AUTOMATION OF SERIES TANK LEVEL CONTROL USING PLC AND HMI

Than Than Min[1], Saw Kay Thwe Moe[2], Hnin Thae Mon[3]

[1] *Than Than Min, Department of Electronic Engineering, Kyaukse, Myanmar*
[2] *Saw Kay Thwe Moe, Department of Electronic Engineering, Kyaukse, Myanmar*
[3] *Hnin Thae Mon, Department of Electronic Engineering, Kyaukse, Myanmar*

ABSTRACT

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). Water level management using PLC is design to control the level of water and avoid wastage of water in the tank. This system has an automatic pumping system attach to it. The purpose of this paper is reducing time consumption and human resource consumption, increase product revenue and greater accessibility or more security. Also by using this paper the wastage of water occurred by overflowing of tanks can be avoided. The proposed model can effectively supervise level control in multiple tanks. Four 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 universal controller was used as the main decision making module. The system was implemented 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 short comings. In future by making some changes this project can be used in different industries related to fluids like petroleum industries or oil refineries for controlling the level of filling the tanks and avoid wastage.

Keyword: - *Automation, PLC, HMI, Tank-level Control*

1. Introduction

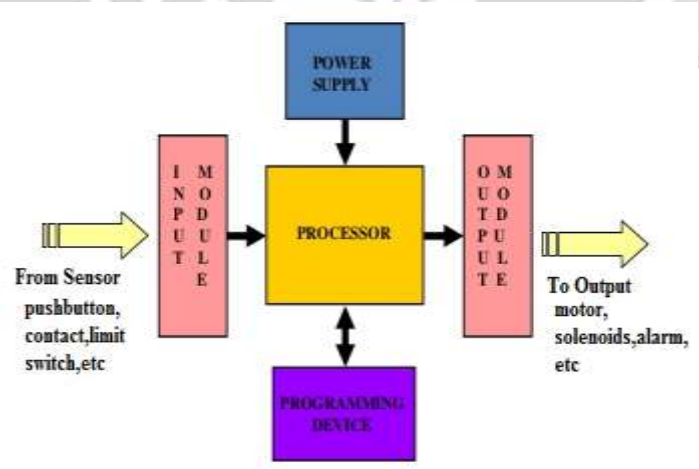

Fig-1 Block Diagram of PLC System

The PLC is a device that was invented to replace the necessary sequential relay circuits for machine control. The user enters a program usually via software that gives the desired results. This control machine operation

is typically stored in battery-backed up or nonvolatile memory. In our project we used SIEMENS PLC has effectively designed tank filling plant using PLC and HMI gives a proposed system that efficiently controls a cement factory using PLC. One of the most widely used control systems is Programmable Logic Controller (PLC). Its applications cover a wide range of industries from cigarette, automotive, petrochemical, paper, and even to the mining industry, for example, in the control of gas turbines and advanced industrial units of mining products. The ease of transitioning from the previous control systems (e.g., from mechanical relay-based control systems) and the ease of troubleshooting the system configurations are the two main factors driving the popularity of this PLC.

PLC is a system that can manipulate, execute, and or monitor the state of the process at a very fast rate, on the basis of programmable data in an integral microprocessor-based system. PLC receives inputs and produces output electrical signals to control a system. Thus the controlled quantities of physics and chemistry, before being processed by the PLC, will be converted into electrical signals both analog and digital, which is the basic data. The formulation of the problem is to know how to enter and run ladder logic PLC program; it will explain how to connect PLC with an induction motor.

2. HARDWARE IMPLEMENTATION

2.1 System Design

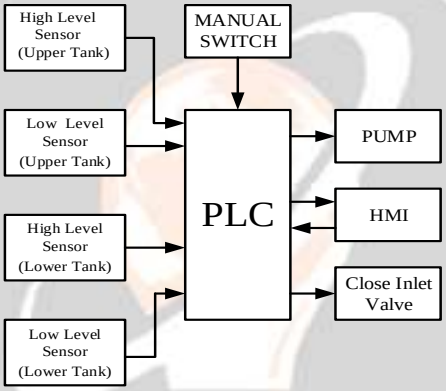

Fig -1 Overall Block Diagram

The storage Tank is to be filled by a Pump. The pump will automatically start when the water level of storage Tank reaches below Low Level and stop when the level reaches High Level. Dry run is checked by the Low Level sensor of the Tank. The implementation is divided into three parts:

1. Sensor Positioning
2. Ladder Programming
3. HMI Designing

2.2 A Sensor Positioning

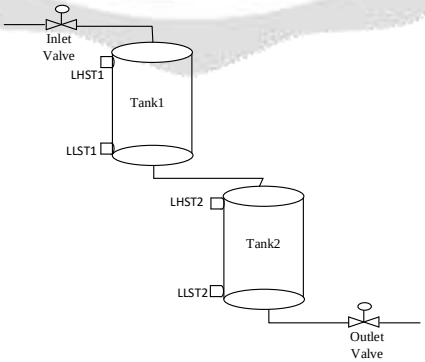

Fig-2 Sensor Positioning

To measure level of both tanks, level sensors are installed. Use interlocking to control the inlet valve. Level sensors to the input module of the PLC, connect inlet valve with the output module of PLC. Four level sensors were used to sense presence of water at required levels. The sensors are LT_LL – Low Level Sensor lower tank (I 0.4), LT_HL – High Level Sensor lower tank (I 0.6), UT_LL – Low Level Sensor Upper tank (I 0.3), UT_HL – High Level Sensor Overhead tank (I 0.5) are placed.

