Non-Contact Temperature Reader with Sanitizer Dispenser (NCTRSD)

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Abstract- The design and development of a non-contact temperature reader and sanitizer dispenser (NTRSD) system is presented in this study. The system is intended to help prevent the spread of SARS-CoV-2 infection and assist in maintaining and/or improving community health and reducing the negative impact of the infection on the economy and society.

The NTRSD has two subsystems, the temperature reader (TR) and the sanitizer dispenser (SD), which is controlled from a common microcontroller and by design, cannot operate simultaneously. The TR is designed and developed to perform comparably in terms of accuracy with existing and commercially handheld infrared thermometers, display to the user the temperature read, and give visual and aural alerts when the temperature read exceeds the critical body temperature of 38 degrees centigrade. The SD is designed and developed to deliver sanitizer economically, by dispensing only once and only at a needed amount when activated.

The design and development of the system go through the following methodology: System Specification, Control System Design, Hardware Prototype Development, System Test and Data Collection. Based on data obtained from tests made on the built prototype, a reiteration of the above steps is carried out wherein the control system software logic and parameters are adjusted so as to meet the specified system performance. The final test results are acceptable and shows the NTRSD provides a significant contribution on temperature monitoring and on disinfecting the hands

The system utilizes a single Arduino Uno, an MLX90614 temperature sensor, two ultrasonic sensors, an LCD, two pilot lights, a buzzer, a submersible sanitizer pump, an alcohol reservoir, a power supply and a frame to house the system.

Photos of the built and tested prototype, a schematic diagram of the control system, and the flowchart on which the Arduino script is developed are shown. The operation and user-interaction of the actual system is also described. Data are also tabulated and shown along with statistical analysis. The control system program is written such that the temperature read and displayed by the NTRSD very closely matches that of a hand held temperature reader.

The non-contact feature for both the reading of body temperature and the dispensing of sanitizer provided by NTRSD precludes the possible viral transmission from using traditional thermometers, renders handheld IR thermometer operators (HITOs) unnecessary, avoids viral transmission between HITOs and subjects of their temperature scans, and ensures a clean and uncontaminated sanitizer. The system is envisioned for strategic deployment in public and private areas like public markets, banks, hospitals, schools, offices, residences, and many others.

Index Terms- Arduino Automated System, Covid19, Temperature sensor, Ultrasonic Sensor.

I. Introduction

The spread of the dreaded and potentially deadly Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-Cov-2) virus has caused a worldwide pandemic, hitting hard and putting at risk the global economy and overwhelming public and private healthcare facilities everywhere. The World Health Organization (WHO) officially named the disease caused by SARS-Cov-2, the 2019 novel coronavirus first identified in Wuhan China, COVID-19[1].

Ethiopia, in the face of a likely acceleration of the virus spread in the country of 110 million people, launched a nationwide door-to-door temperature screening campaign to identify, isolate, and treat those who are infected, or probably are, and prevent or mitigate the spread of the new coronavirus. According to the Ministry of Health, as of August 18, 2020 there are a total 31,336 cases, 18,268 active cases, and 544 deaths. And according to the state-owned Ethiopian News Agency (ENA)[2], many regional states also have begun taking body temperature using thermometer guns.

The WHO issued a bulletin on ways to protect oneself from the virus and to help prevent its spread. These include regular and thorough cleaning of the hands either with soap and water or with alcohol-based products. A regular check of body temperature is also recommended. An elevated temperature is one way to identify a person who may have a COVID-19 infection, although an infected person may not show an elevated temperature or other easily detectable symptoms [3].

Body temperature may be read in a number of ways and using a variety of contact and non-contact devices or systems. Devices that uses mercury to read body temperature fall under traditional methods and require contact with the body. Thermal imaging systems and infrared thermometers, on the other hand, are modern and non-contact temperature assessment devices used to measure a person's temperature.

To provide accurate contact measurement, the testing object and the sensor must be in thermal equilibrium which can lead to longer response times and reading inaccuracies offset by ambient temperature. On the other hand, non-contact measurement using infra-red radiation provides quick and accurate temperature data and without requiring direct touch.

A benefit of thermal imaging systems is that the medical personnel who handles the thermal imaging system is not required to be physically close to the person being evaluated. In fact, the person who handles the thermal imaging system could be in a different area or room, The thermal imaging system may measure surface skin temperature faster than the typical forehead or oral (mouth) thermometers, all of which require the handler a close distance or physical contact with the person being evaluated. Scientific studies show that, when used correctly, thermal imaging systems generally measure surface skin temperature accurately.

