Temperature Based Fan Speed Controller

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Abstract: This practical temperature controller controls temperature of any device according to its requirement for any industrial application. It also displays the temperature on an LCD display in the range of –55°C to +125°C. The heart of the circuit is an ARDUINO board which controls all its functions. An IC LM35 is used as temperature sensor. The LM35 temperature device is interfaced to the pin of the ARDUINO board, through its built-in ADC, which converts these reading and displays that on the LCD, to indicate temperature of the device. User defined temperature settings can be done using push buttons provided through ARDUINO board.

***Index Terms* – ARDUINO Board, IC LM 35, LCD Display.**

I. INTRODUCTION

Many existing systems for temperature monitoring and controlling generally uses micro-controller ATMEL 89C51 (μc 8051). It does the same job by using additional devices. The microcontroller-controlled system contains essentially four parts, i.e., the process, the analog to digital converter, the control algorithm, and the clock. The times when the measured signals are converted to digital form are called the sampling instants; the time between successive samplings is called the sampling period and is denoted by h. The output from the process is a continuous time signal. The output is converted into digital form by the A – D converter. The conversion is done at the sampling times.

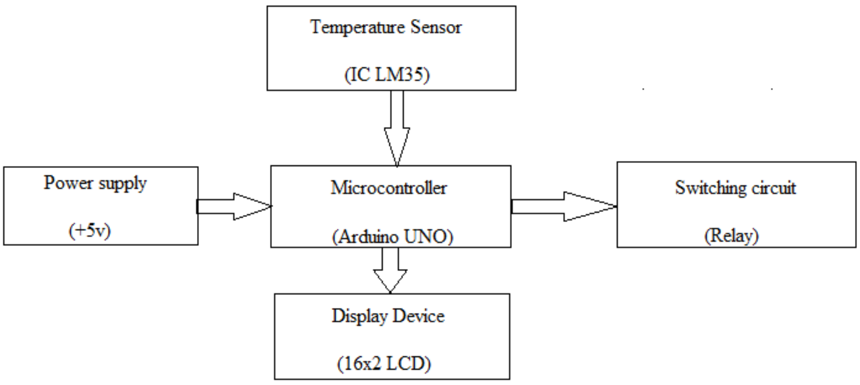
II. PROBLEM ASSOCIATED WITH EXISTING SYSTEM

Many existing systems for temperature monitoring and controlling generally uses micro-controller ATMEL 89C51 (μc 8051). Due to using micro controller 8051 the process of making whole device becomes not only very complex but also difficult and tedious. For operation it requires A-D converter, external clock, microcontroller development board.

Consequently, the problems are as follows: -

a) It takes comparatively more time to process.
b) It requires additional devices for operation.
c) It requires external clock.
d) Programming for microcontroller 8051 is difficult.
e) For programming it requires development system.
f) Circuit size becomes large.

III. PROPOSED SYSTEM



Existing system uses ATMEL 89C51 has many disadvantages as seen above in the section 1.3 above to overcome this problems we use another advanced microcontroller called Arduino (ATmega8). It has in built with many components like analog to digital converter, clock of 16 MHz, shift registers. In this system we uses temperature sensor LM35, to use to detect temperature into appropriate voltage. This voltage is given to Arduino. According to program it processes the analog signal into digital and forms a particular voltage level for a particular temperature.16x2 LCD is used to display the output i.e. surrounding temperature of LM35 in both degree centigrade and Fahrenheit units. At the same time, it also sends the data to Relay, if the temperature becomes maximum from set point relay becomes activate and it switches on the cooling device like fan. In this manner it monitors and controls the temperature.

Temperature is the most often-measured environmental quantity. This might be expected since most physical, electronic, chemical, mechanical and biological systems are affected by temperature. Some processes work well only within a narrow range of temperatures. Certain chemical reactions, biological processes, and even electronic circuits perform best within limited temperature ranges. When these processes need to be optimized, control systems that keep temperature within specified limits or constant are often used. The field of process control has grown rapidly since its inception in the 1959s. It has become one of the core areas of chemical engineering. One of the most important process variables to be controlled is temperature of liquid in many chemical engineering Plants. In brief, how to control the temperature of a water bath is one of the industrial problems. Hence suitable temperature controller for controlling temperature of a water bath is very common requirement of the industries.

