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SMART CONTROL SYSTEM FOR EARLY BOILER DETECTION

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Abstract

Steam boilers are used in many industry sectors, such as the food industry, textile mill, paper factory, sugar mill, oil field, power plants and other industries. Boiler explosion is a very widespread problem that can be easily averted by just keeping a log of boiler data and understanding its behavioural trends in real time systems. Since these data are not accessible nor is properly recorded, every year lots of avoidable boiler explosions still occur. This project devises a strategy to solve this issue by tracking all the vital readings from a boiler and documenting it. Over a period of time, boiler operating logs help distinguish operating trends that can allow problems to be diagnosed, and boiler system maintenance to be scheduled, before an emergency shutdown is necessary. For instance, a steady rise in stack temperature, at the same boiler load, indicates dirty boiler firesides or waterside scale build-up. In either case, remedial action can be taken before it is necessary to shut the unit down for cleaning. This data will be collected by using an Arduino UNO R3 microcontroller and then accordingly a servo motor is rotated so that the right number of substances are sent into the boiler.

Keywords: Boiler, Data, Explosion, Industry, Log, Strategy, System.

1. INTRODUCTION

Every year there are several boiler explosion cases, and we designed a project that can solve this avertable accident. The project is focussed on getting various data required from the boiler and using that to analyse the possible threat, then accordingly the solution will be deployed. One of the classic mechanisms would be, when the temperature rises, our circuit will make the valve sending in fuel reduce the amount sent. Hence the temperature will reduce.

This problem is avertable, because of the fact that there is no timely monitoring and alerting the concerned worker or people responsible for the control of the boiler. So, we have devised a strategy to solve this issue by tracking all the vital readings from a boiler and documenting it. Over a period of time, boiler operating logs help distinguish operating trends that can allow problems to be diagnosed, and boiler system maintenance to be scheduled, before an emergency shutdown is necessary. This problem is not only

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restricted to boiler plants, but any industrial application where there is a need for controlling the amount of input substance into a chamber and monitoring necessary parameters. So on a larger scale the same application could be taken and applied on to several other industrial applications that have similar functionality.

2. LITERATURE SURVEY

In [1] G Lian et al proposed a paper that rigorously examines safety accidents in Chinese power plant boilers, drawing from a decade's worth of literature and case data. The analysis is grounded in scientific and rational methodologies, categorizing factors into human, equipment, environmental, and management aspects to identify primary causes. It distills key accident characteristics and offers valuable insights to prevent and address boiler accidents. This research significantly contributes to improving safety in power plant operations, particularly in China. In [2] Lasse Johansson et al proposed a paper that introduces the design of an industrial microcomputer control system tailored for a 1.6-MW solid fuel boiler. The paper delves into instrumentation and control strategies relevant to the boiler's operation. The microcomputer system, based on standard iSBC microcomputer boards, is detailed along with the software components, which include a real-time operating system RXM/80 and application tasks. The system's design is showcased for its capability to enhance fuel efficiency and overall operational reliability, signifying its potential to contribute to more efficient and dependable boiler performance. In [3] Mr. Hamjad Ali Umachagi et al proposed a paper that addresses the challenges of operating and maintaining thermal power plants in remote and hazardous environments. With increasing power demand, there's a growing need to enhance safety and reduce operational and maintenance costs to ensure power plant reliability. Given the 24/7 operational nature of thermal power plants, continuous on-site monitoring of boiler parameters becomes impractical. To address this, the paper presents the development of a sensor network-based system for remote monitoring of a boiler feed water unit. The system employs level, temperature, and pressure sensors, with data processing facilitated by an 8051 microcontroller and a PCF8591 A-D/D-A Converter. This technology enables the auto mode operation of thermal power plants and provides real-time monitoring of boiler parameters, enhancing safety and operational efficiency. In [4] Michel Fattoucho et al proposed a paper that addresses the traditional manual control methods used in oil pumping units (OPUs) in oilfields, which consume significant power and lack the ability to monitor the structural health of OPUs. To address these issues, the paper introduces a sensor network-based intelligent control system designed for power efficiency and effective health monitoring of oil wells. This sensor network consists of three levels of sensors: basic sensors (first level sensors or FLS) for data sensing, intelligent sensors (second level sensors or IS) for data processing, fault detection, and data transmission, and software-defined control centers (third level sensors or TLS) for data storage, management, and malfunction detection. The system enables power-efficient operation, malfunction reporting, and command transmission, enhancing the efficiency and health monitoring of oil wells in the field. In [5] C. Rojiha et al proposed a paper that addresses the prevailing manual control practices in oil pumping units (OPUs) within the oilfield, which are both power-intensive and reliant on manual labor. To mitigate

