OPEN ACCESS
Global Journal of Research in Engineering & Computer Sciences
Volume 01| Issue 02 | Nov - Dec | 2021
Journal homepage: https://gjrpublication.com/journals/
Review Article

A Study on the Impact and Challenges of Temperature Detection System

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Submission Date: 10 Nov. 2021 | **Published Date:** 22 Dec. 2021

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Abstract
This paper comes in response to the high rate of the dead in the world nowadays as a result of high fever sickness. The main purpose of this paper is to review literature related to temperature detection systems, their challenges faced, and the impact of deploying them in our houses or organizations for preventive measures against the spread of diseases or sickness. The temperature detection system is usually used to measure the temperature of an object depending on the emitted infrared waves of the object without touching the object needed to be tested. It also measures the average temperature of an area or environment. The recent improvements in microelectronics and electronic gadgets permit the development of reliable and low-cost monitoring systems used by organizations, industries, companies, institutions, schools, and individual peoples for detecting patients with higher temperatures which may be signs of any kind of high fever diseases and preventive measures against the spread of the disease.

Keywords: Temperature (MLX90614) Sensor, Arduino, IR Sensor, High fever, Liquid Crystal Display

INTRODUCTION

The temperature measurement is by far the most measured parameter. It brunt the biological, chemical, and physical, world in diverse ways. Intuitively, people have known about temperature for a long time: fire is hot and snow is cold. Greater knowledge was gained as the man attempted to work with metals through the bronze and iron ages. Some of the technological processes required a degree of control over temperature, but to control the temperature you need to be able to measure what you are controlling. It was about 260 years ago the measurement of temperature was very intuitive. A scientist named Galileo was the first person to invent the first documented thermometer in the year 1592. It was an air thermometer subsists of a long tube and glass bulb attached. This tube was soaked into a cool liquid and this bulb was warmed, enlarging the air inside. As this air continued to enlarge, some of it escaped. When the heat was removed, the remaining air decrease causing the liquid to rise in the tube and showing a change in the temperature. This type of thermometer is very receptive, but it is affected by the changes in atmospheric pressure. In the year 1714, another scientist named Daniel Gabriel Fahrenheit invent both the alcohol and the mercury thermometer. Fahrenheit's mercury thermometer comprises a capillary tube, which after being filled with the mercury is heated to increase the mercury and eject the air from the tube. This tube is then sealed, leaving the mercury-free to contract and magnify with the temperature changes. Though this mercury thermometer is not as subtle as the air thermometer, by being sealed it is not pretentious by the atmospheric pressure. Mercury normally freezes at the temperature of -39℃ Celsius, so it cannot be used to measure a temperature below this point. On the other hand, Alcohol, freezes at a temperature of -113℃ Celsius, letting much lower temperatures is measured. Late in the 18th century, a scientist named Anders Celsius realized that it would be profitable to use more common adjustment allusions and to rift the scale into 100 additions instead of 96. Anders chose to use zero degrees as the boiling point and 100 degrees as the freezing point of water. The previous years of the 1800s were very effective in this area of temperature measurement and perception. William Thomson (later Lord Kelvin) presupposes the presence of an absolute zero. William Hershel discovered that when sunlight was spread into a color swath using a prism, he notice an increase in temperature when moving a blackened thermometer across the spectrum of colors. William Hershel found that the heating effect increased toward and beyond the red, in the region, we now call 'infrared'. He measured radiation effects from candles, fires, and stoves, and deduct the similarity of light and radiant heat. In the year 1821 T J See beck discovered that a current can be produced by unequally heating two junctions of two dissimilar metals, the thermocouple effect. T J See beck assigns constants to each type of metal and used these constants to compute the total amount of the current flowing. Likewise in the year 1821, Humphrey Davy discovered that all metals have a positive temperature coefficient of resistance and that platinum could be used as an excellent temperature detector (RTD). They two discoveries marked the beginning of serious electrical sensors. The 19th century saw the introduction of the bimetallic temperature sensor. These types of thermometers contain no liquid but operate on the principle of unequal expansion between two metals. Since various metals expand at different rates, one metal that is

