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ARDUINO UNO-BASED ROOM TEMPERATURE SENSOR FOR AUTOMATIC FAN SPEED CONTROLLER

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Abstract: - This paper introduces an ARDUINO UNO-based automatic room temperature fan speed controller. The purpose of this presentation is to provide an overview of a standalone automatic fan speed controller that regulates fan speed in accordance with our needs. The LM35 temperature sensors are intended to be detected by this system, which then transforms the data into an electrical analogue signal that can be applied to the microcontroller. On the 16*2-line LCD, the temperatures sensed and set values are shown. The system is user-friendly because to the Liquid Crystal Display (LCD). On the LCD panel, the figures for the measured temperature and fan speed level are shown concurrently. The power supply for this project is regulated at 12V, 2A. It can be used for many different purposes, including as air conditioners, water heaters, incubators, snow-melters, heat exchangers, furnaces, and thermal pots. It is also highly compact and only requires a small number of components.

Keywords: Temperature sensor (LM35), ARDUINO UNO, FAN, LCD display, Transistor.

1. INTRODUCTION

The most frequently spelled term in the field of electronics is automation. Due to its user-friendly nature, these had greater importance done any other technology. Using existing switches in home which may produce sparks and also result in fire accidents in few conditions. This project is about creating a automatic fan control system that automatically turns the fan on and off depending on the room temperature. We used an Arduino uno microcontroller here, we can also use in MINI, but there will be some problems with power regulations, so choose UNO. The temperature sensor, here is an LM35 module but we can use and it will also give the most accurate readings. When the heat is applied to the temperature sensor, this will determine the fan automatically increasing or decreasing in speed according to the speed levels of a normal fan that are set to different temperature changes in room. The 2N2222 transistor acts as a switch and controls the fan speed depending upon temperature.1N4007 diode controls the fan from being damaged. The LED glows whenever the temperature attains maximum.

2. LITERATURE SURVEY

A: This introduces a C8051 F005 MCl) governor an energy-saving design clever use of pyroelectric infrared sensing technology, smart placeholder technology, wireless remote-control technology, SCM control technology, steeples speed technology, temperature and humidity sensing technology, the intelligent control of the technology used in the control of household appliances, sampling the ambient temperature around the body, for controlling the humidity and the presence and the number of people on the fan. And apply it in the ordinary fans, it has long-distance operation, automatically sense the temperature and humidity Diaodang timer switch function, so the fans more intelligent and humane, to gain a larger market space. [1]

B: Damar Wicaksono Eka Firmansyah Hanung Adhi Nugroho.A Microclimate Closed House Control Design for Broiler Strain 7th International Annual Engineering Seminar (InAES),Yogyakarta, Indonesia 2017.Through all stages of growing, chickens need a certain climate quality. The old climate quality is only the actual temperaturebased controlling. On modern climate, an organization calledCobb-Vandross detached three climate parameters need to besatisfied: 1) temperature, 2) humidity, and 3) wind speed. It is known that those three parameters are not independent, the area to be controlled are fast area while commonly, this available tool to control those three parameters is only the speed of the exhaust fans inside the broiler house. Therefore, controlling three parameters which were intertwined each other inside a fast area with only single actuator was the main problem of this paper. The main goal was to achieve ideal microclimate control to grow chicken inside a broiler house. Results shows that the climate control that can be implemented effectively to maintain the effective temperature of the broiler house at 32 to 22 degrees Celsius from the day-old chick to be matured in brooding stage. Temperature controller testing shows prototype device has linear set point response between two with maximum heating rate and maximum cooling rate. [2]

C: Vaibhav Bhatia, Gavish Bhatia. Room Temperature based Fan Speed Control System using Pulse Width Modulation Technique International Journal of Computer Applications (0975 – 8887)The design and simulation of a novel fan speed control system based on room temperature using Pulse Width Modulation Technique. The duty cycle is made to vary according to the room temperature and the fan speed is controlled accordingly. This paper elucidates how the autonomous speed control of fan is done based on data from the temperature sensor. The design proposed here is appropriate according to the modern lifestyle. The simulation of the system has been done on Proteus Professional Software v 8.0 and the various graphs showing relationship between temperature and different parameters have been plotted in MATLAB R2013a v8.1 to validate the accuracy of the system. [3]

