Monitoring of Boiler Parameters using Internet of Things

[1]Ms. S Mythili [2]Mr. G. Gokulkumar
[1,2]Department of Electrical and Electronics Engineering
[1,2]Christ the King Engineering College, Coimbatore, Tamil Nadu

Abstract

Boiler is the major part of industries and power plants. Mostly thermal power plants have boilers to produce electrical energy from steam. But thermal power plants are located in remote areas due to it harmful environment. By increasing the power demand and decreasing the cost for operating and maintenance are increase the reliability of the power plant. To satisfy the power need of the nation, power production is done in thermal power plant for 24 hours in 365 days without fail. But monitoring process is not possible for each and every second. Monitoring process is very important for safety of the workers and high secured operation of the power plant. The aim of the project is to develop monitoring of boiler parameters using wireless communication and to avoid the accidents in hazardous places wherever the humans not able to work. Boiler parameters are monitored by using sensors. Temperature, humidity, water level and gas are the parameters to be monitored and monitored values are visualized through think speak by using Internet of Things.

Keyword- Boiler, Steam, Parameters, Wireless Communication Sensors, Thinkspeak, Internet of Things

I. INTRODUCTION

Internet of Things (IoT) is the latest emerging internet technology. IoT is used in all the home appliances, industries and in every device. IoT creates the relationship between people to people, people to things and things to things.
If temperature of steam increases boiler tubes will be puncture. So, monitoring of temperature is important to avoid the problem in power plant. Measurement of water vapour content in atmosphere and surface provides the details about physical, chemical and exobiological process in the surface. Gas monitoring is a part of this system which monitor the LPG gas in and around the boiler. Monitoring of boiler tank level is important to avoid an increase of maintenance cost. If the water level increases beyond the limits, turbine will damage due to overflow of water. If the water level decreases below the low limit value, boiler tubes will be puncture. So, the monitoring of boiler water level is important in the boiler.
In this project various boiler parameters monitored by using sensors and controller. Parameters to be monitored are given below:

- Temperature
- Humidity
- Boiler water level
- Gas

II. LITERATURE REVIEW

Gomathi Sankar A, Jesudass Rabinson Arasu S, Karthick K, Maris Murugan T are proposed a system that deals with the boiler drum level controlling system. The boiler drum level is controlled by the arduino Uno microcontroller from pulse output of ultrasonic level sensor. Arduino Uno microcontroller receives the pulse signal and send to the Liquid Crystal Display (LCD) or Personal Computer (PC) with the help of the Local Area Network (LAN). Another side the same level signal send to the Internet of Things (IoT) by using Wi-Fi module. In this concept the major advantage is boiler drum level controlling, this action is taken by the Internet of Things (IoT), which means the signal from Internet of Things (IoT) connected devices like smart phones or laptops etc., From the devices the signal will be sent to the arduino Uno microcontroller for controlling the feedwater flow inside the boiler drum by relay action. Through the smart phones or laptop can store the N number of data's, as well as control the drum level. In this system the monitoring action can also done with the help of website address.

