The 7th International Electronic Conference on Sensors and Applications

A PRESENTATION

ON

DEVELOPMENT OF A TWENTY-TWO POINT MULTICHANNEL TEMPERATURE DATA LOGGER SPECIALLY CUSTOMIZED AND COUPLED TO A 160Wpeak HYBRID PHOTOVOLTAIC/THERMAL (PV/T) FLAT PLATE SOLAR AIR HEATER

BY

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Abstract

- A low cost multichannel temperature data logger was designed and fabricated in this study. The design was done using Max6675 temperature sensors and linear monolithic (LMs) temperature sensors. This data logger is an electronic device that records data over time based on microcontroller. The utilization of data logger in this work is to accomplish the task of monitoring the temperature measurement of the 160Wpeak hybrid photovoltaic/thermal (PV/T) flat plate solar air heater. This data logger is just customized for this equipment – the hybrid photovoltaic/thermal solar air heater. The developed prototype was internally or externally powered and has a retrievable memory card module. The sensor's response time was observed to be one minute leading to a time series analysis. It was observed from the graphical plots that the temperature patterns were in consonance with the solar radiation patterns. The trend of the temperature flow pattern measured from the hybrid photovoltaic/thermal (PV/T) flat plate solar air heater was in consonance with the solar radiation flow pattern. This indicates that the peaks of the temperature plots fall at the peaks of the plots of solar radiation.

- Keywords: data logger; temperature; sensors; hybrid photovoltaic/thermal; flat plate; solar air heater

Introduction

- This data logger is an electronic device that records data over time based on microcontroller.

- It is small, stand-alone, battery-powered device that is equipped with a microprocessor, memory for data storage and sensors.

- *In* this work, we present a portable and rugged data acquisition module that is designed to monitor the temperatures of the hybrid photovoltaic/thermal flat plate solar air heater

- This temperature data logger could be used in monitoring the temperature patterns of the hybrid photovoltaic/thermal flat plate solar air heater and can also help in determining the efficiency of such system

- Most low-cost temperature measuring devices are hand-held and cannot measure temperature patterns whereas some other temperature loggers are quite expensive.

- Multipoint data logging is a method of automatic data capture (using digital technologies such as advanced microprocessors, solid state sensors and fully featured software, which maximize accuracy) in which values from a sensor are recorded and stored in a regular intervals.

- Understanding of the temperature patterns in sympathy with solar radiation patterns is necessary in this study.

