

IOT BASED SMART ELECTRICAL PANEL OVERHEAT ALERT

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Abstract –

Electrical panels are essential components in power distribution systems used in residential, commercial, and industrial environments. However, overheating of electrical panels due to overload, loose connections, short circuits, or poor ventilation can lead to equipment failure, power outages, and even fire hazards. This paper presents the design and implementation of a Smart Electrical Panel Overheat Alert system for monitoring temperature conditions inside electrical panels. The system uses an LM35 temperature sensor to continuously measure temperature and a microcontroller to process the sensor data. When the temperature exceeds a predefined safe limit, the system activates an alert mechanism using a buzzer to notify the user. The system operates on a regulated 5V power supply and displays information using a 16×2 LCD display. The proposed system provides early detection of abnormal temperature rise, helping to prevent electrical accidents and reduce maintenance costs. The implementation of such a system improves the safety, reliability, and efficiency of electrical installations in industries and other applications.

KeyWords: Electrical panel, Overheat detection, LM35 temperature sensor, Microcontroller, Safety monitoring, Embedded system.

1. INTRODUCTION

Electrical machines convert energy from one form to another during their operation. During this energy conversion process, heat is generated. If the heat generated exceeds the safe limit, it may cause overheating which can damage electrical equipment or lead to system failure.

Overheating in electrical panels is a serious problem in industries and power systems. Excessive temperature may result from overload conditions, loose wiring, insulation failure, or environmental factors. Such overheating can

reduce the lifespan of electrical components and may cause fire hazards.

Therefore, it is important to monitor the temperature of electrical panels continuously. A smart electrical panel overheat alert system can help detect abnormal temperature conditions and provide immediate alerts. This system is especially useful in factories, industries, and large electrical installations where equipment safety and reliability are critical. The proposed system uses a temperature sensor, microcontroller, LCD display, and buzzer to detect overheating and alert users in real time.

2. Body of Paper

2.1 Literature Review

Overheating in electrical and electronic equipment can significantly reduce the lifespan of components and cause system failures. Maintaining an optimum temperature helps extend the life of electrical equipment and prevents unexpected breakdowns. Many studies show that continuous temperature monitoring is necessary to protect electrical systems and improve their reliability. Electrical equipment may overheat due to excessive load, poor ventilation, loose connections, environmental conditions such as dust or vibration, and insulation degradation. Overheating in circuits can damage electronic components and may even lead to fire hazards. Therefore, early detection of abnormal temperature rise is very important in industrial and power systems. In many industrial machines, sensors and monitoring systems are used to detect temperature changes and generate alarms. These alarm systems compare the measured sensor data with predefined threshold values. When the temperature exceeds the limit, the system activates an alert or safety mechanism to prevent damage.

Researchers have also developed systems that predict temperature rise using intelligent techniques such as Artificial Neural Networks (ANN) and machine learning

models. These systems analyze temperature and current data to predict overheating conditions before they occur.

Temperature monitoring and alarm systems are widely used in industries, automotive systems, power plants, and medical electronics to improve safety and protect equipment from excessive heat damage.

2.2 Problem Definition

Traditional electrical panels generally do not provide real-time monitoring of temperature conditions. As a result, overheating caused by overloading, loose connections, or short circuits may go unnoticed until serious damage occurs.

This overheating can lead to insulation failure, equipment damage, electrical fires, and power outages. Such situations pose risks to both property and human safety. Therefore, there is a need for a smart electrical panel overheating alert system that can continuously monitor the panel temperature and provide an immediate warning when abnormal heating occurs.

2.3 Objectives

The main objectives of this project are:

- To continuously monitor the temperature of an electrical panel.
- To detect overheating conditions caused by overload or faulty wiring.
- To generate an alert when the temperature exceeds a safe limit.
- To prevent electrical fires and equipment damage.
- To improve safety in residential, commercial, and industrial electrical systems.
- To design a reliable and low-cost monitoring system.

2.4 Methodology

The Smart Electrical Panel Overheat Alert system is designed to monitor the temperature inside an electrical panel and provide an alert when the temperature exceeds the safe limit. The system mainly consists of a power supply unit, LM35 temperature sensor, microcontroller, LCD display, buzzer, and control buttons.

The system operates on a regulated 5V power supply. Initially, a 12V adapter provides the input power, which is converted into 5V using a voltage regulator. This regulated supply is used to power the microcontroller and other electronic components of the system.

The LM35 temperature sensor is used to continuously measure the temperature of the electrical panel. It

produces an analog output voltage that is directly proportional to the temperature. This analog signal is sent to the microcontroller for processing.

The microcontroller acts as the main control unit of the system. It reads the temperature value from the sensor, compares it with the preset reference temperature, and determines whether the temperature is within the safe limit or not. The current temperature value is displayed on a 16×2 LCD display so that users can monitor the system in real time.

If the measured temperature exceeds the predefined limit, the microcontroller activates the buzzer to generate an alert. This alert warns the user about the overheating condition so that immediate action can be taken to prevent damage.

