Smart Home System (use style: paper title)

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*Abstract*—This paper introduces Smart Home System that includes four main components which are Smart Lamp, Smart Heating and Cooling, Smart Fire Alarm and lastly Smart Door Lock. Source of the image and type of image also will be explained in this paper to make the reader more understand about our Smart Home System works . This article contains a few images and table to make the explanation more understandable. *Do Not Use Symbols, Special Characters, Footnotes, or Math in Paper Title or Abstract*. (*Abstract*)

Keywords—component, formatting, style, styling, insert (key words)

# Introduction (*Heading 1*)

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## Smart Home Fire Alarm System

Fires almost always occur in homes in consequence of carelessness and changes in environmental conditions. That is why fire safety is one of the major concerns for a safe home environment. In recent years, fire detection has become a very big issue, as it has caused severe damage including the loss of human lives. Sometimes, these incidents are more destructive when the fire spreads to the surroundings [2]. In the present circumstances, fires can get out of control because people intend to save money rather than installing proper fire alarm systems.

Study shows that, in the United States, fire is the fourth largest accidental killer behind motor vehicle accidents, falls, and drownings. It is also the disaster that families are mostly likely to experience. Over 80 percent of all fire deaths occur where people sleep, such as in homes or hotels. Most fires occur when people are likely to be less alert such as between midnight and morning. Approximately three-quarters of all fire fatalities occur in residential dwellings. On average in the United States, fires kill nearly 5,500 Americans each year. Over 30,000 people are injured in fires annually and someone dies in a fire every 40 minutes. Most often, victims are children or the elderly. Approximately 1,300 senior citizens die in fires annually. Each year, fire causes over $2 billion worth of damage to homes [1].

Protecting your family from fire requires advance planning for what to do if fire strikes. This includes the use of protective devices, usually smoke alarms, to provide early warning of fire, especially at night when they are most vulnerable.

Early detection of a fire event is an effective way to save lives and reduce property damage. To escape a fiery place and to extinguish the fire source, the fire must be detected at its initial stage. The installation of a fire alarm system is the most convenient way to detect a fire early and avoid losses. A fire alarm system includes components operating together to detect and alarm people by visual and audio methods when smoke, fire, or other dangers are occurred [2]. It also can notify the fire department and control all the fire alarm devices in the area.

Smoke detectors save lives and can help minimize property damage, but what happens when the alarm goes off when nobody is home? [3] In accordance to this problem, we have come out with Smart Fire Alarm System with Automatic Water sprinkler that has been developed to solve the slow response issue of fire accidents. The system reads the heat and smoke data using IoT, analyses these data, and then quickly triggers the automatic water sprinkler. The inputs provide readings for the system to analyse, such as sensors and Wi-Fi module that works as a transmitter for the sensor readings. Temperature and gas sensors are inputs [5]. The readings from the inputs are displayed on the LCD.

Outputs like LED and Buzzer indicate a fire. The water system is supplied with a 12V water pump powered by Arduino and Controlled by a 5V relay. The sprinkler head is the outer of the water output. The alarm is also wired into the fire and smoke detectors and the sprinkler system. The alarm system itself is fault tolerant, has its own internal backup power supply, and is encased in a fireproof box [4] On account of this, our study's importance is to provide a low-cost fire alarm system considering the affordability, effectiveness, and responsiveness.



1. Figure above shows the class diagram for the Smart Fire Alarm System.

As we can see, there are seven main components connected to the main Smart Home System and the components are:

* Smoke detector
* Heater (which also includes temperature sensor)
* Water sprinkler
* Screen (LCD)
* Window
* Sound system
* Door

All of the stated components will respond or react correspondingly to the surroundings and perform their respective functions based on the situation. The concept is simple, a fire alarm system that tells us that there is a fire nearby is great, but the ones that tells us that there is a fire and reacts upon the fire in immediate effect is undoubtedly even better.

