Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF IOT TEMPERATURE MEASUREMENT SYSTEM BY USING INFRARED THERMAL IMAGING CAMERA

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Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

2022

DEVELOPMENT OF IOT TEMPERATURE MEASUREMENT SYSTEM BY USING INFRARED THERMAL IMAGING CAMERA

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A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

BORANG PENGESAHAN STATUS LAPORAN
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Tajuk Projek : DEVELOPMENT OF IOT TEMPERATURE MEASUREMENT SYSTEM BY USING INFRARED THERMAL IMAGING CAMERA

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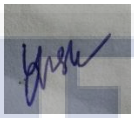
Signature : 

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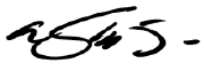
Signature : 

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DEDICATION

I would like to dedicate this research to my beloved mother for helping me financially to make this project successful. Most importantly, my supervisor Madam Aziean Binti Mohd Azize who helped me throughout the project building. Next, my BEET friends who has supported me throughout the journey.

ABSTRACT

This project targets to create a contactless temperature reader. This project primarily uses infrared radiation, a wireless technique that accurately measures a person's body temperature by imaging them. The MLX90640 sensor is a thermal sensor with temperature detection capabilities, is developed in this project to detect the human body temperature. The ESP32 is used to play the major role to process data. The main reason of developing this project is to measure publics body temperature which contactless. Then, the accuracy of the developed device is also compared with the gun thermometer. At the end of this project a device that is contactless will read a human body temperature using infrared radiation is expected. Moreover, the display module will display the human temperature whether it is normal or risky is also expected.

ABSTRAK

Projek ini bertujuan untuk mencipta pengimbas suhu inframerah tanpa sentuh. Projek ini terutamanya menggunakan sinaran inframerah iaitu suatu teknik tanpa wayar yang mengukur suhu badan seseorang dengan tepat dengan pengukuran suhu pengimejan haba. Sensor MLX90640 adalah sensor termal yang mempunyai keupayaan pengesanan suhu. Sensor ini dikembangkan dalam projek ini untuk mengesan suhu badan manusia. ESP32 digunakan untuk memainkan peranan besar untuk memproses data. Sebab utama pembangunan projek ini adalah untuk mengukur suhu badan orang ramai yang tidak bersentuhan. Selain itu, ketepatan peranti yang dicipta juga dibandingkan dengan termometer pistol. Pada akhir projek ini, kami menjangkakan sebuah peranti tanpa sentuh yang mengukur suhu badan manusia dengan menggunakan sinaran inframerah. Bukan itu sahaja, kami juga menjangkakan modul paparan pada peranti tersebut yang akan memaparkan sama ada suhu manusia normal atau berisiko.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my supervisor, Madam Aziean Binti Mohd Azize and for her precious guidance, words of wisdom and patient throughout this project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) and mother for the financial support which enables me to accomplish the project. Not forgetting my fellow colleague, BEET fellow mates for the willingness of sharing his thoughts and ideas regarding the project.My highest appreciation goes to my parents, and family members for their love and prayer during the period of my study.

Finally, I would like to thank all the staffs at the UTeM, fellow colleagues and classmates, the Faculty members, as well as other individuals who are not listed here for being co-operative and helpful.

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LIST OF SYMBOLS

℃	-	Degree Celcius
I	-	Current
A	-	Ampere
Hz	-	Hertz
HEX	-	Hexadecimal
PPM	-	Part Per Million

LIST OF ABBREVIATIONS

MCU	-	Microcontroller unit
APP	-	Application
RTOS	-	Real Time Operating system
Wi-Fi	-	Wireless Fidelity
CMOS	-	Complementary Metal-Oxide-Semiconductor
Pt	-	Platinum
MOSFET	-	Metal-oxide-semiconductor field-effect transistor
BJT	-	Bipolar Junction Transistor
IC	-	Integrated Circuit
ADC	-	Analogue to digital converter
MEMS	-	Microelectromechanical system
MQTT	-	Message Queue Telemetry Transport
LCD	-	Liquid-crystal display
BLE	-	Bluetooth Low Energy
FIR	-	Finite Impulse Response
RAM	-	Random Access Memory
IR	-	Infrared
Ta	-	Ambient Temperature
IoT	-	Internet of Things
USB	-	Universal Serial Bus
TTL	-	Transistor-Transistor Logic
CPU	-	Control Process Unit

