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# Real Time Level Monitoring and Control using DCS

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**Abstract:** *Level monitoring and control play an important role in many industrial processes such as water tanks, chemical plants, and storage systems. Traditionally, level measurement and control were carried out manually, which required continuous human observation and operation. This method can lead to errors, inefficient operation, and possible safety risks. To overcome these problems, automation using a Distributed Control System can be used for real-time monitoring and control of liquid level.*
*In this system, a level transmitter is used to measure the liquid level in the tank and convert it into an electrical signal. The signal is transmitted to the DCS controller where it is processed and compared with the desired set point.*
*Based on this comparison, the controller automatically adjusts the control valve or pump to maintain the required level. The system also allows operators to monitor the level through a DCS in real time. The proposed system provides reliable monitoring, improved process control, and reduced manual effort. Therefore, DCS-based level monitoring and control systems are widely used in modern industrial automation.*

**Keywords:** Level monitoring and control, Distributed Control Systems, programming and configuration, process Tank, Level

## I. INTRODUCTION

In industrial process plants, monitoring and controlling the level of liquids in tanks and vessels is one of the most essential operations. Maintaining the correct level ensures process stability, product quality, and system safety. In earlier times, these operations were carried out manually, which often led to human errors, delays, and inefficiency. With the advancement of industrial automation, modern systems such as Distributed Control Systems have been introduced to improve accuracy, reliability, and real-time supervision of processes [1].A Distributed Control System is an automated control system that uses a network of controllers distributed throughout the plant to monitor and control various process parameters [2].In modern industrial automation, the need for reliable, accurate, and efficient process control has become more important than ever. Among various process parameters such as pressure, temperature, flow, and level, level control holds special significance because it directly influences both process stability and product quality. Improper level control can lead to overflow, equipment damage, wastage of materials, or unsafe operating conditions. Therefore, continuous level monitoring and control form a vital part of process industries such as chemical manufacturing, water treatment, oil and gas, power generation, and food processing [3] To achieve precise and real-time control, industries are increasingly adopting **Distributed Control Systems,** which provide a flexible, modular, and intelligent control architecture. A DCS is designed to distribute control functions across multiple controllers while maintaining centralized supervision through a common communication network [4]. A Real-Time Level Monitoring and Control System is implemented using a DCS platform. The liquid level in a tank is continuously measured by a level transmitter and the corresponding signal is sent to the DCS controller. Based on the level reading, the DCS compares it with a predefined set value and generates a control signal to operate a control valve or pump accordingly.

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This enables the system to maintain the liquid level within the desired range automatically and efficiently [5]. The DCS provides continuous monitoring, real-time response, and automatic control action without the need for manual intervention. It also allows for easy configuration, modification, and expansion if more process parameters need to be added in the future [6]. Overall, this project demonstrates the importance of automation in industrial process control and shows how a DCS can be effectively used for real-time level monitoring and control with improved accuracy, safety, and operational efficiency [7]. A process tank is used in which the liquid level is continuously measured using a level transmitter. The transmitter sends a corresponding analog signal to the **Automation System (AS),** which is the central control unit in PCS 7. The AS processes this signal and compares it with a desired setpoint. Based on the error between the actual and desired levels, the controller configured within PCS7 generates an output signal to control a valve or pump that regulates the inflow or outflow of liquid in the tank. This closed-loop control ensures that the level remains within the desired range at all times [8].

## II. LITERATURE REVIEW

N.Mahalik et al. [1] This paper contributes the knowledge base in the context of applicability of simulation environment (analogous to virtual reality) in the Distributed Control Systems domain. A simulated platform has been designed and developed considering the advanced features of DCS.

Liang, W. P et al.[2] This paper introduces the thermal power plant boiler drum water level control, using cascade three-impulse control strategy, based on the distributed control system to realize the control of the drum water level. This paper analyze the main variables affect the drum water level, the dynamic characteristics of the drum water level, the principle of the cascade three-impulse control strategy, brief introduction to the main function of the main and auxiliary loops, The basic idea and implementation methods of distributed control system and draw a simple logic diagram.

Lei Zou et al.[3] The new DCS system provides two up-computers, the screen on these two up-computers serves as the monitoring view and control view for the new equipment, and also monitors and controls the common process pumps and other old equipment that the operator deems necessary to monitor. The communication between the new desalination system equipment and the desalination monitoring system host computer is recommended to use MODBUS-TCP protocol to communicate between the new host computer and the water network host computer with a shielded network cable direct connection.