D: Surabhi, Upendra Prasad, Vivek Kumar Jain Design and Fabrication of Temperature based DC Fan Speed Control System using Microcontroller and Pulse Width Modulation Technique International Journal of Innovative Research in Science, Engineering and TechnologyTo get rid of the problem of Obscurity to control temperaturein industries, a microcontroller-based controller has been proposed. A temperature sensor has been used to measure the temperature of the room and the speed of the fan is varied according to the room temperature using pulse width modulation technique. Controller is used to control the speed of DCFan and temperature is varied through the Temperature sensor and data is sent to AT89S52 microcontroller using analogue to digital converter. The duty cycle has been varied from 0 to

100% to control the fan speed depending upon the room temperature, which is displayed on liquid crystal display. Duty cycle values between 25% and 95% allow smooth control of the fan. It is easier, reliable and accurate. The simulation of the system has been done on Proteus Professional Software v Hardware implementation has been also done. The results of the research and Output waveforms have been investigated. Various design criteria, performance characteristics, comparison with different parameters have been plotted in MATLAB software system and other simulation results have been discussed in detail in this paper. [4]

E: Jungsoo Kim, Mohamed M. Sabry, David Atienza, Kalyan Vaidyanathan, Kenny Gross Global Fan Speed Control Considering Non-Ideal Temperature Measurements in Enterprise Servers 978-3-9815370-2-4/DATE14/ c 2014 EDAA.Time lag and quantization in temperature sensors in enterprise servers lead to stability concerns on existing variable fan speed control schemes. Stability challenges become further aggravated when multiple local controllers are running together with the fan control scheme. In this paper, we present a global control scheme which tackles the concerns on the stability of enterprise servers while reducing the performance degradation caused by the variable fan speed control scheme. We first present a stable fan speed control scheme based on the Proportional- Integral-Derivative (PID) controller by adaptively adjusting the PID parameters according to the operating fan speed and eliminating the fan speed oscillation caused by temperature quantization. Then, we present a globalcontrol scheme which coordinates control actions among multiple local controllers. In addition, it guarantees the server stability while minimizing the overall performance degradation. We validated the proposed control scheme using a presently shipping commercial enterprise server. Our experimental results show that the proposed fan control scheme is stable under the non-ideal temperature measurement system (10 sec in time lag and 1C in quantization figures). Furthermore, the global control scheme enables to run multiple local controllers in a stable manner while reducing the performance degradation up to 19.2% compared to conventional coordination schemes with 19.1% savings in power consumption. [5]

3. PROPOSED SYSTEM

Fig. 1. Shows the block diagram. In this project microcontroller is plays a vital role in the smart system development. It is an necessary part in the current day-to-day technologies. This paper detailed about the temperature based fan speed control an ARDUINO system. The main aspect of the project is control the room temperature. The system needs an ARDUINO board to implement a control system to this project. With the help of IOT technology, the speed of the fan is varied the temperature.[6]

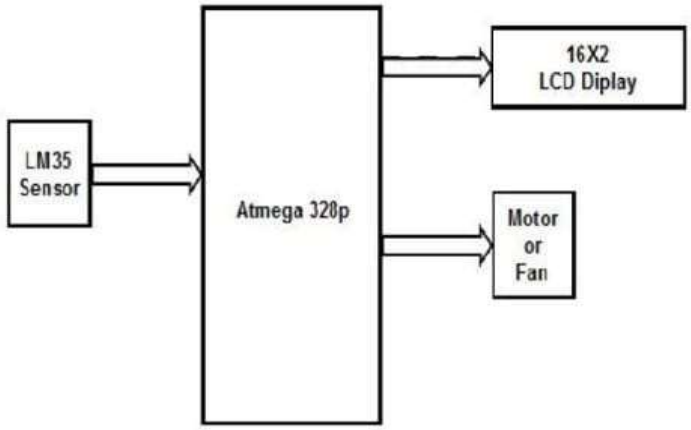

Fig. 1. Block Diagram

3.1. Components Used

The components used are,

- Arduino UNO
- Temperature sensor
- Fan
- LCD Display
- Potentiometer
- Transistor
- Resistor
- Diode
- Jumper Wires