III. PROPOSED METHOD

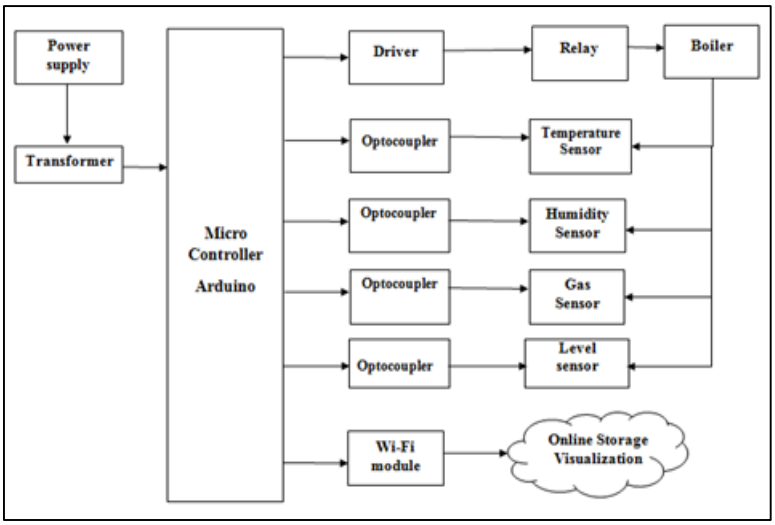


Fig. 1: Block diagram of proposed system

A 230V AC supply is given to the transformer and the voltage is stepped down into 12V. Power supply converts AC into DC by using diode and eliminates the ripples by using capacitors. So the ripple free 12V supply taken from the power supply. To get the 5V supply regulator is used. The supply is given to driver, relay, boiler, sensors and opt coupler. Arduino microcontroller is connected to sensors through optocoupler. So the sensor monitored data stored in controller. Wi-Fi module is used to interface between devices. The stored data are transmitted to other device through Wi-Fi module. So online storage visualization is done in thinkspeak. Transmitting and receiving operation between devices is done using Internet of things.

IV. COMPONENTS TO BE USED

A. Power Supply

The main components used in the power supply are Transformer, Rectifier, Filter, and Regulator. The 230V ac supply is converted into 12V ac supply through the transformer. The output of the transformer has the same frequency as in the input ac power. This ac power is converted into dc power through the diodes. Here the bridge diode is used to convert the ac supply to the dc power supply. This converted dc power supply has the ripple content and for the normal operation of the circuit, the ripple content of the dc power supply should be as low as possible. Because the ripple content of the power supply will reduce the life of circuit.So to reduce the ripple content of the dc power supply, the filter is used. The filter is nothing but the large value capacitance. The output waveform of the filter capacitance will almost be the straight line.This filtered output will not be the regulated voltage. For the normal operation of the circuit it should have the regulated output. Specifically for the microcontroller IC regulated constant 5V output voltage should be given. For this purpose 78xx regulator should be used in the circuit. In that number of IC, the 8 represents the positive voltage and if it is 9, it will represent the negative voltage. The xx represents the voltage. If it is 7805, it represent 5V regulator, and if it is 7812, it represent 12V regulator. Thus the regulated constant output can be obtained.

B. Arduino Microcontroller

Arduino is a single-board microcontroller to make using electronics in multidisciplinary projects more accessible. The hardware consists of an open-source hardware board designed around an 8-bit Atmel AVR microcontroller, or a 32-bit Atmel ARM. The software consists of a standard programming language compiler and a boot loader that executes on the microcontroller.

C. Hardware

A 3rd-party Arduino board with a RS-232 serial interface (upper left) and an Atmel ATmega8 microcontroller chip (black, lower right); the 14 digital I/O pins are located at the top and the six analog input pins at the lower right.

D. Software

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. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. A program or code written for Arduino is called a "sketch".Arduino programs are written in C or C++. The Arduino IDE comes with

a software library called "Wiring" from the original Wiring project, which makes many common input/output operations much easier.

E. Relay Driver

The relay driver circuit is enabled certain time duration only, such enable pulse is depended by delay programming of microcontroller, here darling circuit has been two transistors made connection of cascade network, if input is set to base of the first transistor, then that is turn on and emitter current of that turn the another one. Hereby the circuit is closed through coil and second transistor, now the energized coil is controls the contactors that are change the normally open to close and normally closed to open connection. The enabled signal is not essential after energized that coil because transistor collector current maintains the transistors in saturation state continuously. The induction effect may be affect the indication components and another thing, so diode is connected across the coil which can prevents the chopping effect the inverse magnitude of magnetic field shorted across from coil.

