JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

UV SANITIZATION ROBOT

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Abstract: This project presents design and implementation of UV sanitization robot. This robot employs ultraviolet light technology, known for its germicidal properties to reduces germs, viruses, bacteria that may present on floor surface. The main aim of this project is to contribute in the fight against the diseases which are spread by the microorganisms like COVID-19. It also used in public spaces such as hospitals, schools to minimize the risk of pathogens contamination and propagation. This robot is also help to reduces the human efforts. UV light is an attractive option for disinfection, but ultraviolet lights are harmful for humans so for security purpose UV lights is adjusted in a way that does not harm humans. This robot works automatically, it does not need to operate physically. This abstract introduces a UV sanitization robot designed to autonomously navigate and disinfect various environments, such as hospitals, offices, and public spaces. The robot integrates advanced UV-C technology with intelligent navigation systems to ensure comprehensive coverage and effective eradication of harmful microorganisms. Furthermore, the robot's autonomous operation minimizes human intervention, reducing the risk of exposure to pathogens. This abstract outline the design principles, functionality, and potential applications of the UV sanitization robot, highlighting its role as a frontline defense against infectious diseases.

***Key Words*:** Disinfection, Sanitization, UV lights, Sensors, Robot, DC Motors.

I. INTRODUCTION

The COVID-19 outbreak has been classified as a global public health emergency. According to the report from WHO over 6.57 million deaths have been reported in pandemic. COVID-19 is caused by the viruses. The virus can remain active on surfaces from hours to day tackle this problem there is need to continuous disinfection the surfaces. UV sanitization has valuable tool in combating the spread of COVID-19 due to its ability to effectively deactivated the viruses on surfaces. UV-C light can be used to disinfect surfaces such as hospitals, schools, public transportations, and workplaces. UV-C light effectively destroys the genetic material of the virus. Short wavelength ultraviolet light known as UV-C light [200-280 nm] which is deactivated the DNA/RNA of microorganisms and terminates their cellular activities and reproduction. The UV-C light has been recently used to battle other covid, for example SARS. This strategy for cleaning is exhaustive, quicker and less work concentrated than manual cleaning. UV radiations are harmful to human skin so the modification in existing system may be required to improve the safety and performance of disinfection.

II. LITERATURE SURVEY

[1] Jui-Hasan Yang, et al. "Effectiveness of An Ultraviolet-C Disinfection System for Reduction of Healthcare Associated Pathogens." This paper says that the oddity of the current investigation is the exhibition of the effect of the UV-C sterilization framework against development of infections.

[2] Pacharawan Chanprakon, et al. They have developed an UV contraceptive robot to kill the virus. This robot uses ultrasonic sensors to avoid collisions and these sensors and the webcam is used to direct the robot. The robot uses three UV lamps to cover a wide range of disinfection. The mobility, speed of this robot, and UV light can be controlled by the operator.

[3] Thomas Rubaek, Merima Cikotic, Simon Falden "Evaluation of The UV Disinfection Robot," In this paper, we can say that they have planned and carried out a practical UV sanitization robot with Bluetooth control. The sanitization is done through a pre-characterized way without worker mediation, The UV robot needs in any event requires around a minute to disinfect the surface around.

[4] Aladin Begic, et al. "Application of Service Robot for Disinfection in medical institutions". In this paper they have proposed the help sanitizer robot which are straight forward and powerful in sterilization in clinical establishment. These are partial computerized frameworks which reduce the microscopic organisms and MRSA in room touch surfaces and cleared by MRSA affected people.

[5] Noriyuki Yagi, et al. worked on disinfection robot with high wavelength by using UV-LED. This project looks at the disinfection impacts of ultraviolet rays and demonstrates that UV-LED is equipped for cleaning embarrass microbes. This paper proposes that UV-LED is more modest and more brilliant compared to light pressured mercury light, so UV-LED can be utilized with the end goal of cleansing adequately.

2.2 Objectives

The objectives of UV sanitization robots encompass several key goals aimed at achieving efficient, effective, and safe disinfection in various environments:

1) Thorough Disinfection: The primary objective of UV sanitization robots is to achieve thorough disinfection of surfaces and environments. This includes targeting high-touch areas, hard-to-reach spaces, and surfaces that may pathogens, ensuring comprehensive sanitation to reduce the risk of infection transmission.

