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Speed, Flow & Cooling Proportional Control Using Temperature

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Abstract: ***Automatic control is vast technological area to improve performance, reduce power and reduces the human operator. In every industry flow rate, speed rate are important parameters specially petroleum, chemical, automobile industries. This paper work is to implement an artificial intelligent control method for flow and speed system and is suitable for low temperature applications of PID theory and how this theory can be applied to model and predict 'Speed, Flow and cooling' proportional control using temperature. The PID system provides feedback and response to the system in order to allow the control system to automatically adjust itself. The goal of this project is to explore the application controller to speed, flow and cooling proportional control using temperature sensor LM35DZ. This is accomplished by gathering the distance from a thermistor using PID theory to predict the appropriate K, Kp values for the system correctly adjust itself.***

Keywords: LM35DZ Temperature Sensor, Aurduino UNOMCU, Optcoupler MCT2E, Air cooler

1. Introduction

Heat comes with serious consequences to human life and health which makes the smart use of air conditioning very important. And it makes a good air conditioning system a worthwhile investment.

Now a day one of the basic requirement of the people during summer is a cooling fan. By turning manual switch, speed can be controlled. Different season having different temperature levels. Even during daylight and at night temperature levels are different. Hence through this work cooling fan speed and cooling water motor are controlled automatically.

COOLER CONTROLLER is designed to enhance cooler capabilities to give a new atmospheric mood, Comfort and saving of Electricity & Water. After installing our controller unit you do not require any other fan regulator and pump switch. Air coolers, otherwise known as evaporative or swamp coolers, use the evaporation of water to cool an environment. When the air blows past water, some particles on the surface of the water are carried away. Those particles take some heat with them, cooling the air. That is how sweating works. The water particles on the surface of the skin carry off heat with them as they evaporate, cooling the skin. As a bonus, these air coolers use 75 percent less energy than central air conditioners

2. Working Principal / Methodology

Arduino is at the heart of the circuit as it controls all functions. Temperature sensor LM35 senses the temperature and converts it into an electrical (analogue) signal, which is applied to the MCU through an analogue-to-digital converter (ADC). The analogue signal is converted into digital format by the ADC. Sensed values of the temperature and speed of the fan in % are displayed on the LCD. The MCU on Arduino drive the motor driver to control servo motor rotation angle. Servo motor rotate clockwise or anticlockwise direction with respect to the increase or decrease of temperature. Temperature and angle of rotation are specified in the arduino program. Servo motor is mechanically coupled with AC regulator. The output of regulator controls the speed of cooling fan of air cooler.

The water pump motor i. e flow of water is also controlled. The program is designed in such a way that the relay switch get ON after reaching surrounding temperature about 30 ^{0}C. The pump motor start functioning at 30 ^{0}C.

Servo motor is controlled by PWM (Pulse with Modulation) which is provided by the control wires. The position of a servo motor is decided by electrical pulse and its circuitry is placed beside the motor.

Servo motor is drive through transistor BD139 (NPN Transistor). Collector is connected to motor and emitter to ground. Variation in base current proportional to the variation in the surrounding temperature causes change in collector current.

3. PID Controller Basics

The purpose of a PID controller is to force feedback to match a set point, such as a thermostat that forces the heating and cooling unit to turn on or off based on a set temperature. PID controllers are best used in systems which have a relatively small mass and those which react quickly to changes in the energy added to the process. It is recommended in systems where the load changes often and the controller is expected to compensate automatically due to frequent changes in set point, the amount of energy available, or the mass to be controlled. Proportional controls are designed to eliminate the cycling associated with on-off control. A proportional controller decreases the average power supplied to the

cooling fan as the temperature approaches set point. This has the effect of slowing down the fan speed so that it will not overshoot the set point but will approach the set point and maintain a stable temperature.

4. Block Diagram

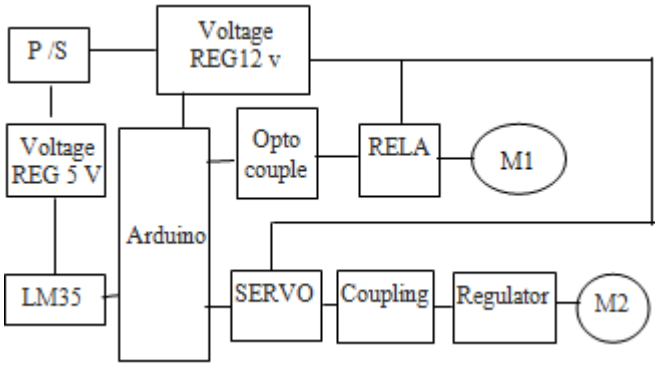

Figure 1: Block diagram

LM35 Temperature Sensor

LM35 is a precision integrated circuit whose output voltage is linearly proportional to Celsius (Centigrade) temperature. It is rated to operate over a -55°C to 150°C temperature range. It has +10.0mV/Celsius linear-scale factor.

Temperature sensor LM35 senses the temperature and converts it into an electrical (analogue) signal, which is applied to the MCU Atmega328.

