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Collation of Temperature Data Logging Between MLX90614 and Fluke Thermal Imager

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Abstract: We are developing a thermal imager using an infrared thermometer MLX90614. This sensor works on the principle of infrared radiation. It is a non-contact type measurement device. An infrared thermometer is a thermometer which infers temperature from a portion of the thermal radiation (blackbody radiation) emitted by the object being measured [1]. The novelty of this project is that we have made it economical compared to the thermal imagers available in the market. We used a single MLX90614 sensor and made it to move on the vertical and horizontal axis using a Pan-Tilt servo motor mechanism. The mechanism was set up in such a way that it would cover the whole object which is being scanned [2]. Also, we attached laser so that non-contact point being measured can be known and the temperature reading of the point are made available on the 16*2 LCD. In addition to this, ELP 2.1mm lens wide angle webcam with low illumination camera for day and night vision compare the original picture of the object with the thermal image of the same [14]. We also plotted live graph of the temperature detected by the IR sensor MLX90614 on MATLAB. We acquired the data by Fluke Thermal Imager and by our system. After that we compared the data acquired from both the sources.

Keywords: Infrared thermometer MLX90614, Fluke thermal Imager, thermal radiation (blackbody radiation), temperature.

I. INTRODUCTION

Thermal imaging is a technique which uses the heat given off by an object to produce an image[1]. All objects emit infrared energy (heat) as a function of their temperature. The infrared energy emitted by an object is known as its heat signature. In general, the hotter an object is, the more radiation it emits. A thermal imager (also known as a thermal camera) is essentially a heat sensor that is capable of detecting tiny differences in temperature. The device collects the infrared radiation from objects in the scene and creates an electronic image based on information about the temperature differences [2]. Because objects are rarely precisely the same temperature as other objects around them, a thermal camera can detect them and they will appear as distinct in a thermal image [14].

II. WORKING OF THE MODEL

Initially, the sensor is placed in front of the object whose temperature is to be measured. Laser is also fitted with the sensor so that observer can know which part of the object is being measured at instant time[25].

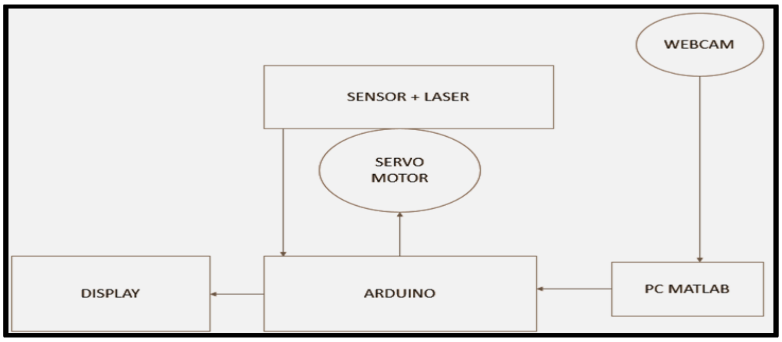

Figure: 01 Working Diagram of the Project model

Through the commands in MATLAB Arduino moves both the servo motors mounted on the PAN-TILT horizontally and vertically[2][19][17]. Data acquired by the sensor is then fed to the Arduino (Arduino ATMega 2560) and it display this

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data on the LCD (LCD 16*2) as well as perform the serial monitoring. Now the data flows from arduino to MATLAB for further processing[17]. Furthermore, MATLAB plots the data in the form of graph of time versus temperature. Thermal Image of the object is now constructed by the MATLAB and compared to the actual image of the object obtained by the WebCam[24]. This comparison will make it is easy to observer for further processing.

Pin Diagram

Here we have used Arduino ATMega2560 to interface it with MLX90614 (IR Thermometer) and the output of the sensor in terms of the temperature is shown using an I2C LCD. Apart from this we have connected two servo motors to make it move horizontally and vertically which is used to scan the object and acquire data and the image in MATLAB using image processing.

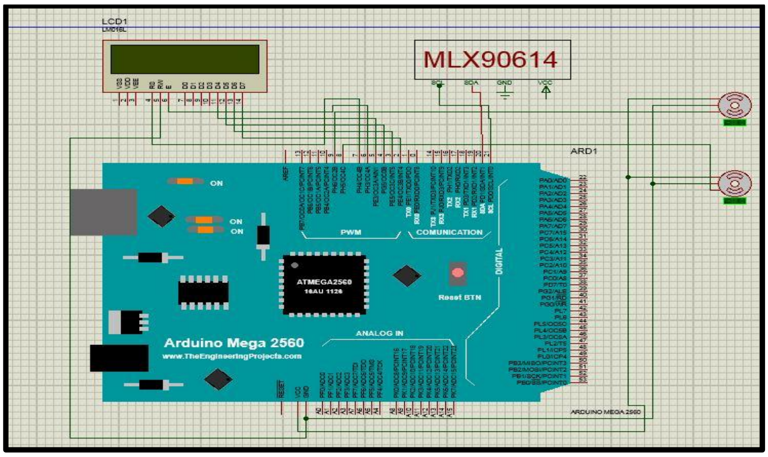

Figure: 02 Pin Diagram of Prototype

III. SENSOR SELECTION

The selection of the sensor was mainly based on its Field of View and its temperature range . Other non contact type temperature sensors like DHT11, DHT 21, DHT 22, Thermistors etc are very slow responding sensors whose response time is large compare to MLX90614-INFRARED THERMOMETER and also does not give accurate reading of a particular point of an object. Whereas MLX90614 gives point measurement and has an accuracy of 0.5°C. It has a 17 bit ADC and a resolution of 0.02°C. The temperature range of the object temperature which it can measure is -40 to +125 °C and the ambient temperature (sensor temperature) range is -70 to.+380 °C. The sensor uses 3.3V of power supply and the output is in the form of PWM which is useful for continuous temperature readout. It also has SMBUS – 2-wire compatible interface for reading Temperature and sensor reconfiguration. We selected this sensor as it had low cost and a small size.