Firoozshahi et al [4] The introduction of microprocessor-based plant control occurred shortly before 1980 with simple single-loop controllers. This technology quickly evolved into a DCS with control processor redundancy, high-density input/output systems, and a human machine interface (HMI). Today's tank management plans are faced with intense pressure to improve storage reliability. Thereby, current business goals focus on increasing operational efficiency and overall equipment effectiveness.

Yang Qiliang et al [5] The drum water level is a very important parameter of the boilers in power plants. One method, using FBD language in IEC61131-3 to implement the water level control system on the platform of the 893-DCS, is probed. On the basis of the description of the IEC61131-3-based DCS and the analysis of the dynamic process of the boiler drum water level, the two-level-tracking technology of the no-disturbance switch and the dead band approach in the control system are presented and discussed in detail.

Li, L et al [6] The characteristics and configuration of a distributed control system: SUPCON JX-300DCS, are introduced. The application of this system to the solution of complete circling urea production, including technological process and design of DCS control scheme is presented.

Romel S. Bhullar et al [7] The paper presents some strategies to implement advanced controls using the tools available within the modern DCS. Application examples of implementing feed forward, non-interacting, model-based multivariable and constraint controls are discussed for common process units. Included are also examples for building quality estimators to substitute for analyzers.

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Vassilios Tzouanas et al [8] The project is concerned with the design of a water tank process and experimental evaluation of feedback control structures to achieve water level and temperature control at desired set point values. The manipulated variables are the pump power, on the water outflow line, and heat supply to the tank. Detailed, first principles-based, dynamic models as well as empirical models for this interactive and multivariable process have been developed and used for controller design.

## III. METHODOLOGY

**System Overview**

The System Overview of the real-time level monitoring system using DCS involves several systematic steps to design, connect, and test the working of the project. The process begins with studying the basic concept of level measurement and understanding how a capacitive sensor can detect changes in liquid levels. The capacitive level sensor is selected based on the type of liquid and tank size. It works on the principle of capacitance change when the liquid level varies. Next, the sensor is connected to the level transmitter, which converts the capacitance-based signal into a standard 4–20 mA current signal. This current signal is then given as an input to the Distributed Control System. The DCS is configured to read the analog signal and display the corresponding liquid level value in percentage or level units. The control logic is then programmed in the DCS to maintain the level within the desired range. A set point is defined in the system to determine the lower and upper limits of the liquid level. When the level goes below the minimum limit, the DCS sends a control output signal to start the pump and fill the tank. When the level reaches the upper limit, the DCS stops the pump automatically.

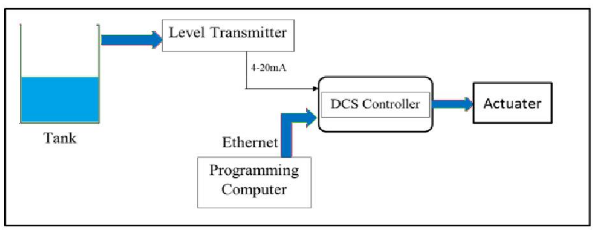


Fig. 1. Schematic Representation of Level Measurement

**Prototype of Level Monitoring and Control System**

The prototype of system aims to design and implement a real-time level monitoring setup for an industrial tank using a Distributed Control System. The system is intended to continuously measure, process, and control the liquid level in the tank with high accuracy and reliability. It replaces traditional manual monitoring methods with a fully automated system capable of maintaining the desired level under varying process conditions

Fig. 2. Distributed Control System (PCS7) module with Input Output Racks

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The DCS works continuously and updates the level readings in real time. It allows the user to observe and control the process easily. It can record the data for future analysis and maintain a smooth process flow. DCS provides high accuracy, reliability, and safety for the operation. It can handle multiple sensors and tanks at the same time, making it very useful for industrial automation. It also includes self-diagnostic features to check for any faults or errors in the system. The DCS also supports various communication protocols such as Modbus, Profibus, or Ethernet, which allow easy connection with field instruments and other systems. It ensures that all components communicate effectively and share real-time information for better control and monitoring.

