Automatic Hydro Power Plant Monitoring and Controlling using PLC & SCADA

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Abstract

In earlier year Hydro Power Plant controlling is manually and only qualified person operate and many person is needed for controlling the plant. In our project on controlling to process variable parameter such a level and limit of water with real time implementation of the gate controlling of stepper motor using programmable logic controller. In our project PLC is use as an industrial computer playing the major role of a control and micro switch provide incoming signal to the controlling unit.in our project system model is provide with two level in the one level is upper and one level output the ladder logic is actuated and SCADA give live monitoring display.

Keywords: Stepper Motor, PLC, Water Level Sensor, Stepper Driver, SCADA

I. INTRODUCTION

In 1895, the world's largest hydroelectric development of the time, the Edward Dean Adams Power Plant, was created at Niagara Falls.

Hydro power plant generates high range of power and installation cost is very high so it's controlling and monitoring is necessary. Up to 1980s, control of a hydro plant's generating units was typically performed from governor panel or unit control switchboard. If the plant had multiple units, from a centralized control board was provided. The unit control board and centralized control board using relay logic contained iron vane meters, hardwired control switches, and hundreds of auxiliary relays to perform the unit start/stop and other control operations. All the necessary sensors and controls required operating the unit or units were hardwired to the unit control board and/ or centralized control board, allowing operator to control the entire station from one location. Data acquisition was manual and qualified personnel operated the equipment manually.

Modern systems still permit control of the entire plant from a single location. Modern control rooms utilize the far more cost-effective supervisory control and data acquisition (SCADA) systems (including programmable logic controllers (PLCs) and distributed computer control systems with graphic display screens to implement a vast array of control schemes. The SCADA control scheme also provides flexibility in control, alarming, sequence of events recording, and remote communication that was not possible with the hardwired control systems. Data acquisition, storage and retrieval is provided by the computer.

A digitally operating electronic apparatus which uses a programming memory for the internal storage of instructions for implementing specific functions such as logic, sequencing, timing, counting and arithmetic to control through digital or analog modules, various types of machines or process. Programmable Logic Controller (PLC) is used to control machines and processes. PLCs can be used with a wide range of control systems, which vary widely in their nature and complexity. After programming the PLC, before starting a real process, the operator has to verify if the program is correct, i.e. if the PLC correctly performs the predefined control task. Therefore, the operator monitors the states at input and output port of the PLC. A usual way is to monitor all the states and program variables online, during the operation of PLC, with the same programming environment which was used for programming the PLC. However, it is best to develop a physical educational model of the system, where the operator manually enters the inputs of the PLC and monitors its output states. However, this can take a Long time depending on the complexity of the system. To rebuild the model if some changes are necessary.