- Figure 1 shows the temperature data logger attached to the hybrid photovoltaic/thermal solar air heater measuring temperatures of the system. Figure 2 shows the temperature logger displaying temperatures. While figure 3 shows the schematic diagram of the whole systems.
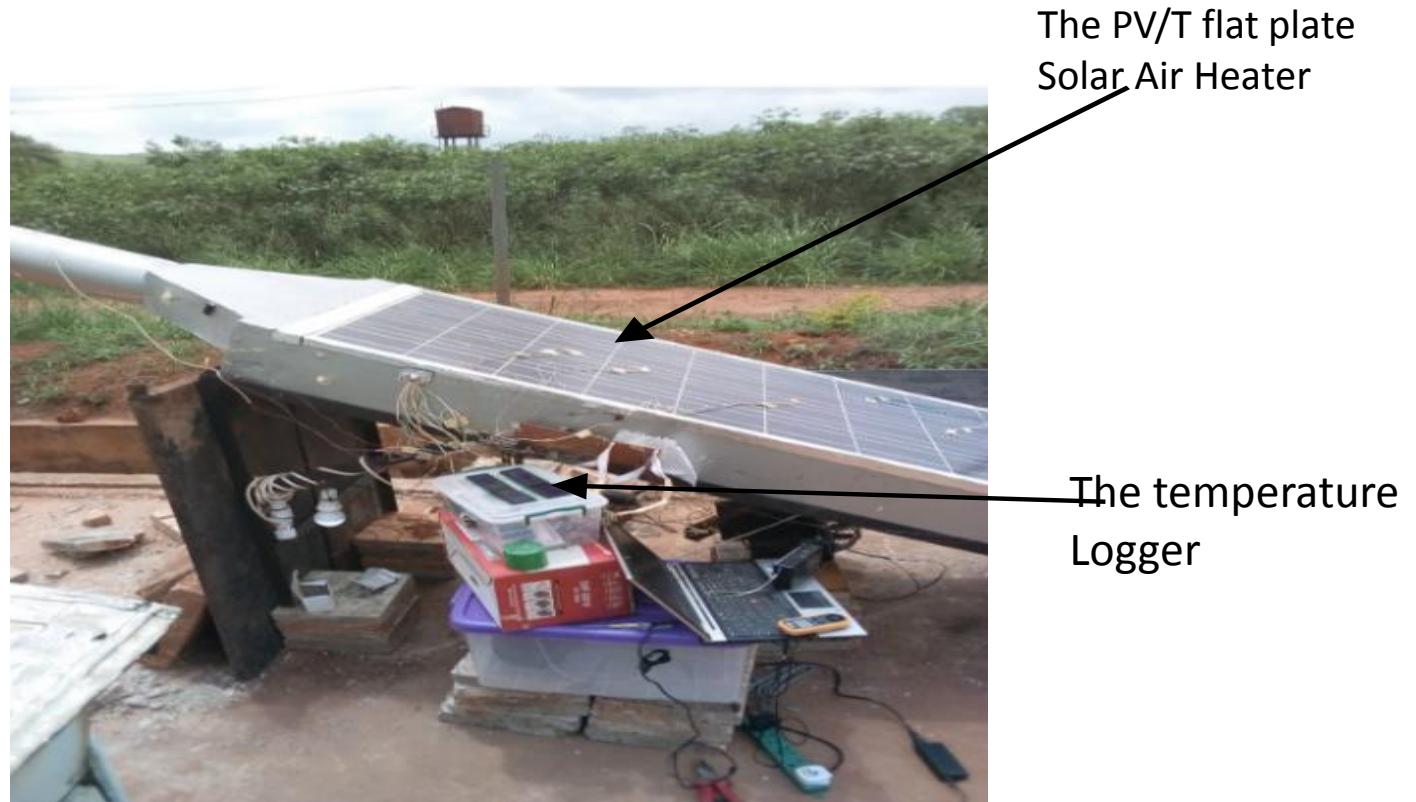
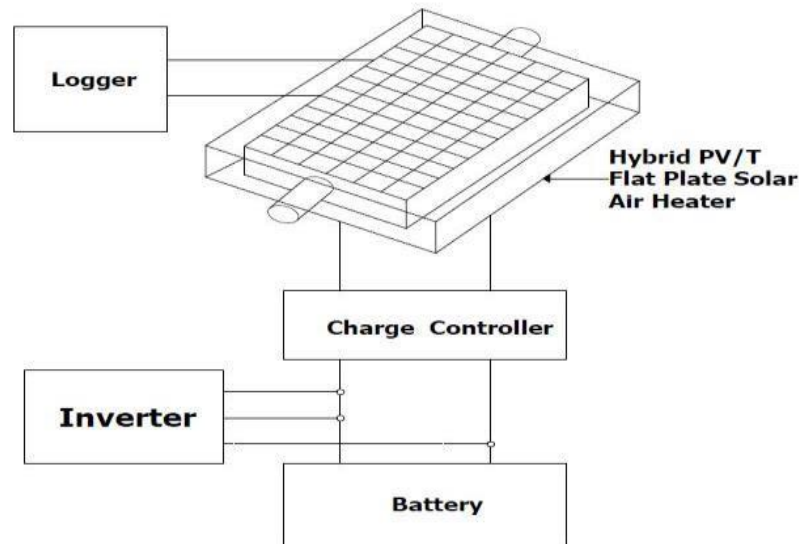The PV/T flat plate Solar Air Heater

The temperature Logger

Fig. 1 Measurement of temperatures using the temperature data logger

The Four LCDs displaying values Temperatures.

