Real-Time Fire Monitoring and Prevention Using IoT and Blynk Software

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Abstract- In this research work, Internet of Things (IoT) based smart fire alarm navigation system is proposed which aims at solving the issue caused by negligence and delayed reaction of fire-related accidents on creating IoT. The presented scheme integrates some sensors like gas, temperature, and GPS modules with the use of Arduino IDE technology for identifying and addressing dangers of residential structures. Arduino software IDE is employed for coding Arduino IDE platform which is central component system thus allowing smoother communication among varied parts. A primary intention of this model is to establish alert system which in turn alerts inhabitants and fireman in real-time via mobile app along with development of IoT dependent smart fire alarm navigation system and assessment of performance functioning. Users will get warnings and incident data through cell phones via Blynk application. The utilization of system with Wi-Fi modules in turn assures remote monitoring & notification ability. This study emphasizes significance of well-informed & prompt reactions to fire occurrences for minimizing flame spread with low loss. This data will be kept in cloud storage service online. For smoke and fire alter, the LED might glow and buffer starts beeping. The alert notification is received once flame sensor detects fire or flame.

Indexed Terms— Internet of Things, Smart fire alerting system, Aduino IDE, Smoke sensor, temperature sensor, fire sensor, Wi-Fi, Blynk app.

I. INTRODUCTION

Recently, rapid development of technology advancement, specifically IoT opens several avenues to enhance the security and safety over sophisticated system of monitoring. IoT thus enables sensor devices to connect through internet, thus transmitting real-time data and thus offering early warnings of the hazardous condition. In this context, detection of gas leakage signifies critical area at which IoT thus provides effectual solution, thereby allowing quick and accurate detection and monitoring. One of the most widely used energy sources in daily life, gas is used for both industrial and domestic purposes, including cooking [1]. Despite all of its advantages, using gas carries a number of concerns, especially if there are leaks. Gas leaks can cause fires, explosions, and even deadly accidents, which emphasizes how important early identification is to avert unintended consequences. Previous research has demonstrated the ability of IoT-based gas leak monitoring systems to deliver timely early alerts. For instance, devices that use MQ-2 gas sensors and microcontrollers have been created to identify gas and methane in the atmosphere.

Using Blynk, a mobile application has been developed that allows users to conveniently monitor gas and fire conditions and receive notifications in text, image, and audio formats.

By utilizing cloud technology, the gas leak detection system enables real-time movement, fire, and gas monitoring from distant areas through a cloud-connected mobile application. This feature enables customers to quickly react to possible threats and continuously monitor the environmental conditions of their homes or businesses [2]. In order to provide comprehensive detection capabilities, this research also attempts to incorporate many kinds of sensors into the gas leak detection system, including motion, fire, and gas sensors.

It has been demonstrated that this integrated system can automatically activate additional safety devices and provides users with faster and more accurate notifications [3]. Finally, emphasis is placed on the creation of home security systems with Internet of Things-based gas leak detecting capabilities. These systems notify users in the case of a gas leak by using gas sensors that are linked to mobile applications [4-6]. The creation of home security systems with Internet of Things-based gas leak detection capabilities is also a priority. In the event of a gas leak, this system alerts people via gas sensors linked to a mobile application [7]. This study highlights how crucial IoT integration is to enhancing home security, especially in the area of gas leak detection [8]. This demonstrates how important IoT integration is to improving home security, especially in the area of gas leak detection. Safety precautions in both residential and commercial settings can be greatly enhanced by combining cutting-edge technology with useful applications in gas leak detecting systems. These technologies create a safer workplace for everyone by combining cloud computing, IoT, and user-friendly interfaces to deliver timely alerts.

II. RELATED WORKS

The paper proposed a wireless IoT gas and smoke detection model using ESP8266 and Blynk integration [9]. The fundamental processing unit of the IoT Smoke and Gas Detector is the ESP8266 microcontroller, a flexible and reasonably priced IoT platform. Sensors on this device can identify smoke and a variety of dangerous chemicals, such as carbon monoxide (CO), methane (CH_4), and propane (C_3H_8). The gadget notifies selected users, sounds alarms, and saves data for examination when harmful concentrations of these compounds are found. This system's interface is the Blynk platform, an intuitive and adaptable IoT dashboard.

