THERMOSTAT MODEL WITH ARDUINO UNO BOARD FOR CONTROLLING A COOLING SYSTEM

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ABSTRACT: *There is a large variety of thermostat models on the market with functionality for various mechanisms and fields. In the present paper we considered thermostat models used for cooling systems and therefore we developed a practical, easy to use thermostat prototype which can be adjusted for systems in aimed area. One of the primary advantages this model brings is that it can be programmed in accordance with the application is designed for by the means of Arduino board and software. Through the programme the prototype can be updated according to the requirements of the application it is used for. As a novelty it was introduced parameter hysteresis used as a lower limit for the cooling system. Once data uploaded on Arduino board, all thermostat needs is a 12V power supply.*

KEYWORDS: Arduino, thermostat, cooling system, hysteresis, breadboard, programming, microcontroller.

INTRODUCTION

The thermostat is a component frequently used in systems that need cooling or heating like heating stations, boilers, refrigerators, automobile engines and many other devices and mechanisms.

In the present paper we designed and developed a thermostat model that can be used for different cooling systems. For prototype build-up there were used electronic components and software needed for thermostat programming [1], [11], [14].

Base component is Arduino UNO board which uses programming interface Arduino IDE 1.8.7. A sensor detects the temperature and this value is compared to a Set Point established in the programme. If the measured value is higher than the Set Point Arduino UNO board sends an impulse USING PIN 8 to the transistor which actuates upon the cooling system. The cooling process works until temperature value reaches the hysteresis value set by the programme.

2. DESIGNIGN AND DEVELOPING THERMOSTAT PROTOTYPE

For designing thermostat model we used following components that will further be described: an Arduino UNO board as main component of the prototype; a Breadboard as a shim for wiring connections; IRF520 transistor (for tests we also used a led and a 1kΩ resistance); LCD visual display unit with 16x2 exposures; DHT11 temperature sensor, 2 command buttons which can be used to adjust values for Set point and hysteresis without reprogramming the Arduino board; programming interface Arduino IDE 1.8.7.

The **Arduino Uno** shown in Figure 1 is a microcontroller board based on the ATmega328. It has 14 digital input/output pins, 6 analogue inputs, 16 MHz ceramic resonator, USB connection, power jack, ICSP header and reset button. It can either be connected to a computer with USB cable or powered with an AC-DC adapter. It has an input voltage of 7-12V, a 32KB Flash memory, 2 KB SRAM, 1KB EEPROM and 16 MHz clock speed [2], [10], [13].

Figure 1. Arduino UNO board used for thermostat model [2]

Breadboard from Figure 2 is a device of a temporary nature used for the purpose of testing electronics and circuits of prototypes. The breadboard has many sockets arranged in a 0.1 grid and requires the use of single core plastic coated wires that have 0.6mm diameter [3].

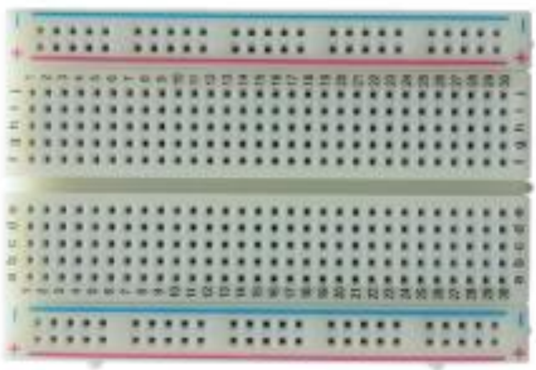

Figure 2. Breadboard used for thermostat model [3]

IRF520 is a channel enhancement mode power MOS transistor with an avalanche rugged technology, low gate charge, high current capability and up to 175^{0}C operating temperature [4], [15].