The person who handles a thermal imaging system is trained and follow all manufacturer instructions to make sure the system is set up properly and located where it can measure surface skin temperature accurately[4]. The trained personnel also needs to properly prepare the person being evaluated. An inaccurate temperature reading, a false negative, may put other people at risk. The effectiveness of temperature checks depends on the device and conditions under which it is used [5].

From the study of G. Marques and R. Pitarma, a web application is designed to access and monitor the collected data and provide the history of the temperature evolution. The results obtained are promising, representing a significant contribution to infrared temperature monitoring systems base [6]. Another study on Infrared temperature measurement module for the measurement of body temperature, the measurement of the traditional contact thermometer is avoided; it is particularly suitable for measuring body temperature for infants and young children. The measured temperature is displayed through the LCD module; it has a voice broadcast function that can be used by a man of poor eyesight[7]

In recent years, non-contact measurement methods have been used for numerous applications such as medical, environmental monitoring, home automation, automotive electronics, aerospace and military applications.[8]

II. Methodology

The development of the Non-Contact Temperature Reader with Sanitizer Dispenser follows a four-part methodology: formulation of the required design based on sensor behavior, operational, manufacturing and economic requirements; design, modeling, and simulation of the micro-controller-based control system; Non-Contact Temperature Reader with Sanitizer Dispenser, hardware prototype development; and system test and data collection.

1. System Requirements

Ethiopia ministry of health encourage every company to check the temperature of every worker leaving and entering the premises to find those who have a fever and be brought to designated quarantine area and to install alcohol dispenser to sanitize workers hands on entering the work premises. The system is designed to help meet these requirements. The control system components are to be selected so that they are the cheapest possible or can be sourced from junk materials. The frame or housing of the Non-Contact Temperature Sensor with Sanitizer Dispenser system should be able to use any locally available materials and could be built in any way, provided that it meets the requirement that is also movable. The code for the micro-controller should be written so that it can easily be modified to suit the actual components used and make the temperature reading and alcohol dispensing system respond

2. Control System Design

The design of the control system is illustrated by way of the NCTRSD schematic diagram

