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Level and Temperature Process Monitoring and Control Using LabVIEW

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ABSTRACT: Boiler is essential in many power plant and chemical industries for steam production, batch reactor and oil refining process. Maintaining the level, temperature is very important. There is a requirement to control the level of the water drum by optimal control of the flow of liquid using pump and to maintain the temperature of the water by controlling the external heater. Here the heater and speed of the 12V dc pump is monitored and controlled. The control action is taken based on the drum water temperature and level compared with desired temperature and level given through LabVIEW, a graphical user interface. This process is controlled by using myRIO, coded with LabVIEW, a graphical user interface. The inflow of the boiler can also be monitored. It is used in the applications like, heater, pump control and flow monitor based on temperature, level of the boiler drum. From this project we can assure more efficiency detection speed and real time response.

KEYWORDS: Level, Temperature, Arduino Uno, NI LabVIEW, NI myRIO.

I. INTRODUCTION

Over the past two decades, Automation has become one of the most important areas in development of Industrial processing. The significant development of Automation technology has covered several technical aspects and is due to advances in the production, computing power, testing facilities, and most importantly due to the acceptance by various industries. Our project focuses on the maintaining and controlling the boiler variables using National Instruments myRIO. The boiler variables are temperature, level and flow. The level and temperature of the boiler drum water are monitored and controlled. And the flow is also monitored. Water Flow is fed to the boiler by using 12v DC Motor pump and measured by using YF-S20 flow sensor. The Boiler temperature is measured by using two-wire thermistor and the heat is fed by the electric heater. The Boiler level is measured by using an Ultrasonic sensor.

[1] This paper presents the speed control of DC motor by variation in temperature. Cooling fans, air conditioning, AC machines and in many applications DC motor is employed. In order to develop the code LabVIEW platform is employed.[2] This paper designed a DC motor speed control system. The controller is ARM S3C2410, and therefore the OS is μC/OS-II, a true time OS. Designed a closed-loop system system of motor speed control, adopted the algorithm of PWM to regulate the armature voltage, and motor speed is controlled by regulating, of armature voltage. The system has a good response. [3] This article presents The regulation and control of boiler drum level utilizing labVIEW by employing various control strategies like Feedback, Feedback and Feed forward and Cascade control with Internal model controller (IMC) based PID tuning method. [4] During this paper intelligent controller (fuzzy logic) is employed to tune the traditional PID controller automatically in online process. Hybrid Fuzzy-PID controller result proves that, it offer better performance than conventional PID controller in boiler drum level control. The simulation results are achieved by using LabVIEW Fuzzy-PID Tool.[5] This paper represents that the temperature of the reactor can be controlled by controlling the flow rate of the coolant.[6] This paper the continuity of water flow in boiler can be

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obtained by using feed forward and feedback controller. [7] In this paper, the author proposes a fuzzy PID controller for temperature superheated steam of boiler based on the fuzzy control methodology.[8] In this paper the control theory of self-adaptable fuzzy-PID is used for controlling the level of the boiler drum. Figure 1 may represent the schematic diagram for the project.

