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Advance Fire Control and Detection System

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ABSTRACT- In recent years, the usage of various domestic Internet of Things (IoT) devices has grown increasingly popular. One required and significant use of home automation with IoT is fire detection and fire accident avoidance. It has been noticed that most of the houses lacks fire detection & control system and Existing systems have too many errors. To solve or overcome this problem, Researcher decided to gather all the data related to fire detection and controlling system and developed a prototype of advance fire detection & controlling system based on IoT and Arduino which is cheap in cost and can be installed easily. User can install this system according to their interest area. This system provides 90% accuracy and doesn't give false alarms like existing one does. This prototype technology can assist users enhance safety standards by preventing mishaps immediately. So, the future of these systems is bright as new technologies can be applied to improve its accuracy.

KEYWORDS- Alarm, Arduino, Control System, Fire Detection, Sensor.

I. INTRODUCTION

Fires have long been regarded as a dangerous disaster that may cause destruction, property loss, and even death. The resident region was hit by one of these disasters. In several disasters, fires have been a recurrent, catastrophic, and most significant calamity when compared to other hazards. With the rapid rise of urban development, the risk of major fires and other extreme disasters has increased year after year. Early detection of flames and prudence are two essential methods for swiftly putting out fires and preventing major losses and property damage. As a result, having a reliable fire alarm system is critical, especially in buildings with a large number of people or valuable goods [1-4].

The concept is based on "automated fire control and detection system." According to a study, many homes do not have a fire detection system. Fire and smoke are the most common causes of accidental harm. Fire detection is critical because fire has a significant impact on human life and non-living property [5-8]. The majority of homes do not have fire alarm systems, posing a serious danger of fire to inhabitants. In the absence of occupants, a fire outbreak may occur. The majority of fire alarm systems on the market are wired and do not meet the new standards for an automated smart home. As a result, an intelligent wireless fire detection and alarm system that is safer, easier to operate, and cost-effective is required [9-11].

One of the most important aspects of fire safety is the early detection of the onset of a fire emergency and the notification of individuals and fire services. Alarm systems and fire detection are responsible for this. Depending on the expected fire scenario, the kind and number of inhabitants, their criticality, and the content and tasks, these systems can play a variety of significant roles. First, they provide a method for manually or automatically detecting a fire, and second, they alert construction workers to the presence of a fire and the need to evacuate. Similar common purpose is sending an alert message to the fire department or another emergency response agency [12-14].

There are various devices connected to fire detection and control systems available on the market today, but none of them give complete security or notify fire services in a timely manner. To address this issue, researchers gathered all data relevant to the development of fire systems and then built a prototype of an autonomous fire detection and control system based on IoT and Arduino that is low in cost and can be readily placed anywhere, including homes, hospitals, and hotels[15]. As shown in Figure 1, this system includes a temperature sensor, a smoke sensor, a carbon monoxide (CO) sensor, and a flame/heat sensor, as well as an Arduino UNO, automatic windows with an electric motor attached to the sensor, and an LED light module.

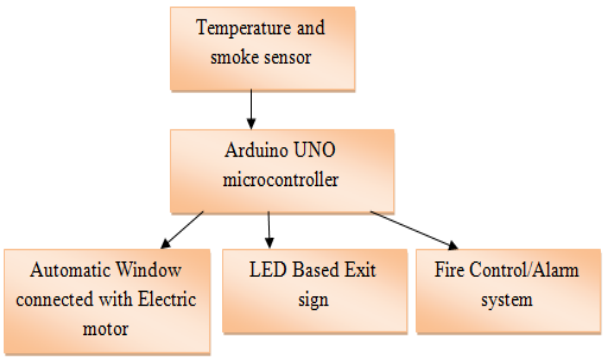

Figure 1: Illustrates the Block diagram of Fire control and detection system

II. LITERATURE REVIEW

Majid Bahrepour et al. surveyed about automatic fire detection form wireless sensors network [16]. For early detection and response, automatic fire detection is critical. Previous research has either treated detection of fire as a use of a certain area or as the primary issue for which solutions have been developed. In this study, Researchers reviewed past research from three perspective: sensor network contributions to early fire detection, forest fire detection techniques and home fire detection approaches.

R. Sowah et al. discussed about a control and detection system for fire in auto-mobiles [17]. Although numerous advantages of detection of fire in street convey, over two-thousand cars are destroyed by unintentional fires every day. A medium-sized physical automobile was used to test the automated system, which included smoke, temperature, and flame sensors. The finding shows that the car fire control and detection system identifies and extinguish fire in under 20 seconds, with no false alarms. Using novel algorithms and fuzzy logic, a unique and extremely talented modular approach for execution of hardware in fire control and detection for vehicles have been created.