F. Humidity and Temperature Sensor

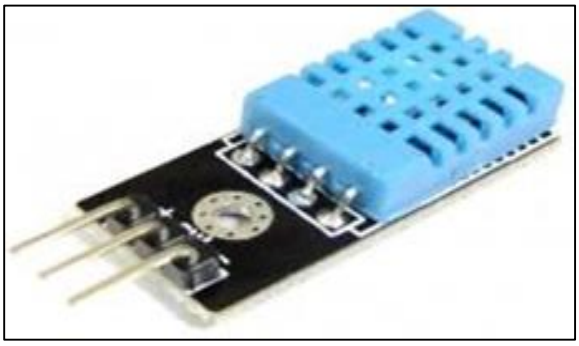


Fig. 2: Humidity and temperature sensor

DHT11 is a Humidity and Temperature Sensor, which generates calibrated digital output. DHT11 can be interface with any microcontroller like Arduino, Raspberry Pi, etc. and get instantaneous results. DHT11 is a low cost humidity and temperature sensor which provides high reliability and long term stability. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and outputs a digital signal on the data pin (no analog input pins needed). Its very simple to use, and libraries and sample codes are available for Arduino and Raspberry Pi. This module makes is easy to connect the DHT11 sensor to an Arduino or microcontroller as includes the pull up resistor required to use the sensor. Only three connections are required to be made to use the sensor - Vcc, Gnd and Output. It has high reliability and excellent long-term stability, thanks to the exclusive digital signal acquisition technique and temperature & humidity sensing technology.

G. Level Sensor

Level sensor is used to measure the Water level and to measure any other fluid level.

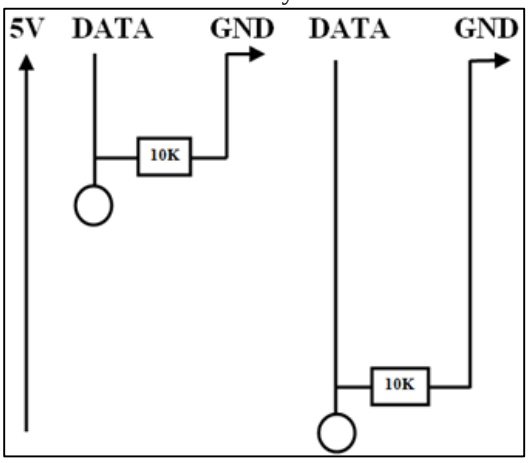


Fig. 3: Level sensor

A level sensor is a device for determining the level or amount of fluids, liquids or other substances that flow in an open or closed system. There are two types of level measurements, namely, continuous and point level measurements. Continuous level sensors are used for measuring levels to a specific limit, but they provide accurate results. Point level sensors, on the other hand, only determine if the liquid level is high or low. The level sensors are usually connected to an output unit for transmitting the results to

a monitoring system. Current technologies employ wireless transmission of data to the monitoring system, which is useful in elevated and dangerous locations that cannot be easily accessed by common workers.

H. Gas Sensor

A gas detector is a device which detects the presence of various gases within an area, usually as part of a safety system. This type of equipment is used to detect a gas leak and interface with a control system so a process can be automatically shut down. A gas detector can also sound an alarm to operators in the area where the leak is occurring, giving them the opportunity to leave the area. This type of device is important because there are many gases that can be harmful to organic life, such as humans or animals.

Fig. 4: Gas sensor

I. ESP8266 WIFI Module

ESP is a low power consumption of the UART-Wi-Fi module, with very competitive prices in the industry and ultra-low power consumption technology, designed specifically for mobile devices and IOT applications, user's physical device can be connected to a Wi-Fi wireless network, Internet or intranet communication and networking capabilities. ESP the use of small ceramic antenna package can support IPEX interface. Users have a variety of installation options.

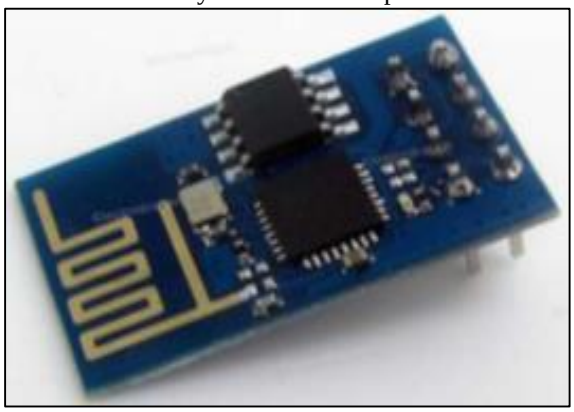


Fig. 5: ESP8266 WIFI Module

J. Thinkspeak

ThingSpeak is an open source Internet of Things (IoT) application to store and retrieve data from things using the Internet. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates. ThingSpeak was originally launched by ioBridge in 2010 as a service in support of IoT applications. Allowing ThingSpeak users to analyze and visualize uploaded data using a graphical system.