2) Autonomous Operation: UV sanitization robots are designed to operate autonomously, minimizing the need for human intervention. The objective is to enable these robots to navigate through spaces independently, identify areas requiring disinfection, and execute cleaning protocols without direct oversight, thereby improving operational efficiency and reducing labor requirements.

3) Coverage and Consistency: Ensuring consistent coverage of surfaces is essential for effective disinfection. UV sanitization robots aim to achieve uniform distribution of UV-C light across target areas, minimizing the risk of missed spots and ensuring thorough disinfection. Objectives in this regard include optimizing robot movement patterns, adjusting UV-C lamp configurations, and implementing sensor technologies to detect and respond to environmental conditions.

4) Safety Protocols: Safety is a paramount concern when utilizing UV-C light for disinfection. UV sanitization robots incorporate various safety protocols to mitigate the risk of human exposure to harmful radiation. Objectives in this area include implementing motion sensors, automatic shut-off mechanisms, and remote monitoring capabilities to ensure safe operation in the presence of humans and animals.

5) Real-Time Monitoring and Feedback: UV sanitization robots may include features for real-time monitoring and feedback

to assess disinfection efficacy and identify areas for improvement. Objectives in this domain involve integrating sensors, cameras, and data analytics capabilities to track cleaning progress, detect anomalies, and provide actionable insights for optimization.

6) Adaptability and Flexibility: UV sanitization robots should be adaptable to different environments, surfaces, and cleaning requirements. Objectives in this realm include designing modular and customizable robot platforms, developing intuitive user interfaces for configuration and scheduling, and incorporating machine learning algorithms for adaptive cleaning strategies.

7) Integration with Existing Systems: UV sanitization robots may need to integrate with existing infrastructure, workflows, and management systems within facilities. Objectives include compatibility with building automation systems, interoperability with other cleaning equipment, and seamless integration with scheduling and reporting platforms to streamline operations and facilitate data-driven decision-making.

By addressing these objectives, UV sanitization robots aim to provide a comprehensive and reliable solution for disinfection, contributing to improved cleanliness, hygiene, and public health across various sectors.

III. Proposed Work

3.1 Block Diagram

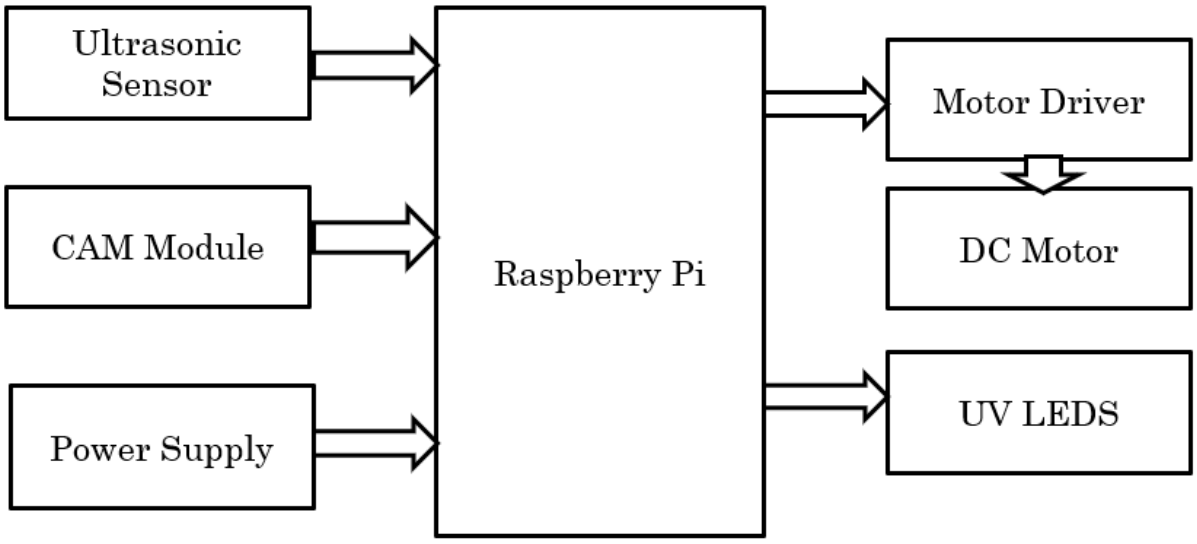

Fig 1 Block Diagram of Proposed System

In this chapter the block diagram of the project and design aspect of independent modules are considered. Arrange all equipment on the chassis (UV LED, Raspberry Pi, Web camera, Motor Driver) but then place your Ultraviolet rays on bottom of the machine. So, we can sanitize the floor surface. Place the Webcam on ahead of robotic so that the video can see easily. Later, utilizing VNC, access its window on either a faraway Computer, and execute your Interface. The Web cam will capture live data with regards to its surroundings and then send it to a particular IP address through internet. The user will be observing this live streaming on the PC and according to that the user will control the robot.

