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Design and Fabrication of UVC based Sanitizing System

Shubham Thakur, Risha Shetty, Sanskruti Sawant, Mrunali Rajigare, Santosh Sonavane

Abstract: ***Washing our hands regularly is extremely important to keep up with sanitation and to prevent ourselves from sickness, and we follow this standard consistently in this period because of the current pandemic crisis. Accordingly, People all around the world have normalized the significance of sanitation and disinfecting surfaces and objects in the area. Sanitation does not usually erase microbes, but instead lessens their presence by removing them. The number of microbes lessened from a surface is quite dependent on type of material and product used to sanitize the area. Hence, we have come up with an object that is not only capable of wiping out the microbes completely but also it is cost effective. The corona virus is transmitted by people coming in contact with each other. This virus lives on variety of surfaces, but we can cleanse it by using various disinfecting and sterilizing products. It is therefore very important that people realize the necessity of sanitizing almost all the surfaces and objects in the environment around us. For example, people working in various sectors including dispensaries, hotels, shopping complexes, salons etc. to maintain hygienic environment. Keeping in mind, several devices have been designed for sanitizing hands and objects and increasing the need creating more such systems in affordable manner. Taking these areas into consideration, we planned to construct a sensor-based product which will play an essential role. Hence, we thought of a unique concept and worked on this latest technology using UV lamps for disinfecting the germs, viruses etc. This solution will not only be innovative but also conveyable so that it is ready to carry.***

Keywords: Environment, Pandemic, Sanitation, UVC.

I. INTRODUCTION

Worldwide, large numbers of people openly dispose waste, that tends to grow harmful bacteria's which later contributes in spreading innumerable diseases. To prevent this from happening, and destroy viruses like COVID-19, it's mandatory to keep objects and surfaces sanitized. That is of utmost importance to recognize the repercussions of not maintaining sanitization of self-including surfaces, preventing from increasing scale of spreading and upcoming viruses. The most vital role of UV-C radiation technique is to disinfect wide number of microorganisms including vegetative and pathogens. This technology has resulted notable reduction of bacterial pollution. All systems and devices are not cheap and also very complicated in use. Thus, we came up with new UVC sterilizing device that is conveyable compact and supports automatic touchless sanitization. Sanitizing device will help to reduce the spread number of different diseases, and promotes sanitized and uncontaminated environments. Disinfecting of objects as well as surface touched by the user is involved in this product. This device composes of a wristband with essential functions. This comprises of an ultraviolet source with a considerable degree of radiation to disinfect whole surface. Moreover, this device with a tilt sensor will showcase the source on/off function of device by the main switch button. The germicidal effect of ultraviolet (UV) light depends on light intensity and exposure time. Our UV disinfection system has required a fixed power and light source. It's a portable, battery-operated ultraviolet water disinfection system for individual use. Our system works rapidly. In fact, it's a safety factor. The use of UV disinfection systems available in the market is currently limited, but our product has already reduced the size, weight and cost significantly which makes it appropriate for use in various sectors at an individual level.

II. OBJECTIVES

Main Objectives of this research paper are: -

- To plan, design and implement handy compact disinfection device for several targets that will offer automatic, integrated and autonomous solution.
- To build a cost-effective UV band.
- To remove and destroy potentially harmful germs and bacteria using rays.
- To contribute towards socially clean areas so that it is easy to maintain healthcare.
- To provide support on the cleaning and disinfection of environmental surfaces and objects especially in the context of COVID-19.

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* Correspondence Author
Shubham Thakur, Tesla Air Technologies, Pune (Maharashtra), India. E-mail: shubham@teslaair.in
Risha Shetty, Mechatronics Engineering, Symbiosis Skills and Professional University, Pune (Maharashtra), India. E-mail: rishashetty92@gmail.com
Sanskruti Sawant*, Mechatronics Engineering, Symbiosis Skills and Professional University, Pune (Maharashtra), India. Email: 27sanskrutisawant@gmail.com
Mrunali Rajigare, Mechatronics Engineering, Symbiosis Skills and Professional University, Pune (Maharashtra), India. Email: mrunali.rajigare25@gmail.com
Santosh Sonavane, Director at school of Mechatronics Engineering, Symbiosis Skills and Professional University, Pune (Maharashtra), India. Email: sssonavane@gmail.com

III. DESIGN ANALYSIS

This research paper mainly focuses on three aspects of our model. Initially, starting from design factor then testing methods and lastly PCB structure along with respective results.

