Digital Temperature Controller Circuit

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Abstract: This article introduces a microcontroller-based programmable temperature controller. This framework is based on a PIC16F877A microcontroller interface with an 8051 temperature sensor, LCD, exchange transistor and transmission. The basic plan is divided into two parts. equipment and programs. The DS1621 temperature sensor measures the temperature of a particular room, which he sends to the PIC16F877A microcontroller. The microcontroller then converts it and compares it with an internally stored preset temperature value. The microcontroller then switches the cooler or fan on or off depending on the result of the comparison. The measured room temperature is also displayed on the LCD. The plan specifies temperature values of a minimum of 26 °C and a maximum of 29 °C. After testing the frame, we found that it exchanged at temperatures of 25 °C and 300 °C. As such, this frame is useful in areas such as rooms, workplaces, and department stores where temperature control is required.

Index Terms - Microcontroller, Temperature, Controller, Automatic, PIC8051, DS1621

1. Introduction

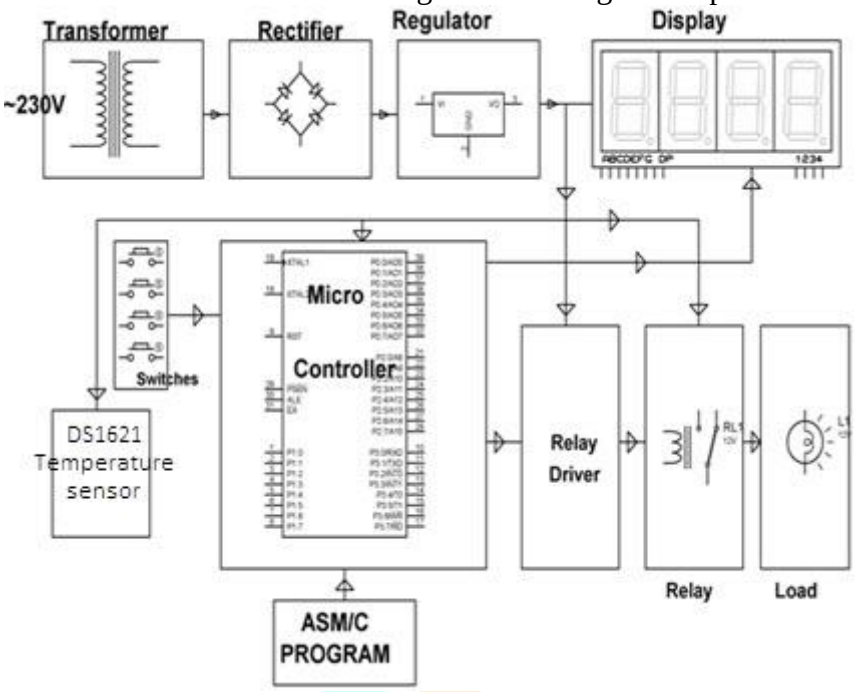
A temperature controller is a system that monitors and regulates the temperature of a room or any location to reduce it if it is too hot. If the temperature is low, the system will raise the temperature as needed. Temperature controllers can be manual or automatic. The former requires full human intervention, while the latter requires little or no intervention. Furthermore, most of the previously developed temperature controllers and related systems use discrete components such as timers, counters, decoder drivers, thermistor temperature sensors [1] [2]. However, some used microcontrollers with external analog-to-digital converters (ADCs) [3]. However, these devices take up a lot of space, are heavy, consume a lot of power, and are inflexible, requiring the replacement of hardware components to change the system. Also, temperature sensors, among other related problems, are nonlinear [4]. Digital temperature controller circuits are precision temperature controllers in medical, industrial, and household applications. This system outperforms inaccurate analog/thermostat systems. For example, it can be used to control the temperature of incubators where maintaining a precise temperature is very important.

2.Design methodology

Digital Temperature Controller Block Diagram Description

This proposed digital temperature control system displays temperature information on the display and turns off the load (ie heater) when the temperature exceeds the set point. A lamp is provided in this project as a

demonstration load. A block diagram of the digital temperature control system is shown below.



