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Scada Based System For Controlling And Monitoring Boiler In Ship

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ABSTRACT : The existing system uses GPS and GSM to locate man overboard victims and accidents, but the proposed method makes use of technology to improve victim localization speed and accuracy. In the growing maritime businesses of global transportation, it is critical to increase sailor safety. This is accomplished through the use of MEMS sensors, RSSI technology, and RSSI wireless technology, which decreases the complexity of looking for a man overboard victim.

Keywords: MEMS sensor, RSSI wireless technology, Field detector, RF technology, mob monitor, ais system.

1. INTRODUCTION

A Shipboard Monitoring and Control System (SMCS) can monitor a variety of system data and can trigger an alarm based on preset alarming thresholds. Because it automates a typical operation, using a PLC for monitoring and control increases efficiency. The suggested system includes automatic governor control in steam turbines and boilers, which can be applied in the power ship industry. The technique entails the automatic control of all processes, including the monitoring and inspection requirements, resulting in a highly efficient system. They save money through reducing human resources, reducing the number of errors, increasing efficiency, and being cost-effective. Automation, often known as automatic control, is the use of various control systems to operate equipment such as machinery, factory operations, boilers and heat-treating ovens, telephone network switching, ship steering and stabilization, and other applications with little or no human intervention. A ship must be constantly monitored and inspected at regular intervals.
There are risks of measurement mistakes and multiple processes involving human workers, as well as the lack of a few microcontroller functionalities. With the help of a PLC (Programmable Logic Controller), we are regulating several parameters such as fuel level, RPM, obstacle, and temperature, among others, and controlling the other devices accordingly in this project. The major goal of this system is to use PLC to control and monitor the ship's parameters; we discussed this notion with Goa shipyard engineers, and they provided the necessary information. It can also create an alarm to notify the operator if any of the monitored data exceeds the set points' normal operating ranges. The other devices are controlled by SCADA. The major goal of this system is to use PLC and SCADA to control and monitor the ship's parameters. It can also create an alarm to notify the operator if any of the monitored data exceeds the set points' normal operating ranges. It necessitates on-going

monitoring and inspection at regular intervals. There are a variety of boiling sections in Power ships.
This part of the boiler creates the steam's high-temperature water. Due to a lack of understanding of the operating principles, boiler steam temperature in thermal power ships is extremely complex and difficult to control; boilers have caused several significant injuries and property devastation. It is necessary for the boiler and steam turbine to operate safely. Overheating and damage to boiler tubes might occur if the level is too low. If the level is too high, it may obstruct the separation of moisture from steam and cause moisture to be transferred into the turbine, lowering boiler efficiency. To ensure that the boiler system operates effectively, a variety of controlling mechanisms and control tactics are employed.

It is necessary to design a Boiler Automation system in order to automate a power ship and reduce human interaction. It is accomplished by the use of a Programmable Logic Controller (PLC) and Supervisory Control and Data Acquisition (SCADA) system, which helps to eliminate human errors and avert catastrophic failure. Almost all sectors require the use of a boiler. It can be used at different pressures, ranging from low to high. The document describes the many steps of operation that go into converting a manually operated boiler to a fully automated boiler. This study focuses on boiler control, which is the most critical aspect of any power ship, and its automation. It is necessary to design a SCADA (Supervisory Control and Data Acquisition) system that monitors the ship and helps eliminate human errors in order to automate a power ship and minimize human intervention.
While the SCADA is used to monitor the system, the PLC (Programmable Logic Controller) is used to store instructions for implementing functions like as logic, sequencing, timing, counting, and arithmetic to operate various types of machinery operations using digital or analogue input/output modules. Telecommunications, water and waste management, energy, oil and gas refining, and transportation industries all employ systems to monitor and control a ship or equipment. The first section of the paper concentrates on passing the inputs to the boiler at a specific temperature in order to maintain a specific temperature in the boiler, as well as illustrating the temperature/pressure relationship. The Properties of Steam Table analysis is used to attain the appropriate steam pressure (2Bar) at a specific temperature. Boiler design and modelling, as well as safety considerations, are taken into account. The SCADA screen, which is connected to the PLC, is constantly monitoring level, pressure, and temperature information. A boiler is a closed vessel in which water is heated until it is turned to steam at the desired pressure. Boilers are divided into two categories: water tube boilers and fire tube boilers. Fuel (usually coal) is first burned in a furnace, which produces hot gases.