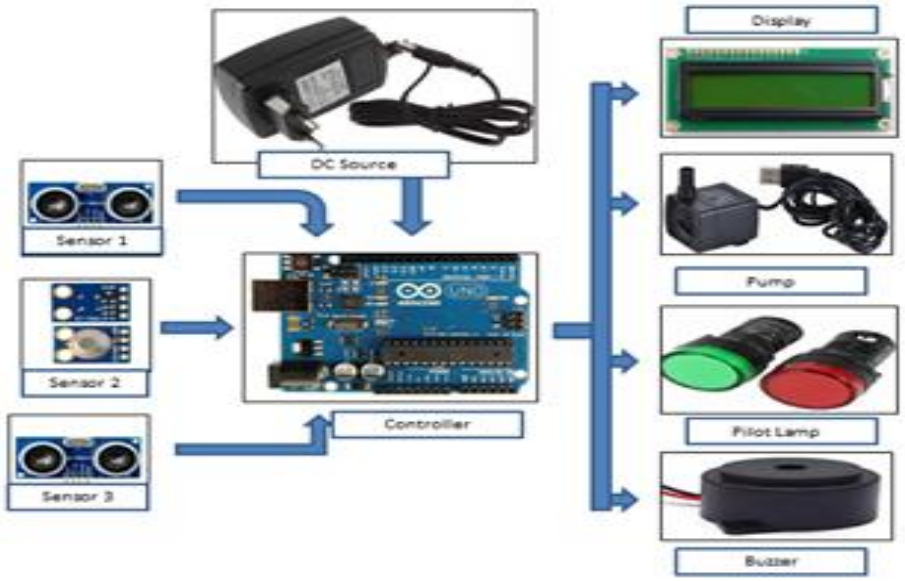


Figure-1: NCTRSD Schematic Diagram

3. Control System Software Modeling and Simulation

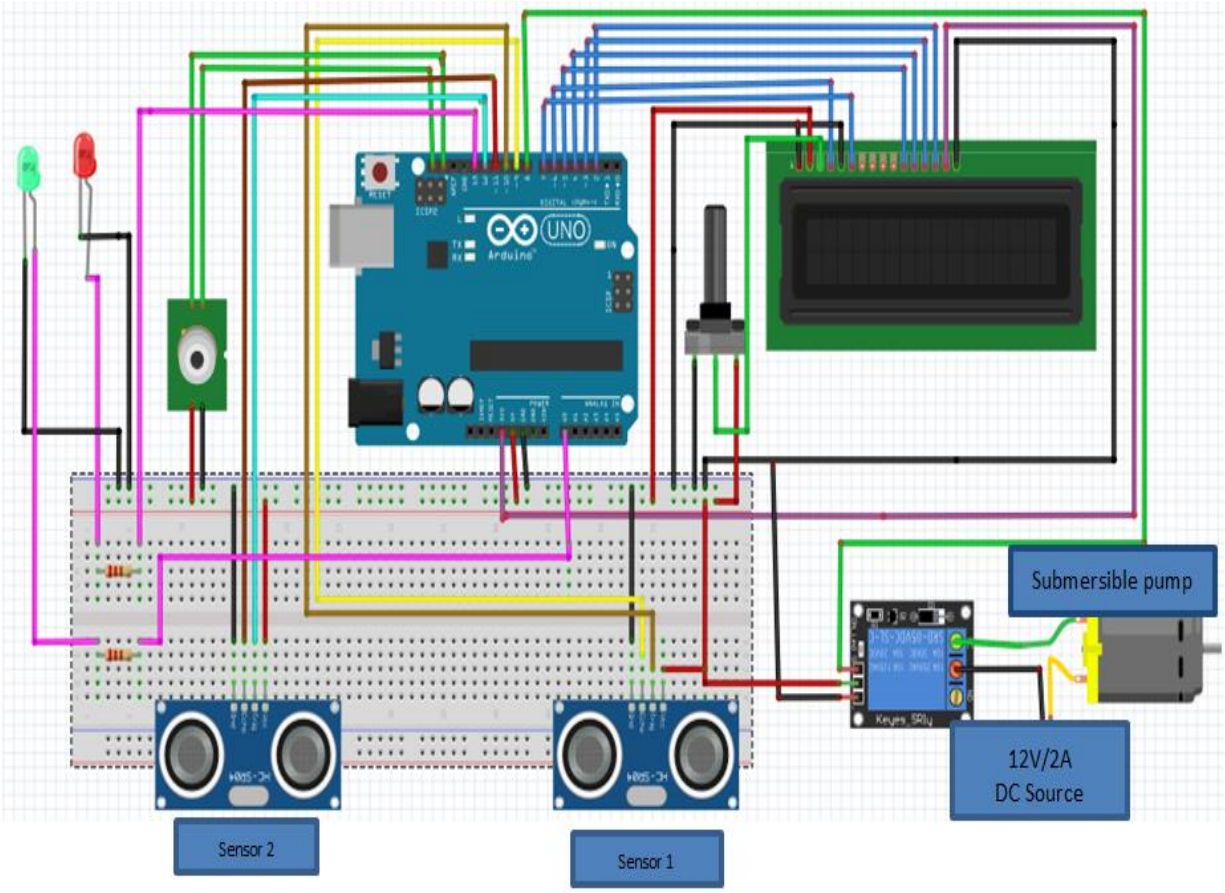


Figure-2: NCTRSD Control System Model

Hardware Model Parts List:

Main Components:

1. Arduino Uno: The Arduino Uno is microcontroller board based on the Microchip ATmega328P microcontroller that controls the Input (ultrasonic and temperature Sensor) and output (Motor Pump and LCD)
2. Temperature Sensor (MLX90614): The MLX90614 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[8].
3. Ultrasonic Sensor: is a device that can measure the distance to an object by using sound waves. It measure distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back.
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. Liquid Crystal Display (LCD): is an electronic display module that uses liquid crystal to produce a visible image and in this paper it display the Temperature of the user.

Flowchart

The Arduino Uno script is based on the flowchart shown in figure 4.

