Fault Detection on Transmission Line Using Thermopile Array and Real time IR Bitmap Generation

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***Abstract*—The main purpose of this project is to find the change in operating temperature range of the high voltage transmission lines and insulators. Therefore it should be monitored frequently in order to avoid faults. In the proposed system thermopile array is used to monitor the operating temperature. The thermopile array sensor is mounted on a parallax servo motor to monitor a vast area and gives us thermal image. This project is made to send an emergency message to the electrical substation through GSM once transmission lines and insulator exceeds maximum operating temperature range.**

Index Terms*— Microcontroller, Thermopile array sensor, RC servo motor, Transmission lines. *(Keywords)

I. INTRODUCTION

High voltage transmission lines are the main source to generate electric current to the residential consumers. The need for electric current is also increasing day by day in our daily life. The process of power distribution is from the generating station and through step up and step down transformers to the industrial and residential consumers by step up and step down transformers. Since it an electric current supply to some miles from one power grid to other grid most of the faults will be occurred. Therefore it is important to transfer the power without any problem.

Insulators used for the high voltage transmission lines are made up of porcelain and polymer materials. They are used in electrical equipment to support and separate the conductors. When insulators are subjected to high voltage it will suffer from the electrical breakdown. Transmission lines and insulators are the important components of the electricity. Both things will work at certain operating temperature range therefore it is important to monitor frequently and to not exceed the maximum range. Mostly thermal imaging cameras are used to detect the faults on transmission lines. It is very expensive therefore thermopile array is used in this project instead of thermal cameras to reduce the expenses. Embedded technology is used in this project to interface the thermopile array sensor. GSM is used for transmitting the data to the electrical substation. The operating temperature range of the transmission lines is higher. They are made up of Aluminum and it melts at about 650°C and insulators are made up of ceramic or polymer materials they operate at the temperature range of 180°C.

II.PROPOSED SYSTEM

In the proposed system GSM module is used for main purpose to transmit the message to the electrical substation. Transmission lines and insulator operating temperature range may exceed the maximum level and due to this wastage of power will be occurred. Human eye can able to see certain level of the electromagnetic spectrum at certain level it is impossible to see the IR radiations emitted by the hot sources. Human cannot able to keep on monitor the temperature level of the transmission lines and electric insulators because they stay in the nearby electrical substations. If there is any change in the operating temperature range they cannot able to inspect it earlier. Therefore GSM module is used to transmit an emergency message to the nearby electrical substations (figure1: illustrates the proposed system block diagram). And also a real time IR bitmaps of the hot source are displayed in the software like VB.

III. THERMOPILE ARRAY SENSOR

In this project real time IR bitmap is generated using the thermopile array sensor. Infrared bitmaps are spectral density maps based on IR rays. Infrared bitmaps shows density and amplitude of IR radiations from various objects. IR rays are emitted by all hot sources and this bitmap can give a thermal image of vast area. A thermopile array sensor is used for accurate and reliable detection. It produces single dimensional information therefore it is mounted on a servo planning mechanism to produce two dimensional bitmap [1]. It has array of very small and very sensitive IR receiver segments and also it has an inbuilt ADC and serial communication interface. The intensity of IR signals received by each of the sensor segments is given out as a digital value. It measures IR radiations in the 2-22um range which is the wavelength of radiated hot bodies.