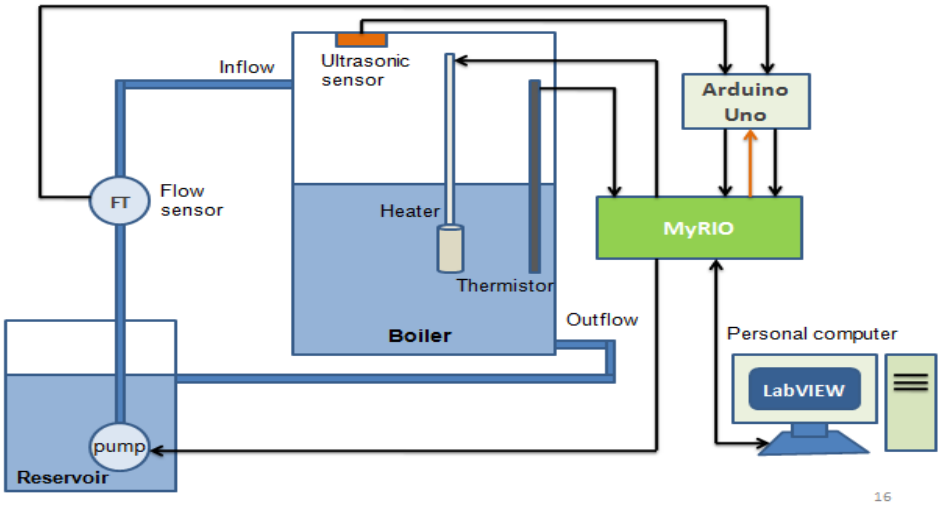
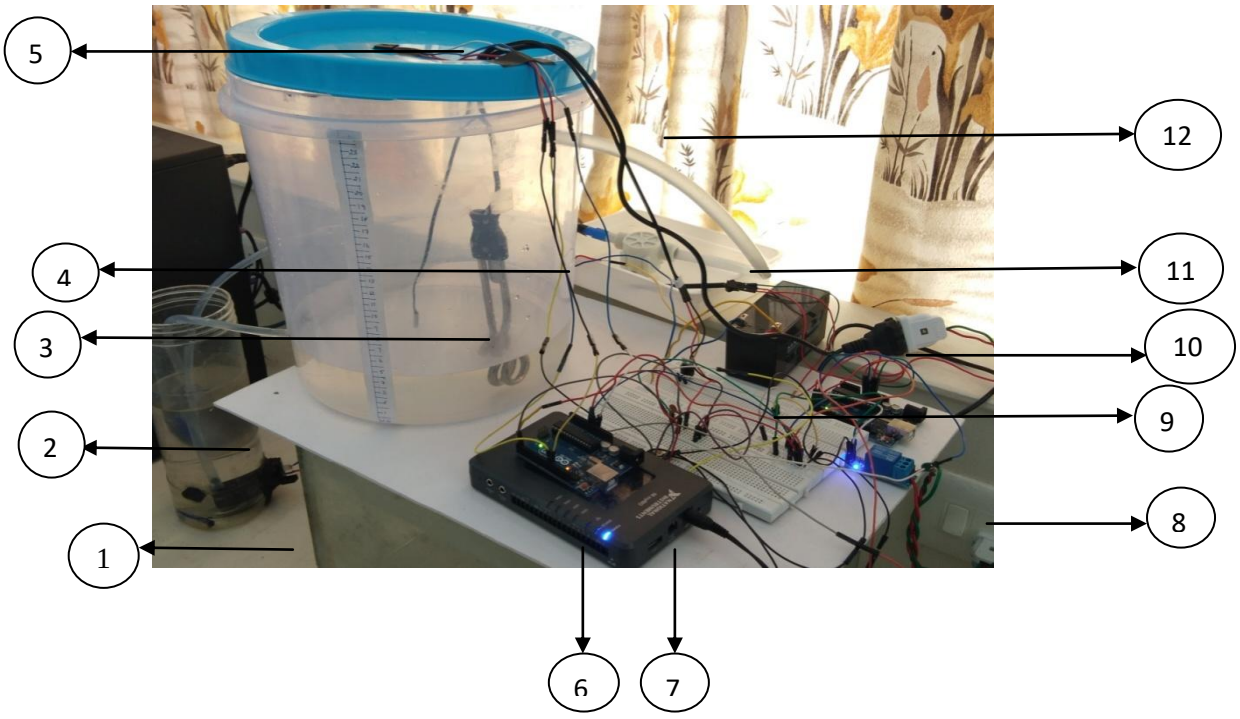


Figure 1: Schematic representation of Level and Temperature monitoring and control process

II. HARDWARE AND MATERIALS USED



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1. 12V dc pump
2. Reservoir
3. Thermistor
4. Heater
5. Ultrasonic sensor HC-SR04
6. NI MyRIO
7. Arduino Uno
8. Relay
9. TIP120G transistor
10. 12V battery
11. Flow sensor YF-S20
12. Boiler

