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Industries Fire Accident Tracking System Based on IoT Using Controller

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A B S T R A C T

Fire alarm and monitoring systems powered by the Internet of Things (IoT) offer significant advantages for both commercial and residential use. Fires are a leading cause of life and property loss, making effective detection and prevention crucial. By leveraging microcontroller Wi-Fi modules and IoT technology, fire monitoring becomes simpler and more reliable. Current research focuses on enhancing fire detection and prevention systems. One innovative approach involves developing a comprehensive fire detection and prevention system for industrial settings using advanced IoT technologies. This system integrates IoT with fire detection sensors to monitor gas levels, temperature changes, and flames. Data from these sensors is transmitted to a microcontroller Wi-Fi module, which can provide real-time alerts and safety instructions to employees or end-users. In this prototype design, strategically placed sensors detect fire threats and pinpoint their exact location. The controller processes incoming data continuously, ensuring swift response and effective fire prevention measures.

Keywords: Microcontroller,L-298,VCD Player, Central Processing Unit (CPU), Input Devices.

1. Introduction

Efficiently managing fire safety in rapidly growing industries and urban areas presents significant challenges, especially considering the frequency and severity of recent fire disasters worldwide. Reflecting on notable incidents like the devastating Beirut port explosion of August 4, 2020, underscores the urgent need for proactive fire prevention measures. This catastrophic event, caused by the detonation of 2,700 tons of ammonium nitrate, resulted in hundreds of casualties, widespread displacement, and extensive economic losses.

In response to such incidents, this paper proposes an innovative approach to fire prevention using advanced technology. By leveraging sensor networks and microcontroller units, real-time environmental data can be collected and transmitted to cloud-based databases for rapid analysis. This data serves as input for predictive deep learning models, enabling the identification of fire-prone areas and early warning systems.

This method aims to enhance fire safety by automating detection and prediction processes, reducing reliance on manual monitoring. By predicting fire risks and alerting authorities swiftly, this approach strives to minimize human and economic losses associated with fire incidents, benefiting communities and industries alike.

1.1 Existing Model

The primary objective of this study is to develop a fire accident detection system tailored for both industrial and residential settings, aimed at minimizing the severity and impact of such incidents. The proposed method focuses on detecting fire accidents in industrial environments where fires can be triggered by factors such as temperature spikes, humidity drops, or the release of hazardous gases like methane, butane, or propane.

To achieve this, we utilized specific sensors within our system. The DHT11 sensor was employed to monitor changes in temperature and humidity levels, which are key indicators of fire risk. Additionally, the MQ-2 sensor was utilized to detect the presence of potentially dangerous gases, offering an additional layer of early warning capability.

Furthermore, communication plays a critical role in the effectiveness of the system. To enable rapid response and notification in case of fire detection, a GSM module was integrated into our setup. This module serves as a communication gateway, allowing real-time alerts to be sent to designated recipients such as emergency services or designated personnel.

1.2 Proposed Model

This proposed system integrates the Internet of Things (IoT) with fire detection and tracking systems. It can detect gas, temperature, flame, etc., and send that information to an Microcontroller Wi-Fi module, providing prevention guidelines for employees or end users.

1.3 Project Description

An embedded system is a specialized computing device designed to perform a specific task or function. Examples of embedded systems include appliances like air conditioners, VCD/DVD players, printers, fax machines, and mobile phones. Each of these devices contains a processor and dedicated hardware tailored to meet the requirements of its intended application, along with embedded software commonly referred to as "firmware."

Unlike general-purpose computers such as desktops or laptops that can run a wide range of applications, embedded systems are designed to execute a fixed set of functions. They cannot be easily reprogrammed to perform different tasks

Embedded systems typically operate with limited resources, especially in terms of memory. They often lack secondary storage devices like CD-ROMs or floppy disks, relying instead on compact memory configurations.

One distinguishing feature of embedded systems is their requirement to meet specific deadlines. Many embedded systems, especially those classified as real-time systems, must complete tasks within strict time limits. Failure to meet these deadlines can result in serious consequences, including loss of life or damage to property.

Power efficiency is another critical constraint for embedded systems, particularly those powered by batteries. To maximize battery life, embedded systems are engineered to consume minimal power.

Moreover, some embedded systems must function reliably under extreme environmental conditions, such as high temperatures and humidity. These environmental factors can pose additional challenges for the design and operation of embedded systems, requiring robust hardware and software solutions to ensure continued performance and durability in adverse settings.

2. MICROCONTROLLER

The Raspberry Pi Pico W is a wireless microcontroller board introduced by Raspberry Pi, designed specifically for physical computing applications. Serving as the successor to the original Raspberry Pi Pico, the Pico W retains the core RP2040 ARM chip developed by Raspberry Foundation but incorporates new Wi-Fi and Bluetooth capabilities.

A notable feature of the Raspberry Pi Pico W is its integration of the Infineon CYW43439 wireless chip, which enables IEEE 802.11 b/g/n wireless LAN and Bluetooth 5.2 functionality. This addition allows for wireless connectivity, enhancing the versatility and connectivity options of the Pico platform.

Compared to its predecessor, the key difference in the Raspberry Pi Pico W lies in the inclusion of the CYW43439 chip for Wi-Fi and Bluetooth support. Additionally, the power regulation system has been updated, utilizing the RT6154A from Richtek instead of the RT6150B used in the original Pico design. The relocation of the debug port near the System-on-Chip (SoC) accommodates space for the Wi-Fi antenna.

To power the Raspberry Pi Pico W, there are two primary methods:

USB Port: The simplest and most common method is to power the Pico W via the USB port, which provides a 5V supply. This 5V can also be accessed from the VBUS pin, allowing for external components to draw power from the same source.

VSYS Pin: Alternatively, the Pico W can be powered using the VSYS pin, accepting a voltage range of 1.8V to 5.5V. This pin can be connected to a battery or similar power source. The onboard voltage regulator then converts the input voltage to a stable 3.3V, which is suitable for powering the board and connected peripherals.

These power options provide flexibility in how the Raspberry Pi Pico W can be integrated into various projects, accommodating both USB-based and external power sources for different application requirements.

3. Result and Discussion

The convergence of Internet of Things (IoT) and Deep Learning is leading to the emergence of Artificial Intelligence of Things (AIoT), offering unique and effective solutions for fire accident prevention. By harnessing AIoT technologies, manual intervention in fire safety measures is significantly reduced, enhancing safety in fire-prone areas and minimizing loss of life and economic impact.

The proposed solution leverages IoT and deep learning to predict and prevent fire accidents by primarily focusing on detecting combustible gases, a common precursor to fire incidents. This implementation continuously monitors environmental factors such as temperature changes, heat index variations, presence of flames, smoke levels, low ignition compounds, and the concentration of gases—all without requiring human intervention.

The scope of this paper is specifically aimed at measuring LPG (liquefied petroleum gas) due to its widespread use in domestic and laboratory settings. Additionally, the system is designed to detect high levels of smoke associated with fire accidents. However, the future potential of this system includes expanding its capabilities by incorporating additional sensors to detect various types of combustible gases, thereby enhancing safety, efficiency, accuracy, and providing advanced features like alarm notifications and mobile application-based control systems

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