Centralized Monitoring and Control of Process Plants using PLC

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Abstract - *The main objective of this project is to monitor and control all the available process plants in the department laboratory. This project involves fetching the real time process variable data from each process plant and communicating the process data through a common communication protocol via Ethernet medium that will run through the entire field. These real time process plant data will be monitored and controlled in the centralized facility that is available in the remote location. The control decision will be taken based upon the behavior of the process plant and the decision will be communicated back to the respective process plant via the communication protocol available and the process plant considers this as input and varies its behavior accordingly. The centralized and remote monitoring and control facility will facilitate the entire operation for implementing the required control specifications for all the process plants available in the department laboratory with the updated real time control data.*

Key Words: Process plants, PLC, DCS, IoT, Profinet, Weintek

1. INTRODUCTION

The process plants available in the department are in need for constant monitoring and control remotely, which will also bring up an advantage of eliminating human errors during physical analysis.

Identifying trends and fluctuations while constantly reading data from the input sensors help us understand their liability of the particular equipment over a specific runtime helping in identifying faults and risks at an early stage.

1.1 PROPOSED IDEA

These connected process stations with the Weintek IIOT module from PLC have been established via Ethernet cable and the module itself is being powered by a 12v battery. The entire station is linked to the easy Access 2.0 app which helps us monitor the remote HMI by providing secure communication, which can be visualized via CMT viewer

2. MATERIALS AND METHODS

The Siemens PLC (S7-1500) receives the sensor data from the process plants. This data is converted to readable format and is being stored in a cloud database provided by EasyAccess2.0.

EasyAccess2.0 provides secure connection with remote HMI and view screens configured for it. The real time data that is being stored in the cloud can be visualized and controlled by providing input to the process station remotely using the same interface. The modified input is instantaneously reflected on the process station and new output is received. This allows for centralized remote monitoring and control.

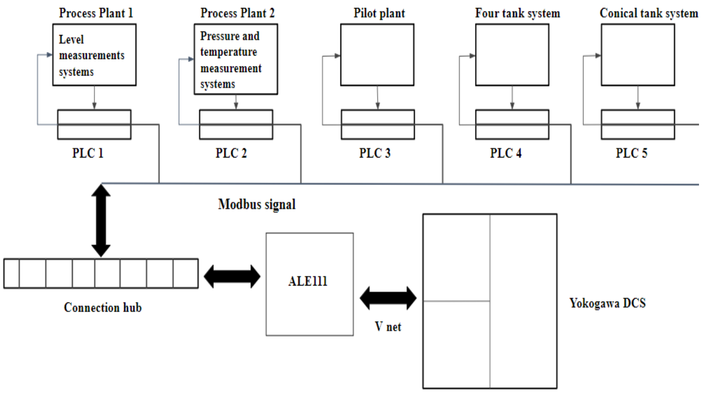
Table -1: Materials

Components Used	
Product/ Materials	**Quantity**
Siemens PLC - S71500	1
ALE111 module	1
Yokogawa DCS System (Centum VP)	1
Process Stations	3
Ethernet Cables	As required

3. DESIGN

The design aims in building a model that assist in developing the centralized monitoring and control application for the process plant that aims to achieve control over different process variables such as level, flow, temperature and pressure. The final control element is majority of the process plant available in the department laboratory is the control valve. Individual process plant or station available is a single input single output system (SISO). Thus, there exists one process variable and one controlled variable from each process plant. The main objective is to achieve individual control of the process plant along with centralized monitoring and remote-control facility.

Figure -1: Block Diagram



Pressure: The mainframe is made of a metal structure which is placed in an open area. The bottom plate has a reservoir tank, a pump and a plumbing fixture. The frame consists of a plate, level transmitter, I / P converter, control valve, process tank and cabinet. The cabinet picks up DC power outages, an overhead wide acquisition system and a disconnected system and an inlet connector for large AC pipelines. The filter part filters the primary air entering the entrance, leaving the debris in the bowl. When the knob is correctly turned, the spring acts on the diaphragm, causing the main valve to open and let a second stream of fresh air with a specific pressure out. Through the feedback hole, exit pressure is returned to the diaphragm, lowering it to the desired pressure. A level investigation and a conditional signal section make up the typical transmitter. Two straight cylinders make up the level probe. Water can enter the center cylinder at any time and behave as a dielectric medium. The power probe level rises as the water level does. The level changes in direct proportion to the power shift. The bridge of the AC power gauge is coupled to voltage variation. The AC millivolt signal includes the bridge's output. A precise adjustment converts the AC signal to DC. Unwanted high-end signals are abundant in the redesign output. It is amplified at (4–20) mA after being filtered with a low pass filter as tank level is represented.

