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Contactless Temperature Reader and Sanitiser Dispenser (CTRSD)

Jogendra Kumar, Swati, Trishita, Chaitanya Sagar, Naman Jindal
Department of Information Technology Dr.Akhilesh Das Gupta Institute of Technology and Management, New Delhi(India).
Department of Information Technology Dr.Akhilesh Das Gupta Institute of Technology and Management, New Delhi(India).
Department of Information Technology Dr.Akhilesh Das Gupta Institute of Technology and Management, New Delhi(India).
Department of Information TechnologyDr.Akhilesh Das Gupta Institute of Technology and Management,New Delhi(India).
Department of Information Technology Dr.Akhilesh Das Gupta Institute of Technology and Management, New Delhi(India).

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ABSTRACT: With the increase in SARS-CoV-2 infection and keeping in mind its high spreading rate, it has become necessary to get every individual's temperature checked and accordingly allow them entry. For fulfilling this purpose, all hospitals, malls, shop owners, etc., have employed security guards to check temperature of people manually right at the entry gate and sanitise them thoroughly. As security guards have to come in close proximity of those people to do the checking manually, they have been at high risk of catching the infection.[2][3]

In this study, the design, development and benefits of Contactless Temperature Reader and Sanitiser Dispenser(CTRSD) is presented which provides the security guard with real time data of the temperatures being recorded on his phone. Apart from reading the temperature, this system also has a Sanitiser dispensing
machine and both these subsystems are controlled by same microcontroller. Temperature Reader uses infrared sensor to give accurate readings and gives aural and visual alerts when temperature rises above the set threshold value i.e., critical body temperature of 38 degree centigrades.

CTRSD uses NodeMCU as microcontroller, two IR sensors, an MLX90614 temperature sensor, 3V Buzzer, 6V DC mini submersible pump, and 6V DC input. Pictures and schematic diagrams of the built and tested prototype of the system, and the flowchart on the basis of which the whole system is developed are shown. The Interface, operation and actual working of the system is also described. The final test results shows that CTRSD proves to be efficient and gives satisfactory contribution in monitoring temperature remotely and disinfecting the hands of entrants.

The System is envisioned to be a great precautionary measure and can be deployed in various banks, etc. The contactless feature in both the sub-systems and the real time records reaching to the supervisor remotely at their convenience ensures a healthy and less prone to disease spreading environment.

I. INTRODUCTION

Towards the end of 2019 i.e., last year, World Health Organization declared a public emergency and later a world-wide pandemic due to spread of a highly contagious and potentially deadly Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-Cov-2). World Health Organisation officially named the disease caused by SARS-Cov-2 as COVID-19. It first originated in Wuhan, China and spread like a wave in the whole world within a few months. Keeping aside the health concerns, this virus has hit the global economy quite hard.

According to the ministry of health, 8 million cases have been recorded yet with 130k deaths approximately. Death rate has been around 2%. Even with a very drastic spike in the number of cases, India's effort to fight this virus has been appreciated world-wide. Lockdown was imposed in the nation within a few days of detection of first hundred cases. Apart from it, very strict rules and regulations have been imposed regarding social distancing as recommended by World Health Organisation.[1][2] Some of the basic measures include wearing mask and thorough cleaning of hands either with alcohol based sanitisers or soap and water regularly. All public centres, shops, offices, institutions are advised to check body temperature of each and every individual before allowing their entry as high body temperature is observed as one of the symptoms among the

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infected people. [3]Various methods have been adopted by people to check body temperatures. Traditional methods such as the one using mercury thermometer are good for personal use but it requires being in touch with the individual, thus is not preferable.

To serve the purpose of a contactless temperature reading, Infrared sensors along with IoT can be used which provide quick and accurate readings.The Internet of Things (IoT) concatenates all things to the Internet with the purpose to interchange information in order to achieve smart recognitions, positioning, tracing, monitoring, and administration, using stipulated protocols through information sensing equipment to conduct information exchange and communications.

CTRSD is an IoT based system which used NodeMCU as microcontroller. NodeMCU has ESP8266 WiFi module which is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network.