2.3 Ladder Programming

The Ladder programming for the Siemens was done in Siemens sematic manager. The Ladder programming for the TIA Portal V13 software was done in TIA Portal V13 software. Figure shows a ladder logic programmed for controlling the water tank level which was simulated for two water tanks level control.

Fig-3 S_7-1200 PLC

3. SOFTWARE IMPLEMENTATION

3.1 Flow Chart of PLC programming

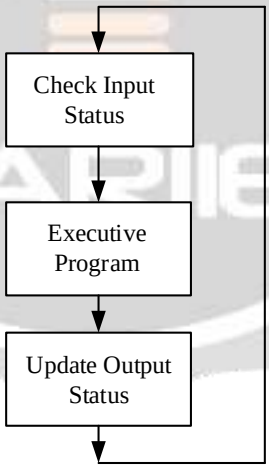

Fig-3 Flow Chart of PLC programming

The pump in the circuit supplies water to the tanks via pipelines. Level of both tanks is to be controlled. The solenoid valves open for the pump to start automatically when the water level in the water tanks reach a low level and close when the level of water reaches high level. The pump will not run when the level sensor in the borehole detects that the water in the borehole is at a low level or is empty. This was to ensure that the pump does not run dry. Provision was made for a manual Start/Stop switch which totally overrules the automated system in offline mode. The water tank filling system is has three main functions and these are, sensing (or detection), making

decisions and implementation. The status of the whole system is communicated by the PLC to the HMI. During the implementation, three dual probe sensors were used. The function of the sensors was to detect the presence of water in the tank whiles the TIA Portal V13 software uses the readings of the sensors to make the required decision of starting or stopping the pump, and also opening or closing the solenoid valves. Finally the decision is implemented by the PLC through a relay switch. The TIA Portal V13 provides information on the current status of the system through the IM port to the computer which is accessible by the HMI.

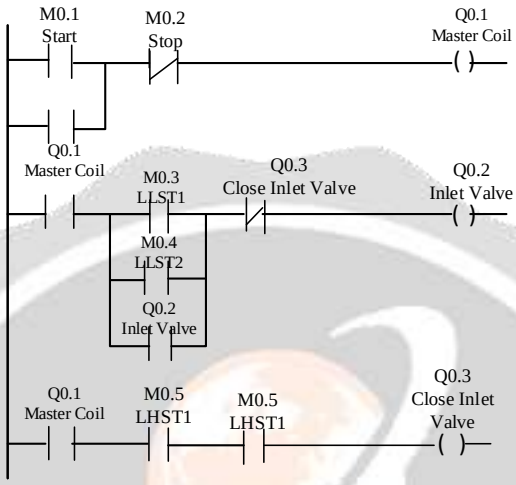

Fig-5 Ladder Programming

3.2 HMI Designing

The Human Machine Interface is the means through which an operator or user can communicate with the system. The present status of the system is sent to the operator or user by means of a graphical user interface (GUI). The operator or user can interact with the system by turning ON or OFF various functions from the interface. We used tags for the communication of the PLC Ladder logic operation in the sematic manager with the HMI. The whole project is shown along with the sensor positions.

4. TEST AND RESULT

The pump will start when the PLC is turned on for the first time presuming all the two Tanks are empty and there is no water flow from the storage tank. Figure 6 is a ladder logic program me and HMI panel for the start of the automation in filling the tank**.**

