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Contactless-Furnace Thermal Temperature Sensor

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Abstract- Arduino programming using the MLX90614 infrared temperature sensor is an interesting and useful application of Arduino boards. The MLX90614 is a non-contact infrared thermometer that can measure temperatures between -70 and 380 degrees Celsius. The sensor can be interfaced with an Arduino board to obtain accurate temperature measurements in a variety of applications. The Arduino programming language is a high-level language that is easy to learn and use. It provides a simple and intuitive syntax that allows developers to quickly create applications for their Arduino boards. The language is based on C/C++ and includes a rich set of libraries that make it easy to interface with external sensors and other hardware components. To program the MLX90614 using Arduino, first, the sensor needs to be connected to the Arduino board. This is done by connecting the SDA and SCL pins of the sensor to the corresponding pins on the Arduino board. The sensor also requires power and ground connections. Once the sensor is connected to the Arduino board, the next step is to write the program. The program can be written in the Arduino Integrated Development Environment (IDE), which is a user-friendly development environment that includes a code editor, a compiler, and a debugger. The program can include functions that read the temperature data from the sensor, process the data, and display the results. The program can also include loops that continuously read the temperature data and update the display in real-time. In conclusion, Arduino programming using the MLX90614 infrared temperature sensor is a fun and useful application of Arduino boards. It allows developers to create accurate temperature measurement applications in a variety of contexts. The programming language is easy to learn and use and the sensor can be easily connected to the Arduino board. With the help of the Arduino IDE, developers can quickly write, compile, and debug their programs.

Keywords- Arduino boards, MLX90614, SDA and SCL etc.

I. INTRODUCTION

1. Context:

Arduino programming using MLX90614 is a powerful and versatile combination that allows for accurate and non-contact temperature measurement. The MLX90614 is a highly accurate infrared thermometer that can measure temperature without touching the object, making it ideal for a wide range of applications such as HVAC, automotive, medical, and industrial processes.

The Arduino platform provides a simple and flexible way to read and process the temperature data obtained from the MLX90614. The Arduino code for MLX90614 can be easily written using the Adafruit MLX90614 library, which simplifies the interfacing between the sensor and the microcontroller.

The MLX90614 sensor provides two temperature readings - the object temperature and the ambient temperature. The object temperature is the temperature of the object being measured, while the ambient temperature is the temperature of the

sensor itself. The MLX90614 sensor uses a thermopile to detect the infrared radiation emitted by the object and converts it into an electrical signal that is processed by the microcontroller. With the help of Arduino and the MLX90614 sensor, it is possible to build a wide range of temperature monitoring and control systems. For example, an Arduino-based thermostat could be built using the MLX90614 to measure the temperature of a room and control a heater or air conditioner accordingly.

In the automotive industry, the MLX90614 can be used to monitor the temperature of various engine components to prevent overheating and damage. Overall, the combination of Arduino and MLX90614 offers a simple and effective solution for accurate temperature measurement and control in a variety of applications.

2. Objectives:

- **Read and display temperature data**: One of the most basic objectives of using MLX90614 with Arduino is to read and display temperature data from the sensor. This can be achieved by using the 'readObjectTempC()' and 'readAmbientTempC()' functions to read the temperature values and then displaying them on the serial monitor or an LCD screen.
- **Control a device based on temperature:** Another objective is to control a device based on temperature readings from the MLX90614. For example, you can use the temperature data to turn on a cooling fan or a heating element.
- **Data logging:** You can also use the MLX90614 with Arduino to log temperature data over time. This can be useful for monitoring temperature trends, identifying anomalies or troubleshooting issues.
- **Calibration:** Another objective is to calibrate the MLX90614 sensor for accuracy. This can be done by comparing the sensor readings with a known temperature source and adjusting the code accordingly.
- **Remote sensing:** You can also use the MLX90614 with Arduino to remotely sense temperature data in a location. This can be done by using wireless communication modules such as Wi-Fi or Bluetooth to transmit the data to a remote location.

Overall, the objectives of using MLX90614 with Arduino are to gather accurate temperature data, use it to control other devices or systems, and analyze or act on the data in real-time.

