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Faculty of Science and Technology

Dept. of Information and Communication Technology (ICT)

Project Report

Topic: "Automatic Smoke Detector and Fire Prevention System"

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Project Report On:

“Automatic Smoke Detector and Fire Prevention System”

Introduction

For an extensive period, humanity has exerted profound deleterious impacts on the environment. Fortunately, owing to recent technological advancements, restorative efforts are now within reach. The imperative to detect fires in residential and industrial settings, stemming from both natural and human-induced causes, is paramount in averting property loss. The ability to promptly identify fires assumes critical significance as it can delineate the distinction between life and death.

The installation of a fire alarm system emerges as a pivotal measure in ensuring the safety of occupants, given the potential for fires to originate unpredictably and at any moment. A smoke detection system serves to alert occupants while concurrently undertaking requisite measures to curtail the fire's escalation within the confines of a residence. In our proposed system, the technological framework leverages the Internet of Things alongside a smoke sensor to dispatch notifications to various home appliances, prompting them to execute requisite actions for fire suppression.

This system's efficacy lies not only in its capacity to activate alarms but also in its capability to orchestrate synchronized responses from household appliances. The implementation involves Cisco Packet Tracer, a sophisticated network simulator boasting an extensive array of Cisco switches, routers, and wireless devices. Beyond its simulated environment, Cisco Packet Tracer offers tangible utility through its assessment tools, facilitating the creation of practical networking models.

Literature Review

Fires can disrupt daily life significantly, causing substantial damage. It is crucial to either prevent them or mitigate their consequences effectively. Despite numerous solutions being developed, false alarms remain a persistent challenge. In our model, incorporating a smoke sensor, we have set a threshold of 0.5. This indicates that necessary actions will be taken if the smoke level detected surpasses this preset level. It's worth noting that this threshold can be adjusted based on individual preferences, specific circumstances, or the environment.

Moreover, our system ensures a controlled response by activating only a limited number of appliances connected to the smoke sensor, and these activations are customizable. When the smoke level exceeds the predetermined threshold, the

system initiates actions such as opening windows, doors, and garage doors. Additionally, to contain the fire's spread within the house, sprinklers are activated, spraying water as a preventive measure.

The primary objective of this project is to design a smart smoke detection system that goes beyond conventional smoke detectors by integrating proactive fire prevention measures. Unlike traditional detectors that solely identify smoke without taking immediate action, our goal is to develop an intelligent system capable of accurately detecting smoke in varied environments. More importantly, this system will trigger proactive measures to minimize or entirely eliminate the potential risks of a fire outbreak.

This intelligent system will be designed to seamlessly integrate with other devices and systems, including fire suppression mechanisms and emergency services. This integration aims to ensure a well-coordinated and swift response in the event of a fire emergency. The overarching aim is to enhance overall safety, mitigate property damage, and ultimately save lives by effectively detecting and preventing fires before they have the chance to escalate.

Application

The project " Automatic Smoke Detector and Fire Prevention System " holds significant promise across a range of applications. Here are brief illustrations:

1. Residential Buildings:
   While smoke detectors are commonplace in homes, integrating fire prevention mechanisms elevates safety measures. This system goes beyond mere detection, taking actions like activating fire sprinklers, closing ventilation systems, and automatically alerting emergency services to curtail fire spread and minimize damage.

2. Industrial Facilities:
   In environments dealing with hazardous materials and intricate machinery, fire prevention becomes paramount. Employing smoke detection with fire prevention systems enhances safety protocols. The system swiftly identifies smoke, triggers alarms, shuts down specific equipment and activates fire suppression systems to prevent or contain fires before they escalate.

3. Data Centers:
   Data centers house critical equipment, making the combination of smoke detection and fire prevention essential. Rapid smoke detection prompts the system to isolate affected areas, cut off power supply, and trigger fire suppression systems, minimizing equipment damage and data loss.

4. Warehouses:
   Warehouses, with their flammable goods, benefit from smoke detection with fire prevention. The system detects smoke, activates alarms, and engages fire suppression systems, reducing potential damage to stored goods and ensuring the safety of warehouse staff.

