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Temperature Control via ATMEGA 32 Microcontroller

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Abstract

The main idea of this paper is to design and implement monitoring and control temperature System in a room; through adjusting a reference set point. The actual temperature will be measured by using LM35 sensor that gives voltage in it is output proportional to the measured temperature comparing between the measured value (actual output) and the desired (setting point) degree by using ATmega32 microcontroller. Measured and desired temperature will display on LCD. The (Fan) will automatically turn when the measured temperature is above the desired value. The Fan will turn off when the measured temperature is below the desired value. In this condition the Heater is on.

Keywords: *Microcontroller (Atmega32), Temperature sensor (LM35), 2x16 LCD, ULN2003, Relay 5VD, Keypad.*

1. Introduction

Temperature measurement and control are vital in many industrial processes. Accurate control of the temperature is essential in many processes. In some applications, an accuracy of around 5-10 degree may be acceptable. There are many applications which require better than 4-1 accuracy.

Temperature sensors come in many different forms and a number of techniques have evolved for the measurement of temperature. There are new forms of sensors which require no contact with the medium whose temperature is to be sensed. The majority of sensors still require touching the solid, liquid, or the gas whose temperature is to be measured. Four technologies are currently in use: thermocouples (TCs), thermistors, resistance temperature detectors (RTDs), and IC sensors

In this research the Atmega32 Microcontroller is used to control the temperature of a certain room by switching the Fan and Heater ON and OFF depending on the feedback signals received from the sensor LM35. The main objective of this project is to: Control a room temperature using Atmega32 microcontroller, Understand and deal with different types of sensors, Understand and learn how to programme different versions of microcontroller. And Compare the results obtained with those presented in the state of art to evaluate the system performance. The conventional control systems are not capable to observe and control automatically. It's requires human operator, and control decision may different from human to another as well as the probability of human mistakes. Therefore an automated control system is used.

1.1 Microcontrollers

A microcontroller Multi Control Unit (MCU) is a single computer that is specifically manufactured for embedded computer control applications. These devices are very low cost and can be used very easily in digital control applications.MCU typically consist of microprocessor (CPU), data memory (RAM), program memory (ROM) an input (I/O) output (O/P) port as shown in figure(1.1). Most MCs have the built in circuits necessary for computer control applications. For example a MCU may have Analogue to Digital (A/D) converters so that the external signals can be sampled. They also have parallel input, output ports so that digital data can be read or output from the MC. Some devices have built-in Digital to Analogue (D/A) converters and the output of the converter can be used to drive the plant through an actuator (e.g. an amplifier). MCUs may also have built-in timer and interrupt logic. Using the timer or the interrupt facilities, thus MCU can be program to implement the control algorithm accurately[1].

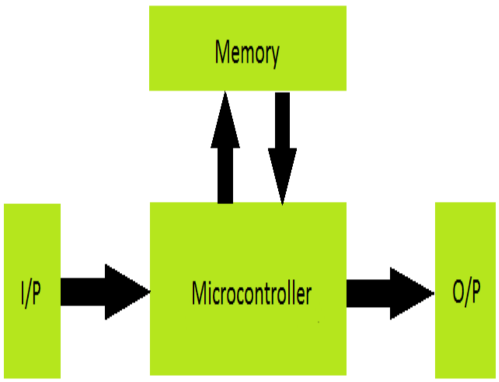

Figure 1.1: Basic Component of Microcontroller

MCUs have traditionally been programmed using the assembly language of the target device. As a result, the assembly languages of the MCUs manufactured by different firms are totally different and the user has to learn a new language before being able program a new type of device. Nowadays MCUs can be programmed using high level languages such as BASIC, PASCAL or C. High-level languages offer several advantages compared to the assembly language

1.1.1 Atmega32

The ATmega32 is a low power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. The ATmega32 AVR is supported with a full suite of program and system development tools including: C compilers, macro assemblers, program debugger simulators, in-circuit emulators, and evaluation kits. As shown in Figure below.[6]