We know that each component of a smart home system is designed to be used in a specific location. In the following parts, we will explore more on the components detail, discover how smoke detectors work and where they are located.



1. Figure above shows the state diagram for the Smart Fire Alarm System.

House combustion is one of the main concerns for builders, designers, and property residents. Singular sensors were used for a long time in the event of detection of a fire, but these sensors cannot measure the amount of fire to alert the emergency response units. To address this problem, as stated earlier, this study also aims to implement a smart fire detection system that would not only detect the fire using integrated sensors but also alert property owners, emergency services, and local fire department stations to protect lives and valuable assets simultaneously [5].

The proposed model in this paper employs different integrated detectors, such as heat and smoke detector. The signals from those detectors go through the system algorithm to check the fire's potentiality and then broadcast the predicted result to various parties using Global System for Mobile Communications (GSM) modem associated with the system. To get real-life data without putting human lives in danger, an IoT technology has been implemented to provide the fire department with the necessary data making this system more reliable. The experimental results showed the superiority of our model in terms of affordability, effectiveness, and responsiveness as the system uses the Ubidots platform, which makes the data exchange faster and reliable [5].

Location and material requirements consideration when designing a smart fire alarm system are:

* For all new home construction, fire alarm sensors must be powered by the home AC power electrical wiring. Although this overcomes the problem of neglecting to replace batteries on a periodic basis, there remains the problem of power outages that would also disable a fire warning sensor that uses the home wiring as a power source [6].
* For homes built prior to 1979, battery-powered smoke alarms are permissible. In newer dwellings, alarms must be powered by the electrical wiring. The problem with battery units is that people often neglect battery replacement. On the other hand, what good are wired-in smoke alarms if we have an electrical fire accompanied by a power outage? The safest arrangement, therefore, is to install wired-in alarms equipped with battery backup. Batteries feed the system as a back-up source while the primary Alternating Current (AC) source function [6].
* As to smoke alarm placement, requirements also vary according to the age of the dwelling. In older homes, most municipalities require alarms in the locations of within a close proximity to all bedroom entrances, on each storey of a multilevel home, and in basements. The latest standards, enacted in 1993, require that there be an additional alarm in each bedroom. Another practical location, although not required, is the garage [6].

Next, we will go deeper on the explanation behind the state machine diagram given in figure 2. Furthermore, the basic implementation of the smart fire alarm is realised by using the Tinkercad platform to take a glimpse on how the smart fire alarm really works in respective situations and conditions. To ease our understandings on the functionalities and responds of this system, we will use the approach with the help of illustration using some diagrams and pictures which we will explain later.

Based on the state machine diagram in figure 2, we can see that there are two state which are Initial State and Burning State. The transition between the states only depends on the analogue value of the sensor. If the analogue value exceeds the sensor’s threshold value, it will go to the burning state where the action of opening the window and door, turning off the heater to reduce the surrounding temperature, turning on the water sprinkler and notify the fire department nearby. The other features of the system will be explained more afterwards using some snaps of photos during the simulation on Tinkercad.

Subsequently, the implementation of the circuit below does not really imply all the detailed components that were supposed to be in the system itself, but rather an adaptation of a simple circuit sample aims for a clearer interpretation of the system implementation.



1. Figure above shows the example simple circuit for the Smart Fire Alarm System when no burning is detected.

Notice that when there is no fire or burning detected in any area of the smart home, the LCD screen displays “All Clear” and the green LED is turned on meanwhilst the red LED and the buzzer stayed turn off.



1. Figure above shows the example simple circuit for the Smart Fire Alarm System when there is fire detected.

Meanwhile, when there is fire or burning detected in any area of the smart home, the LCD screen will be displaying “Evacuate” and the green LED will turn off. Subsequently, the red LED will turn on and the buzzer will play sound to indicate there is emergency or wake the home owner up in case that the inhabitants are sleeping, since most fire deaths occur where people sleep such as between midnight and morning. This aims to warn the home owner or person living at the home that there is a fire and take particular act or precaution.

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