5. Public Spaces:

Implementing this system in public areas like shopping malls, airports, and entertainment venues enhances overall safety. It detects smoke, initiates evacuation protocols, notifies authorities, and provides real-time information to guide people to safety.

6. Vehicles:
   Applying smoke detection with fire prevention to vehicles such as cars, buses, and trains ensures safety on the move. Smoke detectors and fire prevention mechanisms quickly identify smoke, shut off fuel supply, activate fire suppression systems, and alert passengers and emergency services, averting potential accidents or injuries.

7. Household Appliances:
   Smoke detection with fire prevention can be integrated into household appliances such as stoves, ovens, and microwaves. In the event of smoke detection, the system can automatically shut down the appliance, preventing potential fire hazards in the kitchen.

8. Electronics:
   Integrating the system into electronic devices, like computers and charging stations, adds an extra layer of safety. Upon detecting smoke, the system can initiate a shutdown process, preventing the escalation of fires and safeguarding valuable electronics.

These examples underscore how the integration of smoke detection with fire prevention systems contributes to safety across diverse domains, safeguarding

lives, property, and critical infrastructure.

Methodology

Our Smoke Detection and Fire Prevention project was implemented and tested using Cisco Packet Tracer, utilizing various components for a comprehensive system. Here's a breakdown of the key components involved:

Home Gateway:

Description: A router responsible for forwarding data to the server and control information to connected devices for alerting purposes. It facilitates the execution of necessary actions to extinguish a fire.

Door/Garage Door:

Functions: Monitors Argon, Carbon Monoxide, Carbon Dioxide, Hydrogen, Helium, Methane, Nitrogen, O2, Ozone, Propane, and Smoke levels.
Operation: Opening the door triggers a decrease in these gases to a maximum of 2% in total change. Additionally, opening the door enhances the transference rates for Humidity and Temperature by 25%, and for gases by 100%.

Smoke Detector:

Function: Detects the presence of smoke.
Activation: Sounds an alarm when it detects the environmental variable 'SMOKE' at a level of 40%.

Fire Sprinkler:

Operation: Raises the water level at a rate of 0.1 cm per second.
Connection: Linked to the smoke detector, activating in response to detected smoke.

Siren:

Purpose: Produces a loud emergency noise when activated.
Activation: Triggered by specific conditions encountered during a fire emergency.

Smartphone:

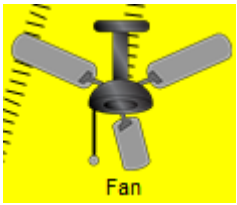
Role: Serves as the user interface, allowing users to receive real-time alerts through a dedicated application. It provides information about the occurrence of a fire, the amount of smoke generated, enabling users to take necessary actions.

Window:

Definition: An opening in a wall, door, roof, or vehicle that allows the passage of light, sound, and sometimes air.

Fan:

Purpose: Facilitates air circulation and ventilation within the monitored environment.
Operation: Can be controlled to adjust the airflow based on the detected conditions, aiding in managing smoke dispersion.

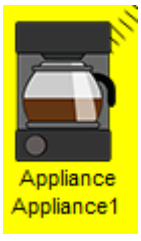


Humidifier:

Role: Regulates and maintains humidity levels within the monitored space.
Integration: Adjusts its operation based on detected conditions, contributing to effective fire prevention measures.

Electrical Appliances:

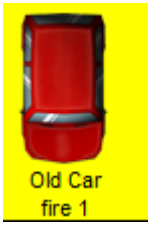
Inclusion: Represents various household electronic devices.
Operation: The system can interface with and control specific electrical appliances, ensuring their safe shutdown or modification in response to fire detection.