Fig. 2 the temperature data logger displaying values of Temperatures.

Fig. 3 The schematic diagram showing the measurement of temperatures

Materials and Methods

- **Arduino connection wires**: They are tiny wires that are generally used to make connections. They are of different types. For use on Breadboards many people use "jumper wires" with male pins on both ends.

- **Arduino Mega:** The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 (datasheet). It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an 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. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.

- **PCB:** This board helps in soldering. Single sided, copper printed circuit boards, fully pierced with holes. PCB is designed primarily for hard wiring of discrete components typically in analogue circuits.

- **Voltage regulator:** A voltage regulator is a system designed to automatically maintain a constant voltage level.

- **20 X 4 Liquid Crystal Display:** A liquid-crystal display A pin (male) header is a form of electrical connector. It consists of one or more rows of male pins (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals.

- **Male header:** A pin (male) header is a form of electrical connector. It consists of one or more rows of male pins.

- **Buzzer:** A buzzer is a mechanical, electromechanical, magnetic, electromagnetic, electro- acoustic or piezoelectric audio signaling device.

- **Variable Resistor:** A variable resistor is a resistor of which the electric resistance value can be adjusted.

- **SD Card module:** The SD Card Module is a simple solution for transferring data to and from a standard SD card.

- **DC fan:** DC fan prevent overheating while still minimizing electromagnetic interference that could negatively affect sensitive applications.

- **Voltage Regulator (7805**): 7808 is an 8V Voltage Regulator that restricts the voltage output to 8V and draws 8V regulated power supply to provide a convenient power source for most TTL components.

- **Max 6675 Thermocouple amplifier:** Thermocouples are very sensitive, requiring a good amplifier with a cold-compensation reference. The MAX6675 does everything for you, and can be easily interfaced with any microcontroller, even one without an analog input.

- **Reset buttons:** In electronics and technology a reset button is a button that can reset a device.

Data Processing Element-Arduino

- The data processing element used in this work is Arduino, a microcontroller. A microcontroller is a small computer on a single integrated circuit containing a processor, memory, and programmable input/output peripherals. The Arduino microcontroller is the heart of the system.

- Next slide is the electronic circuit diagram of the multi-point Temperature, Humidity data logger.