3.2 Hardware Specifications

3.2.1 Raspberry Pi 3

Serves as the central control unit, managing sensor data processing, navigation algorithms, and UV light activation. The UV sanitizing robot is an autonomous mobile platform designed for effectively sanitizing indoor environments while ensuring safety and efficiency. The system integrates various hardware components, software algorithms, and IoT connectivity to achieve its objectives. Below is a detailed description of the key elements of the system:

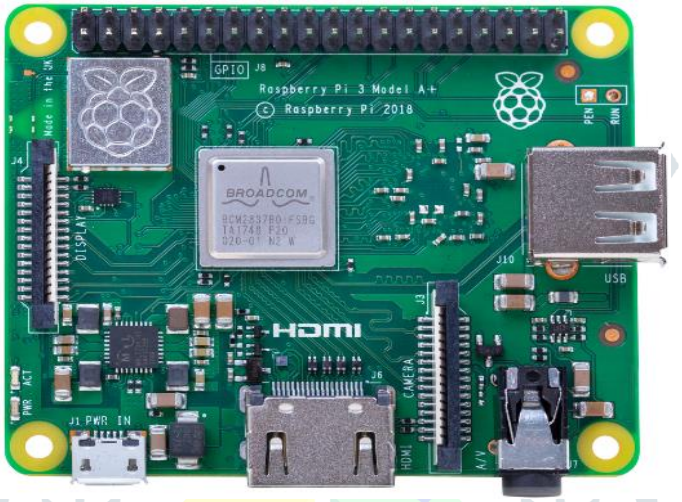

Fig.2 Raspberry pi 3

Raspberry Pi is a series of SBCs (Single Board Computer) founded by the Raspberry Pi Foundation in 2008. It aimed initially at teaching coding to children. Hence, we developed a solution with a low-cost, credit-card sized computer to inspire children and make it more accessible. It is a computer that plugs into a computer monitor or TV and uses a standard keyboard and mouse. Learning programming languages like Scratch and Python is beneficial. It can do everything and anything similar to a desktop computer or laptop, right from browsing the internet, playing high-definition videos, making word-processing, spreadsheets, and playing games. It can communicate with the outside world and has been helpful in a broad array of digital projects, right from parent detectors and music machines to weather-tweeting birdhouses and stations with infrared cameras. So, as a whole, Rpi is to learn to do home automation, programming skills, build hardware projects, and even use them in industrial applications.

3.2.2 Webcam

A webcam is a video camera which is designed to record or stream to a computer or computer network. They are primarily used in video telephony, live streaming and social media, and security. Webcams can be built-in computer hardware or peripheral devices, and are commonly connected to a device using USB or wireless protocols.

Fig.3 Webcam

The webcam is responsible for capturing images of the robot's surroundings, which are then processed to detect obstacles and plan navigation paths. It provides real-time visual feedback to the robot's control system, allowing it to make informed decisions about its movements and avoid collisions.

3.2.3 UV LED's

UV LEDs are effective against eliminating harmful bacteria, fungi, and viruses such as COVID-19. They can be used in water purification systems, air purifiers, and surface sterilization devices to kill bacteria, viruses, and other microorganisms by damaging their DNA.

The UV light source serves as the primary mechanism for sanitizing the environment traversed by the robot. UV-C light, in particular, is known for its germicidal properties and is effective at destroying the DNA and RNA of microorganisms, rendering them unable to replicate and causing their eventual death.