In [10], an IoT-integrable automatic gas leak detecting system was proposed. The primary control unit of a model is an ESP32 microcontroller, which is complemented with a fire sensor to detect fire threats and a MQ2 gas sensor to detect LPG leaks. Other parts include an automatic water pump that turns on when a fire is detected, assisting in the quick extinguishment of the fire, and a fan to improve air circulation in the event of gas buildup. Additionally, the device has an LCD to show customers the current gas levels in the surrounding area, giving them visual feedback. This system can be remotely monitored and controlled via a smartphone thanks to its connection to the Blynk application.

A monitoring gas leak detection system is suggested in the work [11]. Propane, butane, and Liquefied Petroleum Gas (LPG) are detected by the system using a NodeMCU ESP8266 Wi-Fi microcontroller and a flammable gas sensor (MQ-2). The ESP8266 transmits data to the Blynk application after the sensor's voltage output determines the gas concentration. The goal of this approach is to keep the workstation tidy and secure. Sensors and a smartphone app are used by the Internet of Things-based gas and smoke detection system to remotely monitor the property. In the event of an incident, it generates audible alarms for users and sends SMS alerts to authorities and users.

In the study [12], the author proposed a real-time smart fire outbreak detection and extinguisher system that uses Internet of Things (IoT) technology to monitor and control spontaneous fire outbreaks inside buildings. An ESP-8266 module with gas, temperature, and flame sensors for detecting fire outbreaks and an automatic fire outbreak location finder with an extinguisher system served as the basis for the construction of the smart sensor node in this system. Additionally, it uses a smartphone running a specialized mobile app called Blynk Application, which acts as a platform interface between the user and the system.

By developing an IoT-Based Smart Fire Alarm Navigation System, this work [13] seeks to address the issues brought on by carelessness and a delayed response in fire-related incidents. In order to detect and mitigate fire hazards in residential buildings, the proposed system uses Arduino technology to incorporate a few sensors, including temperature, gas, and GPS modules. The Arduino Mega platform, which is the core of the system and enables seamless communication between various components, is coded using the Arduino IDE software.

In [14], a real-time mobile application was created to automate greenhouse farming. The system makes use of the Blynk mobile application, which enables users to automate and monitor many components of the greenhouse environment in real-time, as well as operate them manually and remotely.

The goal of the study described in [15] is to create a system for the detection, monitoring, and warning of forest fires in real time. The system's development began with the assembly of an Arduino microcontroller, a wireless fidelity module, a smoke sensor, and temperature and humidity sensors. Then, Blynk was used to create a fire monitoring and alert system.

III. PROPOSED WORK

The proposed design is described in this section. Figure 1 is the block diagram and the sensors are controlled by the Arduino IDE to gather information from the environment, as shown in the picture. There is a threshold for each of these indicators to verify the potentiality and criticality of fire. The other measurements required to detect fire are smoke and flame, which are markers of fire criticality. Additionally, a backup reading is necessary in the event that one sensor fails. The water system would be turned on to stop the threat if the aforementioned thresholds were reached. The feedback is connected to IoT updates that use additional fire-detecting sensors to regulate the water pump. Additionally, the system uses a buzzer and LED as visual cues to indicate danger. On a smartphone, the ESP8266 continuously displays and retains data.