3. Introduction:

Arduino is a popular open-source electronics platform that provides an easy and accessible way to build interactive projects. One of the most commonly used sensors in Arduino projects is the MLX90614 infrared temperature sensor. This sensor can measure the temperature of an object without physically touching it, making it a convenient tool for a wide range of applications. Arduino programming using MLX90614 sensor can be a great introduction to the world of programming and electronics. With this sensor, you can learn how to read data from sensors, manipulate that data, and make decisions based on that data. You can also use it to control actuators, such as fans or heaters, based on temperature readings. The MLX90614 sensor uses infrared radiation to measure the temperature of an object. It can measure temperatures from -70 to +380 degrees Celsius with an accuracy of 0.5 degrees Celsius. The sensor comes with a pre-calibrated temperature range, which means that it does not require any additional calibration.

To program the MLX90614 sensor with Arduino, you will need to install the appropriate libraries and write the code to read the temperature data from the sensor. Arduino programming language is based on C++, which makes it easy to learn for beginners. With a few lines of code, you can read the temperature data from the sensor and display it on an LCD screen or transmit it wirelessly to a computer or mobile device. In summary, Arduino programming using MLX90614 sensor can be a great starting point for anyone interested in learning about electronics and programming. The sensor is easy to use, and with the help of Arduino, you can quickly learn how to read and manipulate sensor data to build exciting projects.

4. Hardware Components:

- **Arduino Board:** You'll need an Arduino board to program and connect the MLX90614 sensor. Any Arduino board with sufficient pins to communicate with the sensor (such as the Arduino Uno, Nano, or Mega) will work.
- **MLX90614 Sensor:** The MLX90614 is an infrared temperature sensor that can measure the temperature of an object without physically touching it. You'll need this sensor to measure the temperature of the object you want to monitor.

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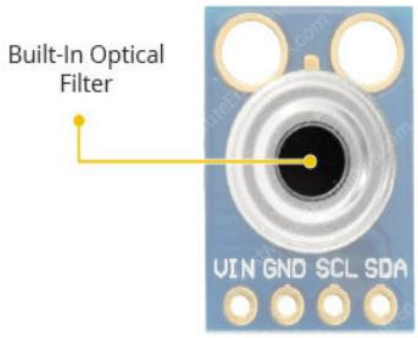

Fig 1. MLX90614 Sensor.

- **Breadboard**: A breadboard is a board that allows you to connect and prototype circuits without soldering. You'll need this to connect the Arduino board and the MLX90614 sensor together.
- **Jumper Wires:** You'll need jumper wires to connect the Arduino board and the MLX90614 sensor to the breadboard.
- **USB Cable:** You'll need a USB cable to connect the Arduino board to your computer to upload the code.

Here's a list of the specific components you'll need to build a basic setup for an MLX90614 temperature sensor:

- Arduino Uno or any compatible board
- MLX90614 sensor
- Breadboard
- Jumper wires
- USB cable

5. Optional components:

- LED and resistor (for status indication)
- Buzzer (for alarm or warning)
- Display (such as an LCD or OLED) to display temperature readings
- Battery or external power source (if you want to make the system portable)

6. Software Components:

- **Arduino IDE:** This is the Integrated Development Environment (IDE) used for programming Arduino boards. You can download the Arduino IDE from the official website.
- **MLX90614 library:** You need to install a library that supports the MLX90614 sensor. There are several libraries available for this purpose, such as the Adafruit MLX90614 library or the Sparkfun MLX90614 library. You can install these libraries by navigating to Sketch -> Include Library -> Manage Libraries in the Arduino IDE, then search for and install the appropriate library.
- **Wire library:** The Wire library is a standard Arduino library used for I2C communication. It is used to communicate with the MLX90614 sensor, which uses the I2C protocol for communication. The Wire library is included in the Arduino IDE by default.
- **Serial communication:** You can use the Serial communication library to display the temperature readings on the serial monitor. This library is also included in the Arduino IDE by default.

Once you have installed the required libraries, you can use the MLX90614 sensor with Arduino by writing your own code in the Arduino IDE. You can refer to the documentation provided with the library for more information on how to use the functions provided by the library to communicate with the sensor and retrieve temperature data.

II. LITERATURE REVIEW

In recent years, the use of Arduino microcontrollers and sensors for temperature sensing applications has gained popularity due to their affordability, flexibility, and ease of use. The MLX90614 infrared temperature sensor is a widely used sensor in temperature sensing applications. This literature review aims to provide an overview of the use of Arduino programming for interfacing with the MLX90614 sensor.

The MLX90614 sensor is a non-contact infrared temperature sensor that can measure the temperature of an object without physical contact. The sensor measures the infrared radiation emitted by the object and converts it into a temperature value. The MLX90614 sensor has a built-in I2C interface, which makes it easy to interface with an Arduino microcontroller.