Level: The mainframe is a metal building that is situated outside. It has a reservoir tank, a pump, and a plumbing fixture on the bottom plate. A plate, level transmitter, I/P converter, control valve, process tank, and cabinet make up the frame. The cabinet detects disconnected systems, huge AC pipeline inlet connectors, overhead broad acquisition systems, and DC power failures. The filter part filters the primary air entering the entrance, leaving the debris in the bowl. When the knob is correctly turned, the spring acts on the diaphragm, causing the main valve to open and let a second stream of fresh air with a specific pressure out. Through the feedback hole, exit pressure is returned to the diaphragm, lowering it to the desired pressure. A level investigation and a conditional signal section make up the typical transmitter. Two straight cylinders make up the level probe. Water can enter the center cylinder at any time and behave as a dielectric medium. The power probe level rises as the water level does. The level changes in direct proportion to the power shift. The bridge of the AC power gauge is coupled to voltage variation. The AC millivolt signal includes the bridge's output. A precise adjustment converts the AC signal to DC. Unwanted high-end signals are abundant in the redesign output. It is amplified at (4–20) mA after being filtered with a low pass filter as tank level is represented.

Temperature: Selective Catalytic Reduction has 3 terminals as in anode, cathode and gate. It is a four-layer PNPN tool. In normal state, it will block the voltage applied in any direction, but when the proper voltage or pulse current is applied to the gate electrode, the current will flow through the anode to the cathode thus opening the power in the circuit. of load. The SCR will then act as a semiconductor switch which has three operating circuits, namely, reverse inhibition, forward blocking, and operating conditions. If the anode has a negative relative to the cathode, junctions J1 and J3 are reverse biased and a small recurrent leak will flow to the SCR. This current has two parts, in which one is saturation current which is related to the type of material used, as it is much lower in silicon. Another current "generation" is because of the filming and release of the network company in the capture centers within the reduction layer of the merger. In silicon the current generation is more advanced compared to the current leak. As the voltage across the device increases, generational power also increases and eventually leads to avalanche cracking. The voltage at which this avalanche breakage occurs is determined by the geometry and construction of the device and is a function of the temperature of the device. Therefore, the SCR will need to be operated under a specified high temperature and deceleration voltage in order to operate effectively in its blockchain retraction mode. In the case of a forward block the anode is right relative to the cathode. Junctions J1 and J3 are forward biased. Junction J2 blocks the full voltage used. In this case too, the current device is made up of two parts, the current leak and the current generation. As the voltage across the device increases the current generation increases to make the J2 as forward biased junction thus assuming SCR to be fully functional. The maximum voltage the device can block when moving forward is approximately equal to the reverse voltage drop. The SCR can be brought to the operating state, with all forward links biased, by increasing the anode voltage across the forward break above the voltage or through the current gate. There are still other ways to take the device into operating condition. In the case of running the current through the device is limited mainly by the external circuit.

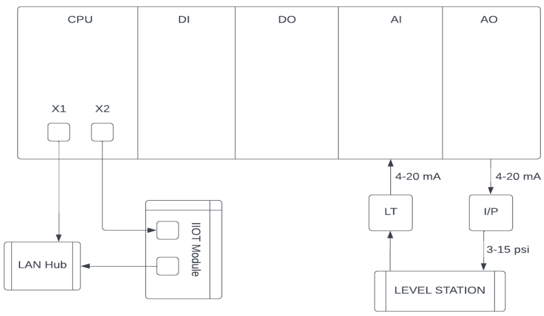
4. WORKING

The available process stations are connected to a singular PLC (Siemens S7-1500) and the program to control each station is designed using TIA portal which also facilitates the use of remote monitoring and control. To visualize the entire process, we make use of easy Builder software by which we create an interface that shows real time data and accepts inputs from the user. The user Input is instantaneously transmitted to the PLC with the help of Weintek IIOT module.

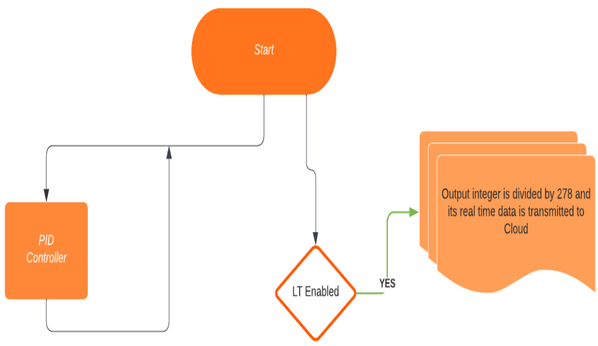
These connected process stations with the Weintek IIOT module from PLC have been established via Ethernet cable and the module itself is being powered by a 12v battery. The entire station is linked to the easyAccess2.0 app which helps us monitor the remote HMI by providing secure communication, which can be visualized via CMT viewer.

5. HARDWARE IMPLEMENTATION

Figure -2: Implementation



6. FLOW CHART



7. RESULT AND DISCUSSIONS

In our analysis, we reviewed and analyzed the above-mentioned process stations and their work flow. The sensors that are used in each process station were examined and its working principles were read. With the knowledge of sensors and its output in the process stations, we got to know about the parameters that are to be checked. Studied on the communication protocol (PROFINET) and tried establishing the connections.

Each ProfiNet device is recognized based on the IP address and device name which is configured using Siemens Totally Integrated Automation (TIA) portal. The communication occurs based on the IP address assigned to the ProfiNet devices. In this way the ProfiNet devices and the MODBUS were configured and used.

8. CONCLUSIONS

The real time monitoring of the process stations has been implemented and the user Input at the app reflects on the process station which was made possible by the IIOT module which facilitates instantaneous transfer of real time data.

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