Improving the Performance of the Pump Station in Pipe Line Transportation System Using PLC Controller and Remote Monitoring

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Abstract. In industries, analysis and control of pressure and flow rate control is very difficult, this leads to factory closings and heavy maintenance through PLC and SCADA implementation. Automatic control plays an important role in the continuous operation of the system. In this project, the actual pump performance is tested in terms of pressure, efficiency, and flow rate of the pump for the operating system using a pipeline by crossing pressure in the pipeline with a length of 2 m by connecting pressure sensing equipment. The global control unit SIMATIC S7-1214 as the main decision-making unit that uses this data to make the required decisions. Thus the operation and stopping of the pump as it asks the details related to all other correct information to SCADA to monitor and control the parameters in the pipeline system of the oil pumping station. Then it performs continuous supervision of oil pump station pipeline in order to allow solving any problem and thereby regulating the control system in the structure consists of three layers. These include the first layer of field devices second remote terminal units, and third domain controllers. The signals are sent from the devices via the transmitters to the dedicated PLC boards in the second layer. The central level of SCADA contains a high-speed computer to supervise or operate the station remotely in order to display information through the LABVIEW screens that was showed the final results of pressure and flow rate by operating the system with a voltage rated by Plus With Modulation at a value of 2.73 V for both light and heavy crude oil. It was showed that the pressure value is 0.22 bar and the value of the flow rate is 0.25 L/M for heavy oil. While the light is 0.23 bar for pressure and the flow rate is 0.652 L/M. In addition, to conducting several experiments that show that an increase in the value of the voltage obtained using heavy oil by a value of 3.77 V the pressure value becomes 0.35 bar the flow rate is at 4.78 L/M, while light oil has shown the results are that the rated voltage value is 3.77 V, the pressure value is 0.33 bar, and the flow rate value through the tube becomes 5.17 L/M. Thus, the greatest value of the voltage 3.77 V , The result when the flow rate through the pipeline increases rapidly, and the pressure decreases, the pipeline passes through the pipeline faster.

Keywords: SCADA ; PLC ; Oil pumps stations; Pressure sensor .
1. Introduction

Oil is formed on the ground of the earth as a result of the remains of animals and plants as a result of the conversion of organic materials in geological conditions under the surface of the earth that led to the formation of crude oil and natural gas, and thus leads to the transfer of large quantities of crude oil between the production site and refining and consumption points and thus be transferred across lines. The pipes for transporting heavy oil from the Qayara refinery and light oil came from the Dora refinery and made a comparison between the two types to control the pressure and flow rate using PLC by conducting a signal transmission SCADA and a linear process with time delay {1.2.3.4} represented by LABVIEW in order to get rid of the labor cost and monitor line safety Oil pipelines while ensuring effective transport safety and assurance [1] can alter the flow rate that can be sensed through monitoring and control using LABVIEW demonstrated differences in pressure value [2] in order to improve control performance by analyzing pressure signals at various points during a period Transport [4] Indirectly maintained fluids are transported as flow rates and pressure stability may enhance production rate as well as safety of oil transport without human intervention and reduce losses around the pipeline [4] therefore it is an innovative model of pipeline control system using the LABVIEW platform which includes Information about the change in pressure status indicating the continuous flow of any liquid in the long-range transport pipeline system [5].

LABVIEW with SCADA has the ability to remotely control distinct parameters such as pressure and flow in the oil pipeline and the result is continuous control in order to regulate the flow rate in the destination in real time [6]. Morsi (2014) [7] generally relies on the control system Conventional (DCS) to provide all the functions of controlling equipment and operation, but it does not provide sufficient conditions for the discovery of problems. Therefore, it was suggested that the SCADA / PLC system be used to control a complete oil refinery instead of conventional control via DCS, thus avoiding wasting manpower and material resources to increase the safety of workers using SCADA / PLC in order to perform the examination time which means observer System, and the discovery of problems by recording and storing the amount of data in addition to the screens SCADA more realistic than the DCS user and the operator can monitor the process from all over the world. Priyanka (2018) [8] suggested that industries need more reliable control, power, efficiency and flexibility, as the Fuzzy-PID controller is designed to automatically regulate the flow rate of petroleum products by controlling multiple pressure signals in long transmission. Fuzzy-PID performance is compared to the PLC-based Cascade-PID console. FUZZY-based and Cascade-PID based PLC controllers are applied for experimental setup, and performance analyzes are verified empirically. Real-time data from pressure and flow is monitored through the SCADA screen using data logging. Therefore experimental analysis has shown that the Fuzzy-PID-based PLC controller maintains a steady state with the minimum installation time is 23 seconds and the minimum exceeds 24.36% compared to the PLC-based Foreman PLC. Fuzzy PID controller provides fair response with minimum error rate of 18.92%

2. Methodology

Identify and classify equipment in the crude oil pumping control and monitoring station using PLC and connected to the supervisory control program and obtain data for a sample from the oil tank with the pump. A case study suggested an understanding of the level of oil in a pipeline pumping station and a switch of support for the design of crude oil pumping station [9].
3. Modelling of the Oil Pump

The study of the characteristics of the oil pump to determine the quality of the product when sending the product through continuous succession in one pipeline. The flow rate and pressure are controlled by PLC and liquid control through the pipeline of SCADA displays as shown in the figure 1. Oil pump station pipeline is measured by piezoresistive and flow rate sensor. Piezoresistive pressure sensor measures the pressure of gases and liquids on the manufacturing scale where pressure sensors are manufactured. In bulk case, the M12 connectors and cable connectors are used as the standard for electrical conductivity (20 mA) or three wires with voltage output as output signal current for obtaining a voltage of 0.5 to 4.5 V. Measuring the flow rate with the help of a flow rate sensor of the type Turbine flow sensor. The flow rate transmitter will convert the fluid flow into an analog signal and the load will be monitored through PLC connected to SCADA to display the results on the LABVIEW screen.

