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AN IMPROVED MICROCONTROLLER-BASED PATIENTS' VITAL SIGNS MONITORING DEVICE

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ABSTRACT

In the medical field, the clinical study of the basic vital signs of a patient represents the simplest and most effective way to detect and monitor health problems. Continuous discoveries in medical sensor technology and mobile devices fields, joined with increasing wireless communication abilities, have made possible the development of new health monitoring models. The research work is to design and construct an improved microcontroller-based patients' vital signs(temperature) monitoring device. The device is a real time monitoring device, that transmits the data gotten from the temperature sensor via Arduino (Microcontroller) to the cloud for easy access/ monitoring through the ESP8266 Wi-Fi cloud module or to the LCD to display the values. The values displayed on the LCD indicates the temperature values and condition of the patient. More so, an alarm system (known as triage system) is added to alert the physician, nurses, and paramedical of the critical changes in the patient health. Additionally, LEDs of different colors (serves as indicator) is incorporated to indicate/alert the physician of changes in patients' temperature values. The implications of the results, and suggestions for further studies were made.

***Keywords**: Vital Signs, Temperature, real-time Monitoring, Arduino, Triage.*

1. INTRODUCTION

Technology is evolving to make our daily activities simple and enjoyable especially in this era of innovative information and communication. Technology has an extensive role in improving human medical needs in our ever expanding health care system. Telemedicine also referred to as telehealth is a generic term which is the use of telecommunication and information technology to provide medical information and services from a distance[1], (Strehle, 2006). The use of electronic signals to transfer information from one location to another is called telemedicine. Telemedicine is part of a larger treatment process or care chain. Telemedicine was presuming to improve this chain and thus boost the quality and performance of healthcare[2], (Manivannan et al., 2013)

The development of this technology started in the nineteenth century[3], (Craig & Patterson., 2005). In 1959, Wittson and colleagues were the first to employ IATV(two-way interactive television) for medical purposes, when they used a microwave link for telepsychiatry consultations between the mental state hospital and Psychiatric Nebraska Institute in Omaha 112 miles away[4] (Douglas, 1995). However, telemedicine became commercially available in 1960's[3], (Craig & Patterson., 2005).The practice of telehealth amongst health professionals has being on an increase due to the replacement of analogue forms of communication with digital methods. This has made health workers organization to envisage future possibilities and use new and more efficient means of providing care[5], (Hamidreza&Fatemen, 2017). Communication and technology teaching in telemedicine has been in used since long time. Applications are pediatrics, cardiology, dentistry, homecare, psychiatric, veterinary medicine etc[4],(Douglas, 1995).

The emerging need for our society is the need for a more advance technology with continuous contact with a supervisor external system during daily activities as well as in extreme conditions This need is both socially (the need to enhance the identification and medical intervention of early illness) and technologically motivated. Advances in sensor technology in particular, as well as communication technology and data processing, form the basis on which new generations of health care systems can consolidate,[6] (Paradiso

et al., n.d). When a patient is being admitted into the hospital whether critical or not, the patient vital signs which are temperature, respiration, pulse rate, blood pressure is been checked first. Afterwards, the results are transmitted to the doctor for patient's assessment, diagnosis, planning treatment and management. However, this routine is somewhat delayed for several hours because of the limited number of doctors, nurses and allied practitioners which has led to death while waiting for patients to be attended to. The doctor-to-patient ratio should be 1:600 per year, according to the World Health Organization, but in Nigeria it is unfortunately high.
Once again, Saturday punch announced that the ratio of doctors to patients in Nigeria as of 2016 was between one doctor and 3,500 patients per year. In addition, the WHO found that health care quality, facilities are definitely at least not because the doctor is not good but because the doctors are being forced beyond their ability. Imagine taking care of approximately 90-100 patients within 24hours and going through many departments,[7](Tunde, 2016).