Block Diagram of Digital temperature controller

The proposed digital temperature control system uses the 8051 family microcontroller, which is central to the application. The display unit consists of a 4- to 7-segment display, a temperature sensor and is connected to a microcontroller.A digital temperature sensor connects with a microcontroller to sense temperature conditions. The system also has four push-button switches for adjusting temperature settings.After that, the microcontroller continuously polls the temperature information through the digital temperature sensor, displays it on the 7-segment display unit, and automatically turns off the lamp when the corresponding temperature exceeds the set value.

Hardware Requirements

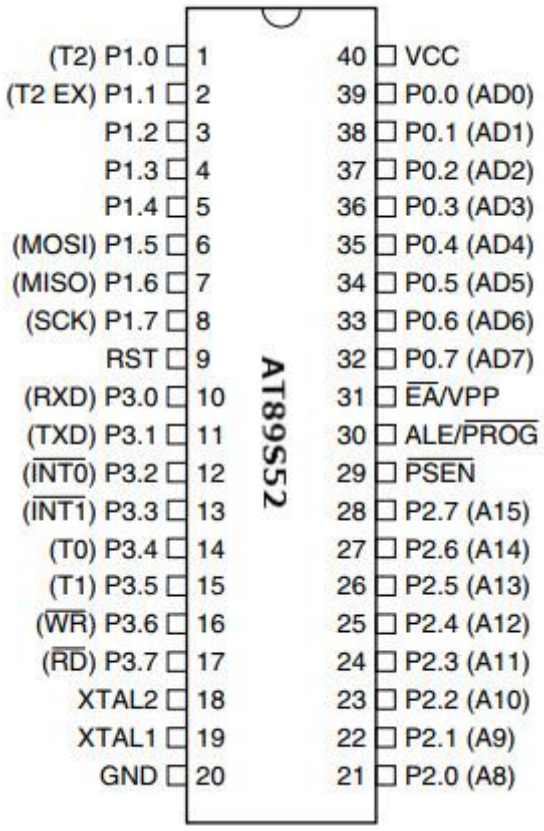
- Transformer (230 – 12 v ac)
- Voltage regulator (LM 7805)
- Rectifier
- Filter
- Microcontroller (at89s52/at89c51)
- DS1621 Temperature sensor
- Push buttons
- 7 segment display
- BC547
- Resistors
- Capacitors
- 1N4007
- Relay

Microcontroller (AT89S52)

The Atmel AT89S52 is a high-performance 8051-based microcontroller that provides a flexible and cost-effective solution for many embedded control applications. AT89S52 offers the following standard features:

- 8K bytes of Flash
- 256 bytes of RAM
- 32 I/O lines
- Watchdog timer
- Two data pointers
- Three 16-bit timer/counters
- A six-vector two-level interrupt architecture
- A full duplex serial port
- On-chip oscillator, and clock circuitry

The pin diagram is given below.



8051 Microcontroller

Temperature Sensor- DS1621

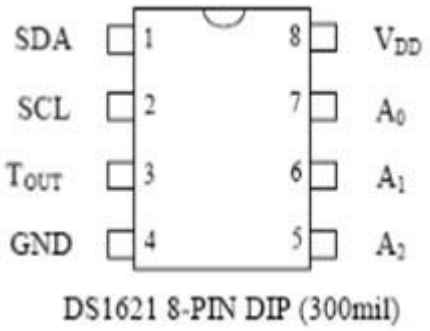
A sensor is a device that receives and responds to a signal or stimulus. Sensors can only convert the signals they receive into electrical form.

The Temperature Sensor- DS 1621 provides the following standard features:

- Measurements require no external components
- Measures temperatures from -55°C to +125°C in 0.5°C increments (67°F to 257°F in 0.9°F increments)

- Temperature is read as a 9-bit value (2-byte transfer)
- Wide power supply range (2.7V to 5.5V)
- Converts temperature to digital word in less than 1 second
- Thermostatic settings are user definable and Nonvolatile
- Data is read from/written via a 2-wire serial interface (open drain I/O lines)
- Applications include thermostatic controls, industrial systems, consumer products, thermometers, or any thermal sensitive system
- It is an 8-pin DIP or SO package

