AC FIREGUARD

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ABSTRACT

Though air conditioners are important to ensure a comfortable temperature, they can become a serious fire hazard in case of an electrical overload, overheating or gas leakage. Our project deals with the development of an inexpensive and sensor-based monitoring system capable of avoiding such fire-related accidents. Our model integrates hardware components—like a fire sensor, gas sensor (MQ6), temperature-humidity sensor (DHT11), and actuators like fans and water pumps with wireless connectivity offered by the ESP8266 microcontroller. The system runs independently and facilitates remote monitoring and control via an IP-based interface. In this paper we present knowledge about the design, operation, challenges and performance of the system, emphasizing its real-world applications in homes and businesses.

KEYWORDS: *Air Conditioner Safety, IoT, ESP8266, Fire Prevention, Gas Leak Detection, MQ6 Sensor, Fire Sensor, DHT11, Remote Monitoring, Smart Cooling System.*

1. Introduction

Since air conditioning units have become a standard in almost every home and office, the incidents of AC-related fires have also increased proportionally. Such incidents mostly happen because of a combination of reasons such as short circuits, excessive usage, lack of proper maintenance, or leakage of refrigerant gas. Conventional AC system usually does not have the type of smart monitoring required to detect issues before they begin. In order to rectify this, our project offers a smart safety system that not only detects such hazardous conditions but also immediately prevents them. The intention of the system is to offer a cost-effective solution that can easily be applied across different environments with automatic and remote-controlled capability. The basis of the system is real-time detection and immediate response—components that are typically lacking in traditional safety equipment.

2. Literature Review

Recent studies in the Internet of Things (IoT) field have identified an increased focus on the application of smart technologies for household safety. Experiments have continually demonstrated that the incorporation of sensors into appliances such as air conditioners can effectively minimize accident rates. For example, a study by Patel et al. (2020) indicated that real-time temperature and gas monitoring can prevent more than 60% of household fires if early action is taken.

In another significant study by Kumar and Rani (2021), a gas leak detection system was implemented using MQ6 sensors and GSM modules. While efficient in detection, the system was manual in intervention and did not have features of autonomous control. Our work is based on these findings but takes it one step ahead. It combines various sensors—fire, gas, and temperature—and links them to a single microcontroller, which not only deciphers the data but also acts automatically. Furthermore, a fan is also an active cooling system, and a water pump switches on immediately if fire has been detected. The fact that the system can be controlled and accessed through a web-based interface makes the system adaptable and scalable.

3. Components Used

To design and deploy this safety system, we put together a set of robust and affordable components. The foundation is the ESP8266 microcontroller (NodeMCU), a small Wi-Fi-capable device acting both as a processing device and communication interface. The DHT11 sensor takes continuous measurements of temperature and humidity levels, providing a simple yet efficient method to sense overheating situations nearby the AC. The MQ6 gas sensor is another added security feature that detects volatile gases such as LPG and butane, which are widely used in AC systems and can be risky for explosions. A flame sensor is also utilized to detect infrared radiation usually given off by fire. These sensors provide information to the ESP8266, which makes decisions based on pre-set safety limits.

Actuators like a DC fan and water pump constitute the response mechanism. When overheating is detected, the fan is activated to reduce the ambient temperature. When fire is detected, the water pump sprays water to extinguish the flames. A MOSFET regulates the actuation based on microcontroller commands. System status and real-time data are shown through a 16x2 LCD with an I2C module, providing both visual feedback and warnings.

4. System Architecture and Design

The sensors are strategically placed around the air conditioner to provide overall environmental monitoring. Data is passed from the DHT11, MQ6, and flame sensors to the ESP8266 microcontroller. The firmware is designed to identify certain danger conditions and initiate corresponding actions.

For instance, if the temperature exceeds 45°C, the fan turns on to cool the environment. If there is a gas leak, the system provides an alarm and prepares the water pump in the event that the condition escalates.

If the flame sensor identifies fire, the water pump will engage immediately even if the rest of the sensors are still at safe levels.

All sensor data and system conditions are displayed on the LCD and sent through an IP-based web interface accessible to the user from any browser. Such remote monitoring ability brings peace of mind and additional security, especially when the AC is mounted in hard-to-reach or unsupervised places.

