

Boiler Parameter Monitoring and Controlling System using Android App

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Abstract:

The boiler drum level control unit was one of the main parameters in the thermal power station. Currently the boiler drum parameters are monitored only by using ESP8266 module to store the data in cloud. There is no automatic control available. In the proposed system the boiler drum parameters such as temperature level, water level and humidity are measured using ESP8266 module. Level identifier is used to check the steam that comes from the boiler. Pure steam is required to run the turbine, so level identifier checks whether the steam is wet or dry if it is wet steam then turbine blades get damaged. So, it identifies the wet or dry steam and convert it to dry steam. To meet out the steam requirement, to safeguard the boiler water tubes and turbine blades, the boiler water drum level control plays an important role in thermal power station. In the proposed system ESP8266 module is used that controls all sub devices connected across to monitor and control the boiler parameters such as temperature level, water level and level identifier is measured by using temperature sensor, level sensor is used. The boiler parameters are monitored and controlled by using ESP8266 module it is also known as node MCu.

Keywords – ESP8266 module, temperature level, water level, humidity

I. INTRODUCTION

At the present, industries are increasingly shifting towards automation. The boiler drum level was controlled to the bounds specified by the boiler manufacturer. If the boiler drum level doesn't stick with these limits, there could also be water carryover. If the extent of the water exceeds the bounds from the boiler water carryover to the super-heater or the turbine may cause damage leading to extensive maintenance costs or outages of either the turbine or the boiler. If the extent is low, overheating of the water wall tubes may cause tube ruptures and high accidents, leading to expensive repairs, downtime, and injury or death

to personnel. A rupture or crack occurs when the tubes hook up with the drum. Within the existing system the boiler parameters are monitored by using Arduino Ide and it is often controlled by manual only. Within the proposed system ESP8266 module is employed that controls all sub devices connected across it. For monitoring and controlling the boiler parameters like temperature level, humidity, water level and droplet identifier is measured by using temperature sensor, water level sensor.

A power station also referred as a generating station, power plant, powerhouse or generating plant is an industrial facility for the generation of

electric power, the term generally being limited to those able to be dispatched by a system operator (i.e., the system operator can, by one means or another, alter the planned output of the generating facility). Most power stations contain one or more generators, a rotating machine that converts mechanical power into electrical power. Pure steam is required to run the turbine, so droplet identifier checks the steam that is wet or dry, if it is wet steam then turbine blades get damaged. The wet steam should be converted to dry steam to meet our steam requirement, to safeguard the boiler water tubes and turbine blades. The boiler water drum level control plays an important role in thermal power station.

II. LITERATURE SURVEY

Rahul Malhotra et al described that the Conventional Proportional Integral Controllers were used in many industrial applications due to their simplicity and robustness. The parameters of the industrial processes are subjected to change due to change in the environment. These parameters are categorized as steam, pressure, temperature of the industrial machinery in use. Various process control techniques were being developed to control these variables. In this paper, the steam flow parameter of a boiler is controlled using conventional PID controller and then optimized using fuzzy logic controller. The comparative results show the better result when fuzzy logic controller was used. Maximum overshoot for fuzzy logic controller was measured as 9.35%, when compared with 47.3% given by conventional PID controller.

Erdal Kayacan et al describes the concept of grey system theory, which features a certain prediction capability, offers an alternative approach for various sorts of conventional control methods, like PID control and fuzzy control. As an example, grey PID type fuzzy controller designed during this paper, can predict the longerterm output values of the system accurately. The forecasting step-size of the grey controller determines the forecasting value. When the step-size of the grey controller is large, it will cause

overcompensation, leading to a slow system response. Here a smaller step-size will make the system respond faster but cause larger overshoots. So as to get a far better controller performance, another fuzzy controller is meant for changing the step-size of the grey controller. The worth of the forecasting step-size is optimized consistent with the values of error and therefore the derivative of the error. The prediction error should be used for updating the output of the grey controller for better controller performance. The proposed adaptive PID type fuzzy controller is effective in controlling such a non-linear system by changing the prediction horizon adaptively for real-time working.

