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WIFI BASED INDUSTRY PROTECTION SYSTEM

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***Abstract*—Security is a fundamental component that every individual seeks in their house, business, or industry in today's fast-paced world. Security is essential in the life of an individual to protect his property from being stolen or physically damaged. It is a duty of the owner, particularly in industries where workers deal with dangerous as well as sophisticated machines, to restrict and prohibit unnecessary access of people into restricted areas. Considering the global increase in crime, it is our responsibility to keep employees safe. To overcome the drawbacks of the previous methods, the proposed research work aims to provide a way of protecting people from entering areas that are restricted and avoiding industrial accidents. Alarms are used in traditional security systems to send the signal. Here Internet of Things is used to communicate with the device for sending and receiving required information and data through internet. Therefore, using a computer, smartphone, or other smart gadget, it may be managed and seen at any time and from any location.**

***Keywords*— Internet of Things (IOT), Node MCU, MQ gas sensor, Flame sensor, DTH Sensor, ESP32, Relay.**

I. INTRODUCTION

The Internet of Things is a network of physical objects that can communicate data using sensors, electronics, software, and networking [1]. These systems do not require any human intervention. The Wi-Fi based system transfers signals from several sensors, such as the temperature and humidity sensor and gas sensors, to the Microcontroller [2]. The result is then transmitted to the IOT platform by the microcontroller. These will receive information from the smoke and temperature sensors in the event of a fire, indicating the presence of smoke and variations in temperature. The microcontroller is linked to the Wi-Fi, buzzer, and exhaust fan. If there are any changes to the illumination, Esp32 receives the information and activates the backup light [4]. When the temperature sensor detects a temperature higher than a specific threshold,the ESP32 is configured to activate the buzzer. This value can be set to a particular value. The sensor values will be transmitted to the website (Thing Speak) simultaneously. Because the data is monitored LIVE by the customer on an IOT platform, immediate action can be carried out. An comprehensive sensor implementation across equipment and instruments, utilizing the Internet of Things (IoT) concept to regulate and monitor conditions, is one suggested solution to this problem. The planned gateway, which is responsible for data collection, processing, uploading, and user control information management, is a key element of the proposed system. Interestingly, in situations when network connections are lost, the system makes sure that the data is saved for later upload when the network is restored. Beyond standard limits, the Internet of Things anticipates a wide range of tangible components, including personal devices like tablets, smartphones, and digital cameras[7][8]. This method represents a major advancement in the integration of technology for increased efficiency as it foresees a spike in linked devices offering data, information, and services.

II. LITERATURE SURVEY

In the recent work by Puli Keerthija, Naraka Hema, Palawar Vaishnavi, and Dr. M. Shyam Sunder [1] focuses on "GSM-Based Industrial Fault Detection System". The research explores the utilization of GSM technology for real-time monitoring in industrial processes. GSM, or Global System for Mobile Communications, serves as the foundation for wireless communication, and its application in industrial settings is examined for its potential benefits. In the existing body of literature, several studies have delved into the integration of GSM for monitoring purposes in the process industry. These investigations collectively shed light on the advantages and challenges associated with employing GSM technology. Notable findings reveal the efficacy of GSM in providing real-time data communication and its positive impact on enhancing monitoring capabilities within various industrial processes. As part of this literature survey, it is crucial to contextualize the GSM-based monitoring approach by comparing it with alternative technologies prevalent in the industry. This comparative analysis aims to elucidate the unique advantages offered by GSM while acknowledging any limitations or challenges encountered in its implementation.

In the recent work by Dr. B. Rambabu, S. Megha Syam, and K. Lakshmi Narayana [2] the focus is on the development of a "GSM-based industrial protection system." This study explores the integration of GSM technology to enhance security and protection measures in industrial settings. The research delves into the application of GSM for real-time monitoring and communication, aiming to establish an effective system for safeguarding industrial facilities. Through this investigation, the authors contribute to the expanding field of industrial protection systems, leveraging the capabilities of GSM to address security challenges and ensure the robust safeguarding of critical infrastructure.

