2019 Novel Coronavirus Disease (Covid-19): Toward a Novel Design for Smart Waste Management Robot

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***Abstract*—With the rise and spread of 2019 novel coronavirus (2019-nCoV), also called severe acute respiratory syndrome coronavirus 2, there is a global health emergency (SARS-CoV-2). Because of the epidemic of new coronavirus disease-2019, clinics and institutions' isolation facilities have generated a massive amount of clinical waste (COVID-19). The biggest contributors to waste volume are personal protective equipment, test strips, medical facemasks, and hand gloves. As garbage functions as a carrier for SARS-CoV-2, it could result in the exponential spread of this devastating disease. Furthermore, proper COVID-waste disposal is urgently required to reduce the risk of pandemic propagation and to ensure long-term treatment of the disease environmental threats. In order to combat the lack of specialized antiviral therapy, it is critical to create new balance techniques and guarantee that existing ones are effective in the field. The objective of this study is to design and develop an intelligent Robot that can collect medical waste from COVID-19 isolation wards and then dispose it of in an environment friendly manner. Furthermore, the focus of this research is to use IoT-based robot technology to design sprinkling with UV devices for antiseptic-disinfection. This study may be useful to avoid and control the pandemic of compatible episodes in the future.**

Keywords—Covid-19, Coronavirus, disinfecting robot, Biomedical waste (BMW), IoT Technology.

I. Introduction

At the end of 2019, a new coronavirus named currently SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) was identified in Wuhan, China. Previously, it was known by Cov-19. At the present, it forms a pandemic. It is a disease caused by a new type of coronavirus family [1-3]. The outbreak is believed to have started from the Wuhan city of China [4]. The virus infection is positive-sense RNA where its diameter ranges from 60-140 nanometre. Its shape is a spike projection where it was revealed under the microscope with a crown appearance and therefore it got this name [5]. Examinations have illustrated bigger viral loads inside the nasal when differentiated with the throat with no refinement in viral weight among symptomatic and asymptomatic people [6]. Patients can be irresistible for an anything time period that the indications keep going and indeed on clinical recovery. The transmission of the contamination was viewed as diffused through human-to-human which creates it viably diffused. The transmissions begin from the patient droplets during the process of coughing or sneezing. These droplets can outlive on the surface indeed in the air and transmit the contamination to humans. previously published works revealed tirelessness of the disease on different surfaces and also air where infection can remain until 3 hours in airborne, 24 hrs on cardboard, 4 hours on copper, and as long as 3 days on the stainless steel and plastic [7-8]. The examination proposes to treat contamination utilizing specialists of biocidal, for case, hydrogen peroxide, sodium hypochlorite, alcohols, or benzalkonium chloride [9-10]. While the world continues to fight the coronavirus epidemic, many technologies are developing new ways to attack the virus. IoT-based medicinal services are deemed cutting-edge from a medical standpoint, as they aid in the direction and management of clinical data. Telehealth, wearable sensors, clinical equipment, healthcare information framework, big data analytics, cloud services, and other top-tier IoT strategies are currently being used in clinical settings [11-14]. Robotics has evolved as among the most rapidly growing engineering fields in the modern invention, and it is now widely used in the industrial sector to perform a wide range of tasks, including the machine and component stacking and emptying, painting, and spot welding. Individuals are likely to be discarded by robots especially those working in dangerous places. Further, robots may be used in remote zones that are blocked off to the people [18]. Robotic devices primarily use mobile and aerial systems in delivery and supply production operations in the logistics and service sector. The aerial robots, on the other hand, maybe unsuitable for use in hospitals. Devices based on manipulators and hybrid systems (e.g mobile base and manipulators) can, on the other hand, be used in this field, emphasizing the same duties and assisting with patient management. Self-driving has also proven to be crucial in the combat against the global epidemic, reducing the burden of coronavirus by transporting clinical supplies and food to healthcare practitioners and patients in infected areas, as well as sanitizing clinics and public surfaces to prevent the virus from spreading [19-20]. Healthcare institutions are critical in the fight against pandemics. In such cases, robotic technologies are critical because they imitate human operations in dangerous contexts, reducing personal interactions [21]. Because of the dramatic increase, most countries have indeed deployed various robots to aid human personnel. The developed countries have been able to rapidly deploy a range of robots that can sterilize, transport medications, and measure vital signs, among other things. Additionally, the COVID-19 accident demonstrates that commonplace robots can function alongside frontline healthcare staff in the event of a life-threatening scenario [22]. The seeping odor, infectious and hazardous wastes become an even bigger menace to humans when the containment dustbin is kept unemptied for hours or Medicare wastes are left untreated. If 10% of hospital staff come into contact with this hazardous material on a regular basis, 75–80% of them will become infected with the virus. In each ward, a greater proportion of patients are segregated, and up to 50% of people may become infected. As a result, in order to eliminate this illness, safety metrics and measures should be implemented to lower the risk. To limit the harm and societal impact, these infectious wastes must be disposed of in a more organized and trouble-free manner [22]. In order to combat the lack of specialized antiviral therapy, it is critical to create new balance techniques and guarantee that existing ones are effective in the field. The objective of this study is to design and develop a smart Robot that can collect medical waste and dispose of it in the COVID-19 isolation wards. Furthermore, the current study aims to use IoT-based robot innovation to design spraying with UV systems for antiseptic- disinfection.

