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Microcontroller based Temperature Controller System

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Abstract - The microcontroller based temperature control system controls the temperature of any device according to its requirement for any industrial application. This report aims at controlling the temperature of an composting process which is being heated by a 50 watt heating element. For controlling the temperature of the heating coil the current through the heating element is controlled. The thermal energy produced by the heater is directly proportional to the square of the current passing through the heater coil. Hence, by controlling the current through the heater coil, the heat produced by the heater is controlled. The target is to control the temperature of the plate between room temperature and 100 °C with the optimal control range being from 50°C to 70°C. Following this significance of temperature control in processes to used different types of temperature controller for composting machine.

Key Words: Temperature Controller, *PIC Microcontroller, Circuit.*

1. INTRODUCTION

Temperature: This is the degree of hotness or coldness of a body or an environment.

Control System: A control system is a device or set of devices that manage, command, direct or regulate the behaviour of other devices or systems. Thus we can literally say that a Temperature Control System is a device or set of devices that manage, command, direct or regulate the behaviour of other devices or systems in order to influence the degree of hotness or coldness of a body or an environment.

A temperature control system consists of a small programmable digital logic controller device, wired to a heating and/or cooling system. About the size of a typical wall-mounted thermostat, a temperature control system contains a small circuit board and a memory chip(s). After setting the temperature control system to a desired temperature, known as a set point**,** the system will utilize the heater and/or air conditioning unit (as needed) as effesctor, to maintain that setting for the duration programmed.

Temperature is one of the main parameter to control in most of the manufacturing industries like chemical, food processing, pharmaceutical etc. In these kinds of industries, some product need the required temperature to be maintained at highest priority the product will fail. So the temperature controller is most widely used in almost all the industries. The goal of this project is to design an ambient temperature measurement and control circuit. The motivation for the project is the fact that temperature measurement has become an integral part of any control system operating in a temperature sensitive environment and the various learning outcomes associated during the implementation of the project. In this project ON-OFF type controller has been implemented. Here the set value for temperature can be externally set by user. The actual temperature is sensed by the thermocouple temperature sensor. It is displayed on common cathode seven-segment LEDs with the set value. If it exceeds the set value the heater is turned off. After then when temperature falls below the specified limit again heater is turned on.

2. METHODOLOGY

The circuit presents the design, construction, development and control of automatic switching electric heater. The idea is based on the problem occurs in human's life nowadays by improving the existing technology. The Peripheral Interface Controller (PIC) based automatic temperature control system is applied to upgrade the functionality to embed automation feature. The electric heater will automatically switch on according to the temperature falls below the specified limit. The system monitors the temperature from the thermocouple temperature sensor, where it will control the electric heater according to the setting values in the programming. The system indicates the temperature from the PIC 16F887A, and it will display it on the common cathode LED display.

If the electric heater temperature goes beyond the preset temperature, then the electric heater will switch off and if temperature goes below to preset value then electric heater will switch on. In this way, the electric heater's temperature can be maintained preset temperature value. It also provides a security characteristic, where it detects on extremely high temperature.

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3. CONCEPT OF TEMPERATURE CONTROL TECHNIQUE

To increase the production of an industry, smooth control of temperature is the key function.5 Different industry has its own individual temperature requirement for specific role. Conventionally, industrial temperature measurement instrument thermometer is used to measure the temperature. After observing temperature reading, operator controls temperature manually. Sometimes controlling is not appropriate because of time consuming human operated control of cooling device and heating device. As a result, efficiency of temperature control fails and production is hampered in industries. Besides that, thermostat is used to select temperature which is not efficient because of erosion of metal and losing to strength of metal for successive using. Consequently, analog system loses its own linearity function since it is mechanically designed temperature control device. The temperature can be controlled more efficiently using interface between temperature sensors LM35 which produce linear voltage signal with rising temperature and microcontroller which takes response fraction of millisecond to response. Microcontroller takes signal from temperature sensor and compare with pre-set value of temperature then take decision when heating device or cooling device would be turned on and the duration of maintained temperature in system.

The pseudo code for control the overall heating and cooling system can be written as:

When asking temperature > real-time temperature

Heating element = 1 for (asking temperature + 1 Degree Celsius)

Cooling element = 0 for 1 minute

When asking temperature < real time temperature

Cooling element = 1 for (real-time temperature – 1 Degree Celsius)

Heating element = 0 for 1 minute

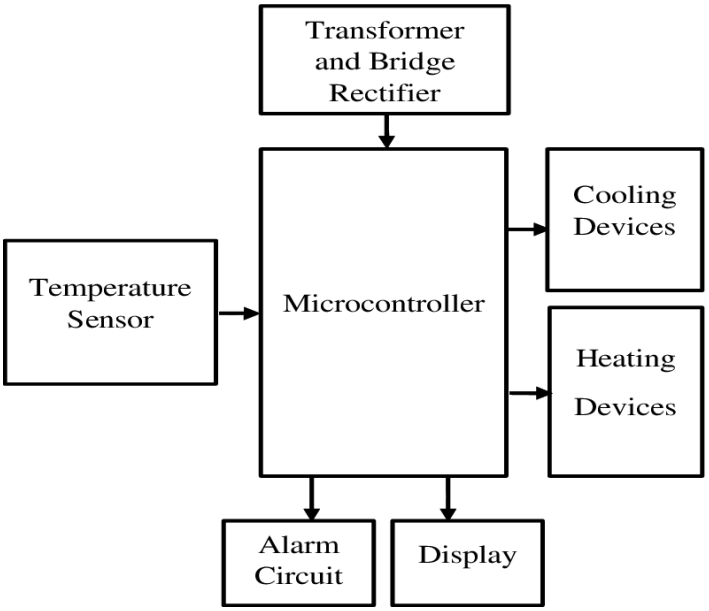

Fig -1: Block Diagram of Total System

A buzzer is turned on when unexpected or large temperature is found in the system can be cause to damage industry. Figure 1 shows block diagram of total system.

