ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 3, Special Issue 14, March 2016

Modern Industrial Power Plant Boiler Automation Using GSM Technology

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Abstract

Now a day, monitoring and controlling the boiler performance is a challengeable task in most of the industries. Lack of monitoring and controlling can affect human and environment. The objective of this paper is control the boiler performance by automatic monitoring of environmental parameters such as temperature, pressure and gas leakage. Current status of the boiler condition will be updated from time to time through wireless network. Authority can control the environmental factor of any boiler by simply sending control information to the controller connected to the boiler. It can be used in hospital, agriculture and other applications. All these monitoring and controlling operations are performed by using Arduino, GSM, LabVIEW and various sensors.

Keywords- Boilers, Temperature, Pressure, Gas Leakage, Sensors, Arduino, GSM and LabVIEW

I. INTRODUCTION

In excess of the years require for high quality, better effectiveness and automatic machinery have improved in the industrial region of power plants. Power plants have need of continuous monitoring and check at frequent intervals. There are possibilities of errors in measuring the various stages involved with human workers and also the lack of a few features of microcontrollers. Hence this paper takes a true attempt to explain the advantages the companies will face by implementing automation keen on them. The boiler control which is the most significant part of any power plant, and its automation is the accurate effort of this paper.

Power plant section is one of the most important departments in the industry. There it is having a number of boiling sections. This boiling section produces the high temperature water of the steam level temperature. This steam level temperature issued for power generation and the steaming waters is applied to the turbine section. After the power is generated, steam waters are supplied to various plants for reuses. If the supply of the high temperature is reduced to low temperature, it

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will be used for all other plants which needs the low temperature.

Here, we are automating the all boiler temperatures and Pressure. And also measure and identify the gas leakage of the boiler. If the all measurement data's are monitored and controlled, and also send the SMS for increasing set values of temperature, Pressure level and Gas leakage using GSM module and display the parameters using LabVIEW through the Serial port.

II. EXPERIMENTAL DESCRIPTION

A. Hardware Setup

Arduino microcontroller 328p of operating volt of5V, 3.3V and frequency of 16MHz is used for this study. It contains three GND, Analog (A0 through A5 on the UNO), Digital (0 through 13 on the UNO), PWM (3,5,6,9,10And 11 on the UNO)). These pins act as normal digital pins, but can also be used for something called Pulse-Width Modulation (PWM). AREF Stands for Analog Reference. Most of the time you can leave this pin alone. It is sometimes used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins. In Analog pin (A0) which connects to the temperature sensors. A1 which is connected to gas sensor. A2 which is connected to Pressure sensor. Digital pins (12, 11, 5, 4, 3, 2) are connected to LCD.TX and RX pin of the Arduino is connected to RX and TX pin of the GSM 900A module. Serial port of the GSM is connected to a PC with LabVIEW by using RS232 Cable.

B. Objective of the Project

The main objective of this project is to measure the boiler temperature measured in analog form. A circuit, havingICLM35temperature sensor measures the temperature of the boilers and having a pressure sensor measures the pressure of the boiler. And also having the gas leakage sensor measure the boiler in leakage. The obtained Parameters levels are measured the data are transferred through the Arduino microcontroller. The microcontroller read the available data and processed. Interface the sensor, LCD, and MAX 232 serial port driver with a microcontroller. Transfer the parameter values are interfacing to Arduino microcontroller and also send the parameter values through GSM and display through LabVIEW.