II. METHODOLOGY

This study aims to design and develop a smart robot to fight the COVID-19 that janitors may be infected with it due to dealing with waste disposal. The task of the proposed robot is to offer support to authorities so as to increase the collection efficiency of medical wastes (e.g. gloves, face masks, and other disposables) to disposal in isolated wards of COVID-19. The robot is enabled to pick up as well as place trash, climb the obstacles or walk on waved surfaces by arm and rocker boogie moving mechanism respectively. The designed robot is provided with servo motors to actuate electrical signals for robot arm motion and DC motors for locomotion of robot wheels. It is supplied also with a designed rocker boogie mechanism and hard chassis as mechanical parts. Furthermore, it is equipped with a vision system and sprinkler to sterilize the gripper after accomplishing the disinfection process. Therefore, it is easy to use a robot and user-friendly that the user just needs to utilize the installed mobile app in his cell phone to control the whole movement of the robot. The disinfection process with the proposed robot is an integrated ultrasonic Fog and UV disinfection to sterilize the working zone automatically by using new industrial technology of combined positioning and navigation. The disinfection process of the premise is done daily by ultrasonic fog and nightly by UV light. It is designed particularly to disinfect large areas like clinics, malls, stadiums, theatres, Etc. It is also provided with an elevator control system to enable automatic navigation to any floor. There is another feature involved that the robot can go back automatically to the central station for charging in case of a low battery. The assembled proposed design is depicted in Figure 1. Every kind of microorganism needs various dosages of ultra-violent light for functional inactivity. In the case of COVID-19, using UV-light is considered here for inactivity mission.

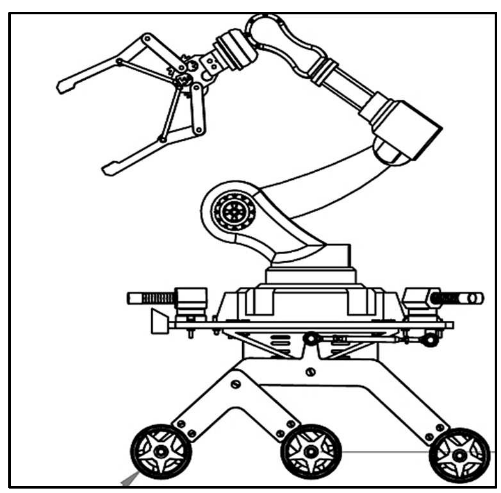

Figure 1. Initial design of the smart robot.

III. Result and Discussion

Taking into account the high rate COVID-19 outbreak hazard, the advancement and deployment of robots for disposal of medical waste and clinical environment cleansing and purification have expanded of late. In arrange to approve the plausibility of the displayed design; simulations ought to be performed on the robot. This would moreover enable us to examine the immovable quality of the control techniques that were inspected already. A robot essential model shows that it was set up in Proteus computer program. The track circuit simulation of the robot is viably performed as shown up in Figure 2.

It consists of Arduino Uno control supply, servo motor, and ultrasonic module. The echo and trigger pins of the ultrasonic sensor are joined to D7 & 8 digital pin. The power supply pin is attached to +5V supply while GND pin is inserted into the ground pin of Uno Arduino. Further, the servo motor control pin is Arduino D9 digital pin. Subsequently, the servo motor is utilized to function the disinfector gun and robot arm. At that point, motor 1, 2, 3, 4, 5, 6 is associated with the h bridge, and it's associated with the A0-A3 at the Arduino Uno to function the parts mechanisms.