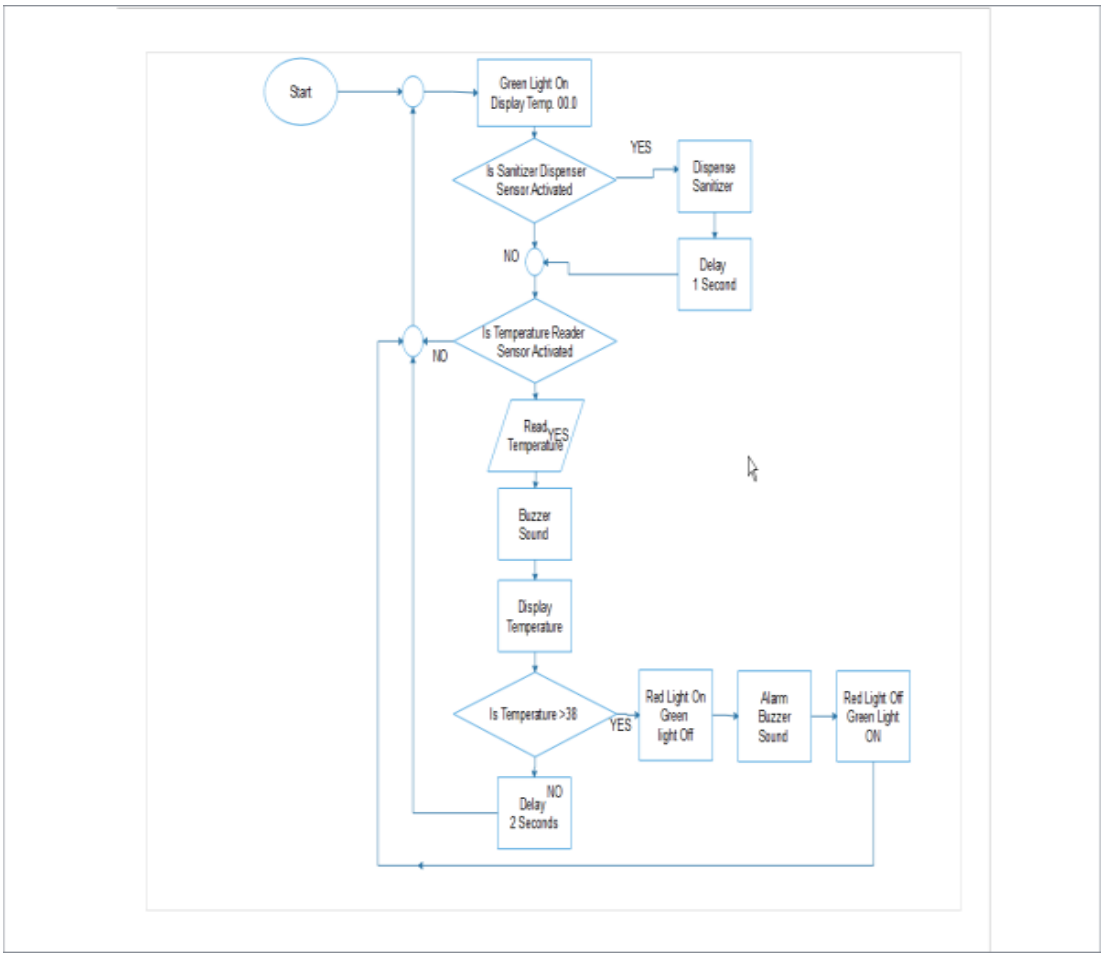


Figure- 4: Process Flowchart

C. NCTRSD ***Hardware Prototype Development***

The development of the Non-Contact Temperature Reader with Sanitizer Dispenser hardware prototype is as shown in Fig. 5 with its components.