![SCADA screen for observation and controlling of flow and pressure.](https://via.placeholder.com/150)

4. Implementation

This work implemented a system to control the parameter such as pressure and flow rate of the pump petroleum products using PLC and SCADA. control information is given to SCADA from HMI. SCADA converted into a control signal in order to be processed in PLC considered as a control signal to operate the final control [10].

5. PLC (programmable logic controller)
The main objective is to monitor and control the pressure and flow rate of the system in the pipeline automatically using an integrated SCADA system and PLC to connect it [14].

Therefore, pressure and flow are transmitted through the pipeline and thus readings appear on SCADA screens so PLC is the continuous scanning of the program and includes the following Procedures:

**Procedure 1: Test input status:**
the information obtained from the processor is storage in memory for using in the next procedures

**Procedure 2: Program implementation:**
the input is taken from the previous procedure and action is taken to activate some output and the result can be postponed and stored in memory for recovery later

**Procedure3 : Checking and Correction of output status from 1&2:**
PLC inspect the output signals and adjusts it by making changes to the inputs that were checked during the first step and executing the program in the second step and then the third step is performed PLC returns the beginning of the cycle and repeat these steps continuously

**Scan time** = Execution time procedure 1 + Execution time procedure 2 + Execution time procedure 3 [2].

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6. SCADA System
Supervisory control and data acquisition are used to control the factory or device and it may be automatic or through commands that work and data is obtained first by a PLC programmable logic controller and then the data transfer is processed again to the central SCADA system [2] includes LABVIEW is a development program mainly used for virtual machines and gets the information that makes up the program from several units that allow the creation of windows applications or graphical user interfaces or connectivity or automatic control or device simulation in a loop [12] Simulation can be used with LabVIEW real and a unit of time income and output the real world, and is fed through the PLC where the signal is given to the PLC block with the desired set point and can change its value in the foreground panel on the basis of the type of liquid transported in the pipeline. The output signal that corresponds to the opening of the control valve is considered to regulate the flow rate and control it [13] as shown in the diagrams for flow control and pressure control in oil pipelines.

![Diagram](image.png)

Figure 4: Monitoring and flow and pressure in oil piping with control

7. Results and Discussion

Simulations were carried out in detail in the experimental preparation section of the performance monitoring of the pump, pressure and flow control in the oil pipeline, the transmission system. The open loop system is obtained using the LIABVIEW control unit and the block control of the Lab VIEW platform is developed where the graph is given Control signal for control valve as shown in Figure 2. Performance analysis. VIEWLAB performance-based PLC controls are exploration of working range of 520 l/h at specified time t = 0-20 minutes Corresponding performance indicators are clearly calculated by PLC control in a short period of time in about 20 and maintaining a stable state with the use of different types straight oil, This ensures high speeds to enhance the operating condition of the oil pipeline transportation system. The same analyzes are performed with different operating points such as 230, 520 and 600 l/h to ensure the durability of the open-loop controller. The simulated responses that have reached different operating points provide better performance with the same settings for different operating points. PLC control settings showed strong response when operating point is deflected. The control valve opens and closes for control. In order to obtain the desired flow rate of the oil pipeline
system by giving simulation and experimental results through LABVIEW-based PLC controllers and by simulating the results the performance in the observation increases 20.64%. A valve to obtain the desired flow rate at the destination.

Figure 5: Pressure & flow rate for 20% of heavy oil for pump

Figure 6: Pressure & flow rate for 20% of heavy oil for pump
Figure 7: Pressure & flow rate for 40% of heavy oil for pump.

Figure 8: Pressure & flow rate for 40% of light oil for pump.
Figure 9: Pressure & flow rate for 60% of heavy oil for pump

Figure 10: Pressure & Flow rate for 60% of light oil for pump

8. Conclusion

This research presented a new plan to meet real time requirements and high data transmission needed for remote monitoring of pipelines as the scheme relies on the SCADA framework for the remote control to monitor oil pipelines and control the transportation of oil and petroleum products through the pipeline on several hundreds to thousands of miles are done using PLC to monitor various physical parameters control valves and pumps along the pipeline to maintain oil flow through the pipeline to be installed and maintained easily devices are easily connected and replaced, the exchange technology was used to create data in order to obtain information in real time remote testing and analysis can be carried out and improvement has been done through service-based SCADA is a promising and profitable option for
improving the oil pipeline, and with this the increased voltage value from 2.73 to 4.65 has led to an increase in the flow rate and consequently an increase in pressure reaching from 0.25 to 0.546 bar and an increase in the flow rate from 0.22 to 5.64 L/M for the heavy oil and increased voltage value from 2.73 to 4.65 has led to an increase in the flow rate and consequently an increase in pressure reaching from 0.23 to 0.43 bar and an increase in the flow rate from 0.657 to 15.37 L/M for the heavy and light oil.

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