Design of Liquid Level Control System based on PLC

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Abstract— A Programming Logic Controller is a digital computer used for automation of the electromechanical process. It is used to convert the previously used relay logic or wired logic for automation of an industrial process into ladder logic. It is used automate respective process but in this project RS-logicx1600 is used which is in the cheapest category or entry level of PLC. This paper deals with Design of Liquid Level Control System Using Programmable Logic Controller. Currently Textile Factory is used conventional relay control system to control level of fluid, however there are a lot of limitations , such as wastage , large no of labours, and difficult to maintained . In order to minimize those problems, we have tried to make Automatic using PLC. Electronic device used in my project are as sensor - switch, level sensor (limit switches), as controller:-PLC and pump motor, solenoid valve. Having the above device, I have also programmed using Ladder logic diagram In RS-logicx1600 Software and stimulate in order to load to PLC.

Key words: Control System, Tankers, Fuel, Solenoid Valve, PLC Controller

I. INTRODUCTION

In this Paper the Controlling of fluid level tank is crucial mechanism in our day to day activity. Fluid is wasted from the tank. The project "Design of Liquid Level Control System Using Programmable Logic Controller "is designed to monitor the level of liquid in the tank .The system has an automatic pumping system attached to it so as to refill the tank once the liquid gets to the lower threshold, while offing the pump once the liquid gets to the higher threshold. Sustainability of available water resources in many reason of the of the world is known dominant issue .This problem is quietly related to poor water allocation ,inefficient use lack of adequate and integrated water management .Water is commonly used for agriculture ,industry and domestic consumption. Therefore, efficient use and water monitoring are potential constraint for home or office water management system. More over the common method of level control for home appliance is simply to start the feed pump at a low level and allow it to run until a higher water level is reached in the water tank. This water level control, controls monitor and maintained the water level in the overhead tank and ensures the continuous flow of water around the clock without the stress of going to switch the pump on or off thereby saving time, energy, water and prevent the pump from over working besides this, the liquid level control system are widely used for monitoring of liquid levels in reservoirs, silos. Proper monitoring is needed to ensure water sustainability is actually being reached with displacement linked to sensing and automation, such a programmatic approach entails PLC based automated water level sensing and controlling. In order to ensure safety in production and quality of products, effectively and timely control of liquid level is necessarily in the previous industry people control liquid level through a fixed liquid level switch .When liquid level is up to certain height, the switch is automatically closed or disconnected to control water level .But now we are controlling the liquid level automatically by using PLC, sensor, motor and valves.

Water level control is equipment used to control the water level in a field .The water level is control using different components like PLC, sensors, motor and valves. The sensors sense the presence of water and give indication to the PLC .The PLC produce control signal to drive the motor .If there is no water content the PLC give signal to start the motor and if there is sufficient water in the field the PLC give signal to stop the motor.

It also prevent <<dry run>> of the pump in case the level in the tank goes below the suction level.

A PLC or programming logic controller is a digital computer used for automation of the electromechanical process. It is used to convert the previously used relay logic or wired logic for automation of an industrial process into ladder logic. In this project automation of water tank is achieved by using level sensor in order to set a low level and high level inside the tank.

A. General Objective

The main purpose of the project is to maintain water in a desire level to any control system. PLC is used in this project as an Automation tool to reduce manual operation and get better accuracy.

1) Specific Objective Monitoring

- To control and measure the liquid level in the tank
- To ensure that enough material is available to complete a particular batch
- To designed an Automatic water monitoring system
- To incorporates an interactive medium between the end user and the machine to develop controller using PLC as programming.

2) Safety

To prevent an industrial accident by over filling an open container to monitor tank over filling.

3) Economy

Good level control of solid also desirable, excessive built up in hoppers can be expensive to clear to avoid wastage of Water to prevent over labour of the pumping Machine Since the demand of electric city is very high, automatic water level control saves energy.