3.2. Arduino Uno

The ARDUINO UNO is the ideal board for beginners in coding and electronics. The Arduino family's UNO board is the most popular and well-documented model. The ARDUINO UNO is a microcontroller board based on the ATmega328P. It contains 6 analogue inputs, a 16MHz quartz crystal, 14 digital input/output pins, 6 of which can be used as PWM outputs, 14 USB ports, a power cable, an ICSP header, and a reset button. Due to its ability to foster creativity and problem-solving, Arduino plays a crucial role in robotics is shown in fig. 2.

Fig. 2. - Arduino Uno

3.2.1. Arduino Specifications

1. Microcontroller: ATmega328P
2. Operating voltage: 5V
3. Input voltage: 7-12V
4. Digital I/O Pins: 14
5. Analog Input pins:6
6. Flash memory:32KB
7. SRAM:2KB
8. EEPROM:1KB
9. Clock speed:16MHz
10. LED_BUILTIN: 13

3.2.2. General Pin Configuration

Fig. 3 shows the Circuit diagram and the pin configuration is given by [13]

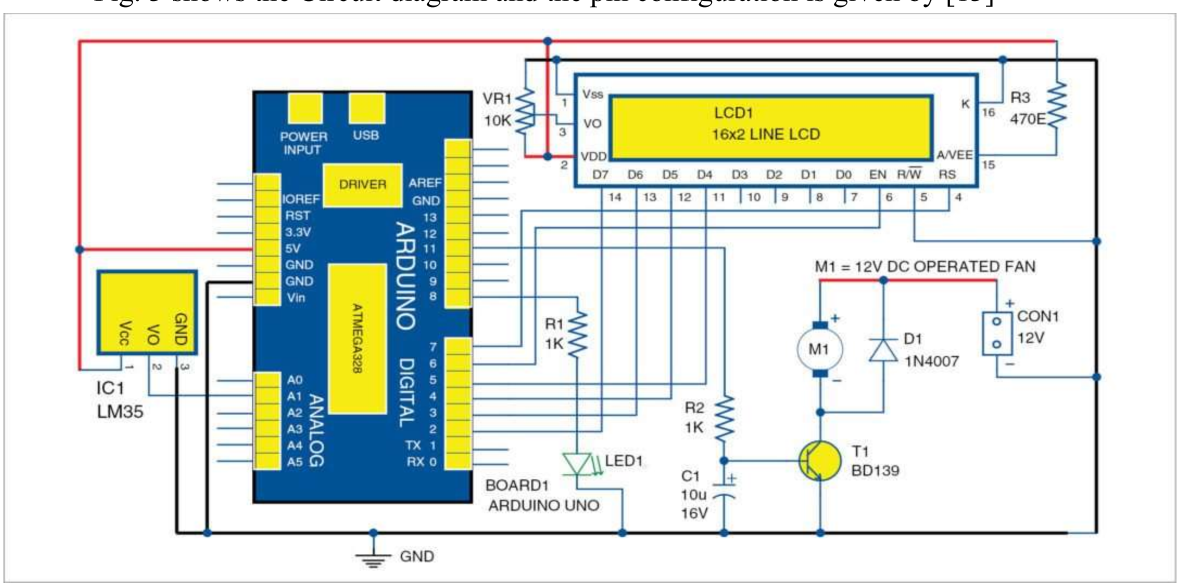

Fig. 3. Circuit Diagram

- Vin: This is the Arduino board's input voltage pin used to supply input power from an external power source.

