Water Heating Process using PLC

Swapnil Arun Namekar[1], Prem Rajendra Vaidya[2]
[1]*Assistant Professer, Department of Electrical Engineering, Bharati Vidhyapeeth Deemed To Be University College of Engineering Pune, India*
[2]*Student, Department of Electrical Engineering, Bharati Vidhyapeeth Deemed To Be University College of Engineering, Pune, India*

***Abstract*- In this paper I have concluded the process of temperature of water using PLC**

I.INTRODUCTION

Fast and Easy PLC Control The object of a PLC simulator is to 'fake out' the input into a PLC so that the programmer can test and debug the program before installation into it's operating environment. Our patent pending PLC simulators achieve this by mounting on the existing terminal strip of the PLC card and providing easy controls to turn digital inputs on/off or adjust analog signals. If you are a engineer who programs PLCs or even a technician in need of a quick way to test a PLC functionality then these devices are for you. Save time, money and embarrassment by fixing problems before they start. These PLC simulators are for sale in our products section.

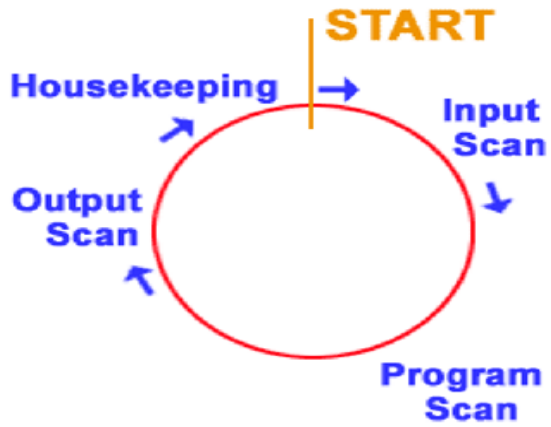


Figure 1.1 Operation of PLC in basic Stages

Early PLCs were designed to replace relay logic systems. These PLCs were programmed in "ladder logic", which strongly resembles a schematic diagram of relay logic. Modern PLCs can be programmed in a variety of ways, from ladder logic to more traditional programming languages such as BASIC and C. Another method is State Logic, a Very High Level Programming Language designed to program PLCs based on State Transition Diagrams. Recently, the International standard IEC 61131-3 has become popular. IEC 61131-3 currently defines five programming languages for programmable control systems: FBD (Function block diagram), LD (Ladder diagram), ST (Structured text, similar to the Pascal programming language), IL (Instruction list, similar to assembly language) and SFC (Sequential function chart). These techniques emphasize logical organization of operations. While the fundamental concepts of PLC programming are common to all manufacturers, differences in I/O addressing, memory organization and instruction sets mean that PLC programs are never perfectly interchangeable between different makers. Even within the same product line of a single manufacturer, different models may not be directly compatible.

II.INTRODUCTION TO WATER TEMPERATURE

The temperature is commonly used in the industrial production process parameters, while closely related to people's lives. In many fields of scientific research and production practice, the temperature control occupies a very important position, especially in metallurgy, chemical industry, building materials, food, machinery, petroleum and other industries, has a pivotal role. Programmable Logic Controller (PLC) is an industrial control computer; inherit computer, automatic control technology and communication technology as one of the new automatic device. It has strong anti-interference ability and cheap price, reliability, programming is simple, easy to learn and use, by the project operator, like in the industrial field, the PLC has been widely used in various areas of industrial control. The configuration software is an

automatic control system monitoring layer a software platform and development environment. Its flexible configuration will provide users with software tools to quickly build industrial automatic control system monitoring and general level.

