IOT Based Boiler Industrial Automation Using Esp8266

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Abstract -This research describes the development and coding of an IoT-based boiler industrial automation system which integrates ESP8266 NodeMCU microcontroller with Blynk platform for real-time monitoring along with control functionalities. The system depends on an HC-SR04 ultrasonic sensor and a DHT11 temperature sensor for measuring boiler temperature and water level in the boiler tank. The system activates buzzer alerts with simultaneous warning notifications in the Blynk application whenever each temperature exceeds 50°C or water level falls below 7cm.The connectivity used to transmit sensor data via Wi-Fi comes from an ESP8266 which provides smooth access to Blynk cloud-based server capabilities. Users gain access to remote key boiler parameter observation through the system which has the effect of minimizing human inspection along with improving operational safety and industrial efficiency. The developed prototype presents an affordable automation solution suitable for industrial applications which follows standards of smart factories in Industry.

Key Words:esp8266 microcontroller, temperature and humidity sensor, ultrasonic sensor, buzzer, Blynk app.

I.INTRODUCTION

This research describes the development and coding of an IoT-based boiler industrial automation system which integrates ESP8266 NodeMCU microcontroller with Blynk platform for real-time monitoring along with control functionalities. The system depends on an HC-SR04 ultrasonic sensor and a DHT11 temperature sensor for measuring boiler temperature and water level in the boiler tank. The system activates buzzer alerts with simultaneous warning notifications in the Blynk application whenever each temperature exceeds 50°C or water level falls below 7cm. The connectivity used to transmit sensor data via Wi-Fi comes from an ESP8266 which provides smooth access to Blynk cloud-based server capabilities. Users gain access to remote key boiler parameter observation through the system which has the effect of minimizing human inspection along with improving operational safety and industrial efficiency. The developed prototype presents an affordable automation solution suitable for industrial applications which follows standards of smart factories in Industry.

II. SYSTEM CONTENT

1. ESP8266 MICROCONTROLLER

The ESP8266 microcontroller implements an IoT-based boiler industrial automation system for live parameter monitoring and control of boiler temperature and pressure alongside water levels. The ESP8266 utilizes connected sensors to gather data that the system processes through established safety threshold definitions. The ESP8266 sends data through Wi-Fi to both cloud platforms and mobile applications where operators inspect the boiler's conditions remotely. Boiler operational safety actions can be automated through relays when the ESP8266 activates a safe condition manual. The system implements efficiency Enhancements by reducing manual inputs as it uses real-time alerts along with remote control possibilities for safety assurance.

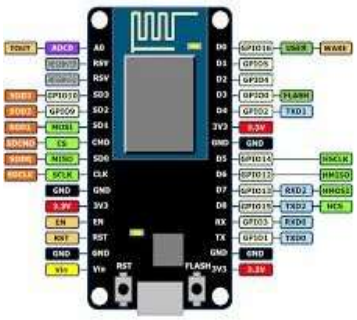


FIG1. ESP8266 MICROCONTROLLER

2. ULTRASONIC SENSOR

The IoT-based boiler automation system functions with HC-SR04 ultrasonic sensor that tracks water level measurements inside the boiler tank. The system transmits ultrasonic waves from the trigger pin to get reflected off water before receiving them through the echo pin. The sensor determines distance by measuring the duration of echo return time from the sound waves it emits. The device converts measured ranges into readings of water level capacity in centimeter. Once the measured level drops beneath the predetermined threshold of 7cm the system triggers an alarm buzzer and delivers a warning to the user through the Blynk mobile application interface. Real-time remote observation functions through this system alongside dry boiler prevention which ensures the boiler's safety in industrial environments.

FIG2. ULTRASONIC SENSOR(HC-SR04)

3. TEMPERATURE AND HUMIDITY SENSOR

The temperature and humidity level in boiler environments is monitored through the DHT11 sensor which operates as part of the IoT-based boiler automation system. The ESP8266 NodeMCU device connects to the sensory element of the system for reading the periodic temperature and humidity readings. Digital data output from the DHT11 sensor removes the requirement for complicated signal processing operations. When boiler temperature reaches unsafe levels 50°C and higher the system activates noise signals through a buzzer along with instant Blynk app alerts. Users receive instant opportunities for fixing issues with the provided system. The system maintains continuous environmental monitoring to stop overheating and pressure accumulation that leads to improved operational safety and enhanced efficiency in industrial boiler operations.

FIG3. TEMPERATURE AND HUMIDITY SENSOR(DHT11)

4. BUZZER:

The buzzer functions as an important alarm system in the Iot based boiler industrial automation system which warms users about dangerous system conditions. The ESP8266 Node MCU controls the buzzer to produce an alert whenever critical thresholds exceed maximum or minimum safety limits. The microcontroller activates the buzzer through signals when it detects temperature and water level alarms from its connected sensors which include temperature sensor DHT11 and ultrasonic sensor HC-SR04. This action produces an instant audible alert to notify nearby personnel. A Blynk mobile application warns users simultaneously while the device send alerts. The dual alerts system operating together delivers increased safety as well as reliability to boiler operations.