The system is integrated with Blynk App such that the guard or person in charge can see real time readings of body temperature on his phone. To sense the body temperature by the sensor the hands needs to be 2cm to 5cm away from the sensor . The sensor used in CTRSD is MLX90614 which has a field view of 80 degrees and range of -70°C to 382.2°C. The ideal body temperature of a healthy person lies between 36.5°C to 37°C.[4][6] So the first subsystem also alerts the guard or the person in charge if the person using the machine has a body temperature higher than the usual with a buzzer sound.

Also, the second subsystem, i.e., Sanitiser dispenser makes sure the entrants hands get cleaned properly, in case he touched anything probable of infecting him as this virus is observed to stay alive longer than normal. Thus, avoiding the spread of the disease to a great extent.

II. METHODOLOGY

The development of the Contactless Temperature Reader with Sanitizer Dispenser follows a three-part methodology: formulation of the required design based on sensor behaviour, operational, economic requirements; design of prototype system; software modelling and simulation of prototype; and system test and data collection.

1. System Requirement

The World Health Organisation (WHO) imposed the many rules for this period of pandemic.[1] Like, checking the body temperature of every person entering a public area, offices, metros etc.; sanitizing everyone's hand frequently and also at the entry of any public area. So, this generated a requirement of a sanitizer dispenser with a inbuilt infrared body temperature sensor. The components are selected so that they are easily available and are economically feasible. We also used IR obstruction sensor in-place of generally used ultrasonic sensor because IR obstruction sensor has a better hand detection rate than the ultrasonic sensor. The integration of Blynk App with this project helps to make it more cheaper to built as it doesn't need any display, al the temperature sensor will be showed on the application.

2. Prototype Design

The design of the prototype system is illustrated by way of the CTRSD schematic diagram.

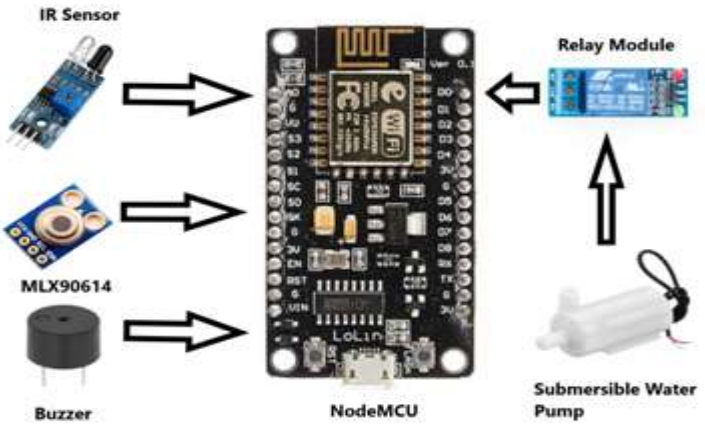

Figure 1: CTRSD Schematic Design

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3. Prototype Software Modelling and Simulation

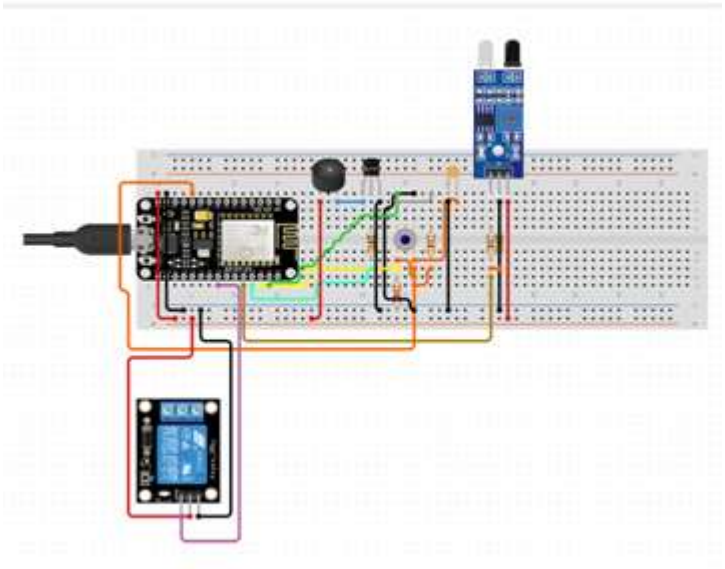

Figure 2: NCTRSD Control System Model

Hardware Model Parts List:

Main Components:

1) NodeMCU : NodeMCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module. As Arduino.cc began developing new MCU boards based on non-AVR processors like the ARM/SAM MCU and used in the Arduino Due, they needed to modify the Arduino IDE so that it would be relatively easy to change the IDE to support alternate toolchains to allow Arduino C/C++ to be compiled for these new processors.
2) Temperature Sensor (MLX90614):The MLX 90614 is an infrared thermometer for non-contact temperature measurements. Both the IR sensitive thermopile detector chip and the signal conditioning ASIC are integrated in the same TO-39 can. Integrated into the MLX90614 are a low noise amplifier, 17-bit ADC and powerful DSP unit thus achieving high accuracy and resolution of the thermometer. A non-contact infrared sensor thermometer is useful for measuring temperature under circumstance where thermocouple or other probe type sensors cannot be used or do not produce accurate data for a variety of reasons[6][7]
3) IR Sensor:This Infrared Obstacle Avoidance Sensor returns a signal when it detects an object in range. The range of the sensor is around 2-40 cm is distance. It operates at 3.5 to 5 volts at around 20 milliamps This device has an infrared transmitter and receiver, that forms the sensor pair. The transmitter LED emits a certain frequency of infrared, which the receiver LED will detect. The receiving LED will detect some of the signal back and will trigger the digital on/off “signal” pin when a specific threshold “distance” has been detected.
4) Submersible Motor Pump: It is electric pump that is fully submerged in alcohol and it does not require a lot of energy to dispense alcohol
5) Relay Module:A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a micro controller. When activated, the electromagnet pulls to either open or close an electrical circuit.
6) .Buzzer:This is a Small PCB Mountable 3V Active Electromagnetic Buzzer. It is great to add Audio Alert to your electronic designs. It operates on 3V supply, uses a coil element to generate an audible tone.