Kaushik Sen et al. discussed about Automated Fire Controlling and Detection System [18]. The fundamental idea of this work is to present an inexpensive system of control & detection fire based on heat & smoke sensing. This is made up of a variety of electronic gear that jointly works to sense the existence of fire and then notify public via auditory means. These alarms will detect smoke and then send a notification tot the user and controlling system gets activated.

Ola Willstrand et al. discussed on Fire detection and alarm system for Vehicle [19]. The work described in this paper is part of a broader project involving heavy-duty vehicle fire detection and alarm systems. The work described here focuses on fire detection technology, industry standards and recommendations, and field research. The primary goal of this task is to offer background information for the project's other work packages. An knowledge of various kinds of detection technologies is given, as well as how the systems work and what their benefits and drawbacks are. The general aim of establishing an international test standard for fire detection in heavy duty vehicles necessitates a comprehensive overview of all relevant standards and recommendations, including those used in related sectors such as rail, aviation, and the maritime industry. Finally, a brief review of previous and current research into vehicle fire detection is given.

A. Proposed Design

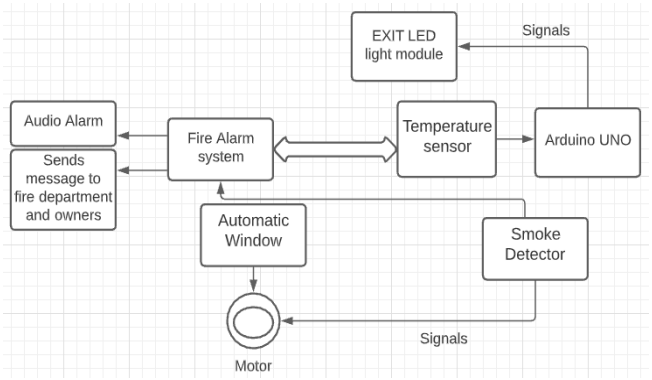

Figure 2: The above diagram shows the Basic design of Fire control and detection system

The design for the fire control as well as detection system is shown in Figure 3. Arduino UNO, Temperature sensor, smoke sensor, Exit sign LED module, Automatic window with electric motor, and Fire alarm system are among the components. The operation of this system is simple: if a fire occurs, the temperature sensor detects the smoke threshold rate, and the temperature sensor detects the smoke threshold rate. If the threshold value exceeds the specified temperature and smoke, a signal is sent to the fire alarm system, which alerts the people and fire departments that a fire has broken out in the structure. Also, to remove the smoke from the room, the smoke sensor sends a signal to an electric motor, which opens the automatic windows, allowing the smoke and heat to escape the room. If the lights are turned off and people are unsure of the emergency exit route, the Arduino UNO will signal the LED exit module, allowing people to quickly exit the building.

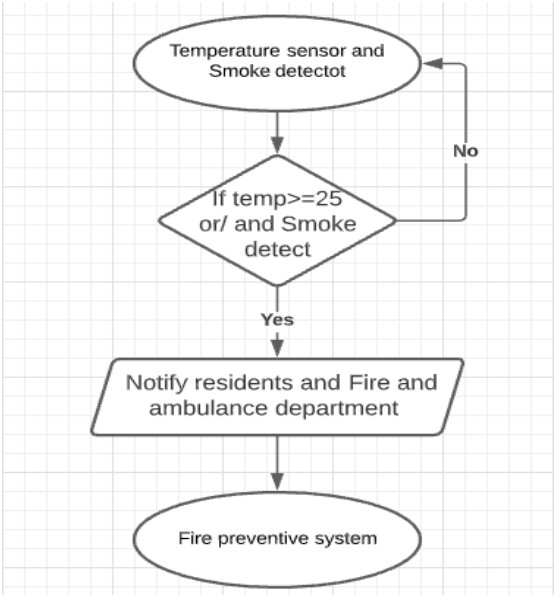

Figure 3: Flowchart to show the working of temperature and smoke sensor

Figure 3 depicts the temperature and smoke sensor's operation. When the fire breaks out, the temperature sensor detects the hotness threshold value, while the smoke sensor detects the smoke threshold value. If the set temperature and smoke values are greater than the

specified values, the sensor alerts the alarm system to take measures and inform the residents that a fire has broken out.

B. Instruments Required for the Proposed system

Smoke sensor, Arduino UNO, Temperature sensor, flame and carbon monoxide (CO) sensor, automatic windows with electric motor, LED based exit, and fire alarm system are among the sensors included in this system:

1) Temperature sensor

As illustrated in Figure 4, it is a digital device that monitors the temperature of its surroundings and converts the input data to electronic data for the purposes of monitoring, recording, or signal transformations.

