

# **Automatic Monitoring and Controlling of Pressure using PLC and SCADA**

Ande Venuprasad<sup>1</sup>, Yeole Shivaraj Narayan<sup>2</sup>

Research Scholar, Department of Mechanical Engineering, VNRVJIEET, Bachupally, Hyderabad, India<sup>1</sup>

Associate Professor, Department of Mechanical Engineering, VNRVJIEET, Bachupally, Hyderabad, India<sup>2</sup>

**ABSTRACT:** In industries, control and regulating the pressure are more important for many processes. But now-a-days industries are facing difficulties to analyse and control the location of leakage which are occurred in pipeline. This results in the plant shutdown and heavy maintenance. By implementing PLC and SCADA, the automatic controlling and monitoring plays an important role for the continuous operation of the system.

In this project, pipeline security provided by traversing pressure in the pipe of one meter length. By connecting the pressure transmitters at starting and end point of pipe and measure the flow rate with the help of pressure transmitters. The pressure transmitter will convert the flow of Pressure into analog signal. According to the level, the load can be monitored by PLC. By measuring the reading and all the stages with the help of pressure transmitter for finding the problem, the entire system communicating with automation system using PLC and SCADA

**KEYWORDS:** PLC, SCADA, Pressure transmitter.

## **I. INTRODUCTION**

Over the year pressure the demand for high quality, greater efficiency and automated machines has increased in the industrial sector. Industries required continuous monitoring and inspection at frequent intervals. There are possibilities of error at measuring and various stages involved with human worker and also the lack of few features of microcontroller. Thus this paper takes a sincere attempt to explain the advantages the companies will face by implementing automation into them. The pressure control which is the most important part of any industry, and its automation is the precise effort of this paper. In order to automate industry and minimize human intervention, there is a need to develop a SCADA (Supervisory Control and Data Acquisition) system that monitor the plant and help to reduce the error caused by humans. While the SCADA is used to monitor the system, PLC (Programmable Logic Controller) is also used for the internal storage of instruction for the implementing function such as logic, sequencing, timing, counting and arithmetic to control through digital or analog input/output modules various types of machines process. Systems are used to monitor and control a plant or equipment in industries such as telecommunication, water and waste control, energy, oil and gas refining and transportation.

## **II. LITERATURE SURVEY**

Slavica Prvulovic<sup>[1]</sup> describes the paper describes the functioning of the pumping station remote monitoring and control system in the water supply system. A modern way of data transmission based on the Web platform is applied. The proposed configuration is developed based on Microsoft tools as Web applications and a set of Web services. It enables stable and reliable data transmission from the pumping station to the dispatch centre as well as the signal commands from this centre to the local control unit. The system provides the operator in the dispatch centre with the visualization of control facilities with graphical and tabular presentation of relevant values and parameters. The operator can monitor the functionality of the entire building on the SCADA screen, and alarm reports assist in locating faults, which contributes to a significant increase in maintenance efficiency. The connection between the pumping stations and the dispatch centre is established with wireless data transmission using mobile phone operators.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

**Kaushik Bhuiya**<sup>[2]</sup> describe low cost wireless control and monitoring using PLC and SCADA. PLC is a controller used to automate the industrial process and monitor itself. Programmable logic controller is used in many industries to control the whole process automatically with less human intervention and to avoid errors. With the rapid growth in technology wireless instrumentation has come into existence to avoid cabling infrastructure and to obtain efficient control. In order to have a wireless control the existing plcs have to be replaced with wireless plcs. In this paper we present a novel approach of converting the existing wired plc into wireless plc by configuring XBEE in direct mode using X-CTU software as communication interface between plc and process, the process used here is batch process and controlled through SCADA.

**Jaswandi G. Joshi**<sup>[3]</sup> describe general survey was first performed to chronicle past research efforts in developing the PLC based system using recent technology SCADA. It is the system which obtains a real time data of industrial parameters and displays it in various forms. It is an automatic control system usually practiced in number of industries. In the recent past, researchers have tested a wide array of control system in an attempt to find improved methods of monitoring and controlling the specific industrial parameters.

