# IOT Based Smart Temperature Controller

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***Abstract***

*In this paper, a smart room heater is implemented by combining IOT, smart mobile devices, and database server. The smart heater consisting of a temperature sensor, data storage unit Wi-Fi connecting module. User can use smart phone to check and control the operation of appliance, and the power consuming information can be remotely monitored by connecting smart plug to the internet via Wi-Fi media. IoT centre via a TCP server over a GPRS/WiFi wireless interface and receives energy commands for the controllers, which thus switch off, on or adjust electric heating operation. The hardware and software descriptions set out here are from a small pilot system which was successfully designed and implemented. Finally, a prototype was built up and tested, the test results validate the feasibility of the proposed smart home electricity saving system.*

**Keywords -** *Microcontroller, Remote Monitoring, Wi-Fi, control Relay, TRIAC, MOSFET.*

## I. INTRODUCTION

Home Temperature management is one of the solutions of user demand side management and it involves turning-off heater appliances in the home remotely to reduce energy cost. The concept of smart room heater started with the advanced Power management infrastructure. However, with the emergence of Internet of Things (IoT) and advancement in communication technologies, home temperature control solutions have gained renewed interests to provide more flexibility to user as well as offer intelligent services.

This is a smart temperature controller which controls the temperature as according to user and also connected through the server through Wi-Fi device, which collect the data of the room temperature and upload it to the server all this information which are stored into the server is used to predict the state of heater and environment of room. This is smart room heater also uses artificial intelligence which observe the data from sensors and apply appropriate method to control heater

By using this artificial intelligence the whole system behave like a control system which controls the gain and feedback. Due to this the system consumes less power as compared to cut OFF on the exact temperature point and control the filament.

this whole system developed with low cost components, and system is only required low speed internet, low data consuming device and also low electrical power consuming device except heater.

## II. REQUIREMENTS & BASIC DESIGN

There are numerous options available for the temperature scanners commercially but there exist a scope of some refinements and cost cutting. This theme defines our requirements for the proposed temperature scanner. The basic requirements for the scanner are the scanning should be real time with fast scanner response along with low cost and multi sensor compatibility. The portability of the system is also a vital feature.

Honouring the pre-request of the requirements, the concept design of temperature scanner considered microcontroller as its integral part to perform entire information processing unit [1], which can be either a PC or any other display device. The basic architecture of the system is shown in the Fig.1. It is taking the analog data from the sensor cluster and process and transforms this data set in to proper temperature values. The system is also capable of displaying the data in to a logger.

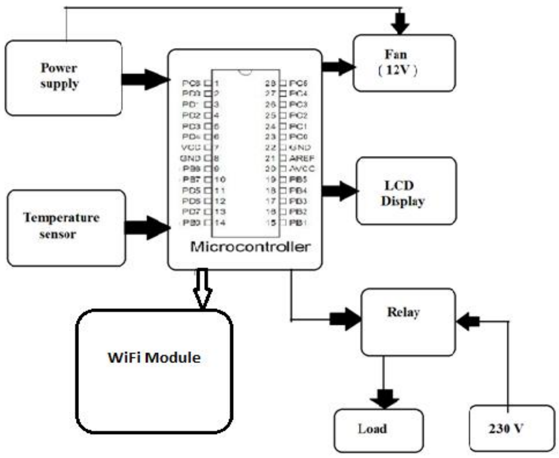


**Fig. 1: Block diagram for the Temperature Scanner**

Modern sensor interfacing designs require precision signal conditioning and A/D conversion as well as processing of the data to control the ADC and perform some signal manipulation in the digital domain.

Microcontrollers [2] are ideal for this function. It can communicate with PC by using different communication peripherals like UART, I2C and SPI. Features like serial wire download and debug, in built processor and ADC (analog to digital converter), memory storage capabilities and general purpose ports makes the microcontrollers best fitted for measuring systems.

## III. HARDWARE DESIGN IMPLEMENTATION

The block diagram of the smart temperature controller consists of several parts. The Set temperature is the input to comparator. The heater and cooler is connected with comparator via power switch so that, comparator can decide in which condition it choose to turn on /off the heater or cooler. The output of heater and cooler is connected with the total system and temperature sensor. There is a closed loop feedback between temperature sensor and comparator input.

