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NUST COLLEGE OF
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RTG FUEL LEVEL MEASUREMENT

A PROJECT REPORT

DE-42 (DC & SE)

Submitted by

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IN

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Certification

This is to certify that GC Taimour khan (358840) and GC Ahtisham Abid (358835) have successfully completed the final project RTG Fuel Level Measurement, at the NUST Co-EME, to fulfill the partial requirement of the degree COMPUTER ENGINEERING.

Signature of Project Supervisor
Dr. AQIB PERWAIZ
Professor

Sustainable Development Goals (SDGs)

SDG No	Description of SDG	SDG No	Description of SDG
SDG 1	No Poverty	**SDG 9**	**Industry, Innovation, and Infrastructure**
SDG 2	Zero Hunger	SDG 10	Reduced Inequalities
SDG 3	Good Health and Well Being	SDG 11	Sustainable Cities and Communities
SDG 4	Quality Education	SDG 12	Responsible Consumption and Production
SDG 5	Gender Equality	SDG 13	Climate Change
SDG 6	Clean Water and Sanitation	SDG 14	Life Below Water
SDG 7	Affordable and Clean Energy	SDG 15	Life on Land
SDG 8	Decent Work and Economic Growth	SDG 16	Peace, Justice and Strong Institutions
		SDG 17	Partnerships for the Goals

Sustainable Development Goals

Complex Engineering Problem

Range of Complex Problem Solving

	Attribute	Complex Problem	
1	Range of conflicting requirements	Involve wide-ranging or conflicting technical, engineering and other issues.	X
2	Depth of analysis required	Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models.	
3	Depth of knowledge required	Requires research-based knowledge much of which is at, or informed by, the forefront of the professional discipline and which allows a fundamentals-based, first principles analytical approach.	X
4	Familiarity of issues	Involve infrequently encountered issues	
5	Extent of applicable codes	Are outside problems encompassed by standards and codes of practice for professional engineering.	
6	Extent of stakeholder involvement and level of conflicting requirements	Involve diverse groups of stakeholders with widely varying needs.	X
7	Consequences	Have significant consequences in a range of contexts.	
8	Interdependence	Are high level problems including many component parts or sub-problems	X

Range of Complex Problem Activities

	Attribute	Complex Activities	
1	Range of resources	Involve the use of diverse resources (and for this purpose, resources include people, money, equipment, materials, information and technologies).	X
2	Level of interaction	Require resolution of significant problems arising from interactions between wide ranging and conflicting technical, engineering or other issues.	
3	Innovation	Involve creative use of engineering principles and research-based knowledge in novel ways.	X
4	Consequences to society and the environment	Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation.	
5	Familiarity	Can extend beyond previous experiences by applying principles-based approaches.	X

This project is dedicated to my supervisor, whose invaluable guidance and support have been instrumental in my success. To my parents, whose endless love and encouragement have been my greatest source of strength. And to my close friends, whose unwavering support and understanding have made this journey possible. Thank you all for being my pillars of support.

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Abstract

The RTG Fuel Level Measuring System is a effective way to monitor fuel levels in tanks or containers. It uses two non-contacting sensors that are easily fitted onto the tanks or containers, eliminating the need for direct physical contact with the fuel. These sensors interface with a Siemens S7-1200 PLC controller, which receives and processes the sensors' real-time data. The system also has a user-friendly graphical interface which displays fuel level information on a computer screen, giving users quick access to important data.The RTG Fuel Level Measuring System supports informed decision-making and effective use of fuel resources by providing an easy and reliable method for monitoring fuel levels. This system is useful for optimising fuel management processes and ensuring smooth operations, whether it is used in factories, warehouses, or other facilities with fuel storage requirements.

Keywords: Fuel Level Measurement, Radar senosrs, PLC Controller.

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Chapter 1

Introduction

1.1 Motivation

The main objective of the RTG Fuel Level Measuring System's design was to increase productivity and dependability in the area of fuel control for a variety of logistical and industrial processes. It is especially helpful for monitoring fuel levels in real time to prevent system failure caused on by low fuel, as well as for controlling fuel waste from irresponsibility and theft. The earlier fuel tracking methods had several drawbacks, including time-consuming procedures, human involvement, and imprecision.

It is also clear that fuel management is one of the key success factors in many companies, allowing the sector to run smoothly and provide its services. This demonstrates that any fuel-related issue can have serious consequences, such as disruptions, higher expenses, and safety issues. Therefore, they may be controlled by using a real-time fuel level metering system. The aim of the project is to build a standardised system with non-touuch sensors and a Siemens S7-1200 PLC controller to control fuel consumption in real time.