bonded to another will bend in one direction when heated and will bend in the opposite direction when cooled. This bending motion is transmitted, by a suitable mechanical linkage, to a pointer that moves across a calibrated scale. Although not as accurate as a liquid in glass thermometers, BiMets are more hardy, easy to read, and have a wider span, making them ideal for many industrial applications. The 20th century has seen the discovery of semiconductor devices, such as the integrated circuit sensor_the thermistor a range of non-contact sensors. Likewise, Kelvin was finally rewarded for his early work in temperature measurement. The increments of the Kelvin scale were changed from degrees to Kelvins. Now we no longer say "one-hundred degrees Kelvin;" we instead say "one-hundred Kelvins". The "Centigrade" scale was changed to the "Celsius" scale, in honor of Anders Celsius. The
20th century also saw the refinement of the temperature scale. Temperatures can now be measured to within about 0.001℃ over a wide range, although it is not a simple task. The most recent change occurred with the updating of the International Temperature Scale in 1990 to the International Temperature Scale of 1990 (ITS-90)[1]. Nowadays, health monitoring is a global challenge in people's lifetime. The comfort of life lies in a healthy condition which affected by environmental and surgical facts. The measurement of human body temperature is very important in other to acknowledge the health status of that person. Installing or mounting a temperature detection system that will measure the body temperature of an individual or object is very important nowadays because of the rising rate of deaths in the world today as a result of various kinds of sickness that is related to high body temperature. The system will measure the temperature of an object or individuals if it is above the expected temperature range of a normal human being that is not ill or feeling well, it will sound an alarm and display the information on liquid crystal display that you should see a medical doctor. The table below shows the expected body temperature.

Table-1: Expected body temperature normal and not normal.

	Mouth/armpit	Ear/forehead	Rectum
Low temperature	< 35.8	< 35.7	< 36.2
Normal temperature	35.0 - 37.0	35.8 – 36.9	36.3 – 37.5
Increased temperature	37.1 – 37.5	37.0 – 37.5	37.6 – 38.0
Light fever	37.6 – 38.0	37.6 – 38.0	38.1 – 38.5
Moderate fever	38.1 – 38.5	38.1 – 38.5	38.6 – 39.0
High fever	38.6 – 39.5	38.6 – 39.4	39.1 – 39.9
Very high fever	39.6 – 42.0	39.5 – 42.0	40.0 – 42.5

Fig-1: The earliest thermometer

Fig-2: Contactless Infrared thermometer

RELATED WORKS

The range of each temperature sensor is assigned and simulation is conducted in LabVIEW. The collective results are illustrated and plotted by the use of different colors. Stereotypically, LM-35 has ascribed the temperature range of -50°C to 100°C, the thermistor is assigned the range of 101°C to 650°C, and the resistance temperature detector has consigned the range of 651°C to 850°C. The simulation experiments are reiterated by varying the assortment of each detector and it was imminent that for a wide-ranging temperature the simulation setup displayed reasonable outcomes and the various sensors were nominated spontaneously to function in their dispense ranges. Consequently, using this suggested way, this devise gadget can usually measure temperature from a range of -50°C to around 1000°C[2]. A tangible time observing of the body temperature using an embedded platform is been presented in this research. The microcontroller controls the gathering of tangible time information. The transmitting of intuited information from the instigated LM-35 and MLX-90614 temperature sensors at the online portal is accomplished through the ESP-Wi-Fi buffer. The podium is wirelessly linked to a monitor and displays the actual time information of positioned S1 and S2 sensors respectively at both the outdoor and indoor environment. This positioning elucidates the properties of advancement in the temperature readings, which differ due to other environmental features that as a barometer, blood pressure, humidity, and heart rate, that are not considered in this research. The outcomes from the research signposts the alteration in average temperature from S2 is about 150°C. However, the day-to-day checking of the body temperature can preclude people from threatening hypothermia, fever, and hyperthermia illness[3]. Resistance temperature detectors linearization is been executed in LabVIEW, using feedback and divider voltage compensation methods. A two-parameter model for resistance temperature detectors ware studied and vacant to simulate and implement linearization procedures within a predictable temperature assortment from 0°C to 500°C. The linearization blunder was appraised to be less than 0.5°C. By evaluation with a resistance RTD without linearization, signifies an enhancement of around twenty-five percent, which is very imperative for industrial applications like thermal compensation and room temperature measurement[4]. His research aims to design and locally produce a Smart Body Temperature Detector, which is capable of activating an alarm for temperature that exceeds 38°C, while the set aims are too decisive the cost of local production without compromising efficiency, produce, calibrate and validate[5]. A tentative design of a resistance temperature detector based on low-temperature sensors was designed with electroplating technique on the variant of the concentration of the solution and the electrode distance. The grander the concentration of the solution, the layer formed by the electroplating process the thicker it gets. The electroplating can upsurge the value of the resistivity of the thin layer of the sample[6]. Study on thermal camera usage for contactless monitoring of the laboratory animals' temperature. Experimentations were implemented in the laboratory conditions by using a commercially available thermographic camera Testo 885 thermal imager. For video processing, he proposed the method of detecting animal position in the thermal video record (ROI), choosing the precise points in ROI and reckoning temperature for them. This suggested system was tested on the experimental thermal information from rats[7]. Contactless infrared irradiation method was applied by carrying out thermal imaging and point measurement techniques with the use of pyrometers to determine the spatial and temporal temperature distribution in wire-based electron beam AM. The emissivity was calibrated by thermocouple readings and geometric boundary conditions. Thermal cycles and temperature profiles were recorded during deposition; the temperature gradients are described and the associated temperature transients are derived. In the temperature range of the $\alpha+\beta$ field, the cooling rates fall within the range of 180 to 350 °C/s, and the microstructural characterization indicates an associated expected transformation of $\beta \rightarrow \alpha' + \alpha$ with corresponding cooling rates. Fine acicular α and α' formed and local disorientation was observed within α as a result of the temperature gradient and the formation of the α'[8]. The purpose of this research is to achieve a protocol for temperature determination, with a high spatial resolution, of the order of the micro-nanometer dimension, manipulating Raman spectroscopy on anisate powder. As multiple signals are present in the Raman spectrum of Titanium dioxide, the choice of the actual Raman mode to be used has been performed based on its sensitivity to temperature. The ratio between Stokes and anti-Stokes signals of the same Raman mode has been investigated as a function of temperature (T), excitation wavelength, and input power. The control of the temperature is obtained by using a temperature controller, which is assumed also as a reference for the determination of the absolute temperature. The performances of the temperature sensor are examined in the wavelength range 488.0–647.1 nm, to individuate the best excitation wavelength in terms of reaching the highest sensitivity, and in the temperature range 283–323 K, which is essential for biological applications. The work will demonstrate that a different calibration constant is necessary for different wavelengths and Raman modes. The calibration constants, determined with this work, have been tested on a titanium dioxide-based Test Sample, obtaining results with high sensitivity and low uncertainty and opening the way to the use, in the future, of titanium dioxide-based new biosensors[9]. The thermometer designed in this research uses the microcontroller as the control core of the research, and it accomplishes accurate contactless temperature measurement and identity mask recognition for the measured person by using the identity recognition component, temperature detection module. The system uses the MLX90614 module and laser distance measurement component to complete the contactless temperature measurement for the human body through the process of distance reimbursement. By using a deep learning system, the K210 module is used to deep learn and extract facial features from the member pictures, and finally, determine the identity of the subject and carry out epidemic prevention detection [10].