**C. Sandberg**<sup>[4]</sup> describe the application of a continuous leak detection system to pipelines and associated equipment. PLC (Programmable Logic Controller) is used control the pressure automatically, if any leakage are in the present system is automatically monitoring by SCADA (Supervisory Control and Data Acquisition) and also if any pressure difference in the pipe line automatically controlled by PLC.

## III.DRAWBACK OF CONVENTIONAL SYSTEM

Conventional equipment systems are prone to error due to the involvement of humans in the data collection and processing using complicated mathematical expressions. Thus what we required is a system that collects raw data, process it and present it in values which can be verified and compared with the standard values. In the coding process of this implementation with microcontroller, it requires a fast and efficient processing -which on the length and sub routines of the coding process. Thus it provides a real challenge with system involving..

## IV.PROPOSED SYSTEM

The basic components in above block diagram are as follows.

- Air compressor
- PLC (Programmable logic Controller)
- SCADA or HMI and Pressure transmitter

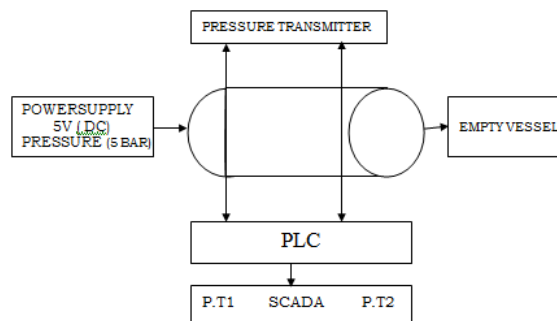


Fig.1 block diagram of proposed system

The main aim and objective of the whole system is to Automatically Monitoring and Controlling of pressure in pipeline with the help of integrated SCADA system and a PLC interfaced to it. An air compressor is connected to the empty vessel from which the pressure is transferred from the compressor to the empty vessel through a pipe. A pressure

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

transmitter at both the ends, that is, one at the air compressor which detects this initial pressure coming from the air compressor and the other pressure transmitter at the final end, that is empty vessel which again records the pressure in the empty vessel. If there is a no leakage in the pipe, the readings at the HMI/SCADA show equal pressure readings at both the pressure transmitter. If the pipe is damaged or some hole present in the pipe, then there will be a pressure difference in the readings of the two pressure transmitter that are displayed on the HMI/SCADA

## V. PLC PROGRAMMING

The main aim and objective of the whole system is to Automatically Monitoring and Controlling of pressure in pipeline with the help of integrated SCADA system and a PLC interfaced to it. An air compressor is connected to the empty vessel from which the pressure is transferred from the compressor to the empty vessel through a pipe. A pressure transmitter at both the ends, that is, one at the air compressor which detects this initial pressure coming from the air compressor and the other pressure transmitter at the final end, that is empty vessel which again records the pressure in the empty vessel. If there is a no leakage in the pipe, the readings at the HMI/SCADA show equal pressure readings at both the pressure transmitter. If the pipe is damaged or some hole present in the pipe, then there will be a pressure difference in the readings of the two pressure transmitter that are displayed on the HMI/SCADA

## VI. OMRON SYSMAC CP1H

The SYSMAC CP1H is an advanced high speed, package type programmable controller. While the CP1H employs the same architecture as the CS/CJ Series and provides the same I/O capacity of 40 I/O points as the CPM2A, the CP1H is approximately ten times faster. There are three types of CP1H CPU units to select from: a basic CPU Unit(x), a CPU Unit with built in analog I/O terminals (XA), and a CPU unit with dedicated pulse I/O terminals(Y)

### A. PLC Working:

Basics of a PLC function are continual scanning of a program. The scanning process involves three steps.

#### Step1: Testing input status

First the PLC checks each of its input with intention to see which one has status on or off. In other words it checks whether a switch or a sensor etc., is activated or not. The information that the processor thus obtains through this step is stored in memory in order to be used in the following steps.

#### Step2: programming execution

Here a PLC executes a program instruction by instruction based on the program and based on the status of the input has obtained in the preceding step, and appropriate action is taken. The action might be activation of certain output and the result can be put off and stored in memory to be retrieved later in the following step.

