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SANITIZATION ROBOT

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Abstract - This project describes the evolving role of robotics in healthcare and allied areas with special concerns relating to the management and control of the spread of the novel coronavirus disease 2019 (COVID-19). The prime utilization of such robots is to minimize person-to-person contact and to ensure cleaning, sterilization and support in hospitals and similar facilities such as quarantine. This will result in minimizing the life threat to medical staffs and doctors taking an active role in the management of theCOVID-19 pandemic. The intention of the present research is to highlight the importance of medical robotics in general and then to connect its utilization with the perspective of COVID-19 management so that the hospital management can direct themselves to maximize the use of medical robots for various medical procedures. This is despite the popularity of telemedicine, which is also effective in similar situations. In essence, the recent achievement of the Korean and Chinese health sectors in obtaining active control of the COVID-19 pandemic was not possible without the use of state of the art medical technology

Key Words: Coronavirus, Sensors, Contactless, Design Concept, Navigation Process

1. INTRODUCTION

In the amidst of this global pandemic, stepping in where humans should not, robots are being used for jobs such as sanitizing hospitals and delivering food and medicines, and have proved to be very much useful and handy. Each and every day as health workers, researchers and governments struggle to control the spread of the virus that has infected more than 22,053,135 people globally and claimed more than 777,489 lives [Last updated: August 18, 2020, 07:11 GMT]. robots are also being deployed for administering treatment and providing support to quarantined patients. The World Health Organization has advised physical distancing for people around the world to prevent community level transmission of Covid-19.

Sanitization, which has become a very important aspect in these pandemic times and plays a very crucial role in preventing us from exposure of this deadly virus and thus helping in eradication of this global pandemic is very important. One of the high-risk zones of exposure to this deadly virus is in the area where people rush to for the cure, that are the hospitals and the medical wards. Sanitization in these areas is indeed challenging and requires very high measures to be taken. But in spite of all these high-end measures taken, there is always a risk associated with it.

The objective of this project is minimizing human association as much as possible and thus automating the tasks such as sanitization with the help of robots. In this case, the use of robots can reduce human exposure to pathogens, which has become increasingly important as epidemics escalates. The project uses Autodesk Fusion 360 software for its design and development of the sanitization robot. Arduino integrated development and HC-05 Bluetooth module used for control and programming. The design of the robot has a smile feature that helps in spreading positivity amidst these times.

2. LITERATURE REVIEW

A few research papers related to medical robots have been reviewed and the following references show influence on the design of the smart medical assistant robot. Marcin Zukowski et al [1] have developed a humanoid medical assistant and companion robot dedicated to children hospitals. They have focused on the robot being able to express emotions and communicate with the children by recognizing their faces and using pictures and text on the chest display to tell stories and present educational videos. The 'Bobot' autonomously navigates through hospital rooms and performs simple medical tests like measuring patient's body temperature or heart rate and sends live video feed to the doctors and nurses. The robot is run using ODROID XU and XU4 with Ubuntu 14.04 operating system and has a dedicated Raspberry Pi 2 computer to animate the robot's eyes.

Marcin Zukowski et al [2] presented the implementation of patients' temperature measurement system for the medical robotic assistant. They have experimented with MLX90614 infrared thermometer and FLIR Lepton thermal camera and found out that the MLX90614 infrared thermometer cannot be used as the only input source of the system and to get more accurate results, robot would need to come as close as less than 0.3 metres to a patient's face. To overcome this they created a hybrid system having infrared thermometer

along with thermal camera to provide ambient temperature and approximate skin temperature that can be used to detect presence of humans in front of the robot.

The paper by Himadri Nath Saha [5] et.al, propose a IoT Based alarm system for Garbage Monitoring and Clearance. This system has a level sensor to monitor the garbage level in the bin and when the level is reached, it alerts the municipality officials. An android app is developed for connectivity. The Microcontroller is Arduino Uno and the system takes energy from a solar panel. This deice has RGB Lights to indicate the exact level of the garbage.

The scope of the present study is to design a smart medical assistant robot by exploring various contactless sensor technologies. The robot should be compact for efficient handling and incorporate a quick learning real time environment recognition technology for its locomotion in a crowded hospital.