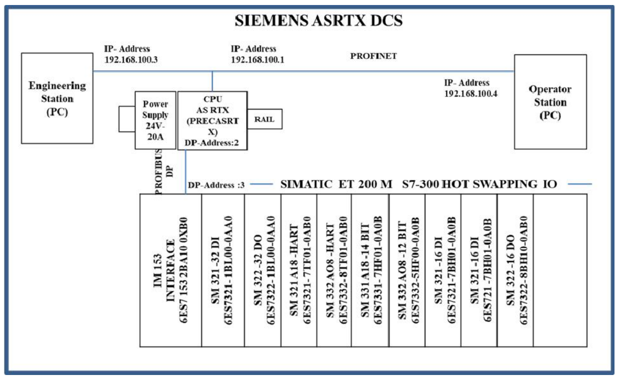


Fig. 3. DCS Engineering Station and Operating Station Arrangement

The Fig.3. represents a **Distributed Control System** used for industrial automation based on the Siemens AG **SIMATIC S7-300** platform. The system includes an **Engineering Station** used for programming and configuring the control system, and an **Operator Station** used for monitoring and controlling industrial processes. The **CPU AS-RTX controller** acts as the main processing unit that executes control logic and communicates with field devices. A **24V power supply** provides power to the system modules. Communication between devices occurs through **PROFINET and PROFIBUS networks**. The **SIMATIC ET 200M remote I/O modules** connect sensors and actuators, allowing real-time monitoring and control of industrial operations.

## IV. EXPERIMENTAL RESULTS

In this section, the results of the proposed Real Time Level Monitoring and Control System using DCS.

First, we have successfully Configure the I/O modules and Profibus Connections for Implementing Hardware for level Monitoring Process.

Software Configuration in DCS

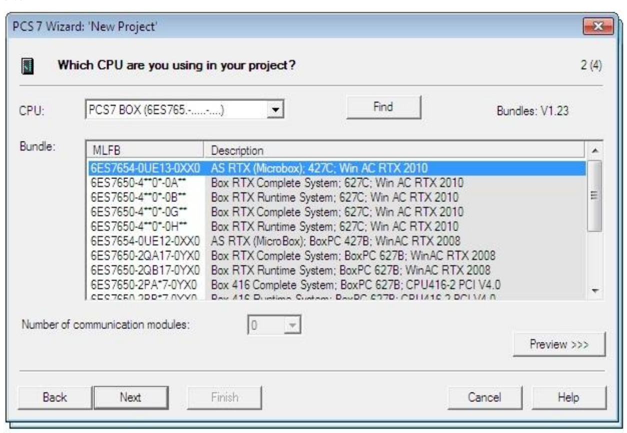


Fig. 4. Insert new project in Simatic Manager (PCS7)


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The Figure4 shows the main interface of SIMATIC Manager, which is used to develop and manage automation projects for SIMATIC S7 PLC systems. It allows to create new projects, configure hardware, program control logic, and manage files. This software is widely used in industrial automation for designing and monitoring PLC-based control systems.

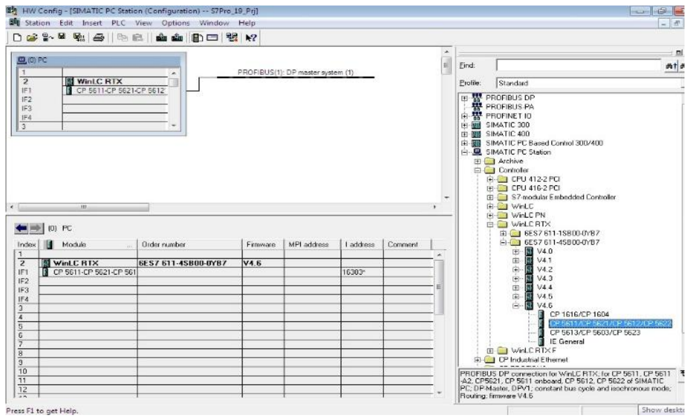

Fig. 5. Hardware Configuration of Controller in DCS

The Fig. 5. Shows Hardware Configuration in Simatic PC Station.The system uses WinLC RTX, which acts as a software PLC running on a computer. Communication with field devices is established through PROFIBUS DP using CP 5611 or CP 5621 communication processors. The PROFIBUS network is configured as a DP master system, allowing the PLC to exchange input and output data with remote I/O modules and field instruments. Engineers can add controllers, communication modules, and networks from the hardware catalog. This configuration helps design, monitor, and control industrial automation systems efficiently.