Before the appearance of the configuration software, the industrial areas of the user by hand or entrust a third party to write HMI (Human Machine Interface software), it has developed a long time, low efficiency and poor reliability shortcomings; or buy a dedicated industrial control systems. It usually is a closed system, the choice of small, often cannot meet the demand, and it is difficult to exchange data with the outside world, upgrade and add functionality to be severely restricted. The emergence of the configuration software configuration software allows users to build a system which best suits their own applications. With the rapid increase in the level of industrial automation, computer widely used in the industrial field, a wide range of control equipment and process monitoring devices in industrial applications, industrial control software has been unable to meet the diverse needs of the user. In the development of the traditional industrial control software, once the industrial controlled object changes, it is necessary to modify the source code control system, leading to long development cycle; industrial control software has successfully developed so that each control different repeated low usage, it's expensive. General industrial automation configuration software can be a good solution to the problems of traditional industrial control software, enables users to any configuration of objects and control purposes, the completion of the final automation control engineering. This project designed a temperature monitoring system based on Siemens PLC.

III.REQUIREMENTS AND SPECIFICATIONS

Programming Languages:

- Ladder Diagram
- Functional Block Diagram
- Instruction List

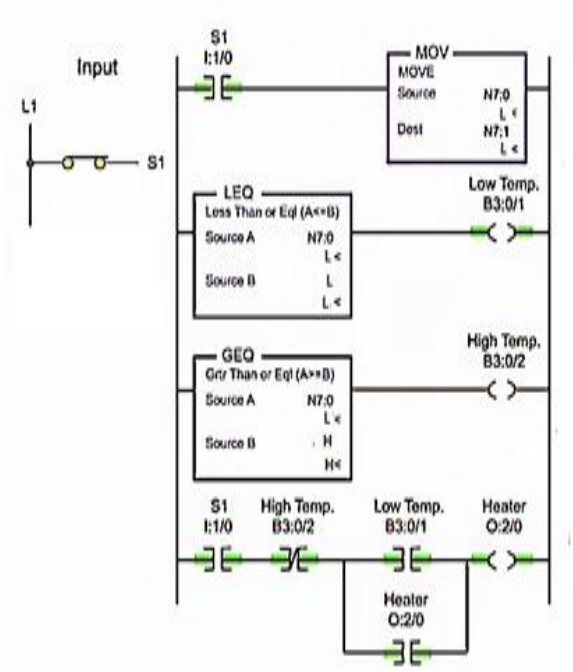
Hardware Requirements:

- PT100
- Temperature Sensor Transmitter
- Level Switch
- Pump
- Heater
- Stirrer
- 24V Relay Switch Board
- SMPS

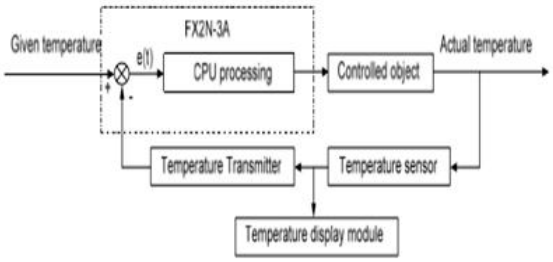
IV.WATER TEMPERATURE CONTROL

ON/OFF Control system is a commonly used method to control temperature. Comparison instructions, that are Less than or equal and Greater than or equal are set to control the temperature range.

A Less than or equal logic energize when the input value is less than or equal to the setpoint. A Greater than or equal logic energize when the input value is greater than or equal to the setpoint.



such as somewhere a escape on a pipeline has occurred, transfers the information reverse to a central site, alerting the home station that the leak has occurred, haulage out compulsory analysis and be in charge of, such as influential if the leak is dangerous, and displaying the information in a commonsense and prearranged fashion. SCADA systems can be moderately simple, such as one that monitors ecological conditions of a diminutive office building, or incredibly compound, such as a system that monitors all the movement in a nuclear power plant or the activity of a municipal water organization



V. SYSTEM REQUIREMENT DESCRIPTION

5.1. PT100:

Platinum resistance thermometers (PRTs) offer excellent accuracy over a wide temperature range (from –200 to +850 °C). Standard sensors are available from many manufacturers with various accuracy specifications and numerous packaging options to suit most applications. Unlike thermocouples, it is not necessary to use special cables to connect to the sensor.

The principle of operation is to measure the resistance of a platinum element. The most common type (PT100) has a resistance of 100 ohms at 0 °C and 138.4 ohms at 100 °C. There are also PT1000 sensors that have a resistance of 1000 ohms at 0 °C.