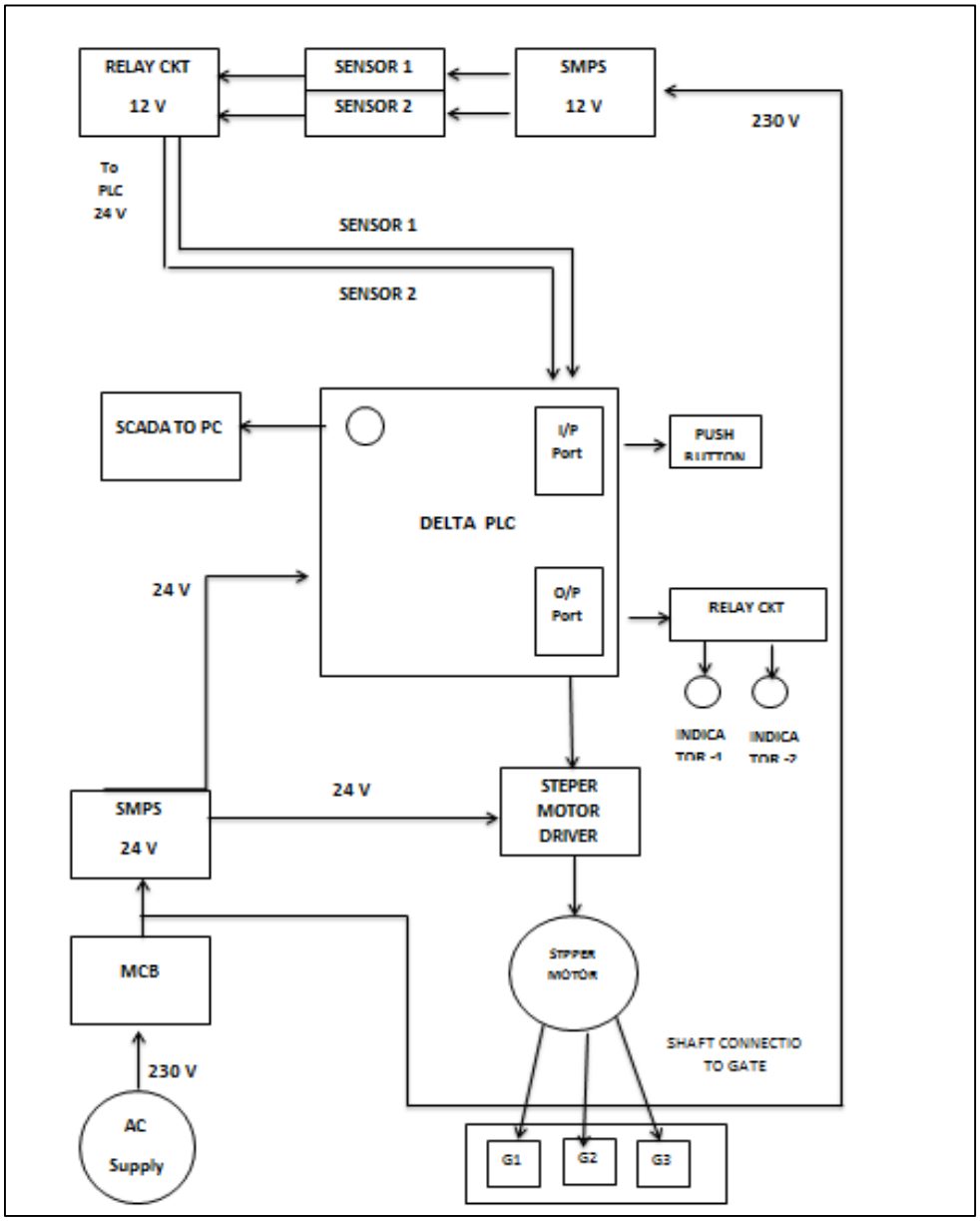

Fig. 1: Block Diagram

The most complex system for monitoring and control of industrial processes which is widely used nowadays is Supervisory Control and Data Acquisition (SCADA) system. This system requires use of communication protocols between the client on one side and PLC and other parts of control system on the other side. Although the SCADA is standard monitoring and data acquisition system in industry, it isn't easy to make, so it isn't appropriate in simple control systems, when it is necessary to make a simple cost-effective monitoring system. The operator uses software simulator to activate certain inputs of the PLC, while the application receives the information about output states of the PLC and it shows them graphically, i.e. in animation. This process is realized through interface board which communicates with PC and controls/reads input/output ports of the PLC.

II. HARDWARE

A. M542 Stepper Drive

The M542 is an economical patented technology based micro-stepping driver. It is suitable for driving two phase and four phase stepper motors. By using the advanced bipolar constant current chopping technique, it can output more speed and torque from the same motor compared with other traditional drivers like L/R drivers. Its 3-state current control technology allows coil currents to be well controlled and with relatively small current ripple, so less motor heating is achieved.

Fig. 2: M542 Stepper Drive

B. PLC

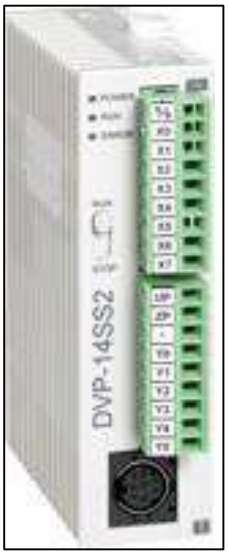

Fig. 3: PLC (Programmable Logic Control)

The first programmable logic controller was introduced by a group of engineers at General motors in 1968.

It is one type of controller which is same as digital computer used for automation in industrial electromechanical processes. As to control machine there is programmable logic controller are used in industries. Programmable logic controllers are designed for various arrangements of digital and analog inputs and outputs.

A PLC is used as "hard" real time system whose output is depend on real time data. The output is generated in response to input in limited range else an unexpected result will be generated. PLCs are used in many machines and many applications based on automation in industries.

In this project used DELTA plc 14SS2. It has 8 input And 6 output and operated on 24volt Dc.