Fig. 4 The Block diagram of the data logger
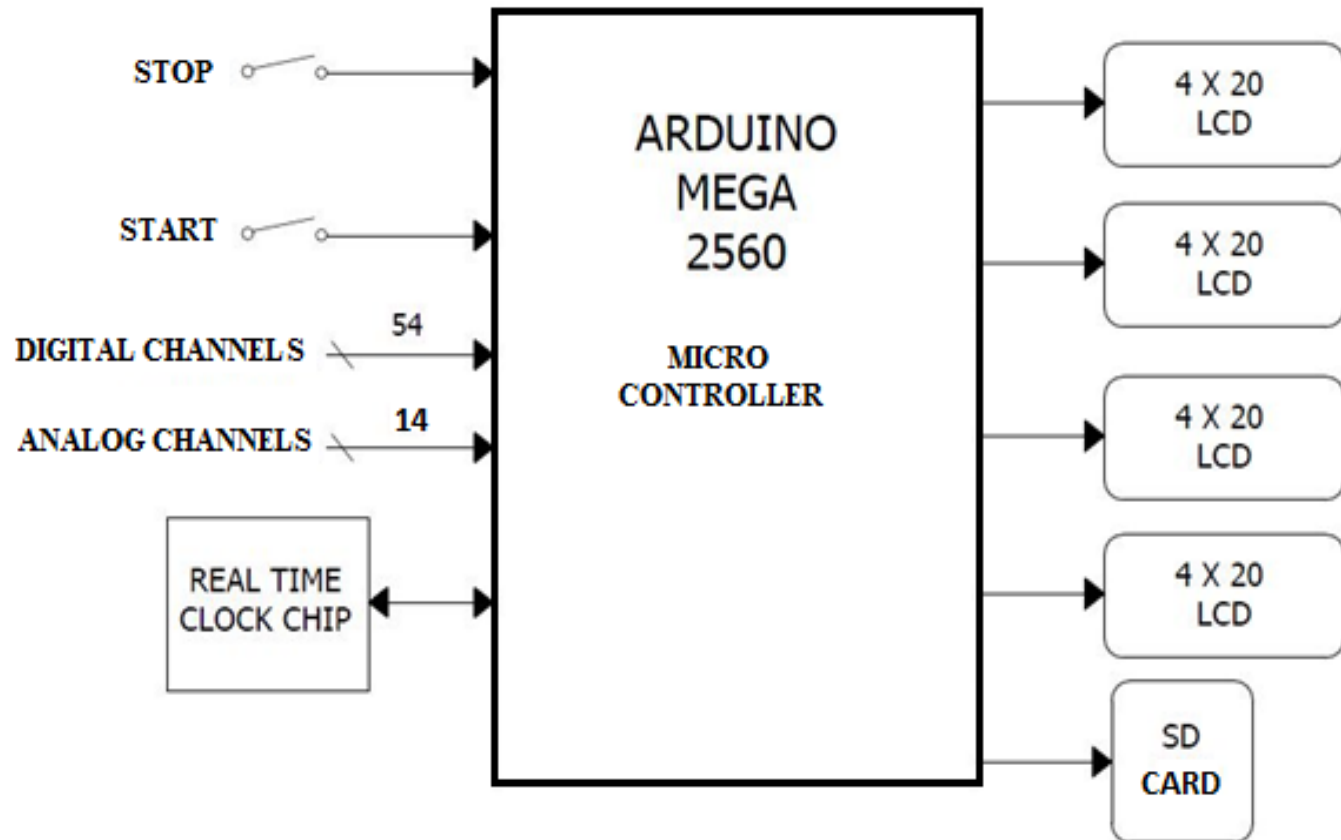
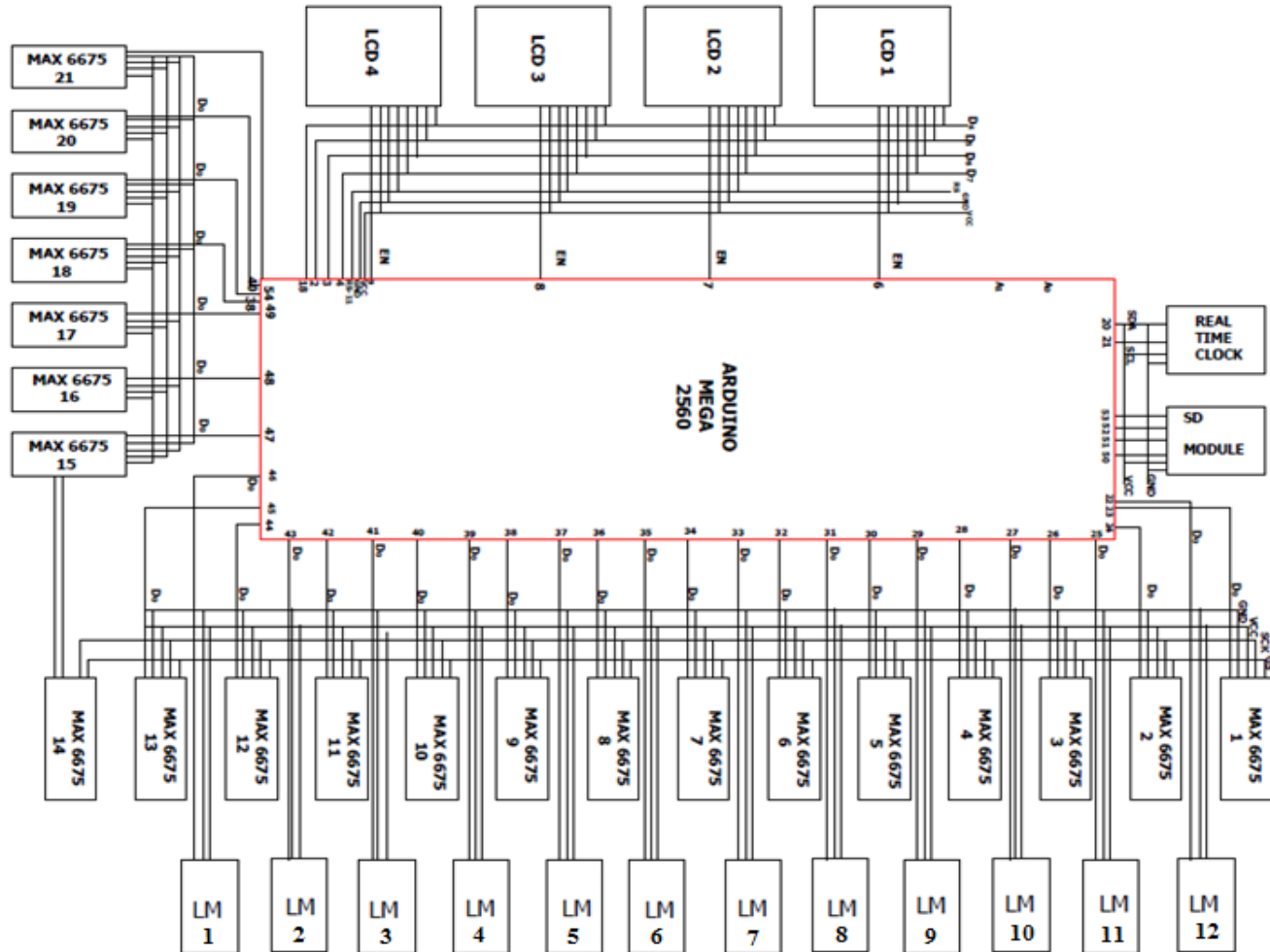# Electronic circuit diagram of the temperature data logger. (Figure 5)

