



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 4, April 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

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Development of PLC Based Automatic Temperature Controller

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ABSTRACT: In the industry problem of slow response and low accuracy of the automatic temperature control system for material processing and boiler heating, a new design method is proposed to work with the PLC-based temperature control system, where the box temperature control may be achieved through the fan and the heating plate. The programmable logic controller (PLC) is an industrial control computer, and it is designed to operate in real time environment. It has been observed that in many industries distributed control system. The main objective of in this system is to maintain the temperature of the process at a specific value target. The objective of the system is to maintain the temperature of the process at a specific target value, ensuring optimal operation and product quality. This is achieved by continuously monitoring the temperature of the process using sensors, and adjusting the output signal to the actuators based on the feedback received from the sensors. The PLC receives the temperature reading from the sensors, makes calculations based on predefined algorithms and then sends the output signals to the actuators to maintain the desired temperature. The HMI interface allows the operator to set the desired target temperature and monitor the temperature of the process in real-time.

KEYWORDS:-Temperature controller, PLC, Automatic Temperature Controller.

I. INTRODUCTION

Temperature control has a very important role in industrial /home applications and is difficult to be implemented through ordinary control techniques. PLC controllers are widely used in temperature control. PLC measures the differences between the desired temperature value and the actual temperature value by using the error calculated. It attempts to minimize it by adjusting the control input in order to obtain the desired output value. The modern sensing technology and control methods are undergoing continuous innovation, where the real-time temperature control is demanding higher accuracy and faster response more than ever. Temperature control is widely used in production and industrial control processes in all aspects. For example, in the iron and steel smelting process, iron and steel to be baked requires heat treatment in order to achieve their performance indicators; plastic qualitative process also needs to maintain a certain temperature range.

II. PROBLEM IDENTIFICATION

1. Inaccurate temperature readings: The PLC-based automatic temperature controller may not provide accurate temperature readings due to faulty temperature sensors or incorrect calibration of the sensors.

2.Slow response time: The temperature controller may have a delayed response time due to slow communication between the controller and other devices in the system.

3.Malfunctioning PLC system: Any failure or malfunction of the PLC system, such as hardware failure or programming errors, can cause the temperature controller to malfunction or fail.

4.Insufficient heating or cooling capacity: The controller may not be able to handle the heating or cooling demands of the system, resulting in inconsistent or unstable temperatures.

5. Inadequate user interface: The user interface for the temperature controller may not be user-friendly, making it difficult for operators to set, modify, or adjust temperature settings.

6. Poor maintenance: The temperature controller may not function optimally if it is not properly maintained, leading to performance issues or eventual failure.

7. Power supply failures: Any power supply issues such as power surges, power cuts or even fluctuations can lead to damage to the temperature controller and other devices in the system.

8. Compatibility issues: The controller may not be compatible with the existing communication protocols or hardware in the system, leading to incongruity or even equipment failure.

III. LITERATURE REVIEW

Fanjie Wei Chongqing Targeting at the problem of slow response and low accuracy of the automatic temperature control system for material processing and boiler heating, a new design method is proposed to work with the PLC-based temperature control system, where the box temperature control may be achieved through the fan and the heating plate. The hardware design and software design of the system are analysed in detail. In this paper, a combination of the traditional PID control and the more popular fuzzy control is taken as the control program to achieve the overall design of the control algorithm. Followed by the simulation in the MATLAB software, the designed system is highlighted by its the characteristics of impressive stability, precision and robustness.

Gabriela Rata In this paper, different solutions for power supply of a resistance used for the liquid heating were analysed. The authors propose the best solution in terms of reliability, harmonic pollution of power network and precision temperature control. The temperature control used a PID controller based on PLC and it was observed by HIM, will try to minimize the error value as the difference between desired temperature and measured temperature.

K. Srujan Raju Automatic temperature control system is an important application used in almost all modern gadgets and smart homes. The system for controlling temperature automatically is achieved by using Arduino Uno-based microcontroller system. Arduino Uno due to its increased popularity finds its varied range of applications. Temperature sensor LM35 and Arduino Uno are the hardware used interfaced with computer, and the temperature is controlled in the room. Temperature is displayed on LCD display employing A1 pin of hardware with the help of analogue pin utilizing pulse width modulation (PWM). We have designed temperature control as an automatic system that has been not attempted before the way it has been implemented.

