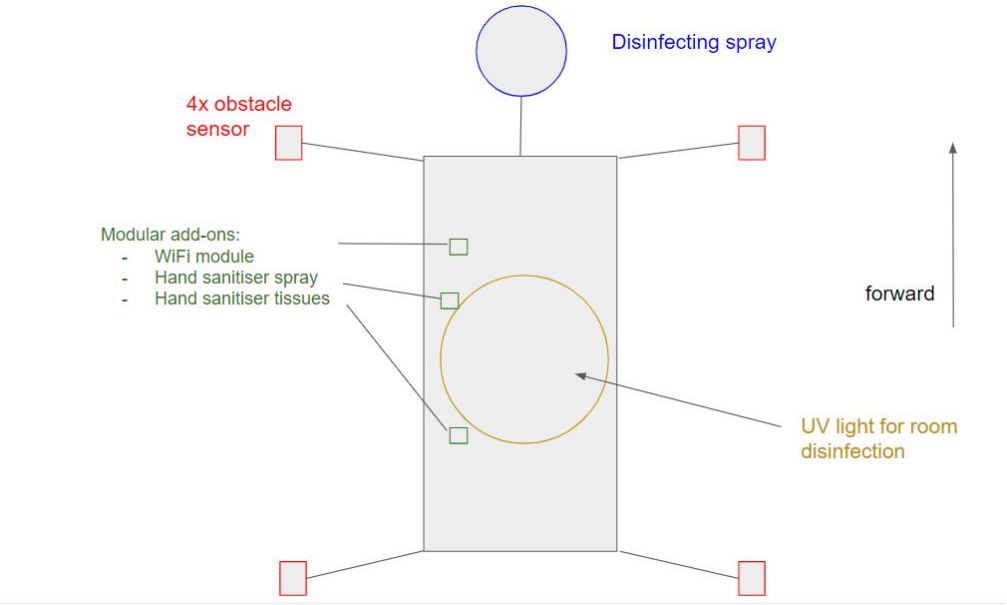
Constantin Gemmingen-Hornberg, Luke Peppard, Fabian Neumueller: Group 4.3
Lab06 - Covid 19 Design Challenge

Automated Disinfecting Machine in Essential Facilities:

A written description of your system and its functionality:

Our system called “Cleanery” is a self-driving robot and at the same time a moving cleaning station. The main function of "Cleanery" is to navigate through the corridors of essential facilities such as hospitals or retirement homes having the unique advantage of being modular and able to operate in any building. "Cleanery" uses sensors to navigate through the corridors measuring distances to the next corner, wall and other obstacles. Once being installed and set up "Cleanery" is able to navigate itself along the corridor and is able to detect doors on either side. By detecting doors with simple programmed Neural Network algorithms such as Mask RCNN it can spray disinfection solutions effectively at every doorstep.
Infrared sensors mounted at the corner of the robot continuously send signals in all four directions. This way, the robot ensures safe navigation through hospital architecture.
"Cleanery" is not only a self-driving robot but also a moving cleaning station: Hand disinfection tubes and a mount for a bag of disinfection tissues are attached to "Cleanery" which then can be used by the caring staff walking past the Robot. It has simple movement detection sensors that perceive if someone is closer than 30 cm to the robot and then stop the robot for a given time period such as 10 seconds to keep the system as reliable and simple as possible.

One schematic figure describing the architecture of your system:



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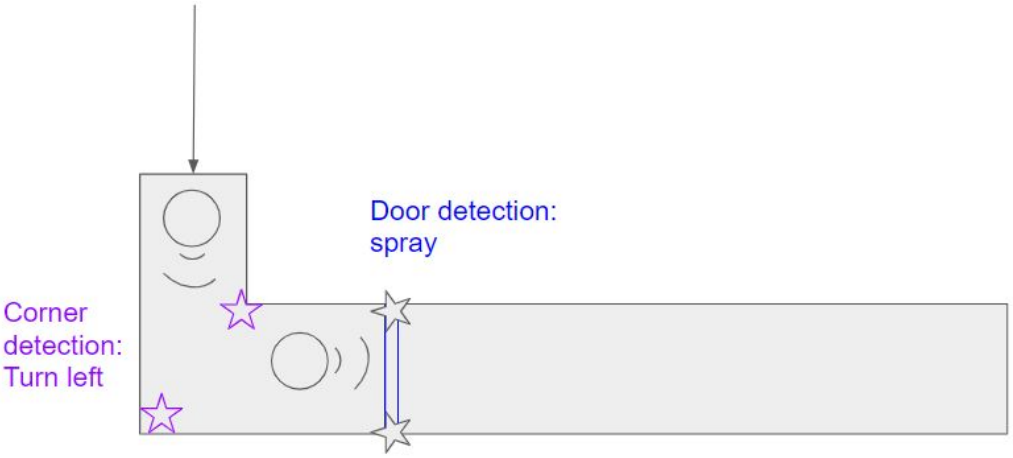

Pseudocode describing the functionalities of the system:

loop(): sending location and fill status of add-ons to mainframe (hospital) via WiFi module
loop(): sending and receiving infra-red sensor information

```
while (true){               %infinite loop
        if (corner detected = true){
                speed = speed / 0.5; %slow down
        }

        if (human approach detected = true){
                speed = 0;      %stop for 30 seconds
                delay = 30s;
                speed = default_speed;
        }

        if (door detected = true){
                speed = 0;      %stop, spray and continue
                spray_door = true;      %function which switches the spray-mechanism on
                speed = default;
        }
}
```

Discussion on the feasibility of design, scalability, ease of use and data privacy:

The concept of Cleanery seems to be very scalable as similar applications have proven the concept such as the “Roomba” hoover or as various automated lawnmowers which are also available in the given price range. Using a modular system you can scale the number and size of the operation area.
The Cleanery system is also simple to use as once it is set up you only need to fill up the disinfection solution once a day (or less - obviously depending on the size of the tubes).
There is no trouble with data privacy.

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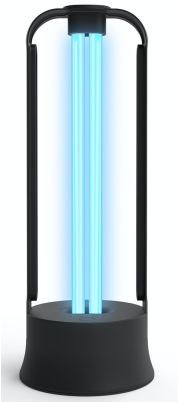
A simple cost analysis of the system and list of components:

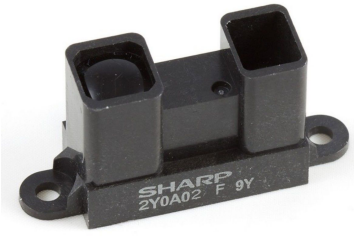
- UV lamps (18 CHF - 27 CHF) - UV lamp



- Roomba-like navigation robot (500 CHF) - navigation robot

- Hand Sanitizer Station (19 CHF) - hand sanitizer dispenser

- Infrared distance measuring sensor (4 x 16 CHF = 64 CHF) - IR sensor



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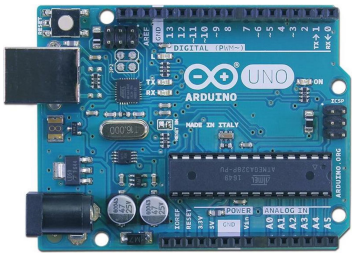
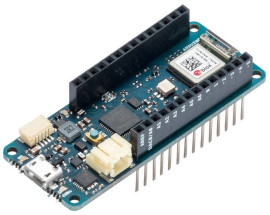
- Arduino Uno (31.40 CHF) - arduino



- arduino wifi module (43.95 CHF) - wifi module



- Disinfection wipes for manual use (42 CHF) - disinfection wipes

Total cost: 725.35 CHF
slightly over the budget...