P. Meenakshi, Mohammed Nazeem, V. Sravya, and Dr. L. Malliga [3] have introduced a cutting-edge "GSM-Based Industrial Security System." have introduced an innovative This research project focuses on leveraging Arduino technology to develop a comprehensive system dedicated to Detecting and preventing industrial safety hazards. By combining the capabilities of Arduino with a tailored approach to industrial safety, the authors contribute to advancing solutions that enhance workplace safety through effective detection and proactive prevention measures.

V.H. Patil , P.B. Patel, A.D. Sonar and Sharada P[4] "GSM-based monitoring in process industry." have introduced a cutting-edge "GSM-Based Industrial Security System." This study is dedicated to the integration of GSM technology for the enhancement of industrial security measures. By leveraging the capabilities of GSM, the authors aim to develop a robust security system tailored for industrial settings. This research marks a significant contribution to the field, showcasing the potential of GSM-based solutions in fortifying industrial security and safeguarding critical infrastructure.

Mrs. D. Aruna Kumari and Dr. Karunaiah Bonigala [5] have introduced a ground breaking "Arduino-Based Industrial Safety Detection and Prevention System This study is dedicated to harnessing GSM technology for the purpose of detecting faults within industrial systems. By leveraging the capabilities of GSM, the authors aim to create an efficient fault detection system tailored for industrial applications. This research signifies a noteworthy contribution to the field, showcasing the potential of GSM-based solutions in early fault detection and prevention in industrial environments.

In the recent work by Subham Raut “Industry based security system using GSM and Arduino” [6] numerous advantages emerge from the concept. The integration of GSM technology into industrial automation processes presents a paradigm shift, enabling remote monitoring and control that significantly enhances operational efficiency. This approach not only proves cost- effective by leveraging GSM's economical communication capabilities but also ensures swift and efficient responses to potential issues, reducing downtime and contributing to enhanced safety measures. The scalability and flexibility of GSM-based systems provide adaptability to changing industrial needs, while the global connectivity of GSM enables standardized monitoring across diverse geographical locations

The Internet of Things (IoT), offering a user-friendly interface and facilitating data logging and analysis for improved decision-making. Ultimately, GSM-based industrial automation emerges as a transformative solution, optimizing processes, reducing costs, and ushering in a new era of intelligent and responsive industrial systems.

III. BLOCK DIAGRAM

The Block diagram consist of fire sensor, MQ gas sensor, DHT senor, metal sensor, relay module, water sprinkler, exhaust fan and a coolant fan. When the fire is detected by the fire senor, it automatically turns on the water sprinkler and display FIRE DETECTED on LED. If hazardous gas is detected by the MQ gas sensor, then it automatically turns on the exhaust fan and display GAS DETECTED on LED. If the temperature is greater than the threshold value, then it turns on the coolant fan automatically, and the temperature and humidity values get displayed on the LED. And if metal is detected by the metal sensor, then it displays METAL DETECTED on the LED

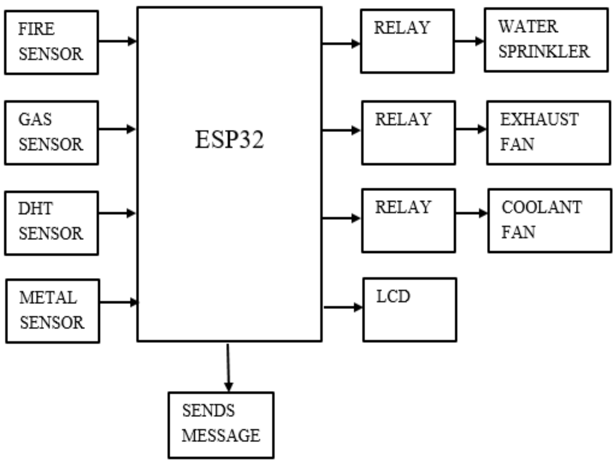

Fig 1: Block diagram for Wi-Fi based industrial protection system

The face recognition system block diagram depicts how the system uses a camera in order to capture an employee’s face .The face has been recognized and extracted from the picture. A database of the employee that are stored is compared with the captured face If the ID of the employee matches then the names will be shown the system screen .If ID doesn’t matches then the message and image are sent via telegram and buzzer rings