3. METHODS AND MATERIALS

3.1 Block diagram-

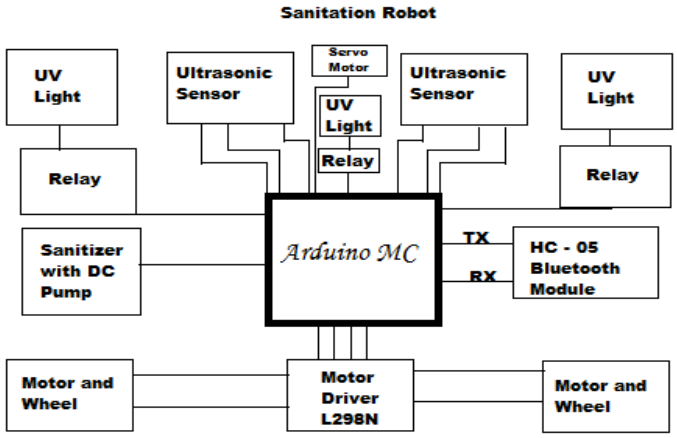


FIG 1. Working system

Components description:

3.1.1. Navigation Part-

Arduino Microcontroller: Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller.

HC – 05 Bluetooth Module: The Bluetooth technology manages the communication channel of the wireless part. The Bluetooth module can receive and transmits the data from a host system with the help of the host controller interface (HCI). It provides a range of up to 10m at a transmit power of 1 m watt. The range can be extended to 100m if the transmit power is increased to 100 m watt. A Bluetooth module is a short range device of around 10 meters which provides both sound and data transmission.

HC-SR04 Ultrasonic (US) sensor: It is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the transmitter and Receiver. The transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the receiver module.

Motor Driver: It is an integrated circuit chip used as a motor controlling device in autonomous robots and embedded circuits. A motor driver is undoubtedly something that makes the motor move as per the given instructions or the inputs (high and low). It listens to the low voltage from the controller/processor and control an actual motor which needs high input voltage.

DC Motor: DC motors are used for the movement of the robot where it is connected with the motor driver, whenever the trigger signal is given to the motor driver then the motor moves according the trigger with the given speed.

Servo Motor: A servo motor is a rotary actuator or a motor that allows for a precise control in terms of the angular position, acceleration, and velocity. In order to control the turning of the robot, servo is used in the design.

3.1.2. Sanitization Part-

DC Pump Motor: DC powered pumps use direct current from motor, battery, or solar power to move fluid in a variety of ways. Motorized pumps typically operate on 6, 12, 24, or 32 volts of DC power. Solar-powered DC pumps use photovoltaic (PV) panels with solar cells that produce direct current when exposed to sunlight. Here, DC pump is used to pump out the sanitizer liquid and spray it through the nozzle in a controlled manner.

Relays: Relays are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. Here, Relay is used to switch the UV lights with separate power.

UV Light: UV light connected to separate power supply via relay and switched on by electronic trigger generated from Arduino. Here UVC lights are being used as it is effective for the destroying pathogens and other bacterial, virus present in air and moisture. From relays UVC lights are connected and when trigger from Arduino is given, switch is closed in relay and UVC lights are ON.