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CHAPTER 1

INTRODUCTION

1.1 Project Background

2020 has become the year that the world has been affected by the COVID-19 pandemic. It has affected the normal social commingling of the society. The daily lifestyle has changed over this one year. 3s' has become the new norm which is the social distancing, safety protocols and sanitising. Government has set different safety protocols to break the covid-19 chain. One of the rule is to scan MYSEJAHTERA APP and to always check body temperature before entering any premises. This is to avoid the symptomatic people from entering public places. A normal body temperature should be 36.1 ºC to 37.2 ºC. Body temperatures that are more than 38 ºC are strictly prohibited from entering any public places. Thus, a proper device is probably important in today's situation to monitor the temperature of the public.

The traditional way of measuring a body temperature is stopping us from practicing the social distancing and physical touch. Having that on mind, the fundamental of this project has been developed. The fundamental plan of this project is to develop an intelligent device that is capable of reading the body temperature without the physical touch. Moreover, it allows the public to follow the standard operation procedure that has been set by the government. Based on the development, analysis and studies been carried out so that it could replace the traditional method of body temperature measurement. This project essentially eliminates the disadvantage of using the traditional method of measuring the body temperature of a person.

This project basically uses the infrared radiation which is the wireless technology precisely measures the body temperature by imaging a person. MLX90640 sensor is the thermal sensor that has features that detects the temperature. This sensor has been developed integrated to this project to detect the human body temperature that helps in the new normal lifestyle that the world is going through.(Mandal & Song, 2015) Besides, a ESP32 microcontroller chip has been used in this project whereby it is integrated with Wi-Fi and dual mode Bluetooth. This MCU chip is system which is the real time operating system (RTOS). (Mercer et al., n.d.)This chip is helpful in processing the data and it is playing the major role on the device. Last but not least, the display module which is the RASPBERRYPI that displays the temperature and comments a person weather it is a normal body temperature or risky temperature. This display module is essentially a touch screen module that is probably being the finest technology of today's world.

This project helps in making the temperature scanning process smooth. This device can be installed in the entrance of a premises. Moreover, this idea can be infused in a surveillance camera that would help to monitor people in a parameter from distance.

1.2 Problem Statement

The world is now facing a major problem that needs a solution right away. The pandemic now is causing many lives into a risk. The government is taking various decisions to break the covid-19 chain. The movement control order is one of the finest way to prevent an outbreak in our country. Restricting the movement of the public could reduce the corona virus spread. At the same time people will always need to go outside to continue their daily life. Considering everything in mind the best decision that can be made is by filtering the people with critical temperature. People with critical temperature might be carrying the corona virus that can cause the pandemic worse.

Traditional way of reading temperature is not applicable in today's world. An alternate solution has to be developed in order to overcome this problem by providing assistance. Development of the advanced technology for this might be useful to adapt the new normal that the world need to follow. The traditional way will lead a person to unavoidably to have physical contact to a person. Moreover, it will also allow the spread of corona virus.

Today thermometer gun is used widely to take temperature of people entering public places. But there will be a need for the owners to employ a person to take care of it. Nowadays the gun thermometer is left at the entrance of the premises. Which has been used by the previous person. Without realising the next person would touch the same gun thermometer. Negligence of the public might risk a lot of people life.

1.3 Project Objective

The main aim of this project is to propose a device that can scan a publics body temperature.

Specifically, the objectives are as follows:

a) To design a contactless body thermal reading device using infrared imaging camera.

b) To develop the device that can contactlessly reads public's body temperature.

c) To analyse the performance of the developed device.

1.4 Scope of Project

The scope of this project is project primarily utilizes infrared radiation, a wireless technology. The MLX90640 sensor is a thermal sensor with temperature detection capabilities. This sensor was created as part of this project to detect human body temperature, which aids in the transition to a new normal lifestyle that the world is experiencing. ESP32 is part of chip that runs in real time operating system (RTOS). This chip aids in data processing and is an important component of the device.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will portray about the study made before executing the project work. This is to learn more about the project background and to understand more about the technical research that has been done previously. This will enhance the project work and will help in making the objectives accomplishment.

2.2 Previous Research review

Previous Research review will give a clear understanding of the project development. The previous research will give an idea on how to develop the project. This will smoothen the process.