2. CONTROLLER DESIGN

A Shipboard Monitoring and Control System (SMCS) can track a variety of system data and can trigger an alarm based on preset alarming thresholds. Because it automates a common operation, the usage of a PLC for monitoring and control increases efficiency. A programmable logic controller (PLC) is a device that allows you to control A PLC, or Programmable Controller, is a digital computer that is used to automate electromechanical processes such as factory assembly line machinery control, amusement rides, and light fixtures. PLCs are utilized in a wide variety of industries and machinery. In contrast to a general-purpose computer, a PLC is built for numerous input and output configurations, electrical noise immunity, and vibration and impact tolerance. Memory backed up or

nonvolatile memory is used to store programmes that regulate machine operation. A PLC is an example of a hard real time system since the output result must be produced in a restricted amount of time in response to the input condition, or else unexpected operation will occur. Continuous or point values can be used for level measurement.
Continuous level sensors identify the exact amount of material in a specific location by measuring the level within a specified range, whereas point-level sensors merely show whether the substance is above or below the sensing point. A temperature sensor is a device that collects temperature data from a source and converts it into a form that an observer or another device can understand. An inductive sensor is a type of electrical proximity sensor that detects metal objects without having to touch them. Sharp IR sensor is a distance measurement sensor unit made up of a PSD (position sensitive detector), IRED (infrared emitting diode), and signal processing circuit all in one. The voltage output of this gadget corresponds to the observed distance. SCADA (Supervisory Control and Data Acquisition) is used to monitor the system, while PLC (Programmable Logic Controller) is used to store instructions for implementing functions such as arithmetic, counting, timing, sequencing, and logic to control various types of machine processes using digital or analogue input/output modules. Continuous monitoring and inspection at regular periods are required for power ships. There are different methods for measuring human worker faults and stages, as well as the lack of a few microcontroller characteristics [1]. It is possible to manage and monitor the turbine speed. This work focuses on automatically establishing governor control in steam turbines in boilers that can be used to power ships. It is primarily concerned with managing the turbine's speed by placing a pulse encoder on the turbine shaft. As a result, the boiler's parameters are constantly checked, and steam is generated according to demand.

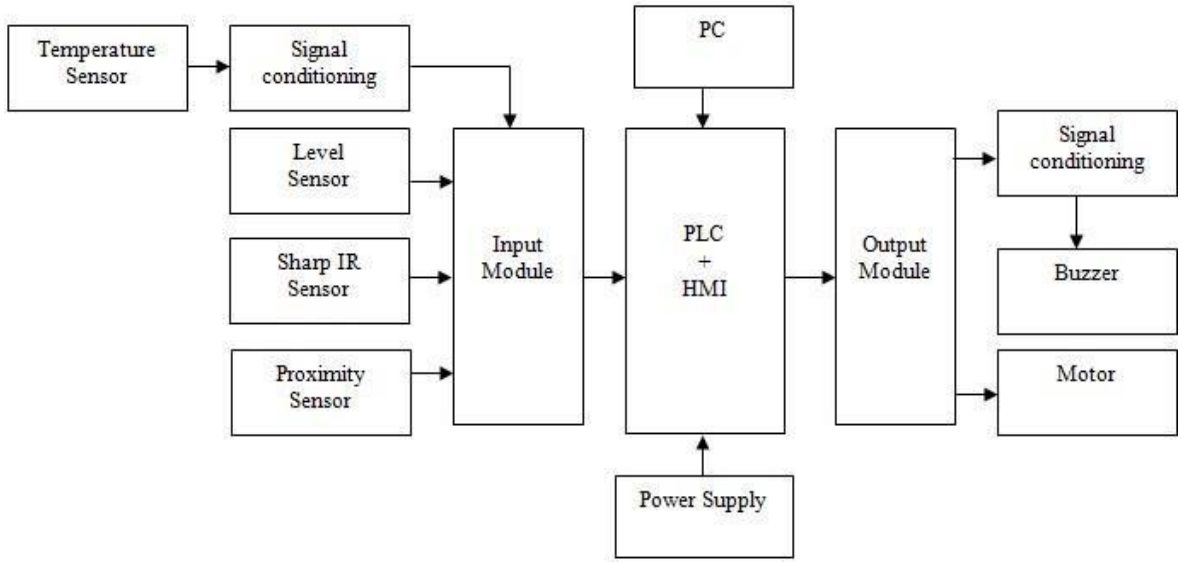

Figure 1. Fully Automated Boiler Control using PLC and SCADA

PLCs can readily automate the process (SCADA). A steam turbine is a device that uses pressurized steam to extract thermal energy and use it to perform mechanical work on a revolving shaft. The rotating motion created by the turbine is ideal for driving an electrical generator. Turbine governor control is critical because turbines must be ramped up gently to