In Nigeria and other developing countries, where there are lots of hospitals but limited doctors, a monitoring system on vital signs for patient is recommended to reduce mortality rate, investigation, faster diagnosis and treatment. This motoring system will help to send a patient comprehensive report on the vital signs to the doctors/nurses once without waiting for individual reports.

1. RELATED WORKS

Monitoring and Analysis of Vital Signs of a Patient Through A Multi-Agent Application System. This was specially designed for home care services to monitor some vital signs (heart rate, oxygen saturation and body temperature) via Raspberry Pi,[8] (Daniel et al, 2015). Vital Signs Monitoring and Patient Tracking over a Wireless network. We have designed and developed a real-time patient monitoring system that integrates vital signs sensors, location sensors, adhoc networking, electronic patient records, and web portal technology to allow remote monitoring of patient status. This system will facilitate communication among providers at the disaster scene, medical professionals at local hospitals, public health personnel, and specialists available for consultation from distant facilities, [9](Tia et al., 2006).

2. MATERIALS AND METHODS

A. Materials
The following materials will be employed to carry out this study; Resistors, capacitors, WIFI cloud module ESP8266, temperature sensor, PROTEOUS, buzzer, LED, LCD, Ardunio UNO, 555 Timer, jumper wire and power adapter.

i. Specific Study Area
This research work will cover the design and construction of an improved real-time microcontroller-based patient' vital signs monitoring device. The vital signs parameters to be checked is temperature. Also, a triage system would be added to alert the doctors/nurses on the critical changes of the parameters. However, blood pressure, pulse rate and respiration are exempted.

B. Methods
i)Flow chart of Improved Microcontroller-Based Patients' Vital Signs Monitoring Device

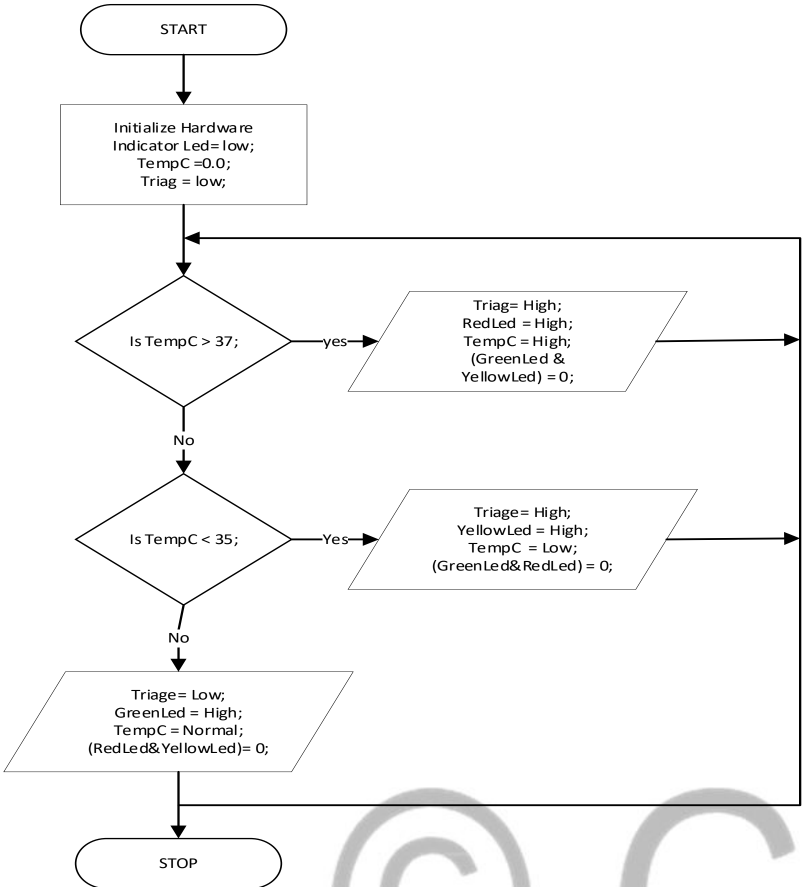

Fig 2.1Flow chart of Improved Microcontroller-Based Patients' Vital Signs Monitoring Device