C. Stepper Motor

Stepper motors are DC motors that move in discrete steps. They have multiple coils that are organized in groups called "phases". By energizing each phase in sequence, the motor will rotate, one step at a time. With a computer controlled stepping you can achieve very precise positioning and/or speed control. For this reason, stepper motors are the motor of choice for many precision motion control applications.

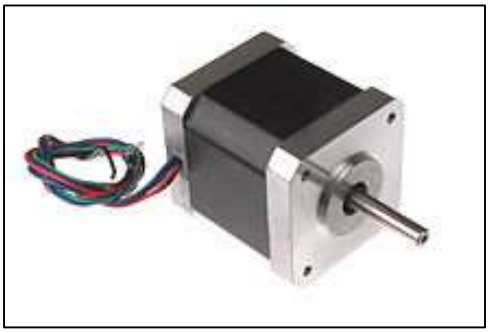

Fig. 4: Stepper Motor

Stepper motors come in many different sizes and styles and electrical characteristics. This guide details what you need to know to pick the right motor for the job.

D. Water Level Sensor

Liquid Level Float Switches operate on a direct, simple principle. In most models, a float encircling a stationary stem is equipped with powerful, permanent magnets. As the float rises or lowers with liquid level, the magnetic field generated from within the float actuates a hermetically sealed, magnetic reed switch mounted within the stem. The stem is made of non- magnetic metals or rugged, engineered plastics. When mounted vertically, this basic design provides a consistent accuracy of ±1/8 inch. Multi-station float switches use a separate reed switch for each level point being monitored.

Fig. 5: Water Level Sensor

Side-mounted float switches use different actuation methods because of their horizontal attitude. The basic principle, however, is the same: as a direct result of rising or falling liquid, a magnetic field is moved into the proximity of a reed switch, causing its actuation.

SCADA

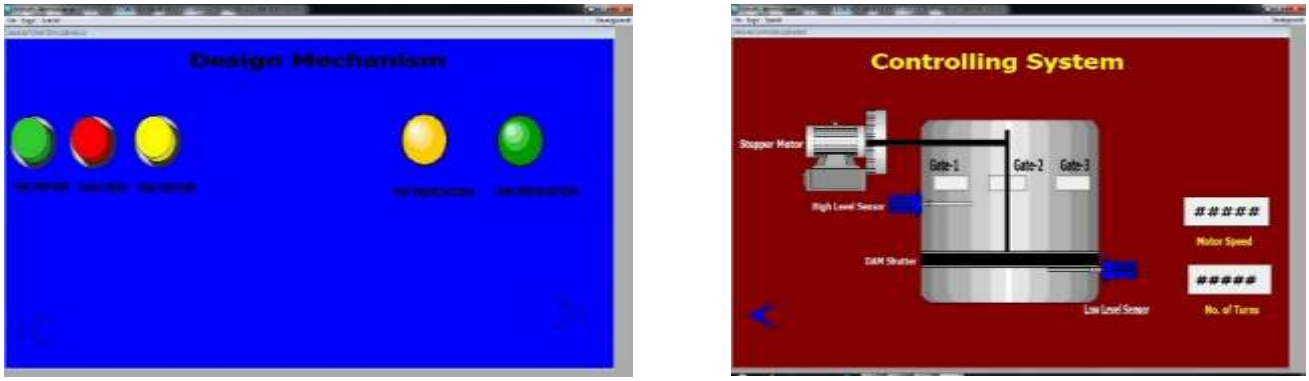

Fig. 6: SCADA design in Intouch Software

Supervisory control and data acquisition (SCADA)is a control system architecture that uses computers, networked data communications and graphical user interfaces for high-level process supervisory management, but uses other peripheral devices such as programmable logic controllers and discrete PID controllers to interface to the process plant or machinery. The operator interfaces which enable monitoring and the issuing of process commands, such as controller set point changes, are handled

through the SCADA supervisory computer system. However, the real-time control logic or controller calculations are performed by networked modules which connect to the field sensors and actuators.

The SCADA concept was developed as a universal means of remote access to a variety of local control modules, which could be from different manufacturers allowing access through standard automation protocols. In practice, large SCADA systems have grown to become very similar to distributed control systems in function, but using multiple means of interfacing with the plant. They can control large-scale processes that can include multiple sites, and work over large distances. It is one of the most commonly-used types of industrial control systems, however there are concerns about SCADA systems being vulnerable to cyber warfare/cyber terrorism attacks.