- 5V: The Arduino board's 5V pin serves as a regulated power supply voltage, supplying electricity to both the board and its internal components.
- 3.3V: This board pin is used to supply a 3.3V supply that is produced by a voltage regulator on the board.
- GND: The Arduino board is grounded via this board pin.
- Reset: The microcontroller is reset using this board pin. The microcontroller is reset with the help of it.
- Analog Pins: The analogue input range for the pins A0 to A5 is 0 to 5 volts.
- Digital Pins: The Arduino board's pins 0 to 13 are used as digital inputs or outputs.
- Serial pins are also referred to as UART pins. The Arduino board and other devices can communicate with one another via it. Data is transmitted and received, respectively, using pins numbered 1 and 0 for the transmitter and receiver, respectively.
- Pins for External Interrupts: The Arduino board's pins 2 and 3 work together to create the external interrupt.
- PWM Pins: These pins on the board are used to change the pulse width to transform a digital signal into an analogue signal. PWM pins are utilised on pins 3,5,6,9,10, and 11.
- SPI Pins: Using the SPI library, this Serial Peripheral Interface pin is utilised to sustain SPI connection. SPI pins consist of:
- SS: The Slave Select pin is number 10.
- Pin 11 serves as a Master Out Slave In (MOSI).
- MISO: The Master In Slave Out (MISO) pin is number 12.
- SCK: The serial clock is activated by pin number 13.
- LED Pin: The board uses digital pin 13 to power an integrated LED. Only when the digital pin is high does the LED begin to shine.
- AREF Pin: The Arduino board's AREF pin serves as an analogue reference. It serves as a reference voltage source from an external power source.

3.3. Temperature Sensor

Fig. 4. Descibe the electrical output of the LM35 integrated analogue temperature sensor is proportional to degrees Celsius. For usual accuracies, the Temperature Sensor doesn't need any external trimming or calibration. extremely simple readout or control circuitry. It is inexpensive and little. Temperature sensors can be used to monitor temperature everywhere in the environment between -55°C and 150°C thanks to their low output impedance, linear output, and excellent intrinsic calibration. [7]

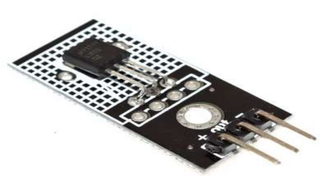

Fig. 4. - Temperature Sensor

3.3.1. Features

- Calibrated directly in Degree Celsius (Centigrade)
- Linear at 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee-able (at a25°C)
- Rated for full -55°C to a 150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 mA current drain
- Low self-heating, 0.08°C instill air
- Non-linearity only 0.25°C typical
- Low impedance output, 0.1Ωfor 1 mA load.

3.3.2. Advantages

Because it is linear (10mv/°C), the output of the LM35 will increase by 10mv for every degree that the temperature rises. Thus, the temperature will be 22°C if the LM35's output is 220mv/0.22V. So, if the ambient temperature is 32 °C, the LM35's output will be 320 mV, or 0.32 V. [8]

3.4. Fan Usage

A fan is made up of numerous radial blades that are fastened to a spinning hub in the middle. An impeller, rotor, or runner is the name for the revolving assembly of blades and hub; it may or may not be housed in a housing. Electric motors, internal combustion engines, steam turbines, gas turbines, and other forms of motive power can all be used to power fans. Axial-flow or centrifugal fans may be used to describe enclosed fans. In centrifugal fans, air is introduced through an intake pipe to the impeller's eye, or central point, where it is forced radially outward into the spiral-shaped volute casing, where it exits through a discharge pipe. An axial-flow fan uses , Air passes through the runner virtually without affecting its distance from the axis of rotation since the runner and guide vanes are enclosed in a cylindrical container. No centrifugal force is present. Guide or stator vanes help to even out airflow and boost performance. [9]

3.4.1 Advantages

- They often consume less energy than a typical AC fan, up to 70% less.
- They are typically quite silent.
- They frequently offer more speed options, feature a reverse button on the remote, and operate more quickly overall when starting, stopping, and changing speed.
- The motor is often smaller and lighter, enabling a sleeker motor design.