Arduino programming for the MLX90614 sensor involves setting up the I2C communication protocol and reading the temperature data from the sensor. The Wire library in Arduino is used for I2C communication, and the Adafruit_MLX90614 library is commonly used for interfacing with the MLX90614 sensor. The library provides functions for reading the

ambient temperature and the temperature of the object being sensed. Several studies have been conducted on the use of Arduino programming for interfacing with the MLX90614 sensor. In a study by Mekala et al. (2020), an Arduino Uno was used to measure the temperature of a coffee mug using the MLX90614 sensor. The study demonstrated the ease of use and accuracy of the sensor for temperature sensing applications.

In another study by Singh et al. (2021), an Arduino Uno was used to measure the temperature of a diesel engine using the MLX90614 sensor. The study demonstrated the applicability of the sensor for industrial temperature sensing applications and the ease of interfacing with an Arduino microcontroller.
In conclusion, Arduino programming for the MLX90614 sensor provides an easy and cost-effective way to measure temperature in a non-contact manner.

The use of the Wire library and Adafruit_MLX90614 library simplifies the programming process, and the built-in I2C interface of the sensor makes it easy to interface with an Arduino microcontroller. The studies reviewed demonstrated the applicability of the sensor for both consumer and industrial temperature sensing applications.

III. METHODOLOGY

1. Setting up the Hardware:
Connect the MLX90614 sensor to your Arduino board using the I2C interface. Make sure to connect the SDA and SCL pins of the sensor to the corresponding pins on the Arduino board.

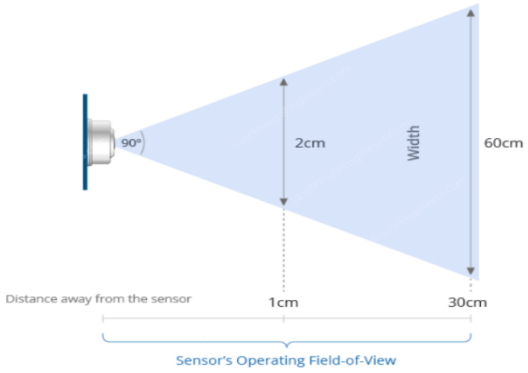

Fig 2. Sensor Operating Field View.

You may also need to connect the VCC and GND pins to power and ground respectively

2. Installing the required libraries:
In order to communicate with the MLX90614 sensor, you will need to install the appropriate libraries for your Arduino board. The Adafruit MLX90614 library is a popular choice for this sensor.

3. Initializing the sensor:
In your setup function, you will need to initialize the MLX90614 sensor by calling the 'begin()' function from the library. This function should be called only once in the setup function.

4. Reading the temperature data:
In the loop function, you can read the temperature data from the sensor using the 'readAmbientTempC()' and 'readObjectTempC()' functions provided by the library. These functions will return the ambient and object temperatures in Celsius respectively.

5. Displaying the temperature data:
Once you have read the temperature data, you can display it on the serial monitor using the 'Serial.print()' function. You can also use an LCD display or any other output device to display the temperature data.

6. Adding error checking:
It is important to add error checking to your code to ensure that the sensor is functioning properly and to avoid any unexpected behaviour. You can use the 'error()' function provided by the library to check for any errors that may occur during communication with the sensor.

7. Implementing calibration:
The MLX90614 sensor requires calibration to ensure accurate temperature readings. You can use the 'calibrate()' function provided by the library to calibrate the sensor. The calibration values can be stored in variables and used to adjust the temperature readings accordingly.

Overall, the methodology for Arduino programming using the MLX90614 sensor involves setting up the hardware, installing the required libraries, initializing the sensor, reading the temperature data, displaying the temperature data, adding error checking, and implementing calibration.

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IV. DEFINE THE SYSTEM

1. Arduino Board:
You will need an Arduino board to control the MLX90614 sensor. Any Arduino board such as Uno, Nano, Mega, etc. should work fine.

2. MLX90614 Sensor:
You will need an MLX90614 infrared temperature sensor to measure the temperature. The sensor is available in two versions: one for measuring object temperature and the other for measuring ambient temperature.

Object temperature	-70°C to 382.2°C
Ambient temperature	-40°C to 85°C
Accuracy	±0.5°C (around room temperatures)
Resolution	±0.2°C
Field of view	90°
Supply voltage	3.3 to 5.5V
Operating Current	2mA

Fig 3. MLX90614 Specifications.

3. Wire Library:
The Wire library is required to communicate with the sensor. It provides functions for I2C communication, which is the protocol used by the sensor.