Shital S. Chopade et al describes the aim of this paper is to present a programmable logic controller (PLC) system that's applied to the water tube boiler which can increase top quality and greater efficiency. This technique monitors boiler's temperature and pressure and volume via different sensors which gives input to PLC. The output of PLC controls the boiler temperature and pressure and provides out the user required volume of steam. On SCADA screen all pressure and temperature variations are shown and are controlled through SCADA. Different automated check valves are wont to release pressure and to tell the concerned authority through alarm just in case of an emergency.

Subodh Panda et al describes the important issue within the modern thermal power station is to develop methodology concept algorithm technologies for designing an impact system which must be ready to evolve, self-develop, self-organized and self-evaluated and to self-improve. Although linear model can provide acceptable performance for several systems, they will be unsuitable for non-linearity. So, it's highly required for a model that reflect the non-liner relationship between cause-and-effect variable. Implementation of sentimental sensor in neural network estimate process data using self-organizing neural network. Here basic requirement of design and neuron control with soft sensor are the knowledge of fundamental

relationship of process variable and therefore the parameter within the question. It's called a process neural network which is an extension of traditional neural network during which the input and output are time variant. So, the info processing is better than traditional neural network, so it is highly suitable to attenuate heat loss at blow down station and increase its ability by operating at peak.

Roopalagrawal describes Internet Based Boiler Drum Level Control System using LabVIEW in this Internet based PID control system is introduced to regulate the drum level with the fixed PID parameters. the control is not ideal so some other control is required to improve the performance of drum level control system. The 3 types of control of boiler are established using the internal model control method. It is designed tool kit in LabVIEW.

III. BLOCK DIAGRAM AND DESCRIPTION

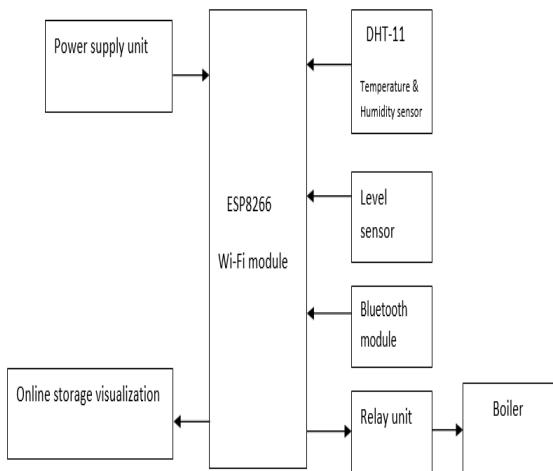


Fig. 1 Block Diagram

A. Power Supply Unit

A power supply unit (or PSU) converts AC to low voltage regulated DC power for the interior components of a computer. Modern personal computers universally use switched-mode power supplies. For selecting input voltage some power

supplies have a manual switch, while others automatically adapt to the mains voltage.

Power supply:

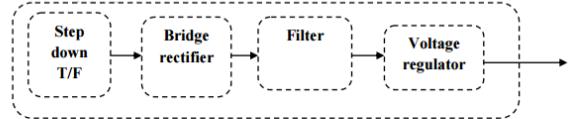


Fig. 2 Power Supply

The power supply unit 230v AC is transferred to the availability to transformer it stepdown in to 12v AC. The rectifier will convert 12v AC to 12v DC then the transformer 7805 will step down the 12v DC to 5v DC. now the 5v will split to offer power supply to DHT 11 sensor (it monitors both humidity and temperature) level sensor, Relay unit, Bluetooth module and the esp8266 module.

B. ESP8266 Module

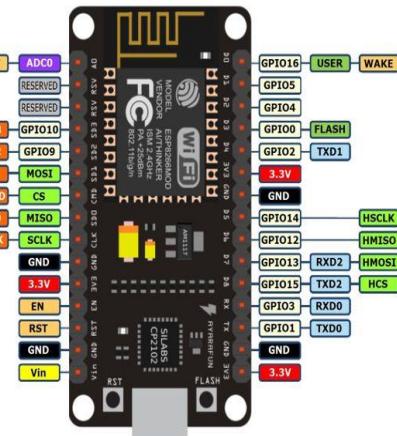


Fig. 3 ESP8266 Module

The ESP8266 WiFi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all WiFi networking functions from another application processor. This module comes with AT commands firmware which allows you to get functionality like arduino wifi shield, however you can load different firmwares to make your own application on the

module's memory and processor. It's a very economic module and has a huge and growing community support. This module has onboard 80Mhz low power 32-bit processor which can be used for custom firmwares. This also means that you can host small webpages without any external controller. For more details see: NODEMCU. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions and requires no external RF parts. ESP8266 is transforming the world with its low cost and high features which makes it an ideal module for Internet of Things (IOT). It can be used in any application where you need to connect a device to your local network or internet. This module ESP-12 has 7 GPIOs. The ESP8266 is a low-cost Wi-Fi chip with full TCP/IP stack and MCU (Micro Controller Unit) capability produced by Shanghai-based Chinese manufacturer, Espressif Systems.

