A DESIGN OF HYBRID FLOOR UV-C STERILIZER ROBOT

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Abstract - *Hybrid Floor UV-C sterilizer Robot is a fluid less device which can be used to perform the disinfection of various bacteria and viruses, it is based on UV-C light. It has an add on hidden vacuum cleaner inside the device. It has various ultrasonic sensors to minimize the jerks and accidents with household furniture or industrial flooring obstacles. It detects all motions happening around it, it has special cliff detection to avoid falling from heights. It is user friendly and cost effective. UV light detects the spatters of viruses and bacteria, which can be seen only in blacklight. UV C light kills almost all the bacteria and viruses and it doesn't use any fluid for sanitization. It is human friendly so it doesn't require attention as it is automatic robot. It has in built UPS system with Battery which can be used as hybrid. We can use it with solar energy or electrical energy to run this device. It is user friendly and cost effective.*

Key Words: Hybrid, UV-C Light, Vacuum Cleaner.

1. INTRODUCTION

Hybrid Floor Sterilizer Robot is a real device which can be used widely on the different basis of human interacted surfaces and areas such as Homes, Hospitals, Industries, etc.

It is self-controlled device which is run by solar or electronically charged battery. It has components like UV C Lights which has been used in many scientific disinfections during any microorganism, viruses or bacteria spread through humans or any other living or non-living objects. In major laboratories of pharma industries were using UV C light chambers to disinfect their employees.

This device is so compact and user friendly to implement at any hard surfaces to disinfect the floor without occupying human resource to run this device. It is fluid less sterilizer which is eco-friendly as water crisis are common in recent situations.

It is combined with vacuum sweeper to clean the surface with suction, it is based on UV C LED lights which is more affordable to equip in this device as it runs on low voltages. It generates zero ozone and flexible in design. It consumes less electricity to charge the battery if we don't use solar panels to charge the battery.

Solar Panel can be used in summer and winters with maximum voltage output, where in monsoon we can use the electrically charged battery. It is cost effective and compact in design with eco-friendly functions available with futuristic applications.

1.1 Different Types of UV Light

- **Far UV or vacuum UV -** these wavelengths only propagate in a vacuum **(**100 nm to 200 nm)
- **UVC –** useful for disinfection and sensing **(**200 nm to 280 nm)
- **UVB –** useful for curing, and medical applications **(**280 nm to 315 nm)
- **UVA (or "near UV") –** useful for printing, curing, lithography, sensing and medical applications **(**315 nm to 400 nm)

1.2 Introduction to UV-C Light

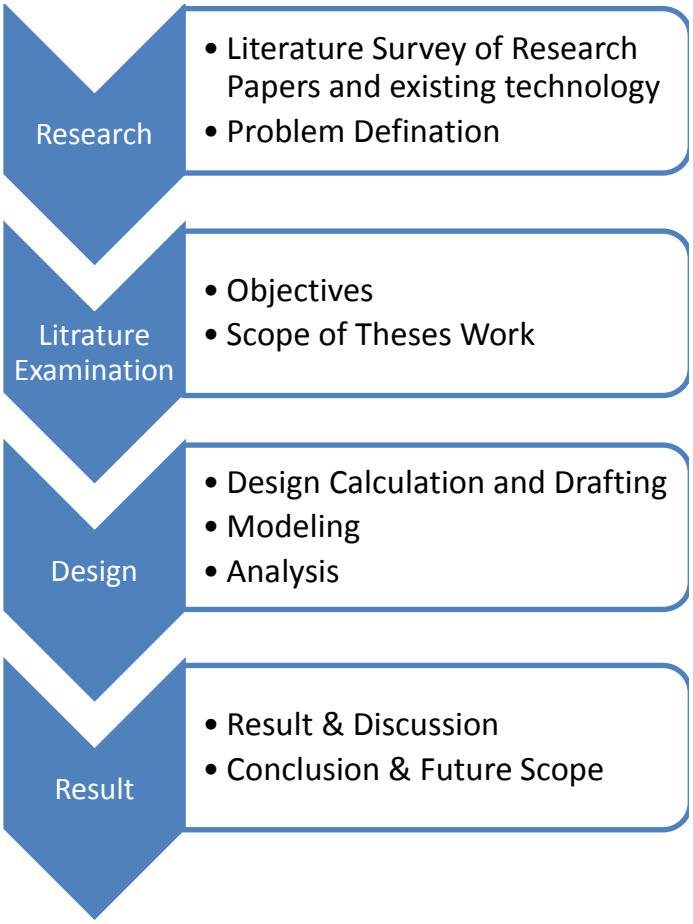
As evident by multiple research studies and reports, when biological organisms are exposed to deep UV light in the range of 200 nm to 300 nm it is absorbed by DNA, RNA, and proteins. Absorption by proteins can lead to rupture of cell walls and death of the organism. Absorption by DNA or RNA (specifically by thymine bases) is known to cause inactivation of the DNA or RNA double helix strands through the formation of thymine dimers. If enough of these dimers are created in DNA, the DNA replication process is disrupted, and the cell cannot replicate.