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Flowchart

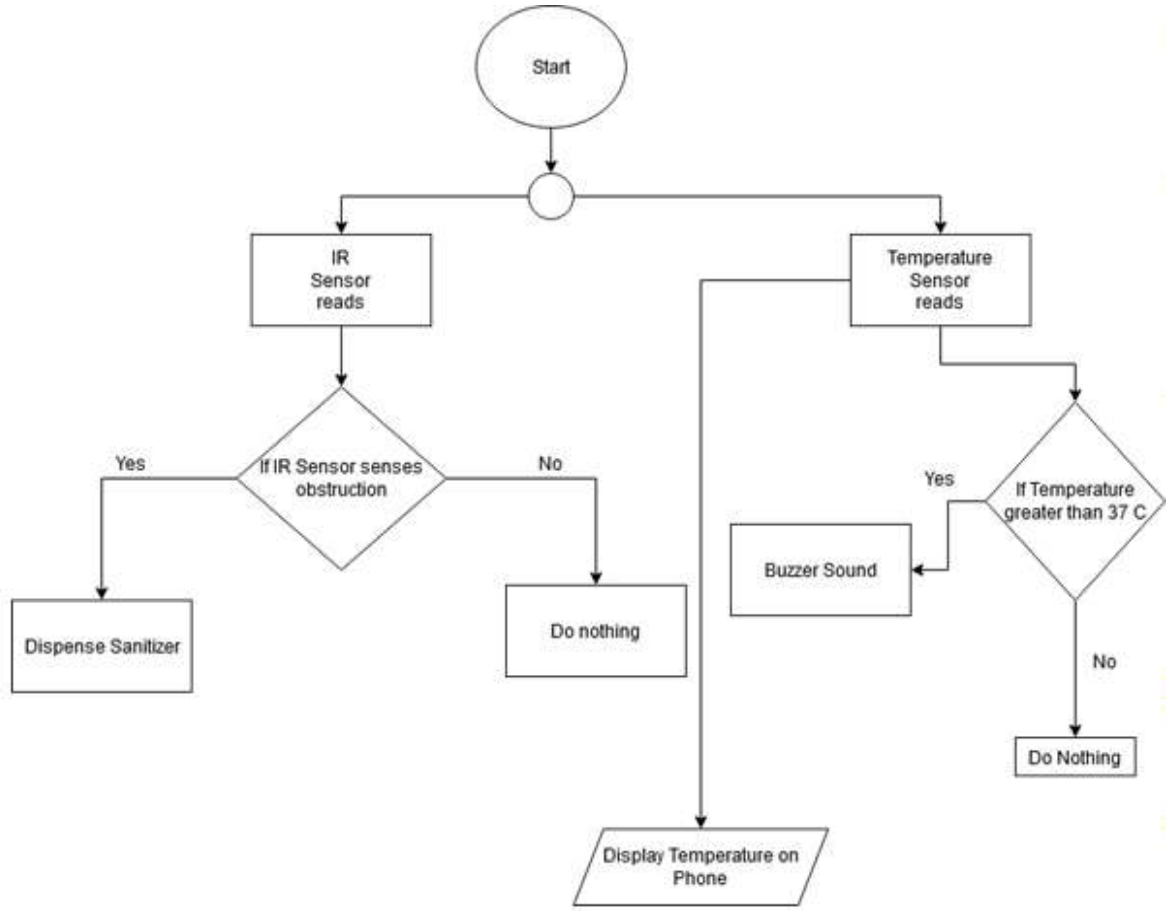

Figure 3: Flowchart

The Arduino Uno scriptis based on the flowchart shown in figure 3.

E.System Tests and Data Collection

Throughout the number of iterations undertaken in the development of the CTRSD, from hardware prototype, a series of similar tests are conducted .There are 4 test cases on the system as follows

- The User approaches sensor 1 : The user puts his/her hand on the over the IR sensor, the sensor senses the obstruction and dispenses the sanitizer.
- The User approaches sensor 2 : The user put his/her hand under the sensor 2 and the infrared temperature sensor reads the body temperature and displays it on the Blynk application.
- The User approaches both sensors: The user put his/her hand on both sensors simultaneously. The sensors detect the temperature and display it; and also dispenses alcohol based sanitizer.
- Sick User approaches both sensors : The sick user put his/her hand on both sensors simultaneously. The sensors detects the temperature, displays it and makes the buzzer sound as the person have higher temperature then the threshold; and also dispenses alcohol based sanitizer.

III. RESULTS

Tests Conducted and Results

The tests conducted and the results for Control System Hardware Model Test are analysed . And also test conducted with different people and check there temperature with traditional mercury based thermometer. The results are summarized as shown in Table 1 and Table 2.

Table 1: Summary of System Responses under the Different Test Cases

Test Case	System Description	System Response
1	The User approaches sensor 1	Correct
2	The User approaches sensor 2	Correct
3	The User approaches both sensors	Correct
4	Sick User approaches both sensors	Correct

Table 2: Analysis from the reading of two different devices

S. No.	MLX90614 Reading	Mercury Based Thermometer Reading
1	33.6	33.9
2	34.5	34.7
3	36.6	36.8
4	31.4	31.6
5	35.4	35.9
6	36.8	37.2
7	38	38.1
8	34.4	34.6
9	33.2	33.6
10	35.6	36

IV.CONCLUSION

In this paper, the Contactless Temperature Reader and Sanitiser Dispense is the best way to avoid the use of handheld temperature sensor by the guard or the person responsible for the thermal screening at the public areas and meanwhile prevent the spread of SARS-Cov-2 infections. The contactless sanitizer dispenser will help to eliminate the virus on the user's hands by dispensing the alcohol based sanitizer.The temperature of the user will also be displayed on the application installed on the guard's phone and indicate if the person's body temperature exceeds 38°C.

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