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these challenges and enhance the efficiency of oil well health monitoring, the paper proposes a sensor network-based intelligent control system. The system incorporates a range of basic sensors, including voltage, current, oil pressure, temperature, and gas sensors, to collect data from the oil wells. This collected data is then processed by a controller, which subsequently provides instructions to the oil pump control unit for managing the oil pumping process. In the event of any abnormalities or malfunctions, the system promptly notifies the maintenance manager. Notifications are relayed via SMS through a GSM network, enabling remote monitoring and control of oil wells, reducing the need for on-site manual intervention and enhancing overall operational efficiency. In [6] Ganesh V. Padole et al proposed a paper that addresses the challenges of overseeing a sprawling oilfield where oil extractors operate continuously. It highlights issues of theft concerning petroleum, transmission lines, and transformers, necessitating a robust security and management system. However, the complex geographical environment poses a considerable obstacle to implementing traditional security measures, such as laying fiber cables across vast areas. To tackle these challenges, the paper proposes the establishment of a remote wireless monitoring and control system. This system is designed to efficiently manage data from various sites while ensuring security through automated control structures. By opting for wireless technology, it eliminates the need for extensive cabling, reducing both cost and resource-intensive maintenance and theft prevention efforts. This solution offers a practical and cost-effective way to monitor and secure oilfields, especially in challenging geographical conditions, where traditional methods are less feasible. In [7] Joshuva Arockia Dhanraj et al did a research which focuses on the vital aspects of temperature and pressure regulation in the continuous operations of thermal power plants. It highlights the integral role of temperature and pressure sensors, which are controlled by a real-time program. These sensors are instrumental in monitoring and controlling temperature and pressure throughout the plant's processes. The study presents the development of temperature and pressure sensors utilizing Micro-Electro-Mechanical Systems (MEMS) technology. These sensors are integrated with LabVIEW for data acquisition and control. The primary application of this research is in thermal power plants, especially those emitting high-frequency waves. These waves can interfere with wireless data transfer. To address this issue, the research employs the Controller Area Network (CAN) for seamless information sharing, reducing the impact of frequency noise. Additionally, the study leverages LabVIEW to centralize the control and monitoring of industrial processes within a single control room. This approach not only streamlines operations but also reduces the need for extensive manpower, contributing to the efficiency and reliability of thermal power plant processes.

In [8] Rong-xing Duan et al proposed a paper that addresses the critical aspect of ensuring the safety and efficiency of boiler operations in power plants, where the stability of combustion plays a pivotal role. To precisely monitor the flame states in real-time, the research introduces a novel boiler flame detection system based on the TMS320DM642 (DM642). The paper primarily focuses on the hardware design, the algorithm design employing fuzzy C-means (FCM), and the integration of this system.The developed detection system undergoes testing using flame image data collected from a power plant burner in southeast China. The results highlight the system's significant advantages,

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including efficiency, real-time monitoring, and stability. This innovative approach offers a robust solution for enhancing the safety and efficiency of boiler operations in power plants, particularly in the context of real-time flame state monitoring. In [9] Huahai Qiu et al proposed a paper that focuses on the extraction methods employed to determine the boiler flame area within the boundary layer. The process involves converting CCD image data into a binary two-direction matrix using binarization techniques. The system leverages ARM (Advanced RISC Machine) for high-speed data processing, enabling the extraction of the boiler flame area's boundary layer position. The boundary layer's various regions, including unburned areas, areas with fire, and combustion zones, are represented as digital images through a circle overlap method. This visual representation is displayed on the screen, effectively delineating the boiler's flame district boundary layer. The ARM-based system then analyzes and extracts this data, providing valuable information for power plant operations. This approach contributes to the accurate and effective monitoring of the boiler's flame boundary layer, enhancing the power plant's operational insights. In [10] MS Ali et al proposed a paper which provides a comprehensive overview of the boiler landscape in Bangladesh, emphasizing standard inspection practices, registrations, and safety considerations. Boilers serve as a primary driving force behind the country's industrial sectors, including textiles, pharmaceuticals, manufacturing, and food processing. With 6,071 registered operational boilers as of 2017-18, the Office of the Chief Inspector of Boiler, a government authority under the Ministry of Industries, is entrusted with ensuring their safe operation nationwide. The paper delves into the various aspects of boiler usage, legislative acts, rules, regulations, inspection protocols, registration procedures, and the functions of the Boiler Inspectorate in Bangladesh. Furthermore, it briefly presents data from the past five years related to boiler accidents and registrations in the country. This comprehensive insight sheds light on the critical role of boilers in Bangladesh's industrial landscape and the measures in place to ensure their safe and effective operation. In [11] L Su et al proposed a paper that addresses the limitations of traditional power plant boiler performance diagnosis methods and introduces a novel approach incorporating fuzzy comprehensive evaluation. The method considers three critical aspects of boiler performance: safety, economy, and environmental protection, to identify performance parameters comprehensively. It employs two rounds of fuzzy comprehensive evaluation to ensure a precise understanding of all facets of boiler performance. By combining fuzzy theory with practical considerations, the paper establishes membership functions for each performance parameter. This approach not only assesses the overall boiler performance but also offers well-informed judgments on safety, economy, and environmental protection. The evaluation method provides boiler operators with a comprehensive grasp of boiler performance, serving as a valuable tool for real-time performance assessment and the early detection of potential operational issues. In [12] Rashmi Welekar proposed research that aims to enhance boiler safety by implementing a monitoring system that assesses crucial parameters such as temperature, pressure, water level indication, and water hardness. The objective is to compare these measurements with reference values to determine the boiler's operational status. Factors such as irregular cleaning and inadequate coal supply can lead to temperature spikes, potentially resulting in explosions.