3.2. Mechanical Design-

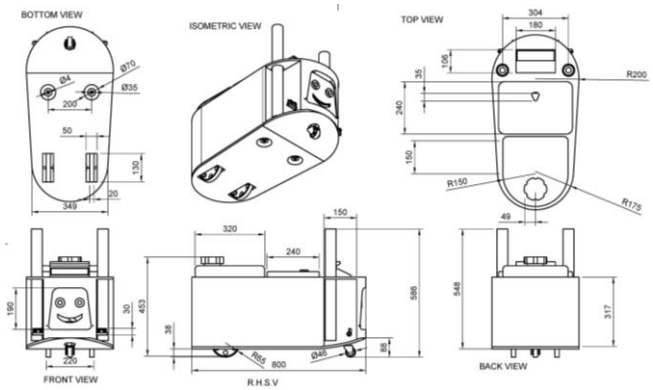


FIG 2. Mechanical Drawing

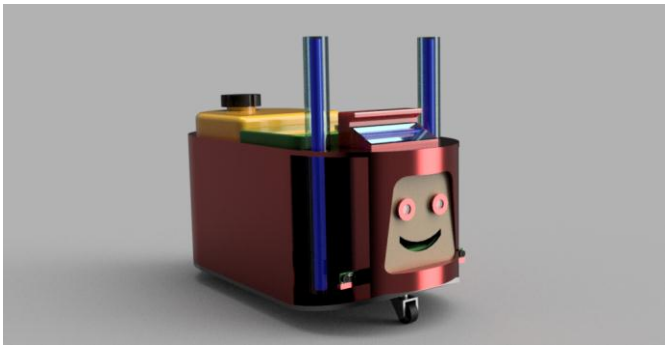


FIG 3. Rendered design of the robot

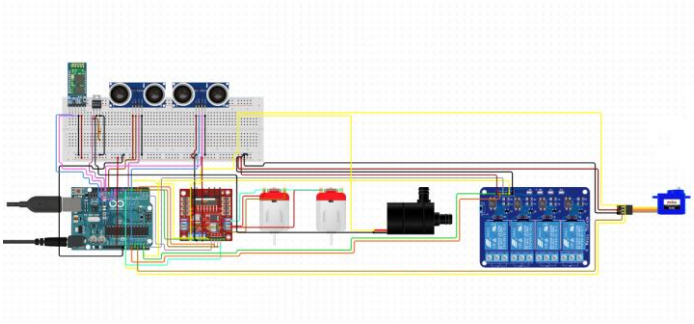
FIG 4. Internal View of the Robot

FIG 5. Internal View from Different angle

3.3 Working Methodology

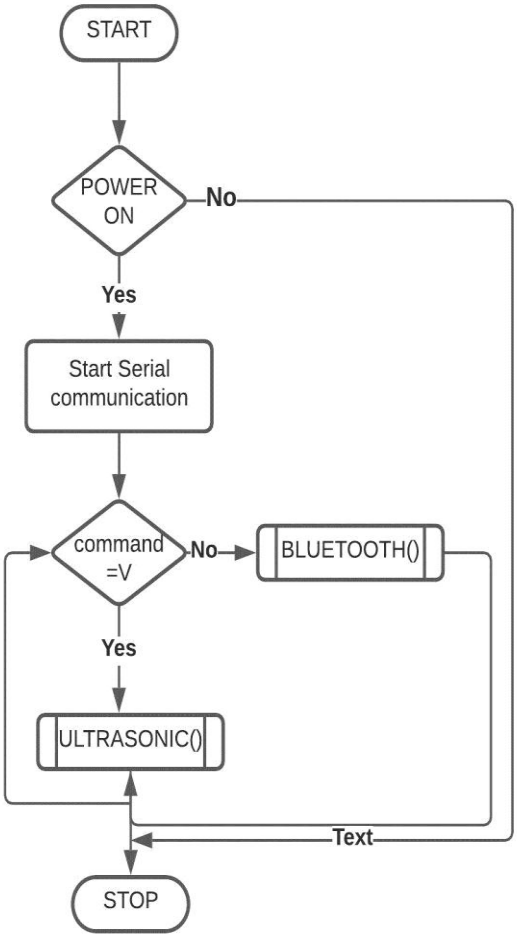
FLOWCHARTS

3.3.1) Schematic Diagram

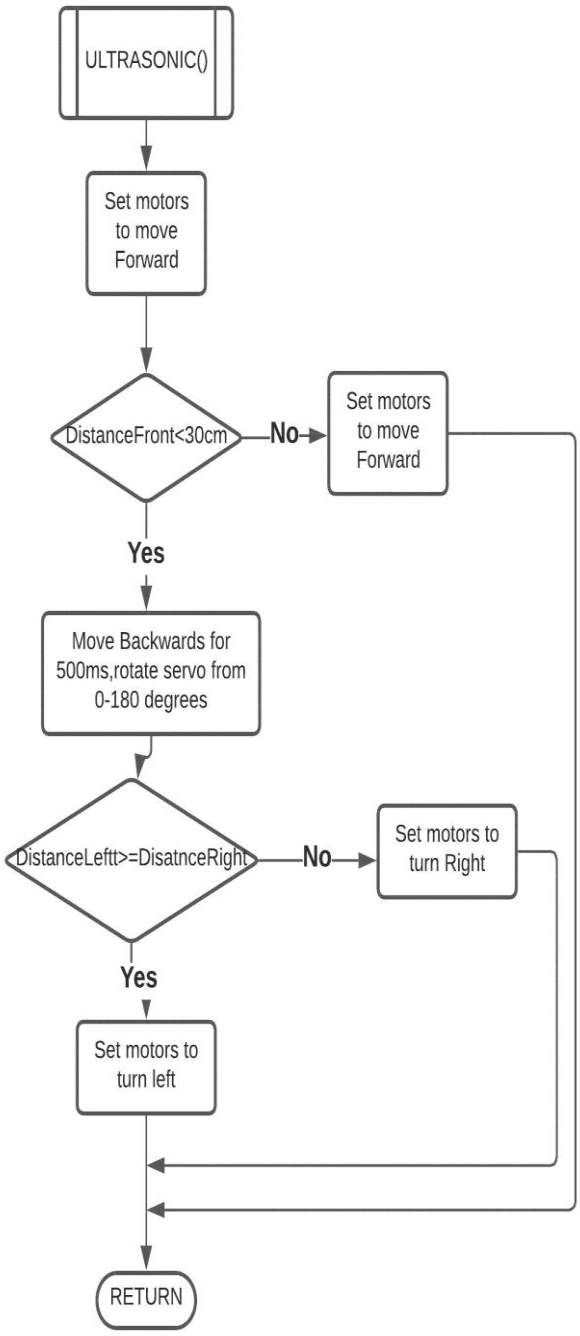


3.3.2) Flow Chart

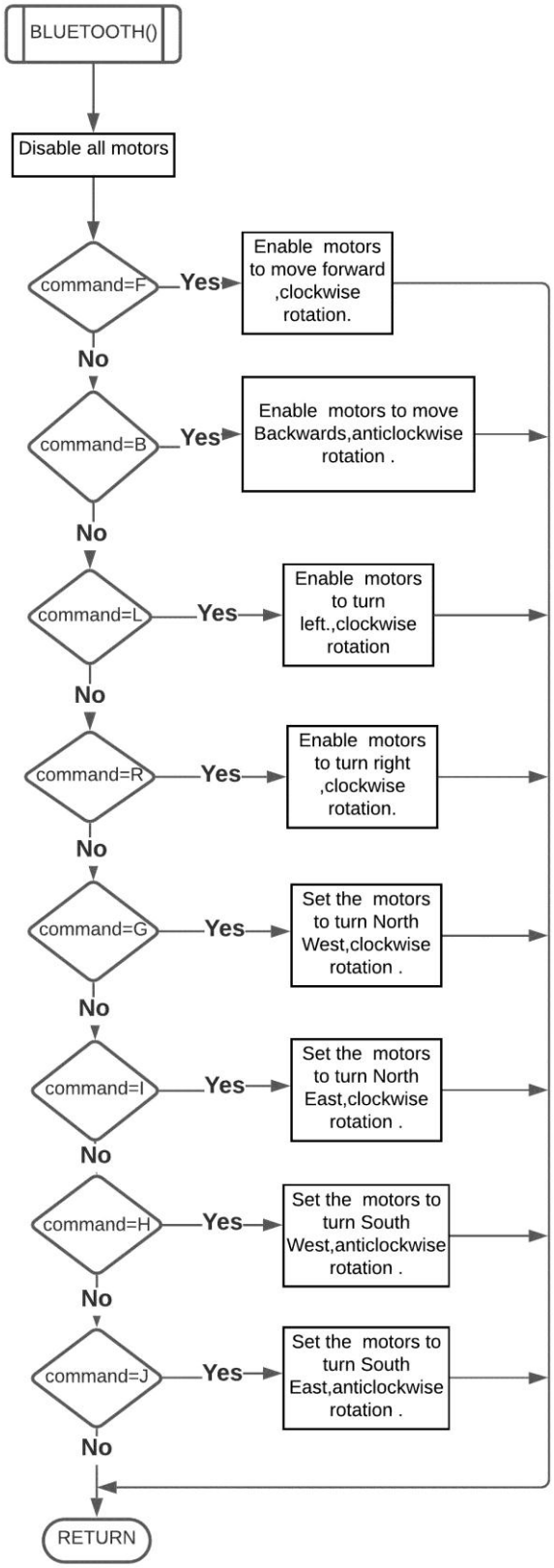
1) MAIN LOOP



2) AUTONOMOUS MODE



3) REMOTE CONTROL MODE



4. CONCLUSION

This study presents a comprehensive overview of the robotics potential in medicine and allied areas with special relation to the control of the COVID-19 pandemic. Effective management of COVID-19 can significantly reduce the number of infected patients and casualties as witnessed in the case of the Chinese outbreak. Since, it has currently turned out to be a global challenge, technologically advanced countries can aid others by donating support equipment and robotic infrastructure to enable a good outcome in controlling this disease. This review substantiates that the introduction of medical robotics has significantly augmented the safety and quality of health management systems compared to manual systems due to healthcare digitization. Classification of medical robots is only done using application-based categories to fit every aspect of hospital service ranging as well as fault tolerant control and dependable architectures for reliable and safe operation within the healthcare facilities.

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