K. Internet of Things

IoT (Internet of Things) is an advanced automation and analytics system which exploits networking, sensing, big data, and artificial intelligence technology to deliver complete systems for a product or service. These systems allow greater transparency, control, and performance when applied to any industry or system. IoT systems have applications across industries through their unique flexibility and ability to be suitable in any environment. They enhance data collection, automation, operations, and much more through smart devices and powerful enabling technology.

V. CIRCUIT DIAGRAM

Arduino microcontroller is interface with sensors through optocoupler. Sensors are connected with boiler. Sensors measure the temperature, humidity, gas and water level in this system. All the sensor values are stored in memory of arduino. The measured values are transmitted to other devices through Wi-Fi module. The monitored result is verified in thinkspeak. Transmitting and receiving the data between the devices internet connection is must. So, the monitored result viewed by using internet of things.

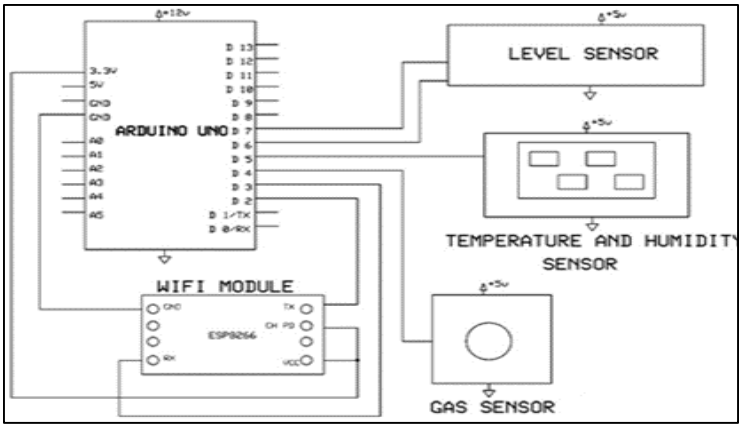


Fig. 6: Circuit diagram

VI. PROTOTYPE MODEL

The below figure shows the prototype model of this project. The boiler parameters are measured using sensors like level sensor, temperature sensor, gas sensor and humidity sensor. These sensors are connected to the microcontroller. The measured values are stored in cloud through Wi-Fi module. The stored data are retired and updated using the application of thinkspeak. Thinkspeak is an application used in Internet of Things.

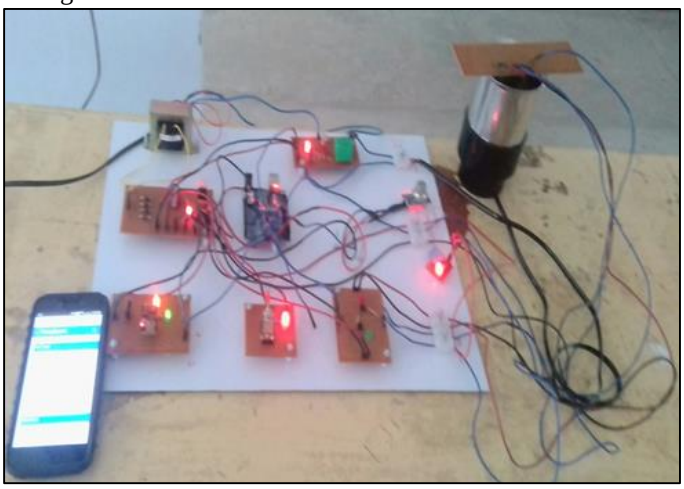
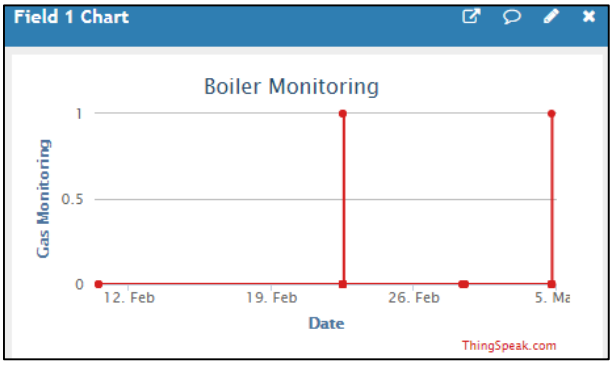
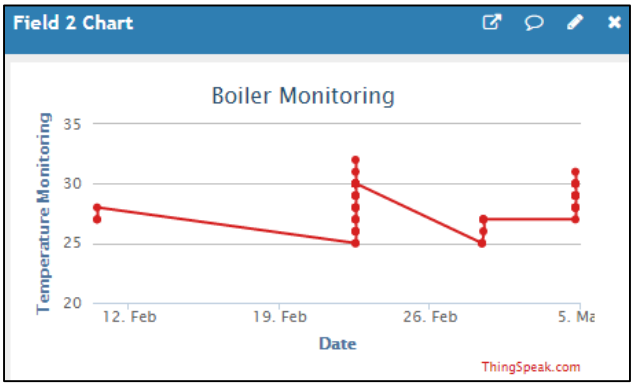
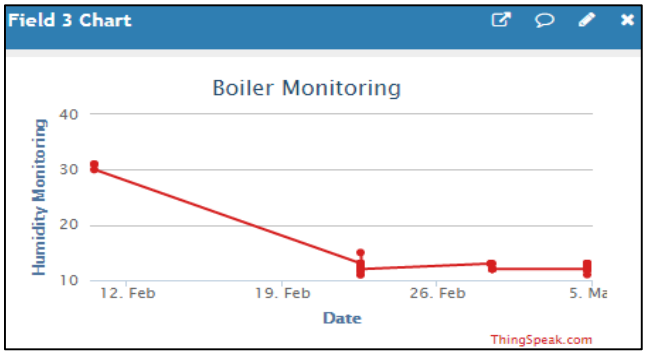