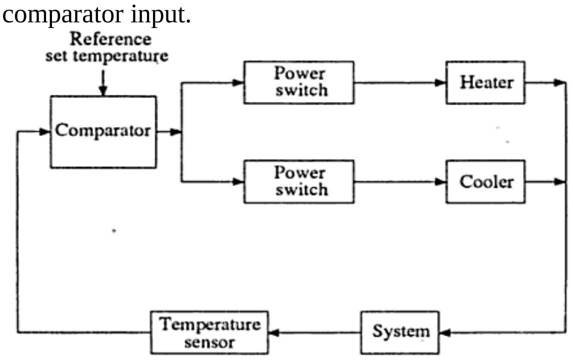


**Figure 2 : Block diagram representation of the smart temperature controller.**

Microcontroller: In the design, the analog devices microcontroller [3] is used which is a fully integrated, 4 kSPS and 24-bit data acquisition system incorporating dual, high performance, multichannel sigma-delta analog-to-digital converters (ADCs), 32-bit ARM Cortex-M3® processor, and Flash/EE memory on a single chip. This is designed for direct interfacing to external precision sensors in both wired and battery-powered applications. It can also integrates UART, I2C, and dual SPI serial I/O communication controllers, 19-pin GPIO ports, two general-purpose timers, wake-up timer, and system watchdog timer.

Power Section: The part operates from an external 1.8 V to 3.6 V voltage supply. So a power regulator is used in the design to convert standard 12 V supply into 3.3 V

Reset and UART Download Section: Two external switches are used to force the part into its flash boot mode. By holding SD low and toggling the RESET button, the controller enters boot mode instead of normal mode. In boot mode, the internal flash can be reprogrammed through the UART interface.

Analog Input Section: This section describes the sensor interface. Thermocouples [4] are the most widely used sensors. They have the widest measurement range and are inexpensive, rugged, and have a fast response time. RTD's are the best choice for repeatability and are the most stable and accurate. In given design, 5 differential analog input channels are provided. Transient and overvoltage conditions are possible with analog input with both during manufacturing and in the field. To achieve a high level of protection, additional external protection circuitry is necessary to compliment the IC’s internal integrated protection circuitry. So Input transient and overvoltage protection are provided by low leakage transient voltage supressors (TVS) and Schottky diodes in the design.

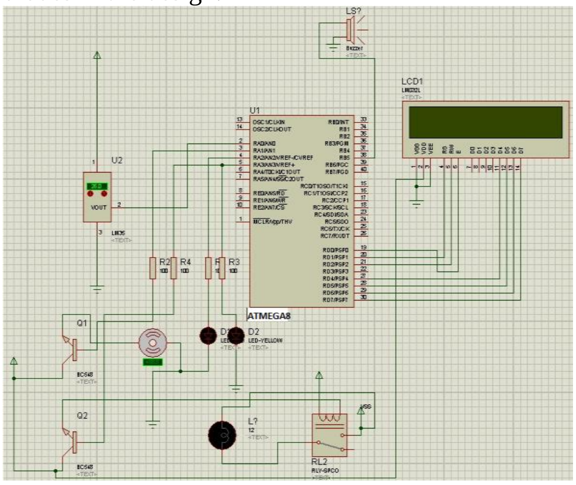


**Fig 3: Main Circuit Diagram**

Analog Output Section: A single-channel buffered voltage output DAC is also provided on chip. Once the final temperature has been measured, the DAC output voltage is set to the appropriate value that gives the required current across RLOOP between 4 to 20 mA.

Digital Input and Output Section: These can be used for testing or relay connection. While digital input/output connection are in action from microcontroller, I/O isolation for MCUs (Micro Controller Units) are needed and for this PC817X Series optocouplers are used.

Communication Peripheral Section: Present design communicates with PC using RS 232 communication protocol. RS-232 is a standard for serial communication transmission of data. It formally defines the signals connecting between a DTE (data terminal equipment) such as a computer terminal, and a DCE (data circuit-terminating equipment or data communication equipment). In hardware design options are also provided for RS 485 and Ethernet communication protocol.

Display Section: LEDs are used in the design for status display. Different Coupling capacitors are used in the circuit design to remove noise or other disturbances and make sure the output of previous stage is compatible with the next stage.