In addition to improving fuel level measurement accuracy, advanced sensors and real-time data processing enable quick repair as well as supply chain management by enabling essential checks and provisions. This ensures timely fuel delivery, efficient fuel use, and a reduction of costly and unpleasant situations where fuel inventories run low. Furthermore, certain systems might offer the ability to remotely access fuel data via computers; as a result, fuel resources are simpler to manage regardless of the location of employment.

Thus, it can be concluded that the primary goals of the RTG Fuel Level Measuring System's implementation were to improve the fuel measurement method's smooth operation, reduce costs, strengthen security features, and expand the system's application to particular industrial units. The current study aims to ensure a more durable future and change the concept of fuel management in order to address these concerns.

1.2 Problem Statement

Fuel management is an essential component of multiple sectors and processes involving logistical movements. Fuel management issues arise when fuel levels are measured incorrectly or when fuel measurements are subjective and imprecise. These issues are particularly common when fuel reporting is incorrect. Fuel management usually involves physical handling of the fuel,which is an effort that can result in many mistakes and dangers to human life.

The main problem that many organisations have with fuel management is that they have an effective control tool that gives them the most recent information about the fuel supply. This is especially true if the fuel container is huge or the storage is located far away. This is because there are no hard figures or data accessible, and it can happen when there is too much or too little fuel, two scenarios that result in a lot of issues and repair and maintenance work. Moreover, when fuel is set aside for a certain user, it can be easily removed or combined with other fuels by unauthorised consumers, which further complicates fuel management.

One of the most significant issues to think about and sort out is how to integrate the fuel level that has been entered into the system into the other monitoring processes. Ineffective and insufficient methods for displaying, processing, and distributing fuel intake data have an impact on how decisions are made, which promotes bias and inefficiency. A central repository for fuel information also implies that, in the unlikely event of a fuel issue, the information will be faraway and hence not be able to be fixed quickly.

In conclusion, the following are the main obstacles to efficient fuel management:

1. **Inaccurate Measurements:** The precision required for reliable fuel monitoring is missing from older methods.

2. **Manual Data Collection:** Insufficient and time-consuming, with a high chance of errors compromising safety.

3. **Problems with Data Integration:** Failure to combine fuel level information with current systems in an easy way.

4. **Processing Delays:** Delay brought about by centralised data processing restricts immediate responses.

5. **Cost and Scalability:** There is a need for widely applicable, scalable, and affordable solutions.

Reducing operating costs, avoiding downtime, and enhancing the general efficiency and durability of fuel management in logistical and industrial settings all depend on addressing these issues.

1.3 Scope

The aim of the RTG Fuel Level Measuring System project is to get industrial fuel monitoring up to date. It will offer accurate, up-to-date fuel level data via advanced sensors and easy user interfaces. The project's goals are to increase safety and improve operations by reducing costs and boosting productivity.

The technology uses two non-contact sensors that are mounted on fuel tanks or containers to detect fuel levels accurately without direct contact with the container. A Siemens S7-

1200 PLC controller is connected to these sensors, and it is in charge of collecting and analysing the data in real time. Users are able to access and monitor fuel levels from a computer by using a simple graphical user interface (GUI) that displays the processed data.

The following crucial components are included in the project's scope:

1. **Development and Installation:** Design and put into use non-contact radar sensors to accurately monitor gasoline levels. To get data in real time, integrate sensors with the Siemens S7-1200 PLC controller.

2. **Data Processing and Display:** Set up the PLC controller to accurately process data from the sensors. Create a simple graphical user interface (GUI) for remote monitoring and real-time data display.

3. **System Integration:** Make sure that the current industrial and logistical systems are integrated smoothly. Establish safe channels of communication for the exchange of data.

4. **Testing and Validation:** Carry out extensive testing to confirm the reliability and precision of the system in practical situations.

5. **Maintenance and Alerts:** Create automated maintenance techniques to find any problems before they become critical. - Put alarm systems in place to inform users of flaws or critical fuel levels.

Because of its scalable and affordable design, the RTG Fuel Level Measuring System can be used in a variety of industrial applications. This technology will help to minimise operating downtime, increase fuel management efficiency, and improve overall safety by giving precise and timely information on fuel levels.

1.4 Aims and Objectives

The RTG Fuel Level Measuring System project aims to create an accurate, real-time system that will revolutionise fuel monitoring in industry. It aims to increase efficiency, reduce expenses, and enhance safety through advanced sensor integration and easy user interfaces.

Objectives

• Develop and put in place non-contact radar sensors to accurately measure fuel levels.