LCD Display (Figure 3) is a 16 character, 2-line alphanumeric LCD display connected to a single 9-way D-type connector. It requires data in a serial format and a 5V power supply. Potentiometer RV1 is a contrast control that should be used to adjust the contrast of the display for the environment it is being used in. The LCD Module uses a Samsung KS0066U controller. When the LCD board is turned on, data can only be sent to it after 30ms, time taken for the LCD to initialize, as it clears the RAM and sets up the Entry Mode [5].

Figure 3. LCD Display 16x2

DHT11 sensor is a digital temperature and humidity module which includes a NTC temperature measurement device connected to a high-performance 8-bit microcontroller [6], [12].

The microcontroller is as a computer that includes a central processing unit, a program memory, an operating memory, standard configurable interfaces I/O, timer and interruptions controller [8].

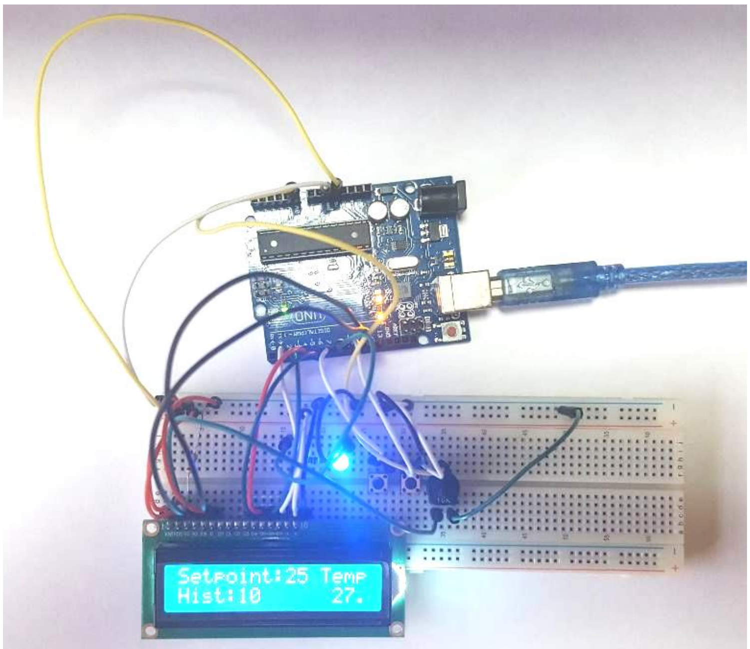

Figure 4. Thermostat model with Arduino UNO board

The complete thermostat prototype is shown in Figure 4 where the programme is already loaded on Arduino UNO board and parameters are pre-set as following: Set Point is 25^0C and hysteresis at 10^0C.

For testing we used a PT 15 carbon potentiometer, mounted on Breadboard, in order to vary temperature values. If temperature value is higher than Set Point (25^0C), for this case is 27^0C, the diode connected through Breadboard lights.

3. PROGRAMMING ARDUINO UNO BOARD

The programme for thermostat model functioning was made in Arduino IDE 1.8.7 interface, which is an open source software used to write and upload code within a real-time work environment [7]. Among its advantages it can be implemented on several operating systems and supports JavaScript and C coding.

The programme for Arduino UNO board uses the two parameters, SetPoint and hysteresis as constants. The link to LCD Display is made through the following code lines:

lcd.setCursor(0,0);
lcd.print("Setpoint:");
lcd.setCursor(12,0);
lcd.print("Temp");
lcd.setCursor(0,1);
lcd.print("Hist:");

Code lines used read data from sensor and write on LCD Display are:

sensorInput=analogRead(sensorPin)(50.0/1023.0);*
Serial.println(sensorInput);

For test conditions in this study we used command for diode. When cooling system is mounted line codes should be different. In given case diode is commanded to light if temperature value is greater than SetPoint. The decreasing of temperature value is made according to hysteresis:

if (sensorInput >= setPoint)
digitalWrite(ledpin, HIGH);
if (sensorInput <(setPoint - Histeresis))
digitalWrite(ledpin, LOW);

REFERENCES

[1] SUCIU, Lenuta; MARTA, Constantin; TATUCU, Iancu; BIZAU, Viorel; LUPINCA, Cinca Ionel; ROSU, Monica, The determination of the characteristics of a welding transformer with DAQ system, Annals of DAAAM & Proceedings, Jan 2009, p587-588.