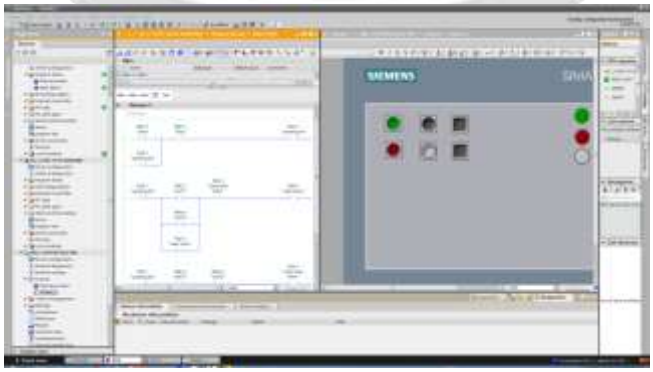

Fig-6 Create the HMI Panel for Level Tanks Control

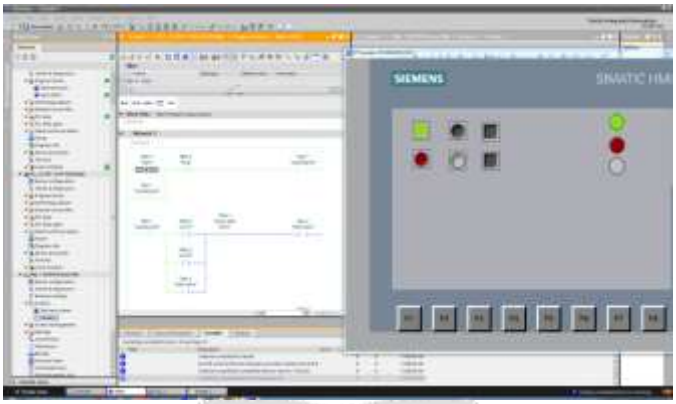

Fig- 7 When Start button is press, the master coil is active

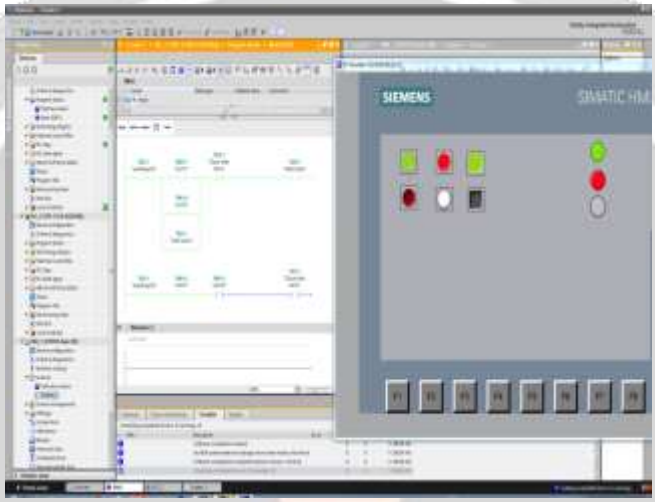

Fig- 8 When Start button and Low Level switch is press, the master coil and inlet valve is active

Now all the two tanks are full, the pump is stopped, the inlet valves is close.

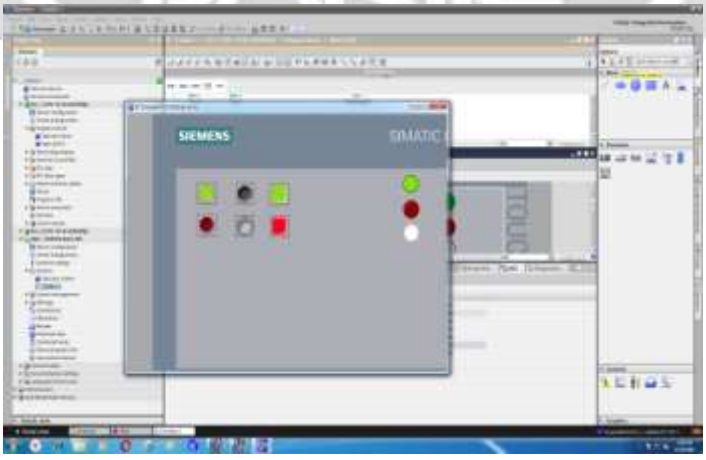

Fig-9 When Start button and High Level switches is press, the master coil and close inlet valve is active

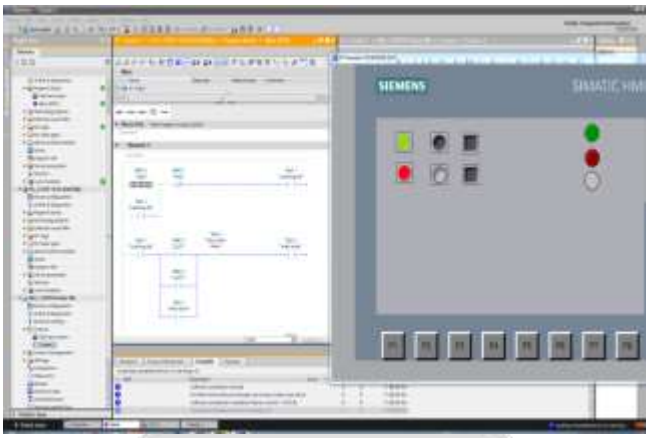

Fig-10 When Start button and Stop button is press, this process is stop

5. Conclusion

An automated system of water tank filling at a water processing unit using a PLC system has been designed and implemented through simulation. The simulation clearly shows that the automation of the water tank filling will prevent, the incidence of tank overflow since water tank filling is automatically controlled, the incidence of pump overheating since the pump will not run dry, the stress associated with manual operation, the human dependent of the system.

6. Acknowledgment

The author would like to thank to their parents and their colleagues. The author has to express out appreciation to their candidate for hard working during the course of this research.

7. REFERENCES

[1] http://www. Sanfoundry.com/plc-progra

[2] http://www. Semanticscholar.org/…..Tank

[3] Siemens system Manual, 2014

[4] Hao, L. and Ruilin, P. (2005). Application of Centralized PLC Automation Control in Painting Line of Steel Plant. Proceeding of the 4th Asian Conference on Industrial Automation and Robotics, Landmark Hotel, Thailand

[5] Collins, K. (2007), PLC Programming For Industrial Automation, Exposure Publishing, Australia, pp. 140.