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Detection of High Fever Related Diseases Using Contactless Infrared Sensor

Modu Mustapha Tijjani[1]; Usman Ali[2]; Kalli B. Mai[3]; & Falmata B. Wakil[4]

[1,2&4]Department of Computer Engineering, Ramat polytechnic Maiduguri [3]Department of [3]Electrical and Electronics Engineering, Ramat polytechnic Maiduguri

Abstract: *Detection of High Fever Related Diseases Using Infrared Sensor in our contemporary society can never be over emphasized; because several contagious diseases associated with high fever such as Ebola, Corona Virus, Avian influenza, and SARs have emerged and are highly epidemic in nature that can easily be transmitted from one person to another. The device can measure body temperature, log them into an excel along with the picture of the individuals so that the record can be easily shared with concerned authorities. The system start by detecting infrared radiation from an object using either an infrared sensor. In this work, infrared sensor was selected due to its cost-effective nature. This study will interface TCRT 5000 IR Infrared sensor and MLX90614 thermal sensor with an Arduino IDE to measure the thermal pixel value of the object. A program that describes how TCRT 5000 IR sensor captures, measures and records thermal pixel values was writing and loaded unto the Atmega microcontroller on the Arduino IDE (Arduino Nano).*

Keywords: *MLX90614 thermal sensor, TCRT 5000 IR sensor, Arduino IDE etc*

1.0 Introduction: Due to the increasing new cases of high fever related diseases and its devastating effects, the need to monitor human elevated body temperature in places of mass gathering of people cannot be over-emphasis. Also, seeing that we cannot avoid the coming together of people

either for business purposes or worship, elevated human body temperature must be checked to avoid the spread of infection.

Several approaches such as Sun et al, 2014, Chin et al, 2015, Vanessa et al, 2016, Alametsäet al, 2017, and Armoteet al,2017 were suggested as a means to mitigate the spread of these high fever related diseases, some of which used infrared thermal camera (Chin et al, 2015), others used thermal sensor (Sun et al, 2014) to monitor elevated human body temperature.Although these approaches have demonstrated the ability of infrared thermography in detecting febrile subjects from a given population of people, however, these approaches are easily affected by factors such as the ambient temperature, operational distance, lack of technical know-how and cost of implementation.

Therefore, there is need to developed a more robust system that would be used to monitor human elevated body temperature in the place of mass gathering of people.

2.0 Review of Related work: Tamasakiet al (2019), developed an Infrared based thermometer and Esophageal Thermometry. The study shows a high correlation between tympanic and esophageal temperature. However, the system cannot be used on paediatric and young patient due to the tip diameter of the system and the contact nature of the system.

Somboonkaewet al (2017), proposed a mobile-platform for automatic fever screening system based on infrared forehead temperature. The system was able to achieved 100% sensitivity but loses to specificity. Thereby giving room for missed diagnosis of patients.

Povenda and Nascimento (2016), performed a study aimed to compare the temperature measurements of infrared thermometer and esophageal thermometer during intraoperative period and to verify the correlation between the measurements of tympanic and esophageal temperature. The study found that among the core temperature measures, pulmonary artery readings are the most accurate form of measurement. Nevertheless, it is an invasive procedure that brings risks to the patient.

S/N	Author/Year	Method Used	Strength	Weakness
1.	Tamasakiet al (2019)	Infrared Thermography	The study shows a high correlation between tympanic and esophageal temperature	The system cannot be used on pediatric and young patient due to the tip diameter of the system
2.	Somboonkae wet al (2017)	Infrared Thermography	• Fast and portable • Achieved 100% sensitivity	• Accuracy of the system dropped significantly with increase in the temperature of the device • Noise pollution because of the alarm used.
3.	Alametsäet al (2017)	Infrared Thermography	• Non-invasive • Easy to use	Using Flir technology in a mobile phone increases the computational power of the phone and also generates heat
4.	Povenda and Nascimento (2016)	Infrared Thermography	The study found that among the core temperature measures, pulmonary artery readings are the most accurate form of measurement.	Nevertheless, it is an invasive procedure that brings risks to the patient.