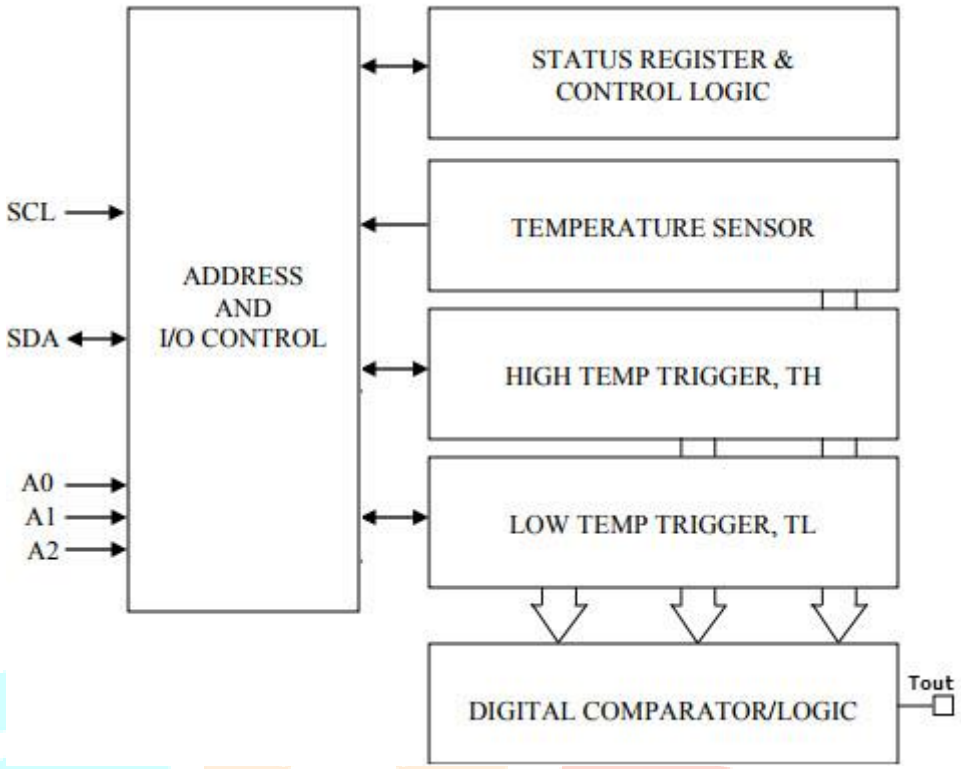
Pin Description



DS1621 Pin Description

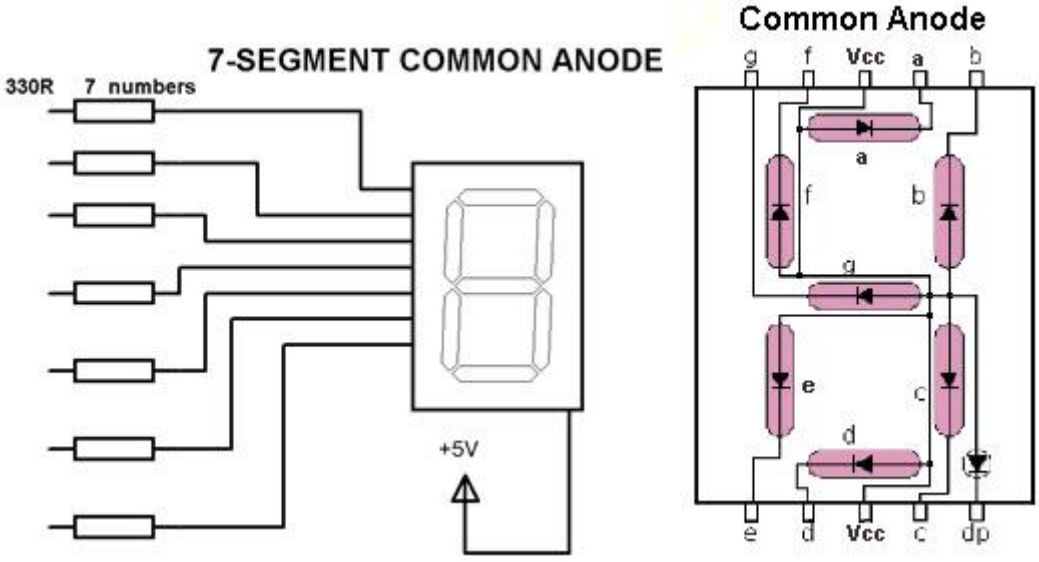
- SDA – 2-Wire Serial Data Input/ Output
- SCL – 2-Wire Serial Clock
- GND – Ground
- TOUT – Thermostat Output Signal
- A0 – Chip Address Input
- A1 – Chip Address Input
- A2 – Chip Address Input
- VDD – Power Supply Voltage