5. Working Mechanism

After power-up, the system goes into an endless loop in which it keeps monitoring the surroundings in real time.

In regular conditions, the LCD indicates a "System Normal" message. When a notable increase temperature is sensed, the fan is automatically engaged. When MQ6 sensor senses a gas leakage, an alarm is signalled, and the system prepares itself for further response.

In fire sensor triggering situation, the water pump is energized immediately in order to neutralize the fire.

Whichever part of the system triggers the response, the entire action gets recorded and posted both on LCD and on the user's browser through the IP interface. This two-channel feedback keeps the user always aware and can step in if needed.

6. Remote Monitoring and Control

One of the most impressive aspects of this system is its remote controllability. By having a simple HTML interface on the ESP8266, users can see real-time readings from all sensors, get timely alerts, and even operate the actuators manually. This is particularly helpful in industrial or distant buildings real-time human monitoring isn't always feasible. The IP-based interface provides users with the ability to intervene or monitor anomalies at any time, providing flexibility and improving overall system utility.

7. Results and Evaluation

The system was tested thoroughly under controlled conditions to verify reliability. A butane spray was employed to simulate gas leakage, which the MQ6 sensor identified within seconds. Heat exposure from a heat gun caused on-time fan activation, and a reduced flame initiated the water pump within less than two seconds.

During the tests, the LCD and web interface properly showed sensor data and response actions with little latency.

The system's capability to repeat performances under varied hazard simulations ensures it's ready for actual deployment.

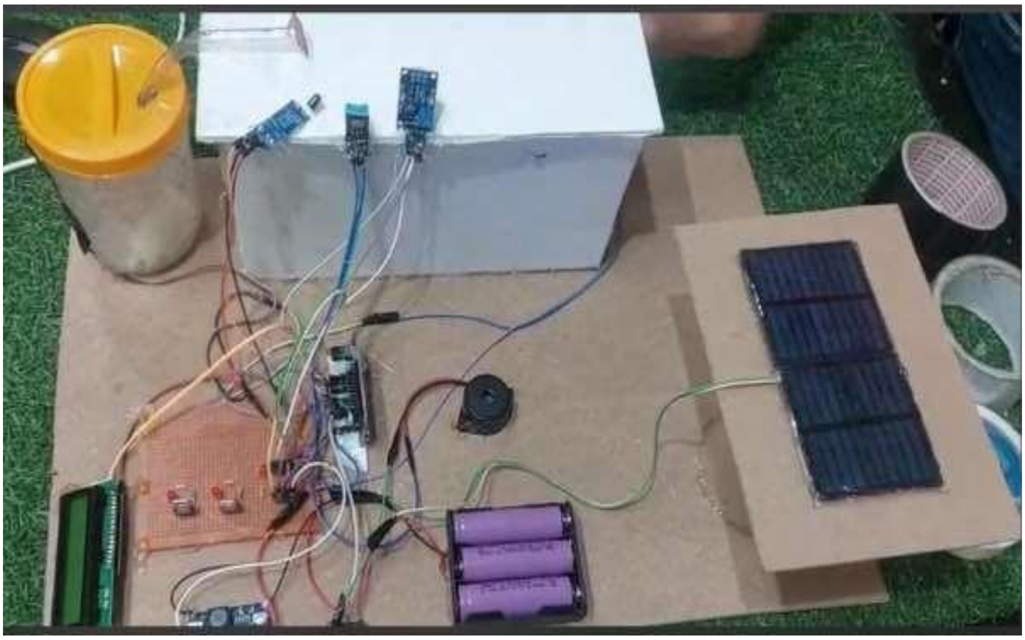

FIG 1: Working Model of AC FireGuard

The above photo indicates a homemade prototype of a project referred to as AC Fireguard, meant to automatically sense and act on possible fire risks—particularly in areas where air conditioners are installed. The concept behind this project is to create an intelligent, low-cost system that can avoid fire accidents by taking action early and even acting autonomously, all while being energy-efficient.

An ESP8266 microcontroller—a tiny but robust device that links to Wi-Fi and serves as the system's brain. It receives data from various sensors and subsequently makes a decision based on the information received.

