

THERMOGLOW: TEMPERATURE GAUGE WITH LM35

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Abstract- This paper outlines the design and implementation of a temperature indicator using LM35 temperature sensor and LED without the use of Arduino. The LM35 sensor provides an accurate temperature reading, and the LED visually represents the temperature level. This paper covers the paper's objectives, components, circuit design, and working principle. The paper provides a captivating blend of temperature monitoring, creating an engaging and informative visual display of changing environmental conditions. This innovative circuit employs a thermistor (LM35), to capture real time temperature data. The sensor's output is then meticulously processed by an integrated circuit (IC) that intricately controls a series of vibrant LEDs. What makes this paper truly enticing is its ability to transform mundane data into a mesmerizing visual spectacle. As temperatures rise or fall, the LEDs gracefully light up or dim, creating a dynamic and eye-catching display. It can be used as a learning tool, or simply a decorative temperature indicator. The "Temperature indicator LED circuit" paper serves as an excellent example of data visualization in a way that is both accessible and visually captivating.

KeyWords: Temperature; LM35; Measurement; Resistor; IC; LED.

1. INTRODUCTION

The "Thermoglow: Temperature Guage with LM358" paper presents a novel and user-centric solution for real-time temperature monitoring [1,2]. The LM35 temperature sensor has gained popularity for its accuracy and ease of integration. This paper presents a detailed exploration of a temperature indicator using the LM35 eliminating the need of Arduino or microcontroller [3,4].

The scope of this is wide ranging, with potential applications in diverse fields, offering versatility and adaptability for various temperature monitoring needs. In this increasingly interconnected and technology-driven world, we often need to keep an eye on temperature, whether it's for our comfort at home, in a factory, or even for our health, but understanding temperature can be risky sometimes. The ability to interpret and visualize this data in a comprehensible and instinctive manner is essential for making informed decisions and ensuing safety and comfort. LEDs are renowned on their energy efficiency, brightness and versatility, making them an ideal choice for creating a visual representation of

temperature information. Thermoglow is an innovative temperature indicator leveraging LED technology to provide a visual representation of temperature changes [5,6,7]. This intelligent device offers a user-friendly way to monitor temperature variations in various settings. By employing a range of LED colours and patterns, ThermoGlow offers an intuitive and convenient method for users to assess temperature changes, making it an ideal tool for diverse applications, from home use to industrial settings. Its sleek design and functionality make it a versatile and reliable temperature indicator, catering to the needs of users across different environments The LM35 is a precision integrated-circuit temperature sensor that provides an accurate and linear output directly proportional to the Celsius temperature. It's a popular choice for temperature measurement due to its simplicity, accuracy, and ease of use. The LM35 sensor doesn't require external calibration or trimming and provides temperature readings in the range of -55°C to 150°C. Its straightforward analogue output makes it compatible with most microcontrollers and digital systems, making it widely utilized in various applications such as environmental control systems, industrial automation, medical devices, and automotive applications. Its small form factor, low power consumption, and reliability have made the LM35 a staple in temperature sensing technology [8,9,10]. The significance of LED Temperature indicator lies in its ability to address various practical needs and applications such as:

- i. Enhanced Temperature Monitoring
- ii. Energy Efficiency
- iii. Safety and Comfort
- iv. Automation and Control
- v. Educational Tool
- vi. Research and Development
- vii. Versatility