3.0 Methodology: the components for this research are IR temperature sensor, microcontroller, Display, and the Battery. With the sensor selected, we are only left with Microcontroller, Display, and Battery. So we decided to cut down the cost of all these three parts by leveraging an Android Mobile Phone. Today almost everyone has a good android phone with a decent camera. We can create a simple Android application that can communicate with our thermometer and perform other activities like data logging and image capture. This way we can not only make it work faster but can also increase its potential application by instantaneously sharing log results with pictures on WhatsApp, Gmail, or any other preferred platform. This is why we created our Android application in which the APK need to be installed in the android apps. So the only material required for this project is-

1. MLX90615 IR Temperature Sensor
2. TCRT5000 IR Sensor
3. Arduino Nano

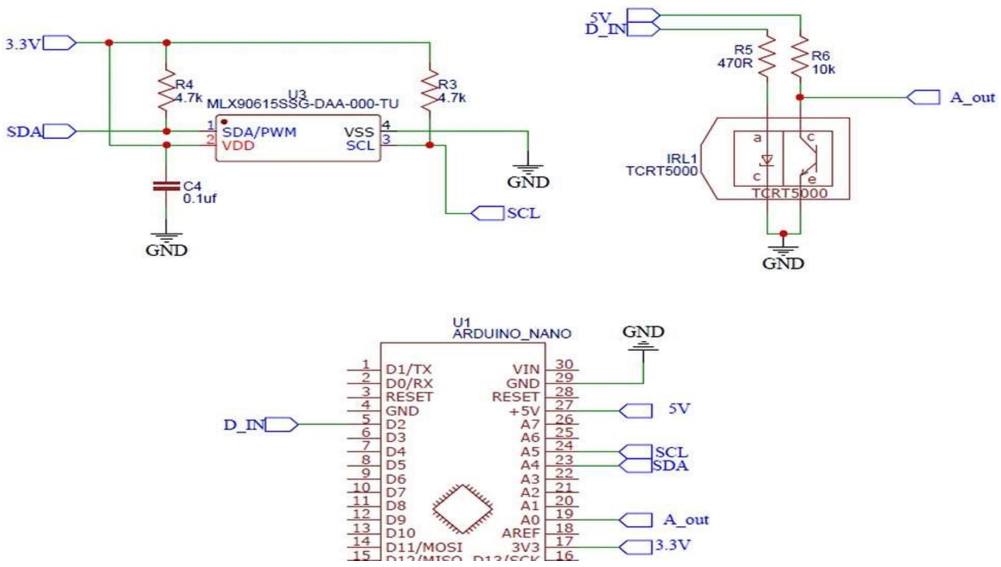
3.1 Why TCRT5000 and Arduino Nano?

The reason for using a TCRT5000 IR sensor is to detect the position of the thermometer and take temperature reading automatically. This way you would never have to do anything with the application once it is launched making it easy to use. Also, the reading will be taken only when the sensor is in the right distance from the person so we not worry about false readings.

The reason for using Arduino Nano is that it has an in-built USB interface which is important to communicate between the controller and the phone. If you do not have one, you can also use the Mega or even the UNO. But speaking on cost terms, you can even use a much low power microcontroller like STM8S or any other controller that supports I2C, ADC, and UART will work fine for this project.

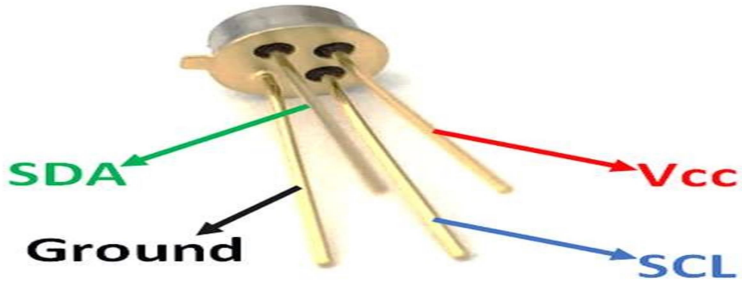
3.2 Interfacing MLX90615 and TCRT5000 with Arduino

The circuit diagram of our project is very simple, we only have to connect the MLX90615 and TCRT5000 sensor with our Arduino nano board. The complete circuit diagram for Contactless Body Thermometer is given below.



The MLX90615 and TCRT500 operate on 3.3V and 5V respectively so we can power it accordingly. I2C communication pins A4 (SDA) and A5 (SCL) are used to communicate with the MLX90615 sensor. It is common to use TCRT5000 with an Op-Amp in comparator mode like we did in our BLDC remote car project but here we need it to be more reliable and our IR sensor should be immune to sunlight. So I have connected the IR diode to a digital pin and the Photodiode to an Analog pin of the Arduino. This way we

can measure the value from photodiode during the normal stage and then measure again after turning on the IR LED, the difference between these two values should help us deal with noise.



I have directly soldered the components on a vero board. My set-up looks like this when completed, we will be building a 3D printed case for this, so try following the same component spacing when you are building your protoboard.

