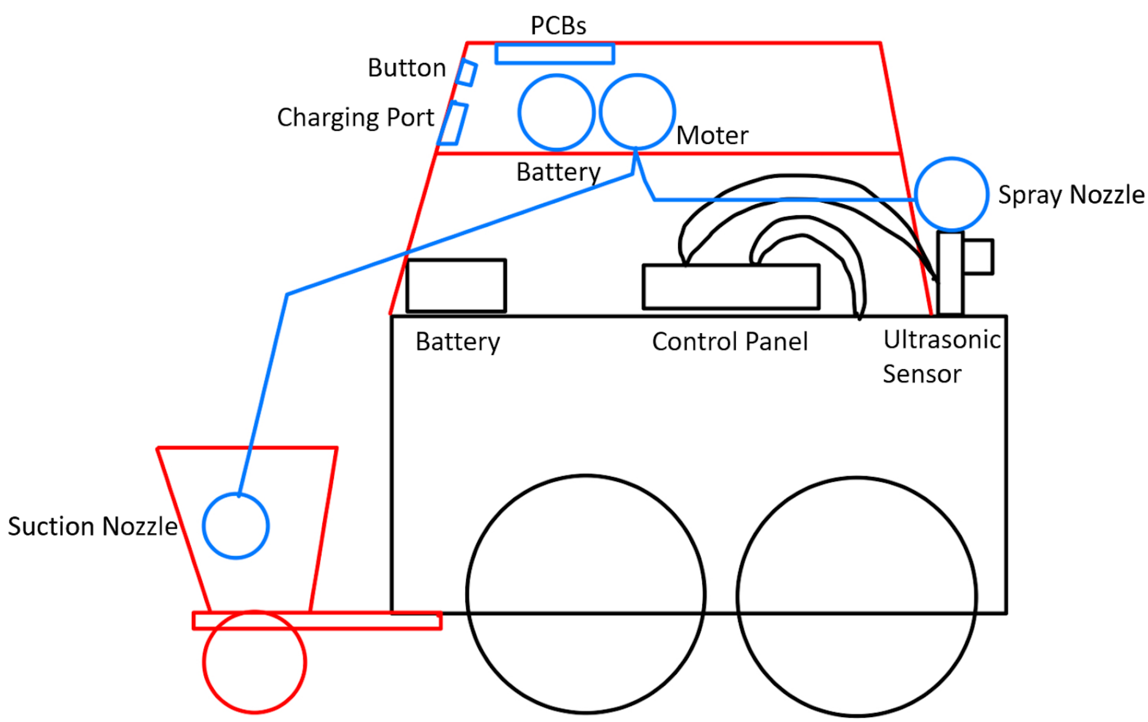

Fig.6 Overall Schematic Diagram

4. 3D Printed Parts

- Trailer
- Alcohol tank
- Robot shell
- Bumper printed by soft material

5. Summary

- Due to the COVID-19 pandemic, we plan to develop a smart alcohol sanitizing robot, named COVID-19 Killer.
- We decided to use the existing intelligent obstacle avoidance robot and integrate it with a fully automatic electric disinfectant spraying device and a 3D printed trailer-mounted alcohol bin.

- The robot will have several functions, such as programmable route, automatic obstacle avoidance, rotatable multi-angle nozzle and USB rechargeable design.
- We will use Solidworks and AutoCAD to design components, COMSOL-Multiphysics and ANSYS to do analysis, and the PRUSA i3 3D printer to build parts.

6. Next steps

- Buy the components we need
- Measure the size of each component
- Build the 3D CAD model of the robot
- Design the trailer, alcohol tank, robot shell, bumper and the way to assemble them
- 3D printing
- Analysis and test