• For real-time data processing and collecting, connect sensors with a PLC controller.

• For remote monitoring and real-time data display, provide a user-friendly graphical interface.

1.5 Outcomes

1. Providing an Accurate Live Monitoring industrial fuel level Solution

2. Improving operations through better fuel management practices.

3. Optimizing resource utilization and avoiding fuel wastage to save operational costs

4. For increasing accuracy in fuel-related incidents to reduced measures of dangers.

5. Establishing a system that can scale and be used in differing industrial environments, which will help contribute to wider adoption and growth.

1.6 Report Organization

The organization of the thesis is as follows:

Chapter 2 defines the project related work done previously and its background, difficulties etc.

Chapter 3 defines and explain project's components that we have used and material we were required.

Chapter 4 defines the methodology of project and explain our working that how we are measuring fuel level through sensors.

Chapter 5 explains how we are deploying our project in real world and ensuring seamless integration with existing infrastructure. also conducting extensive testing to ensure accurate measuring of fuel.

Chapter 6 wrap up the report and determining the project's potential and future directions.

Chapter 2

Background & Related Work

2.1 Background

The management of fuel supplies is vital in a variety of industrial contexts, including factories, warehouses, and other facilities that require dependable fuel storage and monitoring. Traditional methods of fuel level measuring sometimes entail manual inspection and dipstick measurements, which can be time-consuming, prone to human mistake, and potentially dangerous. With advances in sensor technology and automation, more complex methods have been created to improve the accuracy and efficiency of fuel monitoring.

The RTG Fuel Level Measuring System takes use of these improvements by using non-contact radar sensors to measure fuel levels in tanks or containers. These sensors offer various advantages over previous approaches, including increased precision, non-intrusive measurement, and the capacity to operate in severe settings. The combination of these sensors with a Siemens S7-1200 PLC controller allows for real-time data processing and gathering, guaranteeing that fuel level information is constantly up to date and easily accessible.

One of this system's key features is its user-friendly graphical interface, which displays real-time fuel level data on a computer screen. This interface streamlines the monitoring process, enabling users to make educated decisions quickly and efficiently. The RTG Fuel Level Measuring System promotes improved fuel management practices, reduces waste, and optimizes resource utilization, resulting in cost savings and increased safety.

2.2 Algorithms related to fuel and water level

2.2.1 Radar Sensing Algorithm

Utilizes radar sensors to send signals towards the liquid surface and measure the time taken for the reflection to return. The distance is calculated based on the time-of-flight principle.[1]

2.2.2 Ultrasonic Sensing Algorithm

Similar to radar, ultrasonic sensors emit sound waves and measure the time it takes for the echo to return from the liquid surface. The distance is then calculated to determine the liquid level.[2]

2.2.3 Capacitive Sensing Algorithm

Uses capacitive sensors to measure changes in capacitance caused by the presence of liquid between sensor plates. This method is highly sensitive to dielectric properties of the liquid.[3]

2.2.4 Float-Based Algorithm

Mechanical floats that rise and fall with the liquid level. The float position is measured and converted to an electrical signal indicating the liquid level.

2.2.5 Hydrostatic Pressure Algorithm

Measures the pressure at the bottom of the tank and calculates the liquid level based on the hydrostatic pressure equation. This method requires knowledge of the liquid density.[4]

2.3 Incidents Due to Failure of Fuel or Liquid Level Monitoring Systems

Failures in liquid level monitoring systems can lead to catastrophic consequences, including environmental damage, safety hazards, and significant financial losses. Here are some notable incidents that highlight the importance of reliable monitoring systems:

2.3.1 Buncefield Oil Depot Explosion (2005)

On December 11, 2005, a series of explosions occurred at the Buncefield oil storage depot in Hertfordshire, England. The incident was caused by the overfilling of a storage tank due to a failure in the fuel level monitoring system. The explosion resulted in a massive fire that burned for several days, causing extensive damage to the facility and surrounding areas. This incident emphasized the critical need for accurate and reliable fuel level monitoring to prevent overfilling and associated risks [5].

2.3.2 BP Texas City Refinery Explosion (2005)

Another significant incident occurred on March 23, 2005, at the BP Texas City Refinery in Texas City, Texas. A failure in the liquid level control of a raffinate splitter tower led to the overfilling and subsequent explosion of the unit. The disaster resulted in 15 fatalities and over 170 injuries, as well as extensive damage to the refinery. This incident highlighted the importance of robust level monitoring systems in preventing such catastrophic failures [6].