ii) Block diagram of the Improved Microcontroller-Based

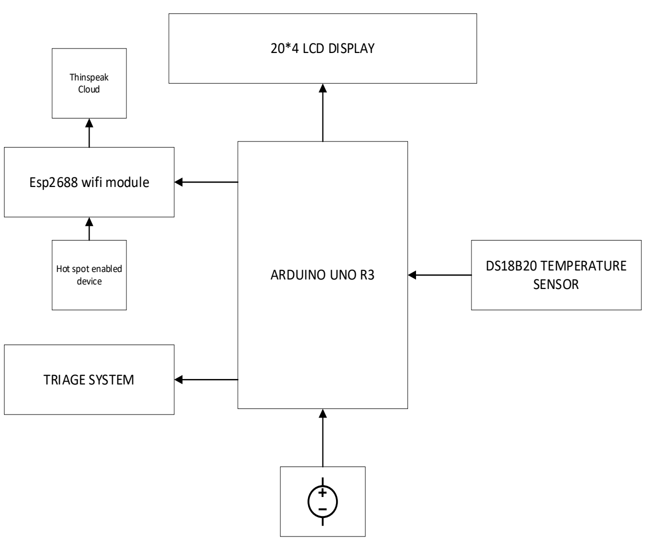

Fig 2.2 Block Diagram of Microcontroller-Based Patients Vital Signs Monitoring Device

iii) Construction Methodology

the following were considered during constructionof the improved microcontroller-based patients' vital signs monitoring device

- Preliminary Design

- Permanent installation
- Packaging and labelling

3. RESULTS AND DISCUSSION

A. Overall System

The figure 3.1 presents the overall system with all elements. The analysis is aimed at collecting the temperature of the human body which will be shown real time and evaluating the performance of the sensor, the wireless platform through the WIFI module to ensure the result can be accessed easily.

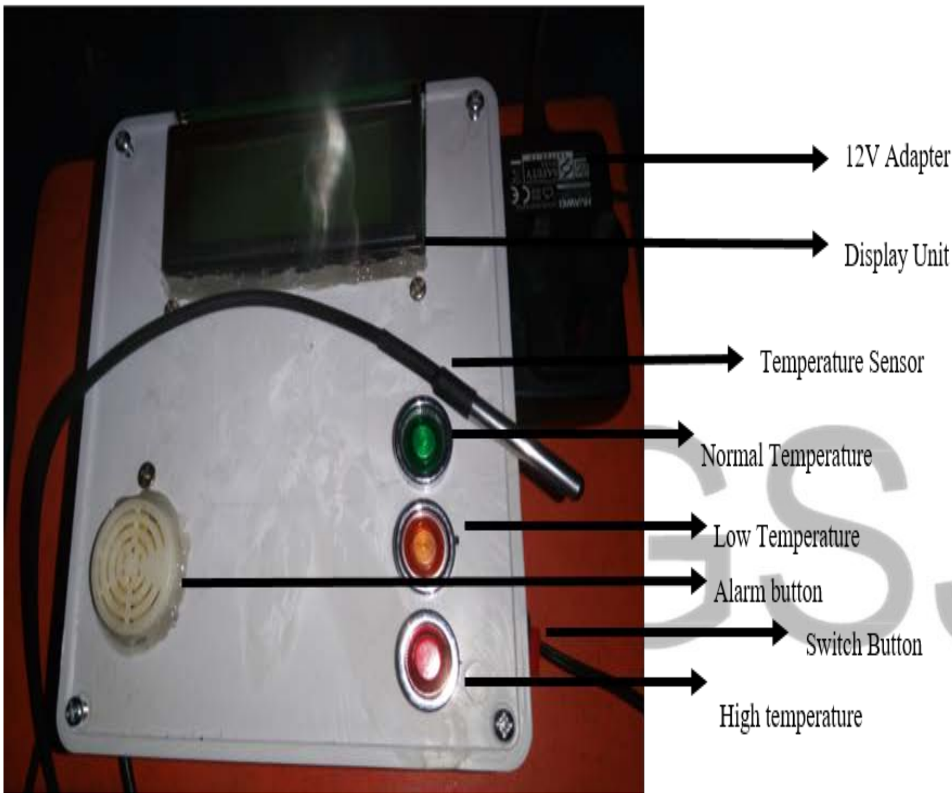

Fig 3.1 Figure of the Constructed Device

The table below shows the summary of the color code when the device is activated.