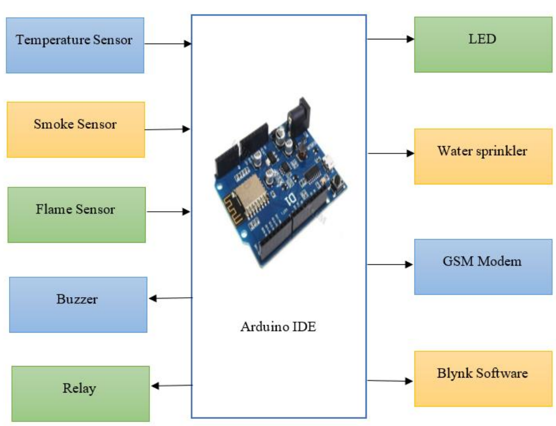

Figure 1 Block Diagram of proposed design

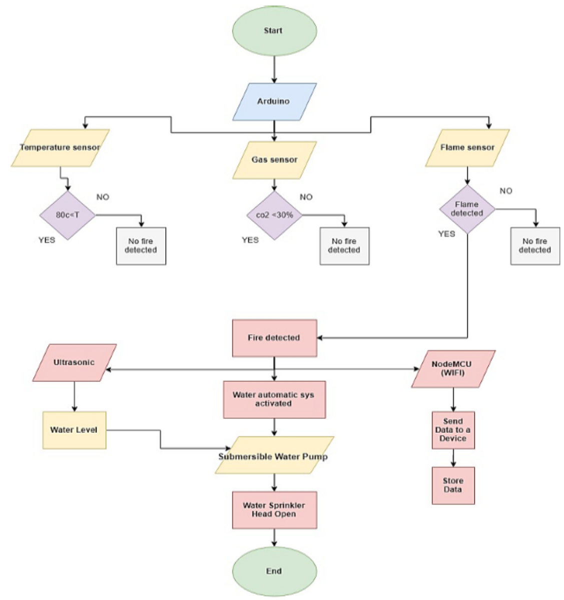

Figure 2 Flowchart of proposed design

a. Sensor Placement

The suggested fire detector system prototype includes a room with gas, temperature, and flame sensors that are spread out to provide quick readings, evenly spaced water sprinklers, a router for the Global System for Mobile Communications (GSM) module, and add-ons like an LED and a buzzer. The prototype serves as a fire testing stand with a water system emergency backup.

b. Sensors and components used

The main function of the various sensors that are available for different physical quantities is to convert them into electrical form.

An instrument that senses and measures temperature and usually transforms it into an electrical signal for use in control or electronic systems is called a temperature sensor.

Smoke Sensor: The MQ-2 gas sensor has been employed as a smoke sensor. The sensitivity of this sensor to carbon monoxide is high. The sensor is inexpensive and appropriate for a variety of uses. This sensor has outstanding sensitivity and a fast response time. The output of the sensor is an analog voltage.

Figure 3 MQ-2 Gas sensor

Flame Sensor: A flame sensor definition is a type of detector that is used to detect as well as react to the occurrence of a fire or flame. A flame sensor frequently responds faster & more precisely as compared to a heat or smoke sensor because of the mechanisms it utilizes to notice the flame. Flame sensors are usually used to verify whether the furnaces are functioning correctly.

Figure 4 Flame sensor

In addition, water sprinklers, GSM modems, LEDs, and buzzers are utilized. Usually driven by DC voltage, a beeper or buzzer (Figure 5) is a device that transforms audio signals into sound. Depending on its design, it can emit a variety of sounds, such as music and alarms. The output is indicated via an LED. The primary feature offered by this system is a GSM modem.

Figure 5 Buzzer

A device that employs GSM mobile telephone technology to establish a wireless data link to a network is known as a Global System for Mobile Communications (GSM) modem or GSM module. A Subscriber Identity Module (SIM) card can be used with a GSM modem. It serves as a significant improvement that notifies the consumer via SMS. In order to transmit SMS, the GSM modem receives the current data from the sensors. The water pump was automatically turned on and alerts were issued to the Blynk app in the event that the flame sensor detected a fire.

c. Arduino IDE

The most important part of the project is the Arduino. The Arduino is responsible for locating the peripherals and assessing their condition. It has to decide on the connected devices. It is responsible for allocating a priority to every task. It is an essential part of the system that controls all circuit activity, including communication between Wi-Fi modules and LED interfaces. It also determines which messages will be shown on the LED and for how long. There is only one serial connection on the Arduino for sending and receiving data. It is possible for transmission and reception to occur simultaneously. Arduino's four communication modes provide programmers and system designers the ability to build incredibly intricate data transfer networks. It is the central component of the system that regulates all of the inputs and the output action. The Arduino IDE is utilized here.