3.5. LCD Display

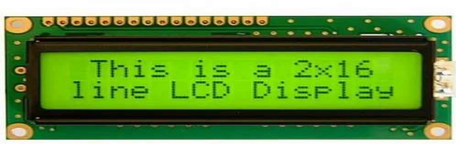

Fig. 5. LCD Display

The above fig. 5. shows a type of flat panel display known as an LCD (Liquid Crystal Display) operates primarily using liquid crystals.

Since they are frequently used in cellphones, televisions, computers, and instrument panels, LEDs offer a wide range of applications for consumers and enterprises.

When compared to the technologies they replaced, such as light-emitting diode (LED) and gas-plasma displays, LCDs represented a significant advancement. Compared to cathode ray tube (CRT) technology, LCDs permitted screens to be far thinner. As opposed to LED and gas-display displays, LCDs operate on the idea of blocking light rather than emitting it, which results in a significant reduction in power consumption. The liquid crystals in an LCD use a backlight to form an image where an LED emits light. LCDs started to be superseded by new display technologies like OLEDs as they took the place of earlier display technologies.[10]

3.5.1. PIN Configuration

- Pin1 (Ground/Source Pin): This is the display's GND pin, which is used to link the microcontroller's GND terminal to a power source.
- Pin2 (VCC/Source Pin): This is the display's voltage supply pin, which is connected to the power source's supply pin.
- Pin3 (V0/VEE/Control Pin): Used to connect a switchable POT that can supply 0 to 5V, this pin controls the display's difference.
- Pin 4 (Register Select/Control Pin): This pin switches between a command and data register. It is used to connect a microcontroller unit pin and receives either 0 or 1 (where 0 corresponds to data mode and 1 to command mode).
- Pin 5 (Read/writing/Control Pin): Connected to a microcontroller unit pin to receive either 0 or 1 (where 0 indicates a writing operation and 1 indicates a read operation), this pin toggles the display between reads and writes.
- Pin 6 (Enable/Control Pin): This pin connects to the microcontroller unit and is always kept high to execute the Read/Write process.
- Pins 7 through 14 (Data Pins): You can send data to the display using these pins. Two-wire configurations, such as the 4-wire and 8-wire modes, are used to connect these pins.
- Pins 7 through 14 (Data Pins): You can send data to the display using these pins. Two-wire configurations, such as the 4-wire and 8-wire modes, are used to connect these pins. Only four pins, such as 0 through 3, are linked to the microcontroller unit in 4-wire mode, while eight pins, such as 0 through 7, are connected in 8-wire mode.
- Pin15 (the LED's positive pin): This pin is attached to +5V.
- GND is connected to pin 16, the LED's negative pin.

3.5.2 Features

This LCD's operating range is from 4.7 to 5.3 volts. There are two rows, each of which may output 16 characters.

1. With no lighting, 1mA of current is being used.
2. A 58 pixel box can be used to create any character.
3. The numerals and alphabets on the alphanumeric LCD.
4. Its display can operate in both 4-bit and 8-bit modes.

5. These are available in backlights in blue and green.
6. A few randomly generated characters are displayed.

3.6. Potentiometer

An electrical instrument used to gauge electromotive force is a potentiometer.

A potentiometer is a three-terminal variable resistor that may be manually adjusted. A resistive element has two terminals attached to its ends and a third terminal attached to an adjustable wiper. The resistive divider ratio is determined by the wiper's position.

3.7. Transistor

Fig. 6. Shows the NPN transistors, like the 2N2222, are frequently used in switching and VHF (very high frequency) amplifier applications. Silicon is the primary component of the transistor. This kind of transistor is utilised similarly to an NPN transistor and is regarded as a standard transistor. On this transistor, the three terminals are Base, Emitter, and Collector.