The project is design to automatically control the pump which ensures constant reserve of water in the reservoir.

There are two scopes in this project which is hardware development and software development. For the first scope which is hardware development are two main sections and those section are:

- To select input sensors
- To design PLC block diagram

For the second scope which is the software development, there are two main sections and that section are:

- To develop a software using ladder logic diagram.
- To simulate the control system using RS-Logix.

The scope of the design was keep concise and simple to in other not to introduce un necessary complexities and render it generally un comfortable ,well-built automatic water pump was used to achieve this aim ,the Automatic water level controller detects and control the water in the tank.

B. Problem Statement

The traditional fluid level control tank had many disadvantage such as;

- Traditional fluid level must draw the water manually to the tank when there is no water in the tank.
- The problem of manual control is sometimes people turn off or turn on the valve.
- For the automatic water level control, if the manual float broken or damages, all the system cannot function properly.
- There is over flow of in the open container in the industries.
- Time delay
- High cost, less reliable.
- Difficult to maintain
- Have large panel.

II. LITERATURE REVIEW

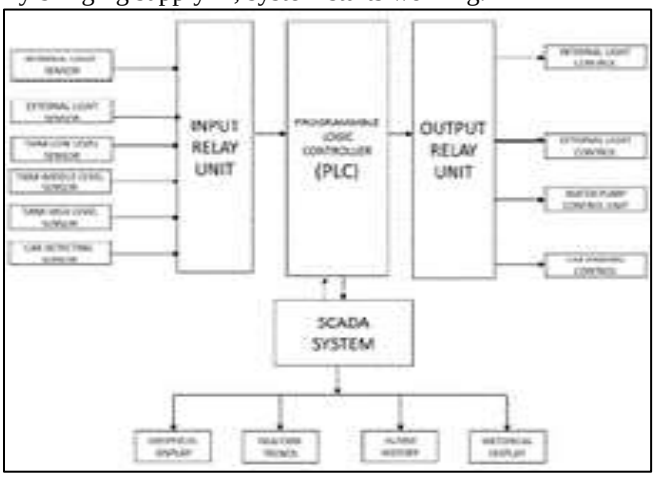
In the past, humans were the main methods for controlling a system as Manual controller. When the operator operates the process to a desired condition, then it carries out the corrective action is said to be manual control. The operator adjusts the output to operate the plant. During start-up, this mode is normally used. More recently electric city has been used for control and early electrical control was based on Conventional control system.

Conventional control system consists of electromagnetic relay, timer, and switch. Which can be used to control a specify process operation. But if any changed is required in the process then whole control system has to be changed and rewiring is need.

Relays- This relay allows power to switch on and off without a mechanical switch. It is common to use relay to make simple logical control decisions. At the outset of industrial revolution, especially during sixties and seventies, relays were used to operate automated machines, and these were interconnected using wires inside the control panel. In some cases a control panel covered an entire wall. To discover an error in the system much time was needed especially with more complex process control systems. On top of everything, a lifetime of relay contacts was limited, so some relays had to be replaced. If replacement was required, machine had to be stopped and production too. Also, it could happen that there was not enough room for necessary changes. Control panel was used only for one particular process, and it wasn't easy to adapt to the requirements of a new system. As far as maintenance, electricians had to be very skill full in finding errors. In short, conventional control panels proved to be very inflexible. As explained above manual or conventional control has some draw backs due to this case we forced to make automatic control system using PLC.