COMPONENTS USED IN THE IMPLEMENTATION OF THE CONTACTLESS TEMPERATURE DETECTION SYSTEM

A. Infrared (IR) Sensor

This is an electronic gadget that detects and measures infrared radiation in its surrounding environment. Infrared is invisible to human eyes, as its wavelength is longer than that of visible light. Active infrared detectors emit and detect infrared radiation. Active infrared sensors have two parts: a light-emitting diode and a receiver. If the object comes closer to the sensor, the infrared light from the light-emitting diode reflects off the object and is detected by the receiver.

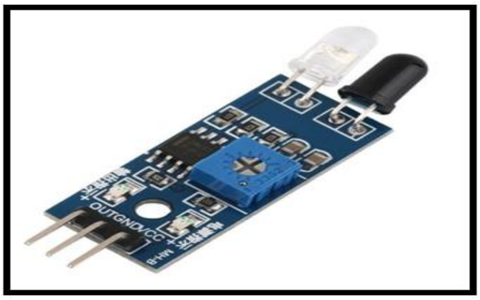

Fig-3: Infrared (IR) Sensor

B. MLX90614 Temperature Sensor

The temperature (MLX90614) detector is used to measure the temperature of an object without any physical contact with it. Thus, the temperature (MLX90614) sensor calculates the temperature of an object by measuring the amount of infrared energy emitted from it.

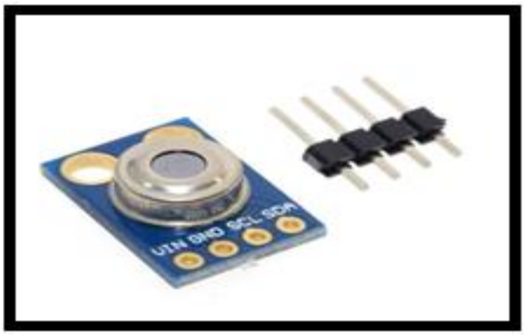

Fig-4: MLX90614 Temperature Sensor

C. Arduino

This is a microcontroller board based on the ATmega328P. The Arduino microcontroller has fourteen (14) digital pins input and output six (6) of these pins are used as pulse width modulation (PWM), another 6 of these pins are used as analog inputs, it has a universal serial bus (USB) connection cable, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), it also has a power jack, a reset button, an ICSP header.