IV. METHODOLOGY

1. Define the System Requirements

The first step is understanding the requirements of the temperature control system, such as the desired temperature range or the speed of response to changes in the temperature.

2. Choose the PLC

Once the requirements of the system are defined, choose a PLC suitable for the temperature control process. The PLC should have sufficient input and output channels to accommodate the sensors, actuators, and any other necessary devices.

3. Select the Sensors

Choose the sensors suitable for measuring the temperature of the system. The sensors can include resistance temperature detectors (RTDs), thermocouples or thermistors depending on the accuracy required and the temperature range to be controlled.

4. Write the PLC Program

Develop a PLC program for the automatic temperature control system. The program needs to be written using the software provided by the PLC manufacturer, and should include algorithms for proportional, integral, and derivative (PID) control.

5. Configure the HMI

Configure the Human Machine Interface (HMI) to allow the operator to interact with the system. The HMI should be user-friendly and intuitive, and should include displays to show the current temperature, set point, and any alarms or faults.

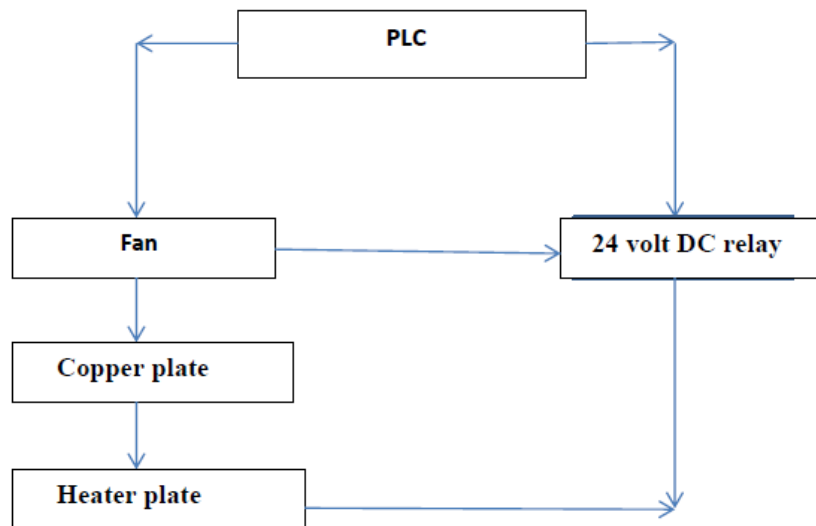
6. Test the System

Once the PLC program and HMI are completed, test the system to ensure that it meets the specifications laid out in the system requirements. Conduct various tests and simulations to ensure that the system can safely and accurately control the temperature of the process.

7. Maintenance

Ensure that regular maintenance is carried out on the system to prevent any failures or errors. This includes monitoring sensor performance, checking system software, and replacing worn or damaged components.

Block Diagrams



V. COMPONENTS



1. Heater plate :- PTC heaters are a type of electric heater that uses semiconductor materials to convert electricity into heat. The material used in a PTC heater is specially designed to have a high resistance, which causes it to heat up when electricity is passed through it. PTC heaters are often used in space heaters and hair dryers because they can provide a consistent level of heating without the use of coils or other moving parts. PTC heater is a new type of heater that uses PTC (positive temperature coefficient) semiconductor as the heating element.



2. **Copper plate** :- Copper is an essential component in the motors, wiring, radiators, connectors, brakes, and bearings used in cars and trucks. Copper has many desirable properties for thermally efficient and durable heat exchangers. First and foremost, copper is an excellent conductor of heat.



3. **RTD PT-100** :- Resistance temperature detectors, or RTDs, are a class of sensors that change resistance when the temperature of the medium they are inserted into changes. Resistance Temperature Detectors - are temperature sensors that contain a resistor that changes resistance value as its temperature changes. The most popular RTD is the Pt100.