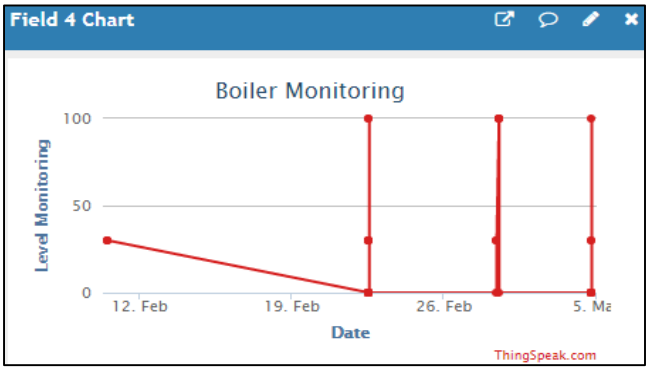
Fig. 7: Prototype model

VII. RESULT









The parameters are monitored by using the application with internet of things. The monitored values are visualized as big data. The stored and retrieved data is visualized from thingspeak app using the Internet.

VIII. CONCLUSION

An important parameters such as temperature, humidity, gas level and boiler water level are monitored in Thinkspeak by using Internet of Things. If the internet connection is given to the monitoring system through wifi module then the monitored result visualized in Thinkspeak at any place with internet connection. Allowing ThingSpeak users to analyze and visualize uploaded data using a graphical system. The parameters of the boiler unit can be monitored by using Effective communication medium.

REFERENCES

[1] De Paola.A,M.Ortolani, Lo Re Anastasi G. and Das S. K.,(2014),'Intelligent management systems for energy efficiency in buildings: A survey',ACM Computing Surveys, Vol. 47, No. 1, pp. 23-26.
[2] Nguyen.T.A and Aiello M.,(2013) 'Energy intelligent buildings based on user activity: A survey', Energy and buildings, Vol. 56, No. 2. pp. 244–257.
[3] Rajkumar "Boiler drum level control by using wide open control with three element control system" International Monthly Refereed Journal of Research in Management & Technology2013.
[4] Roopal Agrawal ,Umesh C.Pati "Internet Based Boiler Drum Level Control System Using LabVIEW"

[5] Shital S. Chopade, Pradhuman Verma, Prashant Verma" Simulation of Boiler Control using PLC & SCADA" International Journal of Engineering and Advanced Technology (IJEAT), 2013.
[6] Jagannath, V.M.D and B.Raman (2007). " WiBeam: Wireless Bearing Monitoring System" communication systems software and Middleware, COMSWARE 2007, 2nd International conference.
[7] Industrial Boilers by David Gunn and Robert Horton, Longman Scientific & Technical, New York