Disinfection is quantified by inactivation rates or Log Reduction Value (or LRV). Log reduction is a simple mathematical term used to express the relative number of live microbes eliminated by disinfection.

2. OBJECTIVE

- Hybrid Floor Sterilizer Robot is a device which can kill germs, bacteria and viruses by UV C Light, it also has vacuum cleaner in it.
- It runs on hybrid technology of Solar + Electric charging.
- Hybrid Floor Sterilizer is a fluid less sterilizer device.
- It will disinfect and vacuum the floor surface by UV C light and vacuum pump.
- It will work fully automated.
- Its design will be compact, so it can go through low base area.

3. METHODOLOGY



4. DESIGN OF DEVICE

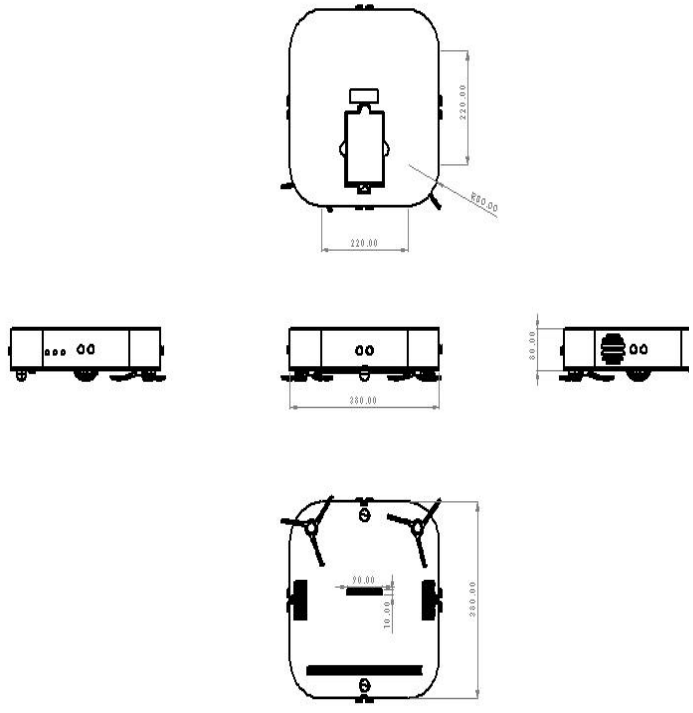
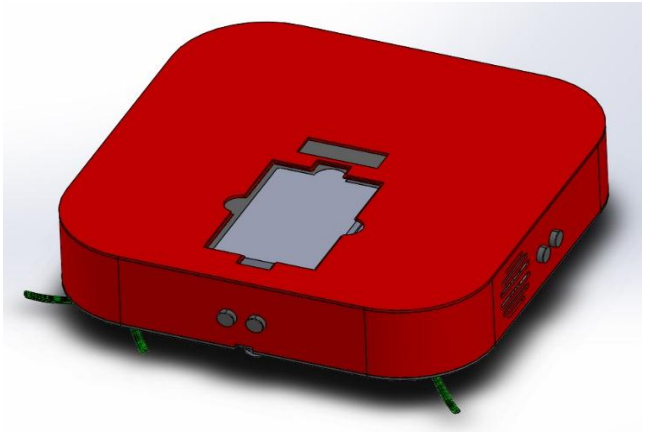
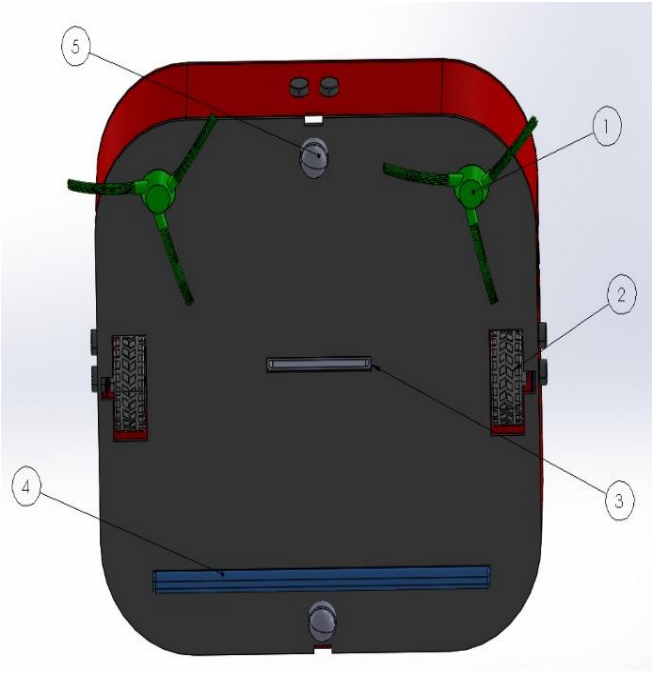


Fig.1- Design of Device

5. OUTER BODY DESIGN WITH PARTS





1. Side Brush
2. Axial Wheel
3. Vacuum Slot
4. UV-C Light
5. Ball Caster Wheel

Fig.2- Outer Body Design with Parts

6. Wheel Balancing

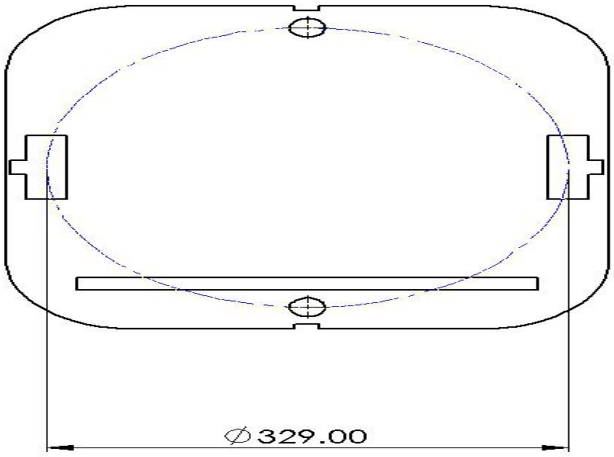


Fig.3- Wheel Balancing

Here, we can see the balancing of wheels. Wheels are arranged in circular manner. So, that load distribution will not affect the movement of device. We can clearly see that 2-ball caster wheels and 2-axial wheels are in exact same direction from center of body. So, that unbalancing will not be produced.