Temperature rise due to resultant increase in molecular activity of substances on application of heat, which also connotes an increase in internal energy of the material. Heat exchange, heat balances, safe temperature limits of various equipment's and multitude of other problems involving temperature are important in all phases of power generation and process industries. The means of indicating, recording and controlling temperatures are important in design, fabrication, operation, and testing power generating and utilizing equipment and associated apparatus. Correct measurement of temperature is of paramount importance to power and process engineers and great strides have been made in this branch. The ultimate aim is to measure temperatures correctly and reliably, at the same time keeping the cost of instruments down.

IV. REQUIREMENT ANALYSIS

Arduino

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. This guide is for students in ME 2011, or students anywhere who are confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources.

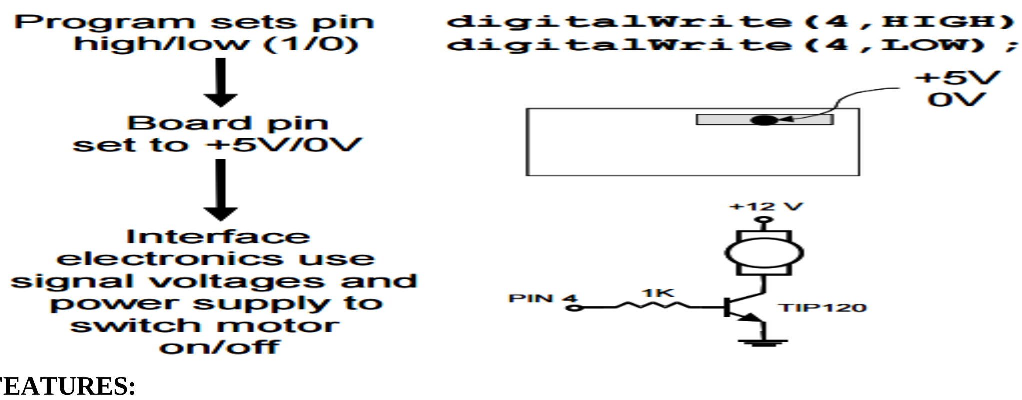
The Arduino programming language is a simplified version of C/C++. If you know C, programming the Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions.

An important feature of the Arduino is that you can create a control program on the host PC, download it to the Arduino and it will run automatically. Remove the USB cable connection to the PC, and the program will still run from the top each time you push the reset button. Remove the battery and put the Arduino board in a closet for six months. When you reconnect the battery, the last program you stored will run. This means that you connect the board to the host PC to develop and debug your program, but once that is done, you no longer need the PC to run the program.

Arduino Hardware

The power of the Arduino is not its ability to crunch code, but rather its ability to interact with the outside world through its input-output (I/O) pins. The Arduino has 14 digital I/O pins labelled 0 to 13 that can be used to turn motors and lights on and off and read the state of switches.

To interact with the outside world, the program sets digital pins to a high or low value using C code instructions, which corresponds to +5 V or 0 V at the pin. The pin is connected to external interface electronics and then to the device being switched on and off. The sequence of events is shown in this figure.



ATMEGA328P FEATURES:

High Performance, Low Power AVR® 8-Bit Microcontroller

Advanced RISC Architecture

– 131 Powerful Instructions

– Most Single Clock Cycle Execution

– 32 x 8 General Purpose Working Registers
– Fully Static Operation
– Up to 20 MIPS Throughput at 20 MHz
– On-chip 2-cycle Multiplier

➢ High Endurance Non-volatile Memory Segments

– 4/8/16/32K Bytes of In-System Self-Programmable Flash program memory (ATmega48PA/88PA/168PA/328P)
– 256/512/512/1K Bytes EEPROM (ATmega48PA/88PA/168PA/328P)
– 512/1K/1K/2K Bytes Internal SRAM (ATmega48PA/88PA/168PA/328P)
– Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
– Data retention: 20 years at 85°C/100 years at 25°C(1)
– Optional Boot Code Section with Independent Lock Bits In-System Programming by On-chip Boot Program True Read-While-Write Operation
– Programming Lock for Software Security