Figure 1.2: ATMega32 Microcontroller

1.1.2 Features

- High performance and Low power AVR
- 8-bit Microcontroller
- Advanced RISC Architecture
- 131 Powerful Instructions
- 32*8 General Purpose Working Registers.
- Nonvolatile Program and Data Memories.
- Programming Lock for Software Security. [5]

1.1.3 Atmega 32 Pin Descriptions

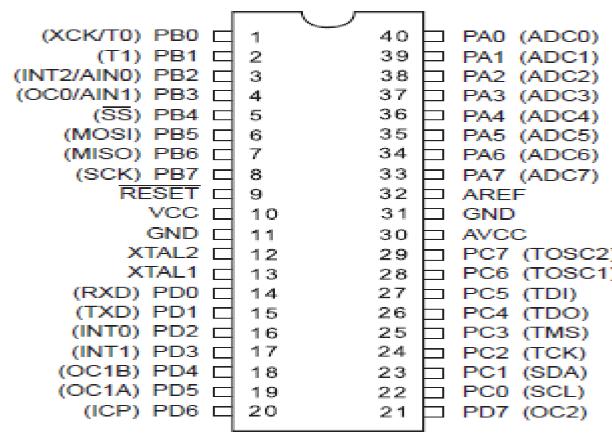

Figure 1.3: Atmega 32 Pin Descriptions

1.2 Temperature Sensor LM35

The LM35 series are precision integrated circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The accuracy of LM35 is around 1.5C [7]

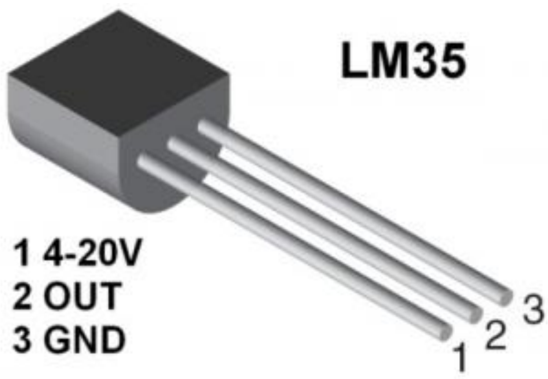

Figure 1.4: LM35 Sensor

1.2.1 Features

- Calibrated directly in Centigrade.
- Linear a 10.0 mV/C scale factor.
- 0.5C accuracy guarantee able at a 25C.
- Rated for full b55 to a150 C range.
- Suitable for remote applications.
- Low cost due to wafer level trimming.
- Operates from 4 to 20 volts.
- Less than 60mA current drain.
- Low self heating 0.08 C in still air.
- Nonlinearity only 4 C typical.

1.3 ULN2003

ULN2003 is the original high voltage, high current Darlington array. The output transistors are capable of sinking 500Ma and will sustain at least 50V in the off state. ULN2003 Darlington arrays are furnished in a 16 pin dual inline plastic package. As shown in figure bellow [9].

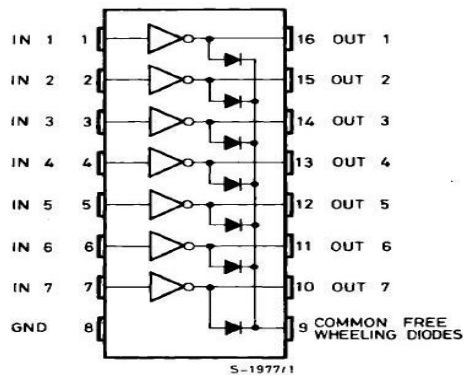

Figure 1.5: ULN 2003 Logic Diagram

1.3.1 Features

- 500mA rated collector current Single output.
- High voltage outputs: 50V Inputs.
- Compatible with various types of logic Relay driver application.

2. Case Study

To achieve the objectives of this study the following will be performed for Building the code required to load. The hardware designing in the MC. Comparing the results obtained to those stated literature review. And compare simulation result with those obtained from experimental setup.