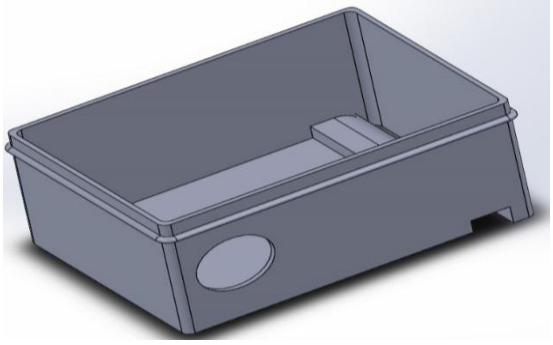
From, center of gravity of body to every wheel has a same radius of 164.5mm. So, it will help in turn the device in any direction without jerk or unbalanced.

7. REMOVABLE DUST COLLECTOR

It is the main part of the device to collect and store the dust and dirt from floor by vacuum pump. As shown in below figure it is 3d printed box. That is fitted in the front of device.

It is connected with vacuum pump pipe. When the vacuum pump is started, negative pressure is created inside the box and its nozzle is closer to surface. So, all the dust and dirt particles come inside the box.

It is removable box to collect the dust and dirt. After the box is full, we can easily empty the box by removing it from device. It is so easy to remove with bigger capacity of storage.



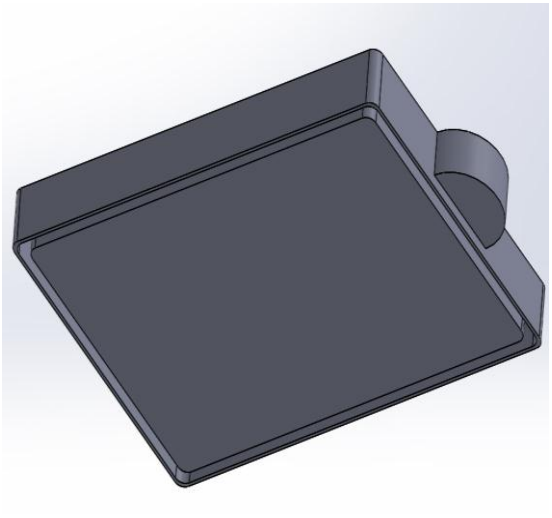


Fig.4- Dust Collector

Specification:

Dimensions: 134 x 90 x 67 mm^3

Capacity: 0.600 ltr.

Material: PLA+

8. SIDE BRUSHES

We can see in the figure that brushes are placed in front of vacuum pump. It is rotated by dc motor and dust and dirt collection area is increased and more dust sucked by vacuum pump.

The main function of side brushes is to clean the wall corners. Because, vacuum cleaner never reach the corners and it is essential to clean every place of the floor. So, it is covering larger area to clean the floor.

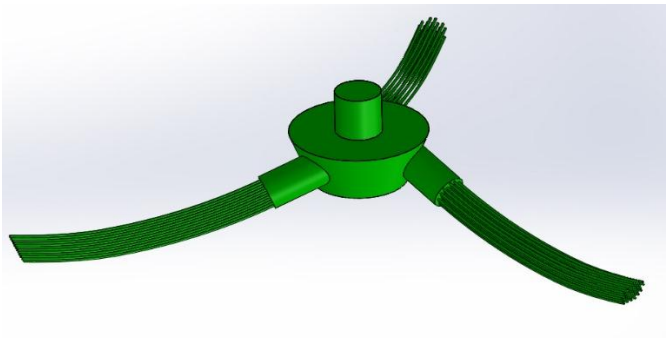


Fig.5- Side Brushes

Specification:

Length of brush: 10 cm

Suction Entrance without Side Brushes: 10 cm^2

Suction Entrance with Side Brushes: 900 cm^2

9. STRESS ANALYSIS

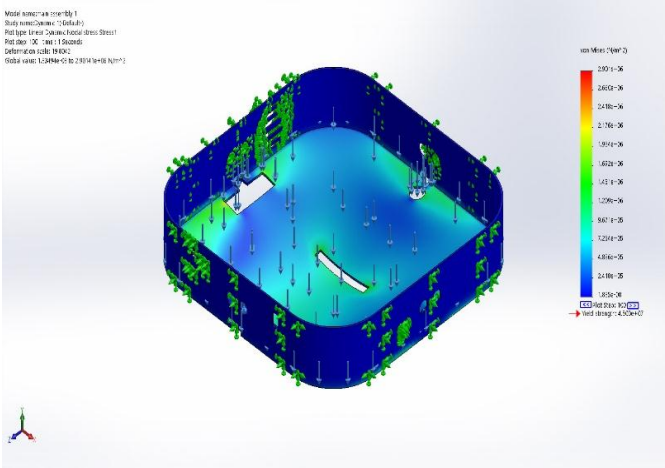


Fig.6- Stress Analysis

10. DEFORMATION ANALYSIS

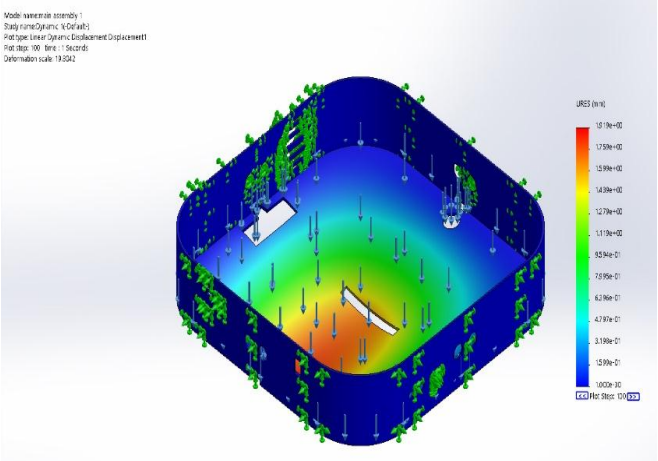


Fig.7- Deformation Analysis

11. PROPOSED DESIGN SPECIFICATION

DIMENSIONS	380 x 380 x 90(mm)
BODY MATERIAL	Acrylic
WEIGHT	3.55 kg
UV-C LIGHT	8W (AC)
UPS INVERTER	40W
RUNNING TIME	5 hrs.
CHARGING TIME	180 min.
CLEARING EXTENT	60m^2
BATTERY	18000mAh
CLEANING MODE	Zigzag and Distance Based
SENSORS	Ultrasonic, IR
SUCTION POWER	1300 Pa
SUCTION ENTRANCE WITHOUT SIDE BRUSH	10 cm^2
SUCTION ENTRANCE WITH SIDE BRUSH	900 cm^2
DUST BOX CAPACITY	0.600 lit.
DISPLAY	LED Module
SPEED (variable)	0.10m/sec to 0.20m/sec
MODES	Auto, Manual and Offline

12. APPLICATION

- Homes,
- Hospitals,
- Educational Institutes,
- Offices,
- Commercial Sectors,
- Shops.

13. CONCLUSION

The main focus of this project is to make a human less vacuum cleaner with sterilization and run with both electricity and solar energy. So, the utility of this device is increased and cleaning and sterilization of floor now become very easy, convenient and eco-friendly. The above system will give promising results and it is able to do both cleaning and sterilization in auto, manual and offline mode. Also, costing for developed this device will become very less compare to other existing product into market. Wall corners dust is biggest issue for any vacuum robot. But this device is easily clean the wall corners by giving the shape of square with round corners and attaching side brushes. Dust collector capacity is improved by 100ml and still it can be improved further. we have made a clearance as minimum as possible from the floor to run the device with maximum vacuum pressure. It is very essential to design the device in way that UV-C light will not affect the humans or its rays will not come in the eyes of users. Here, we have developed the design that follow the guidelines of using UV-C light and it will not affect the humans as it is very dangerous to direct exposure. Here, we have chosen acrylic material for its outer body. Because, acrylic is resistance to UV-C light and its weight is very less. Also, we can make any shape easily by laser cutting.

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BIOGRAPHIES

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