Old Car:

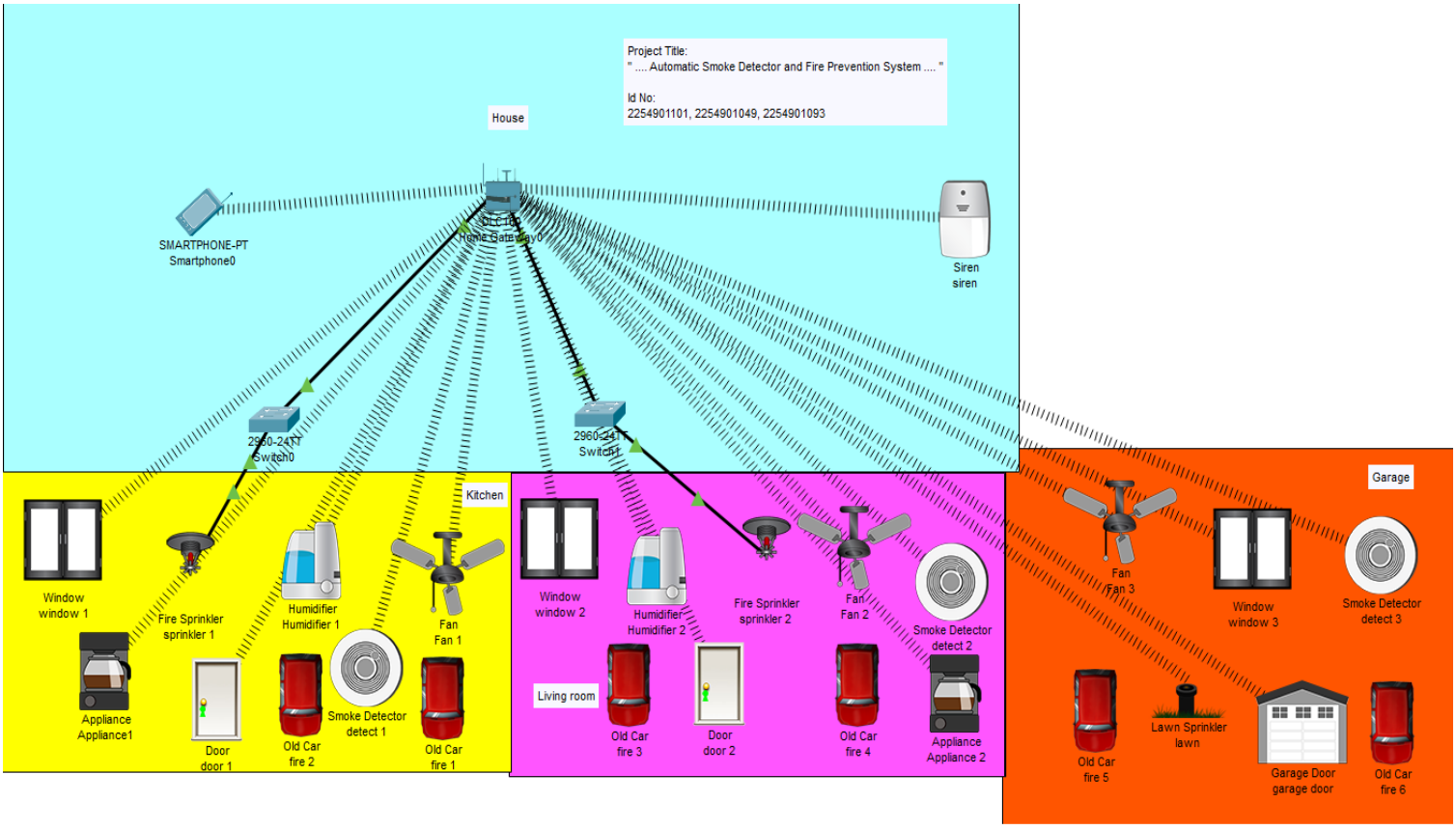
Consideration: Extends the application to include vehicular environments.
Integration: The system can be adapted to monitor an old car, with sensors

detecting smoke and initiating relevant actions to mitigate fire risks in the vehicle.



Implementation

Project Design:



Configuration:

1. DLC Home Gateway
   - Created a web page with a username and password to connect and gain control of the system.
   - Registration can be done on this router.
   - The range of the router is set to a maximum (1000 meters or 1km).

2. Smartphone
   - Connect to the system by going to the web browser entering the IP of the registration server and logging in using ID and Password.
   - IP is set automatically through DHCP.

3. Smoke Detector
   - Smoke Detector is used to detect any smoke. E.g. When a fire breaks out the smoke detector will detect it. In our project when the smoke level goes beyond 0.5, certain conditions are triggered such as door, windows are opened and the fire sprinkler, fan, humidifier, and siren are turned on and electric appliances are turned off.
   - It is connected to Home Gateway using the advanced setting in I/O config i.e. (PT-IOT-NM-1W) network adapter setting.
   - Dynamic IP address is assigned using DHCP.