Figure-5: Control System Prototype Implementation

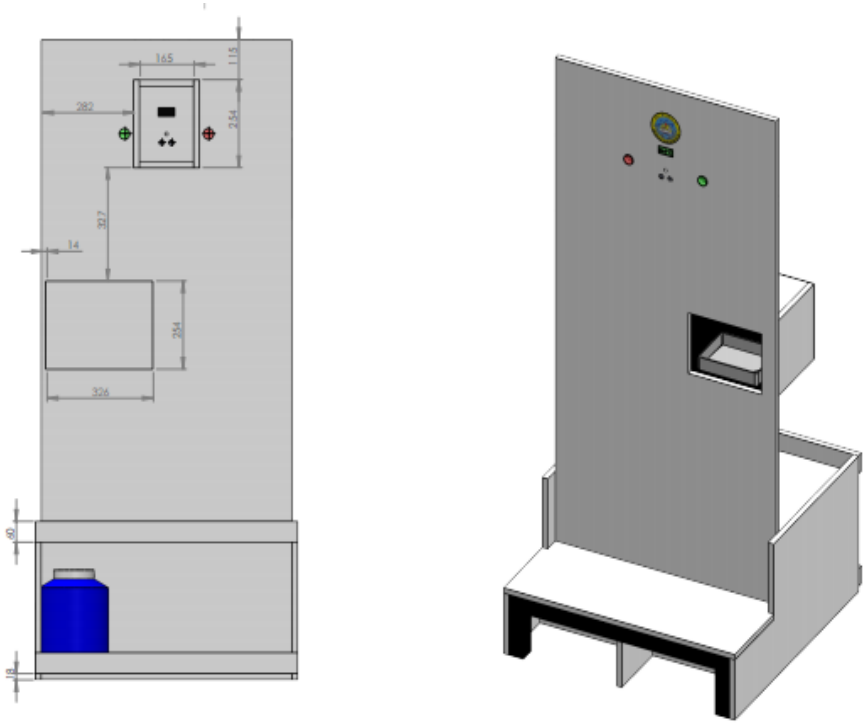


Figure-6a: NCTRSD Prototype

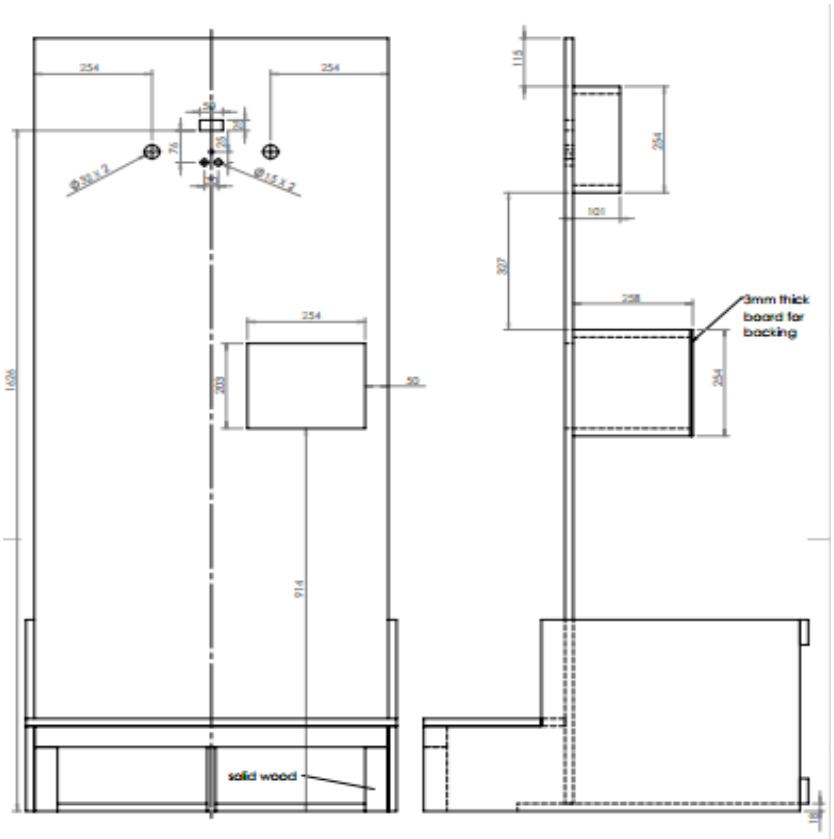


Figure- 6b: NCTRSD Frame Dimension

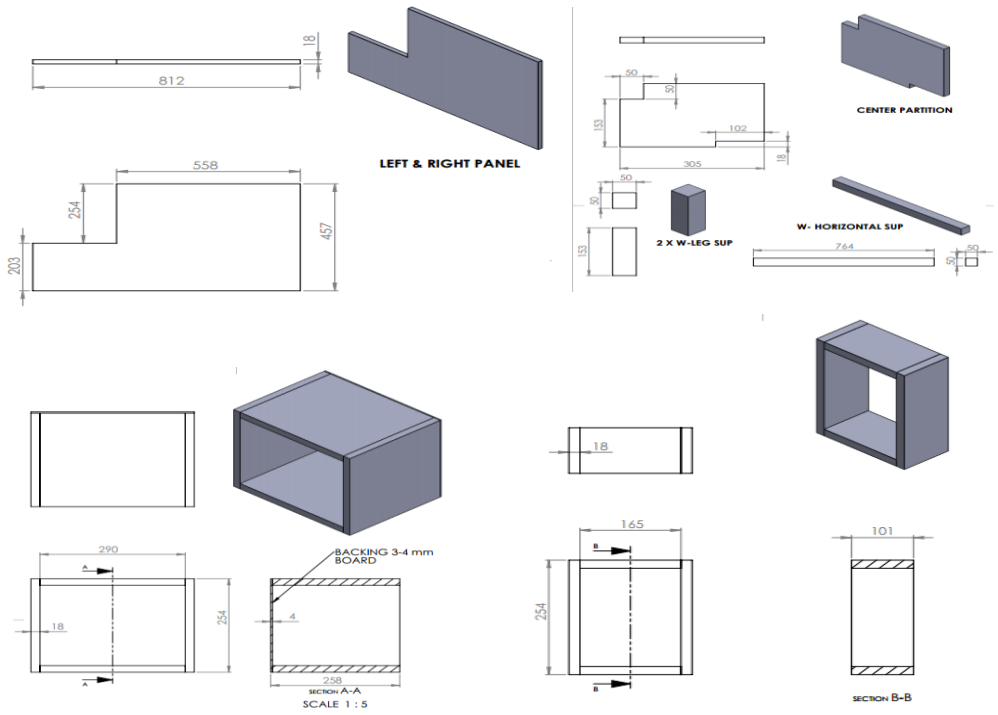


Figure-6C: NCTRSD Frame Parts Dimensions

E. System Tests and Data Collection

Throughout the number of iterations undertaken in the development of the NCTRSD, from hardware prototype, a series of similar tests are conducted. There are 7 test cases on the system as follows.

- User Approach Sensor 1- The User will put his/her hand in the hand sanitizer box and the sensor 1 will be activated than it will dispensed after that he can go to temperature sensor.
- User Approach Sensor 2-The user approached the sensor 2 within a distance of 20 cm, than the sensor 2 will read the temperature and the LCD will display the reading.
- User Approach sensor 1 and do again in sensor 1(Sensor 1 dispensing)- The user approach sensor 1 and it dispense while the user hand not removed the machine will not dispense but if the user hand he remove in the dispensing machine and return the machine will dispense.
- User Approach sensor 2 and do again in sensor 2(Sensor 2 Reading)- The user approach sensor 2 , the reading will be displayed and if the user move away in at least one(1) meter from sensor 2 and he return in same sensor than the reading will be display again.
- User Approaches Sensor 1 and another User Approaches Sensor 2 at the same time – Once a sensor is activated the other is waiting.