[2]www.farnell.com/datasheets/1682209.pdf

[3]http://roboromania.ro/datasheet/Breadboard-roboromania.pdf

[4] http://pdf1.alldatasheet.com/datasheet-pdf/view/22389/STMICROELECTRONICS/IRF520.html

[5]http://www.farnell.com/datasheets/58820.pdf

[6]https://www.mouser.com/ds/2/758/DHT11-Technical-Data-Sheet-Translated-Version-1143054.pdf

[7]https://arduino.en.softonic.com/

[8] Marius Tufoi; Ion Vela; Constantin Marta; Mihaela-Dorica Stroia, Microcontroller's Applications in Driving of Industrial Robots, Analele Universităţii Eftimie Murgu Reşiţa. Fascicula de Inginerie, Volume 17, Number 2, 2010, pp. 305-314(10).

[9] S. Drăghici, O. Proştean, E. Răduca, C. Haţiegan, I. Hălălae, I. Pădureanu, M. Nedeloni, L. B. Haţiegan, Study regarding the density evolution of messages and the characteristic functions associated of a LDPC code, IOP Conference Series: Materials Science and Engineering, Hunedoara 2016, Vol. 163, Nr.1, 2017.

[10] E. Răduca, D. Ungureanu-Anghel, L. Nistor, C Haţiegan, S. Drăghici, C. Chioncel, E. Spunei, R. Lolea, Web server with ATMEGA 2560 microcontroller, International Conference on Applied Sciences 2015 (ICAS2015), IOP Conf. Series: Materials Science and Engineering 106, 012018, 2016.

[11] Eugen Raduca, Lucian Nistor, Cornel Hatiegan, Mihaela Raduca, Ioan Padureanu, Silviu Draghici, Web server for command, control and monitoring of industrial equipment, Advanced Topics in Electrical Engineering (ATEE), 2015 9th International Symposium on, 7-9 May Bucharest, 2015

[12] Anghel Drugarin Cornelia Victoria, Stroia, Mihaela Dorica, Draghici Silviu, Relative Research Upon Data Transmission Channels, The 2nd year of Global Virtual Conference, April, 7-11.2014, ISSN: 1339-

2778;
[13] Anghel Drugarin Cornelia Victoria, Stroia, Mihaela Dorica, Draghici Silviu, Method For Programming An Autonomous Vehicle Using PIC 16F877 Microcontroller, Information and Communication Technologies International Conference-ICTIC 2014, At Žilina, Slovakia, Volume: Faculty of Management Science and Informatics, University of Žilina, Slovakia.
[14] Eugen Răduca, Marius Schmidt, Dan Ungureanu-Anghel, Mihaela Răduca, Cornel Haţiegan, Nicolina Pop, Florica Novăcescu, The command of the Flour Transport Pumps in a Cereal Mill with PLC Siemens S7-1200, Conferința Națională de Acționări Electrice - CNAE 2014-Reşiţa, Analele Universităţii "Eftimie Murgu", Fascicula de Inginerie, Anul XXI, Nr. 2, Reşiţa, ISSN: 1453-7397, 2014.
[15] Eugen Răduca, Adrian-Florin Păun, Mihaela Răduca, Cornel Haţiegan, Silviu Drăghici, Cristian Rudolf, Lenuţa Candea, Command and Running of an Experimental Model Vehicle for Covering a Labyrinth Type Runway, Conferința Națională de Acționări Electrice - CNAE 2014-Reşiţa, Analele Universităţii "Eftimie Murgu", Fascicula de Inginerie, Anul XXI, Nr. 2, Reşiţa, ISSN: 1453-7397, 2014.