1.2 LITRATURE REVIEW

In February 2017, Shekhar Mishra et al in their paper "Temperature Control Based LED indication system" have done an Industrial Temperature Controller using LED, LM35 Temperature Indicator, and AT90S22 Microcontroller [11]. They have also used a 89S52 microcontroller brain, temperature sensor LM35 which senses the actual temperature of the system, to convert the temperature recorded by the sensor into a digital quantity, LCD for display and to turn the LED's on or off. In 2017, Fahimeh Dehkoda

et al in their paper “LED-Based Temperature Sensor” have done a LED as micro photonic emitter using CMOS technology [12]. Their paper represents a method to measure the device surface temperature. In 2020, Kyi Kyi Khaing et al in their paper “Automatic Temperature Control System using Arduino” have done a simple method of Temperature control system automatically utilising Arduino [13]. Their work is focused mainly on temperature control, and no other parameter is involved. In 2009, A.Goswami et al in their paper “Design of an Embedded System for Monitoring and Controlling Temperature and Light” have done a design for an embedded system for monitoring the temperature and light intensity [14]. Their paper describes the controlling action incorporated in the hardware. In our paper, we have done a Temperature indicator using LED and LM35 without the help of Arduino.

2.DESIGN AND SIMULATION

A few essential parts and procedures are required while designing and modelling an LM35 temperature indicator using LED circuit. Here is a simple simulation and circuit design.

2.1 COMPONENT REQUIRED

- 1) **Temperature Sensor (LM35):** It is utilized to measure temperature [15]. The output voltage is linear and directly proportionate to the temperature being monitored. One LM35 is utilized here [16].
- 2) **Operational Amplifier (LM358):** It is dual operational amplifier integrated circuit. It contains to separate op-amplifiers with a single 8-pin package. Here 1 LM358 is used.
- 3) **Potentiometer:** It is the type of arable resistor that is often used to adjust resistance. It has three terminals and a movable wiper that makes contact with a resistive track. Here 1 Potentiometer is used. (10 kΩ).
- 4) **(Bipolar Junction Transistor BC547):** It is used for amplification and switching purposes [17]. It is NPN type BJT. Here 2 BC547s are used.
- 5) **Resistor:** It is designed to limit the flow of current in an electrical circuit. It is measured in ohms (Ω). Here 6 resistors are used (10kΩ=2,10kΩ=1, 1kΩ=1,230Ω=2).
- 6) **LED:** - It is Light Emitting Diode [18]. Here 2 different coloured LEDs are used. Yellow =1, Red=1.

2.2. CIRCUIT DESIGN

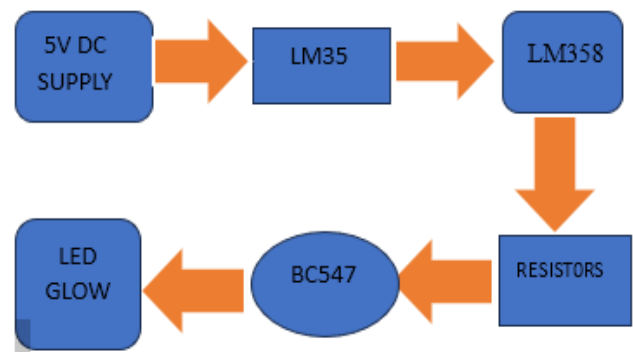


Fig 1: block diagram of circuit LM35

Here We have to give the 5v power supply to the LM35's VCC pin, which is the input pin no.1. Then the pin no 2 we have to connection with the pin 2(inverting pin) of the LM358 amplifier. The third pin (non-inverting) of the LM358 amplifier should be connected with the ground. The non-inverting side of the amplifier should be connected to 10 KΩ potentiometer. The eighth no. pin of the amplifier should be connected to the 5v DC supply. The fourth pin of the amplifier should be connected to the ground other 5, 6, 7 pins of amplifier shouldn't be connected to any component The 10kΩ resistor and point 2 should be connected to the amplifier's 1 no pin The 10kΩ resistor and point 2 should be connected to the amplifier's second pin. The variable resistor of 10kΩ should be connected to the amplifier's second pin. Another 10kΩ resistor should be connected to the variable resistor with series The two LED should be connected with the 2 230Ω resistor.

The connection is done as per the diagram given.