III. METHODOLOGY

There are many methods of designing an automatic fluid level control with switching device but all this methodologies require human assistance. In this project an Automatic fluid level control for reserve tank, overhead and underground tank with switching device is designed using electronics control to refill the water without human intervention the system design was carefully arranged to refill the water tank any time water get low to a certain level finally the system automatically shut down the water pump by putting the electric pump off when the tank is full. The overhead tank is to be filled by a pump. The pump will automatically start when the water level the overhead tank reaches below the low level and stop when the level reaches high level. Provision of manual start or stop switch is incorporated which will totally override the automatic system. The following procedures are used to do this project First, you need to select an instrument or a system that you wish to control. Automated system can be a machine or a process and can also be called a process control system. Function of a process control system is constantly watched by input devices (sensors) that give signals to a PLC controller. In response to this, PLC controller sends a signal to external output devices (operative instruments) that actually control how system functions in an assigned manner (for simplification it is recommended that you draw a block diagram of operations' flow) Secondly, you need to specify all input and output instruments that will be connected to a PLC controller. Input devices are various switches, sensors. Output devices can be solenoids, electromagnetic valves, motors and relays. Following an identification of all input and output instruments, corresponding designations are assigned to input and output lines of a PLC controller. Allotment of these designations is in fact an allocation of inputs and outputs on a PLC controller. Third, make a ladder diagram for a program by following the sequence of operations that was determined in the first step. Finally, program is entered into the PLC controller memory. When finished with programming, checkup is done for any existing errors in a program code (using functions for diagnostics) and, if possible, an entire operation is simulated. Before this system is started, you need to check once again whether all input and output instruments are connected to correct inputs or outputs. By bringing supply in, system starts working.



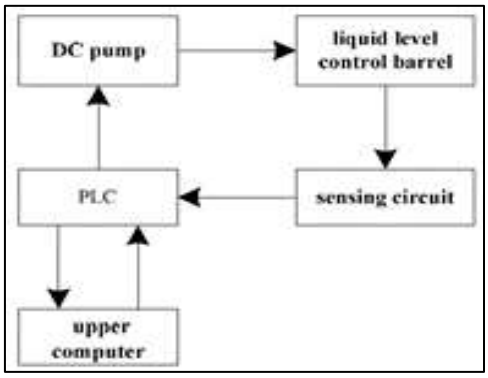


Fig. 1: Block Diagram

A. Design Mechanism

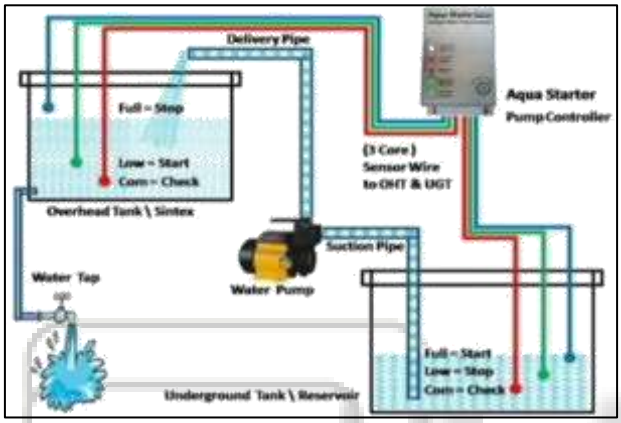


Fig. 2:

B. Equipment's used

1) Reserve Tank

A liquid tank is a container for storing fluids (liquid). A mixing tank is a container that is used to blend several components together. In most manufacturing facilities, the use of a mixing tank to prepare materials that will be used in production is common. Large containers of raw materials are placed into a large mixing tank and are blended into a smooth mix that can be used to produce a plethora of materials.

- This tank is used to mix water with chemicals.
- This tank has an amount 5 L mixing of liquid.
- In this tanker there is a low level control system which controls the dry run implies that, if the water (liquid) is finished the motor operation to stop.

Operation the upper sensor of reserve tank controls the over flow of liquid .when the amount of liquid is 2 L the sensor sends electric signal to plc and plc control the solenoid valve to be off the lower sensor of the reserve tank detects when the water (liquid) become minimum this controls sends signal to stop the pump motor.