#### Step3: Checking and Correction of output status.

Finally, a PLC Check up output signals and adjust it has needed. Changes are performed based on the input status that had been read during the first step and based on the result of the program execution in step two following execution of step three PLC returns a beginning of the cycle and continually repeats these steps.

Scanning time = Time for performing step1+Time for performing step2+Time for performing Step3

At the beginning of each cycle the CPU brings in all the field input signals from the input signal from the module and store into internal memory as process of input signal. This internal memory of CPU is called as process input image (PII).

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

User program (Application) will be available in CPU Program memory. Once PII is read, CPU pointer moves in ladder program from left to right and from top to bottom. CPU takes status of input from PII and processes all the rungs in the user program. The result of user program scan is stored in the internal memory of CPU. This internal memory is called process output image or PIQ. At the end of the program run i.e., at the end scanning cycle, the CPU transfer the signal status in the process image output to the output module and further to the field control.

## B. Interfacing:

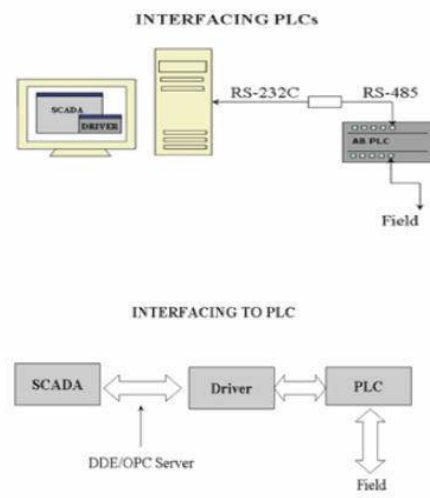


Fig.2 Interfacing PLC

Above figure 2 shows Interfacing between input field to PLC and interfacing between PLC and SCADA through the driver. Here input field connected to the PLC with the cable and between the driver to the PLC is connected with RS-485 cable and driver to SCADA system is connected with RS-232 cable.

## C. Plc Wiring:

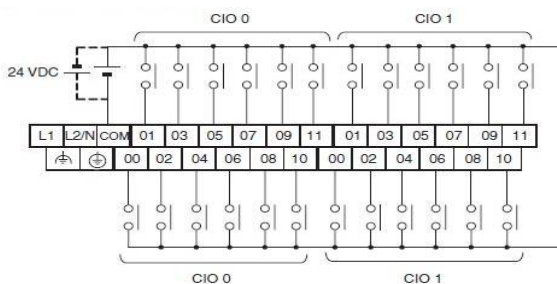


FIG.3 Upper Terminal Block

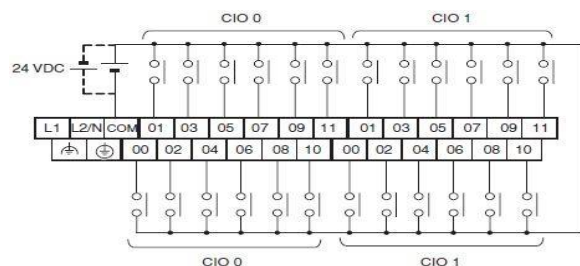


FIG.4 Lower Terminal Block

Fig.3& fig.4 shows input wiring for upper terminal block and lower terminal block. Input circuits for X and XA CPU Units have 24 point/common. Use power line with sufficient current capacity for the COM terminals. These terminals are indicating specific port numbers are helpful for easy wiring.

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

SCADA stands for supervisory Control and Data Acquisition. As the name indicates, it is not a full control system, but rather focuses on the supervisory level. SCADA is used to monitor and control plant or equipment. The control may be automated or initiated by operated commands. The data acquisition is accomplished firstly by the RTUs scanning the field inputs connected to the RTU (It may be also called a PLC programmable logic controller). This is usually at a faster rate. The central host will scan the PTUS (usually at slower rate). The data processed to detect alarm condition, and if an alarm is present, it will be displayed on special alarm lists.