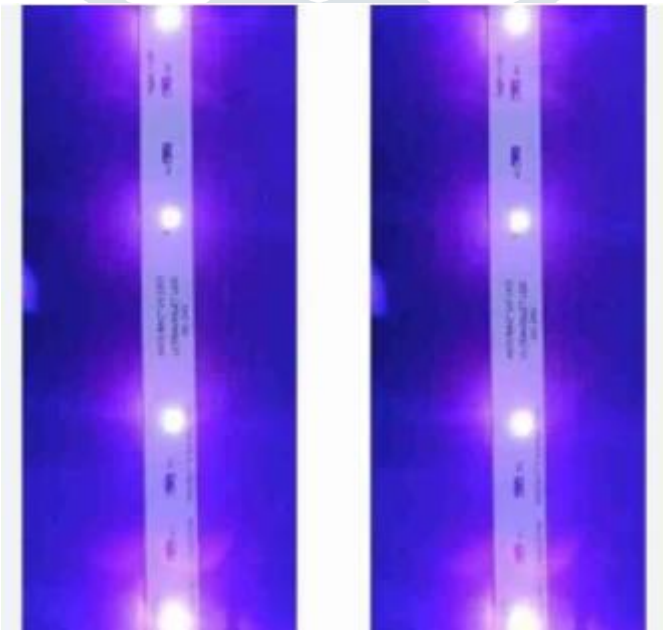

Fig.4 UV LED's

3.2.5 L293D Motor driver

We use motor drivers to give high power to the motor by using a small voltage signal from a microcontroller or a control system. If the microprocessor transmits a HIGH input to the motor driver, The driver will rotate the motor in one direction keeping the one pin as HIGH and one pin as LOW.

By positioning a drive between the electrical supply and the motor, power is fed into the drive, and the drive then controls and regulates the power that is fed into the motor. This allows control of speed, direction, acceleration, deceleration, torque and, in some applications, position of the motor shaft.

These precision drives are frequently used to control 2-quadrant operation of motors in machine tools, industrial robots etc.

Fig.5 L293D Motor driver

3.2.6 Ultrasonic sensor

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves.

An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect across boundaries to produce distinct echo patterns. Provides distance measurements to detect obstacles and enable navigation.

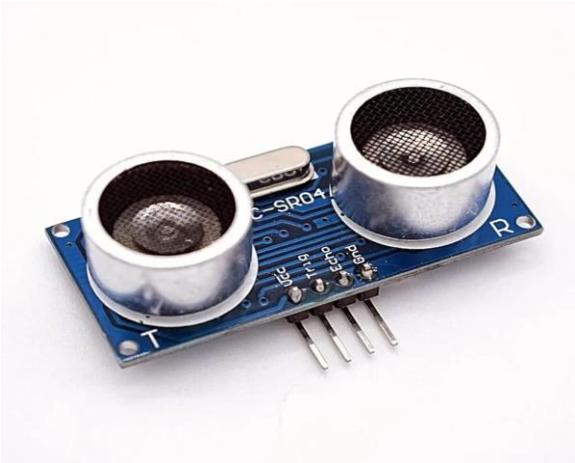

Fig.6 Ultrasonic sensor

3.2.7 Gas sensor

Gas sensors are designed to measure the concentration of gases in the environment. MQ2 gas sensor is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke or Propane.

MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide.MQ2 gas sensor is also known as chemiresistor. It contains a sensing material whose resistance changes when it comes in contact with the gas. This change in the value of resistance is used for the detection of gas.

Fig.7 Gas sensor

3.3 Software Specifications

3.3.1 ThingSpeak API:

The ThingSpeak API is a powerful tool for integrating Internet of Things (IoT) devices and applications with the ThingSpeak platform. ThingSpeak is an IoT analytics platform that allows users to collect, analyze, and visualize data from sensors or other devices in real-time. The API enables developers to interact with ThingSpeak programmatically, facilitating tasks such as data logging, retrieval, visualization, and control. In the context of the UV sanitizing robot project, the ThingSpeak API can be used to:

1) Send Sensor Data:
   The UV sanitizing robot can transmit sensor data, such as obstacle detection events, gas levels, UV light activation status, and other relevant parameters, to ThingSpeak channels using HTTP or MQTT protocols. This allows operators to monitor the robot's performance and environmental conditions in real-time.
2) Retrieve Data:
   Operators can retrieve historical sensor data from ThingSpeak channels for analysis and visualization. The API provides endpoints for querying data within specified time ranges, enabling trend analysis, anomaly detection, and performance evaluation of the UV sanitizing robot over time.
3) Visualize Data:
   ThingSpeak offers built-in visualization tools for creating custom charts, graphs, and gauges to display sensor data in real-time. The API allows developers to programmatically create and update visualizations based on incoming sensor data, providing operators with actionable insights into the UV sanitizing robot's operation.
4) Control Devices:
   In addition to data logging and visualization, the ThingSpeak API can be used to control devices or trigger actions based on predefined conditions. Operators can send commands or instructions to the UV sanitizing robot via ThingSpeak channels, allowing for remote operation and management of the robot's functions.