IV. BLOCK DIAGRAM

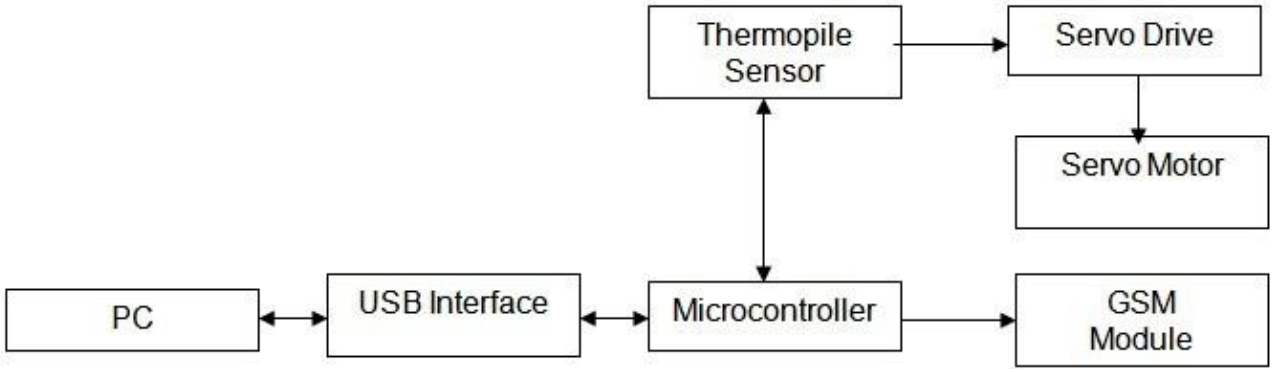

Figure 1: Block diagram

The working of block diagram is the thermopile array sensor is connected to the microcontroller PORT C of RC0 and RC1. This is mounted the RC servomotor and motor is interfaced to the sensor board. The pulse to the servo motor is given by the thermopile array sensor. The USB interface is connected to the microcontroller PORT D of RD6 and RD7 which is the UART pin. From the pin 11 and 12 of FT2321X is connected to the USB and it is connected to PC.

V. Servo motor

The project uses RC servo motor and it can hold any position from 0 to 180 degree. It accepts four mounting screw. The communication is through the pulse width modulation. The operating temperature range is -10°C to 50°C. The purpose of the RC servo motor in the project is to monitor a vast area. Servo planning mechanism has been implemented in this project. Thermopile array sensor is mounted on a servo motor to get two dimensional IR bitmap.

VI. Microcontroller

PIC 18F45K22 microcontroller is used in this project. The code is written in embedded c. Generally we use RS232 for transmitting data from the micro controller but in this project UART IC FT231X is used. It is inbuilt in the controller board and which has a USB to interface PC. Maximum clock frequency is 48MHz and hence faster than 8051and is based on RISC as well as Harvard architecture therefore it is even very faster [2].

VII. GSM

GSM (Global System for Mobile Communications, originally Groupe Spécial Mobile). It is for mobile communication purpose and it is divided into three parts namely mobile station, access network and core network [3]. GSM user can able to receive and send the short service message and also the user can receive the information sitting in the substation [4].

VIII. USB to UART interface

The below figure 2 is the USB to UART interface. The IC used in this project is FT231X. Most of the microcontrollers and other embedded hardware have a conventional UART interface (figure 2: illustrates the UART interface circuit diagram). But the USB port of a computer cannot be connected directly to the UART interface [5]. Additionally any hardware connected to the USB port needs device drivers that have to be installed on the computer for the operating system to identify the external device and communicate with it accordingly.

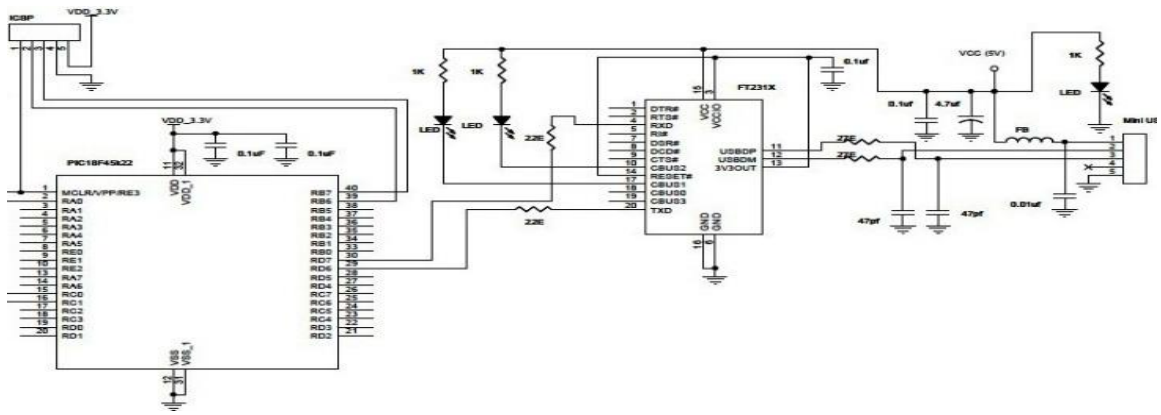

Figure 2: UART interface circuit diagram

Hence there is a need for a device that can enable communication between the UART interface of an embedded system or a FPGA and the USB port of a computer. Various ICs are available that can perform this function. The FT231X is one such IC that

can perform the function of UART to USB conversion. FT231X is an ideal IC to use for connecting any project hardware to a PC or a laptop (figure 3: illustrates the hardware setup).

