JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Smart mirror using raspberry Pi

Kshitish Tembhekar, Rohit More, Yash Nashte, Viren Rahane

Mechanical Department, SPPU University

Kshitishtembhekar7@gmail.com
rohitmore2502@gmail.com
yashnashte@duck.com
virenrahane@gmail.com

Abstract— In recent years personal health monitoring systems have been gaining popularity, both as a result of the pull from the general population, keen to improve well-being and early detection of possibly seri- ous health conditions and the push from the industry eager to translate the current significant progress in computer vision and machine learning into commercial products. One of such systems is the Smart Mirror. The project aims to translate the semeiotic code of the human face into computational descriptors and measures, automatically extracted from videos, multispectral images, and 3D scans of the face. The multisensory platform, being developed as the result of that project, in the form of a smart mirror, looks for signs related to cardio-metabolic risks. The goal is to enable users to self-monitor their well-being status over time and improve their life-style via tailored user guidance. The project describes the concepts, methods and the developed implementations as well as reports on the result s obtained on both real and synthetic datasets.

This project depicts the design and development of a smart mirror that represents an elegant interface for glancing information and also used for thief detection in a home environment. A smart mirror is a system that functions as a mirror with additional capability of displaying date, time, current temperature, weather details; it also can be used to display vital signs like heart rate and skin temperature. To design a smart mirror that receives online news an d displays it using Internet of things (IoT) circuitry and to detect thieves when nobody is at home. Main Objective of this mirror is that it can be used to measure vital signs of users. In Last two years i nfrared t hermal cameras/ sensors have been applied i n contactless thermometers for the screening of patients with suspected infectious disease. However these contactless vital signs monitoring devices are limited to large facilities and healthcare. This study aims to develop and evaluate smart mirrors which use “infrared thermal sensor ” and “Visible Spectrum (RGB) cameras” to monitor vital signs of users which can be deployed in every home. With this technology in every house users can keep a tab of their vital signs everyd ay from their home itsel f witho ut any extra nee d of he althca re equip ment.

INTRODUCTION

1.1 Problem statement

A healthy lifestyle has become universally recognized as a key factor in disease prevention. Efforts at promoting lifestyle improvements are now considered as a viable and effective way for reducing the incidence of pathologies, such as cardiovascular diseases and metabolic disorders. This coupled with the more active role people aspire to have, so as to shift from passive recipients of care towards actively managing their own health, has opened a new important prevention realm for the assistive technologies. The health related self-monitoring and self-assessment are gaining momentum. Many personal well-being and fitness monitoring tools are available on the market, mainly in the form of wearable devices such as wristbands, smart - watches, eye wear and wearable bio - monitors, as well as dedicated apps on smart - devices such as My Fitness Pal, Endomondo, Argus, Google Fit. It has been shown that these technologies are predominantly embraced by the younger generation (25 – 34 years old) focused on fitness, and the older users (55 – 64 years old) mainly interested in improving overall health with the aim of improving the quality of life and the life expectancy. Interestingly, in contrast with the increasing acceptance of wearables, many consumers stop using the device within six months. Usually, the increase in temperature of an individual indicates the possibility of being infected with a disease that might be risky to other people, such as coronavirus. Traditional techniques for monitoring body core-temperature require body contact either by oral, rectum, axillary, or tympanic means, which are unfortunately considered intrusive in nature as well as causes of contagion. Therefore, sensing human core- temperature non-intrusively and remotely is the objective of this research. This project has been developed with the idea of making home smart to save time. The Internet transformed our lives by connecting us more easily to information and other people in the virtual world. The state of innovation currently is to provide more information with less interaction to get it. The device that has been researched and designed is called Smart Mirror. It is a wall mounted mirror which displays relevant items to the user such as weather, time, date, temperature, humidity and news.

