



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 5, May 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

Design of A Medical Prototype Robot for Covid-19 Patients Using Arduino

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ABSTRACT: Robotics in the medical field is an ongoing trend in both research and commercial sectors. Robots are used in every hospital department for assistance in delivering things, surgery, checking vital signs, tele presence, etc. Medical prototype robot is a scenario-based assistive robot with a customized design to help the hospital staff fight against Covid-19 (Corona virus disease) outbreak, ensuring social distancing. It has basic features like delivering medicine and small handheld devices, remote temperature sensing using IR (infrared) and UVC (ultraviolet type C) disinfection unit. The main aim of this prototype is to make the nurse not to handle the devices which was handled by the patients in which we can convey the information through an audio system (which is already available in the hospital) or a nurse will be assisting the initial instructions required (by ensuring the social distance) that is in the isolated ward so that the patient can do the task properly. For this prototype, we are using the basic microcontroller, that is, Arduino UNO. We were successful in taking readings with the help of a temperature sensor and were able to supply power to the UVC lamp in which it sterilized the objects inside the unit when it was exposed for 2-3 minutes. And finally, the robot was able to move successfully with the help of Arduino and Bluetooth setup.

KEYWORDS- Robotics, Covid-19, telepresence, Arduino , Bluetooth, IR, UVC.

I. INTRODUCTION

Medical prototype robot is an assistive robot; the need for this robot is to reduce the hospital staff workload such as doctors, nurses, cleaning staff and other services [1]. The services include delivering hospital documents to various departments, food and medicine to patients, blood samples to the laboratory and even checking the vital signs of patients. This is a scenario-based robot specially designed for the Covid-19 (Corona virus disease) pandemic as it ensures non-contact support and assistance to patients to avoid the spread of the virus. Viruses such as COVID-19 become a threat to humankind's health globally The wheels attached enables mobility and the UV-C (ultraviolet type C) sterilization unit ensures the disinfection of probes and small hand-handled device. Additional vital sign measurements include temperature sensing, which follows a non-contact infrared temperature sensor for body temperature measurement preferred in most hospitals [3]. Even though temperature measurement is the oldest method to diagnose, but it still plays a vital role as an indicator for diagnosing disease Several studies in recent years have investigated robots' social acceptance in various close contact situations with humans. For instance, the deployment of robots in the healthcare workflow across the continuum of care goes from prevention, screening, and diagnosis to treatment and home care [5]. The Psychosocial Aspects in Robotics (PAIR) Lab aims to study psychological and social factors relevant to robots' application, such as the views of stakeholders across the globe.

II. OBJECTIVE

This pilot study investigates the perceived ease of use and perceived usefulness (acceptability) of a customized service robot as determined by nursing students (as proxies for nursing staff in health care environments). This service robot, referred to as the Adaptive Robotic Nurse Assistant (ARNA), was developed to enhance the productivity of nurses through cooperation during physical tasks (eg, patient walking, item fetching, object delivery) as well as

nonphysical tasks (eg, patient observation and feedback). This pilot study evaluated the acceptability of ARNA to provide ambulatory assistance to patients.

III. LITERATURE SURVEY

We designed this medical prototype robot based on the hospital's challenges in this pandemic situation of Covid-19. One of the most critical areas is really challenging inside the quarantine buildings or houses and isolation wards in hospitals [7]. As you can see from the Fig. 1, when we give inputs from the controlling device, our medical robot moves towards the patient and guides the patient accordingly. For instance, if we want to get the patient's temperature reading, the robot will go near and get the readings without any direct contact with the patient helping the doctors treat the patient accordingly. In this medical prototype robot, we also incorporated a UVC sterilization unit to sterilize small disposables or handheld devices. UVC light is widely used in healthcare facilities for disinfecting healthcare equipment, probes, surfaces, and operating rooms [8]. The ultraviolet light of wavelength 280 nm (nanometer) damages the DNA (deoxyribonucleic) and RNA (ribonucleic acid) of the virus and prevents them from multiplying further robot.

IV. MATERIALS AND METHODOLOGY

The overall connection from Arduino board to the IR temperature sensor, Bluetooth module, motor and battery. It communicates with USART (Universal Synchronous Asynchronous Receiver Transmitter) at a 9600 baud rate. Using this Bluetooth, we can move the robot even without using Bluetooth beacons for way finding [10]. Bluetooth can be used only within some distance since the range for communication is of short-range. The Arduino is used for debugging the code into the board for the mobility of the robot. It is also used to interface with the temperature sensor, where the code for the temperature measurement is debugged into the Arduino to measure the temperature based on the object as well as the ambient temperature. The sensor is powered from the Arduino, which is 3 volts, but since it has a regulator, it can be used with 5 volts, which will get regulated to 3 volts. The UVC is mainly used for disinfecting the probe to prevent contamination. UVC can be harmful when a person is exposed to it [12]. Therefore, the nurse has to carefully check that the patient keeps the probe inside the robot for the disinfection process.

V. APPLICATION

Food transport and supply support. cleaning or disinfection tasks. storage and distribution of medicines. surgical assistance. Administrative and logistical tasks that are routine and burden the health care workers. tele-assistance.

VI. FUTURE SCOPE

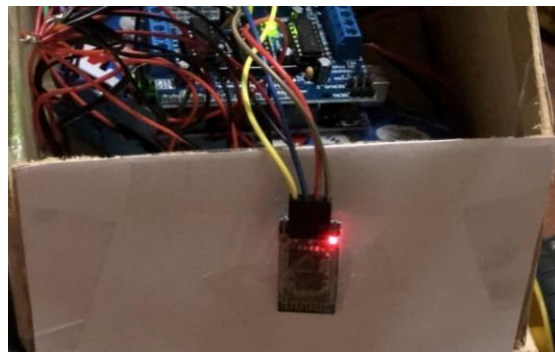
With new applications and features, healthcare robots are expected to increase the quality, operational efficiencies, accuracy, and safety in healthcare service delivery. The advancement in AI will provide a new dimension to robotics. As expected the combination of Artificial intelligence and robotics will make the operation faster and much safer. Apart from this, data analytics, improvement in hardware and software systems will diversify robots' scope in other healthcare fields. The investment and the collaboration between the robotic companies and healthcare providers will further boost the Healthcare robots market. However, the robots' cost and the affordability by the common person will remain the key challenges to address.

VII. RESULT

Represents the sensor temperature readings taken from the forehead of the subject (sub) in which the sensor reading varies according to the distance between the sensor and the subject. At the same time, the clinical thermometer is measured from the underarm. Compared with the clinical thermometer, the sensor reading shows an error value of ± 3 degrees Celsius. The UVC light is germicidal and could sterilize with an exposure time of 2 minutes. We know that the dose relates to the irradiance.



The Arduino based robot was able to move around successfully with the help of controlling devices (for example, phone, tab and laptop) wirelessly through the Bluetooth module. Fig. 7 shows the pin connections with the Bluetooth module of the remote control robot. Fig. 8 shows the front panel of the mobile app for controlling the robot. shows prototype setup of the final remote control robot.



VIII. CONCLUSION

This is a low-cost medical prototype robot that is designed using readily available components from the Indian market. This robot can help the nurse in this pandemic situation by gathering the temperature information (which is a vital signal used for screening the Covid-19 patients) and sterilizing small handheld devices to prevent the virus from spreading. In the future, more vital signs can be integrated with this system, such as SpO₂; its probe can be easily sterilized using our inbuilt feature.

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Impact Factor: 8.423



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