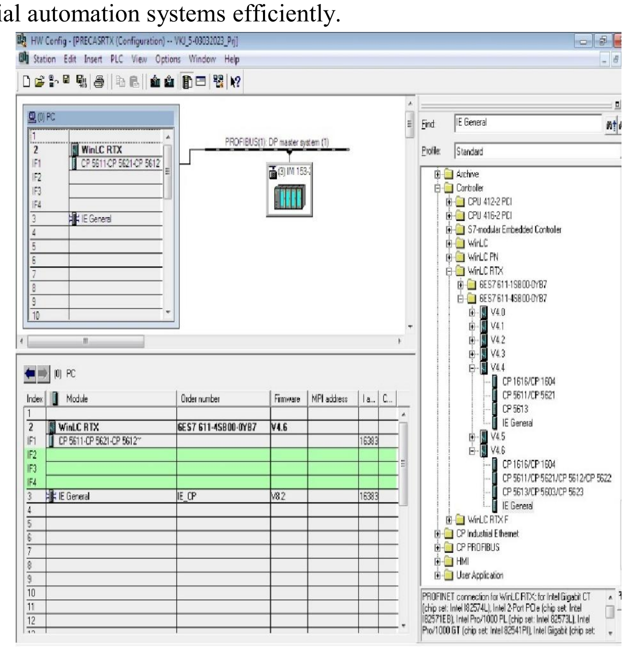

Fig. 6. Ethernet Connection Configuration

IE General represents a general Industrial Ethernet communication interface used in a SIMATIC PC Station. It allows the WinLC RTX to communicate over PROFINET or Industrial Ethernet networks. This interface connects controllers for data exchange and process monitoring in industrial automation.

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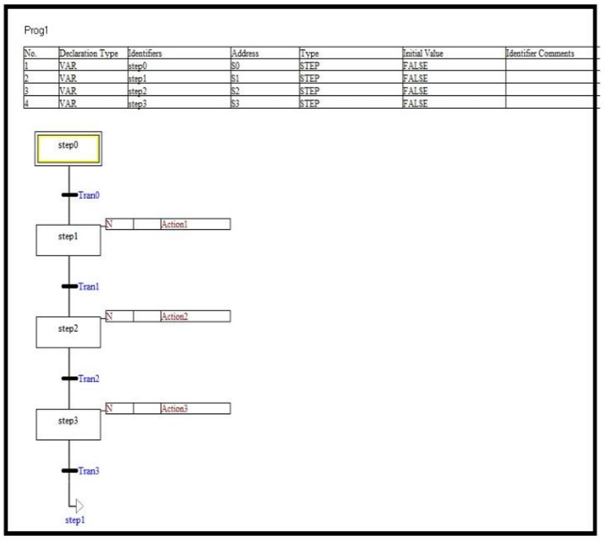


| No. | Declaration Type | Identifiers | Address | Type | Initial Value | Identifier Comments |
|---|---|---|---|---|---|---|
| 1 | VAR | step0 | S0 | STEP | FALSE | |
| 2 | VAR | step1 | S1 | STEP | FALSE | |
| 3 | VAR | step2 | S2 | STEP | FALSE | |
| 4 | VAR | step3 | S3 | STEP | FALSE | |

Fig. 7. SFC Programming in DCS PCS7 for Tank level control

Sequential Function Chart (SFC) programming in Siemens PCS 7 is used to design and control processes that follow a step-by-step sequence. In tank level control applications, SFC helps automate operations such as filling, maintaining, and emptying the tank in a structured and logical manner.

An SFC program consists of **steps, transitions, and actions**. Each step represents a specific state of the process (e.g., filling the tank), while transitions define the conditions (like reaching a certain level) required to move to the next step. Actions are the operations performed during each step, such as opening or closing valves.

Using SFC in PCS7 improves **process visualization, control accuracy, and safety,** making it ideal for industrial automation tasks like maintaining tank levels within desired limits.

In Siemens PCS 7 SFC programming, an action is the operation or task that is executed when a particular step becomes active. It defines what the system should do during that step.

Actions are associated with steps and can include tasks such as:

- Opening or closing valves
- Starting or stopping pumps
- Setting output signals

Each action is executed based on specific conditions and may continue as long as the step is active or for a defined time.

## V. CONCLUSION

The Real-Time Level Monitoring Project successfully demonstrates the use of sensors and digital systems to continuously monitor and display liquid levels. Through the implementation of level transmitters and a simple monitoring setup, we achieved accurate, real-time tracking of tank levels without the need for manual measurement. This project highlights the practical application of automation in monitoring processes, improving efficiency and reducing human error. The results obtained confirm the system's reliability and ease of use, making it a suitable solution for basic industrial or educational setups. Overall, this project provides hands-on experience in sensor integration, data acquisition, and real-time monitoring systems.

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