➢ Peripheral Features

– Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
– One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
– Real Time Counter with Separate Oscillator
– Six PWM Channels – 8-channel 10-bit ADC in TQFP and QFN/MLF package Temperature Measurement – 6-channel 10-bit ADC in PDIP Package Temperature Measurement
– Programmable Serial USART
– Master/Slave SPI Serial Interface
– Byte-oriented 2-wire Serial Interface (Philips I2 C compatible)
– Programmable Watchdog Timer with Separate On-chip Oscillator
– On-chip Analog Comparator
– Interrupt and Wake-up on Pin Change

➢ Special Microcontroller Features

– Power-on Reset and Programmable Brown-out Detection
– Internal Calibrated Oscillator
– External and Internal Interrupt Sources
– Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby

➢ I/O and Packages

– 23 Programmable I/O Lines
– 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF

➢ Operating Voltage:

– 1.8 - 5.5V for ATmega48PA/88PA/168PA/328P

➢ Temperature Range:

– -40°C to 85°C

➢ Speed Grade:

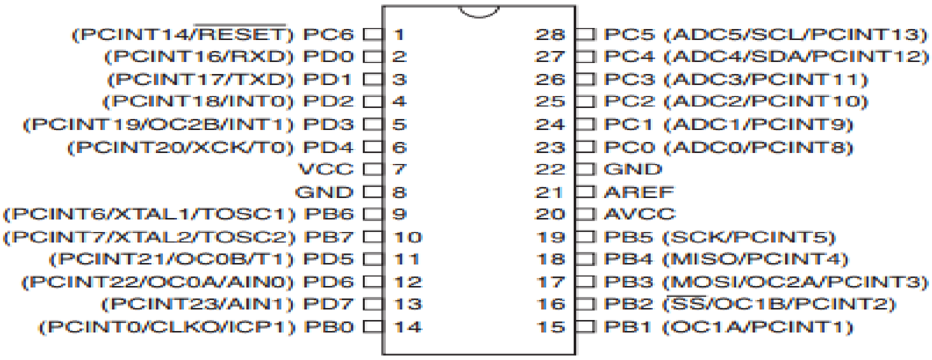
– 0 - 20 MHz @ 1.8 - 5.5V

➢ Low Power Consumption at 1 MHz, 1.8V, 25°C for ATmega48PA/88PA/168PA/328P:

– Active Mode: 0.2 mA
– Power-down Mode: 0.1 µA
– Power-save Mode: 0.75 µA (Including 32 kHz RTC)

The ATmega48PA/88PA/168PA/328P is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the Atmega48PA/88PA/168PA/328P achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.



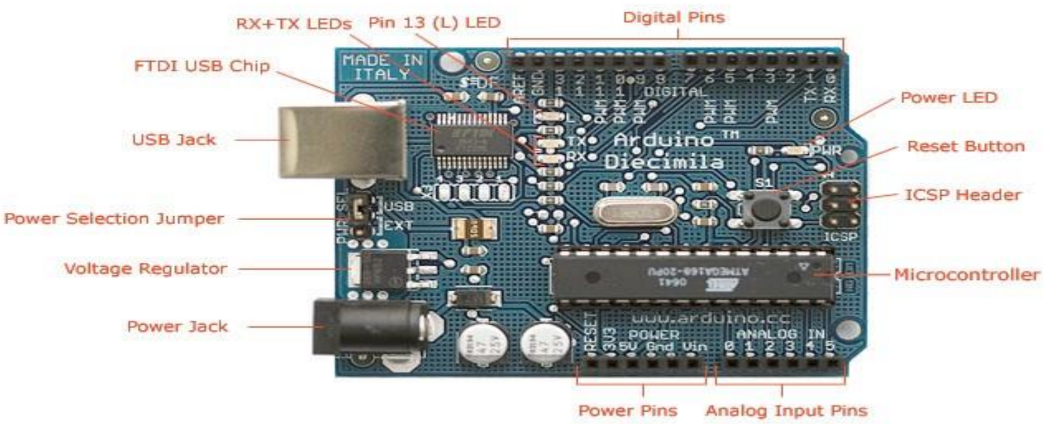
ATMEGA328P Pin Diagram

V. COMPARISON BETWEEN ATMEGA48PA, ATMEGA88PA, ATMEGA168PA AND ATMEGA328P

The ATmega48PA, ATmega88PA, ATmega168PA and ATmega328P differ only in memory sizes, boot loader support, and interrupt vector sizes. Table summarizes the different memory and interrupt vector sizes for the three devices.