The sanitizer gun initially operates as a result of sensing by the servo motor. The controller screens the feedback from the ultrasonic module. When an obstacle is detected by the ultrasonic module, the controller examines whether the predetermined distance set by the smart robot is exceeded. Once that happens, a signal is fired by the controller to the motor to start moving. So as to activate and de-activate the smart Combat Covid-19 robot at whatever needed, an ON/OFF button is provided.

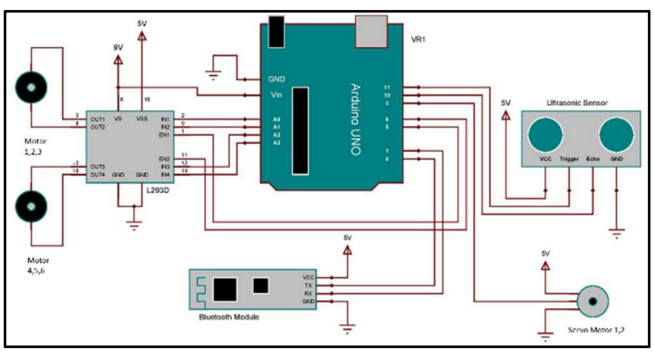

Figure 2. Smart robot circuit diagram.

Around the world, the usage of portable robots for cleaning and disinfecting objects is fast rising. In the case of infectious diseases like COVID-19 [21], cleaning and cleanliness are essential for safe indoor/outdoor circumstances. Majorly source contacts, such as doorknobs and lifts, are the most common ways for viruses to spread through direct contact. As a result, an automated sterilizing process provides not only safety but also efficiency. This group suggests using an AI-enabled Human Support Robot (HSR) to automate the cleaning procedure [22].

The robotic operating system creates the control between spraying and cleaning. The control module uses the information gathered by the discovery module to construct an assignment/operational area for the robot, as well as determine the best circumstances in which to operate the controllers [23]. One example of a disinfection robot is the UVD-bot. It's a self-moved germicidal robot that employs UV light to kill germs (UVC-254 nm). This robot's UVC light is efficient against the coronavirus because it breaks DNA base pairing, leaving the virus harmless. The end result, which can disinfect a room in 10 minutes, is completely self-contained and incredibly effective in disinfection. The robot is typically employed to sanitize hospital facilities, preventing individuals from coming into close touch with infected areas [24]. Furthermore, its functional merits include its ease of use, which allows anyone without technically advanced expertise to run it. The Android platform was used to construct the monitoring application, which can be loaded on Android devices such as phones and tablets. Figure 3 depicts the final draft for a smart robot in various perspectives, whereas Figure 3 displays the finished Robot Design in its entirety. It is easy to claim that the design was successful based on the entire process of designing all of the robot's features and design. This robot can be made in real life, even if it isn't flawless. With regard to the goal, a strong conceptual robot was created. There are many other aspects or characteristics of the general design that could be enhanced. Even if there are still a lot of things that could be done better, it's excellent enough to gratify having a disinfection robot design.

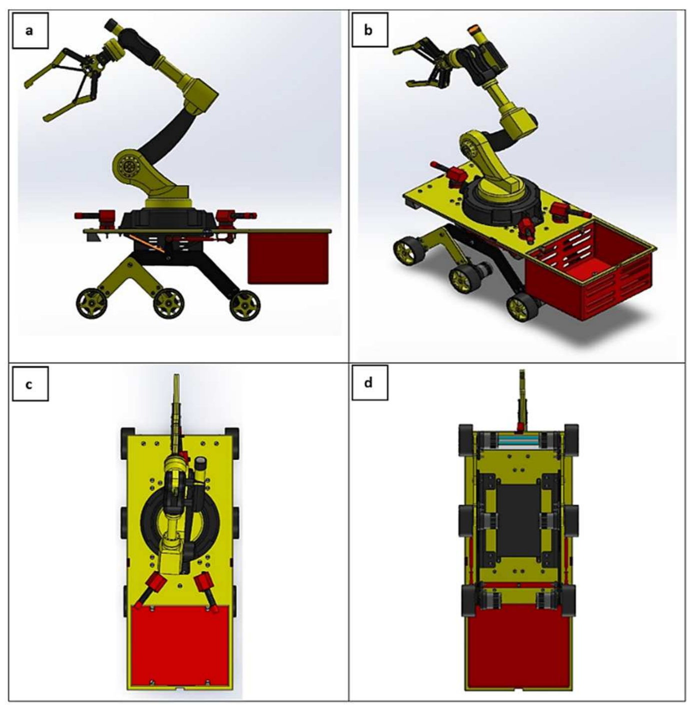

Figure 3. Final Design for smart robot a: Front view, b: Isometric view, c: Top view, d: Bottom view.