Its function is to control process equipment at remote site, acquire data from the equipment, and transfer the data back to the central SCADA system. Software enables to configure a system environment that provides: Supervisory control, batch processing, data acquisition, continuous control, and statistical process control for industrial application.

| [Program Name : NostProgram1]            |                |       |                              |
|--|----------------|-------|------------------------------|
| [Section Name : Section1]                |                |       |                              |
| 000000<br>(000000)                       | H0.00          | H0.03 | H0.02                        |
|  |                |       | <H00002><br>a01 a04 a20      |
| 000001<br>(000004)<br>000002<br>(000000) | H0.02          | H0.02 | Q:100.00                     |
|  | CF113          |       | MOTOR                        |
|  | P_On           |       | MOV                          |
|  | Always ON Flag | 200   | [OP1] FRESURE1               |
|  |                | DM10  | [OP2] OUTPUT 1               |
|  |                |       | <d000110><br>c11             |
| 000003<br>(000003)                       | CF113          |       | MOV                          |
|  | P_On           |       | [OP1] FRESURE2               |
|  | Always ON Flag | 201   | [OP2] OUTPUT 2               |
|  |                | DM11  | <d000111><br>c18 c19 c23     |
| 000004<br>(000000)                       | CF113          |       | -                            |
|  | P_On           |       | [OP1] OUTPUT 1               |
|  | Always ON Flag | DM10  | <d000110><br>c07             |
|  |                | D0003 | [OP2] [OP3] <d001003><br>c17 |
| 000005<br>(000002)                       | CF113          |       | -                            |
|  | P_On           |       | [OP1] OUTPUT 2               |
|  | Always ON Flag | DM11  | <d000111><br>c09 c19 c23     |
|  |                | D0004 | [OP2] EQUAL OUTPUT 2         |
| 000006<br>(000004)                       | CF113          |       | /                            |
|  | P_On           |       | [OP1] <d001000><br>c17       |
|  | Always ON Flag | DM10  | [OP2] [OP3] EQUAL OUTPUT 1   |
|  |                | D0004 | <d001003><br>c11             |
| 000007<br>(000000)                       | CF113          |       | *                            |
|  | P_On           |       | [OP1] <d001003><br>c15       |
|  | Always ON Flag | DM10  | [OP2] [OP3] <d001000><br>c15 |
|  |                | D0003 | <d001003><br>c11             |
| 000008<br>(000003)                       | CF113          |       | -                            |
|  | P_On           |       | [OP1] OUTPUT 2               |
|  | Always ON Flag | DM11  | <d000111><br>c09 c13 c23     |
|  |                | D0001 | [OP2] [OP3] <d001001><br>c21 |

Fig.5 PLC program

In the figure5 shows a program is developed with the ladderlogic method using PLC software,this developed program is used to controll proceess automatically with out any errors.If any errors find in the proceess the program will stop automatically and the program will start automatically deteting of error in the process.



# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

## VIII.RESULT

This is the real picture of the setup. An air compressor is connected to an empty tank through a pipe from where the pressure will be sent over and stored in tank. An induction motor is connected to the air compressor to provide a certain pressure. In fig 6 two pressure transmitters, one on the air compressor and the other on the empty vessel is attached to detect if any leakage is there.



Fig.6 Setup

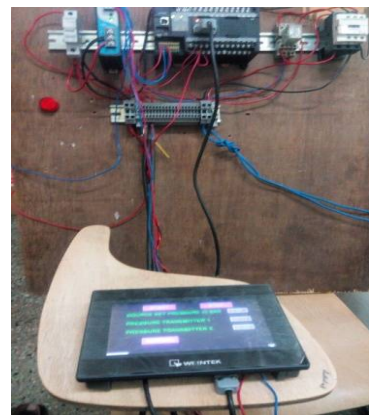


Fig.7 Front view of PLC and SCADA

This is how the PLC and SCADA connection look like. To make the wiring connection simple and a little less complicated, here wooden plank is used and MCB is used to prevent short circuit. The red lamp seen is the indicator or - an alarm. If there is a leakage in the pipeline, which will be shown on the SCADA, THE red light will be turned on to give an indication

As you can see, the SCADA device or an HMI has got an option of START and STOP. The setup can be switched ON and OFF from the HMI itself. Here, the recorded readings are of when there is no leakage in the pipeline. Both the pressure transmitters show equal reading. When there is no leakage, there will be a tab shown on the HMI which reads NORMAL AND has no leakage.