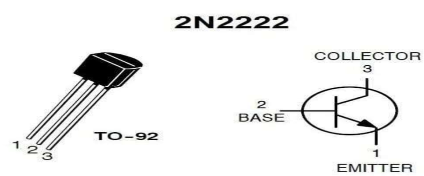

Fig. 6. - Transistor

The 2N2222 transistor is the best choice for low- to medium-current applications since it offers a steady 800mA DC collector current. It operates on a high transition frequency of 250MHz and employs a 10ns delay time, 225ms storage time, 60ms fall time, and 25ms rise time. It is included in the TO-92 package.

3.8. Jumper Wires

Jumpers are typically tiny metal connectors that are used to open or close circuit components. They have two or more connecting points that control a circuit board for an electrical system. They are responsible for setting up the motherboard and other computer devices. Imagine your motherboard has intrusion detection capabilities. It is possible to enable or disable a jumper. Electrical wires having connector pins at each end are known as jumper wires. They are employed to connect two circuit points without the usage.

4. WORKING OF THE CIRCUIT

The fig. 7. Shows the temperature sensor LM35 monitors the temperature and transforms it into an electrical (analog) signal that is applied to the ATmega328 microcontroller of the Arduino UNO Board in order for the project to function. The Arduino UNO board is used in this to convert the analogue signal that was recorded into a digital signal. so that the fan's recorded speed and temperature readings can be seen on the LCD. The fan begins to turn when the temperature reaches 30°C.To change the fan's speed, a low-frequency pulse-width modulation (PWM) signal is employed, with a variable duty cycle. Here, a cheap, single, small pass transistor, such as the 2N222 or BD139, can be employed. The usage of the pass transistor as a switch makes it efficient. [11]

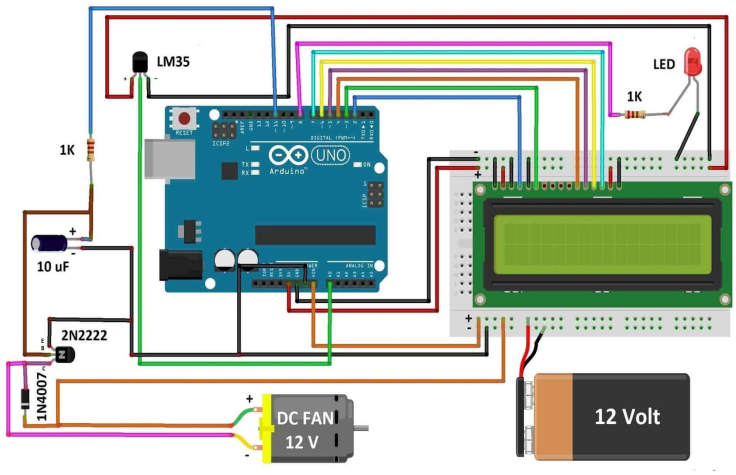

Fig. 7. Working Diagram

5. ARDUINO UNO PROGRAMMING

Fig. 8. Shows the flow chart for the Arduino Uno Controller Using IDE software may be programmed. A boot loader that is pre-burned into the board's microcontroller allows for the upload of new code without the need for an external hardware programmer. This can be sent using a protocol like STK500. By using the header instead of the boot loader, similar to in-circuit serial programming, we may upload the programme to the microcontroller as well. [12]