2.3.3 Prestige Oil Spill (2002)

The Prestige oil spill, which occurred in November 2002 off the coast of Spain, was caused by the structural failure of the oil tanker Prestige. While not directly a failure of a level monitoring system, the inability to accurately monitor the internal pressure and structural integrity of the tanks contributed to the disaster. The spill caused extensive environmental damage and highlighted the need for advanced monitoring technologies to ensure the safe transport and storage of hazardous liquids [7].

2.3.4 Kingston Fossil Plant Coal Fly Ash Spill (2008)

On December 22, 2008, a dike ruptured at the Kingston Fossil Plant in Tennessee, releasing 1.1 billion gallons of coal fly ash slurry into the surrounding environment. The failure was attributed to inadequate monitoring of the containment structures and liquid levels within the ash ponds. This environmental disaster underscored the necessity for accurate and continuous monitoring of liquid levels in storage and containment facilities to prevent such incidents [8].

2.4 Related Work

2.4.1 Emerson's Role

Equipment, including as sensors and controls. Emerson has vast experience with these components, but they have never worked on a project like this before. Their assistance in supplying high-quality equipment assures that the RTG Fuel Level Measuring System is equipped with cutting-edge technology and dependable components, which are critical to the project's success.

2.4.2 Lennart Hägg's Contributions

Lennart Hägg, the former Technical Manager at Rosemount Tank Gauging, has made substantial contributions to fuel level measuring. His work paved the way for modern tank gauging systems that use advanced sensors and automated technologies. Hägg's R and D efforts have been concentrated on enhancing the accuracy and dependability of tank gauging systems, thereby making them more efficient and user-friendly. His knowledge and earlier work serve as a helpful reference for the RTG Fuel Level Measuring System, guaranteeing that the project is based on industry-proven procedures and best practices.For more detailed information on his contributions, see Hägg's work on radar-based tank gauging systems in the [9].

2.5 Conclusion

The RTG Fuel Level Measuring System uses a number of methods, each with specific benefits for measuring fuel levels, including radar, ultrasonic, capacitive, float-based, and hydrostatic pressure. As evidenced by previous tragedies like the Buncefield Oil Depot Explosion and the BP Texas City Refinery Explosion, which were caused by faults in liquid level monitoring, dependable monitoring systems are essential to avoiding catastrophic events. Related work includes the Army's Sohawa Cantt project, which is presently undergoing renovations for increased functionality, as well as contributions from Emerson, which supplied top-notch equipment, and Lennart Hägg, whose groundbreaking work in tank gauging systems laid the groundwork for the RTG system. These developments aim to improve fuel management procedures while maintaining industrial fuel monitoring's dependability, efficiency, and safety.

Chapter 3

Material & Component

3.1 Hardware

3.1.1 Power Supply

In order to ensure that every system component operates and functions correctly, the power supply used in your project performs the vital role of providing electrical power to each one of them. It transforms an input voltage from a power source—such as a battery into an output voltage that is stable and regulated and meets the requirements of the electronics in the project.

The power supply in your project can be used to power the graphical user interface (GUI), sensors, controllers, actuators, and communication modules. It ensures that these parts receive the voltage and current levels they require to function reliably and efficiently.

Power supply converts input power into a stable output voltage for devices.

Figure 3.1: Power supply S7-300-5A

Characteristics are:

1. Acceptable input voltages within the input voltage range.

2. Stable voltage for devices.

3. Output Current: The component's maximum current.

4. Regulation: Keeps the output voltage constant.

5. Efficiency: The ratio of power input to output.

6. Protection Features: Prevents electrical faults.

3.1.1.1 Specification

Specification	Details
Model	Siemens SITOP PSU100C
Input Voltage	120/230 V AC
Output Voltage	24 V DC
Output Current	2.5 A
Efficiency	Up to 90%
Mounting	DIN rail
Protection	Overload, short-circuit
Operating Temperature Range	-25°C to +70°C
Dimensions	90 mm x 100 mm x 75 mm
Weight	450 g

Table 3.1: Power Supply Specifications

3.1.2 PLC Controller

The scalable SIMATIC S7-1200 controllers include integrated inputs and outputs, as well as communication options, and can be modularly expanded. Digital and analogue input and output modules, as well as a variety of communication modules, allow for flexible adaptation to the specific automation task. SIMATIC S7-1200 controllers, which include integrated technologies such as high-speed counters, pulse width modulation, pulse sequence outputs, speed control, and positioning, are ideal for temperature control, pump and fan control, and packaging machines. The SIMATIC controllers' seamless integration into the common engineering framework TIA Portal enables consistent data management, the smart library concept, and an overall operating philosophy. This makes it particularly simple to use system-spanning functions.