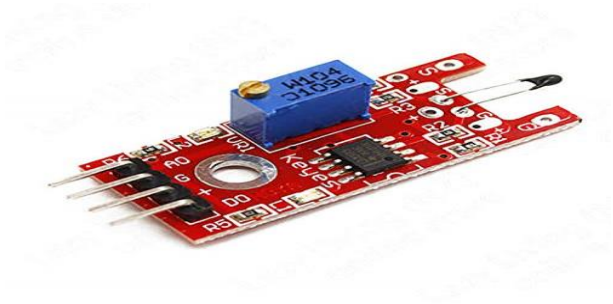

Figure 4: Illustrates the module of temperature sensor to detect temperature[20]

2) Smoke sensor

It is a piece of smoke detection equipment. As seen in Figure 5, a smoke alarm is designed to detect smoke in a structure and alert people to the onset of a fire. A smoke alarm, which includes not only a smoke sensor but also a loud audio sound, emits an average of 85 decibels to alert residents [21].

Figure 5: Illustrates the module of smoke sensor use for detecting smoke[22]

3) Flame sensor

It is the most sensitive to ordinary light of any sensor. Aside from that, this sensor detects flame from light sources with wavelengths between 760 and 1100 nm. At extreme temperatures, this sensor is quickly damaged. Its controls the flow of gas into your furnace, turning off the gas valve automatically if the furnace does not light up. The goal of such a working principle is to avoid gas buildup or catastrophic explosions.

4) Automatic Windows

Automatic windows are linked to an electric motor, and when the smoke sensor alerts the motor, the motor opens the window, allowing the smoke to gently exit the room.

5) LED based Exit module

In general, a lot of smoke collects in this specific place in fire-prone areas, and at that moment, everything becomes too filthy for anybody to easily recognize the escape zones as well as exit signs. Then, in this specific module, we connect our Arduino to the exit signs in those areas, which have some, led lights on them, and Arduino manages the led lights on the exit sign. As soon as the fire detector/sensor signals are received, they are transmitted to Arduino, who then controls the leaded lights on the escape board, as seen in Figure 6.

Figure 6: Illustrates the Exit sign based on LED module[23]

6) Arduino UNO

Arduino Uno is an ATmega328P-based microcontroller board as mentioned in Figure 7. It features fourteen digital input/output pins (Six of them PWM), Six analog inputs, an ICSP and a reset button, a USB connection, a 16 MHz ceramic resonator and power connector, a CSTCE16M0V53-R0.

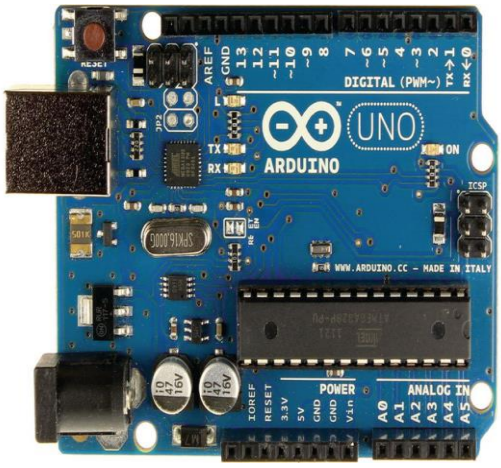

Figure 7: Illustrates the module of Arduino UNO used in this system[24]

III. DISCUSSION

Fire detection system is designed to identify the presence of flames early in the growth of a fire so that people may be evacuated. Alarm systems, which typically send a signal to or from an employee's monitoring station, alert

at least the building's occupants. In this research, the authors describe a prototype of a fire control and detection system based on IoT as well as Arduino that is low in cost and can be readily placed anywhere, including homes, hospitals, and hotels. This system includes temperature, CO, smoke, and flame/heat sensors, as well as an Arduino UNO, automatic windows with an electric motor linked to the sensor, and an LED light module.

This method outperforms the current innovation because it offers early fire detection, which is the primary benefit. They keep an eye on our home or building 24 hours a day, seven days a week. Fire alarms may help you save a lot of money on your house insurance. Unlike current systems, this one does not generate false alarms. In comparison to previous systems, this one does not use radioactive materials and offers 90 percent accuracy. As emerging technologies are utilised to these systems to enhance accuracy, the future of this technology/system is bright.

IV. CONCLUSION

According to this research, employing this fire detection and control system will benefit the building, home, or hospital owner. Through this research, the researchers were able to solve the issue of strange fire detecting systems that produce false alarms and lack accuracy. The author has created a system to regulate and detect fire using an Arduino Uno, different sensors such as temperature, smoke, and flame sensors, an LED-based Exit module, and an automated window with an electrical motor in this research work. This system has a 90% accuracy rate and does not generate false alerts. This method is inexpensive and simple to maintain. Users may simply put the device to the area they are concerned about to protect it from fire. When the temperature rises over the set point, the device sends a GSM text message to the users. It will raise awareness of the dangerous event, prompting the use of fire extinguishers and calls to the fire department, among other things. As a result, the system's future looks bright, as numerous new technologies will be added to improve fire detection and management.

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