1.2 Objectives

To develop a smart mirror integrating different sensors, collecting multidimensional data of individuals standing in front of the mirror. The data is processed by dedicated algorithms, which can extract the temperature of the object standing in front. The descriptors are integrated to define a virtual individual model for a wellness index traced over time. The Mirror also offers suggestions and coaching messages, with personalized user guidance, aimed at achieving and then maintaining a healthy life-style. The guiding principle behind the design of the smart Mirror has been that it should easily fit into daily- life settings, by *maximizing* non- invasive . The focus of this project is on a subset of sensors, methods and processes deployed on the smart Mirror using medical semeiotics signs. The principle of medical semeiotics considers the face as an important source of information about the health status of individuals. The description of an overall concept of the inexpensive device for self-monitoring and assessment of well-being to promote, im- prove and maintain a healthy lifestyle is the key novel contribution of this paper. The other technical contributions are linked to different subsystems integrated on the mirror.

1.3 Scope :

The project can be used with other technical contributions which can be linked to different subsystems integrated on the mirror, these include: use of the Kalman filter in conjunction with the random forest for face pose predictions; the processing pipeline integrating face tracking, 3D pose estimation, segmentation, range data scans alignment and fu- sion for efficient and robust 3D face reconstruction; estimation of body weight and body weight variations using geometric features extracted from the 3 D reconstruction of the face; the fusion of mo - tion features from different facial areas for the assessment of the psychological state with focus on stress and anxiety.

1.4 Methodology

1. Smart Mirror As A Mirror:

We can see our view as we can see it in a natural mirror while looking and groomingwith the help of a one way mirror with high concentration of aluminium content.

2. Smart Mirror As A Information System

Time, Date, weather details and news are fetched from online using predefined URL.

News is fetched from websites

like CCN, BBC etc. A DHT22 digital sensor is used to get the humidity and temperature details. DHT22 is connected to GPIO pins of Raspberry Pi board usingjumpers.

3. Smart Mirror As Security System

When there is nobody in home it can be switched into a security system by using a VNC viewer to detect human presence. When someone enters into room, PIR sensorwill detect the movement of the person when he passes by the mirror and capture theimage and stores it in the drop box

Also informs the owner by updating captured images in the dropbox ,by this way smartmirror systems can also be used as a security system.

4. Algorithm For Information System

○ Step 2: Get the date, time, and weather details predefined from the URL.
○ Step3: Get the news from www.zeenews.com
○ Step 4: In the code section write down all the compliments to be displayed on themirror.
○ Step 5: Display it on mirror via LCD monitor
○ Step6: Switch to thief detection mode using VNC viewer.
○ Step 7: .Switch off the power supply when it is of no use.

5. Algorithm for temperature detection

○ Step 1:Start
○ Step 2: Setup the sensor
○ Step 3: Check whether PIR sensor output is high or low
○ Step 4: If it is low, go to step 3.
○ Step 5: If it is high, the temperature is turned ON.
○ Step 6: temperature is captured and stored on raspberry pi.
○ Step 7: Temperature will be displayed on the LCD screen,

In this world everyone needs a comfortable l i fe. Modern man has invented different technology for his purpose. In today's world, people need to be connected and they are willing to access the information easily. Whether it is through the television or internet, people need to be informed and in touch with the current affairs happening around the world. The Internet of Things means interconnection via the internet of computing devices embedded in everyday , This project has been developed with the idea of making home smart to save time.The Internet transformed our lives by connecting us more easily to information and other people in the virtual world. The state of innovation currently is to provide more information with less interaction to get it. The device that has been researched and designed is called Smart Mirror. It is a wall mounted mirror which displays relevant items to the user such as weather, time.

Software Information

2.1.1. Raspbian :

Raspbian is a free operating system based on Debian optimized for the Raspberry Pi hardware. An operating system is the set of basic programs and utilities that make your Raspberry Pi run. However, Raspbian provides more than a pure OS: it comes with over 35,000 packages, pre-compiled software bundled in a nice format for easy installation on your Raspberry Pi.

2.1.2. Arduino IDE:

The **Arduino Integrated Development Environment (IDE)** is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.

The source code for the IDE is released under the GNU General Public License, version The Arduino IDE supports the languages C and C++ using special rules of code structuring.

2.1.3. Magic Mirror

MagicMirror² is an open source modular smart mirror platform. With a growing list of installable modules, the MagicMirror² allows you to convert your hallway or bathroom mirror into your personal assistant. MagicMirror² is built by the creator of the original. Magic Mirror with the incredible help of a growing community of contributors.