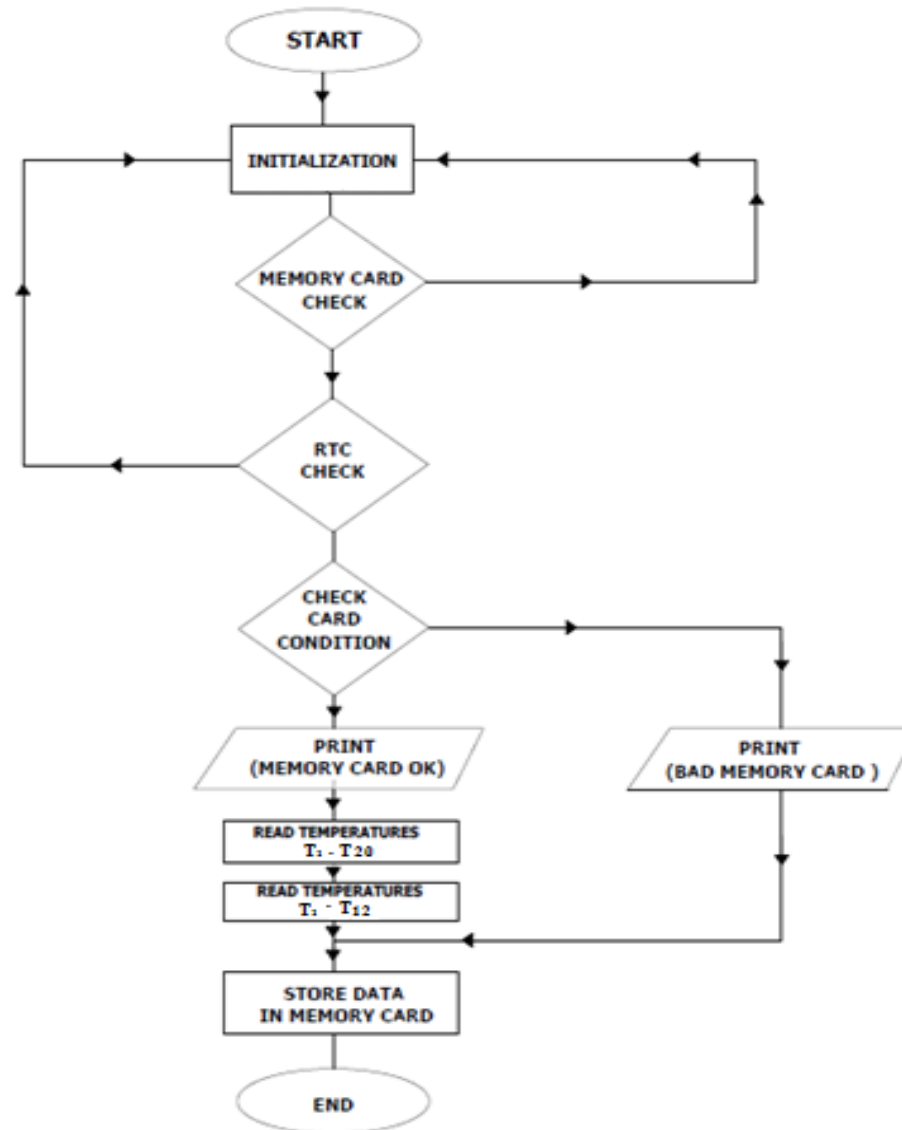# Fig. 6 The temperature logger software flowchart