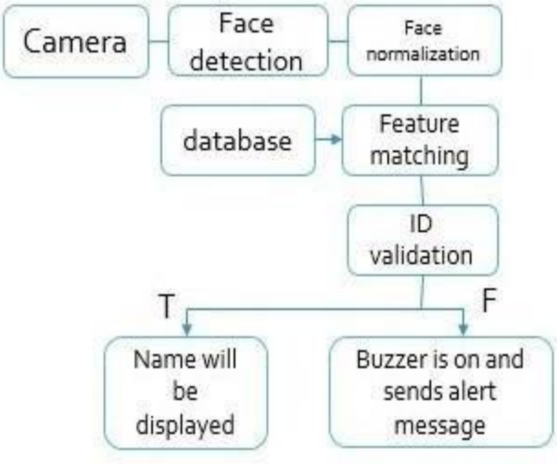

Fig 2: Block diagram for face recognition

COMPONENTS SPECIFICATION:

A. MQ3 Gas Sensor

The MQ-3 gas sensor is a semiconductor device designed to detect alcohol vapor in the air. Operating on the principle of a chemical reaction between alcohol molecules and its internal elements, typically tin dioxide (SnO_2), the sensor measures changes in electrical conductivity. When exposed to alcohol vapor, the sensor's conductivity alters, generating an analog output voltage proportional to the concentration of alcohol present. This output can be interfaced with electronic circuits or microcontrollers for further processing.

Fig 3: MQ3 Gas Sensor

B. ZigBee

ZigBee is a wireless communication protocol commonly used in smart home devices, industrial automation, and sensor networks. ZigBee creates a mesh network, enabling devices to communicate with each other directly or through intermediary nodes, which increases reliability and range. It's often utilized in applications requiring low data rates, such as home automation, lighting control, and environmental monitoring.

Fig 4: ZigBee Module

C. Buzzer

A buzzer operates on a simple yet effective principle of converting electrical energy into sound energy. It consists of an electromechanical component called a transducer, which converts electrical signals into mechanical vibrations. When an electric current is passed through the buzzer, it energizes an electromagnet or a piezoelectric element, depending on the type of buzzer. This energization causes the transducer to vibrate at a specific frequency, generating sound waves in the surrounding air. The frequency and intensity of the sound produced depend on factors such as the voltage applied, the design of the transducer, and any resonant structures present in the buzzer. In applications such as industrial protection systems, the buzzer is activated by a control unit in response to predefined conditions or events, alerting operators or personnel to take appropriate actions. Whether it's a loud, continuous tone or a series of beeps, the buzzer serves as a reliable audible indicator, ensuring timely response and intervention in critical situations.

Fig 5: Buzzer

D. Inductive proximity Sensor

An inductive proximity sensor is a type of sensor used in industrial automation to detect the presence or absence of metallic objects without physical contact. It operates based on the principle of electromagnetic induction. Inside the sensor's housing, there is a coil of wire wound around a ferrite core. When an alternating current (AC) is passed through this coil, it generates an oscillating electromagnetic field around the sensor. When a metallic object enters the sensing range of the sensor, it interacts with this electromagnetic field, causing eddy currents to flow within the object. These eddy currents generate their own magnetic field, which in turn induces a voltage in the coil of the sensor. The presence of this induced voltage is detected by the sensor's electronics, triggering the output signal to indicate the presence of the metal object. The sensing range of an inductive proximity sensor depends on factors such as the size and material of the target object, the frequency of the AC signal, and the design of the sensor itself. Due to their non-contact operation and reliability in harsh industrial environments, inductive proximity sensors find wide applications in machinery automation, conveyor systems, material handling, and assembly lines.