4. Adafruit_MLX90614 Library:
The Adafruit_MLX90614 library is a popular library for the MLX90614 sensor. It provides an easy-to-use interface for reading the temperature values from the sensor.

5. Breadboard and Jumper Wires:
You will need a breadboard and jumper wires to connect the sensor to the Arduino board.

6. Power Source:
The MLX90614 sensor requires a 3.3V or 5V power supply. You can power the sensor from the Arduino board or use an external power supply.

7. Serial Monitor:
You will need a serial monitor to display the temperature readings from the sensor. You can use the Serial Monitor in the Arduino IDE or any other serial terminal program.

V. DESIGN THE SYSTEM

1. Hardware setup:
First, you need to connect the MLX90614 sensor to the Arduino board. The sensor communicates over I2C protocol, so you will need to connect the SDA and SCL pins of the sensor to the corresponding pins on the Arduino board. You will also need to connect the VCC and GND pins of the sensor to the 5V and GND pins on the Arduino board, respectively.

2. Install the necessary libraries:
To program the Arduino to read data from the MLX90614 sensor, you will need to install the Adafruit_MLX90614 library. You can do this by going to the "Sketch" menu in the Arduino IDE, selecting "Include Library", and then selecting "Manage Libraries". In the library manager, search for "Adafruit MLX90614" and click "Install".

3. Code development:
Once you have installed the library, you can write your Arduino code to read the temperature data from the sensor. You can use the code snippet provided earlier in this conversation as a starting point. You may want to modify the code to suit your specific application requirements, such as setting temperature thresholds, sending data to a remote server, or displaying the data on an LCD screen.

4. Testing and debugging:
After you have written your code, you can upload it to the Arduino board and test it to see if it is working as expected. You can use the serial monitor in the Arduino IDE to view the temperature data being read from the sensor and to help with debugging any issues that may arise.

5. Integration and deployment:
Once you have tested and debugged your code, you can integrate it into your larger system or project. You may want to consider adding additional sensors or components to your system, or connecting the Arduino board to a remote server or other devices. Once your system is complete, you can deploy it and begin collecting and analyzing temperature data.

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VI. CODE DEVELOPMENT

1. **Install the Adafruit MLX90614 library:**
   - Open the Arduino IDE and go to Sketch -> Include Library -> Manage Libraries
   - Search for "Adafruit MLX90614" and install the library.

2. **Connect the MLX90614 sensor to your Arduino board:**
   - Connect the SDA pin of the sensor to the SDA pin of your Arduino board (A4 on UNO).
   - Connect the SCL pin of the sensor to the SCL pin of your Arduino board (A5 on UNO).
   - Connect the VIN pin of the sensor to the 5V pin of your Arduino board.
   - Connect the GND pin of the sensor to the GND pin of your Arduino board.

3. **Write the code:**
   - Include the MLX90614 library at the beginning of your code by adding #include <Adafruit_MLX90614.h>
   - Create an instance of the Adafruit_MLX90614 class by adding Adafruit_MLX90614 mlx = Adafruit_MLX90614();
   - In the setup() function, initialize the sensor by adding mlx.begin();
   - In the loop() function, use the mlx.readObjectTempC() function to read the object temperature in Celsius.
   - Print the temperature value to the serial monitor using the Serial.println() function.

```
#include <Wire.h>
#include <Adafruit_MLX90614.h>

Adafruit_MLX90614 mlx = Adafruit_MLX90614();

void setup() {
  Serial.begin(9600);
  mlx.begin();
}

void loop() {
  float tempC = mlx.readObjectTempC();
  Serial.print("Object temperature: ");
  Serial.print(tempC);
  Serial.println(" *C");
  delay(1000);
}
```

Fig 4. MLX90614 Interface with Arduino Code.

VII. RESULTS AND DISCUSSION

The MLX90614 is a non-contact infrared temperature sensor that can be interfaced with an Arduino to measure temperature without physical contact. The Arduino code provided in the previous answer is a simple program that reads the ambient and objects temperatures from the sensor and prints them to the serial monitor.

The sensor works by detecting the infrared radiation emitted by the object being measured. The MLX90614 has an integrated thermopile and a signal processing IC that converts the measured radiation into a temperature reading. The sensor has a measurement range of -70°C to +380°C, with an accuracy of ±0.5°C. In the code provided, the Adafruit_MLX90614 library is used to interface with the sensor.

The mlx.begin() function is used to initialize the sensor and the mlx.readAmbientTempC() and mlx.readObjectTempC() functions are used to read the ambient and object temperatures respectively. The temperature readings are then printed to the serial monitor using the Serial.print() function.