System hardware design is the base work for PCB layout design as shown in Fig. 3.Schematic Circuit design and PCB Layout are done with OrCAD software. OrCAD is a suite of tools from Cadence for the design and layout of printed circuit boards (PCBs). OrCAD consists of two tools. Capture is used for design entry in schematic form and Layout is a tool for designing the physical layout of components and circuits on a PCB.

## IV.TECHNICAL APPROACH

The user will be able to manipulate the speed of a DC motor. Mainly the speed of the DC motor depends on time, for how long this motor will be On/Off and set the needed power to be delivered to the fan.

The PID controller part is responsible of making accurate algorithms depending on the input values/errors. Before forwarding the signal, it must be digitalized and scaled to be implemented in order to process it to the output. After the delay calculations have been done, the next step is to generate puls chain to the output. In the mean time a feedback from the output must be considered to give more accurate result and to make of it a real closed loop progress. The accuracy itself can be determined regarding to the requirements, in this project eventually the input signal has been divided into 15 steps/degrees, therefore the output should be adjusted to give an expected result, see the diagram below.

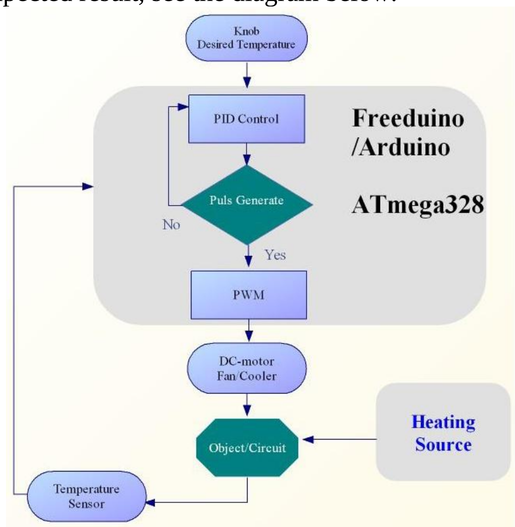


**Figure 4, Flow chart**

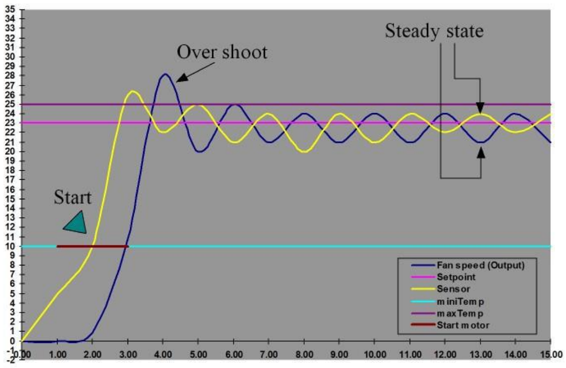


**Figure 5, Input/Output signals**

## V. RESULT AND DISCUSSION

| Sr | Set Point | Time Training Power UP Relay | Time Calculate Power UP Relay |
|---|---|---|---|
| 1 | 200 °C | 7.9 Minut | 6 Minut |
| 2 | 250 °C | 9.7 Minut | 8 Minut |
| 3 | 300 °C | 10.3 Minut | 9 Minut |

**Table 1, Results**

The whole system developed to predict the time to achieve the set point. There are various type of heaters in consumer market which have different time constant for heating , we have developed a mathematical model using PID controller, PID controller calculate Kp, Ki, and Kd.

This paper present an attempt to design and develop a Temperature Scanner, which is of less cost, portable, very low power consumption, self contained and able to communicate with PC. It is an efficient Scanner, which works in real time mode.

## REFERENCES

[1] Dogan Ibrahim, "Microcontroller Based Temperature Monitoring and Control", ISBN: 978-0-7506-5556-9, Elsevier Science, 2002.

[2] Steven Frank Barrett, Daniel J. Pack, "Microcontrollers Fundamentals for Engineers and Scientists", ISBN 1-5982-9058-4, Morgan and Claypool, 2006.

[3] Analog Devices Microcontroller, http://www.analog.com

[4] Matthew Duff, Joseph Towey, "Two ways to measure temperature using thermocouples feature simplicity, accuracy and flexibility", Analog device library.

[5] L. Michalski, K. Eckersdorf , J. Kucharski, J. McGhee, "Temperature Measurement", ISBN: 978-0-471-86779-1, 2 ed. Wiley.