Color	Ranges	Meaning
Red	>37^{0}C	High Temperature
Yellow	<35^{0}C	Low Temperature
Green	35^{0}C – 37^{0}C	Normal Temperature

B. Performance of the Real Monitoring System

I) The graph fig 3.2 present the data (from entry id no 9-108) collected from the real human body and the temperature collected from the microcontroller, Arduino. Also, the values when exported from the cloud (real-time monitoring) to EXCEL as shown in fig 3.3 was used to plot a graph of Temperature versus Entry ID.

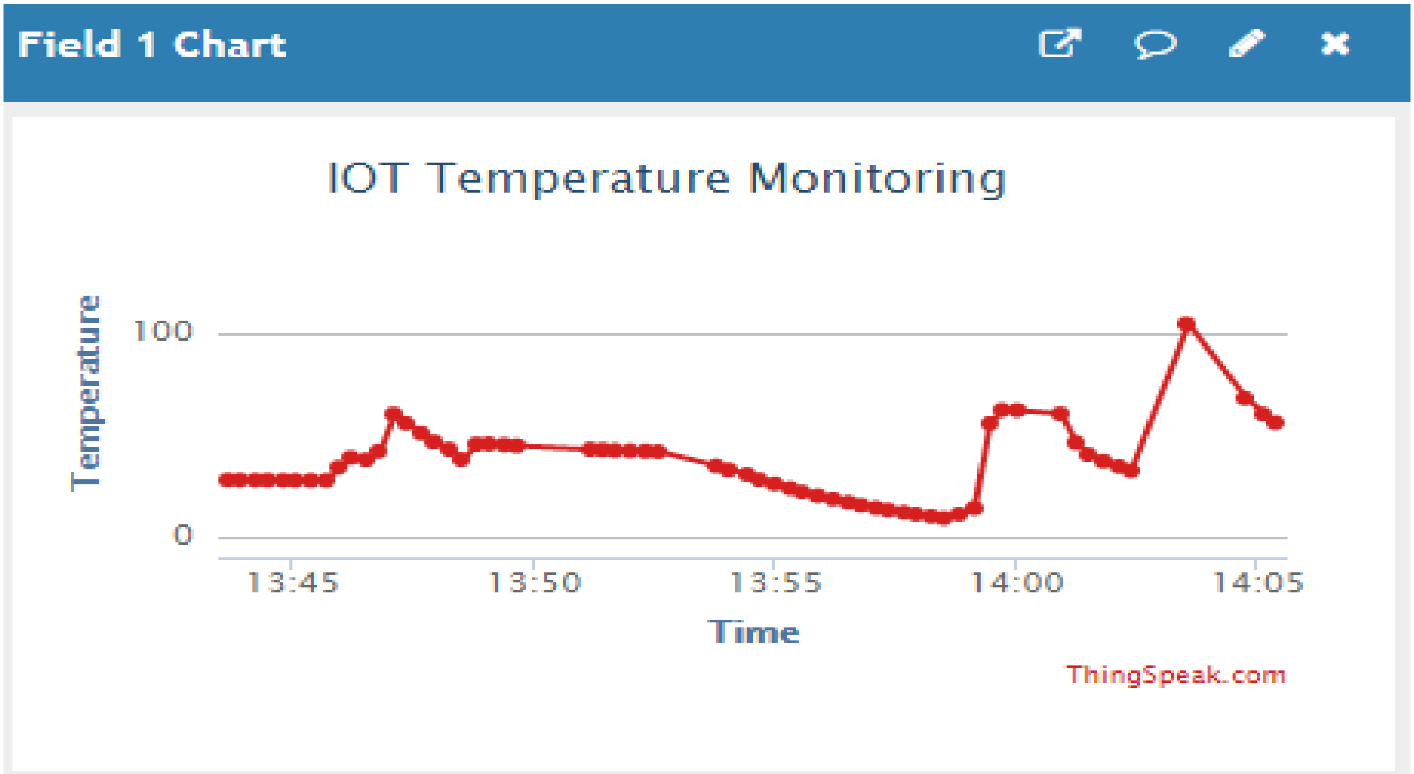