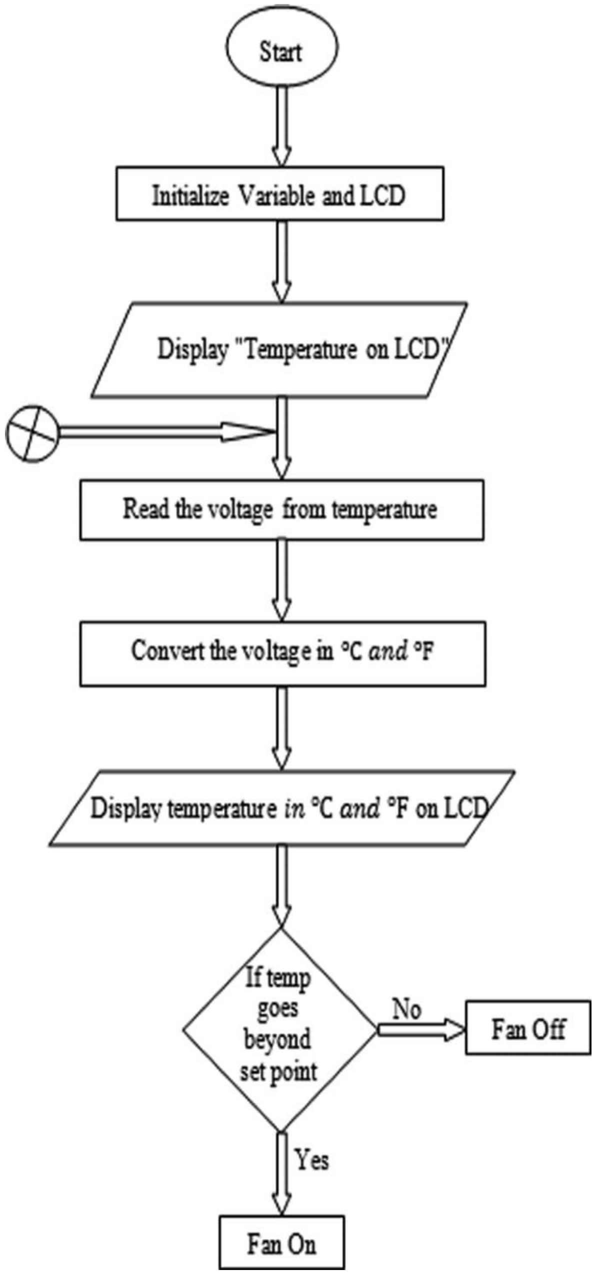

Fig. 8. Flow Chart

```
 #include <LiquidCrystal.h>
LiquidCrystal lcd(2,3,4,5,6,7);
int tempPin = A0; // the output pin of LM35
int fan = 11; // the pin where fan is
int led = 8; // led pin
int temp;
int tempMin = 30; // the temperature to start the fan 0%
int tempMax = 60; // the maximum temperature when fan is at 100%
int fanSpeed;
```

```
int fanLCD;
 void setup() {
pinMode(fan, OUTPUT);
pinMode(led, OUTPUT);
pinMode(tempPin, INPUT);
lcd.begin(16,2);
Serial.begin(9600);
}
 void loop()
{
temp = readTemp(); // get the temperature
Serial.print( temp );
if(temp < tempMin) // if temp is lower than minimum temp
{
fanSpeed = 0; // fan is not spinning
analogWrite(fan, fanSpeed);
fanLCD=0;
digitalWrite(fan, LOW);
}
if((temp >= tempMin) && (temp <= tempMax)) // if temperature is higher than minimum temp
{
fanSpeed = temp;//map(temp, tempMin, tempMax, 0, 100); // the actual speed of fan//map(temp, tempMin, tempMax, 32, 255);
fanSpeed=1.5*fanSpeed;
fanLCD = map(temp, tempMin, tempMax, 0, 100); // speed of fan to display on LCD100
analogWrite(fan, fanSpeed); // spin the fan at the fanSpeed speed
}
 if(temp > tempMax) // if temp is higher than tempMax
{
digitalWrite(led, HIGH); // turn on led
}
else // else turn of led
{
digitalWrite(led, LOW);
}
 lcd.print("TEMP: ");
lcd.print(temp); // display the temperature
lcd.print("C ");
lcd.setCursor(0,1); // move cursor to next line
lcd.print("FANS: ");
lcd.print(fanLCD); // display the fan speed
lcd.print("%");
delay(200);
```

```
lcd.clear();
}
 int readTemp() { // get the temperature and convert it to celsius
temp = analogRead(tempPin);
return temp * 0.48828125;
```