avoid damage, and some applications necessitate precise speed control. The SCADA system is used to monitor the system, and the PLC (Programmable Logic Controller) is used to store instructions for implementing functions such as arithmetic, counting, timing, sequencing, and logic to control many types of machine processes using digital or analogue input/output modules. Increased human resources, reduced human resources, increased efficiency, and, most crucially, cost effectiveness are all reduced [3]. The amount of steam produced is utilized to rotate and control the turbine's speed. As a result, electricity can be created based on demand. In the industry, centrifugal and fly-ball governors are employed to keep the turbine running at a constant speed regardless of the load or fuel supply.
The suggested system includes automatic governor control in steam turbines and boilers, which can be applied in the power ship industry. The technique entails the automatic control of all processes, including the monitoring and inspection requirements, resulting in a highly efficient system. They save money through reducing human resources, reducing the number of errors, increasing efficiency, and being cost-effective.

3. SYSTEM DESIGN

This project has been meticulously planned to ensure optimal synchronization. The entire project is divided into two parts: (i) control and (ii) field device.

3.1. Simulation of Boiler Control Using PLC & SCADA

The temperature, pressure, and volume of the boiler are all monitored by this system, which is controlled by a PLC [8]. The PLC output regulates the temperature and pressure of the boiler, allowing the user to get the exact amount of steam they want. All temperature and pressure changes are displayed on the SCADA screen and managed by SCADA. In the event of an emergency, various types of automatic check valves are utilized to release pressure and notify the appropriate authority via an alert. There is the possibility of measurement errors and multiple processes involving human workers, as well as the lack of a few microcontroller functionalities. As a result, this article makes a sincere effort to illustrate the benefits that firms would experience as a result of applying automation. This study focuses on boiler control, which is the most critical aspect of any power ship, and its automation.