The level of the boiler is measured by using HC-SR04 ultrasonic sensor. This sensor is based on the principle of reflection which measures the distance at the range of 2cm to 400 cm. This sensor is placed at the top of the boiler and measures the level continuously. The inflow of the boiler is measured by using YF-S20 flow sensor which measures the velocity of water. It is placed at the pipeline between the reservoir and boiler drum. By calibrating this, the flow rate of the water flowing through the pipe can be determined. It measures at the range of 1 to 30 Liters/Minute. The thermistor is used to measure the temperature of the boiler in voltage. By calibrating this voltage, the temperature is measured. The ultrasonic and flow sensors are calibrated using Arduino Uno. The Arduino Uno is interfaced with MyRIO controller. The set point is given to this controller and compared with the manipulated variable from the MyRIO controller. The difference between those values varies the control action of the pump and heater. The level is controlled by the 12V dc pump and temperature is controlled by heater. The DC motor is kept in a sealed case which is attached with the impeller and powers it through 12V battery. The 12V battery is used to drive the pump. The TIP120G transistor is used to amplify the electric signal which is used to control the pump. The myRIO controller is used as hardware for controlling the speed of the pump and level of the boiler drum.

III. PRESENTATION OF MAIN CONTRIBUTION OF THE PAPER

In this paper we discussed the maintaining and controlling of the boiler parameter. First, pump the water from reservoir to the main boiler by using 12V DC Submersible Water Pump. Here by using the YF-S20 as a flow rate sensor for measuring the flow rate of the water from the reservoir. Then after that the water from the reservoir will carried out to the boiler drum. Thus the value of flow rate at which boiler drum gets filled.

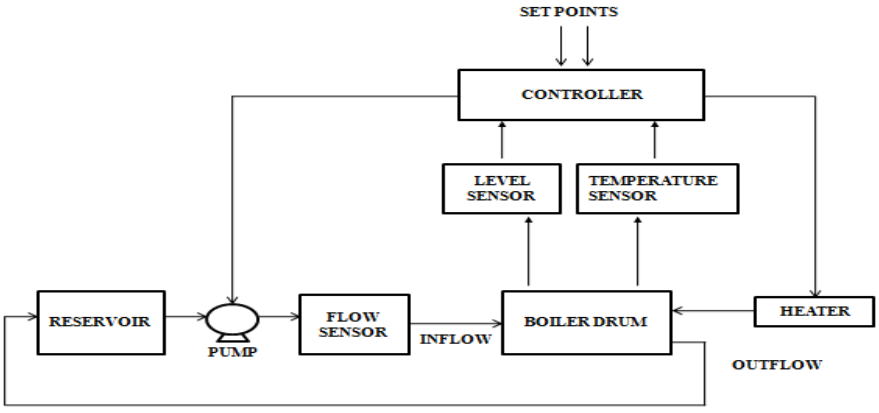

Figure 6: Block diagram for controlling boiler parameter

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Now for measuring the level of the drum using HC-SR04 ultrasonic sensor and controlling the level by varying the speed of the dc pump. The set point is given to the controller. And the controller will compare the setpoint with the desired value which was obtained from the sensor.. If the level of the drum is below the setpoint, then the pump speed will increase. And if the level of the tank is above the given setpoint, then the pump will decrease its speed. And the level is mainly depends on inflow and outflow respectively. For temperature control, thermistor is used as temperature sensor, and set point is given to the MyRIO. Then we use external heater for varying the temperature. Now by using controller we can able to maintain the temperature of the boiler drum at a certain level. And flow rate is also measured by using YF-S20 flow rate sensor respectively.