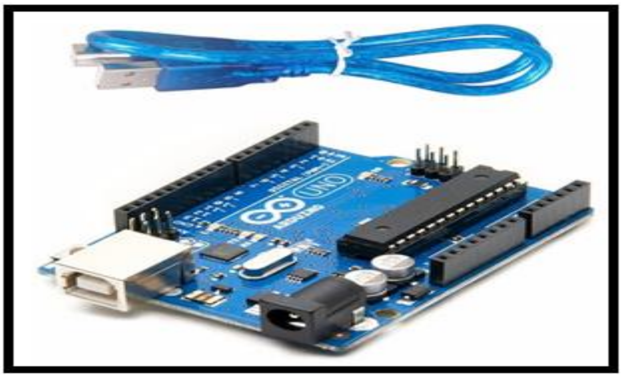

Fig-5: Arduino Uno board microcontroller

D. Liquid Crystal Display

This is an electronic gadget that is used to display information and message in alphanumeric form. It has 16 columns and 2 rows so that it can display 32 characters in total and every character will be made with 5×8 (40) Pixel Dots. So the total pixels within the liquid crystal display can be calculated as 32 x 40 otherwise 1280 pixels.

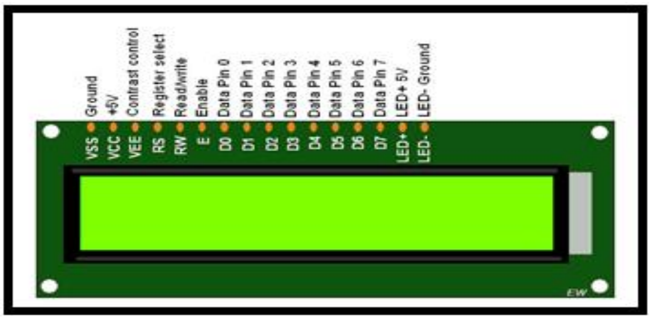

Fig-6: Liquid Crystal Display

IMPACTS OF THE CONTACTLESS TEMPERATURE DETECTION SYSTEM

1. Remote Measurement of Temperature: One of the main impacts of the temperature measuring detector is measuring the temperature of an object from a distance exactly, without touching the object that is going to be measured. Apart from measuring the temperature of objects or human bodies, the infrared thermometers can likewise measure the temperature of a location where a fire is occurring and measuring of metal surfaces that may likely cause injuries when touched.
2. It Store the Detected Temperature Directly in the system: The infrared thermometers nowadays usually have a memory installed in them that is used to store each measured temperature in real-time it can also be deleted when needed. It is usually used to measure the temperature of an environment after fixing the air conditioner and the sampling test of the temperature generated by electronic gadgets.
3. Measuring Moving Objects: The infrared thermometers can likewise measure or detect the temperature of a moving object. It is usually used and can be seen at airports. This is because the infrared thermometer does have the impact of precisely detecting the temperature of the object's movement.
4. Does Not Damage Brain Tissue: In fact, infrared thermometers are known to have an infrared sensor used to detect infrared energy emitted by each object. If an object generates hot energy, the released molecules will be more active and infrared energy will be greater. Infrared sensors work to detect heat waves emitted by the surface of the human body. So it won't damage brain tissue.
5. The infrared thermometers have a shape like a gun. It is usually small, practical, and compact form is easy to carry anywhere.

Challenges faced using the temperature detection system

1. The price is usually expensive: the price of an automatic infrared thermometer is costly than other types of thermometers.
2. It requires a high-temperature range: The infrared thermometer work accurately and effectively if an object or human bodies emit a high or hot temperature. For such reason, it will be challenging or even unable to measure objects with a smaller temperature.
3. It is easily distracted when taking the temperature readings: The infrared thermometers are easily dreamy when taking the readings of the temperature. What hinders the process of measuring the temperature of an object or something is the presence of smoke or dust that is around the environment or areas.
4. Sometimes infrared thermometers can produce temperature errors because measuring temperature from a distance tends to be far away. The farther the distance to measure a person's temperature, the wider the infrared thermometer will measure. Therefore, the use of an infrared thermometer must be done appropriately, so that there is no wrong temperature measurement that can be incurable.

CONCLUSION

This review aimed to generate awareness concerning the measures and actions individuals can take in day-to-day life due to the increase in dead in the world today. The paper reviewed some studies relating to temperature detection systems; it highlighted the challenges faced, and the impact of installing them in our homes, industries, organizations, markets, institutions, and offices. In addition, the components used in the design of the whole system are discussed in detail.

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