4. Window
   - A window is an opening in a wall that allows the passage of light, sound, and sometimes air.
   - It is connected to Home Gateway using advanced setting in I/O config i.e (PT-IOT-NM-1W) network adapter setting.
   - Dynamic IP address is assigned using DHCP.

5. Door
   - A door is an opening from where people can enter or leave in a normal routine life as well as in emergency.
   - It is connected to Home Gateway using advanced setting in I/O config i.e (PT-IOT-NM-1W) network adapter setting.
   - Dynamic IP address is assigned using DHCP.

6. Garage door

- A Garage door is an opening from where vehicles can enter or leave. In our case this is very crucial as garage doors are huge and can help the air escape when there is a fire outbreak, releasing carbon dioxide and other Smoke Detection and Fire Prevention gases into the air and helping people to take clean air if they are stuck in the house.
- It is connected to Home Gateway using the advanced setting in I/O config i.e. (PT-IOT-NM-1W) network adapter setting.
- Dynamic IP address is assigned using DHCP.

7. Fire sprinkler

- The fire sprinkler sprays streams of water to suppress or extinguish the fire when ordered by the home gateway. This happens when the smoke detector detects a smoke level of more than 0.5.
- It is connected to Home Gateway using the advanced setting in I/O config i.e (PT-IOT-NM-1W) network adapter setting.
- Dynamic IP address is assigned using DHCP.

8. Siren

- A siren is a device that makes a loud emergency sound when the smoke detector detects smoke level greater than 0.5.
- It is connected to Home Gateway using the advanced settings in I/O config i.e (PT-IOT-NM-1W) network adapter setting.
- Dynamic IP address is assigned using DHCP.

9. Car

- In Cisco-packet tracer there is no object or entity which can simulate the generation of smoke other than a car. So, we have used cars to represent smoke generation which is similar to smoke generated during fire.

10. Humidifier

- The humidifier turns on when the smoke detector detects smoke level greater than 0.5.
- It is connected to Home Gateway using advanced setting in I/O config i.e (PT-IOT-NM-1W) network adapter setting.
- Dynamic IP address is assigned using DHCP.