IV. PROPOSED METHODOLOGY AND DISCUSSION

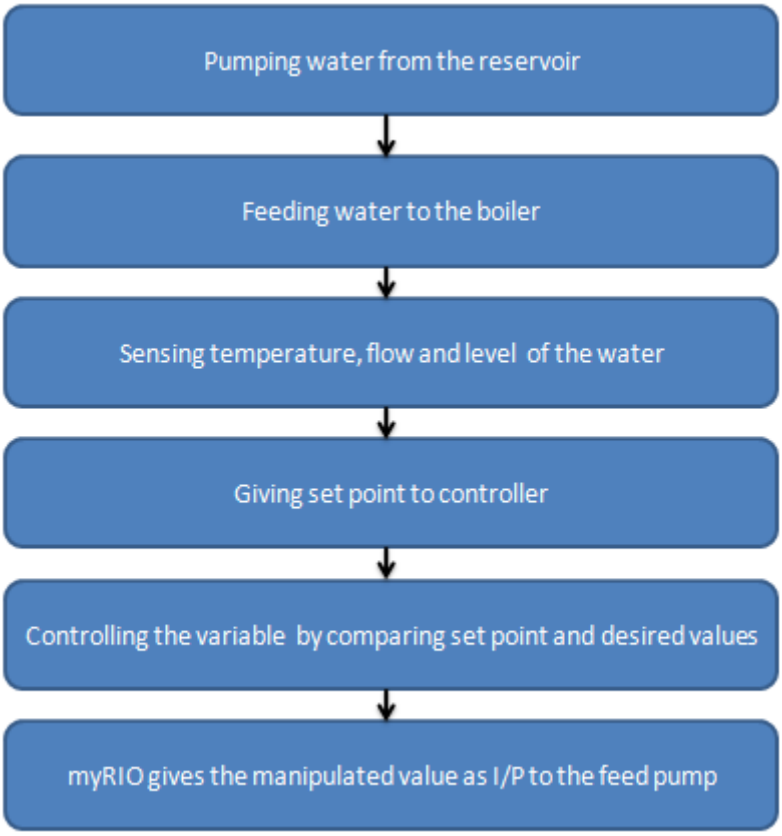

Figure 7: Methodology for Level and Temperature control process

V. EXPERIMENTAL RESULTS WITH TABLE AND GRAPH

The designed LabVIEW front panel is shown in Figure 11. The temperature measured using thermistor is displayed in the front panel in Celsius. The setpoint is entered in the driver code which can be changed to the desired value. Once the set point is given, the signal from the LabVIEW is transferred to the MyRIO which drives the relay circuit. The relay circuit controls the current to the heater. The level of the boiler drum is measured using ultrasonic sensor is displayed in the front panel. The setpoint to the level can be changed in the code. The level is measured to drive the

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12V DC submersible pump. The inflow of the boiler is measured using Hall Effect. Flow meter is displayed through the output indicator in the front panel.

Figure 4 represent the experimental setup for level and temperature process monitoring and control using LabVIEW. Here the miniaturized structure of the boiler is developed. The small vertical drum act as a reservoir and a 12V dc pump is fitted along with it. Then the reservoir is connected with boiler drum along with the pump through the flow rate sensor. The ultrasonic flow sensor was placed on top of the boiler and thermistor and heater were immersed inside the boiler drum.

Those sensors are interfaced with the Arduino Uno and MyRIO controller. This controller is interface with the LabVIEW software. Through this software the output are displayed in the computer. The setpoint is adjusted depends on the demand. The control action takes place when set point was given to the controller. And finally the output was displayed in the computer and controlled. The level and temperature of the boiler is maintained. The figure 9 and 10 represents the characteristics of level and temperature.