Fig 3.2: Graph of Real-Time Monitoring from the Cloud (from entry id no 9-108)

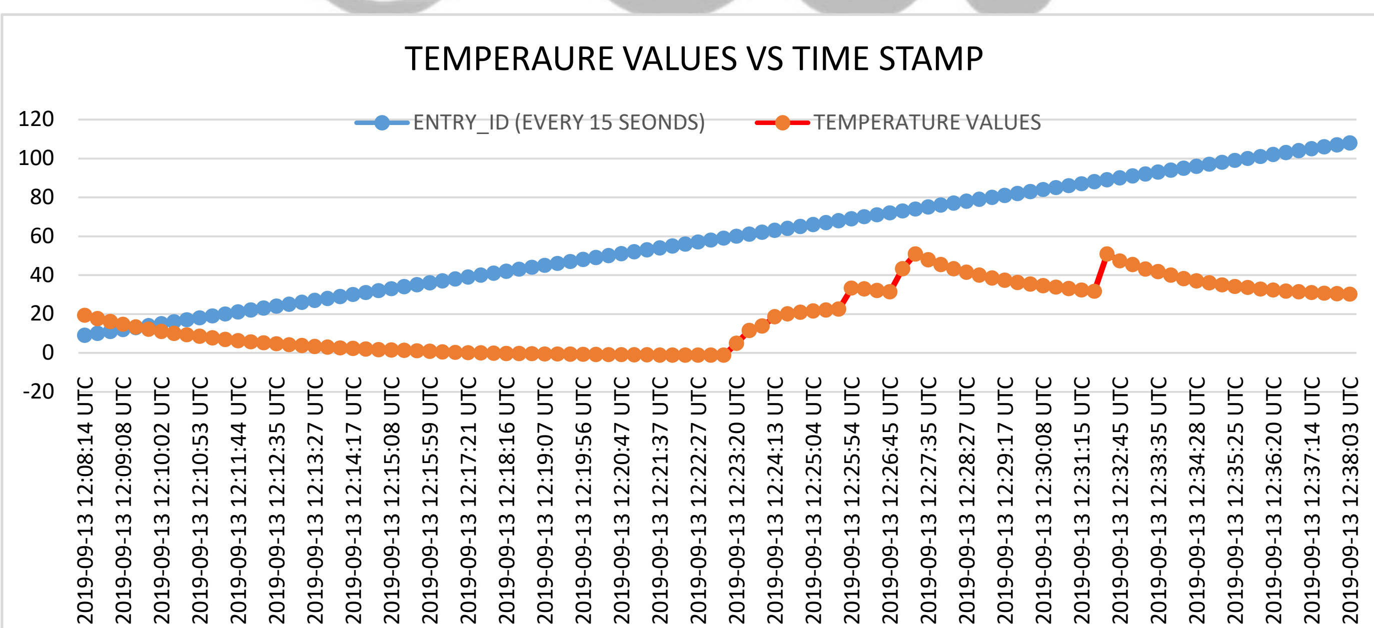

Fig 3.3 Graph of Temperature versus Entry ID and Date (from entry id no 9-108).

ii) The graph fig 3.4 present the data (from entry id no 101- 200) collected from the real human body and the temperature collected from the microcontroller, Arduino. Also, the values when exported from the cloud (real-time monitoring) to EXCEL as seen in fig 3.5 was used to plot a graph of Temperature versus Entry ID