As Magic Mirror is a fantastic project that is highly connected with aesthetics.

2.1.4 Third Party Modules

We have installed third party modules. You can use them to add functionality to your code,

https://github.com/MichMich/MagicMirror/wiki/3rd-party-modules,

Building Mirror Frame And Assembly of parts

A wooden frame was built In order to encase the 32 inch Monitor.This was assembled using 1×4 wood and a hacksaw to cut the dimensions. Strong PVA (Gorilla) glue and nails were used to reinforce the frame. The final mirror dimensions are W 47.6cm x L 77cm x H 7cm. A monitor strap/ back support was added to secure the support of the Frame. An opening on the strap was made to allow space for HDMI ports on the monitor for the Raspberry Pi display input. An Interior varnish coat was added to the frame to give it a nice glossy finish.

3.1 Circuit design

We concealed the hardware in a way that looks like a normal mirror. Raspberry Pi and Arduino are mounted on the backside of the monitor. Two-way mirror is attached on top of the monitor. The circuit is assembled inside this structure. The custom-cut two way-mirror was placed directly on top of the 32″ Monitor.

MLX90614:

Non-contact temperature sensors like the MLX90614 are used in situations where you need to measure temperature of surfaces without necessarily physically touching them. For example, when measuring body temperature using temperature guns, in infrared thermometers for taking temperature of air conditioning units and engine cooling systems.The MLX90614 sensor measures temperature using infrared radiation emitted by bodies.

The sensor is made up of an infrared thermopile detector and a Digital Signal Processing unit with low noise amplifier and a high resolution 17-bit Analog to Digital Converter. These components are inside a TO-39 metallic casing.

This sensor measures temperatures in the range -40ºC to 125ºC for ambient temperature and -70ºC to 380ºC for object temperature. The ambient temperature is the temperature of the air around the sensor itself. Object temperature is the average temperature of the surface the sensor is pointed at.The MLX90614 offers a standard accuracy of ±0.5˚C around room temperatures. There is also a special version of this sensor for medical applications with an accuracy of ±0.2˚C in a limited temperature range around the human body temperature.

The MLX90614 contactless temperature sensor has a 90º field of view therefore the measured value is the average temperature of all the objects in the field of view of the sensor.

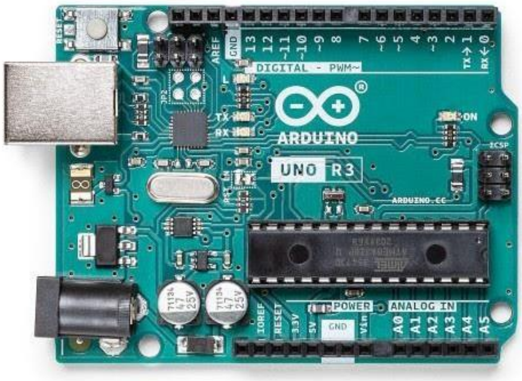


Fig 1. Arduino Board

Arduino

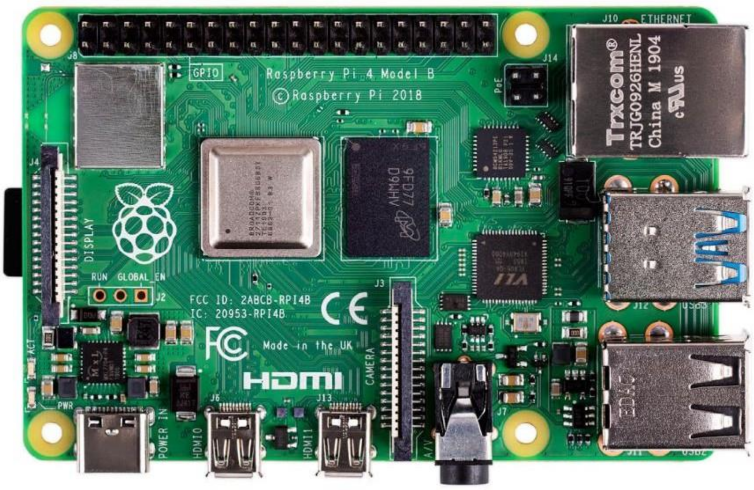
Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