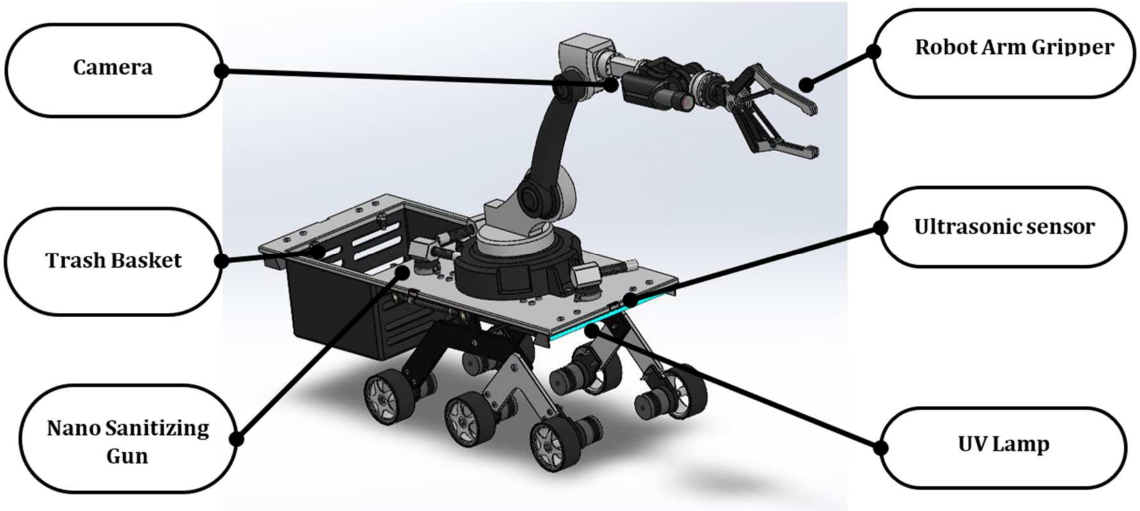

Figure 4. Smart waste management robot.

The possibility of SARS-CoV-2 spreading by COVID waste fomites cannot be ruled out. In reality, the new coronavirus may survive beyond its host organism for long periods of time, such as 72 hours on the surface of a surgical mask. As a result, if COVID-waste is managed improperly, it may spread across the community. Chemical disinfection that used a 1% NaOCl solution is among the better in-situ techniques that is very straightforward to sprinkle and is not only useful for COVID-waste but also for sanitizing bigger spaces, shopping centers, hospital facilities, and isolation clinics. Microwave disinfectant is effective for sanitizing recyclable and reusable PPE and cloths, and burning is useful for dealing with a higher volume of COVID waste that is energy consuming operation but effective as a result of high processing temperature which is in the range 800–1200 °C.

IV. CONCLUSION

Nowadays, with the increase and spread of 2019 novel coronavirus, the development and deployment of robots for disinfection and decontamination of healthcare environments have gone up dramatically. In order to combat the lack of specialized antiviral therapy, it is critical to create new balance techniques and guarantee that existing ones are effective in the field. A smart Robot was proposed in this study for gathering medical waste for disposal in the COVID-19 isolation wards. In addition, using IoT-based robot innovation, the objective of this study was to design sprinkling with UV solutions for antiseptic- sanitizing. This study develops a smart robot to better treatment of this critical condition. The primary goal of this study is to reduce human resources, enhance waste disposal, and recycle waste. Moreover, the use of no-touch automated disinfection (NTD) robot aims to reduce infection risk by eliminating human error, enhancing cleaning effectiveness, and shortening disinfection timeframes. As robots become more smart and responsive and make deeper inroads into medical processing, an entirely new world of technology is available. The rising number of COVID-19 cases has created a significant need for robots, particularly in the clinical sector. SARS-CoV-2 spreads mostly through close human contact and infected surfaces, necessitating on-going surveillance and keeping social distancing.

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