The relationship between temperature and resistance is approximately linear over a small temperature range: for example, if you assume that it is linear over the 0 to 100 °C range, the error at 50 °C is 0.4 °C. For precision measurement, it is necessary to linearize the resistance to give an accurate temperature. The most recent definition of the relationship between resistance and temperature is International Temperature Standard 90 (ITS-90).

Heater:

Figure 5.4 Heater

The cold water that is put into a water heating device can be preheated using the reclaimed thermal energy from a shower so that the input water doesn't need as much energy to be heated before being used in a shower, dishwasher, or sink. The water entering a storage tank is usually close to 11 °C but by recovering the energy in the hot water from a bath or dishwasher, the temperature of the water entering the holding tank can be elevated to 25 °C, saving energy required to increase the temperature of a given amount of water by 14 °C. This water is then heated up a little further to 37 °C before leaving the tank and going to the average shower.

When recycling water from a bath (100-150 litres) or shower (50-80 litres) the waste water temperature is circa 20-25 °C. An in-house greywater recycling tank holds 150-175 litres allowing for the majority of waste water to be stored. Utilizing a built-in copper heat exchange with circulation pump the residual heat is recovered and transferred to the cold feed of a combi-boiler or hot-water cylinder, reducing the energy used by the existing central heating system to heat water

Specification :

- Voltage : DC 12V / DC 24 V
- Wattage : 120 watt – 140 watt

5.6. 24V Relay Switch Board :

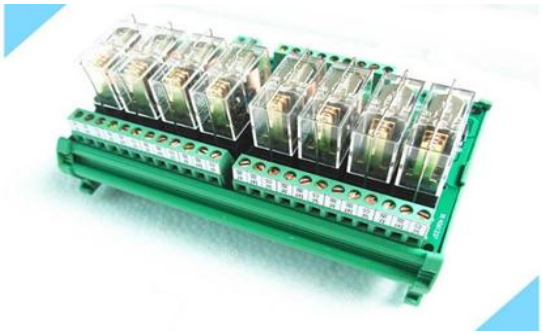


Figure 5.6 24V Relay Switch Board

Relays are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. As relay diagrams show, when a relay contact is normally open (NO), there is an open contact when the relay is not energized. When a relay contact is Normally Closed (NC), there is a closed contact when the relay is not energized. In either case, applying electrical current to the contacts will change their state.

Relays are generally used to switch smaller currents in a control circuit and do not usually control power consuming devices except for small motors and Solenoids that draw low amps. Nonetheless, relays can "control" larger voltages and amperes by having an amplifying effect because a small voltage applied to a relays coil can result in a large voltage being switched by the contacts.

Protective relays can prevent equipment damage by detecting electrical abnormalities, including overcurrent, undercurrent, overloads and reverse currents. In addition, relays are also widely used to switch starting coils, heating elements, pilot lights and audible alarms.

5.7. SMPS:

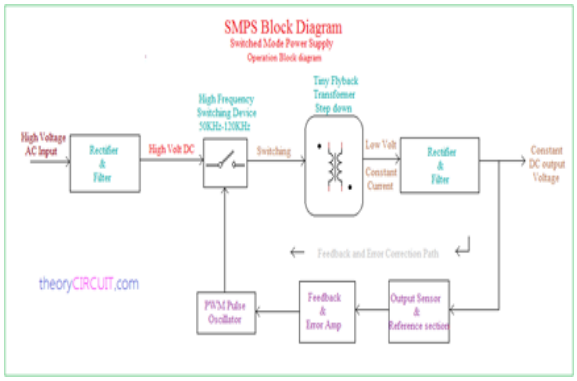


Figure 5.7 SMPS

Switch mode power supplies (SMPSs) are used in a range of applications as an efficient and effective source of power. This is in major part to their efficiency. For anybody still working on a desktop, look for the fan output in the central processing units (CPU). That's where the SMPS is. SMPS offers advantages in terms of size, weight, cost, efficiency and overall performance. These have become an accepted part of electronics gadgets. Basically, it is a device in which energy conversion and regulation is provided by power semiconductors that are continuously switching "on" and "off" with high frequency.