III.HARDWAREDESCRIPTION

BLOCK DIAGRAM:

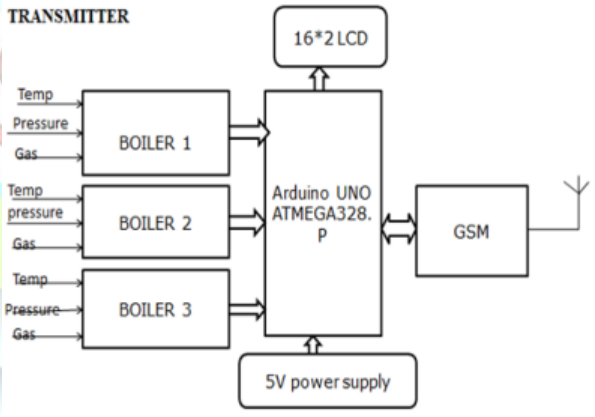

Fig 1. Block Diagram of Transmitter Unit

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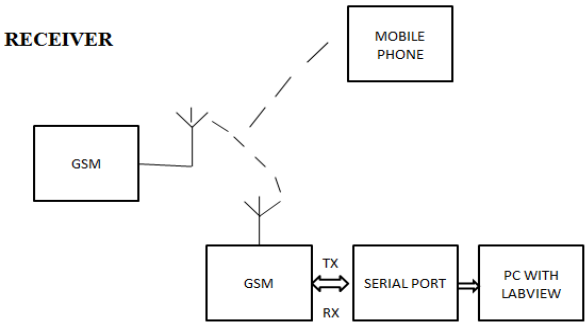

Fig 2. Block Diagram of Receiver Unit

B. Parameters Measurement Descriptions

Principles of Temperature sensor

Temperature sensor has three ends and required Maximum of 5.5 V supply. This case of sensor consists of a textile that performs the procedure according to temperature to alter the resistance. This change of resistance is sensed by circuit and it calculates temperature. When the voltage increases, then the temperature also rises. We can understand this operation by utilizing a diode.

Temperature sensors at once connected to microprocessor input and therefore capable of direct and dependable communication with microprocessors. The detector unit can put across effectively with low-cost processors without the need of A/D converters.

An example of a temperature sensor is LM35. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius temperature. The LM35 is operating at -55˚ to +120˚C. The basic centigrade temperature sensor (+2˚C to +150˚C).

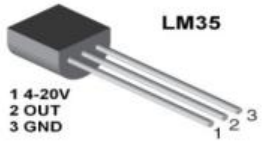

Fig3:LM35 IC

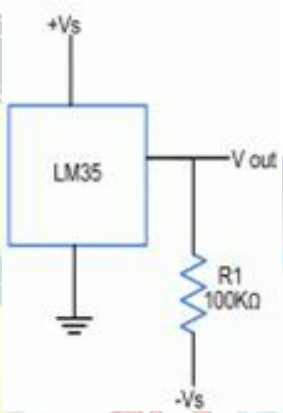

Fig4: Circuit Diagram Of LM35

Principles of Pressure sensor

This pressure sensor operates on the basis of measuring stresses produced by the deflection of pressure sensitive, thin mono crystalline silicon diaphragm. Diaphragm stress is measured using piezoresistive elements along the edges of the deflecting diaphragm. These piezoresistive elements are created through the diffusion of boron impurity atoms into regions of localized high stress on the diaphragm surface (along the edges). These boron impurity atoms become sub situational elements

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within the silicon crystal lattice. The boron impurity atoms, in conjunction with internal stress within the diaphragm, produce an anisotropic mobility of electrons in the lattice resulting in resistivity that depends on the current direction within the lattice and internal stresses within the surface of the diaphragm. The internal stresses created in the crystal lattice create a shift in the band-gap energy, resulting in a change in resistivity. It should be noted that this is not how a typical metallic strain gauge work. A metallic strain gauge works by measuring a change in resistance caused by the actual deformed geometry of the resistive element.

Fig5:BMP180 Pressure Sensor

Principles of Gas sensor

Sensitive material of the MQ-2 gas sensor is SnO2, which with lower conductivity of clean air. When the target combustible gas exist, The sensor's conductivity is higher along with the gas concentration rising. Convert change of conductivity to Correspond output signal of gas concentration. The MQ-2 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with a low cost and suitable for
Different applications.