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The research focuses on automating temperature monitoring and establishing a robust warning and alarm system to promptly address any deviations from optimal operating conditions, thereby ensuring the safe and efficient functioning of the boiler. In [13] Trung Do Cao conducted a study that builds upon prior research, applying a practical application in the industrial context. It introduces a numerical method utilizing the "cleft-over-step" algorithm for identifying technological processes. Additionally, robust-based control theory is employed to fine-tune the PID (proportional integral derivative) controller. These methodologies are integrated into an industrial boiler control system, implemented through a programmable logic controller (PLC), specifically the Siemens PLC S7-1200. The focus is on designing and programming a comprehensive control and monitoring system for a Circulating Fluid Bed (CFB) industrial boiler. The outcome enables fully automated operation of industrial boilers, with a control interface on the PLC S7-1200, facilitating remote monitoring and intervention by operators from a central control room. In [14] Akshay Talware et al proposed a paper that addresses the crucial role of boilers in power plants, chemical industries, and pharmaceutical industries, emphasizing the need for continuous monitoring and inspection. It discusses the transformation of manual boiler operation into an Atomized Industrial system through the integration of Programmable Logic Controller (PLC) and Supervisory Control and Data Acquisition (SCADA) technology. The paper highlights the effectiveness of this automated approach compared to conventional methods, aiming to eliminate human errors such as unreliable readings and poor inspection. The main focus is on designing and developing a boiler automation system using PLC, SCADA, and sensors to maintain the required water level in the boiler drum. The SCADA system monitors boiler feed water flow, steam flow rate, and water level through sensors, with the PLC controller regulating these parameters. The system is designed to shut down and trigger an emergency alarm if the water level deviates from the critical value. The ladder diagram for boiler automation is created using RS Logix 500, and SCADA design is implemented with Factory Talkview software. In [15] Sangeeth G et al in the context of increasing energy demand surpassing supply, there is a critical emphasis on energy conservation programs and policies. Many continuous process plants consume substantial amounts of energy, prompting a need for efficient management of process systems. This management is seen as a means to achieve energy savings, enhance process efficiency, reduce operating and maintenance costs, and enhance environmental safety. Given the heightened focus on energy conservation, existing process systems are undergoing modifications to improve energy efficiency. The primary objective of the present work is to investigate the impact of system modifications on energy efficiency, with a keen awareness that any proposed enhancements must demonstrate economic feasibility to gain acceptance for implementation. In [16] Tahsin et al proposed a research paper that addresses the escalating demand for automated machinery in a globalized world, with a specific focus on the significance of boilers in industrial and power plant operations. Acknowledging the limitations of manual monitoring and measurement of boiler parameters, the paper presents the design and implementation of an automated boiler control system using Programmable Logic Control (PLC). The core objective of the research is to mitigate errors and ensure uninterrupted monitoring by automating the start and stop functions of the boiler system based on

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predefined values. The system incorporates sensors to measure temperature, with the PLC processing these signals to regulate the boiler. Additionally, manual control is facilitated through an ON-OFF push button, allowing the boiler to operate for a specified duration. The research emphasizes the relevance of automated systems in enhancing efficiency and meeting the increasing demands of the globalized industrial landscape. In [17] T. Karuppia et al proposed a paper for an embedded system based industrial power plant boiler automation system using microcontroller and GSM technology. The system consists of a main water tank that supplies a number of boilers. Each boiler has two pipes, one for inlet and one for outlet. The pipes' valves are controlled by temperature sensors located in each boiler. The microcontroller is responsible for monitoring the water level in the main tank and controlling the valves on the boiler pipes. The GSM modem is used to send SMS alerts to the user when the temperature inside any boiler reaches a maximum preset value. In [18] James et al proposed a research paper that explores the fundamental characteristics and classifications of steam boilers, which are sealed vessels designed to generate steam pressure exceeding atmospheric levels. The process of "harnessing" steam is discussed, emphasizing the resulting increase in pressure, boiling temperature, and energy content. Differentiation among boiler types is based on design, combustion method, and fuel type. The paper specifically focuses on two high-pressure steam generation designs: water tube boilers and flame tube/smoke tube boilers. These designs cater to different pressure and output ranges, with applications ranging from quick steam generation to high-pressure water tube systems. The importance of boiler control, recognized as a critical element in power plants, is highlighted. The paper underscores the necessity for automation in power plants to minimize human intervention, proposing the development of a Distributed Control System (DCS). This DCS is envisioned to effectively control and monitor the power plant, thereby reducing human errors and enhancing overall operational efficiency. In [19] Udaykumar S. et al proposed an article that discusses the increasing demand for automation in industrial applications, driven by the need for higher productivity, lower total cost of ownership, and improved safety. It highlights the role of FPGAs (Field Programmable Gate Arrays) in meeting these design goals, offering a range of devices with varying complexity and performance levels. The paper proposes the design and implementation of boiler automation using FPGAs, with water level control and temperature sensing. The system allows users to retrieve real-time temperature information from boilers through SMS alerts, providing a cost-effective and integrated solution. The design is described using VHDL and implemented in hardware using FPGAs, GSM modems, and sensors. In [20] S. Kalaivani et al proposed a research paper that discusses the automation of critical equipment in a thermal power plant, specifically focusing on the boiler and coal conveyer system. The automation, facilitated by Programmable Logic Controller (PLC) and Supervisory Control and Data Acquisition (SCADA) systems connected through communication cables, aims to improve efficiency and reliability in power generation. Various sensors monitor parameters like temperature, pressure, belt tearing, overloading, and water level. If these parameters exceed set values, the SCADA system alerts the operator. Automation involves creating ladder logic for controlling the boiler and coal conveyer belt. The SCADA system provides real-time status updates, enabling operators to take corrective actions. In emergencies,

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automated check valves release pressure and steam, triggering alarms for authorities. The paper also addresses common faults in the coal conveyer belt, emphasizing the importance of automated systems in fault detection and response.