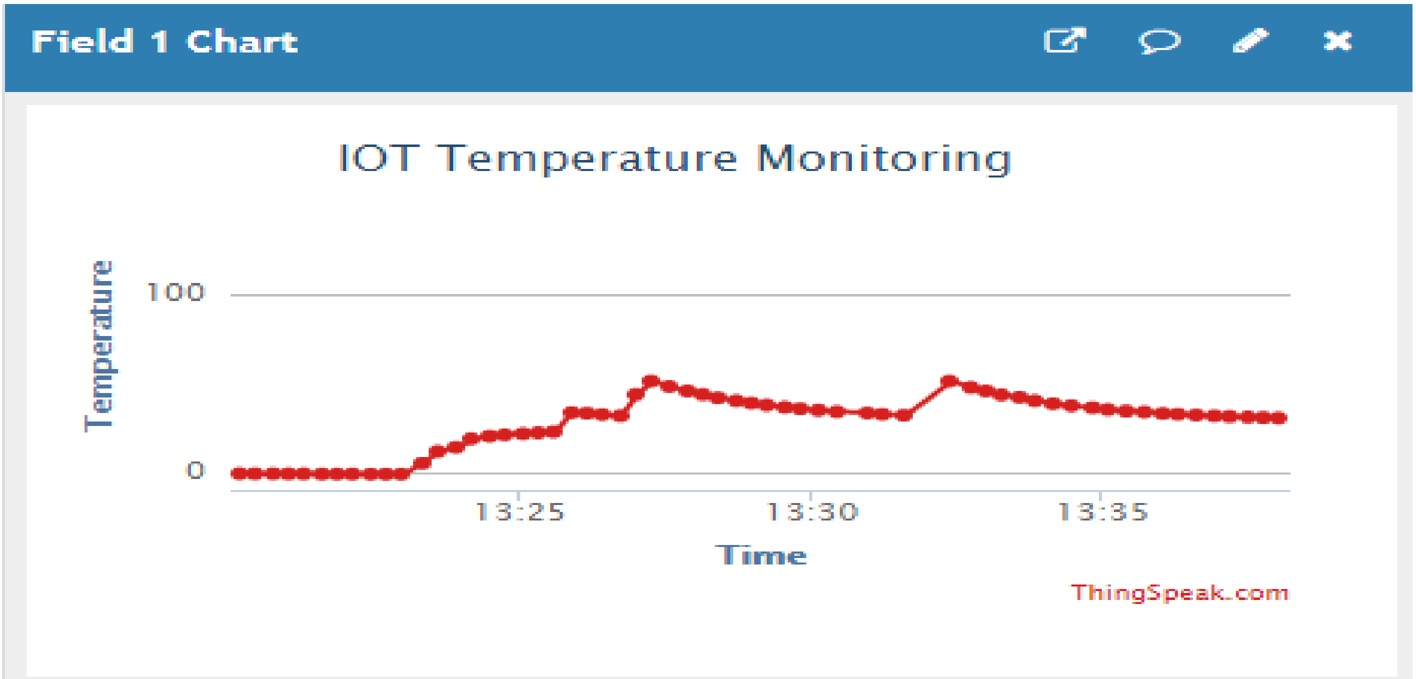

Fig 3.4: Graph of Real-Time Monitoring from the Cloud (from entry id no 101-200)