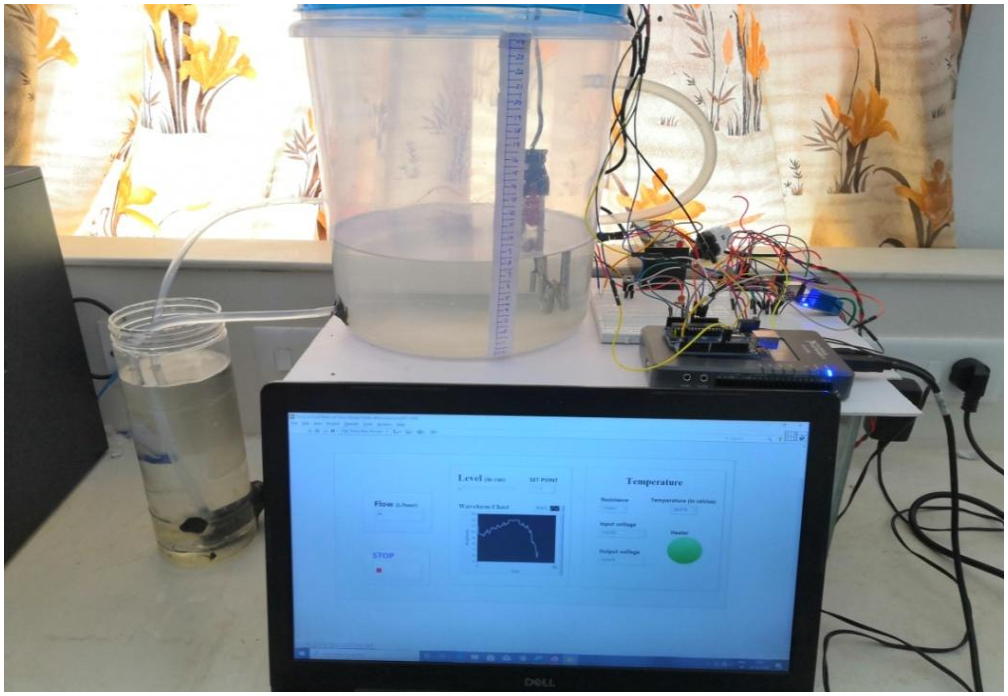

Figure 8: Experimental setup for controlling boiler variables

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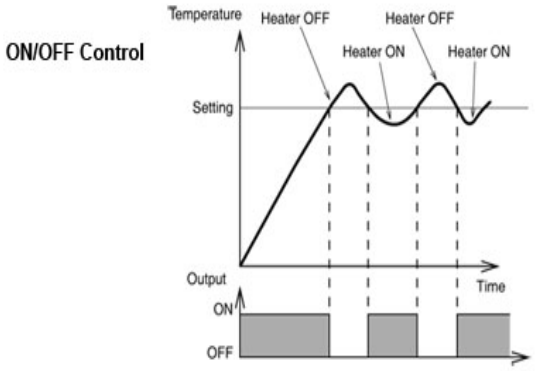

Figure 9: Characteristics of temperature

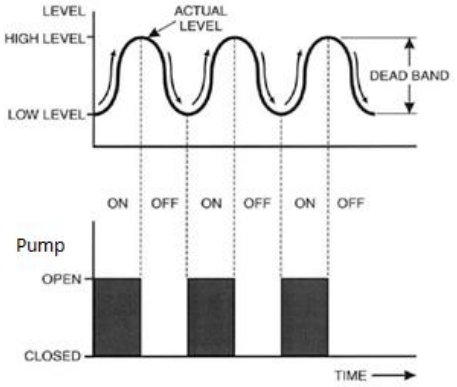

Figure 10: Characteristics of level

VI. CONCLUSION

In the present work we have analyzes the response of the temperature and level of the boiler which can be monitor and control using LabVIEW software. The temperature measured value is send to the controller which actuates the heater ON and OFF. The heater controls the temperature of the drum water. The level of the boiler is measured and controlled by 12V dc pump using MyRIO controller. The inflow of the boiler is monitored by the controller using Arduino Uno which interfaced with MyRIO controller. Based on the setpoint, the level and temperature can be controlled. By this, the efficiency of the boiler drum level is improved.

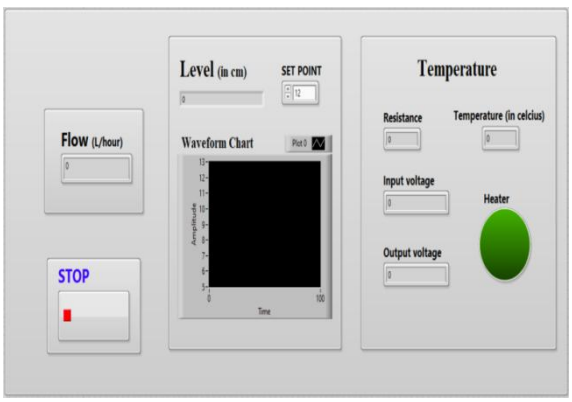

Figure 11: Front panel for the LabVIEW program

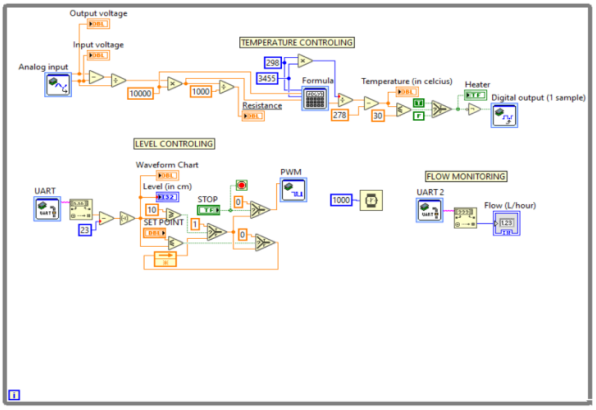

Figure 12: Block diagram for LabVIEW program

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15. Generally the process is divided into 3 segments. They are controlling the level of the boiler drum, controlling the temperature of the boiler drum, monitoring the flow rate of the inflow of the boiler.