3. THEORY

The overall project incorporates the mixture of sensor integration, LCD integration and serial communication which has been used in the case of the proteus simulation virtual terminal. The sensors used are temperature sensor, PIR sensor, servo motor which is an actuator. The entire theoretical portion can be divided into the portions used in the making of this project.

3.1 LCD Integration

Liquid Crystal Display (LCD) is a display system which uses crystal and consumes less power compared to that of the LED. For our case we are using a 16x2 display LCD. It means that 16 characters can be printed in a line and contains two lines of display. Therefore, our LCD can print 32 characters overall.

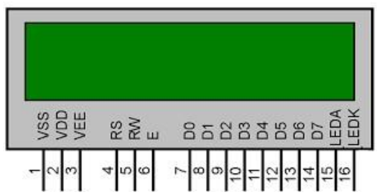

Figure I: 16x2 LCD Pinout

The Vss pin is connected to the ground and the Vcc in the input voltage required in order to switch the LCD on which is 5V. RS stands for Register Select, when it is 0, it stands for command register where the MCU gives the command to the LCD. If the register select is 1, MCU sends the data that is to be displayed to the LCD. RW is the read and write pin of the LCD. When the value is 0, it enables the read activity of the LCD where the data is written to the LCD or in other terms, MCU sends the data to the LCD. When the value is 1, it activates the write mode in which the LCD displays the contents and the value is read by the user displayed on the LCD. The pin E is toggled in order to display the data. Initially it is set to 1 but when it turns to 0, the LCD displays the data and again the normal condition of 1 is set when the displaying process is completed. Pin D0 to D7 are the data pins which are connected to the microcontroller which sends the data in bits format starting from the LSB to the MSB.

4. WORKING

Our project is mainly focused on getting sensor values of temperature and humidity and using those values, we control the servo motors. The servo motors are responsible for controlling the valve that opens and closes the fuel or any stored liquid based component being sent into the boiler. This can give an overall control over the hazard regulations of the boiler. The overall Simulation was done in Proteus, we connected all the sensors to the microcontroller, except the Pressure sensor the rest were digital sensors, therefore

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an analog to digital converter was connected to the pressure sensor so that the values are stored in the microcontroller. The real time values of the sensors are tracked and displayed in small intervals in the LCD display placed in the circuit. Overall the servo motors are made to rotate according to the amount of value difference shown in the sensors. If it goes above or below certain values, the servo motors are rotated in respective directions.