Fig 6 . Inductive proximity sensor

E. ESP32

The ESP32 stands as a robust and versatile microcontroller with integrated Wi-Fi and Bluetooth capabilities, designed to empower a myriad of electronics and Internet of Things (IoT) applications. Its dual-core ten silica LX6 processor, operating at up to 240 MHz, ensures high computational efficiency for diverse tasks. With built-in Wi-Fi and Bluetooth (BLE), the ESP32 facilitates seamless wireless communication, making it a favored choice for IoT projects. Its generous Flash memory and RAM, coupled with a variety of peripheral interfaces, provide flexibility for interfacing with sensors and devices. Noteworthy features include low-power operation, support for Over- The-Airupdates, and compatibility with popular development environments like Arduino IDE and Platform IO. Boasting a vibrant and supportive community, the ESP32 remains a go-to microcontroller for developers engaged in creating innovative solutions in areas ranging from home automation and robotics to sensor networks and beyond. Its open-source nature further encourages customization, making the ESP32 a cornerstone in the realmof embedded systems and IoT development.

Processors – The ESP32 uses a Tensilica Xtensa 32-bit LX6 microprocessor. This typically relies on a dual core architecture, with the exception of one module, the ESP32-S0WD, which uses a single-core system. The clock frequency reaches up to 240MHz and it performs up to 600 DMIPS (Dhrystone millions of instructions per second). Moreover, its low power consumption allows for analog to digital conversions as well as computation and level thresholds, even while the chip is in deep sleep mode.

Wireless connectivity – The ESP32 enables connectivity to integrated Wi-Fi through the 802.11 b/g/n/e/i/. Moreover, Bluetooth connectivity is made possible with the v4.2 BR/EDR, and the series also features Bluetooth low energy (BLE).

The ESP32 supports all IEEE 802.11 standard security features, including WFA, WPA/WPA2 and WAPI. Moreover, ESP32 has a secure boot and flash encryption.

Fig 7: ESP32

F. MQ2 Gas sensor

The MQ-2 Smoke Sensor is a highly versatile gas sensor widely recognized for its effectiveness in detecting a range Of gases, including smoke, methane, propane, and carbon monoxide. Operating on the principle of conductivity changes in its semiconductor material, the sensor offers valuable applications in fire detection systems, gas leakage alarms, and industrial safety measures. With a capacity to integrate seamlessly with microcontrollers like Arduino or Raspberry Pi, the MQ-2 sensor provides analog voltage output, allowing for real-time monitoring and control. However, users should exercise caution, considering factors such as cross-sensitivity and the necessity for proper calibration to ensure accurate and reliable readings. Overall, the MQ-2 Smoke Sensor stands as a crucial component in enhancing safety by offering early detection capabilities for various gases in diverse environments.

Fig 8: MQ2 Gas Sensor

G. Water Pump

A water pump, a fundamental mechanical apparatus, serves the pivotal function of transferring water from one location to another across a diverse spectrum of applications. Distinguished by various types, including centrifugal pumps, submersible pumps, jet pumps, reciprocating pumps, and axial flow pumps, each variant is meticulously crafted to cater to specific needs. Centrifugal pumps, employing a spinning impeller, are ubiquitous in numerous water transfer scenarios, while submersible pumps find their niche submerged in wells for efficient water extraction.

Fig 9: Water Pump

H. Coolant Fan

A coolant fan, an integral component in automotive and industrial cooling systems, serves the vital role of dissipating heat generated by engines or machinery. Also known as a radiator fan, it operates to regulate and maintain optimal temperatures, preventing overheating and ensuring efficient performance. Typically located near the radiator, the coolant fan activates in response to temperature sensors or engine control units, drawing air through the radiator to facilitate the cooling process.

Fig 10: Coolant Fan

I. FlameSensor

The flame sensor, a vital part of fire detection systems, works by identifying infrared radiation released by an open flame. These sensors are highly sensitive and respond particularly to the particular wavelengths that are associated with fires. Within their authorized range, they provide fast and accurate detection[15]. Flame sensors are frequently incorporated into gas appliances, industrial furnaces, and fire alarm systems. They are essential for guaranteeing the prompt detection of possible fire threats. These devices, which are distinguished from conventional heat sources by Characteristics like UV and IR sensors, are made with precision and safety regulations in mind.