Design	PCB	Analysis
Schematic	PCB outline	Design Analysis
Overview of model-1	PCB assembly	PCB Analysis
Overview of model-2	PCB designing	Process Analysis

Let's see all the aspects in brief.

A. Design

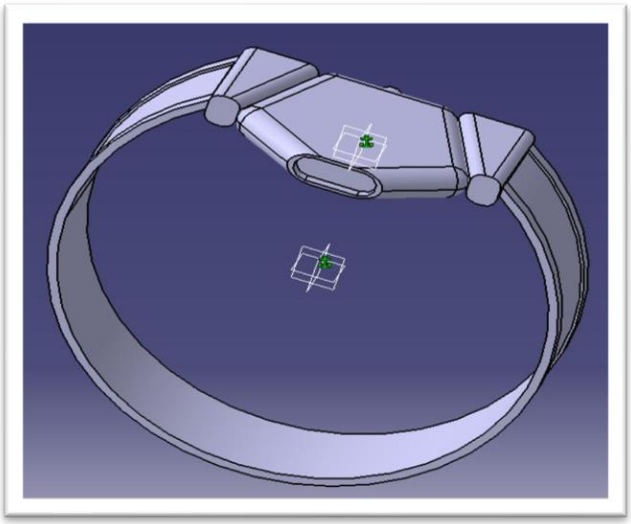
An automatic touch less hand sanitizer device is developed considering the factors. Demands for hand sanitizers have augmented since corona virus outbreak and here we take the opportunity to build low weight, cost effective and touch less hand sanitizer wristband with unique design. As an improvement over the existing designs, a new and more effective portable disinfectant device has been developed with twin treatments, using the properties of UV-C radiations while spraying sanitizing liquid simultaneously, in order to ensure greater chances of destroying the virus. The device can be used for disinfecting electronic gadgets as well by using the UV-C mode only.

a. Schematic

Schematic diagrams or models played a crucial role in developing our final product.

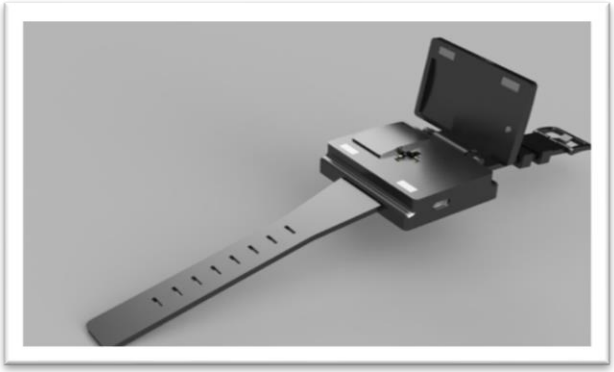
b. Overview of Model-1

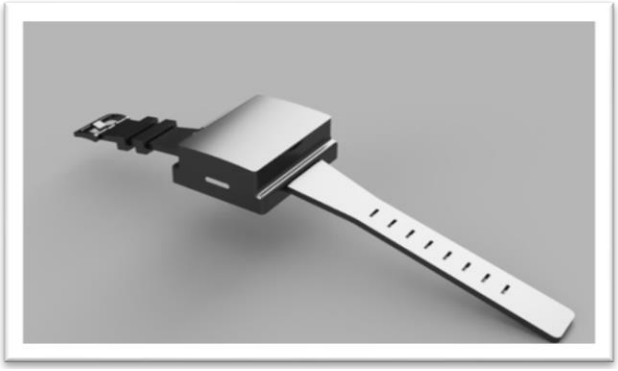
Taking this into account, prototype of sanitizing band was designed. This is the overview of model-1. It was made using various Cad software and exact dimensions needed. This is the assembly of our model which consists of band and a dial. At front part UVC will be placed with an exact angle for sanitizing. But due to some PCB board designs and angle requirement, design needed to be changed.



c. Overview of Model-2

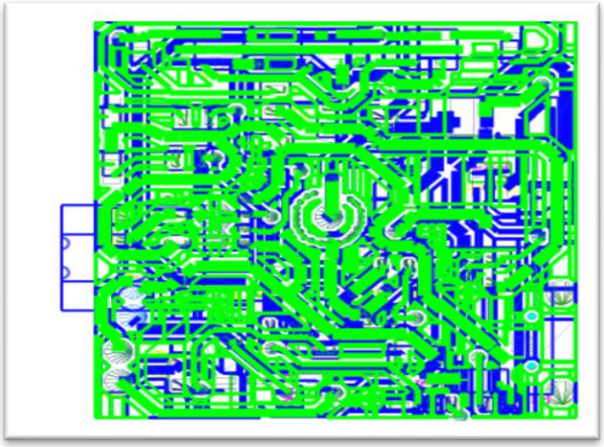
After getting few complications while testing model-1, it was decided to modify the whole model. As few major changes also took place in PCB design there was sudden change in cad model according to measurements. This is final model for automatic sanitizing band with added feature of timer. It will also play a crucial role in act.