Fig6:MQ 2 Gas sensor IC

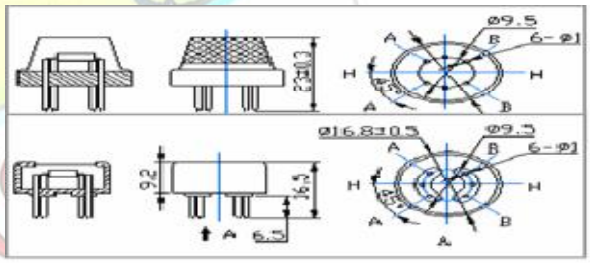

Fig 7: MQ-2 Gas Sensor Configuration

Motor Driver Circuit:

L293D is a typical Motor driver or Motor Driver IC which allows the DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motors with a single L293D IC. Dual H-bridge *Motor Driver integrated circuit* (*IC*). The l293d can drive small and quiet big motors as well, check the Voltage Specification at the end.

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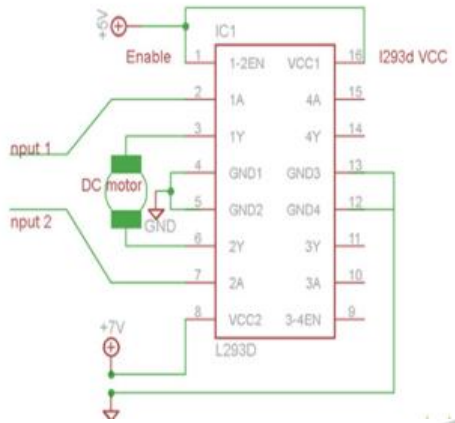

Fig8: Circuit Diagram of Motor Driver IC

Working of L293D

There are 4 input pins for l293d, pin 2, 7 on the left and pin 15 , 10 on the right as shown on the pin diagram. Left input pins will regulate the rotation of a motor connected across left side and right input for the motor on the right hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1. In simple you need to provide Logic 0 or 1 across the input pins for rotating the motor.

L293D Logic Table

Consider a Motor connected on left side output pins (pin 3,6). For rotating the motor in clockwise direction the input pins have to be provided with Logic 1 and Logic 0.

• **Pin 2** = **Logic 1** and **Pin 7** = **Logic 0** | Clockwise Direction

• **Pin 2** = **Logic 0** and **Pin 7** = **Logic 1** | Anticlockwise Direction

• **Pin 2** = **Logic 0** and **Pin 7** = **Logic 0** | Idle [No rotation] [Hi-Impedance state]

• **Pin 2** = **Logic 1** and **Pin 7** = **Logic 1** | Idle [No rotation]

In a very similar way the motor can also operate across input pin 15, 10 for the motor on the right hand side.

GSM

The Global System for mobile (GSM) communication is the second generation of mobile technology. Although the world is moving towards third and fourth generation, but GSM has been the most successful and widespread technology in the communication. Here in our project we are interfacing GSM module with MC micro controller. The message will be sent to a particular GSM mobile number using AT commands with the help of MC.

Operation:

The operation uses GSM are

- Test the simple AT command.
- Find out the International mobile station equipment identify (IMEI) number of the GSM modem.
- Connect a call to a GSM mobile number (i.e) dial a number.
- Send a text to that mobile number.
- These operations are done using AT commands. The provision of these four operations has been provided by means of four tactile switches. Each switch

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corresponds to each of the above functions. A line converter MAX232 is employed to convert a GSM module to TTL logic so that it can be processed by the micro Controller. IT can be tested in the window Hyper terminal software.

- AT+CMGF message format: this command is used to select SMS protocol data units (PDU) mode or SMS text mode.
- At+CMGS send message: sends a message from GSM to the network (SMS+CMGS). The message reference value <Mr> is returned to the GSM on successful message delivery.
- Sending can be cancelled with the <ESC> character <Ctrl-z> must be used to indicate the ending of the message body.