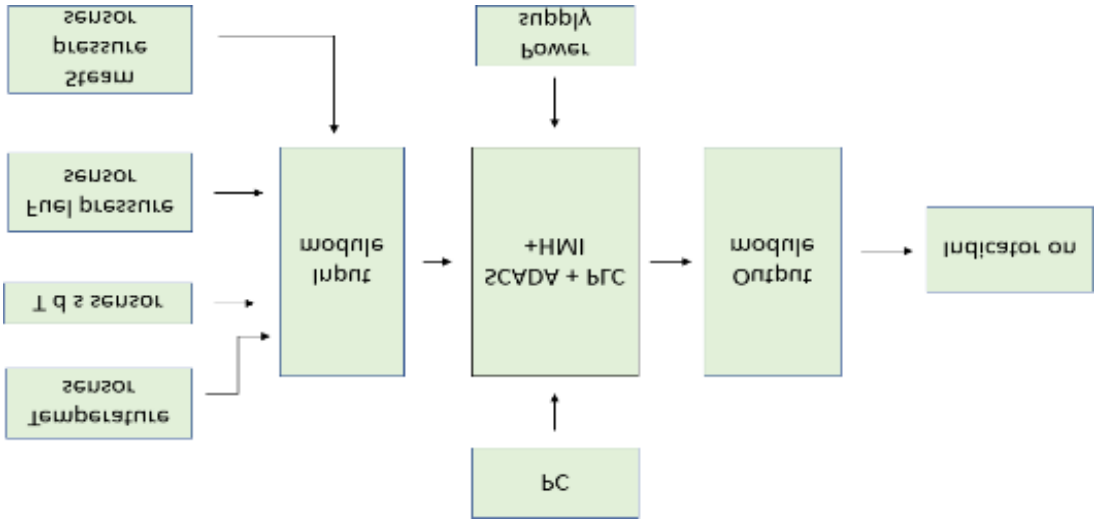

Figure 2. Design of Boiler using PLC and SCADA

3.2. PIC 16F877A:

Because of its unique properties, it is a logical embedded controller that can replace today's Microcontroller. The PIC16F877A is employed due to its excellent performance, inexpensive cost, inbuilt analogue to digital converter, and EPROM; it only contains 35 instructions, making programming simple. In comparison to other 8-bit micro controllers in their class, PIC16F877A micro controllers typically achieve a 2:1 code compression and a 4:1 speed boost. The PIC is the system's primary control region. All data collected in the field is processed in accordance with the requirements. If an emergency situation arises, the PIC transmits a voice output to the train driver, alerting him to the situation and preventing an accident from occurring. The PIC transmits signals to the control region based on the train's position, causing the gate to close at the proper kilometer from the gate. When the train is 4 kilometers away from the gate, the gate is totally closed, and when the train is 2 kilometers away from the gate, the gate is completely closed. If something goes wrong during this operation, a voice output is generated to alert the controller and driver.

3.3. RS232 Converter:

When serial data must be transferred over a long distance, the PIC's USART will not be effective. As a result, an RS232 interface is recommended for this project. When an embedded system is connected to a computer, it must adhere to the RS 232 protocol (recommended Std 232). The RS232 is used to demonstrate the computer in real time. A speed of 19,200 baud is used to transmit an 8/7-bit signal. The RS232 uses a voltage range of +10 V to -10 V, whereas the PIC uses a voltage range of +5 V to -5 V. As a result, a MAX232 circuit is provided to enhance the voltage value. This creates a seamless connection between the PIC and the RS232. In industries, the Max233 is utilized instead of the Max232 since the MAX232 circuit requires more capacitors.

3.4. Personal Computer:

The RS-232 port connects the PIC Micro controller to the PC. The train's animated output is displayed on the PC, allowing us to see the train's actual location. The trains exact location can be viewed by all of the stations in its course, and any difficulties that occur on the track may be signaled to all of the stations in its path, all with the use of this networking feature. Customers should expect a transparent and dependable railway service as a result of this.

3.5. Boiler:

A boiler is a closed vessel in which water is heated until it is turned to steam at the desired pressure. Boilers are divided into two categories: water tube boilers and fire tube boilers. First, fuel is burned in a furnace, resulting in hot gases, as seen in Fi. These heated gases come into contact with a water vessel, where their heat is transferred to the water, resulting in the production of steam in the boiler. The steam is then pumped to a thermal power ship's turbine. Boilers are used for a variety of functions, including running a production line, sterilising equipment, disinfecting a space, and warming the environment.

3.6. Temperature Sensor:

The temperature difference is detected using a Resistance Temperature Detector (RTD PT 100). It is a passive circuit element whose resistance increases in a predictable manner as the temperature rises. A PT-100 is a precision platinum resistor with a resistance of 100 ohm at 0 degrees Celsius. Figure 3 depicts a typical RTD. It is necessary to convert the resistance to a voltage and utilize that voltage to drive a differential input amplifier in order to measure it.

The differential input amplifier rejects common mode noise on the RTD leads, resulting in the highest voltage sensitivity.

4. SIMULATION

4.1 SOFTWARE USED:

4.1.1. Delta PLC

A programmable logic controller (PLC) is an electronic-based control system. Delta's DVP series programmable logic controllers are used in a wide range of industrial automation units because they are fast, stable, and reliable. PLC stands for programmable logic controller, and it was first used in the control and instrumentation industries to replace relay-based logic [4]. Better I/O handling capabilities and new programming features, as well as improved communication, have been added over time.

4.1.2. King View Scada

WinTr is a sophisticated SCADA software system for monitoring and storing data from manufacturing operations that span broad areas. Devices can be connected to OPC Client, S7 MPI, S7 PPI, Profinet (S7 1200), Modbus RTU, Modbus TCP/IP, Host-Link protocols (Omron), and Mewtocol protocols from a single station (Panasonic). Our SCADA SYSTEMS preserve historical data about processes in a database.