To monitor and coordinate the operations of the fuel level measuring system, we are integrating the S7-1200 PLC controller as a central control unit in our project. The PLC can be programmed to create logic sequences and algorithms that manage the collection of sensor data, process data in real-time, and initiate the proper actions in response to preset conditions. In order to gather fuel level information, check system status, and give input to the user interface, the PLC communicates with sensors, actuators, and other external devices.

- **Innovative design**

The SIMATIC S7-1200 Basic Controller can be customised to the specific automation task by incorporating a variety of expansion options. The modular board concept enables the controller to be easily expanded while maintaining its physical size. Terminal strips allow for easy replacement of devices without the need for rewiring.

- **Safety Integrated**

Fail-safe automation is as simple to programme as the standard, and safe devices are linked via PROFINET and ETHERNET.

Figure 3.2: PLC Controller

Feature	**CPU 1212C**
Physical size	90 mm x 100 mm x 75 mm
Work memory	25 Kbytes
Load memory	1 Mbyte
Retentive memory	2 Kbytes
On-board digital I/O	8 inputs and 6 outputs
On-board analog I/O	2 inputs
Process image (Input)	1024 bytes
Process image (Output)	1024 bytes
Bit memory (M)	4096 bytes

Table 3.2: Specifications of CPU 1212C

3.1.3 Sensors

- **Level Sensor (Rosemount 5408)**

The Rosemount 5408 Non-Contacting Radar Level Transmitter uses technology and human-built design to provide precise and reliable measurements on any type of material, liquid or solid. The Rosemount 5408 always produces an echo to obtain the maximum radar signal and provide a stronger and more accurate measurement using FMCW technology in a two-wire system. Rosemount 5408 uses an easy-to-use software application to guide the operator through the installation, application, proof-testing, and maintenance processes, ensuring seamless operation from installation to maintenance. It also includes a comprehensive onboard diagnostics suite that monitors the transmitter's overall health and various components to detect any problems.The Rosemount 5408:SIS excellent for safety its applications are certified on IEC 61508 for SIL 2 which reduces cost of risks improve productivity and save people and environment.

Figure 3.3: level sensor

- **Temprature Sensor(Rosemount 2240)**

The ultra-stable Rosemount 2240S has been approved for requiring control transfer applications that require very precise temperature measurements to calculate net standard volume. It is compatible with Rosemount's 565, 566, and 765 temperature sensors. The Rosemount 2240S can connect up to sixteen 3- or 4-wire temperature spot elements, as well as an integrated water level sensor. It calculates average liquid temperature for net volume using each individual spot temperature element and the corresponding level value. It has a high temperature conversion accuracy of ± 0.05 °C (± 0.09 °F).

Figure 3.4: Temperature sensor

3.2 Software

3.2.1 TIA Portal

Siemens offers a complete engineering software package called Totally Integrated Automation (TIA) Portal, which is used to configure, programme, monitor, and manage automation systems. It combines into a single platform a number of automation tasks, such as network configuration, HMI design, and PLC programming. For our project, TIA Portal was selected because of its smooth integration with the S7-1200 PLC, which ensures compatibility and outstanding operation. The clear display of fuel level data is an additional advantage of the user-friendly HMI design. Overall, TIA Portal's scalability makes it perfect for our RTG Fuel Level Measuring System's future expansions.

Figure 3.5: TIA Portal

3.2.2 Unity

Unity is a versatile development platform primarily used for creating interactive 3D and 2D applications, including games and simulations. Unity's exceptional visualisation capabilities and modern appearance make it the ideal option for developing the graphical user interface (GUI) of our RTG Fuel Level Measuring System. By enabling the establishment of interactive, real-time fuel levels, it can improve data display and user-model system interaction. Furthermore, GUI is efficient since its accessibility is not limited to a single device, making it suitable with a variety of devices. We demonstrate from our example that a strong asset store and community facilitate quick production and facilitate the use of complex capabilities.

Figure 3.6: Unity Software

3.3 Conclusion

The RTG Fuel Level Measuring System combines innovative hardware and software elements to improve the precision and dependability of fuel monitoring. A power supply for consistent voltage distribution, a SIMATIC S7-1200 PLC controller for data processing and system synchronisation, and accurate measurement tools like the Rosemount 2240S temperature sensor and the Rosemount 5408 radar level transmitter are among its hardware components. Siemens' TIA Portal for system configuration and Unity for GUI development are examples of software parts. When combined, these components guarantee excellent fuel management, real-time data processing, and an intuitive user interface, which enhances industrial fuel monitoring's safety and affordability.