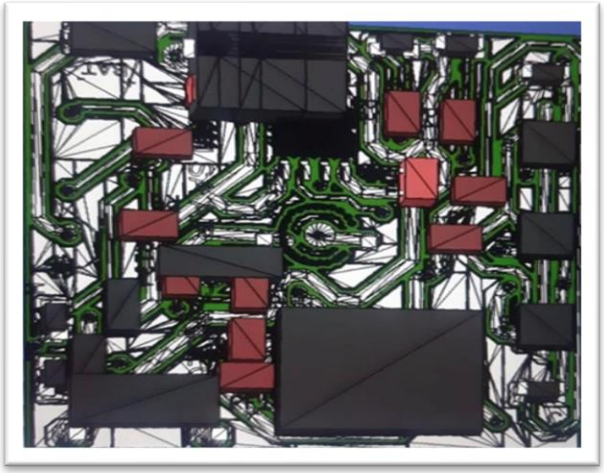


B. PCB Structure

a. PCB Outline



b. PCB design



c. PCB Assembly

C. Analysis

a. Design Analysis

Design Analysis played an essential role in developing a design including research, planning and further communications.

Initially we did Market Research for "Sanifit" and accurate design for easy use.

Further, we started brainstorming pool of ideas for unique design and created prototypes for testing. So, we can experiment on those and design a final version quickly.

Starting from schematic diagram to final 3d cad model it was done using various cad software.

b. PCB Analysis

PCB Analysis played a crucial role in developing this product. Using various required hardware components all were soldered manually except few which were machine soldered. Simulation design was done on software named Altium Designer20.

After getting results of first prototype testing, few errors were noticed in PCB. Hence, PCB was modified again for final product.

c. Process Analysis

Firstly, we did Gap Analysis where it was clearly identified the gaps between current state gadgets and desired gadget that is needed for this situation. Here, we found an innovative solution for sanitizing surface with cheaper cost,

lightweight band and highly efficient. Secondly, we went through Goal Setting and cost estimation. Main objective of the product is figuring out success and failure rate and working accordingly. Estimating the cost, time and use of design material. Then designing of PCB and CAD model was noticed an important step in overall process. While having market research, it was quite clear about future clients for Sanifit product.

IV. APPLICATIONS

The far-UVC 222 lamps can securely be used or combined into overhead lamps for enormous expanses. This includes work places like factories and industries, Restaurants, salons, malls, cinema halls, schools, universities etc. Far-UVC 222 lamps can be used along with face masks; sanitizers hand washes, and face shields etc. for destroying the germs also for well-being of humankind against CORONA virus and other pathogens. Additionally, far-UVC lamps could also put a stop to the spread of airborne infectious diseases like Whooping cough, Bubonic plague, tuberculosis.

V. BENEFITS

- Adequately disabling infectious and deadly Corona virus and other microbes' public spaces.
- Swift-on in
- Extensive functioning temperature range.
- Compact measurements.

VI. CHALLANGES

After revising the literature of wearable computing, we found many reproving challenges and concerns. As stated, the major technical challenge faced by wearable devices is prolong usage. This challenge is associated to many attributes: battery lifespan, user acceptance, security, weight, fault tolerance, and privacy concerns. On the other hand, there are challenges related to making standardized wearable systems. Moreover, there are challenges in building a relationship with the commercial sector to ensure installation and process completion. We provide advanced and conveyable solutions for overcoming each challenge in future work.

CHALLENGE TYPE 1

User Acceptance

This is the main claim of wearable devices. User acceptance has many challenges with respect to customization, connection, presentation, and data. Customization is the capacity to support a person's style of living, for example, allowing the person to make the form that they want. Also, it is focusing on connectivity that is accessible, simple, and easy to use. In addition, there is a need for adaptivity.