6. MATHEMATICAL CALCULATION

Table 1 shows the Mathematical conversion is using to calculate temperature for fan speed controller is given by

Table 1. Mathematical conversion

Temperature Conversion Formula Table

Unit	To Celsius	To Fahrenheit
Celsius (C)	**C (°)**	**C(⁹⁄₅) + 32**
Fahrenheit	(F − 32) × ⁵⁄₉	F
Kelvin	K − 273.15	(K − 273.15) * 9/5 + 32

7. RESULTS AND DISCUSSION

Fig. 9. Shows the regulation of various speed with respect to the temperature is measured by the table is given by.

Table 2. Various Fan Speed Regualtion

S.No.	Temperature in degree celsius	Fan speed	Speed
1.	< 0	0%	ZERO
2.	0-10	25%	SLOW
3.	10-20	50%	MEDIUM
4.	20-30	75%	FAST
5.	30-40	100%	VERY FAST
6.	> 40	100%	VERY FAST

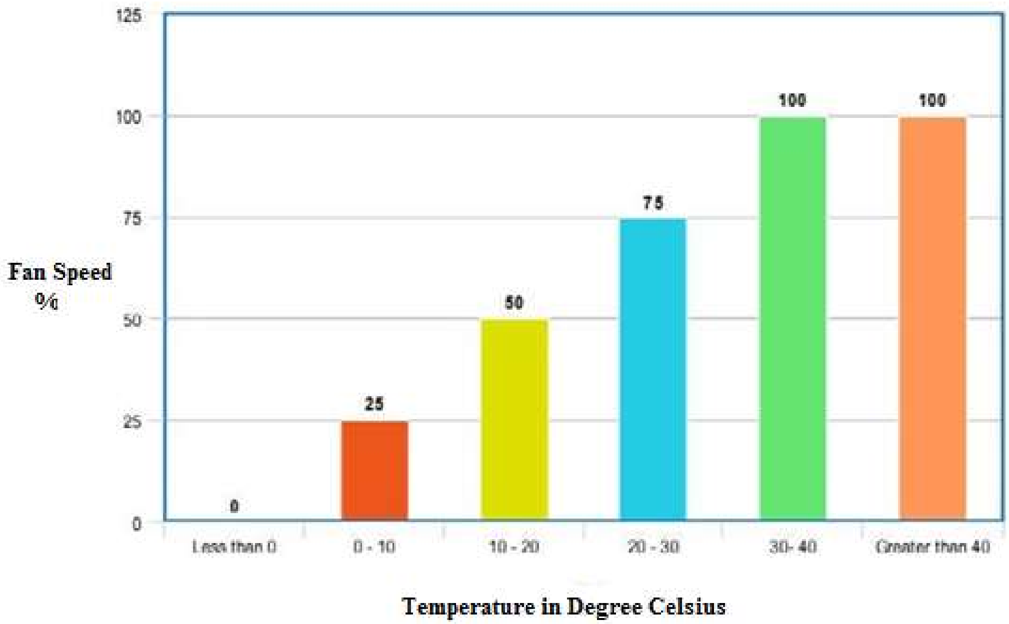

Fig. 9. Results of various fan speed requlation

8. CONCLUSION

This project has uses both at home and at work. It contributes to energy and power conservation. The automatic room temperature controlled fan speed controller unit was put through a series of tests to determine its performance as a controller device, and the findings were very satisfactory. This device was also found to be adequately quick, ensuring the safety of the equipment under any undesirable transient condition of the main supply. This gadget is extremely sensitive. It is also simple in form, reliable in operation, and competitive in price with any other product on the market. Based on the analysis presented above, it is determined that this device can easily regulate the fan automatically based on room temperature.

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