Device	Flash	EEPROM	RAM	Interrupt Vector Size
ATmega48PA	4K Bytes	256 Bytes	512 Bytes	1 instruction word/vector
ATmega88PA	8K Bytes	512 Bytes	1K Bytes	1 instruction word/vector
ATmega168PA	16K Bytes	512 Bytes	1K Bytes	2 instruction words/vector
ATmega328P	32K Bytes	1K Bytes	2K Bytes	2 instruction words/vector

ARDUNIO IDE



Arduino Board

The Arduino is an amazing device and will enable you to make anything from interactive works of art to robots. With a little enthusiasm to learn how to program the Arduino and make it interact with other components a well as a bit of imagination, you can build anything you want. This book and the kit will give you the necessary skills needed to get started in this exciting and creative hobby. So, now you know what an Arduino is and what you can do with it, let's open up the starter kit and dive right in. The Arduino can be used to develop stand-alone interactive objects or it can be connected to a computer to retrieve or send data to the Arduino and then act on that data (e.g. Send sensor data out to the internet). The Arduino can be connected to LED's. Dot Matrix displays, LED displays, buttons, switches, motors, temperature sensors, pressure sensors, distance sensors, webcams, printers, GPS receivers, ethernet modules.

The Arduino board is made of an an Atmel AVR Microprocessor, a crystal or oscillator (basically a crude clock that sends time pulses to themicrocontroller to enable it to operate at the correct.

To program the Arduino (make it do what you want it to) you also use the Arduino IDE (Integrated Development Environment), which is a piece of free software, that enables you to program in the language that the Arduino understands. In the case of the Arduino the language is C. The IDE enables you to write a computer program, which is a set of step-by- step instructions that you then upload to the Arduino. Then your Arduino will carry out those instructions and interact with the world outside. In the Arduino world, programs are known as sketches.

Arduino Program pattern

Serial Monitor

The Toolbar buttons are listed above. The functions of each button are as follows: -

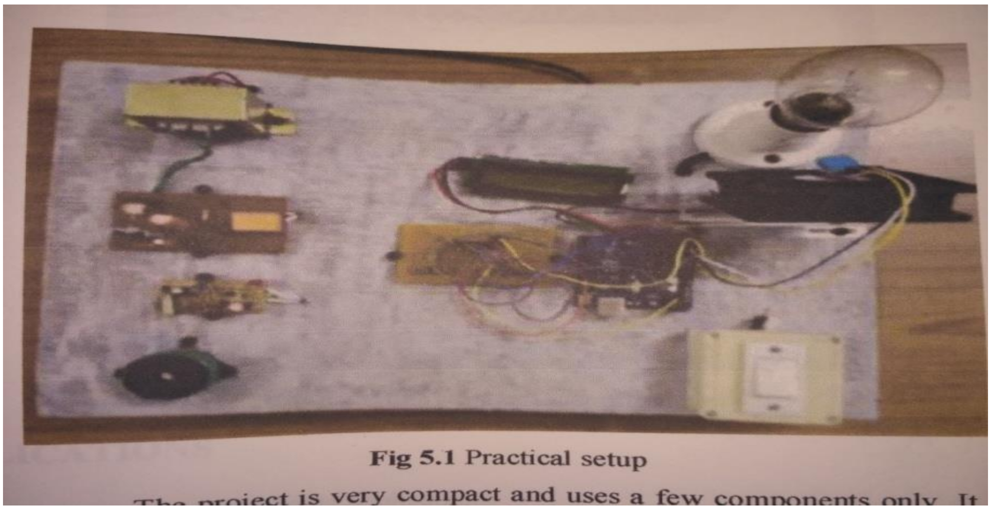
Verify/Compile	Checks the code for errors
Stop	Stops the serial monitor, or un-highlights other buttons
New	Creates a new blank Sketch
Open	Shows a list of Sketches in your sketchbook
Save	Saves the current Sketch
Upload	Uploads the current Sketch to the Arduino
Serial Monitor	Displays serial data being sent from the Arduino