d. Blynk App in IoT system

The Blynk app provides a flexible framework for creating Internet of Things (IoT) applications that let users remotely control and keep an eye on gadgets using smartphones. A cloud server, libraries for many hardware platforms, and an intuitive mobile UI are all part of its strong architecture. Blynk's usefulness is further improved by its connection with well-known microcontrollers like the ESP8266, which makes it the perfect option for projects requiring data visualization and real-time monitoring. By integrating a comprehensive automatic response system for gas leak and fire detection with the Blynk application, our research expands on the current understanding. In addition to using Blynk for remote monitoring and alerting, our system has features like automatic water pump activation for fire suppression and a fan to improve ventilation in the event of gas buildup. By offering real-time monitoring and prompt remedial actions, this integration greatly enhances safety measures and sets our methodology apart from earlier research.

Figure 6 Blynk application

The Arduino Integrated Development Environment (IDE) was used to create the system's software architecture, which allowed the ESP8266 microcontroller to be programmed to process sensor inputs and carry out control logic. For remote monitoring and control, the Blynk program was used, which enables users to administer the system using a smartphone interface and receive real-time notifications.

The methodology encompassed a comprehensive procedure for combining the different parts into a coherent whole. First, schematic diagrams were made to show how all of the hardware components were connected. The microcontroller was configured to react automatically to PIR, gas, and flame sensor inputs. The system triggered the alarm, turned on the red LED, and turned on the fan to spread the gas when the gas level over a 600-ppm threshold. The water pump was automatically turned on and alerts were issued to the Blynk app in the event that the flame sensor detected a fire. It was easier to comprehend the system's functioning from beginning to end thanks to the utilization of a block design model, which was essential in clarifying the process flow.

IV. PERFORMANCE ANALYSIS

The fire alerting system uses three sensors: smoke, flame, and temperature. The analog signals received at the sensor end are converted to digital using the Arduino IDE. The Arduino is configured to sound the buzzer when a temperature, flame, or smoke threshold value is achieved. The GSM module receives the data from Arduino simultaneously. Microcontrollers are connected to the internet using a GSM modem. GSM modems are used to link microcontrollers to the internet. The following information will then be communicated by GSM modem to the IOT website so authorized users can take the appropriate steps to extinguish the fire. This Internet of Things-based fire alarm system requires that the GSM module be linked to a network. The loT module is not used in the implementation of this project either. The IoT module has been replaced by SMS alerts, and in this project, an SMS is sent anytime the buzzer is activated.

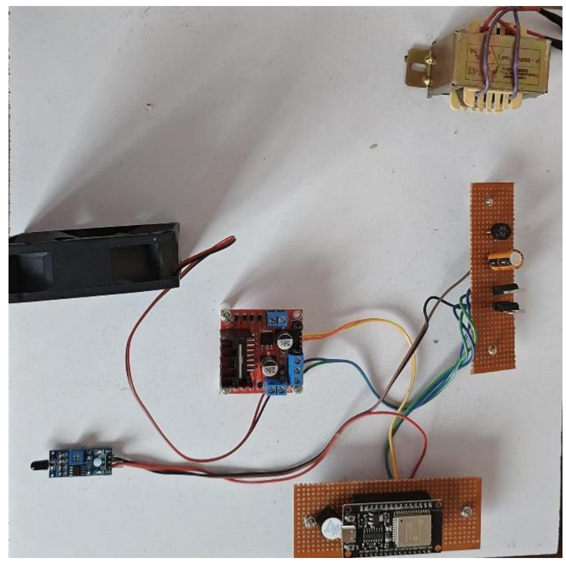

Figure 7 Initial setup of component

Figure 7 is the primary setup of hardware components for the detection of fire and smoke. Figure 8 is the sensor sensed level of smoke and flame in Blynk app.