C. DHT 11



Fig. 4 DHT 11 Sensor

Humidity is defined as the amount of water present in the surrounding air. This water content in the air is a key factor in the wellness of mankind. For example, we will feel comfortable even if the temperature is 00C with less Humidity i.e., the air is dry. But if the temperature is 100C and the Humidity is high i.e., the water content of air is high, then we will feel quite uncomfortable. Humidity is also a major factor for operating sensitive equipment like electronics, industrial equipment, electrostatic sensitive devices and high voltage devices etc. Such sensitive equipment must be operated in a Humidity environment that is suitable for the device.

D. Level Sensor

This device is used to measure the distance from an object. The sensor needs a 5V power supply to run. 10uS pulse is required to the trigger input and start the ranging, and then the module will send out an 8-cycle burst of ultrasound at 40 kHz and raise its echo. The Echo is a distance object that is pulse width and the range in proportion. Then calculate the range through the time interval between sending trigger signal and receiving echo signal. It can detect objects that are within a range of 2cm – 450cm (.78" – 14' 9"). The device uses two digital pins to communicate the distance found. Ultrasonic Range Detection Sensor works by sending an ultrasound pulse at around 40 KHz. It then waits and listens for the pulse to echo back, calculating the time taken in microseconds. We can trigger a pulse as fast as 20 times a second and it can determine objects up to 3 meters away and as near as 3cm.

E. Relay Unit

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

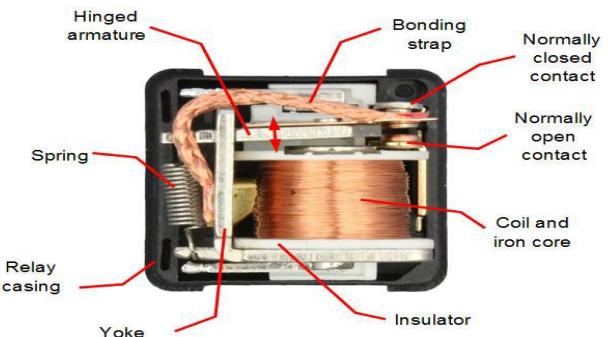


Fig. 5 Relay Unit

F. Bluetooth Module

BLUETOOTH MODULE (HC-05) is an easy-to-use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

The Bluetooth module HC-05 is a MASTER/SLAVE module. By default, the factory setting is SLAVE. The Role of the module (Master or Slave) can be configured only by AT COMMANDS. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices. The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project, etc. Remember the models HC-04 or HC-06 are SLAVE only modules. HC-05 is the module of interest in this post. To identify the model, you can see the pin count. If the module has 5 or 6 pins it is HC-05. If the module has only 4 pins then it is HC-04 or HC-06. The firmware for HC04 is LINVOR & for the HC05 it is HC05 itself. If you scan for Bluetooth devices from your Android phone you can see this name. The extra pins in HC-05 are the KEY & STATE pins. The KEY pin is used to enter the Command mode.

The slave modules can not initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices. Be sure not to make the mistake of buying 2 slaves (HC-04). To enter the Command mode, you can either use an USB TO TTL Module or your Arduino UNO board. The HC-05 Bluetooth Module has 6pins. They are as follows:

ENABLE: When enable is pulled LOW, the module is disabled which means the module will not turn on and it fails to communicate. When

enable is left open or connected to 3.3V, the module is enabled i.e the module remains on and communication also takes place.