VI. OVERVIEW OF TEMPERATURE CONTROLLED DC FAN USINGMICROCONTROLLE

In this project we used ATmega8 microcontroller, driver IC, temperature sensor and DC motor. The function of each equipment depends on each other. The function of temperature sensor is to sense the temperature from the environment and give the analog input to the microcontroller at the Port C where ADC pin converts the analog signal into digital signals. Microcontroller has 28 pins. Some of the pins are known as VCC, GND, AVCC, etc. AVCC is used for ADC.

There are three ports in the ATmega8 microcontroller which are Port B, Port C and Port D. each port can be used as input or output ports. In the project we used Port B as an output and output from the port is given to the motor driver. Pin PB1 is connected to the input 1 and pin PB2 is connected to the input 2 of the driver IC. The output of the motor driver IC is connected to the DC motor. DC motor runs when input 1 and input 2 is either 01(low high) or 10(high low).

WORKING OF THE CIRCUIT



1. First power supply is given to the Arduino board.
2. Temperature sensor starts sensing the temperature from the environment.
3. The temperature sensor starts giving analog signal to themicrocontroller.
4. ADC pins of the microcontroller starts converting analog signal into digital signal.
5. Using the internal successive approximation method the conversion of analog value to digital value is done by themicrocontroller.
6. Whenthetemperatureisgreaterthanthethresholdorsetvaluethenthemicrocontrollergivesoutput to the motor driver for starting the DC fan.
7. Now the motor starts running.

Fig 5.3 Circuit under Operating condition

APPLICATIONS

- This can be used in home applications.
- The circuit can be used in CPU to reduce the heat.

VII. CONCLUSION

Basic idea of this project is to run the DC motor fan when temperature sensed by the temperature sensor is greater than threshold value. In this project we have used Arduino board for the programming of microcontroller through the USB.

The microcontroller uses the hex file to execute the program. The temperature sensor output is connected to the microcontroller and it gives the output to the motor driver IC which runs the motor. In this way our main objective of the project is achieved.

REFFERENCES

[1] Vaibhav Bhatia and Pawan Whig, “A Secured Dual Tone Multifrequency Based Smart Elevator Control System," International Journal of Research in Engineering and Advanced Technology, Volume 1, Issue 4,Aug-Sept,2013.

[2] F. Luo, X. Zhao, and Y. Xu, "A new hybrid elevator group control system scheduling strategy based on particle swarm simulated annealing optimization algorithm", Intelligent Control and Automation (WCICA), 2010,pp.5121-5124.

[3] IEEE Vehicle Power and Propulsion, Sept. 3-5 Harbin, China, 2008, pp. 1-6.

[4] I. Panagopoulos, C. Pavlatos and G. Papakonstantinou, "An Embedded Microprocessor for Intelligent Control," Journal of Intelligent and Robotic Systems. Springer Netherlands, vol. 42, 2005, pp.179-211.

[5] Md. M. Islam, F. H. Md. Rafi, A. F. Mitul and M. Ahmad, "Development of a Noninvasive Continuous Blood pressure Measurement and Monitoring system", Proceedings of the International conference on ICIEV, May-2012,pp.1085-1090.

[6] S. Kwakyea and A. Baeumner”An embedded system for portable electrochemical detection", Sens. Actuat. B, vol. 123, no. 1, 2007, pp.336-343.

[7] B. Ismail, S. Taib, A. R. M. Saad, M. Isa and C. M. Hadzer, "Development of a Single Phase SPWMMicrocontroller-Based Inverter", Proceedings of the Annual International Conference of the PECon, November 2006,pp.437-440.

[8] Xiaodong Xia, Based on Single Chip MicrocomputerRemoteWireless Control System Design.

[9] Coal Mine Machinery, vol. 32 (8), 2011, pp. 202-204.