A functional diagram of the DS1621 is shown in the below figure.



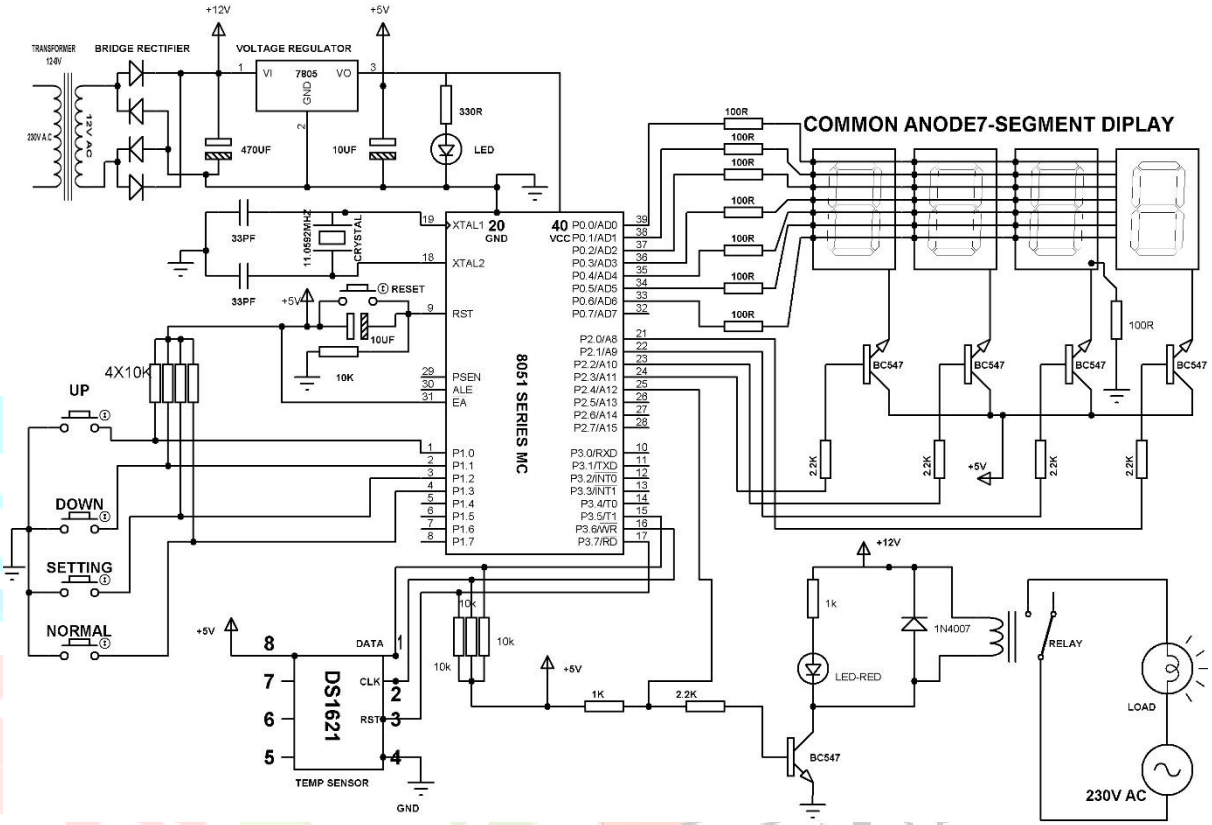
DS1621 Functional Block Diagram

The DS1621 provides a 9-bit temperature value that indicates the temperature of the device. A thermostat output signal (TOUT) is activated when the temperature of the unit exceeds a user-defined temperature (TH).The output remains active until the temperature drops below the user-defined temperature TL, accounting for the required hysteresis. Custom temperature settings are stored in non-volatile memory, allowing you to program the part before assembling it into your system.All temperature settings and temperature readings are communicated between the microcontroller and his DS1621 via a simple 2-wire (I2C) serial interface. measure the temperatureThe DS1621 measures temperature using a bandgap-based temperature sensor. A delta-sigma analog-to-digital converter (ADC) converts the measured temperature to a calibrated digital value in °C or °F units.Temperature readings are provided in 9-bit two's complement values by issuing the READ TEMPERATURE command. Data is sent via a 2-wire serial interface - MSB first (I2C serial communication interface).Simple 7-segment displayThis version is the common anode version. This means that the positive branch of each LED is connected to a common point (pin 3, Vcc in this case). Each light-emitting diode has a negative terminal, which is connected to one of the device's pins.



7- Segment LED display

Pin 3 must be connected to 5 volts for this to work. Then, to light each segment, connect the ground pin of that LED to ground through a resistor. For example, it can also be used through any microcontroller port pin in sink mode. Port 0 on 8051 series microcontrollers.softwareI wrote the application code using the 'C' language and compiled it with the KEIL Micro Vision (IDE) compiler. Once the software has been written, this code is translated into hexadecimal code to drive the microcontroller. The generated hexadecimal code is burned into the microcontroller using a suitable programming device.Schematic diagram of connections for a digital temperature controllerFor the system to work, it needs a 5V power supply connected to pin 40 of the microcontroller and a GND connected to pin 20 of the microcontroller. Port 1 pins 1.0 to 1.3 are connected to push buttons. Pins 3.5 to 3.7 of the microcontroller are connected to pins 1, 2, and 3 of the DS1621 temperature sensor respectively.



Digital Temperature Controller Schematic Diagram

Pin 0.0 to 0.6 of port 0 of Microcontroller is connected to 7 segment display. Pin 2.0 to 2.3 of port 2 of Microcontroller are connected to transistors BC547 of Port 2 of Microcontroller is connected to transistor's BC547. Pin 2.4 is connected to another transistor BC547 which drives the relay.