5) Integrate with External Systems:
   The ThingSpeak API enables integration with external systems, such as web applications, databases, and other IoT platforms. This allows for seamless data exchange and interoperability between the UV sanitizing robot and other components of the IoT ecosystem.

Overall, the ThingSpeak API provides a flexible and scalable framework for connecting the UV sanitizing robot to the cloud, enabling real-time data monitoring, analysis, and control. By leveraging the capabilities of the ThingSpeak platform, operators can gain valuable insights into the robot's performance and environmental conditions, ensuring effective sanitization of indoor spaces and enhancing overall safety and efficiency.

Used to establish communication between the UV sanitizing robot and the ThingSpeak platform for real-time data monitoring and analysis.

IV. RESULT DISCUSSION

The below image shows the Hardware implementation of project which includes various components like UV LED's , Ultrasonic sensor ,Webcam, gas sensors are connected to raspberry pi .

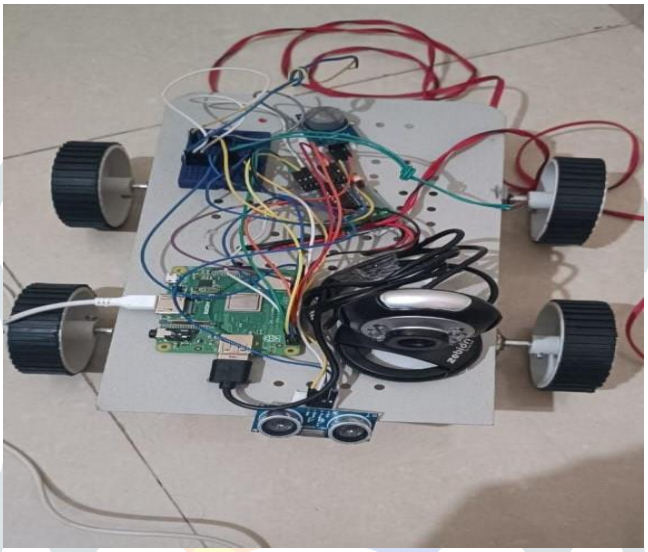

Fig.8 Top view of Hardware Implementation

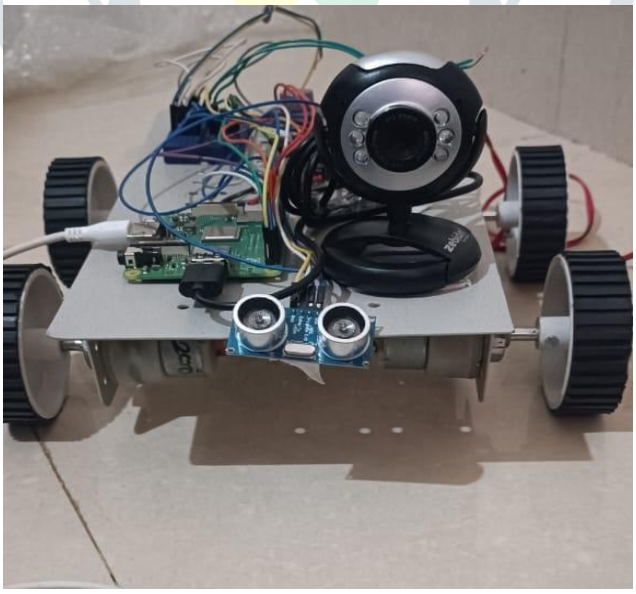

Fig.9 Front view of Hardware Implementation

Below image shows the sensed data from raspberry pi and visualize on ThingSpeak Cloud. This visualized chart includes data of various sensors like Gas , Ultrasonic sensor .