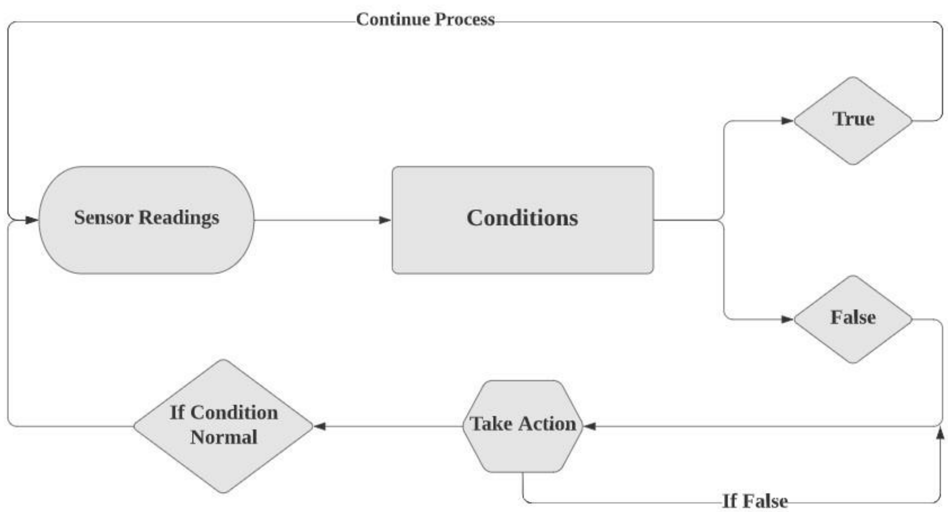

Figure II: Algorithm Structure of the System

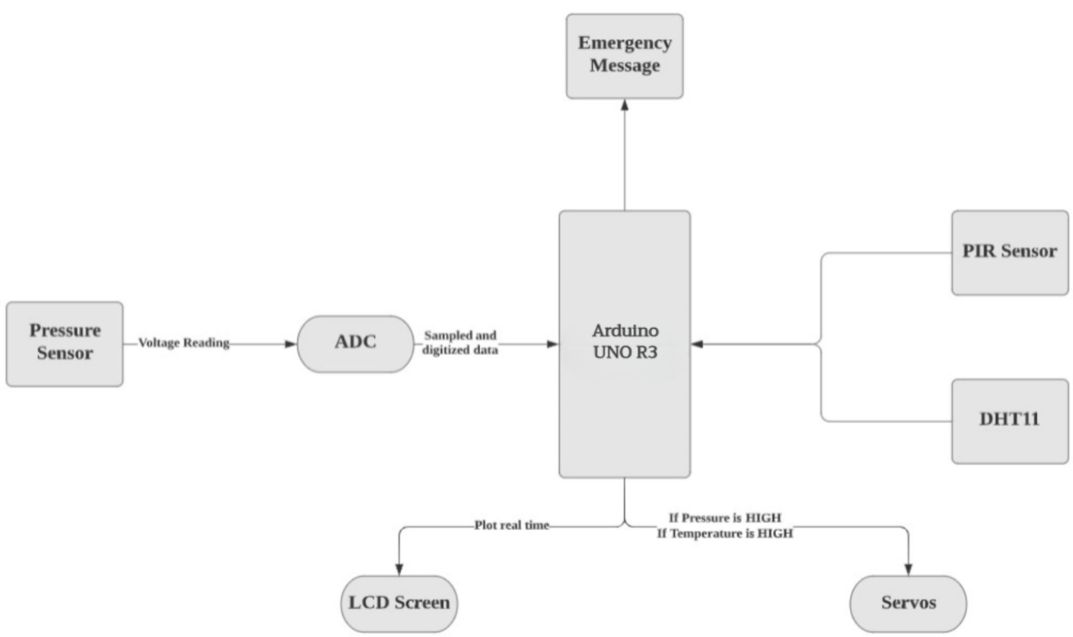

Figure III: Project Block Diagram

Presently, we use distributed control systems in the industries, using a panel control unit to control and monitor the temperature and flow parameters. Manual assistance at all

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times when the plant is in operation is the limitation of this system. The person who is present inside the plant during an emergency also is in risk of his/her life in case of any emergency. Hence, we propose a model so that the operating person can remotely control and monitor the boiler feed water in a power plant. Boiler parameters such as water level, pressure and temperature are monitored using water level sensor, pressure sensor and temperature sensor respectively. The real time information of these parameters will be sent to the programmed decision making microcontroller unit which will turn ON/Off corresponding parameter relays and its associated switching units depending upon the real time information received from the various parameter relays, if the operating conditions are well within the preset limits then no control command will be sent to the relay via the decision making microcontroller or else if there is any violation in the operating conditions then microcontroller will send the control signal to the associated relay to turn ON/OFF depending on the real time information. The real time information can be visualized on the LCD display and the same information can be sent to the mobile-phone registered number in the form of SMS via GSM