Push buttons such as enter, positive, and negative are used to adjust the reference temperature settings. The user can change the temperature limit according to the application requirement.

Thus, the system continuously monitors temperature, displays real-time data, and provides alerts during overheating conditions, helping to improve the safety and reliability of electrical panels. and using the positive and negative buttons the temperature limit can be increased or decreased. This system helps in early detection of overheating and provides a warning before damage occurs.

Table 1: Sample Hardware Components

Sr.no	Component	Description
1	LM35 Temperature Sensor	Measures temperature of electrical panel
2	Microcontroller	Processes sensor data
3	16×2 LCD Display	Displays temperature values
4	Buzzer	Provides overheating alert
5	Voltage Regulator	Converts 12V supply to 5V

This flowchart shows the working process of a Smart Electrical Panel Overheat Alert System.

The process starts with the system reading the temperature from the sensor. The sensed temperature data is then sent to the ESP32 controller, which processes the information. The controller checks whether the temperature has crossed the preset threshold limit. If the temperature is normal, the system continues monitoring. If the temperature exceeds the threshold, the alert system is triggered.

Once the alert is triggered, the buzzer and LED provide a local warning, and the data is also sent to the cloud. The

user receives a notification through mobile or web application. The system then checks if the temperature has reached a critical level. If it is critical, a relay is activated to cut off the power supply, preventing damage or fire hazards. If the temperature is not critical, the system continues monitoring the panel temperature continuously.

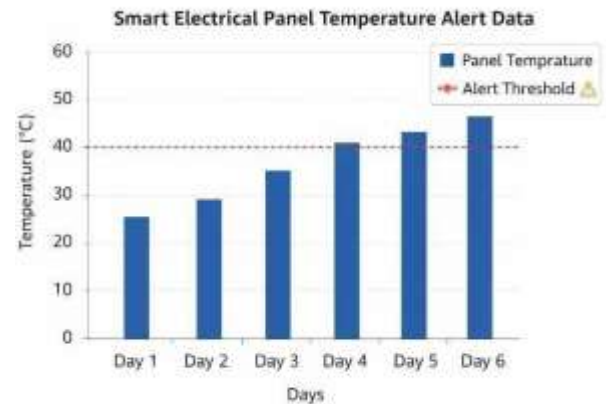


Fig:1.2

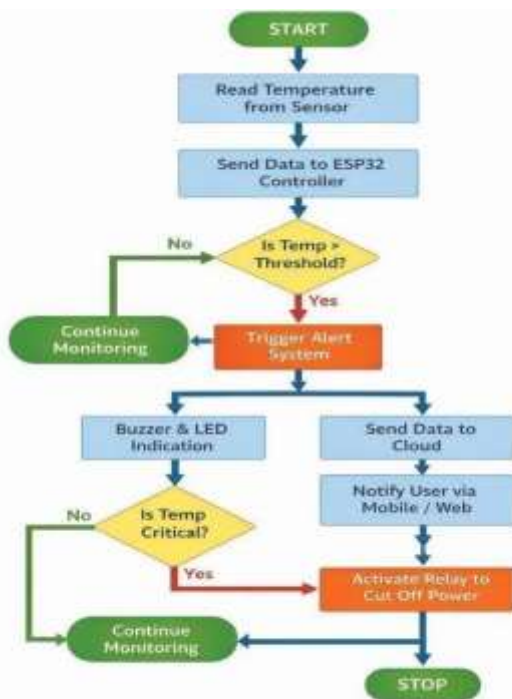


Fig:1.1

Chart:

This chart represents the temperature variation in a Smart Electrical Panel Overheat Alert System over several days. The horizontal axis shows the days of monitoring, while the vertical axis shows the temperature in degrees Celsius (°C) measured inside the electrical panel.

As the days progress, the temperature gradually increases due to load conditions and continuous operation of electrical equipment. A threshold limit is marked on the chart to indicate the maximum safe temperature.

When the temperature crosses this limit, the system activates an alert mechanism such as a buzzer or notification. This chart helps in understanding how the system monitors temperature changes and provides early warning to prevent overheating, equipment damage, or fire hazards in electrical panels.

3. CONCLUSION

The Smart Electrical Panel Overheat Alert system provides an effective method for monitoring the temperature of electrical panels and detecting overheating conditions at an early stage. The system uses a temperature sensor and microcontroller to continuously measure temperature and compare it with a predefined safe limit. When the temperature exceeds the limit, the system generates an alert using a buzzer and displays the temperature on the LCD display.

This system helps prevent electrical accidents, equipment damage, and fire hazards by providing timely warnings. Continuous monitoring improves the safety and reliability of electrical installations in industries, commercial buildings, and residential areas. It also helps reduce maintenance costs and downtime by identifying

faults early.

The proposed system is simple, low-cost, and easy to install, making it suitable for practical applications. In the future, the system can be enhanced by integrating IoT technology for remote monitoring and automatic notification through mobile devices, which will further improve the efficiency and safety of electrical panel monitoring systems.

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