There are three primary types of sensors used in this system:

MQ6 Gas Sensor – This sensor tests the air for any flammable gases such as LPG or propane. In case it senses a gas leak, it triggers a warning signal.

DHT11 Sensor – This sensor monitors the temperature and humidity of the room. If the temperature abruptly increases—something that typically occurs when a fire is ignited—it sends an alert to the system.

Flame Sensor – This one detects flames directly, which assists in verifying that a fire has been ignited.

When the system senses something amiss—such as a gas leak, unusual heat, or flames—it doesn't merely stop short of issuing a warning. It also acts. A MOSFET transistor is utilized to switch on two significant devices: a fan and a water pump. The fan blows away smoke or cools down things, and the water pump pumps water along a tube to function as a mini fire extinguisher. Both are activated automatically without the intervention of humans.

To keep everything readable, there is an LCD screen attached via an I2C module, which minimizes wiring and space. The screen indicates real-time feeds such as temperature, gas, or whether any hazard is detected.

One of the standout features of this project is its power supply. Rather than relying solely on electricity, it is powered by rechargeable batteries augmented by a solar panel. This implies that the system will still operate even on occasions of power breakdowns—something that's most crucial in situations of emergency.

All the pieces are arranged elegantly on a wooden board to present; the sensors being fitted onto a mock air conditioner model. It simulates realistic placement and depicts how the system would behave in a real room.

At its core, AC Fireguard is an elementary yet effective prototype that integrates everyday electronic parts to construct an automated fire detection and response system. It's intelligent, green, and potentially lifesaving if implemented in real life. The project is an excellent demonstration of how electronics and IoT (Internet of Things) can be combined to produce low-cost safety solutions for homes and offices.

8. Discussion

This project has successfully incorporated low-cost smart technology into air conditioner safety, which is usually neglected. It gains actual-time, independent measurements using user-friendly remote control.

Its speed of modularity allows simplicity of upgrades and modifications for different AC models or building types.

Nonetheless, there are some shortcomings. The system's dependence on stable Wi-Fi might be problematic in areas of poor connectivity. Also, some ambient conditions could trigger false alarms, especially in the case of flame or gas detection. These problems could be addressed in future versions by machine learning algorithms to improve interpretation of sensor data and by means of hardware upgrades such as SMS/email notification modules and battery backup for usage during power loss.

9. Conclusion

AC FireGuard system offers a low-cost, innovative, and useful solution to the growing threat of air conditioner fires. Its autonomous security features, real-time feedback, and remote access make it the best option for improving building security in residential and commercial settings. With ongoing advancements and wider testing, the system has great potential for large-scale deployment and may have a crucial role to play in contemporary smart home systems.

References

[1]. Patel, R., Mehta, N., & Shah, D. (2020). Home Safety Automation Using IoT. International Journal of Engineering Research.

[2]. Kumar, A., & Rani, S. (2021). Design and Implementation of a Gas Leakage Detection System using IoT. Journal of Sensor Systems.

[3]. Singh, P., Joshi, V., & Khandelwal, M. (2019). Arduino Based Fire Detection and Safety System. International Journal of Scientific Research in Engineering and Management.

[4]. Khiyal, M. S. H., Khan, A., & Shehzadi, E. (2009). SMS-based Wireless Home Appliance Control System (HACS). IJCSNS International Journal of Computer Science and Network Security, 9(6), 23–28.

[5]. Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (IoT): A vision, architectural features, and future trends. Future Generation Computer Systems, 29(7), 1645–1660.

[6]. Lavanya, B., & Prakash, M. (2018). IoT-based Smart Fire Alerting System Using Arduino. International Journal of Innovative Research in Computer and Communication Engineering.

[7]. Prasad, K. N., & Tejeswini, M. (2021). Smart Safety System for Gas Leakage and Fire Detection using IoT. International Journal of Scientific & Engineering Research, 12(2), 456– 460.

[8]. Varghese, J., & Thomas, S. (2020). Design of an IoT Based Smart Safety System for Home Applications. Proceedings of the 2020 International Conference on Emerging Trends in Information Technology and Engineering.