Table 1 Charge controller specifications

Charging method	PWM (pulse width modulation)
Solar input capacity	20 ampere
Load capacity	20 ampere
Regulator Voltage	14.2V
Overload Capacity	20 ampere
Self-Consumption	10 mA
Operating Temperature	-35°C - +50°C

Table 2 Solar cell module specifications

Number of module	1
Nominal Voltage	12
Maximum Power	160W$_P$
Voltage Max (Pmax)	17.5V
I max P(max)	9.15 ampere
Short Circuit Current, Isc	10.07 ampere
Open Circuit Voltage	21.5V
Diode	Blocking & Bypass

Table 3 Inverter specifications

Output Waveform	Modified sine wave
Output Power	1000watt
Output Voltage	220 VAC
Output Frequency	50Hz+/-2Hz

Table 4 Battery specifications

Acid	H_2SO_4
Capacity	100Ah
Nominal Voltage	12volt

A graph of temperature against time
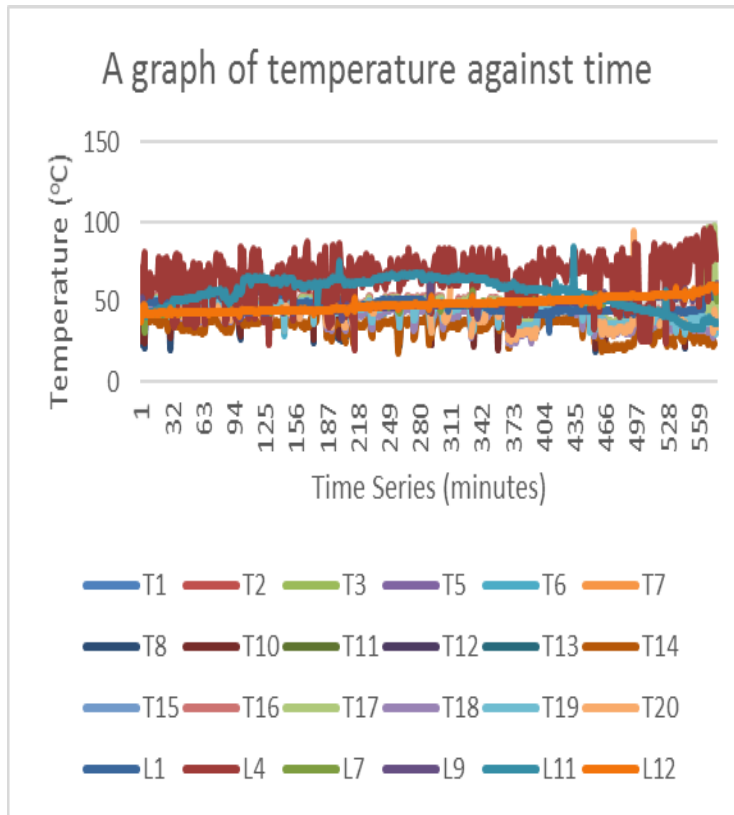
Fig. 7 Module Temperature, Power and Load   for 12/12/2019 Measurement