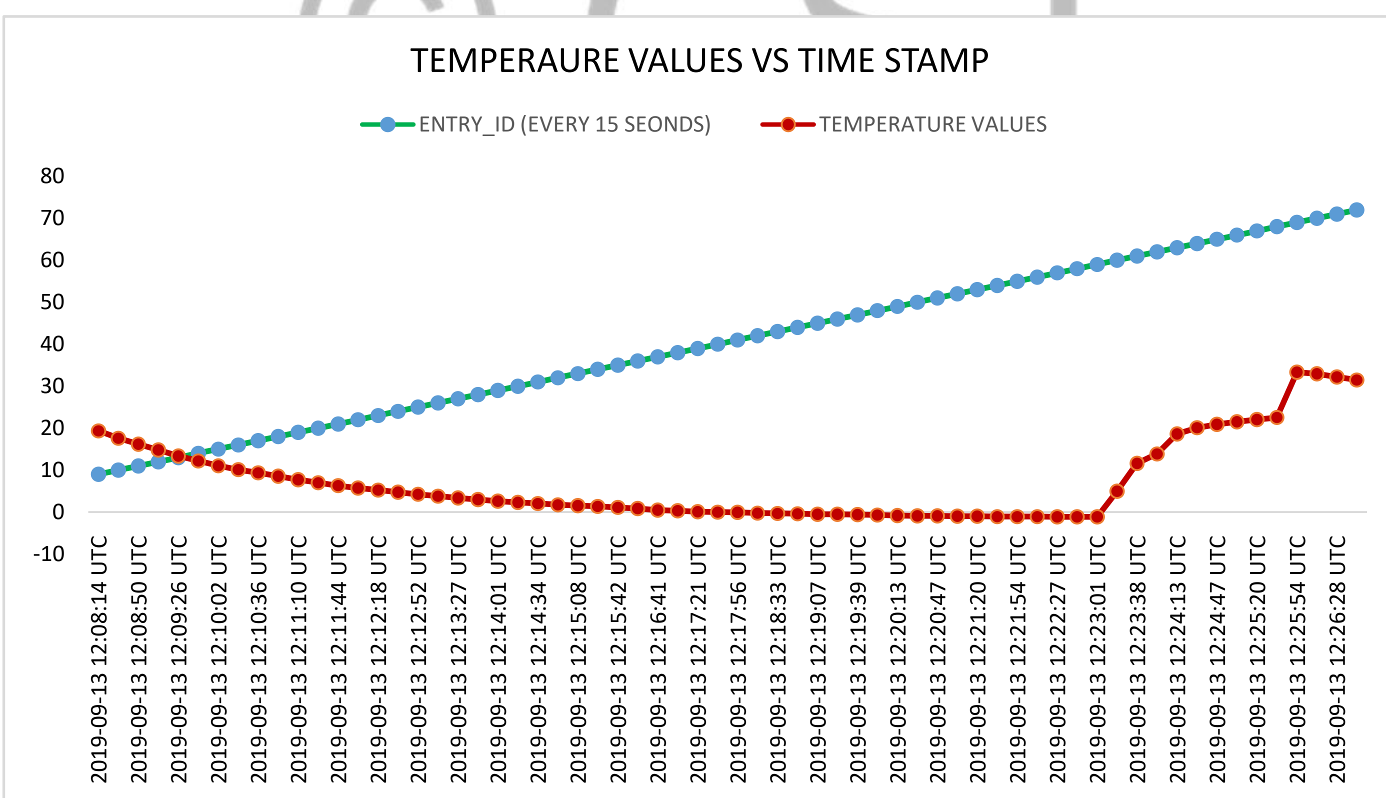

Fig 3.5 Graph of Temperature versus Entry ID and Date (from entry id no 101- 200).

4. Conclusion

This paper presents a monitoring system of real-time which was designed and constructed to monitor a patient's temperature via LM35. Also, the design and construction of a triage system was realized to alert the physician of critical changes in the patient's vital signs. Additionally, LEDs of different colors were used to indicate changes in parameters. The simulation of the circuit was designed, tested and run on PROTEUS software.Furthermore, microcontroller was incorporated using the Arduino device, which receives the signal from the sensor and transmits it to the LCD, this aids in detecting the changes in parameters. More so, the signal gotten and transmitted by the Arduino can be viewed over the cloud, which can be accessible through a given URL.

Finally, the construction of the microcontroller-bases patient's vital signs monitoring device was a huge success. It was tasking to obtain the required and associated concepts. However, after some rigorous efforts, a functional and workable design was conceived, implemented, actualized and finally constructed. vital signs monitoring device

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