In this project, ATmega32 microcontroller will be used as the controller to control and monitor the temperature in room at desired value. The Flow Chart of the system is shown in Fig. 2.1. It represents a closed-loop with a real time control system. The actual temperature will be measured by using LM35 sensor that gives voltage in it is output proportionally to the measured temperature and feedback to microcontroller. In microcontroller, the error between the desired and the actual temperature and then send actuator signal to the FAN.
When model start the measured temperature will be display on LCD. If measured temperature above the maximum set point; the FAN will be turn on; otherwise if the temperature less than minimum set point the Heater on. Otherwise the process will begin from start.

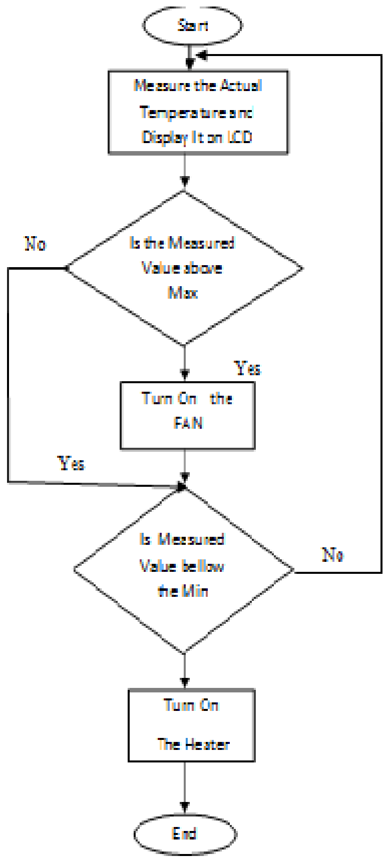

Figure 2.1: Basic Flow Chart of Temperature Control System

2.1 Simulation Diagram

Proteus simulation package has been used to connect and simulate the proposed circuit as show in Fig. 2.2 below.

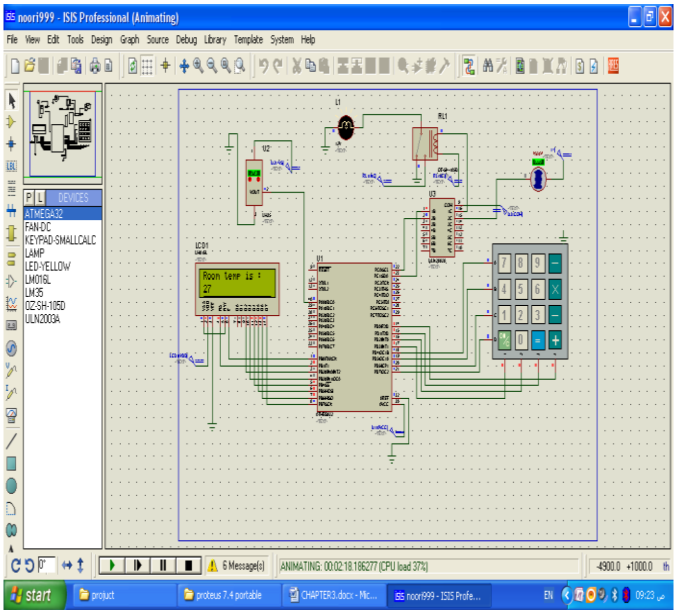

Figure 2.2: Simulation Diagram

2.2 Software Development

Programming tool is used to implement the task between the hardware and software. This tool of programming is BASCOM AVR.

2.3 Simulation Results

The designed program loaded into ATmega32 microcontroller and executed. Initially the temperature degree of the room was 27 C. This temperature exceeds the maximum set point of the room temperature. Consequently the microcontroller compares the two temperatures and automatically switches on the FANs. The result obtained is shown Figure 2.3