5. SOFTWARE IMPLEMENTATION

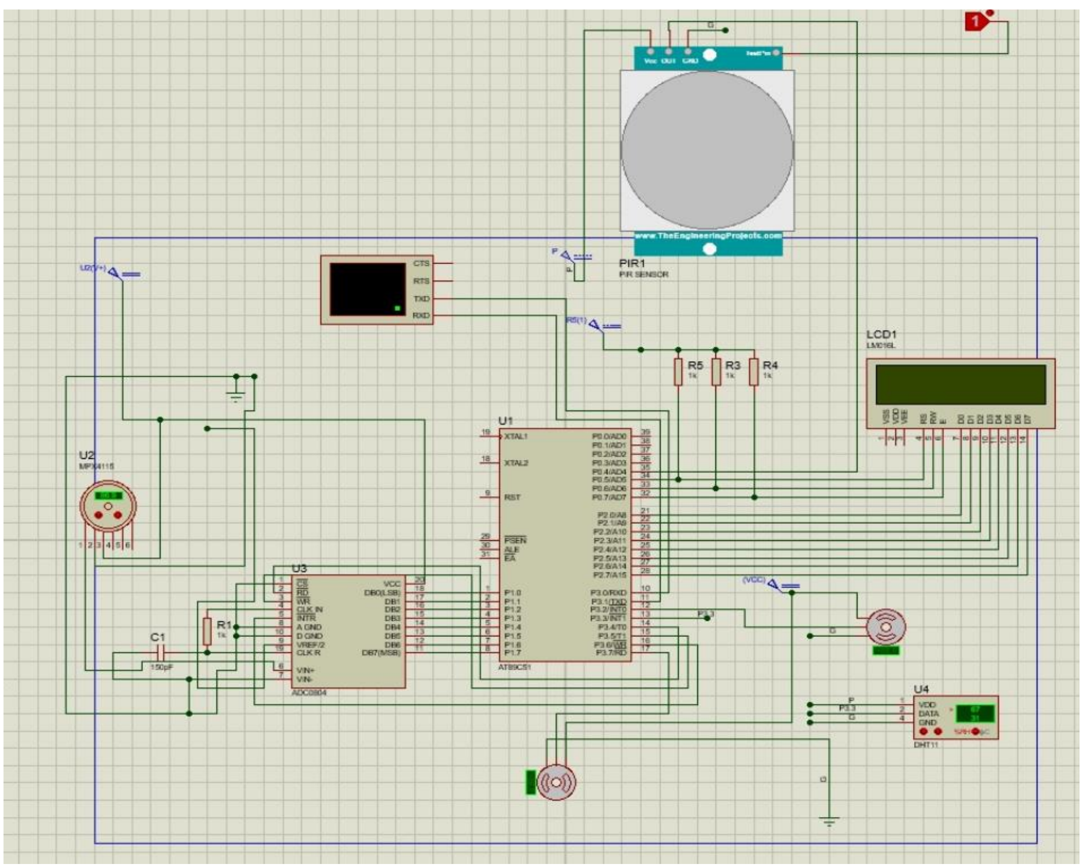

Figure IV: Proteus Circuit Diagram

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In this system transmitter section mainly consists of three sensor networks which senses various boiler parameters. Temperature sensor, PIR sensor and pressure sensor are used in this model. Sensors analog output are connected to ADC (Analog to Digital Converter) to convert analog information to digital form, then this digital information is processed using Arduino UNO R3 microcontroller. Arduino UNO R3 microcontroller does the controlling section. Whole sensor’s data are stored in the processor memory and sent to the database then to the display device. It indicates the workers through a buzzer in the workplace and through an alarming system in the user system by GSM receiver in remote places which have connectivity to the Arduino UNO R3 microcontroller if any of the sensor's data exceeds or below its threshold level. The connected servos are used to turn ON/OFF the fuel and water tank valves according to the situation. Hence we can automatically control the environment of the boiler.

6. HARDWARE IMPLEMENTATION

A specific set of parameters are the basic reason for boiler explosion, such as temperature, humidity, water conditions. These parameters have short or long term effects on the overall wellbeing of the boiler. We use these parameters to determine and control changes in order to reverse the negative effects. The amount of fuel or other liquid chemicals sent in the boiler is controlled depending on the parameter values.

The following are the hardware components used in the project –

6.1 Arduino UNO R3 Microcontroller Development Board –

Figure V: Arduino UNO R3 Development Board with on board chip

The Arduino UNO R3, often referred to simply as the Arduino UNO, is a widely popular open-source microcontroller board known for its versatility and ease of use. Developed by the Italian company Arduino, it is a member of the Arduino family of microcontroller boards and is widely used by students, hobbyists, and professionals for a wide range of applications. At its heart, the Arduino UNO R3 is built around the versatile ATmega328P microcontroller, which offers 32KB of Flash memory for program storage and 2KB of SRAM for data storage. It also includes 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection for programming and power, and a reset button.

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One of the key features that make the Arduino UNO R3 so accessible is its user-friendly development environment. Arduino uses a simplified version of C/C++ to write and upload code to the board. The Arduino Integrated Development Environment (IDE) provides an intuitive interface for writing code, and the board is recognized by the IDE, making it easy to program and upload sketches.

The UNO's digital and analog pins enable it to interact with a wide variety of external devices and sensors. It can be used for projects ranging from simple LED blinking and temperature sensing to more complex applications like robotics and home automation. Moreover, an extensive ecosystem of shields, which are expansion boards that can be stacked on top of the UNO, adds further functionality and flexibility to the board. These shields can include features like Wi-Fi, Bluetooth, motor control, and more, allowing for rapid prototyping and experimentation.

Overall, the Arduino UNO R3 is a versatile and accessible microcontroller platform that has played a significant role in making embedded electronics and microcontroller programming accessible to a wide audience. Its open-source nature has encouraged a thriving community of users who contribute libraries, projects, and resources, further enhancing its appeal to both beginners and experienced developers.

6.2 DHT11 Temperature and Humidity Sensor-

Figure VI: DHT11 sensor

The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed).

6.3 PIR sensor –

Figure VII: PIR Sensor

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based

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motion detectors. PIR sensors are commonly used in security alarms and automatic lighting applications. PIR sensors detect general movement, but do not give information on who or what moved. For that purpose, an imaging IR sensor is required.

6.4 SG90 Servo motor –

Figure VIII: Servo Motor

A servomotor is a rotary actuator that allows for precise control of angular position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servo motors are not a specific class of motor, although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system.

6.5 LCD display-

Figure IX: LCD Display

The LCD Display is used in order to display the real time values of the important environment parameters present inside the boiler.

6.7 Pressure sensor:

Figure X: Pressure sensor

A pressure sensor is a device for pressure measurement of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated

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in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. For the purposes of this article, such a signal is electrical.

Pressure sensors are used for control and monitoring in thousands of everyday applications. Pressure sensors can also be used to indirectly measure other variables such as fluid/gas flow, speed, water level, and altitude. Pressure sensors can alternatively be called pressure transducers, pressure transmitters, pressure senders, pressure indicators, piezometers and monometers among other names.