MICROCONTROLLER Atmega328

- Operating Voltage: 5 Volts
- Input Voltage: 7 to 20 Volts
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz

OPTOCOUPLER MCT2E

MCT2E is a phototransistor Opt coupler, the base current is controlled by the IR light

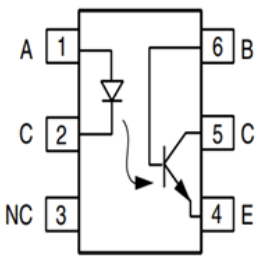

Figure 2: Pin diagram of IC MCT2E

This IC is used to provide electrical isolation between two circuits, one part of the circuit is connected to the IR LED and the other to Photo-transistor. The input is given at terminal 1 from aurduino output pin no 12 through limiting resistance 1 kilio-oham .The output is taken from emitter end and is used for biasing the transistor.

Power Supply and Voltage Regulatores

From 230 V AC source 12 V DC and 1Amp regulated power supply is designed for servo motor and relay operation. 12V DC supply is given to IC 7805 for generation of 5V DC and is used for Arduino MCU and LCD display. 230V AC is applied to cooling fan through regulator which is driven by servo motor. Another 230V AC supply is given to pump motor through relay which operates after 30 ^{0}C.

5. Assembly

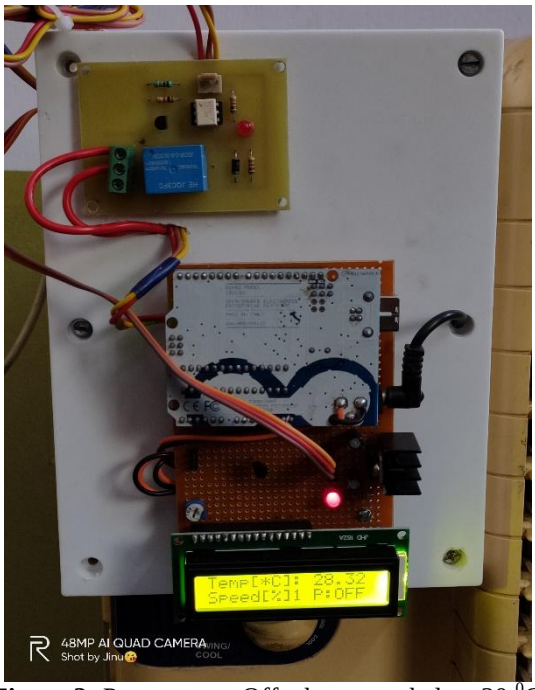

Figure 3: Pump motor Off when temp below 30 ^{0}C

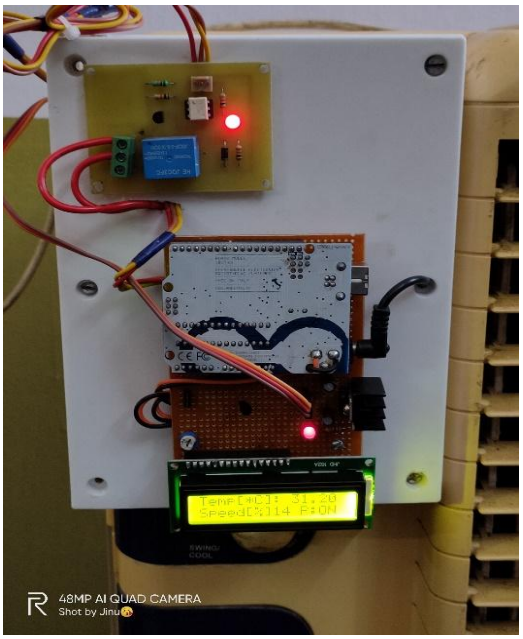

Figure 4: Pump motor is ON when temp is above 30^{0}C

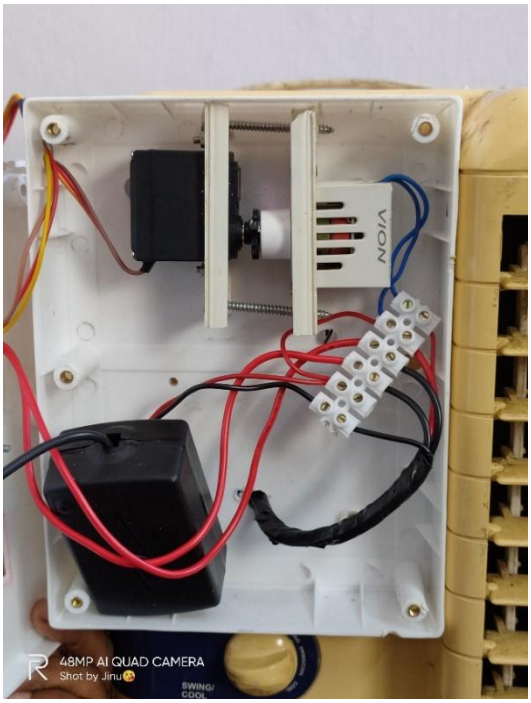

Figure 4: Coupling mechanism of servo and AC voltage regulator

6. Software Parameter

Arduino program should be loaded into arduino. The rotation of servo motor is at 10^0 at 10^0C, and 270^0 at 50^0C. That means the maximum speed is achieved at 50^0C.The pump motor start functioning above 30^0C.

7. Results and Conclusion

The pump motor is start working after 30^0C .Hence the power saving and water savings takes place. Above 30^0C water droplets absorb in air with fast rate because air droplets are harmful for electronic equipment. The life of electronic equipment increases. The cooling fan speed changes with surrounding temperature so it reduces the manual operation.

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