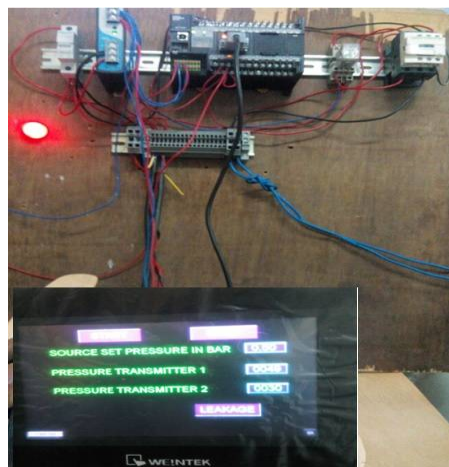


Fig.8, Result

Here, these are the readings that are recorded when there is a leakage in the pipeline. There is a major difference in the readings of both the pressure transmitter and a tab saying 'LEAKAGE' will appear on the HMI which indicates that the initial pressure is not being obtained at the second pressure transmitter.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

## IX. CONCLUSION

A wide variety of leak detecting techniques is available for gas pipeline. Some techniques have been improved since their first proposal and some new ones were designed as a result of advances in sensor manufacturing and computing power. However, each detection method comes with its advantages and disadvantages. Leak detection techniques in each category share some advantages and disadvantages. For example, all external techniques which involve detection done from outside the pipeline by visual observation or portable detectors are able to detect very small leak location, but the detection time is very long. Methods based on the mathematical model of the pipe have good result at high flow rates while at low flow rates a mass balance based detection system would be more suitable.

Hybrid system benefiting from the real time detection capacity of a software based method and the high localization accuracy of a hardware based technique, along with other specific advantages of both approaches, seem to be the future trend in gas leak detection. Selecting from the wide verity of commercial solution available is ultimately an action that has to be taken after assessing the needs of the system in which gas leak detection is need.

## REFERENCES

- [1] Slavica Prvulović, Dragiša Tolmač, Ljubiša Josimović, Jasna Tolma "Remote Monitoring And Control Of Pumping Stations In The Water Supply Systems" Mechanical Engineering, Vol. 11, No 1, 2013, pp. 113 – 121
- [2] Kaushik Bhuiya, Kintali Anish, Dhvani Parekh, and Kilaru Laxmi Sahiti " Low cost wireless control and monitoring using PLC and SCADA" Department of Electronic and Instrumentation . Vol.3, Issue 9, 2013, pp.28-35
- [3] Jaswandi G. Joshi<sup>1</sup>, Prof. D.D. Ahire<sup>2</sup> " A Brief Survey On Programmable Logic Controller And Its Versatile Applications Using Scada System" Department of Electronics and Telecommunication Vol-1 Issue-4 2015, pp.121-129
- [4] C. Sandberg, J. Holmes, K. McCoy and H. Koppitsch, "The Application of a continuous Leak Detection System to Pipelines and Associated Equipment," IEEE Transaction on Industries Application, Vol.25, No. 5, 1999, pp. 906-909.
- [5] F. Kenya, M. Reiko, K. Akira, S. Hitoshi and K. Ichiro, "Gas Pipeline Leak Detection System Using the PLC and SCADA," Computers and Chemical Engineering, Vol. 24, No. 2-7, 2000, pp. 453-456.
- [6] E. B. Liu, S. B. Peng and C. J. Li, "Discussion of Modern Pipeline Leak Detection Techniques," Pipeline Technique and Equipment, Vol. 5, 2004, pp. 17-19.
- [7] RELI, "A Review of Pipeline Leak Detection Methods," REL Instrumentation Project Report, Shell International Exploration and Production Limited, London, Vol.24, No. 1997.
- [8] D. Scott, "API Document for Leak Detection," Oil and Gas Journal, Petroleum News, Tulsa, Vol.128, No.5, 1999, pp.30-34.
- [9] X.J. Zhang, "Statistical Leak Detection in Gas and Liquid Pipeline," Pipes & Pipeline International, Vol.38, No.4, 1993, pp.20-26.