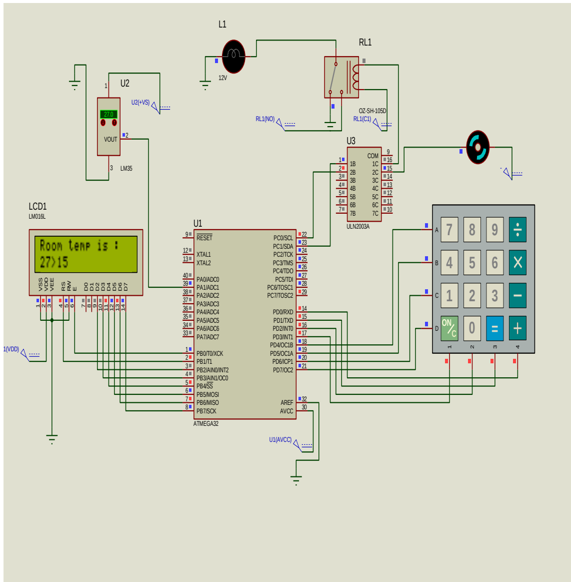

Figure 2.3: Temperature Degree above the Measure Degree

When the room temperature has been changed and set to 10C.This temperature less than the minimum set point of the room temperature. Consequently the microcontroller compares the two temperatures and automatically switches on the HEATER. The result obtained is shown in Fig.2.4.

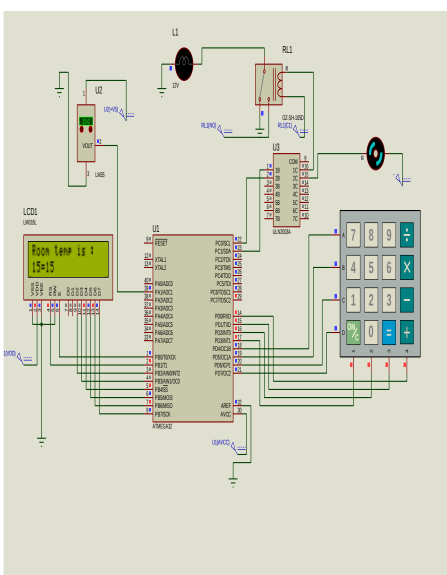

Figure 2.4: Temperature Degree below than Measure Degree

When the room temperature has been changed and set to 10C.This temperature equal the set temperature in this case the FAN is off and the HEATER is off. Figure 2.4Temperature Degree equal to Measure Degree.

2.4 Hardware Result

The temperature control system has been successfully implemented for hardware construction and tests have been carried out after the program loaded into ATmega32 microcontroller, to verify that the circuit functions correctly and probably as shown in Hardware Circuit figure 2.5.

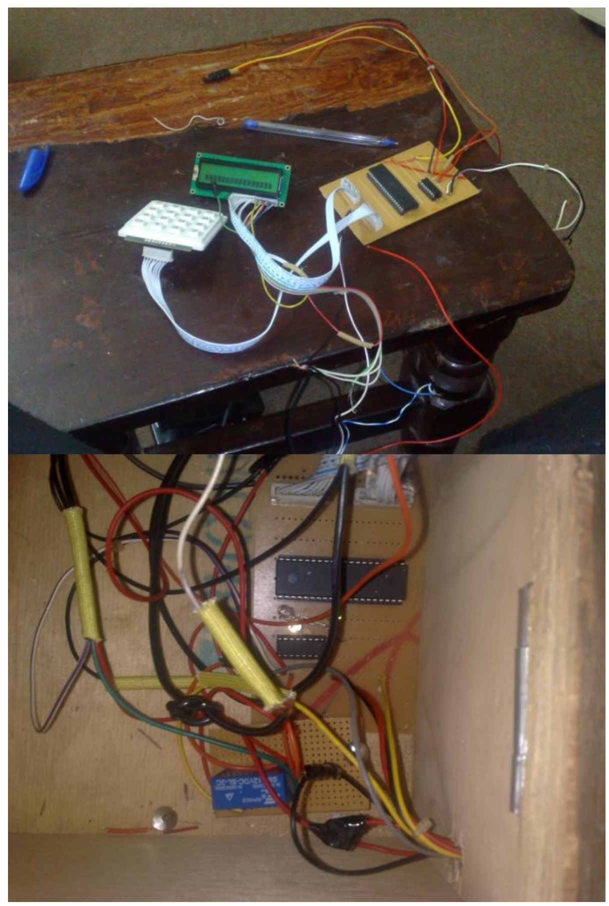

Figure 2.5: Hardware Circuit

3. Conclusions

The ultimate aim of this project has been completely achieved where the temperature

Control System was capable to maintain the desired temperature when comparing with conventional system.

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