Vcc: Supply Voltage 3.3V to 5V

GND: Ground pin

TXD & RXD: These two pins' acts as an UART interface for communication

STATE: It acts as a status indicator. When the module is not connected to / paired with any other Bluetooth device, signal goes Low. At this low state, the led flashes continuously which denotes that the module is not paired with another device. When this module is connected to/paired with any other Bluetooth device, the signal goes High. At this high state, the led blinks with a constant delay say for example 2s delay which indicates that the module is paired.

BUTTON SWITCH: This is used to switch the module into AT command mode. To enable AT command mode, press the button switch for a second. With the help of AT commands, the user can change the parameters of this module but only when the module is not paired with any other BT device. If the module is connected to any other Bluetooth device, it starts to communicate with that device and fails to work in AT command mode. we know that Vcc and Gnd of the module goes to Vcc and Gnd of the Arduino. The TXD pin goes to RXD pin of Arduino and RXD pin goes to TXD pin of Arduino i.e., (digital pin 0 and 1). The user can use the on board Led. But here, led is connected to digital pin 12 externally for betterment of the process.



Fig. 6 Bluetooth Module

G. Arduino IDE

If you haven't written "code" in any computer language yet, you'll have to get used to writing very specific commands to get things done. But Arduino gives you many easy-to-use commands. Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. Arduino is a small circuit board with an Atmel Micro Controller chip and other parts. See examples [HERE](#). Arduino is intended for use by both non-technical people with no previous programming experience and seasoned pros who love to tinker. Arduino was developed in Italy by Massimo Banzi and a group of people who believed Hardware and Software should be "Open Source" and available to everyone. Physical Computing is quite different than writing software for personal computers where the only physical inputs are the Mouse and Keyboard. With Arduino you can connect and control literally hundreds of different devices and write software that creates new Intelligent Devices.

H. Blue term

Working in the Electronics industry, particularly with Arduino boards, and the VirtualBox BT2S Slave (Bluetooth 2 Serial) it didn't take long before the need for a Bluetooth terminal application on the phone became a serious need for me. After having used many different Bluetooth serial terminal applications on the Android OS Blue term has become one of my favorite Utility applications for Arduino/Versalino projects.

The Blue term App is simply put a Serial Terminal for your Android Phone or Tablet. It provides many of the basic features you have come to expect from a standard Serial Terminal on a PC. The big difference is that it is on your Phone or Tablet, and that it is designed specifically to work with Bluetooth to Serial devices. It doesn't emulate web terminal, SSH, or other options that you might find on the drop-down menu in Tera Term or Hyper terminal. Once you have the application installed you simply click the options button and connect to the appropriate device (such

as HC-05/HC-06 in the case of the Virtual box BT2S Slave) and enter the pairing code (1234 in the case of the BT2S Slave default) and complete the pairing process. Once properly paired you will see a blue screen that is actually a text field where inbound data can be seen. Clicking on the text field will allow you to send data through your Bluetooth device as if it was physically connected to a computer.

IV. WORKING

The power supply unit 230v AC is transfer the supply to transformer it steps down in to 12v AC. the rectifier will converts 12v AC to 12v dc then the voltage regulator 7805 will step down the 12v DC to 5v DC. now the 5v will split to give power supply to DHT 11 sensor (it monitors both humidity and temperature) level sensor, Relay unit, Bluetooth module and the esp8266 module. the DHT 11 sensor reading and the level sensor reading will monitored and upload to the esp8266 module. It was connected with the internet and uploaded to the online. now the thing speak server will downlink the data and visualized in the monitor via wireless communication. Bluetooth module connected with the Esp8266 control the relay unit attached with the boiler will be controlling via Blue term android app.

V. RESULTS AND DISCUSSION

The parameter values such as temperature, humidity and level values are made to met continuously measured and the measured values are made to be displayed in the android app. The boiler parameters are monitored and controlled by using ESP8266 module it is also known as node MCu.

VI. CONCLUSION AND FUTURE ENHANCEMENTS

A. CONCLUSION

An important parameter such has humidity, temperature, level is continuously monitored and controlled in the mobile /PC screen. One of an important thing is to maintain these parameter

values at the set point level if not there will be an occurrence of fault in the system. To control the parameter values these values are made to be displayed in the mobile/PC.

B. FUTURE ENHANCEMENT

In future a greater number of parameters can be used, and this parameter are used to sense all the values in the boiler and these values can be made to be displayed in the control room and direct control for each parameter can be done through the controller.

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