Figure 8 Smoke sensor detecting level of smoke at blynk app

Figure 9 is the output of fire detection system while testing the hardware setup with the fire. The alert is created by turning on LED light.

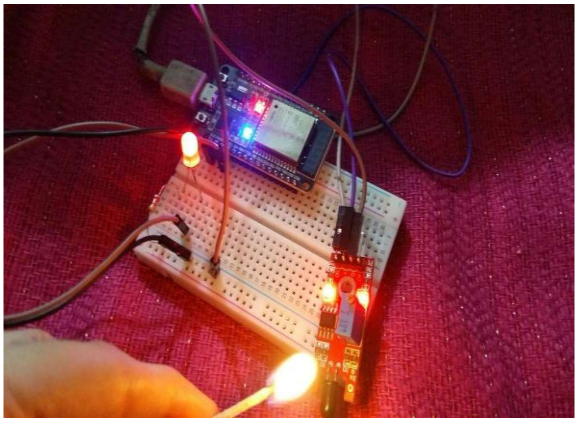

Figure 9 Output of Fire detection system

Figure 10 is the detected smoke and alert smoke detected notification sent to user from the IoT connected Blynk application.

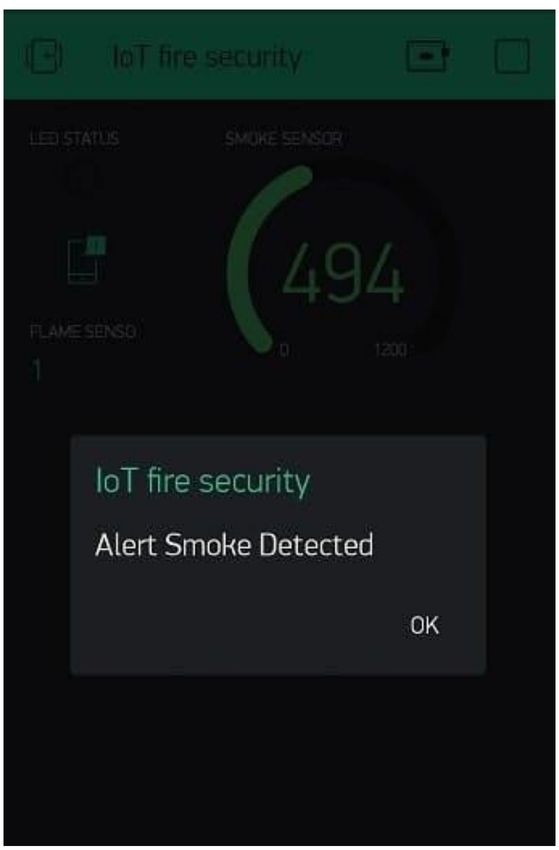

Figure 10 Detected smoke and alert notification in Blynk app

On connecting the components as per circuit diagram and testing is now carried. For smoke and fire alter, the LED might glow and buffer starts beeping. The alert notification is received once flame sensor detects fire or flame. On the successful detection of smoke and if gauge level increases by 500, then alert is given. The values could be changed as per the needs to see result.

CONCLUSION

An IoT integrated real-time fire and smoke detection system was presented in this work. In order to detect and mitigate the risks associated with residential structures, the proposed strategy combines a number of sensors, including temperature, gas, and GPS modules, with Arduino IDE technology. The Arduino IDE platform, which is used for coding, is a central component system that facilitates easier communication between various components. This model's main goal is to create an alert system that uses a mobile app to notify residents and firefighters in real time. It also aims to design an IoT-dependent smart fire alarm navigation system and evaluate how well it works. Via the Blynk app, users will receive incident data and warnings on their phones. In turn, using a system with Wi-Fi modules ensures the ability to monitor and notify remotely. In order to minimize flame, spread with little loss, this study highlights the importance of timely and knowledgeable responses to fire incidents. This data will be stored online in a cloud storage service. The LED may illuminate and the buffer may begin to beep in response to smoke and fire changes. When a flame sensor detects a fire or flame, an alert notification is sent.

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