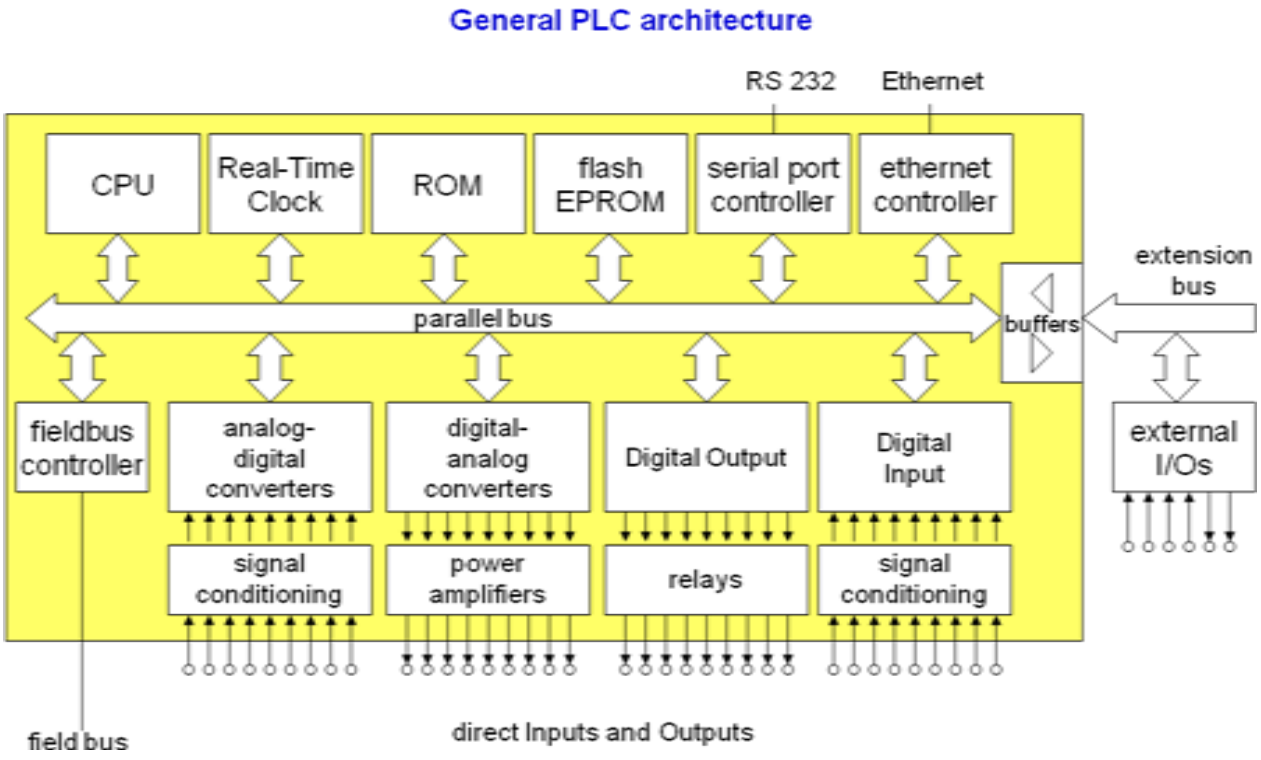

Figure 3. General PLC Architecture

4.1.3. PLC Working

At the start of each cycle, the CPU gathers all of the field input signals from the module's

input signals and stores them in internal memory as a process of input signal. Process input picture refers to the internal memory of the CPU (PII). In CPU programme memory, a user programme (Application) will be available. After reading PII, the CPU pointer in the ladder programme advances from left to right and from top to bottom. The CPU receives input status from the PII and processes all of the rungs in the user application. The results of the user programme scan are saved in the CPU's internal memory. Process output image, or PIQ, is the name given to this internal memory. The CPU sends the signal states in the process image output to the output module and then to the field control at the end of the programme run, i.e. at the end of the scanning cycle. Continuous scanning of a programme is the foundation of a PLC function.

There are three essential processes in the scanning process.

Step 1: Checking the status of the input
Step 2: Execution of the programming
Step 3: Verifying and correcting the status of the output

4.1.4. SCADA

Supervisory Control and Data Acquisition is an acronym for supervisory control and data acquisition. It is not a full control system, as the name implies, but rather concentrates on the supervisory level. As a result, it is essentially a software package that sits on top of hardware with which it communicates, usually using Programmable Logic Controllers (PLCs) or other commercial hardware modules. SCADA systems are utilised in a variety of industrial operations, including steel production, power generation (both conventional and nuclear), and distribution, as well as some experimental facilities such as nuclear fusion. The number of input/output (I/O) channels on such ships might range from a few thousand to many tens of thousands. SCADA systems, on the other hand, are fast evolving and are now infiltrating the market for ships with several hundred thousand I/O channels; we are aware of two cases with close to one million I/O channels under development. SCADA systems used to run on DOS, VMS, and UNIX, but all SCADA suppliers have switched to Windows NT in recent years. A Linux-compatible product was discovered.