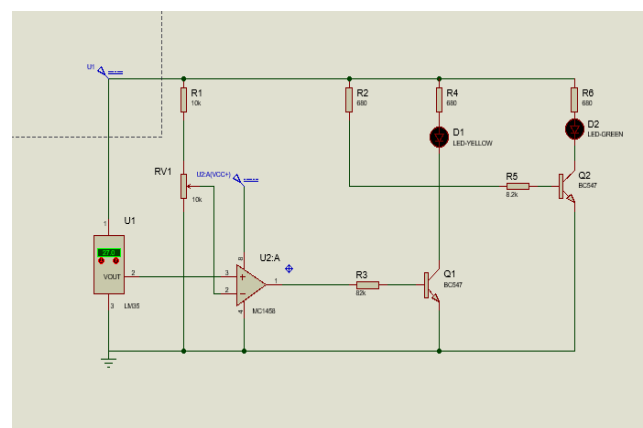


Fig 2: simulation diagram done by using the proteus software.

Thus this paper operates with ease. It relies on a 9V or 12V battery to power the circuit, with an IC regulating a 5V supply. When the temperature is under 50 degrees Celsius, the YELLOW LED illuminates while the RED one stays

inactive. This is achieved by the LM35 sensor outputting a low signal, keeping transistor Q1 off and allowing transistor Q2 to stay on.

When the LM35 output exceeds 0.5 volts, it links to Pin 3 of the Op-amp LM358[17]. By establishing the reference voltage at 0.5 volts on Pin 2 of LM35, the voltage at Pin 3 (the non-inverting input) surpasses that at Pin 2 (the inverting input). Consequently, the output of the LM35 operational amplifier (PIN 1) rises to a high state. The equations governing the operational amplifier output (Vout) are as follows:

$$a) V_{out} = (R2/R1+R2) * V_{in}$$

(Here R2 is the second part of the potentiometer:2kΩ
First part of the potentiometer is 10+8=18kΩ)

$$b) V_{out} = (2/18+2) * 5 = 0.5v$$

3. SIMULATION PARAMETERS

PARAMETERS	VALUE
VCC	5V
U2A	5V
R1	230Ω
RV1	10kΩ
R2	230Ω
R3	10kΩ
R4	1kΩ
R5	1kΩ
R6	10Ω

Table 1: simulation parameters table

Here the 5v DC supply is given by the DC charger which is initially made by using a stepdown transformer and bridge rectifier to remove the negative lobe of the sinusoidal waveform and a resistor of 680Ω.

4. RESULT ANALYSIS

Here in this paper Without the LM358 component in the simulation, the output behaviour changes. When the temperature remains below 50°C, the LM358 remains inactive, keeping Q1 off. Consequently, Q2's base receives power through R2, leading to the illumination of the green LED. However, once the temperature surpasses 50°C, the LM358 generates an output, causing Q1 to activate and the red LED to light up. This action results in Q2 being unable to receive bias, causing it to turn off. Hence, the paper operates with a threshold temperature of 50°C, signified by these changes in LED status.

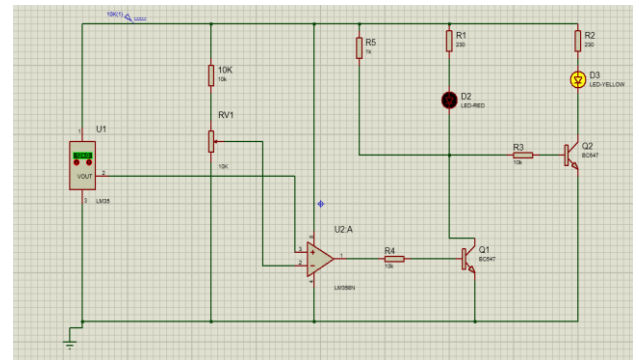


Fig 3: simulation below the threshold temperature

Output of LM35 connected to the base of NPN transistor Q1, so Q1 also becomes ON and Red LED start to glow. At the same time, base of Transistor Q2 gets ground and Q2 becomes OFF and Green LED also becomes OFF. So this is the process how the circuit detects the temperature and indicates by glowing the Red LED, which is the colour of danger.