FIG4. BUZZER

5. BLYNK APP APPLICATION:

The IoT-based boiler monitoring system uses Blynk application as remote dashboard to provide real-time boiler

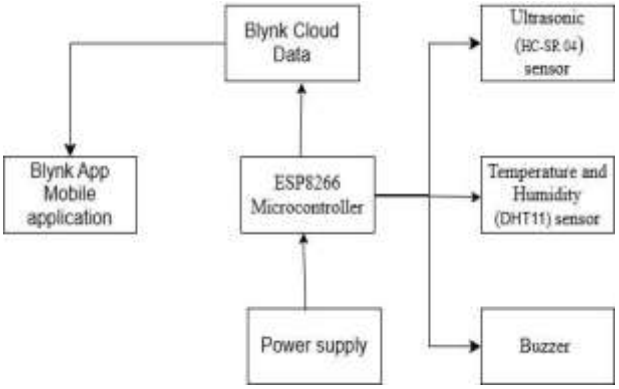
parameter visibility. Through its connection to the internet with an SSID and password the ESP8266 Wi-Fi module obtains Blynk authentication by using the unique BLYNK_AUTH_TOKEN. Transported data from a DHT11 sensor through Virtual Pin V0 provides temperature readings and the water level measurements arrive through Virtual Pin V1 from the ultrasonic sensor. Virtual Pin V2 functions as a trigger point for relay mechanisms. Abnormal situations such as temperature fluctuations or declining water levels activate the alerts that same device sends out. This system enables remote notifications or visual alerts in the application. The system provides instant access to monitor crucial boiler conditions by using mobile devices in real-time.

FIG5.BLYNK APP APPLICATION

III. METHODOLOGY

An industrial boiler safety system using Blynk IoT platform needs to monitor temperature and water level measurements for real-time protection purposes. The main controller functions with the ESP8266 NodeMCU while multiple components connect to Blynk IoT platform for real-time observation and warning features. Measures the temperature of the boiler. The NodeMCU enables the connection of this component through GPIO2 (D4). The trigPin (D5) and echoPin (D6) together measure the water level present inside the boiler tank. A warning sound will activate when the system notices dangerous situations. Programming occurs through the Arduino IDE and connects to Wi-Fi with preinstalled information in the sketch before using Blynk for remote data viewing. Temperature information displays at virtual pin V0 while water level information shows at virtual pin V1 alongside alert status shown at virtual pin V2. The system maintains perpetual DHT11 sensor data retrieval. When the temperature rises above 50°C the system activates both a buzzer alarm and sends an alert through the Blynk platform. The ultrasonic sensor determines the distance to which it stands above water through calculation. When the water level measurement falls below 7cm the buzzer activates while simultaneously alerting the user through Blynk. The buzzer function receives power in safe conditions at the same time sensor data automatically transfers to the Blynk app which enables live smartphone-based monitoring.

IV. BLOCK DIAGRAM



V. RESULTS AND DISCUSSION

The IoT-based boiler automation system which used the ESP8266 for implementation achieved real-time boiler parameter monitoring and control capabilities including temperature and water level measurements. The water level measuring abilities of the ultrasonic sensor matched precision standards and the temperature sensor maintained reliable output regarding boiler heating conditions. Users could check the status of the system through the Blynk app as the system sent parameter readings from the devices to the platform. The buzzer system provided warning notifications to users when abnormally high temperature level and water level amounts were detected. The Blynk application allowed operators to monitor system conditions from any remote location which enabled them to act promptly thus reducing potential hazards to equipment and safety risks.

FIG1. BOILER MONITORING SYSTEM

FIG2. TEMPERATURE AND ULTRASONIC LEVEL RESULTS

Industrial boiler systems achieve better efficiency alongside safety improvements and convenience measures when IoT technology integration takes place. A system based on the ESP8266 components delivered both economic and expandable features for industrial automation needs. Through its remote monitoring capabilities and real-time alert system and automatic response capabilities the system decreases manual workload while stopping hazardous occurrences to provide smooth boiler performance. The system implementation proves how IoT technology can transform conventional industrial processes into high-performing reactive operational frameworks.

VI. CONCLUSION

His project includes developing a boiler monitoring system based on the ESP8266 microcontroller to connect temperature and water level sensors with the Blynk IoT platform that performs real-time monitoring and alerting functions. The system monitors essential parameters consisting of boiler temperature and water level by using the DHT11 sensor together with ultrasonic distance measurement. At any point when temperature crosses 50°C or water reaches 7cm below minimum mark the system sounds an alarm and sends warning messages through the Blynk dashboard. The system presents a usable solution to oversee remote boiler operations cheaply while improving safety measures as well as operational efficiency. Users will find the setup friendly to operate while it runs reliably and additional features including push alerts plus relay-activated shutoff capabilities and smartphone integration remain possible for later implementations.

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