4. **24 volt DC Relay** :- The working principle of the relay is similar, all control the opening and closing of the contact point. A relay is an electrical control device, which is an electrical appliance that makes a predetermined step change of the controlled quantity in the electrical output circuit when the change of the input quantity meets the specified requirements. The 24-volt DC relay consists of a coil, an iron core and several groups of normally open and normally closed electric shocks.



5. Fan :- Fans are used to draw cooler air into case from the outside warm air from inside and move air across a heat sink to cool a particular component.

6. Programmable Logic Controller (PLC) :- The PLC receives information from connected sensors or input devices, processes the data, and triggers outputs based on pre-programmed parameters. Depending on the inputs and outputs, a PLC can monitor and record run-time data such as machine productivity or operating temperature, automatically start and stop processes, generate alarms if a machine malfunctions, and more. Programmable Logic Controllers are a flexible and robust control solution, adaptable to almost any application.



Working : A PLC based automatic temperature controller works by continuously monitoring the temperature of a particular system or process that needs to be controlled. This is accomplished through a temperature sensor, which is connected to the input side of the PLC. The PLC then reads the temperature data and compares it to the desired set point temperature that has been programmed into the system. If the temperature is too low or too high, the PLC automatically triggers an output signal to activate or deactivate the heating or cooling system. The temperature controller can also be programmed with multiple zones, allowing it to monitor and control the temperature of various parts of a system or process simultaneously. The PLC can even be programmed with advanced algorithms to optimize energy consumption and reduce waste. Overall, a PLC based automatic temperature controller provides a reliable and efficient way to maintain consistent temperature control in industrial and commercial settings.

VI. RESULT

A PLC (Programmable Logic Controller) based automatic temperature controller can provide precise control over the temperature of a system or process. The result of such a controller would be maintaining the temperature at a set point or within a desired range with minimal error. The PLC-based temperature controller would typically use temperature sensors to measure the actual temperature of the system or process and compare it to the desired set point. Based on this

comparison, the controller would send control signals to heating or cooling equipment to adjust the temperature accordingly.

VII. APPLICATION

PLC (Programmable Logic Controller) temperature controllers are widely used in industrial and manufacturing applications to control temperature in various processes. They provide accurate and reliable temperature control, which is essential for many industrial processes. Here are some common applications of PLC temperature controllers:

- 1. Heating and cooling systems:** PLC temperature controllers are used to control the temperature of heating and cooling systems in various industries. For example, in the food industry, PLC temperature controllers are used to control the temperature of ovens, fryers, and refrigerators
- 2. Chemical processes:** PLC temperature controllers are used to control the temperature of chemical processes in the pharmaceutical, petrochemical, and other industries. These processes require precise temperature control to ensure product quality and safety.
- 3. Environmental control:** PLC temperature controllers are used in environmental control systems, such as HVAC (heating, ventilation, and air conditioning) systems, to maintain a comfortable temperature in buildings.
- 4. Plastics processing:** PLC temperature controllers are used in plastic injection moulding and extrusion processes to maintain the correct temperature of the moulds and extruders.
- 5. Automotive manufacturing:** PLC temperature controllers are used in automotive manufacturing to control the temperature of paint booths, curing ovens, and other processes that require precise temperature control.

In all of these applications, PLC temperature controllers offer several advantages, including flexibility, reliability, and accuracy. They can be programmed to perform specific temperature control functions, and they can operate in harsh industrial environments. Additionally, they can communicate with other control systems, such as SCADA (Supervisory Control and Data Acquisition) systems, to provide real-time temperature data for process monitoring and control

VIII. CONCLUSIONS

In conclusion, a PLC based temperature controller is a sophisticated control system that can maintain precise and accurate temperature control in a variety of applications. It utilizes a temperature sensor to monitor the temperature of the environment, and sends signals to the PLC to adjust the temperature as necessary. One of the main advantages of a PLC based temperature controller is that it provides consistent and reliable temperature control, which can be crucial in industrial processes where precision is essential. It also reduces the need for manual temperature adjustment, saving time and increasing efficiency.

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