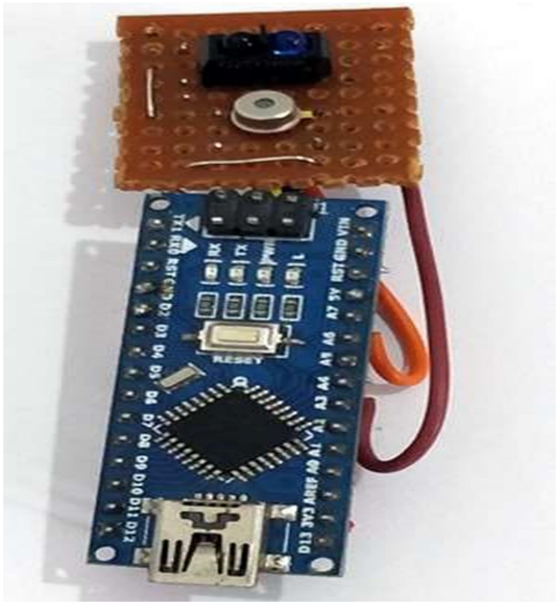
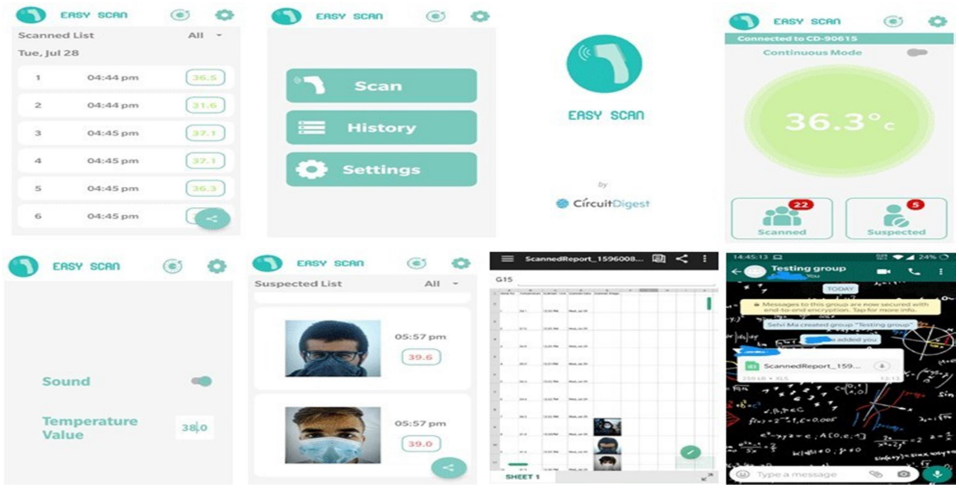


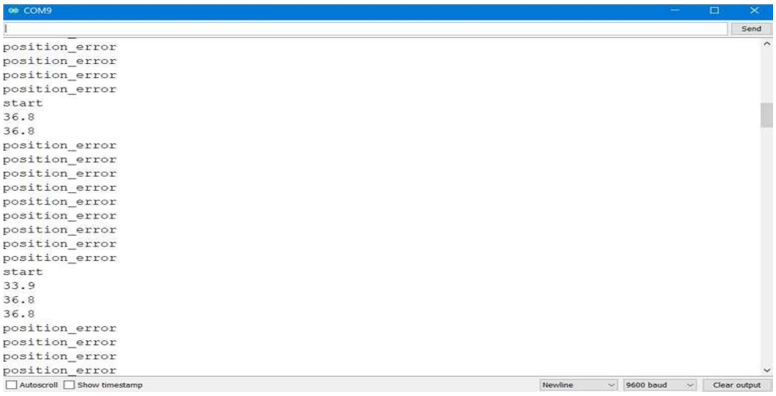
Fig2: Contactless Smart Thermometer – Arduino Program

3.4 Android apps: the Android application allows us to store all the temperature values with a photograph and also share it as an excel file through Whatsapp, E-mail, etc. Few screenshots of the applications are shown below.



4.0 Testing Contactless Smart IR Thermometer with Easy Scan Android Application

Once the hardware is ready, upload the Arduino code given below. Then open the serial monitor and you see position error being displayed. If you bring your hand close to the sensor, you will see the value of temperature. You can use any existing IR thermometer to check if the values are correct if not you have to change your error correction value. My Serial monitor screenshot is given below.



This will help us make sure the hardware and program are working as expected. After that use an OTG connector and connect your device to mobile phone. Both mobiles, with Type-C and micro USB port, were tested and found to be working. Make sure you turn on OTG in your mobile phone under setting options. Not all phones ask for this, but it never hurts to check.

After making the connection, install the Easy Scan application using the APK shared earlier and launch the Application. Place the device against an object and if everything is working as expected, you should see the temperature value on the application.

The application allows you to set threshold temperature, if the temperature is more than this threshold value, it will prompt you to take a picture. All the scanned records and be viewed on the application with time and date and can also be shared in Excel format for maintaining records.

Reference:

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