7. RESULTS AND DISCUSSIONS

From both the simulation and the hardware implementation we could cover the objectives of the project. Even though the simulations provided trustworthy results, hardware implementations verifies all the simulation data and outputs. Simulations were conducted using Proteus software as shown in the figure given down below. Normal pressure indicates that the pressure inside the boiler is under safe limits. A lot of boiler explosion cases have been seen due to extreme pressure build up inside the boilers due to the steam produced by the fluids of the container. If the pressure exceeds the safe range which has been applied inside the code, an alarm of high pressure will be displayed

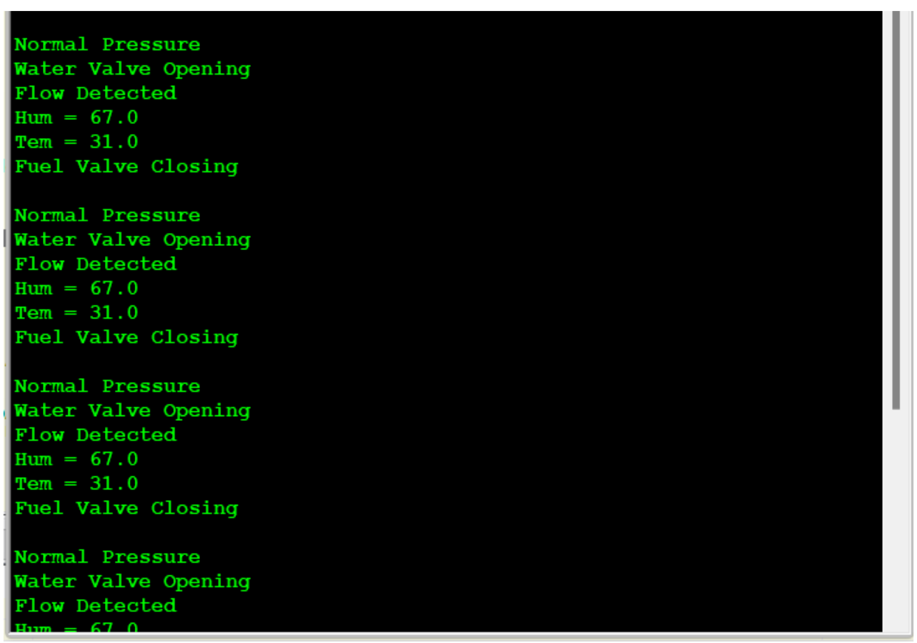

Figure XI: Simulation Output under normal condition

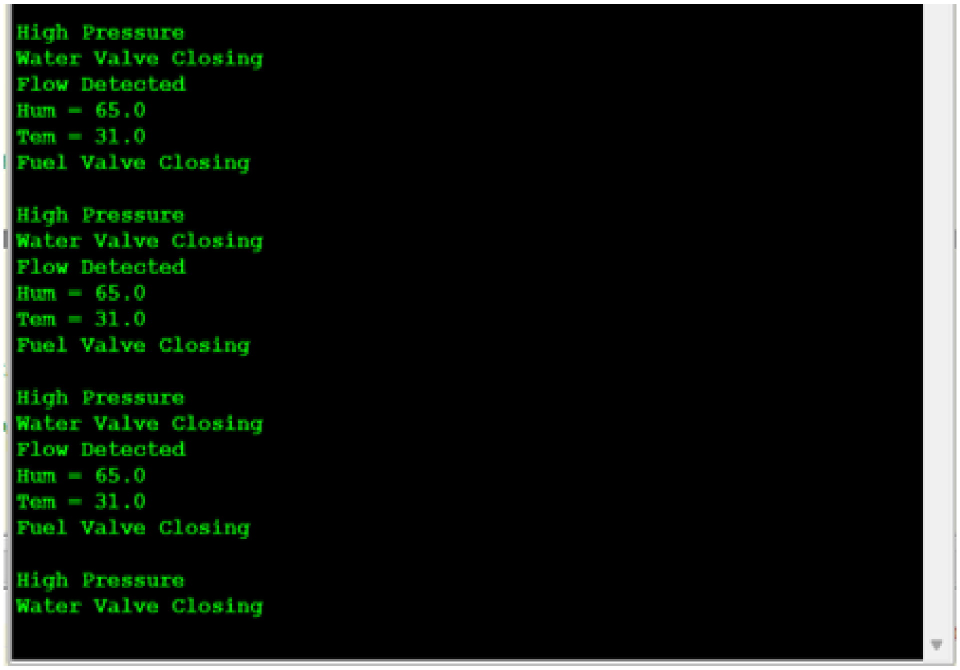

Figure XII: Simulation Output under emergency condition

Flow Detection uses a PIR sensor which detects the movement of the fluids through pipes. This leakage can cause hazards not only to the workers but can be inflammable which will put the entire factory in danger. Therefore, the PIR sensor notifies in case of any change in the fluid level or outflow of fluid even if it's not needed. The temperature and humidity sensor is very important and notifies the real time value. Sometimes the rise in temperature causes the formation of steam of the fluids present inside the boilers. Two servo motors are also connected which will be activated in case of high temperature and high pressure. It has been added for safety which will eject excess pressure and excess fluids when the temperature rises due to any situation. The virtual terminal is added to replicate the GSM module which will give real time updates and emergency messages to the head of the factory or the owner who can take any actions required in the case of any emergency. Such systems are very important as seen after the unforgettable scenarios of Bhopal Gas Tragedy. In terms of the hardware demonstration of the system, pressure, temperature, humidity and PIR sensor was added in order to check the conditions of the simulations and was verified. The GSM module could not be added into the demonstration since there was no stock in the market. Apart from the GSM module, all the other connections have been checked and the working picture has been added in the figure below.