- User Approaches Sensor 2 and another User Approaches Section 1 at same time- Once a sensor is activated the other is waiting.

III. RESULTS AND DISCUSSION

Tests Conducted and Results

The tests conducted and the results for 1 Control System Hardware Model Tests and 2 NCTRSD Prototype Tests are all similar.
And also test conducted in different time in a day to determine the system reliability in different environment and compare to the result obtain in manufactured handheld temperature reader. The results are summarized as shown in Table 1.

Table-I: Summary of System Responses under the Different Test Cases

Test Case	System Description	Control System Hardware Model	NCTRSD Prototype
1	User Approach Sensor 1	Correct	Correct
2	User Approach Sensor 2	Correct	Correct
3	User Approach sensor 1 and do again in sensor 1(Sensor 1 dispensing)	Correct	Correct

4	User Approach sensor 2 and do again in sensor 2(Sensor 2 Reading)	Correct	Correct
5	User Approaches Sensor 1 and another User Approaches Sensor 2 at the same time	Correct	Correct
6	User Approaches Sensor 2 and another User Approaches Section 1 at same time	Correct	Correct

Table-2: Summary of System Responses under different time (Environment)

	TIME(L)	TEMP(X)	HH(Y)	NCTRSD(Y)
1	7:00	1	36.5	36.4
2	7:05	2	36	36.1
3	7:08	3	35.8	35.6
4	7:15	4	36.1	36.1
5	7;30	5	36	36
6	7:31	6	36.3	36.2
7	8:00	7	36.2	36.1
8	8:05	8	36.5	36.6
9	8:07	9	36	36
10	12:10	10	36.2	36.1
11	12:30	11	36.6	36.5
12	1:30	12	36.8	36.6
13	1:35	13	36.3	36.3
14	1:38	14	36.2	36.2
15	1:40	15	36.5	36.5
16	1:50	16	36.6	36.5
17	1:55	17	36.2	36.3
18	4:30	18	36	35.8
19	4:50	19	36.8	36.8
20	5:10	20	36.2	36.1