2.2.1 CMOS Smart Temperature Sensor(Law et al., 2016)

Wearable or implantable biomedical technologies that can enable long-term monitoring for detecting essential aberrant bodily conditions are becoming increasingly popular with the goal of enhancing human healthcare. Temperature sensing with great accuracy is commonly required in such systems, as it is one of the most significant physiological indicators. Human body temperature sensors should have an accuracy of 0.1°C between 37°C and 39°C, and 0.2°C both below 37°C and above 39°C, according to. The temperature sensor should ideally have ultra-low power consumption to achieve a long operating lifetime at a low cost. These strict application-specific criteria necessitate the development of low-power, high-accuracy smart temperature sensors. Traditional

temperature sensors are large, high-power discrete devices like thermistors, platinum resistors, and Pt wire that are incompatible with the CMOS process. Because the sensor interface and readout circuitry can be easily built in a single chip, smart temperature sensors based on low-cost standard CMOS technology are becoming increasingly common giving a digital temperature readout that is easy to understand.

Two types of common temperature sensor devices, MOSFET and BJT, have been extensively explored in CMOS technology. Due to the wide range of gate oxide thickness and channel doping in MOSFETs, two-point calibration is required for good sensing accuracy. It is unsuitable for mass manufacturing due to the imposed additional production expense. With only one-point calibration, BJT-based sensors have been shown to be more precise, with an error of less than 0.2 °C. A high precision reading circuit is required to reach this degree of accuracy.

A CMOS temperature sensor with excellent precision and ultra-low power consumption is devised in this study, making it particularly appropriate for passively-powered clinical temperature monitoring applications where the human body temperature can be recorded non-invasively. In this study, it is proposed integrating a multi-ratio pre-gain stage (k14) to amplify the temperature signal while providing an offset to prevent integrator saturation under low voltage operation, rather than employing a fixed pre-gain stage as in traditional temperature sensor designs. The I-ADC requirement is also relaxed because only a moderate resolution (e.g. 12-bit for 0.1°C) is required. Figure 2.1 below shows how the conventional and smart temperature worked with per gain stage.

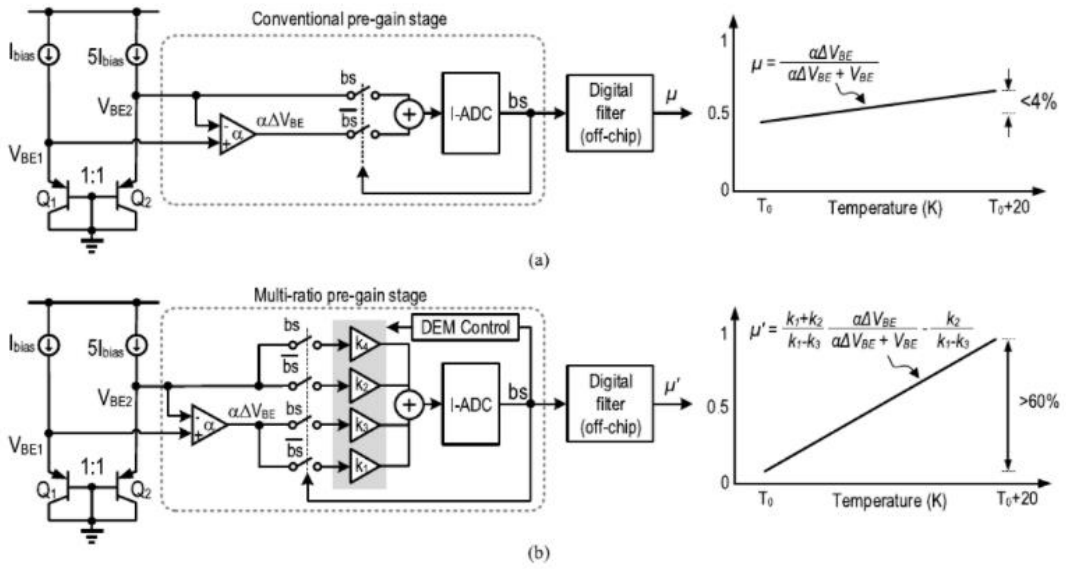

Figure 2. 1 Block diagram of (a) conventional and (b) smart temperature sensor with multi-ratio pre-gain stage(Law et al., 2016)