2) Operation Tank (Overhead Tank)

- This tanker has an amount of 2 L
- Down time reduced
- Wastage of temperature
- Reduce power of motor pump, since it drains from high to low level of user tank

The upper sensor (pressure switch I2) controls the over flow of operation tank .when the tank at full level or the amount of liquid level becomes 2L, the sensor sends electric signal to the plc .and plc understand to close the solenoid valve V2.the lower sensor (I5) detects the minimum level of operation tank .when the liquid become below the desire level, the pressure switch (I5) sends an electric signal to plc and plc give a respond to open V2.

3) User Tank (Working Tank)

Is the applicable tanker, to perform what we need? In this tanker we have used upper sensor, because this working tank always contains the same amount of 2 L.so it must be kept constant. So Level switches (I4) control the over flow of user tank. This senses signal to plc to close (Q3).

a) Actuator

Converts an electrical signal from PLC into physical conditions. Actuators are connected to the PLC output.

b) Solenoid valve

A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

IV. SIMULATION

A. SCADA Designing

The proposed system provides an analysis of the simulation and components required for the implementation of an automated level control system by the help of Programmable Logic Controller (PLC). Supervisory Control & Data Acquisition (SCADA) was established and the HMI was created. The proposed model can effectively supervise level control in multiple tanks. Three level sensors were used to provide the level data to the PLC. PLC used this data to take the required decisions and thereby turning ON and OFF a pump. A manual switch was also provided to override the automatic system. The SIMATIC S7-300 universal controller was used as the main decision making module. The system was implemented in SCADA to create the required Human Machine Interface (HMI). Modifications can be made by using float sensors model which would effectively provide the correct level but cost would increase and vibration of the sensor might disrupt the result, our model effectively counters those shortcomings.

The Human Machine Interface was created in WinCC Explorer. Tags were used for the communication of the PLC Ladder logic operation in the Semantic manger with the SCADA. The created SCADA is shown in Fig below. The whole project is shown along with the sensor positions.

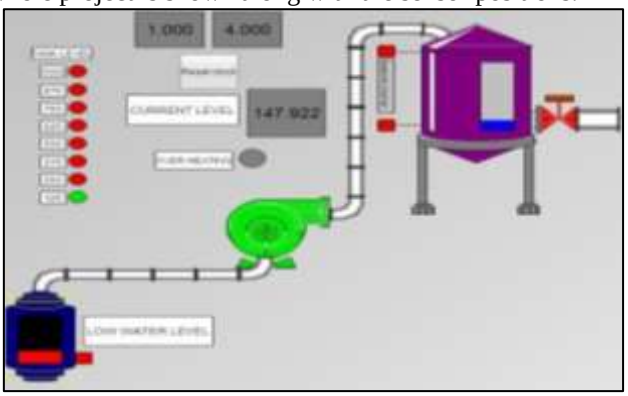


Fig. 3:

V. RESULT

This project automatic fluid level control is used in Fluid Level Control, Water Level Control in Boiler,
Gasoline Level Control in Any Type of Fuel Station, Chemical Level Control in Washing Plant, Homely Use Water Tank Level, Water Treatment Plant and It also can use in arithmetic functions of different process and modern industries like Pharmaceuticals, fertilizer, power station, cement factory, packaging and so on.

VI. CONCLUSIONS

It has been a great pleasure to work on practice and progress of PLC based fluid level control system. It provides information about many topics relevant to controlling system and equipment automation. We have learned more about water level control system. It can run automatically by the help of PLC. The great advantage of PLC based fuel and water level control system is with maximum accuracy also the system has higher reliability, small space requirement reduced cost and able to work as friendly with environment.

A. Recommendation

In this project we used programmable logical controller as automation tool. It is a combination of solid state device to perform specific task using ladder logic. It may easily run a control system with more system accuracy, smoothly and efficiently. In other hand we can control this system by microcontroller instead of PLC controller. It will make this project perfect and success in many ways .Firstly, we can make this project in less cost and due to high expenses it is not a good idea in mass production .Secondly it requires less space than PLC. Thirdly, PLC cannot handle complex situation.

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