Comparison: The comparison between Fluke thermal imager and our prototype is depicted in the table below.As per table we can compare the specifications of both the products. The temperature range of the Fluke Ti200 is -20 °C to +650 °C and the temperature range of the sensor used in our prototype is -70 °C to 380 °C. The FOV of the sensor used in our prototype is 5° which helps in acquiring the data accurately and point temperature measurement becomes possible. Accuracy of the thermal imager is ± 2 °C whereas the accuracy of the sensor MLX90614 is ± 0.5 °C which is considerably high. The cost of the Fluke Thermal imager is relatively very high as compared to our prototype (Approximately 10X). Fluke thermal Imager has minimum focus distance is only 15 cm, on the other hand, our prototype can acquire the data from as close as 1 cm. In addition to this, the operating temperature of the sensor has the range of -20°C to +120°C (-4°F to 248°F) while the Fluke Thermal Imager has operating range is comparatively very low (10°C to +50°C (14°F to 122°F)).

Factors	Fluke Ti200	Our Model
Temperature measurement range (not calibrated below -10 °C)	-20 °C to +650 °C (-4 °F to +1202 °F)	-70 °C to 380 °C (-94 °F to 716 °F)
Temperature measurement accuracy	± 2 °C or 2 %	± 0.5 °C
Field of view	24 ° x 17 °	5°

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Minimum focus distance	15 cm (approx. 6 in)	1 cm
Thermal sensitivity (NETD)	≤ 0.075 °C at 30 °C target temp (75mK)	≤ 0.5 °C
Visual (visible light) camera	Industrial performance 5.0 megapixel	Industrial Performances 1.3 megapixel with Day-Night vision
Operating temperature	-10 °C to +50 °C (14 °F to 122 °F)	-20 °C to +120 °C (-4 °F to 248 °F)
Relative humidity	10 % to 95 % non-condensing	10 % to 95 %

Financial breakup
For the prototype we bought the Items which are listed below. The total cost of our prototype amounts to 15,700 Rupees whereas the Fluke thermal imager costs around 1 lakh Rupees.

Sr. No	Description of Components / Items	Cost (INR) per item	Number of items	Total Cost (INR)
1	MLX90614 IR temperature sensor	2,500/-	1	2,500/-
2	Webcam - ELP 2.1mm Lens Wide Angle Webcam Low Illumination USB Camera Module for Day night Linux Vision	7,000/-	1	7,000/-
3	Arduino mega 2560	800/-	1	800/-
4	Sun Robotics Mini Pan-Tilt	800/-	1	800/-
5	Servo Motor	600/-	2	600/-
6	Fabrication & Miscellaneous expenses	4000/-	-	4000/-
			TOTAL	15,700/-

IV. RESULTS

We performed an experiment taking a candle as a sample. Firstly, we took readings using the Fluke thermal Imager Ti200 and noted the temperature readings of the flame of the candle. After that we measured the temperature reading of the flame using our prototype. As you can see in the image (1), Temperature of the subject by the Fluke is 181 °C from the distance of 50 cm. Furthermore, Reading from our model which is in image (2) is 184 °C from the distance of 5 cm. And as you can see, readings are almost equal.

(1) Reading of Fluke Thermal Imager Ti200

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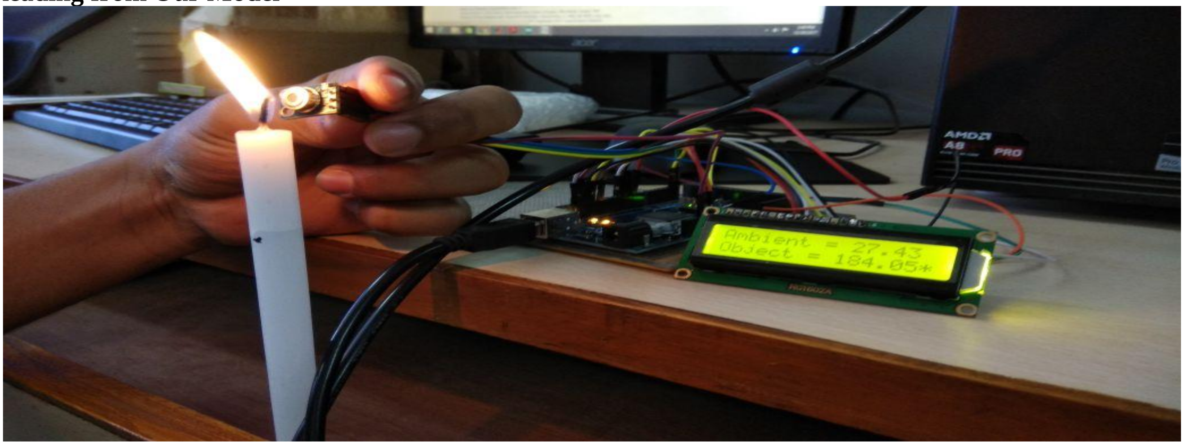
(2) Reading from Our Model



V. CONCLUSION

The prototype which we have created is very cost effective and economical as compared to the Fluke thermal imager and also good in terms of resolution and accuracy. The objective of this model can be improved by boosting the speed of motor and scanning speed of the sensor. The object temperature can be measured from a larger distance by selecting a higher range Infrared Thermometer.

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