A switching regulator does the regulation in the SMPS. A series switching element turns the current supply to a smoothing capacitor on and off. The voltage on the capacitor controls the time the series element is turned. The continuous switching of the capacitor maintains the voltage at the required level.

Specifications:

- Input Voltage : AC 110 – 261V, 50 Hz
- Output Voltage : 12V DC

5.8. Temperature Sensor Transmitter:

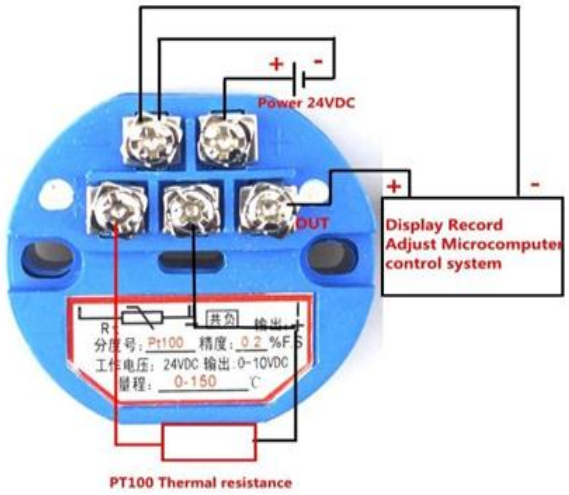


Figure 5.1 Temperature Sensor Transmitter

A temperature transmitter is an electrical instrument that interfaces a temperature sensor (e.g. thermocouple, RTD, or thermistor) to a measurement or control device (e.g. PLC, DCS, PC, loop controller, data logger, display, recorder, etc.). Typically, temperature transmitters isolate, amplify, filter noise, linearize.

Convert the input signal from the sensor then send (transmit) a standardized output signal to the control device. Common electrical output signals used in manufacturing plants are 4-20mA or 0-10V DC ranges. For example, 4mA could represent 0°C and 20mA means 100°C.

Specifications

- Rank : 0.2% FS
- Voltage : 24vdc
- Out : 4 – 20 mA
- Range : 0 to 150 °C

Calculation of Temperature Control in PLC

Position 1 : Temperature measurement Using PLC

It is arrangement made using PLC that will control the temperature in the predetermined range. Measurement and control of input temperature in the range of 275 °C to 300 °C.

It temperature below 275 °C, heater will 'ON' and fan will 'OFF'.

It temperature above 300 °C, heater will 'ON' and fan will 'OFF'.

Concept Structure:

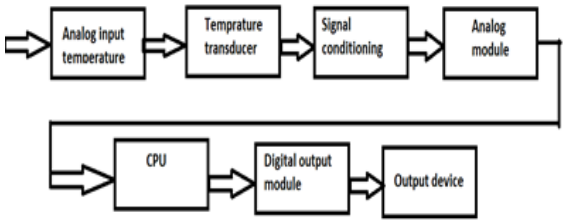


Figure 6.1

Position 2: Analog Input Module:

It is a device that connects PLC to analog input signal.

It interfaces a PLC to analog input signals. Analog input module given the PLC ability to monitor continuously charging input signals representing temperature, flow, level, pressure, etc.

Analog input module converts the analog signals from the temperature signlas to digital signal for transfer to processor.