Chapter 4

Methodology

4.1 Sensor Integration

Fuel tanks or containers with integrated Rosemount 5408 level sensors and 2240 temperature sensors are used in the RTG Fuel Level Measuring System. These sensors give precise measurements and continuously check the fuel level.

4.1.1 Sensor Installation

- Do Research on Rosemount 5408 level sensors and 2240 temperature sensors for fuel level measurement.
- Install sensors on the fuel tank or container.

4.2 PLC Integration

Our project PLC controller is the Siemens S7-1200. It establishes connections with the sensors, handles the processing of data, and interacts with the GUI. The PLC is set up and programmed using TIA Portal software.

4.2.1 PLC Setup and Programming

-

- Configure PLC S7-1200 Siemens.
- Use the TIA Portal software to set up the PLC to receive sensor data.

4.3 Data Processing Logic

- Apply logic to the PLC's data processing.
- Assure quick error checking and data processing.

4.4 GUI

Unity software is used to create a simple graphical user interface (GUI) that lets users see the fuel levels on their PCs.

4.4.1 GUI Design and Implementation

- Design GUI in unity.
- Implement Data Fetching and display through GUI.

Figure 4.1: GUI Made In Unity

4.5 System Integration

- Integrate Sensors with PLC and GUI for real time readings.

4.6 Validation and Testing

- Do different tests of the system for functionality and reliability.
- Validate the system's reliability. and performance.

4.7 Current Simulator

As our sensors are delayed, so we are using a current simulator instead of sensors to get outputs for testing and development purposes. This current simulator performs same functions as sensors do.

Figure 4.2: Current Simulator

Parameter	**Specification**
Working Voltage	DC 15–27V / Micro USB 5V
Analog Output Channels	1 CH
Output Types	Voltage or Current (Selectable)
Voltage Output Range	0/2–10V (Optional)
Current Output Range	0/4–20mA (Optional)
Voltage Output Impedance	$\geq 2K\Omega$
Current Output Impedance	$\leq 500\Omega$
Switch	1 key switch for output type selection
Size	85 x 50 x 22mm
Ports	PWR: DC15-27V Positive Supply
	GND: Power and Signal Ground
	V0: Voltage Analog Output Interface
	mA0: Current Output Analog Output Interface

Table 4.1: Current Simulator Specifications

4.7.1 Implementation of current simulator

- Integrate current simulator to replicate sensor outputs.
- Use current simulator for testing and validating.

4.8 Deployment:

- Deploy the system on site.
- Throughout the first deployment, keep an eye on things and address any problems.

4.9 Maintenance and Updates

- To keep the system up-to-date and functional, routine maintenance and software updates are necessary.