Interfacing GSM with MC

- The connection is simple. We shall use the hardware serial port of the MC (pin 0&pin1).
- Pin 0 (RX) OF MC is connected to the RX pin of GSM
- Pin 1 (TX) of MC is connected to TX pin of GSM
- General rule is always TX to RX & RX to TX. But the GSM board I'm using has a MAX232 level converter IC &the RX printed on board is that 0 (in 0) goes to pin 11 (T1 in) of the MAX232 level converter IC & the TX, RX printed on the board is that 0 (in 0) goes to pin11 (T1 IN) of Max232
- TX of MC (pin 1) goes to pin 12 (R1 OUT) OF MAX232
- AS we use TTL logic, we need not bother about the presence of 232IC.
- Do not power the GSM from MC. Use a separate adapter of minimum 1 Amp rating.
- Make GND pins of both GSM&MC common.
- To start with place a valid SIM to the holder on the GSM board. Connect the power adapter to GSM.
- Now dial a call from another phone to the SIM number &ensure that you get a link back tone.
- This is the initial test to confirm that your GSM is ready to accept commands from MC.

IV. SOFTWARE DESCRIPTION

A. Arduino IDE

IT is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control the physical world.

The Arduino integrated development environment (IDE) is a cross-platform application written in Java, and is derived from the IDE for the Processing programming language and the Wiring projects. Which also supports the languages C and C++.

A typical Arduino C/C++ sketch consists of two functions that are compiled and linked with a

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program stub *main ()* into an executable cyclic executive program:

- *Setup ()*: a function that runs once at the start of a program and that can initialize settings.
- *Loop ()*: a function called repeatedly until the board powers off.

After compiling and linking with the GNU tool chain, also included with the IDE distribution, the Arduino IDE employs the program *argued* to convert the executable code into a text file in hexadecimal coding that is loaded into the Arduino board by a loader program in the board's firmware. Arduino more straight forward by allowing the use of an ordinary computer as the programmer. Currently, optiboot loader is the default boot loader installed on Arduino UNO.

At a conceptual level, when using the Arduino integrated development environment, all boards are programmed over a serial connection. Its implementation varies with the hardware version. Some serial Arduino boards contain a level shifter circuit to convert between RS-232 logic levels and transistor–transistor logic (TTL) level signals. Current Arduino boards are programmed via Universal Serial Bus (USB), implemented using USB-to-serial adapter chips such as the FTDI FT232.

B. Proteus VSM

Traditionally, circuit simulation has been a non interactive affair. In the early days, net lists were prepared by hand, and output consisted of reams of numbers. If you were lucky, you got a pseudo-graphical output plotted with asterisks to show the voltage and current waveforms.

PROTEUS VSM brings you the best of both worlds. It combines a superb mixed mode circuit simulator based on the industry standard SPICE3F5 with animated component models. And it provides an architecture in which additional animated models may be created by anyone, including end users. Indeed, many types of animated model can be produced without resort to coding. Consequently PROTEUS VSM allows professional engineers to run interactive simulations of real names, and to reap the rewards of this access to circuit simulation.