A graph of temperature against solar radiation
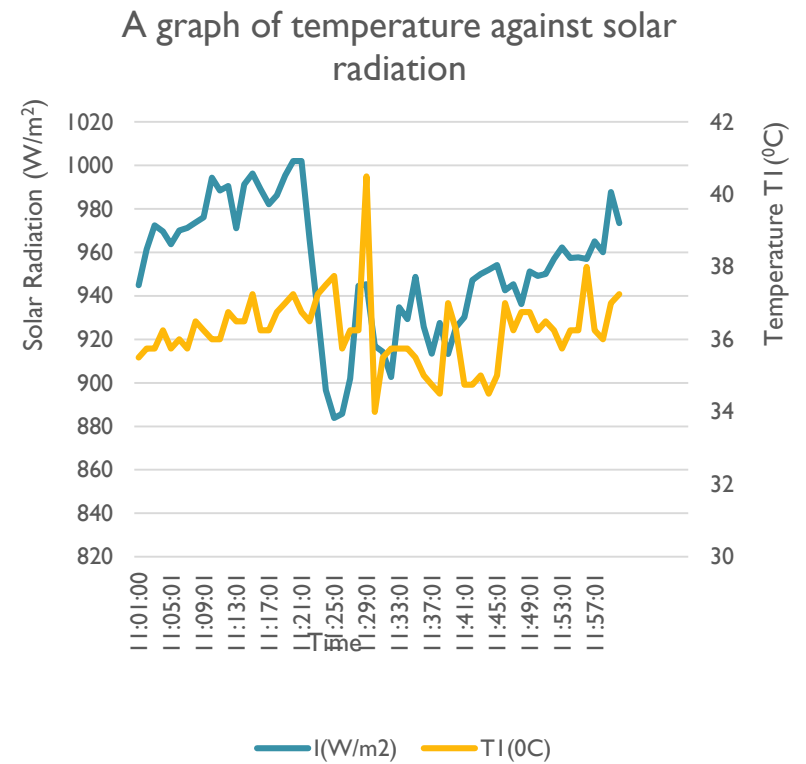
Fig. 8 Module Temperature, Power and Load   for 17/01/2019 Measurement

A graph of temperature against time
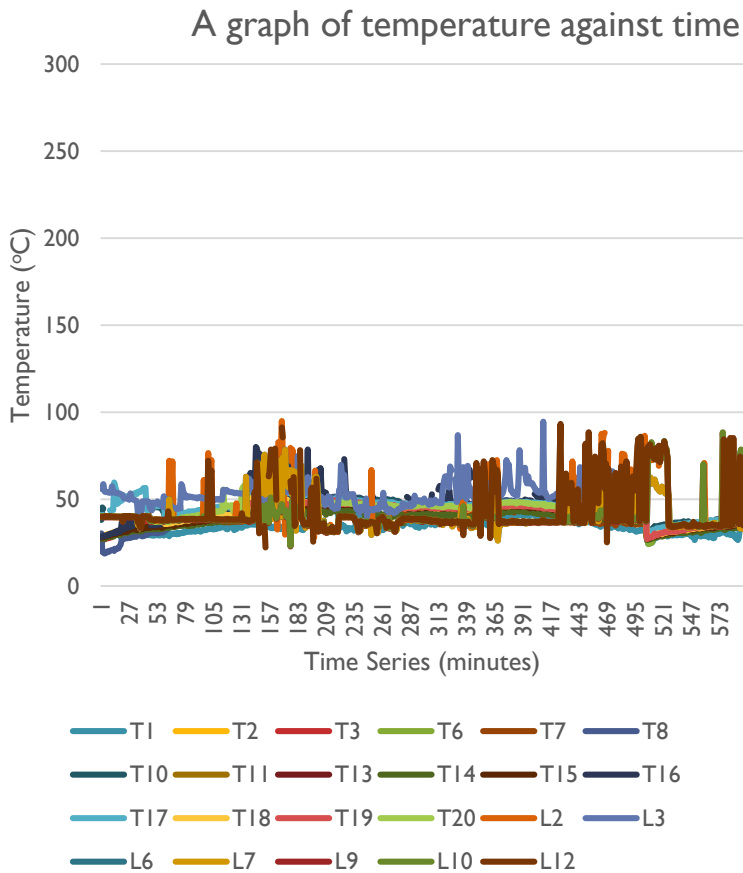
Fig. 9 Module Temperature, Power and Load Measurement for 13/02/2019