MICROCONTROLLER	ATmega328P
OPERATING VOLTAGE	5V
INPUT VOLTAGE (RECOMMENDED)	7-12V
INPUT VOLTAGE (LIMIT)	6-20V
DIGITAL I/O PINS	14 (of which 6 provide PWM output)
PWM DIGITAL I/O PINS	6
ANALOG INPUT PINS	6
DC CURRENT PER I/O PIN	20 mA
DC CURRENT FOR 3.3V PIN	50 mA
FLASH MEMORY	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
CLOCK SPEED	16 MHz
LED_BUILTIN	13
LENGTH	68.6 mm
WIDTH	53.4 mm
WEIGHT	25 g

Raspberry Pi 4:

Features	**Raspberry Pi Model**
SoC	BCM2835
CPU	ARM11
Operating Freq.	700 MHz
RAM	512 MB SDRAM
GPU	250 MHz Videocore IV
Storage	micro-SD
Ethernet	Yes
Wireless	WiFi and Bluetooth

Raspberry Pi 4 Model B is the latest product in the popular Raspberry Pi range of computers. It offers ground-breaking increases in processor speed, multimedia performance, memory, and connectivity compared to the prior-generation Raspberry Pi 3 Model B+, while retaining backwards compatibility and similar power consumption. For the end user, Raspberry Pi 4 Model B provides desktop performance comparable to entry-level x86 PC systems.



Simulation work

Connecting the MLX90614 non-contact temperature sensor to Arduino.

This sensor uses I2C communication and is therefore connected to microcontrollers like Arduino through the I2C pins. Different Arduino boards have different I2C pins but since I am using Arduino UNO, the I2C pins are A4 and A5 for Data (SDA) and Clock (SCL) pins respectively.

The MLX90614 uses 0x5A as the fixed 7-bit I2C address therefore you can only connect one sensor per microcontroller.

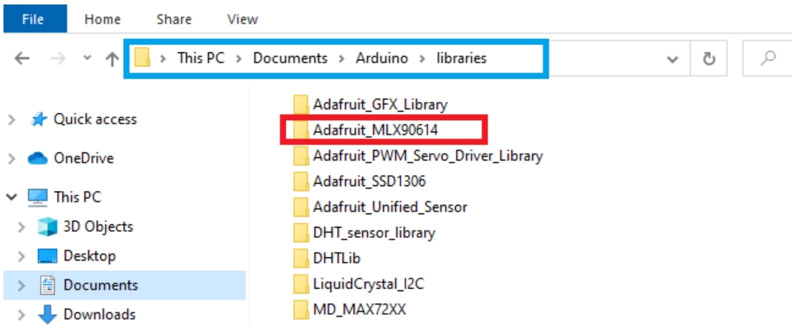


Fig 2. Raspberry Pi

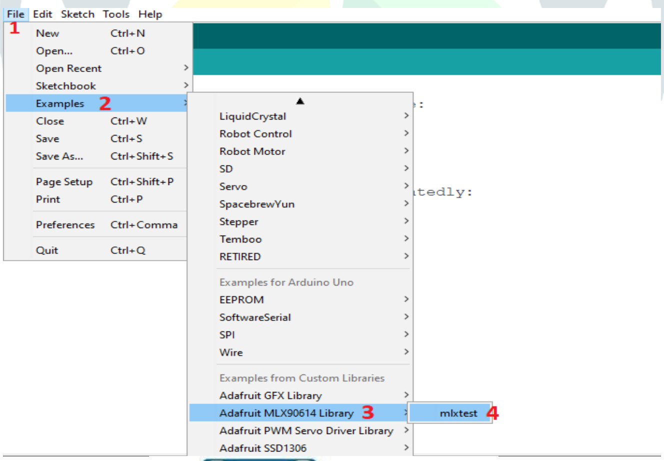
The MLX90614 comes in two variants, that is, the MLX90614Axx version which uses power supply of 4.5V to 5V and the MLX90614Bxx version that uses 2.6V to 3.6V. We are using the 3.3V variant so we connected the sensor to Arduino likewise.