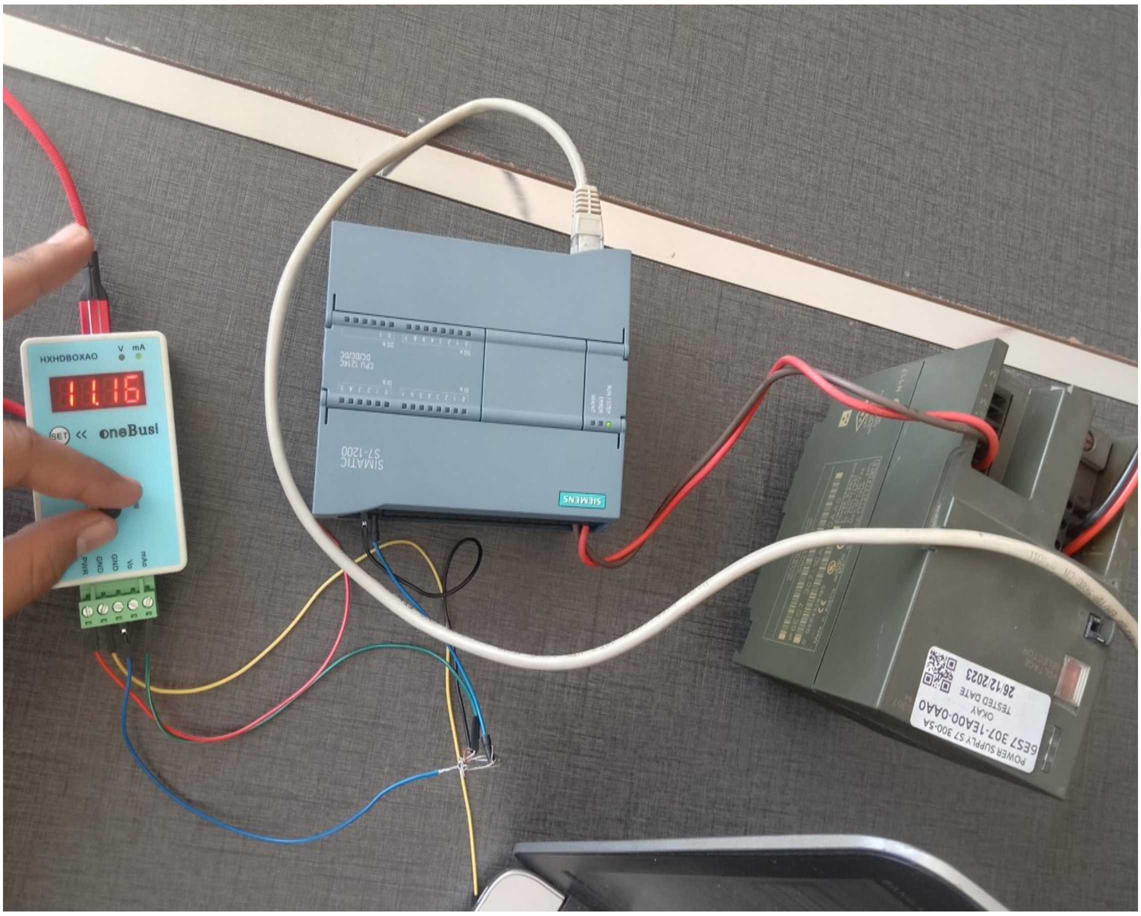

Figure 4.3: Current Simulator integration with PLC and Power Supply

All the necessary steps for your RTG Fuel Level Measuring System project are covered in this comprehensive methodology, which includes using Rosemount 5408 level sensors and 2240 temperature sensors, using a current simulator in the meantime, and configuring the PLC using the TIA Portal software.

4.10 Conclusion

Steps like sensor integration, PLC setup and programming,, GUI design and implementation, system integration, testing, deployment, maintenance, and updates are all part of the methodology for putting the RTG Fuel Level Measuring System into practice. This comprehensive strategy ensures accurate fuel level measurement, effective data processing, a user-friendly interface, and system reliability over every phase of its lifetime.

Chapter 5

Deployment & Validation

5.1 Deployment and Integration

To precisely measure the fuel levels and tank temperature, we have integrated the Rosemount 5408 level sensor and the 2240 temperature sensor into our RTG Fuel Level Measuring System project. For the purpose of delivering real-time data without physical contact, these sensors are mounted on the fuel tank. Due to delays in sensor arrival, we are first simulating sensor signals using an existing current simulator. We can verify the smooth integration of hardware components and test the system's functionality with this simulator.

The data from the sensors is retrieved and processed by the Siemens S7-1200 PLC Controller. With the TIA Portal software, we were able to programme the PLC and monitor its operations through an all-inclusive platform. After the PLC processes the incoming data, it sends it to our Unity-developed GUI, which shows the temperature and fuel level readings on connected PCs in an easily readable format.

Accuracy and real-time monitoring are ensured by the data flow from the sensors to the PLC and GUI. Sensor data is gathered by the PLC, which converts it into useful metrics that are displayed on the GUI. By enabling operators to make well-informed decisions based on temperature readings and current fuel levels, this setup improves operational safety and efficiency.