3.Working

This project uses a DS1621 digital temperature sensor connected to a microcontroller. The surface of this 8-pin IC senses the ambient temperature and provides serial digital data on pin #1. This data is displayed by the microcontroller via 4 units of common-anode 7-segment displays, all connected in parallel to port '0'.Four push-button switches are connected to a microcontroller with pull-up resistors to easily program the set temperature according to your needs. The pin 25 output of the microcontroller drives a transistor that drives a relay to turn the heater on or off to maintain temperature.However, this project uses lamps instead of heaters for demonstration purposes. The lamp is always on and turns off when the set temperature is reached.

4.Applications of Digital Temperature Controller

The following are some examples of applications for which particular attention must be given.

- Outdoor use uses involving potential chemical contamination or electrical interference
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems
- Medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations
- Systems, machines, and equipment that could present a risk to life or property

Thus, this is all about Digital temperature controller using a microcontroller. We hope that you have got a better understanding of this concept.

5. Discussion of Results

After final assembly, the system was tested. The test was conducted by disassembling the control switch part of the manual heater/fan dual system and incorporating it into the automatic temperature control system. The combined system was then installed in a room with the air conditioner on. It has been observed that the fan automatically turns on when the room temperature rises above 30°C. However, if the room temperature is below 25°C, the heater will automatically turn on. Also, at room temperature between 25°C and 30°C, the system remains idle. From the above results, we can see that the system is not working as expected. This may be due to the ADC conversion process not covering full resolution. H. 8-bit resolution is used instead of 10-bit. It also shows the linearity of the temperature sensor.

6.conclusion and Recommendation

his article introduces a microcontroller-based automatic temperature controller. The AT89S52 temperature sensor captures the temperature of a particular room and relays it to the ds1621 microcontroller, which decodes it and compares it with preset temperature values stored there. The microcontroller then automatically turns the heater or fan on or off based on the result of the comparison. We recommend adding a method to your system to change the temperature limits, such as a matrix keyboard.

References

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