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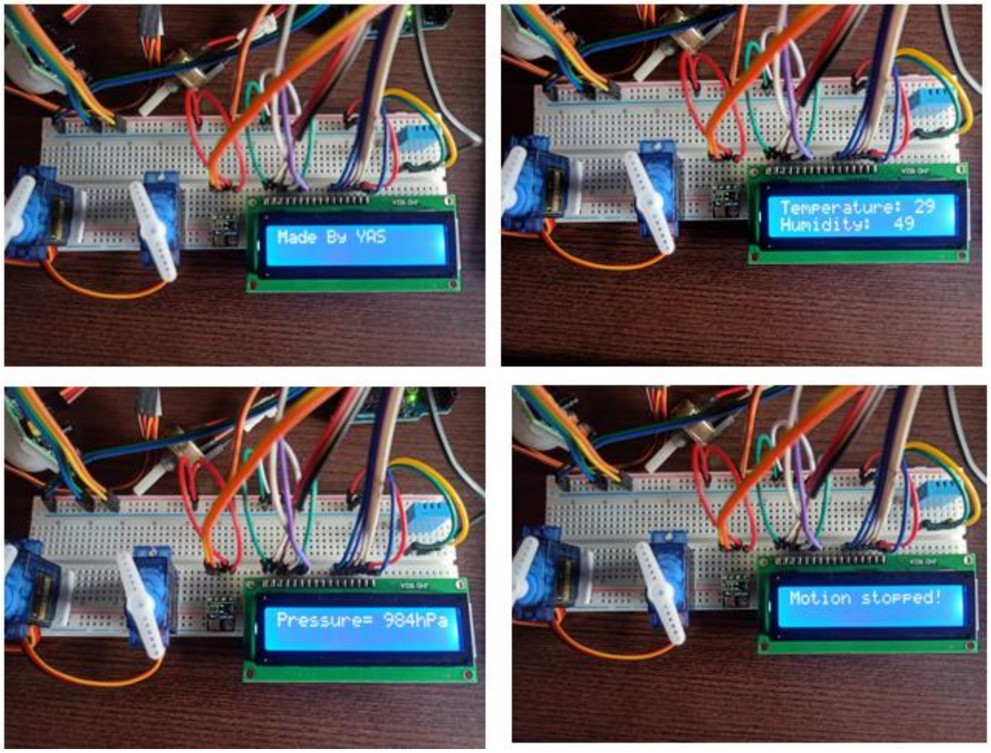

Figure XIII: Hardware Demonstration of the entire system

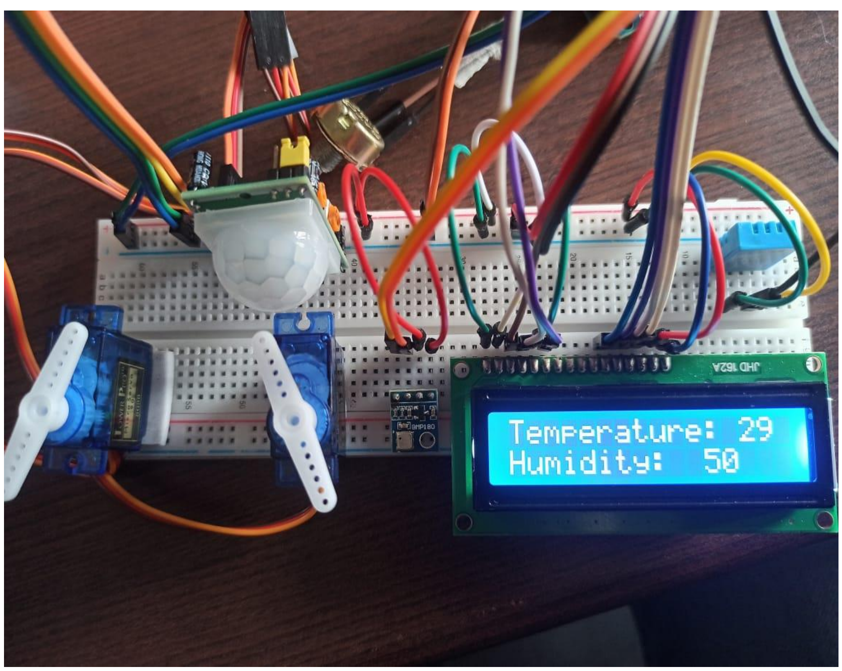

Figure XIV: Complete Hardware System

8. CONCLUSION

Even though our project is a miniature small scale replica of what can be done, we could use this exact same application at a larger scale and actually solve this extremely prevalent problem in the industry. The future prospects of the project range from publishing the outputs online to sending quick messages to factory workers as an alert. This problem is not only restricted to boiler plants, but any industrial application where there is a need for controlling the amount of input substance into a chamber and monitoring necessary parameters. So on a larger scale the same application could be taken and applied on to several other industrial applications that have similar functionality. By the integration of basic sensors and using them to calculate the parameter values we are reducing the costs, and also by fully rotating the servo motor without a control system application, we are further reducing the complexity and solving this problem in the most straightforward way possible.

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