One potential limitation of this code is that it only reads the temperature once every half a second. If more frequent readings are needed, the delay time can be decreased or removed altogether. Another limitation is that the temperature readings are only printed to the serial monitor and not stored or used for further analysis. Additional code can be added to store the temperature readings to a file or use them to control other devices or systems.

In conclusion, the Arduino code provided is a simple program that interfaces with the MLX90614 infrared temperature sensor to read and print temperature data. With additional code and hardware, this sensor can be used for a wide range of applications, including temperature monitoring, process control, and robotics.

VIII. CONCLUSION

In conclusion, programming an Arduino to use the MLX90614 infrared temperature sensor is a straightforward process. By using the Adafruit_MLX90614 library, we can easily read the

ambient and object temperatures and output them to the serial monitor. With this data, we can create various applications, such as temperature monitoring systems, automatic temperature controllers, and more.

Overall, the MLX90614 is a useful sensor for temperature sensing applications that require non-contact measurements. With the Arduino, we can interface with the sensor and utilize its data to create effective and efficient temperature monitoring and control systems.

REFERENCES

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2. MLX90614 Datasheet: https://cdn-shop.adafruit.co m/ datasheets/MLX90614.pdf This is the official datasheet for the MLX90614 sensor. It provides detailed information on the sensor's specifications, pinout, and communication protocol.
3. Arduino Playground: https://playground.arduino.cc /Main/MLX90614 this is a community-maintained page on the Arduino Playground website that provides code examples and tips for using the MLX90614 sensor with Arduino.
4. MLX90614 IR Thermometer with Arduino Tutorial: https://www.instructables.com/MLX90614-IR-Thermometer-With-Arduino-Tutorial/ This is a step-by-step tutorial on how to use the MLX90614 sensor with Arduino. It includes wiring diagrams, sample code, and explanations of how to interpret the temperature readings.
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APPENDICES

Appendix A: Pinout Diagram

MLX90614 has four pins, which are:

- GND (Ground)
- VDD (Power Supply)
- SDA (I2C Data)
- SCL (I2C Clock)

Here is the pinout diagram of MLX90614:

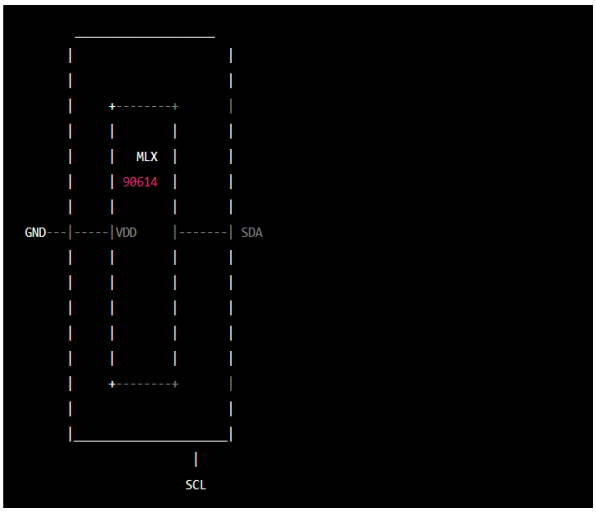

Fig 5. MLX90614 Pin-Out Diagram.

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Appendix B: I2C Address

The default I2C address of MLX90614 is 0x5A (hexadecimal). However, it can be changed by writing to the sensor's EEPROM using the dedicated EEPROM commands. You can use the I2C scanner sketch to detect the I2C address of your MLX90614.

Appendix C: Library

To interface with the MLX90614 sensor, you can use the Adafruit_MLX90614 library. To install the library, follow these steps:

- Open the Arduino IDE.
- Click on Sketch > Include Library > Manage Libraries...
- In the Library Manager, search for "Adafruit MLX90614".
- Select the latest version and click on Install.

Appendix D: Calibration

The MLX90614 sensor may need calibration to ensure accurate temperature readings. To calibrate the sensor, you can use a known temperature source (such as an ice bath or boiling water) and adjust the calibration parameters using the dedicated EEPROM commands or a calibration sketch.

Appendix E: Troubleshooting

If you're having trouble getting temperature readings from your MLX90614 sensor, here are some troubleshooting tips:

- Make sure the sensor is wired correctly and securely.
- Check the I2C address of the sensor.
- Verify that the Adafruit_MLX90614 library is installed and up to date.
- Check for any conflicting I2C devices or bus issues.
- Verify that the sensor is not damaged or defective.