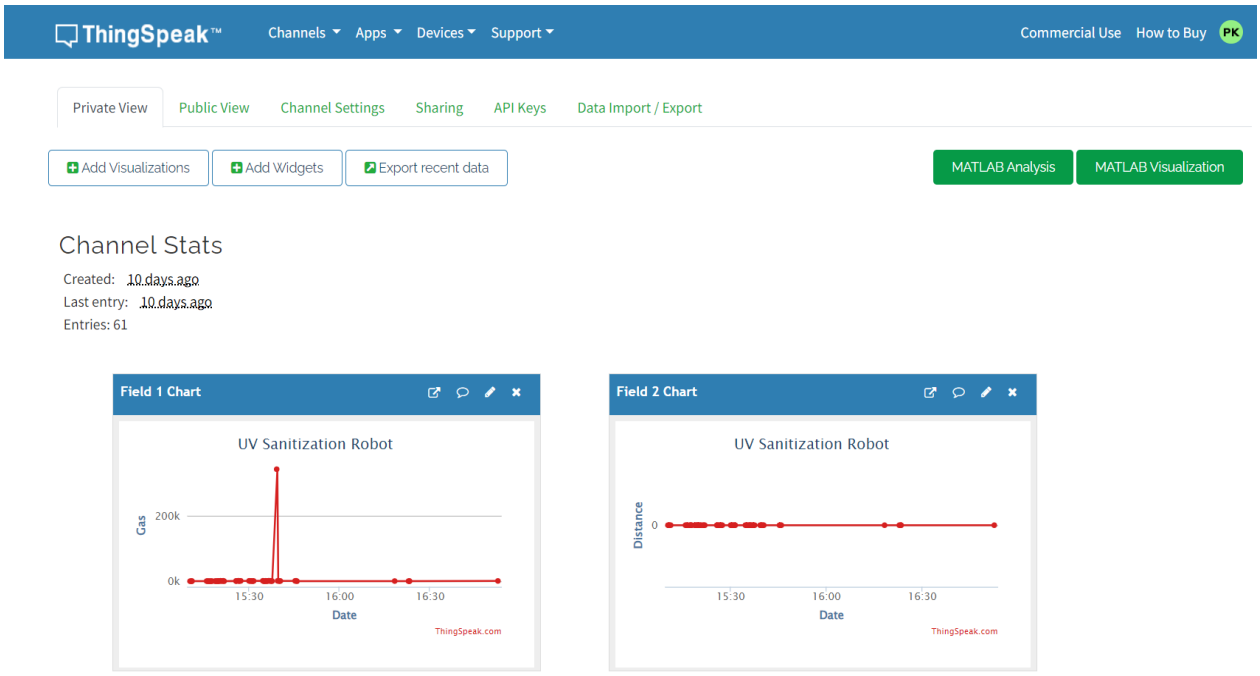

Fig.10 ThingSpeak Cloud Integration with Raspberry Pi

V. CONCLUSION

In conclusion, UV sanitization robots present a cutting-edge solution to the pressing need for effective disinfection in various environments. These robots leverage the power of ultraviolet (UV) light to efficiently deactivate pathogens on surfaces, offering several key benefits.

Firstly, UV sanitization robots demonstrate remarkable efficiency by swiftly disinfecting large areas without the need for manual intervention. This efficiency makes them invaluable assets in environments such as hospitals, schools, airports, and public spaces where maintaining cleanliness is crucial.

Moreover, the effectiveness of UV-C light in neutralizing a wide array of pathogens, including viruses and bacteria, underscores the importance of these robots in preventing the spread of infectious diseases. By providing a thorough and reliable disinfection process, UV sanitization robots contribute significantly to overall hygiene and public health.

Safety is another critical aspect addressed by UV sanitization robots, with many models equipped with features to prevent exposure to harmful UV radiation. These safety measures ensure that users are protected while the robots perform their disinfection tasks.

Furthermore, the automation capabilities of UV sanitization robots streamline cleaning processes, reducing the need for manual labor and minimizing the risk of human error. This automation not only improves efficiency but also ensures consistent and thorough disinfection results.

Despite these benefits, it's essential to acknowledge the limitations and challenges associated with UV sanitization robots, such as their limited reach and maintenance requirements. Additionally, integrating these robots into existing cleaning protocols may require careful planning and coordination.

VI. ACKNOWLEDGMENT

First, we extend our appreciation to our team member whose dedication, hard work and collaborative efforts.We are deeply thankful to our project advisors for their invaluable guidance, support and encouragement throughout the entire duration of project.In conclusion, we extend our heartfelt gratitude to everyone who played a part in this project.

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