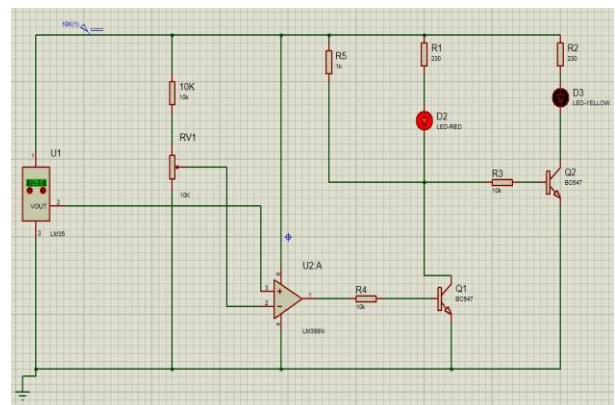


Fig 4: simulation above the threshold temperature

5. DESIGN AND IMPLEMENTATION OF THERMOGLOW

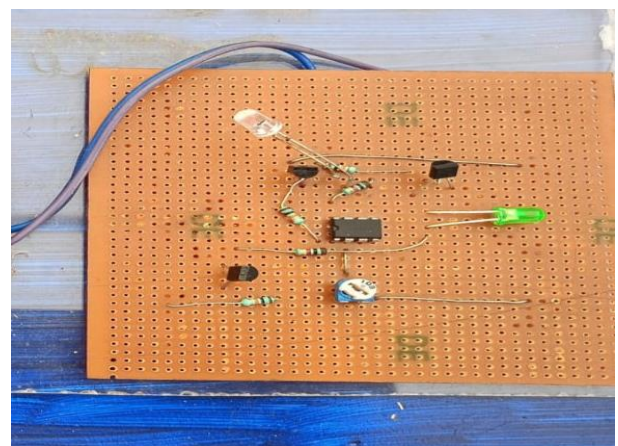


Fig 5: below threshold temperature

Here in the above observation the natural temperature is below 50° C, so the green LED is glowing itself. Green is the sign of good to go so the circuit will give a sign of safety for any equipment where it will be implemented.

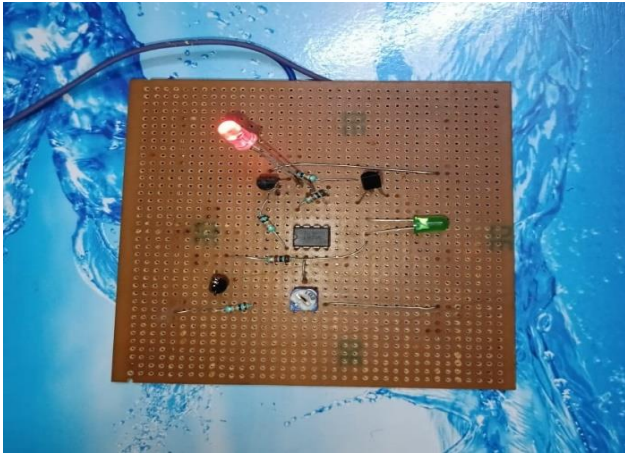


Fig 6: Above threshold temperature

Here in the above analysis the temperature increased up to 50° C, so the red LED started to glow itself. And it will be sign of danger for any equipment where it will be implemented.

6. CONCLUSION

The paper involving the LM35 temperature indicator using LED has demonstrated the practical application of temperature sensing and display technology. Through careful design and implementation, we have successfully created a cost effective and efficient temperature monitoring system that can find applications in various fields. This paper underscores the importance of temperature control and measurement in numerous industries, and the LM35 sensor, in combination with LED indicators, provides a reliable solution for real-time temperature monitoring. As we move forward, further enhancement and refinements can be made to extend its usability and accuracy, making it an invaluable tool in temperature management and control systems. This paper not only fulfils its intended purpose but also serves as a testament to the potential for innovation in electronics and sensor technology.

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