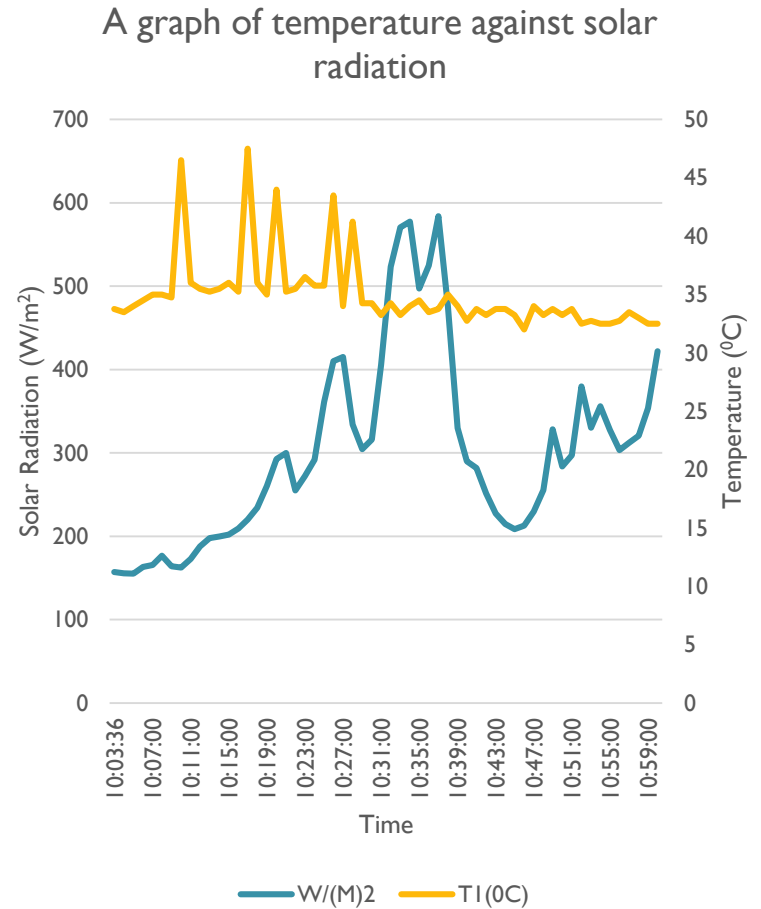A graph of temperature against solar radiation

Fig. 10 Module Temperature, Power and Load Measurement 15/03/3030

❖ Discussion and Conclusion

The data logger was developed and tested. It showed good picture of the temperature flow patterns in sympathy with insolation and compared well with standard loggers. The temperature data logger prototype was developed based on ATmega 2560 microcontroller. The total power consumption measured of the data logger on active state was about ≈8.5W {0.037A (ac) at 225V (ac)}. For further development, the logger can be equipped with ability to check MPPT functions of the solar PV module and also to measure alternating current of electrical systems.

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THANK YOU