Fig 11: Flame Sensor

J. DHT-11 Sensor

The DHT-11 Digital Temperature and Humidity Sensor is a basic, ultra-low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed). For measuring humidity they use the humidity sensing component which has two electrodes with moisture holding substrate between them. So as the humidity changes, the conductivity of the substrate changes or the resistance between these electrodes changes.

Fig 12: DHT-11 Sensor

K. Relay

A relay, an essential component in electrical systems, operates as an electromechanical switch governed by an electric current. Comprising a coil, an armature, and sets of contacts, the relay's functionality hinges on the generation of a magnetic field when the coil is energized. This magnetic influence prompts the movement of the armature, resulting in the opening or closing of contacts and thereby controlling the flow of current in the circuit. With diverse types, including electromagnetic and solid-state relays,

relays find applications across industrial, automotive, and home automation systems Their adaptability extends to controlling motors, lights, heaters, and various devices. Providing electrical isolation, relays safeguard control systems from potential high-voltage damage, ensuring reliability and longevity. The flexibility in configurations, such as normally open, normally closed, and changeover contacts, caters to diverse application requirements. In industrial settings, relays are often DIN rail-mounted, offering a standardized and efficient arrangement for organizing multiple relays

L. LCD

Liquid Crystal Displays (LCD) represent a pervasive flat-panel display technology that harnesses the unique properties of liquid crystals to generate visual outputs. Constructed with two layers of glass or plastic, encapsulating a layer of liquid crystals equipped with transparent electrodes, LCDs form the fundamental structure. Pixels, composed of subpixels with red, green, and blue color filters, constitute the building