4. TEMPERATURE MEASUREMENT PRECISION

The LM35 series of temperature sensors are manufactured by National Semiconductor Corporation and are rated to activate over a -55 °C to 150°C temperature range. These sensors do not need any peripheral calibration and the output voltage is proportional to the temperature. The scale factor for temperature to voltage conversion is 10 mV per °C. The LM35 series sensors come in different packages. The measurement of negative temperatures (below 0°C) needs a negative voltage source. However, this project does not use negative voltage source, and therefore would validate the use of sensor for determining temperatures above 0°C (up to 100°C). The output voltage from the sensor is converted to a 10- bit digital number using the internal ADC of the PIC16F587A. Since the voltage to be measured by the ADC ranges from 0 to 1.0V, the ADC requires a lower reference voltage (instead of the supply voltage Vdd = 5V) for A/D conversion in order to get better accuracy. The lower reference voltage can be provided using a Zener diode, a resistor network, or sometime just simple diodes. Figure 2 shows an approximate 1.2V reference voltage by connecting two diodes and a resistor in series across the supply voltage. Irjet Template sample paragraph .Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

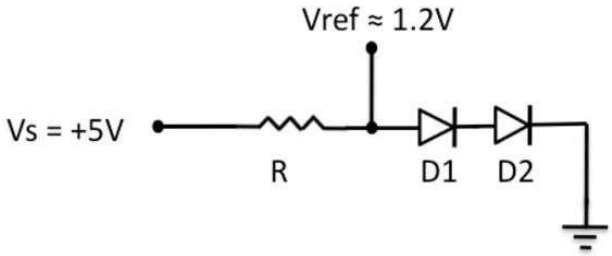

Fig -2: Block Diagram of Total System

4. DESIGN of TEMPERATURE CONTROL CIRCUITS

A 220 V AC supply is stepped down to 18V by using potential transformer (TR1). Transformer (TR1) is connected with a bridge rectifier (BR1) to create pulse- setting DC where a capacitor (C1) is used to produce smooth DC. A heater coil (L1) is directly connected to power supply through relay (RL1), when relay "ON" heater would produce heat. Figure 3 shows the complete circuit diagram of industrial temperature control system.

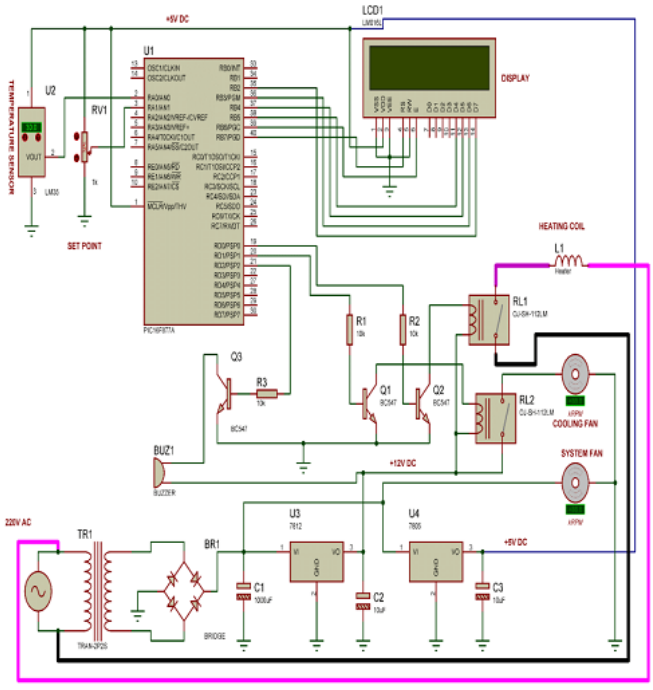

Fig -3: Complete Circuit Diagram of Temperature Control System

Two voltage regulators of 7412 and 7405 are used to get fixed DC voltages for different part of the circuit where U3 (7412) provides 12V and U4 (7405) provides 5V. Furthermore, capacitor C2 and C3 are used to filter output signal in case of presence of any oscillation into the provided DC voltage. The Buzzer (BUZ1) is connected with 12V DC voltage supply from U3 and the relays RL1 and RL2 are also connected with 12V DC voltage supply from relays RL1 and RL2. The display (LCD1), microcontroller (U1), set point (RV1) and temperature sensor (U3) are connected with 5V voltage DC voltage supply. In temperature controller there are two fans, one is system fan or circulating fan and another is cooling fan which are indicated in Figure 3. System fan is directly connected with 18V and cooling fan is connected with RL2. When power is supplied to system fan is turned on whereas cooling fan is controlled by the relay (RL2). Microcontroller is connected directly with sensor (U2), set point (RV1) and display (LCD1). Microcontroller is also connected with Buzzer (BUZ1), relay (RL1) and relay (RL2) through a switching device (BJT) and a resistor. Common emitter configuration of transistor (Q1, Q2 and Q3) works as a switching device.

5. CONCLUSION

In this paper, microcontroller based temperature measurement and controlling system has been designed which contains few basic element having couple of lines control code using MicroC. This system measures temperature using LM35 temperature sensor device and compares the results with standard industrial thermometer value having negligible deviation. It is also able to keep maintaining laboratory temperature at constant level. The hardware validation shows that the temperature can be maintained between 50 ^{0}C to 70 ^{0}C which is displayed in LCD. In addition, a control knob has been used to set temperature according to application having a range of selection choice. Further investigation is required for getting precise temperature control in remote area application.

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