III. IMPLEMENTATION & RESULTS

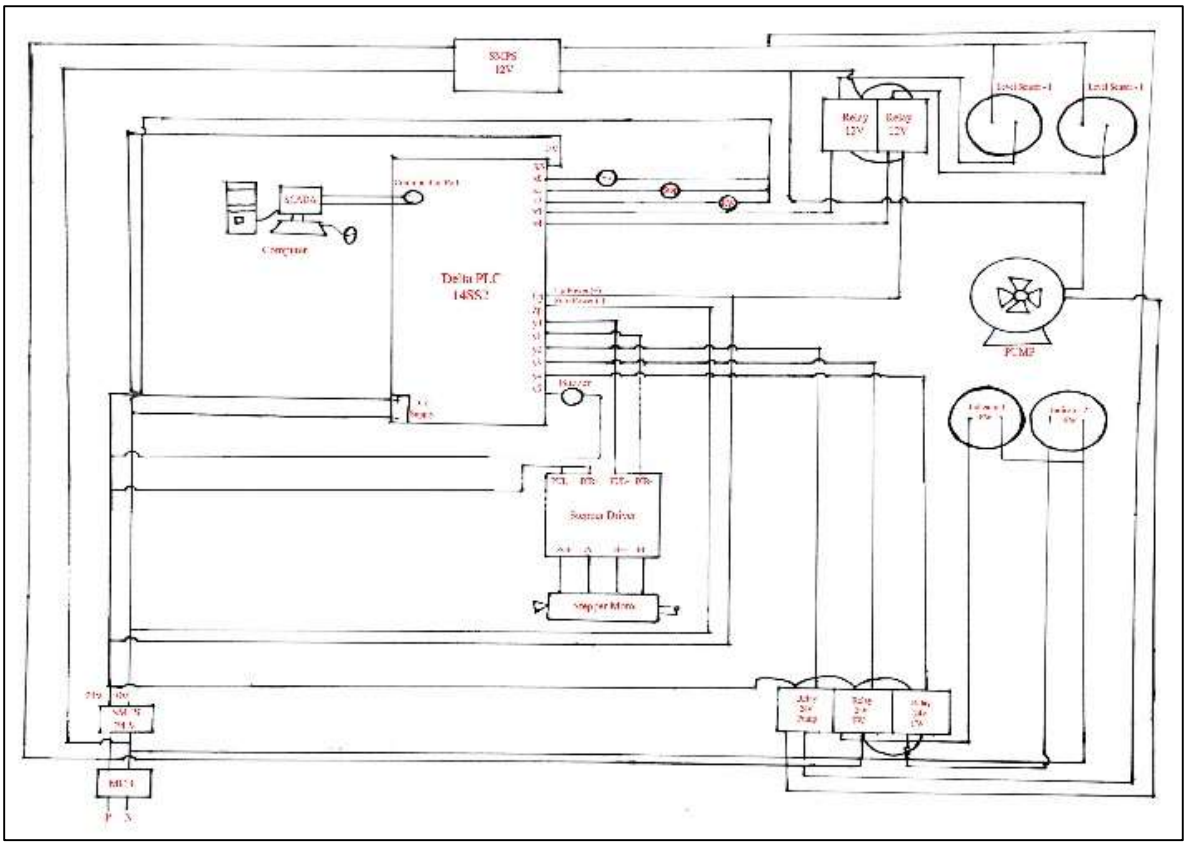

Fig. 7: Circuit Diagram

Here above figure is automation of hydro power plant using plc and scada system.in this project we used delta plc 14ss2 has 8 input and 6 outputs. In input side we connect three push button for forward, reverse and stop for stepper motor. And also connect two water level sensor one indicate the higher level and other indicate lower level of water in water tank. This level sensor operates on 12V dc. And output side of plc.

Connect stepper driver, two indicator and pump. When tank fill by water and water reached up to higher level sensor on this situation sensor give command to stepper motor and pump so, motor rotate in forward direction and door of the tank is open and pump is start to flow of water on outside generate and produce electric city. And when water reach below lower level sensor on this situation motor is rotate reverse direction door of the tank is closed. And wall system monitories on scada in computer.

IV. CONCLUSION

In this paper, it represents an automatic controlling of a Stepper motor using PLC and SCADA. This System model of Hydro power plant automation system which is the completely automated can control the level of the dam gates using backup of the water. Thus using PLC and SCADA the level of water in the dam is controlled effectively there by opening and closing the gates of the dam whenever the level increases. Therefore the use of Programmable logic control has opened doors for a level of automation Dam system and SCADA also monitoring the entire plant and stored the entire information about opening and closing of the gate.

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