CHALLENGE TYPE 2

Security

A new random optimization framework has been allowed to consider safety and sustainability requirements that count on users' analysis and derive standardized design parameters for wearable sensor applications. Dependability on data is another challenge. Thus, such data collected should be used that uses accurate thresholds with minimum or null/no fault tolerance. Fault tolerance of devices is also a concern in terms of resistance to impact, heat, cold, and water.

CHALLENGE TYPE 3

Battery Lifespan

This challenge could be defeated with respect to hardware, software, or connectivity. Hardware could also use energy meter technology, which pulls power from the surroundings via solar, kinetic, and electromagnetic emission energy. On the subject to software, we could decrease the power utilization of the system firmware, which can be classified as event-driven, duty cycle, feature selection, or sensor selection. For connectivity, the micro interactions complete the task in less than 3 seconds.

CHALLENGE TYPE 4

Weight

We could use energy meter technology to root out the need for a battery, which can reduce total weight.

VII. FUTURE SCOPE

- We can extend the working time of the wristband.
- It can be made detachable so that the device can be fixed to a regular wristwatch or pocket watch which will act as an additional item.
- However, compact and miniatured device can be constructed with unique design.
- The sanitizing wristband can be modified with an optional watch or any other time piece so that it plays vital role in practical life.

VIII. CONCLUSION

A single restraint of using a portable UVC lamp is that output is not steady. Source of target to length and beam geometry were disapproving factors about radiation intensity and kill rates. Additionally, there are terms while considering the ideal source to target distance. A small target distance gives higher intensities but sustains a small surface area. A last concern of exposure to UVC may result in optical or dermal effects. Our analysis shows that there is a possibility for considerable amounts of scatter radiation to the worker using the wristband UVC Sanitizer. Thus, it is necessary that all individuals operating the device, take special care to avoid exposure.

Sterile UVC is assisted for use in dispensaries without taking into account its efficiency or potential risks. By acknowledging and appropriately using of UVC for surface disinfection, from health and safety professionals can be better advised to healthcare administrators to use this technology. By considering current sanitizing systems, we have developed an unique one which is portable and easy to use.

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AUTHORS PROFILE

Shubham Thakur, a mechanical engineer by education, as an innovator, has filed multiple patents and has been a part of multiple early-stage hardware startups. He is also the serving chief at TeslaAir Technologies Private Limited, an IoT Devices startup. TeslaAir has received the accolade of one of the fastest growing IoT startups by Innovation Zone magazine.

Risha Shetty, currently studying Btech from Symbiosis Skills and Open university in Mechatronics Engineering. She has gained practical experience as an intern from Motherson Automotive Engineering and Technologies in the field of Robotics, Automation, Artificial Intelligence etc. She has also completed several extra-curricular courses in embedded systems, machine learning, Data analysis etc. She has successfully published a Research paper in a well-known journal with the title "Smart Sanitization System".

Sanskruti Sawant, currently pursuing Btech from Symbiosis Skills and Professional University and recently in final year of Mechatronics Engineering. She has worked on many projects in Robotics and Automation domain. She has gained work experience in domains such as IOT, Robotics and Automation, Machine Learning, Electric Vehicles. She has successfully published research Paper in known journal.

Mrunali Rajigare is pursuing her Btech from Symbiosis skills and professional University and currently in last year specializing in Mechatronics Engineering. She is also currently working in multinational company Marquardt India Pvt Ltd. and has trainee experience in Forbes Marshall Pvt Ltd. She has successfully published one research paper in known research journal.

Dr. S. S. Sonavane had completed PhD (Electronics Engg.) from IIT, Dhanbad in 2009. He is having 23 years of experience in educational field and served for 12 years as Director in many well-known organizations such as DY Patil Technical Campus, Pune. Currently he is working as '**Director'** at **School of Mechatronics Engineering** of **Symbiosis Skills & Professional University (SSPU), Pune**. He was also First Vice Chancellor of Ajeenkya DY Patil University, Lohegaon, Pune. His area of expertise is Wireless Sensor Networks, IoT & Mechatronics Engineering. He has a successful academia and published 3 books at International level. He had more than 85 International and National publications on his name. He was the registered PhD guide in University of Pune and other NITs. Also received grant of Rs 92 Lakhs from European Union for R&D project in IOT based underwater sewage pipe monitoring & control with Automatic Robot. He is also Reviewer of many Electronics International Journals including IEEE Sensor Journal and IEEE Communication Letters. He had successfully completed two Research Projects funded by University of Pune and currently working on International Projects.