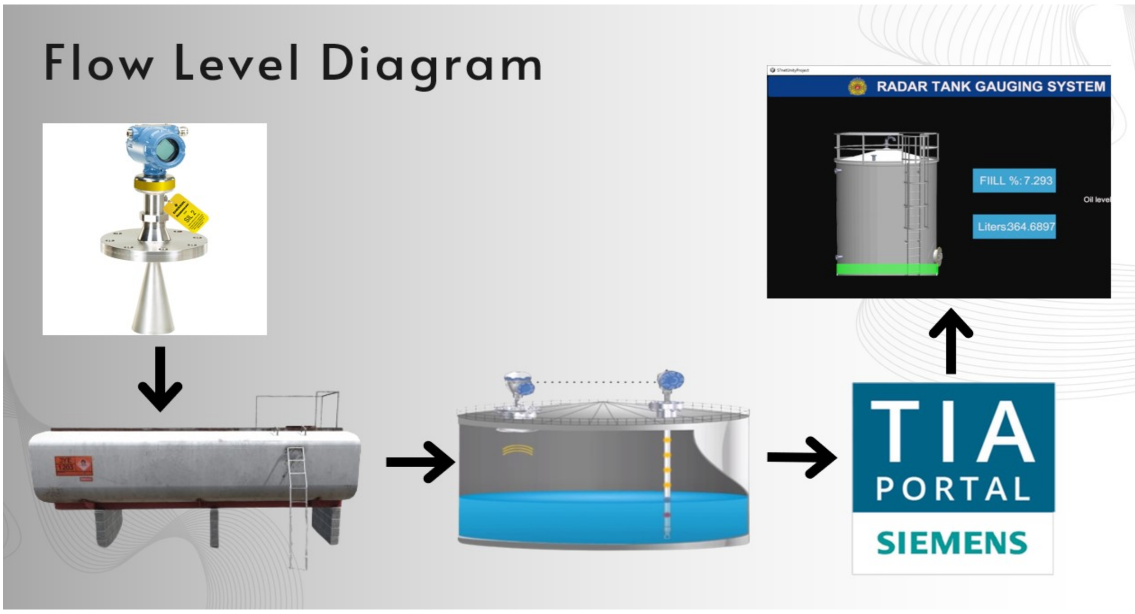

Figure 5.1: Level Diagram

5.2 Validation and Testing

We have put in place a thorough testing procedure to verify the accuracy and reliability of our RTG Fuel Level Measuring System. The main tool for early testing is the current simulator, which simulates sensor outputs. We check how the system reacts to different simulated fuel levels and temperatures to make sure the PLC understands and processes the data correctly.

We will install the system on functional fuel tanks and conduct field tests after the actual sensors are integrated. To verify accuracy, our system's readings will be compared to manual measurements during these tests. We'll also keep an eye on the system's performance over time to spot any unusual behaviours or possible areas for development. Our goal is to ensure the reliability and effectiveness of our system in industrial applications by validating it under real-world scenarios.

5.3 Conclusion

The deployment and integration of the RTG Fuel Level Measuring System involve the incorporation of Rosemount 5408 level sensors and 2240 temperature sensors for precise fuel level and tank temperature measurements. Because of sensor delays, the system first uses an existing simulator to make sure hardware integration and functionality testing go well. Enhancing operational safety and efficiency, data processing by the Siemens S7-1200 PLC Controller is programmed via TIA Portal software and flows into a Unity-developed GUI for real-time monitoring on connected PCs. In order to sustain system effectiveness in industrial applications, comprehensive validation and testing procedures—including virtual and field tests—ensure accuracy and dependability under real-world conditions.

Chapter 6

Conclusion and Future Work

6.1 Conclusion

Fuel monitoring technology has advanced significantly with the RTG Fuel Level Measuring System, which provides an effective and dependable solution for industrial applications. The system ensures high accuracy and safety in fuel level measurement by using non-contact radar sensors, specifically the 2440 Rosemount temperature sensors and the 5408 Rosemount level sensors. Real-time data processing is made possible by the integration with the Siemens S7-1200 PLC controller, giving users access to current data that is essential for efficient fuel management.

Users can easily monitor fuel levels and make quick decisions due to the system's user-friendly graphical interface, which was developed in Unity. Fuel monitoring is a complicated process, but this interface makes it easier to understand reducing the potential for human error.

By lowering the risks involved in manual fuel level measurement, the project seeks to improve safety in addition to operational effectiveness and use of resources. The system's scalable architecture guarantees its flexibility in a range of industrial settings, encouraging greater adoption and encouraging the development of cutting-edge fuel management techniques.

The RTG Fuel Level Measuring System establishes a new benchmark in the industry by combining cutting-edge technology with conventional techniques, enabling smart choices and efficient fuel resource management. The revolutionary technology has the potential to completely transform the way fuel levels are tracked in warehouses, factories, and other types of facilities, guaranteeing uninterrupted operations and organising fuel management procedures.

6.2 Future Prospects

Future developments and integrations for the RTG Fuel Level Measuring System are expected to bring about a variety of improvements and improve its range of applications in a number of industries. Through the application of industry trends and new technologies, the system can provide more reliable and effective fuel level monitoring solutions. Future developments that could occur include:

1. IoT Integration: Using IoT platforms to enable remote monitoring and control.

2. Predictive Maintenance: Early issue detection and maintenance through the use of advanced analytics.

3. Improved Connectivity: Wireless connectivity enables easy integration with additional automated systems.

4. Energy Efficiency: Integrating renewable energy sources and optimising for reduced energy consumption.

5. Global Market Expansion: By addressing various regional needs, it can be used to more global markets.

With these developments, the RTG system will continue to lead the fuel level monitoring technology and provide scalable and effective solutions for a range of industries.

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