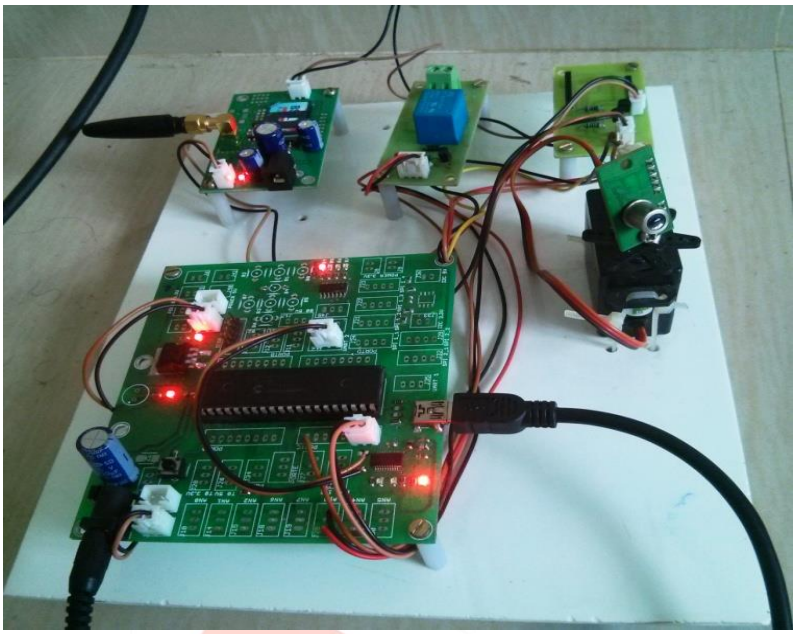

Figure 3: Hardware setup

IX. RESULTS

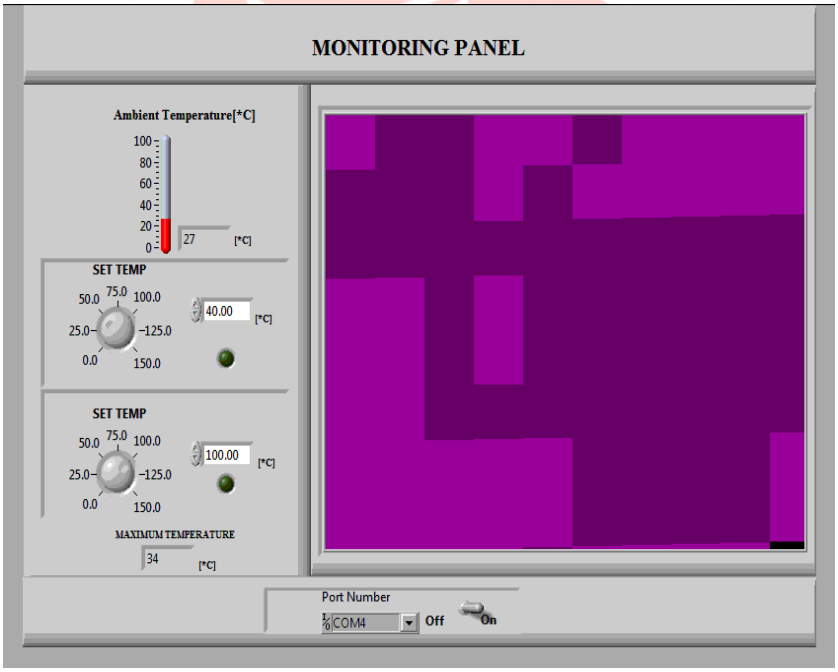

Figure 4: Monitoring panel

The above (figure 4: illustrates the Monitoring panel) panel is the output of this project. Initially communication port is set and FT231X driver should be also installed in the PC. The thermopile array sensor used is TPA81 which holds set of ten registers they are software revision number, ambient temperature and eight pixels of temperature. There are two set temperatures in the display which is set by the human they are maximum operating temperature range and the value nearer to the maximum temperature. The purpose of the two set temperatures in this project is to intimate the electrical substation if there is change in the operating temperature of transmission lines and insulators before it exceeds the maximum operating temperature level. When first temperature exceeds the GSM will send an emergency message to the substation that temperature level exceeded level one whereas if second temperature is exceeded then once again second message will be transmitted to the substation that temperature exceeded level two [6]. The expert should take necessary action when first message is received to the electrical substation.

X. CONSULSION & FUTURE ENHANCEMENT

This paper presents for detecting the change in the operating temperature of transmission lines and electrical insulators. The project could be further extended by using the mobile robot with thermopile sensor and made the robot to move on the ground wire of the transmission line to monitor a vast area. By this without the presence of human being any drastic change in the operating temperature will known earlier and can be rectified so that unwanted power wastage will be avoided. Now a days the transmission lines are made to operate at 200 to 300°C on aluminum conductor thermopile sensor can even able to work on this temperature.

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