Including the MLX90614 Library in Arduino IDE.

To be able to read this sensor's data using Arduino, we first installed the Adafruit_MLX90614.h library. This library was downloaded from GitHub.
After downloading the zip folder from GitHub, we unzipped this folder and renamed the uncompressed folder from "Adafruit-MLX90614-Library" to "Adafruit_MLX90614".
Then place the Adafruit_MLX90614 folder in the directory path for other libraries used by your Arduino IDE and restart the Arduino IDE.

Testing the sensor using the "mlxtest" example.

After installing the Adafruit_MLX90614 library, we followed the following path;
File->Examples->Adafruit_MLX90614->mlxtest



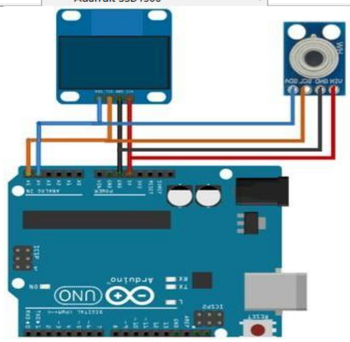


Fig 3 Circuit Diagram

Displaying MLX90614 Temperature sensor readings on I2C OLED.

We were able to show the readings of the MLX90614 non-contact temperature sensor on a number of displays. Below we will demonstrate how this sensor was connected to the 128x32 I2C OLED.The connection is as shown in the schematic. Both the sensor and OLED use I2C communication have their Data and Clock pins attached to pins A4 and A5 of Arduino respectively and also share the ground and power lines.

Code for MLX90614 sensor with I2C OLED.

```
#include <Wire.h>
#include <Adafruit_GFX.h>       // Include core graphics library for the display
#include <Adafruit_SSD1306.h> // Include Adafruit_SSD1306 library to drive the display
#include <Fonts/FreeMonoBold9pt7b.h> // Add a custom font
#include <Adafruit_MLX90614.h>  //for infrared thermometer

#define SCREEN_WIDTH 128 // OLED display width, in pixels
#define SCREEN_HEIGHT 32 // OLED display height, in pixels
#define OLED_RESET -1

Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, OLED_RESET);

Adafruit_MLX90614 mlx = Adafruit_MLX90614(); //for infrared thermometer
int temp; // Create a variable to have something dynamic to show on the display

void setup()
{
  delay(100);  // This delay is needed to let the display to initialize
  display.begin(SSD1306_SWITCHCAPVCC, 0x3C); // Initialize display with the I2C address of 0x3C
  display.clearDisplay(); // Clear the buffer
  display.setTextColor(WHITE); // Set color of the text
  mlx.begin();  //start infrared thermometer
}

void loop()
{
  temp++;  // Increase value for testing
  if(temp > 43)  // If temp is greater than 150
  {
    temp = 0;  // Set temp to 0
  }

  temp = mlx.readObjectTempC(); //comment this line if you want to test

  display.clearDisplay(); // Clear the display so we can refresh

  // Print text:
  display.setFont();
  display.setCursor(45,5); // (x,y)
  display.println("TEMPERATURE");  // Text or value to print
  // Print temperature
  char string[10];  // Create a character array of 10 characters
  // Convert float to a string:
  dtostrf(temp, 4, 0, string);  // (variable, no. of digits we are going to use, no. of decimal digits, string name)

  display.setFont(&FreeMonoBold9pt7b);  // Set a custom font
  display.setCursor(22,25);  // (x,y)
  display.println(string);  // Text or value to print
  display.setCursor(90,25);  // (x,y)
  display.println("C");  // Text or value to print
  display.setFont();
```

```
  display.setCursor(78,15);  // (x,y)
  display.cp437(true);
  display.write(167);

  // Draw a filled circle:
    display.fillCircle(18, 27, 5, WHITE); // Draw filled circle (x,y,radius,color). X and Y are the coordinates
for the center point

  // Draw rounded rectangle:
   display.drawRoundRect(16, 3, 5, 24, 2, WHITE); // Draw rounded rectangle
(x,y,width,height,radius,color)

   // It draws from the location to down-right
    // Draw ruler step

   for (int i = 3; i<=18; i=i+2){
    display.drawLine(21, i, 22, i, WHITE);  // Draw line (x0,y0,x1,y1,color)
  }

  //Draw temperature
  temp = temp*0.43; //ratio for show
  display.drawLine(18, 23, 18, 23-temp, WHITE);  // Draw line (x0,y0,x1,y1,color)

  display.display();  // Print everything we set previously
}
```

CONCLUSION

Smart mirrors have great potential to enhance the user experience of accessing and interacting with information.