Fig 14: LCD Display

IV.FLOW CHART

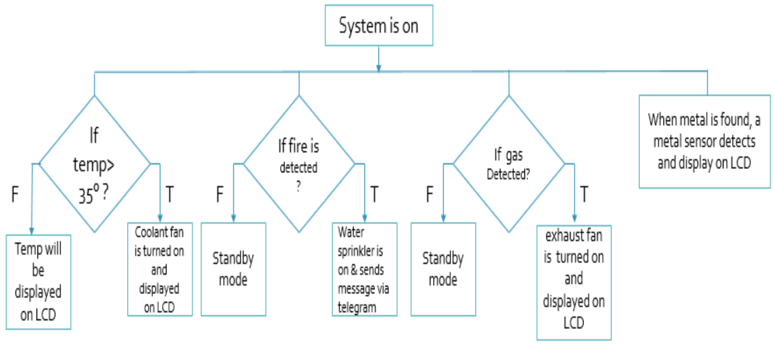

Fig 15: Flow Chart

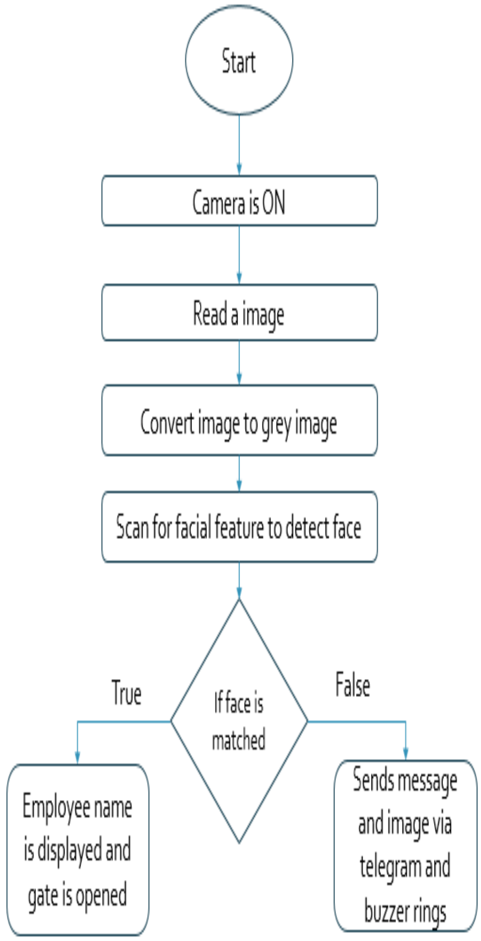

Fig 16: Flow chart for face recognition system

V. METHODOLOGY

To develop a Wi-Fi-based industrial protection system, integrating an ESP32 microcontroller, DHT sensor, MQ gas sensor, LCD display, Telegram messaging, relay, and fire sensor, a structured methodology is essential. Initially, meticulous component selection is crucial, opting for devices with compatibility and robust features. Hardware setup involves connecting sensors to the ESP32's GPIO pins, configuring the LCD display, and integrating the relay and fire sensor. Subsequently, firmware development is undertaken, focusing on ESP32 programming to read data from the DHT and MQ sensors, process it, and trigger alerts or actions based on predefined thresholds. Additionally, firmware includes logic for displaying sensor readings on the LCD and integrating Telegram for remote alerts. Network configuration ensures ESP32 connectivity to the Wi-Fi network and establishes communication protocols for data exchange. Rigorous testing and calibration verify system functionality, sensor accuracy, and threshold settings. Upon successful testing, integration, and deployment, the system is positioned within the industrial environment, strategically placing sensors for optimal coverage. Regular monitoring and maintenance routines are implemented, ensuring system integrity through proactive measures such as sensor calibration and firmware updates. This comprehensive methodology ensures the development and deployment of a reliable Wi-Fi-based industrial protection system, safeguarding against potential hazards and enhancing operational safety.

VI. RESULT

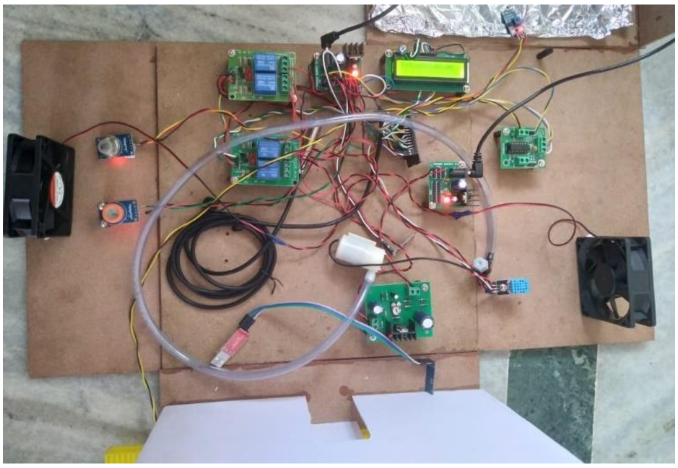

Fig 17: Model for Wi-Fi based industrial protection system

VII. CONCLUSION

In conclusion, the Wi-Fi-based industrial protection system integrating the ESP32 microcontroller, DHT sensor, MQ gas sensor, LCD display, Telegram messaging, relay, and fire sensor presents a robust solution for safeguarding industrial environments. By leveraging the capabilities of the ESP32 microcontroller and Wi-Fi connectivity, real-time monitoring of environmental conditions such as temperature, humidity, gas presence, and fire detection is enabled. The integration of the DHT sensor and MQ gas sensor facilitates accurate measurement and detection of critical parameters, ensuring prompt response to potential hazards. The LCD display provides local visualization of data, enhancing situational awareness for onsite personnel. Additionally, the integration of Telegram messaging enables remote monitoring and alerts, allowing for timely intervention even when personnel are offsite. The relay functionality offers the ability to trigger automated actions or alarms based on predefined thresholds or sensor readings. Overall, this comprehensive system offers enhanced safety and protection for industrial facilities, empowering stakeholders with actionable insights and proactive measures to mitigate risks and ensure operational continuity.

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