4.1.5. Field Instrumentation

The SCADA RTU is a compact ruggedized computer that delivers intelligence in the field and allows the central SCADA master to interface with field instruments (ideally). It's a self-contained data acquisition and control system. Its job is to control process equipment at a remote location, collect data from the equipment, and send the data back to the SCADA system in the control room.

4.2. SIMULATION OUTPUT

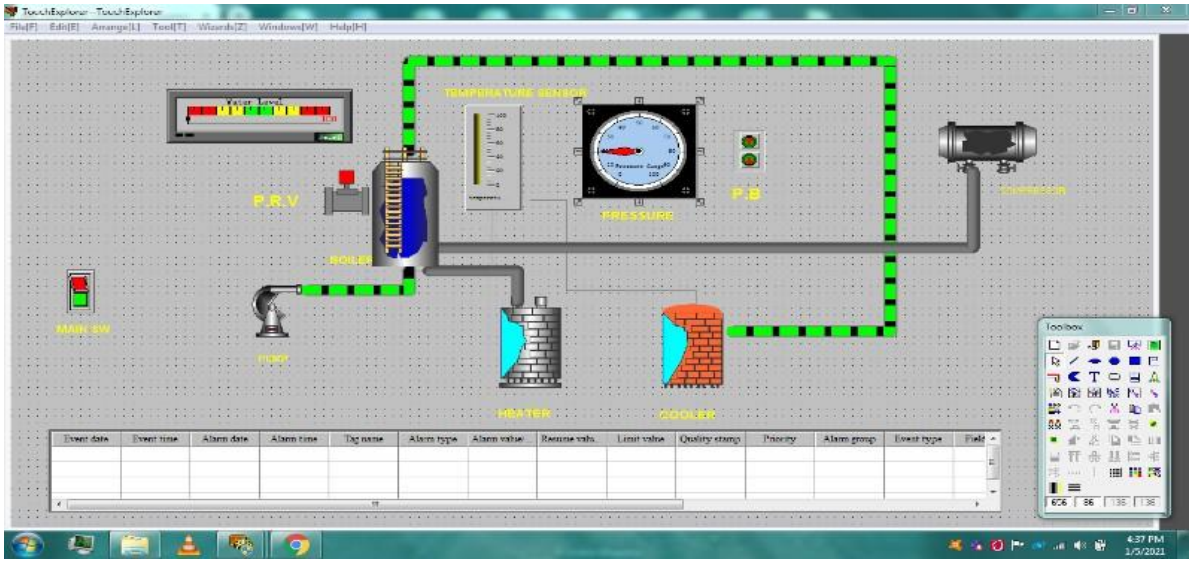

Figure 4. Boiler Automation using PLC and SCADA

5. CONCLUSION

PLC and SCADA were used to develop and implement boiler automation. Temperature, pressure, and water level are all measured using various sensors. The parameters are monitored using SCADA, and the operation is controlled using PLC. The entire arrangement will shut down if the temperature and pressure reach a predetermined value, and automatic check valves will open to discharge the steam and pressure. To avoid catastrophic failure, an emergency alert was activated and automatic check valves were opened. WPL soft is used to model the ladder diagram of a Delta PLC, and Intouch wonder ware software is used to simulate the SCADA design of boiler automation. The next research will concentrate on the application-oriented implementation of SCADA internet connection for remote monitoring of boiler automation. The boiler control is the most crucial part of any power ship. The boiler in a power ship can be controlled using a variety of methods. The method that must be employed is determined by varied objectives such as improved profit, increased efficiency, superior quality, and other factors that are dependent on the company's purpose. Automation has become necessary to meet the primary goal of catering to these facilities and the needs of the industries.

The changes that are constantly taking place in the contemporary industrial sector are the subject of this work. The automation process, which is gradually assuming its position in all power ships throughout the world, has been given priority. It has prepared itself to investigate the critical components of the entire process, as well as their implementation and any questions that may arise. The job entails utilising a PLC to regulate the boiler's settings, namely the turbine's speed.

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