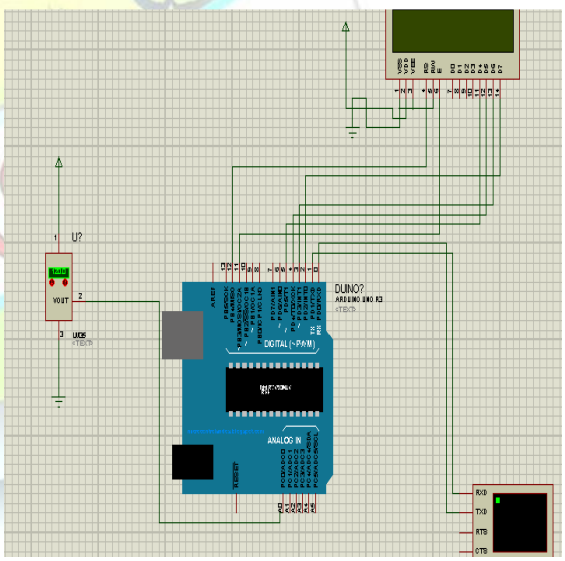

Fig9: Circuit diagram

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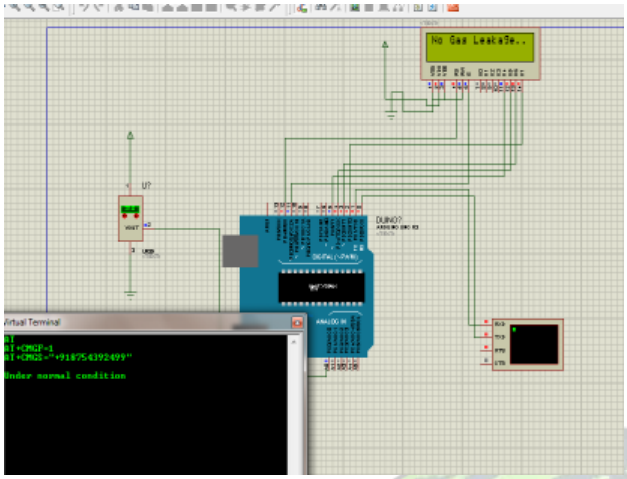

Fig10: output of the System when the Temperature is below the predefined value.

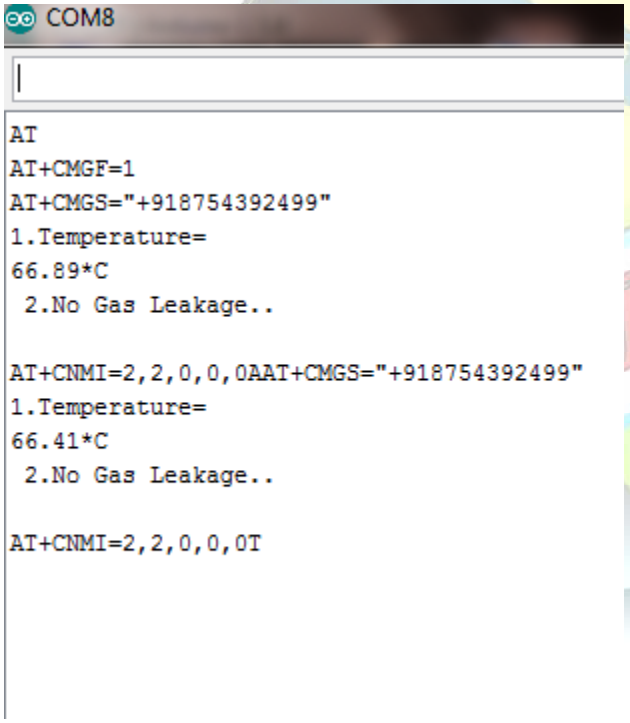

Fig 11: Serial monitor displays in Arduino IDE

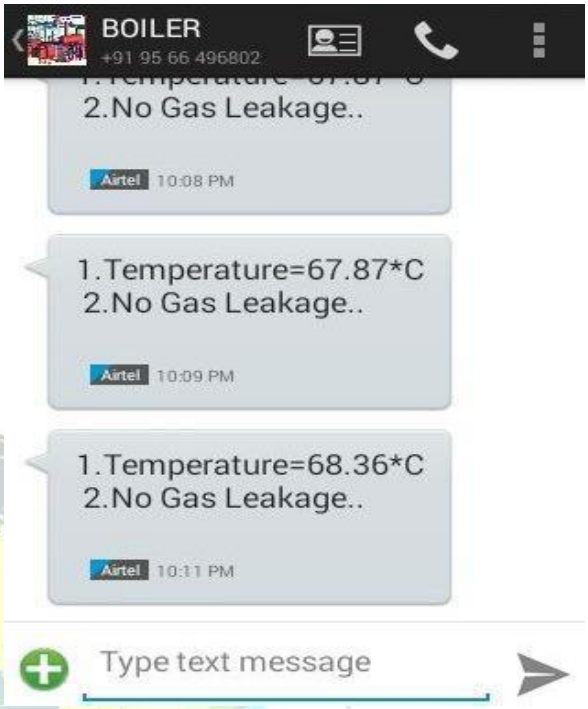

Fig12: Message Received in Mobile phone.