Concept Structure:

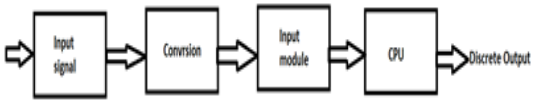
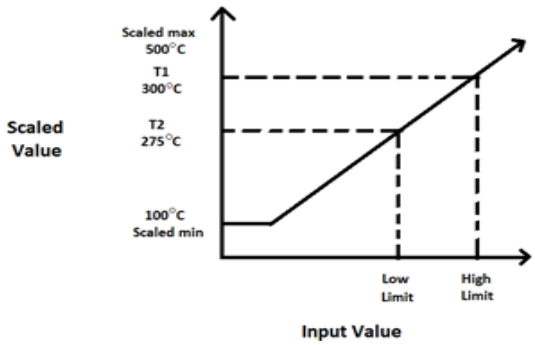


Figure 6.2

Position 3: Conversion of Analog Signal to Digital Signal:



Sr. No.	Voltage Current Range	Decimal Representation
1.	-10V dc to +10V dc	-32766 to +32767
2.	0V dc to +10V dc	0 to 32767
3.	0V dc to +5V dc	0 to 16384
4.	+1V dc to +5V dc	3277 to 16384
5.	-20mA to +20mA	-16384 to +16384
6.	0mA to +20mA	0 to 16384
7.	4mA to +20mA	3277 to 16384

Above graph displays the linear relationship between the input and the resulting scaled values.

Design Calculation :

- Scaled minimum = 100°C
- Scaled maximum = 500°C
- Temp control rang -275°C to 300°C
- Scaled value = (Input Value * Slope) + offset

Slope = (scaled max – scaled min)/(input max – input min)

- = (500 - 100)/(32767 - 0)

= (400 / 32767)

Offset = scaled min – (input min * scope)

- = 100 – (0 * (400 / 32167))

= 100

Scaled Value =[Input Value * (400 / 32767)] + 100

Therefore,

- Input Value = (Scaled Value - offset) / Slope
- Low limit = (275 - 100) / (400 / 32767) = 14344-
- High limit = (300 - 100) / (400 / 32767) = 16398

Position 4: Analog Output Module:

It is a device that connects PLC to output device.

Analog input Module accepts 16 bit output status word which they convert to an analog value through the DAC.

Typical analog signals are 0 to 10 volt DC,-10 to +10 Volt DC, 0to 5 Volt DC, 1 to 5 Volt DC, 0 to 20 mA, -20mA to +20 mA.

Analog output modules are selected to send out either varying current or voltage signal.

Each value of current and voltage will represent a particular operation (e.g. temperature 0°C to 100°C to 4mA to 20mA).

Disadvantages:

1. Without electricity it is not able to operate.

Advantages:

1. The work has automated with this system
2. Flexible
3. Fast response time
4. Less expensive
5. Less and simple wiring
6. Easy to troubleshoot

CONCLUSION

Automation is wheels on which world's vehicle are running. So automation is not important but it is need. This controlling of water level and Temperature using PLC helps us not only to bring automation but also to reduce use of electricity and wastage of water.

Hence by using various electrically, electronically and mechanical operated devices, we have assembled and operated assembled instrument successfully.

ACKNOWLEDGMENTS

We want thanks our principal Prof. Anand Bhalerao sir, and our head of department Prof. D S. Bankar sir and all the staff members of electrical engineering department who helped and guide us for making the review paper .

REFERENCES

[1] Fedoryszyna, "Assessment of systems for mechanization of casting production," April 27, 2007.

[2] PravinKshirsagar et al., "A novel approach in automation for foundry," International Journal of Engineering Innovation & Research, Vo 1, Issue 1, 2012,ISSN: 2277 – 5668, pp. 23-27.

[3] RichaNetto et al., "Programmable logic controllers," September 2013.

[4] Avvaru Ravi Kiran et al., "The principle of programmable logic controller and its role in automation," 2013.

[5] Thomas Bangemann et al., "State of the art in industrial automation," Industrial Cloud-Based Cyber-Physible Systems,©Springer International Publishing Switzerland 2014, pp. 23-47.

[6] AmoghTayade et al., "PLC based hydraulic auto ladle system," Journal of Engineering Research and Applications, vol.4, issue 3, (version 5), ISSN: 2248-9622, March 2014, pp. 19-22.

[7] Akhil Dixit et al., "Review paper on PLC & its applications in automation plants," March 2015.

[8] Jaswandi G. Joshi, Prof. D. D. Ahire, "A brief survey on PLC and its versatile applications using SCADA system,"