11. Fan

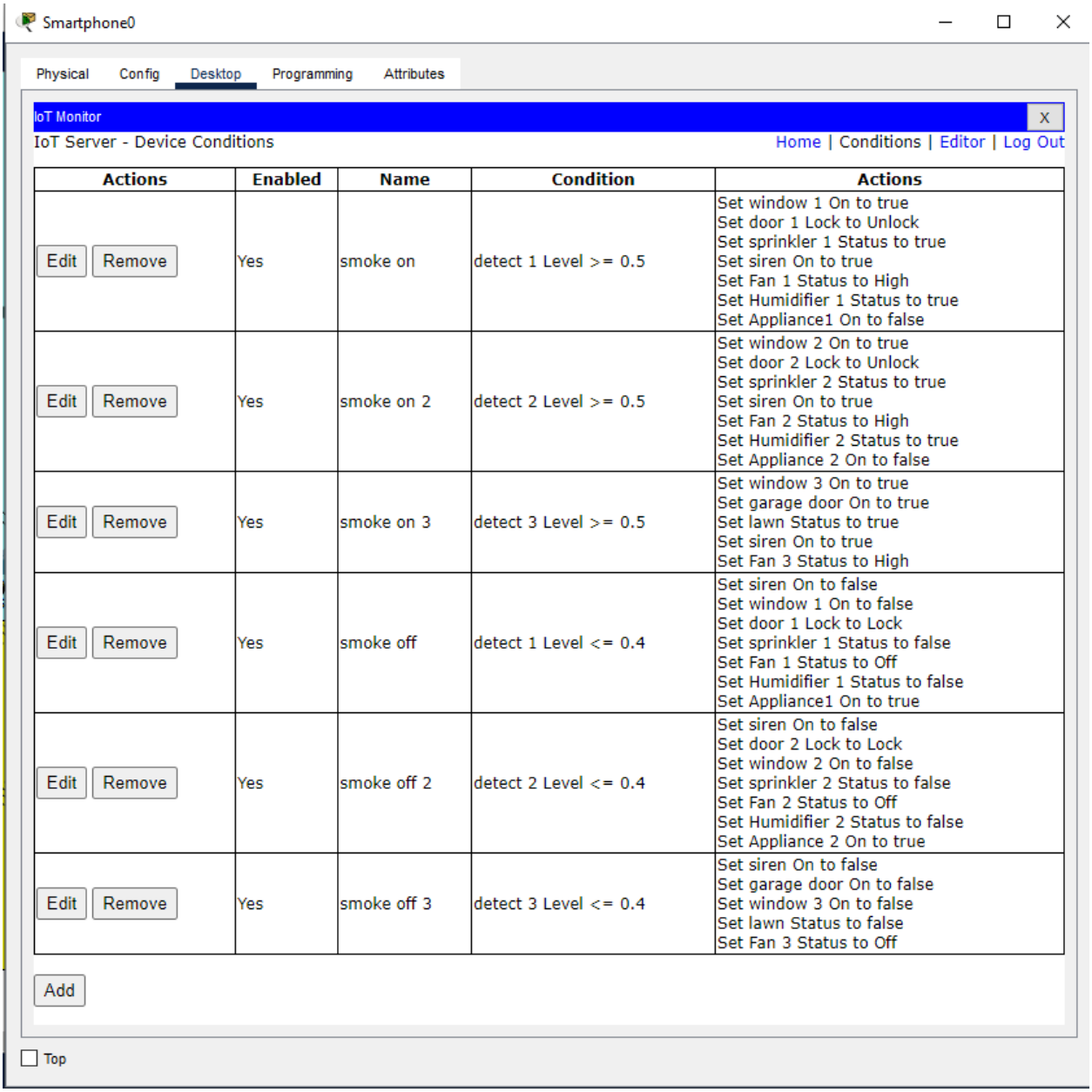
- The ceiling fan turns on when the smoke detector detects smoke level greater than 0.5.
- It is connected to Home Gateway using advanced setting in I/O config i.e (PT-IOT-NM-1W) network adapter setting.
- Dynamic IP address is assigned using DHCP

12. Appliance

- Appliances turn off when the smoke detector detects smoke level greater than 0.5.
- It is connected to Home Gateway using advanced setting in I/O config i.e (PT-IOT-NM-1W) network adapter setting.
- Dynamic IP address is assigned using DHCP

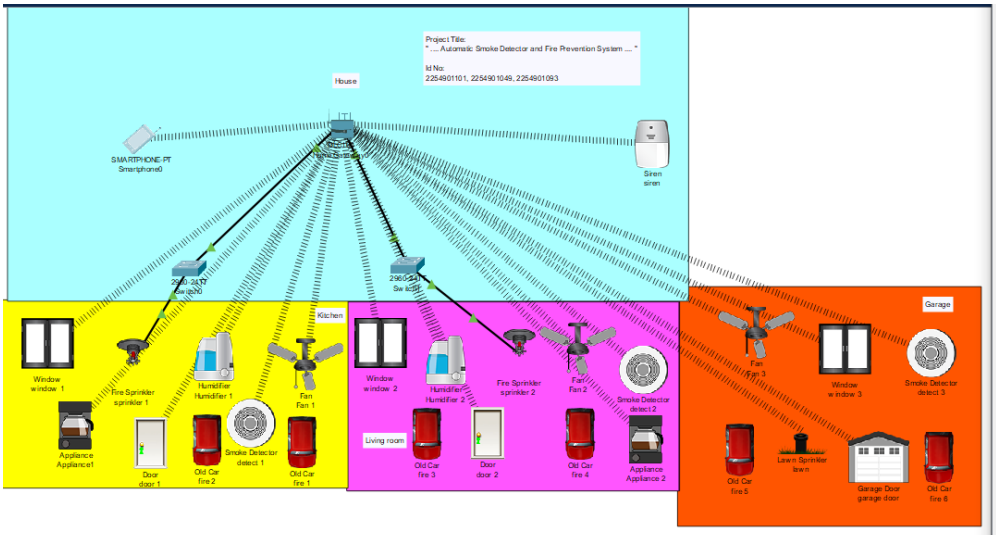
Conditions

For the successful execution of the project, it is essential to define specific conditions that govern the activation and deactivation of all devices. The state of these devices will undergo changes depending on when and how these conditions alter. Cars are utilized to simulate smoke in this context. The critical conditions for this simulation are outlined below:



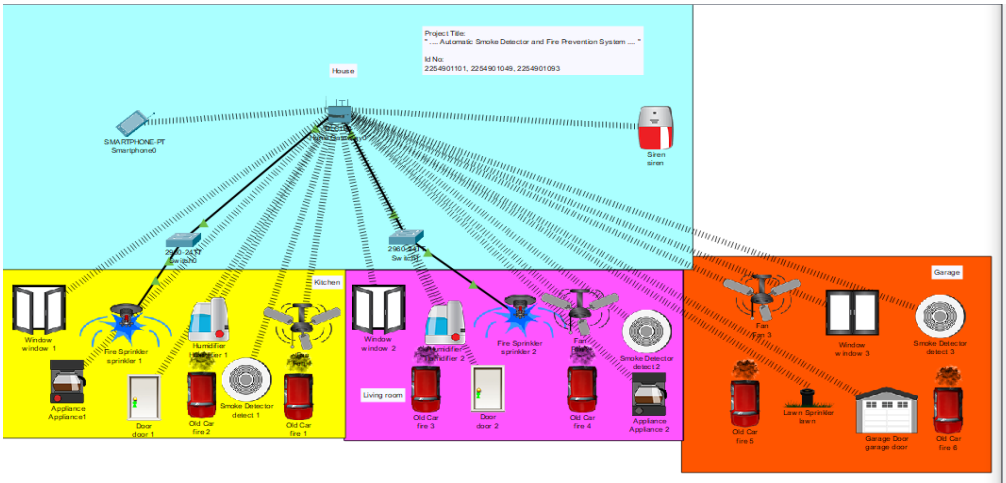
Results

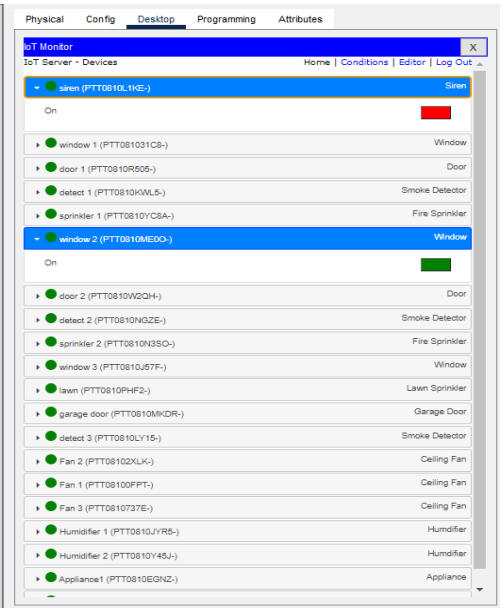
When smoke level is less than 0.5:



When the smoke detector detects smoke level less than 0.5, we can clearly see that fire was not detected by the system; and thus, no action will be taken by the system.

When smoke level is more than 0.5:





When the smoke detector detects smoke level more than 0.5, we can clearly see that fire was detected by the system, and the programed instruction like opening doors, ringing of siren etc., will be executed by the system.

Conclusion

In summary, the project "Automatic Smoke Detector and Fire Prevention System" effectively demonstrated the deployment of a robust smoke detection and fire prevention system. By incorporating smoke detectors, alert notifications, and preventive measures, the system showcased its capability to swiftly identify smoke, notify relevant parties, and implement preventive actions to mitigate potential damage and risks. The utilization of Cisco Packet Tracer streamlined the design, simulation, and testing of the network infrastructure, ensuring accuracy and facilitating efficient troubleshooting. The project's adaptability and scalability enabled seamless integration into various building layouts, and its modular design facilitated the addition of extra components as necessary. Overall, this project lays a solid foundation for advancing fire safety systems, underscoring the significance of proactive measures in safeguarding lives and property from the threat of fire incidents.