We were able to integrate third party sensors and measure the temperature of the surrounding, not only do they allow users to see relevant information effortlessly, they can also be integrated as a thief detection system. Our smart mirror saves time and makes it easier to access information. In today's society security is of crucial importance. By keeping this in mind we have integrated a thief detection system into our smart mirror. In future this project can be improved by adding an interactive touch screen.

REFERENCES

1. https://www.thehindu.com/sci-tech/technology/a-contactless-robotic-platform-to-m onitor-patients-vital-signs/article32435205.ece
2. https://pubmed.ncbi.nlm.nih.gov/31304340/
3. https://maker.pro/raspberry-pi/projects/how-to-create-a-smart-mirror-using-raspbe rry-pi-and-magic-mirror/
4. https://www.ijert.org/iot-based-smart-mirror-using-raspberry-pi
5. https://smartbuilds.io/smart-mirror-touchscreen-raspberry-pi/
6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6697643/
7. https://github.com/MichMich/MagicMirror/wiki/3rd-party-modules/
8. https://github.com/yashatgit/MMM-Breathwork#installation/
9. https://github.com/bibaldo/MMM-COVID19
10. https://makersportal.com/blog/2020/6/8/high-resolution-thermal-camera-with-rasp berry-pi-and-MLX90614#preparation
11. http://www.ijsrp.org/research-paper-1217/ijsrp-p7250.pdf

12. https://www.magicmirrorcentral.com/bestglass-smart-mirror- project/
13. https://www.twowaymirrors.com/smart-mirror/
14. https://magicmirror.builders/
15. https://www.melexis.com/en/product/MLX90614/Digital-Plug-Play-Infrared-Thermometer-TO-Can
16. https://www.melexis.com/en/documents/documentation/datasheets/datasheet-mlx90614
17. https://learn.sparkfun.com/tutorials/mlx90614-ir-thermometer-hookup-guide?_ga=2.46335662.842356325.1647340706-1023050121.1647340706
18. https://components101.com/sensors/melexis-mlx90614-contact-less-ir-temperature-sensor
19. https://www.researchgate.net/publication/351999190_An_IoT-Based_Smart_Home_Automation_System
20. https://www.researchgate.net/publication/340815185_Smart_Mirror_for_Home_Automation
21. https://www.researchgate.net/publication/356184861_Smart_Mirror_Based_Home_Automation_Using_Voice_Command_and_Mobile_Application
22. https://circuitdigest.com/microcontroller-projects/iot-based-contactless-body-temperature-monitoring-using-raspberry-pi-with-camera-and-email-alert
23. https://www.hindawi.com/journals/js/2021/9995871/
24. https://www.sciencedirect.com/science/article/pii/S1877050919309822
25. https://www.mdpi.com/2227-9032/10/3/454
26. https://www.ingentaconnect.com/content/ben/eng/2021/00000015/00000004/art00013
27. https://create.arduino.cc/projecthub/SurtrTech/contactless-temperature-sensor-mlx90614-1e7bc7
28. https://www.keller.de/en/its/pyrometers/applications/basics/principles-of-non-contact-temperature-measurement.htm
29. https://biomedpharmajournal.org/vol12no3/a-novel-approach-for-non-contact-heart-rate-measurement/
30. https://www.aimspress.com/article/doi/10.3934/electreng.2022004?viewType=HTML
31. https://link.springer.com/article/10.1007/s11119-016-9470-9
32. https://www.researchgate.net/publication/232844877_Study_of_Emissivity_Scaling_and_Relativity_of_Homogeneity_of_Surface_Temperature