C. LabVIEW

LabVIEW (short for Laboratory Virtual Instrument Engineering Workbench) is a system-design platform and development environment for a visual programming language from National Instruments. LabVIEW includes extensive support for interfacing to devices, instruments, cameras, and other devices. Users interface to hardware by either writing direct bus commands (USB, GPIB, Serial) or using high-level, device-specific, drivers that provide native LabVIEW function nodes for controlling the device.

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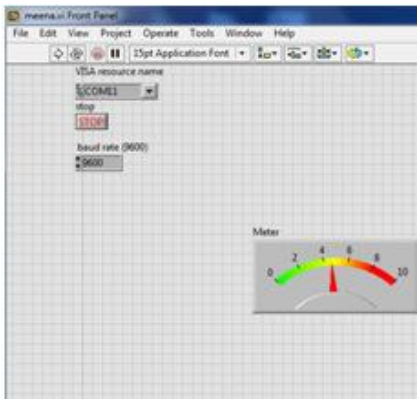

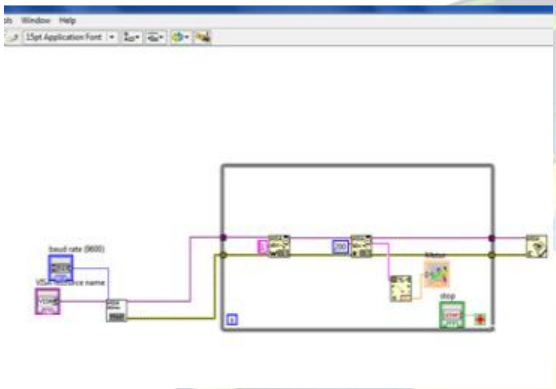

Fig13: LabVIEW Circuit Diagram

S.NO	Actual voltage	Output voltage in mV	Temperature Value in Degree
1	0.30	300	30˚C
2	0.40	400	40˚C
3	0.50	500	50˚C
4	0.60	600	60˚C
5	0.70	700	70˚C
6	0.80	800	80˚C
7	0.90	900	90˚C

Table 1: Temperature Analysis.

V. RESULT AND DISCUSSION

The Temperature, Pressure and Gas leakage of power plant boiler automation has designed and implemented in simulation as well as hardware.

The fig. 9 results shows that sensors and what terminal operation with Arduino controller in proteous simulation software. The result is shown in fig. 12 describes the various sensor value in authority mobile and also fig. 13 describes a sensor demonstration in Labview. Sensing was done by sending every possible command to the Boiler and observed the Boiler's response. We also control the Boiler Power Plant by Sending a control message. The Boiler automation replied with the status of Serial Port to GSM and the current Boiler temperature. The result of this measuring is as expected. Fig.12 shows the message received by Power Plant Boiler Operating Engineer when the Boiler temperature is above80°C or below 30°C, the Pressure Level is High and Gas leakage in the boiler Power Plant. The Arduino controller with GSM sent a warning message to the Boiler Operating Engineer with the current Boilers Temperature, Pressure and Gas leakage. For all measuring scenarios, in general, the Boiler Automation can work well according to our specification and expectation. The measuring results are shown in Table 1.

VI. CONCLUSION

This paper suggests effective modern power plant automation to various industries and agriculture and also it provides safety to human and environment. The graphical representation and sensor value

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displayed in mobile are easy to understand the boiler performance for authorities.

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