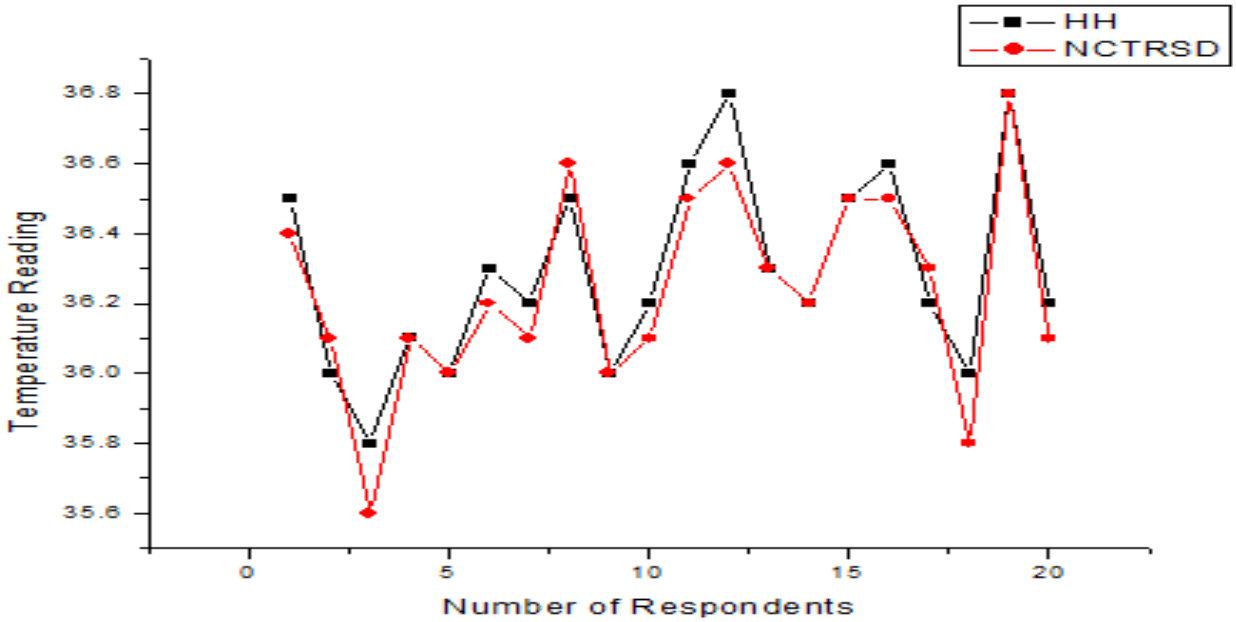
Time (L) - Respondent Testing Time

TEMP(x) - X-axis for Number of Respondents on data collection.

HH(y) - Y Axis which is the measurement of the user in Hand Held Temperature Reader

NCTRSD- is the prototype system being test .

From the graph 1 as shown below it's clearly shows that the reading in handheld device is almost similar in the NCTSD Prototype.



Graph 1: Handheld Vs NCTRSD

Table 3: Analysis from the reading of two different devices to twenty despondent .

Data from Worksheet Data1
Col(HH) => Col(NCTRSD)

	Row(X)	Mean(Y)	sd(yEr±)	se(yEr±)	Min(Y)	Max(Y)	Range(Y)	Sum(Y)	N
1	1	36.45	0.07071	0.05	36.4	36.5	0.1	72.9	2
2	2	36.05	0.07071	0.05	36	36.1	0.1	72.1	2
3	3	35.7	0.14142	0.1	35.6	35.8	0.2	71.4	2
4	4	36.1	0	0	36.1	36.1	0	72.2	2
5	5	36	0	0	36	36	0	72	2
6	6	36.25	0.07071	0.05	36.2	36.3	0.1	72.5	2
7	7	36.15	0.07071	0.05	36.1	36.2	0.1	72.3	2
8	8	36.55	0.07071	0.05	36.5	36.6	0.1	73.1	2
9	9	36	0	0	36	36	0	72	2
10	10	36.15	0.07071	0.05	36.1	36.2	0.1	72.3	2
11	11	36.55	0.07071	0.05	36.5	36.6	0.1	73.1	2
12	12	36.7	0.14142	0.1	36.6	36.8	0.2	73.4	2
13	13	36.3	0	0	36.3	36.3	0	72.6	2
14	14	36.2	0	0	36.2	36.2	0	72.4	2
15	15	36.5	0	0	36.5	36.5	0	73	2
16	16	36.55	0.07071	0.05	36.5	36.6	0.1	73.1	2
17	17	36.25	0.07071	0.05	36.2	36.3	0.1	72.5	2
18	18	35.9	0.14142	0.1	35.8	36	0.2	71.8	2
19	19	36.8	0	0	36.8	36.8	0	73.6	2
20	20	36.15	0.07071	0.05	36.1	36.2	0.1	72.3	2

Based on the table 3, The standard error is 0.05 which means that the system is accurate and acceptable

IV. Conclusion

In this paper, the Non-Contact Temperature and Sanitizer Dispenser Devices is best way to avoid the used of traditional contact thermometer and Handheld device for preventing the spread of SARS-Cov-2 infections, The measured temperature is displayed through the LCD and with Pilot Lamp indicator if the reading is normal or above 38 degrees centigrade. The system shows that the temperature reading results is accurate based on the data gathered. The system help the frontlines on checking the temperature and dispensing alcohol to workers in any company. The advancement of the Sanitizer dispenser is that virus will be eliminated easily since no body will touch the pump and this system is will Dispense only few amount of alcohol per motion activation and its highly efficient in which waste will be minimal.

References

[1] "Coronavirus (COVID-19) frequently asked questions | CDC." https://www.cdc.gov/coronavirus/2019-ncov/faq.html (accessed Aug. 06, 2020).

[2] "Door-to-door temperature screening launched in Ethiopia." https://www.aa.com.tr/en/africa/door-to-door-temperature-screening-launched-in-ethiopia/1803391 (accessed Aug. 05, 2020).

[3] "Non-contact Temperature Assessment Devices During the COVID-19 Pandemic | FDA." https://www.fda.gov/medical-devices/coronavirus-covid-19-and-medical-devices/non-contact-temperature-assessment-devices-during-covid-19-pandemic (accessed Aug. 05, 2020).

[4] "Thermal Imaging Systems (Infrared Thermographic Systems / Thermal Imaging Cameras) | FDA." https://www.fda.gov/medical-devices/general-hospital-devices-and-supplies/thermal-imaging-systems-infrared-thermographic-systems-thermal-imaging-cameras (accessed Aug. 05, 2020).

[5] "Enforcement Policy for Clinical Electronic Thermometers During the Coronavirus Disease 2019 (COVID-19) Public Health Emergency | FDA." https://www.fda.gov/regulatory-information/search-fda-guidance-documents/enforcement-policy-clinical-electronic-thermometers-during-coronavirus-disease-2019-covid-19-public (accessed Aug. 04, 2020).

[6] G. Marques and R. Pitarma, "Non-contact infrared temperature acquisition system based on internet of things for laboratory activities monitoring," Procedia Comput. Sci., vol. 155, pp. 487–494, 2019, doi: 10.1016/j.procs.2019.08.068.

[7] G. Long, "Design of a non-contact infrared thermometer," Int. J. Smart Sens. Intell. Syst., vol. 9, no. 2, pp. 1110–1129, 2016, doi: 10.21307/ijssis-2017-910.

[8] P. Ajmera, "A Review Paper on Infrared sensor," Int. J. Eng. Res. Technol., vol. 5, no. 23, pp. 1–3, 2018.

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Publications:

1. Wubishet Degife, Jolan Baccay S Y, 2020, Design and Analysis of Small-Scale Wind Turbine as An Alternate Power Source for Addis Ababa City Residents, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) Volume 09, Issue 06 (June 2020),
2. Wubishet Degife, *Experimental Analysis of Liter of Night Light*. Lambert Acadamic publishers, 2020.
3. Degife, W.; Bogale, W. Experimental Analysis of Liter of Night light for Potential Use in Rural Electrification. Preprints 2019, 2019080083 (doi: 10.20944/preprints201908. 0083.v1).
4. W. D. M. 3 Prabhakar. S 1* , Seid Endro 2, “EXPERIMENTAL ANALYSIS OF MAHUA OIL BLEND – AN SUSTAINABLE ENERGY,” *Int. J. Adv. Res. Basic Eng. Sci. Technol.*, vol. 4, no. 9, pp. 20–29. (ISSN (ONLINE):2456-5717)
5. Degife, Wubishet, et al. "Extracted Biodiesel as Feed for Internal Combustion Engine." *Journal of Mechanical Design and Vibration* 3.1 (2015): 1-7.

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