IoT-Based Smoke Detection and Smart Home Safety System

Semester (3)

Program

BSCS

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1. Introduction

Modern smart homes increasingly rely on IoT (Internet of Things) to enhance safety, automation, and monitoring. One critical application is **automated smoke detection and fire response**, which reduces human risk and enables rapid reaction to emergencies.

This project demonstrates a **Smart Smoke Detection and Fire Response System** using **Cisco Packet Tracer IoT**. The system automatically detects smoke, activates safety devices, informs the user, and controls environmental conditions.
The project simulates a smart home divided into three areas:

- **Kitchen**
- **Garage**
- **Bedroom**

Each area includes IoT devices such as smoke detectors, sprinklers, doors, windows, and sensors that communicate through switches and a **Home Gateway (DLC100)**.

2. Project Objectives

The main objectives of the project are:

1. To design a smart home safety system using IoT devices.
2. To simulate smoke detection and automated response actions.
3. To demonstrate real-time communication between IoT sensors, actuators, and user devices.
4. To implement safety automation rules using a Home Gateway.
5. To alert the user through a smartphone notification.

3. Tools and Technologies Used

Component	Description
Cisco Packet Tracer 8.2+	Used for IoT simulation
Home Gateway (DLC100)	Controls automation rules and device communication
2960-24TT Switches	Connect IoT devices in each room
IoT Smoke Sensors	Detect fire/smoke
IoT Sprinklers	Activate to extinguish fire
IoT Doors & Windows	Automatically open/close
Siren	Alerts home occupants
Smartphone	Receives notifications
Garage IoT Car	Fire/smoke simulation trigger (ALT + click)

4. System Architecture

The system is divided into four layers:

4.1 Device Layer

Includes IoT sensors and actuators:

- Smoke detectors (Kitchen, Garage, Bedroom)
- Fire sprinklers
- Smart doors and windows
- IoT car (used to generate smoke)
- Siren alarm

4.2 Network Layer

Communication devices:

- Three 2960 switches
- Wired and wireless connections
- Home Gateway acting as central controller

4.3 Control Layer

Automation rules configured inside the **Home Gateway**, such as:

IF smoke_detected THEN activate_sprinkler, open_door, trigger_siren, send_notification

4.4 Application Layer

User interaction through:

- Smartphone alerts
- Real-time monitoring

5. Working Mechanism

Below is the detailed workflow of how the system reacts when smoke is detected.

5.1 Step-by-Step System Workflow

Step 1: Smoke Generation

In Packet Tracer, pressing **ALT + Click** on the **Garage IoT Car** simulates smoke/fire.
This smoke is detected by the **Garage Smoke Sensor**.

Step 2: Sensor Sends Alert Signal

The garage smoke detector:

- Sends a detection signal to the **Garage Switch**
- Switch forwards the signal to the **Home Gateway**

This establishes communication through the IoT network.

Step 3: Automation Rules Executed

The Home Gateway identifies the smoke alert and immediately executes automation rules configured earlier.

Step 4: Fire Sprinkler Activates

The **garage fire sprinkler** turns ON automatically:

- Sprays water
- Suppresses the fire
- Prevents spreading

Step 5: Garage Door Opens Automatically

To ensure safety and ventilation:

- The **garage door** opens automatically
- Allows smoke to exit
- Reduces suffocation hazards

Step 6: Siren Alarm Activates

A loud siren is triggered:

- Alerts occupants inside the home
- Creates awareness of danger

Step 7: Smartphone Notification Sent

A message is sent to the smartphone:

"Warning: Smoke detected in Garage!"

This feature ensures the user is informed even if they are not at home.

Step 8: Other Rooms Remain Unaffected

The system only takes action in the affected zone:

- Kitchen and Bedroom devices remain unchanged
- Only Garage devices respond

This shows area-specific control.

6. Results and Observations

After running the simulation, the following results were observed:

✔ Real-time smoke detection works accurately

The smoke detector immediately senses smoke from the IoT car.

✔ Automation rules trigger instantly

Sprinkler, door, and siren activate without delay.

✔ Notification is successfully delivered to smartphone

User receives an alert in the mobile interface.

✔ Devices respond only in the affected area

This improves system efficiency and avoids unnecessary activation.

✔ Complete smart home fire-response system achieved

7. Advantages of the System

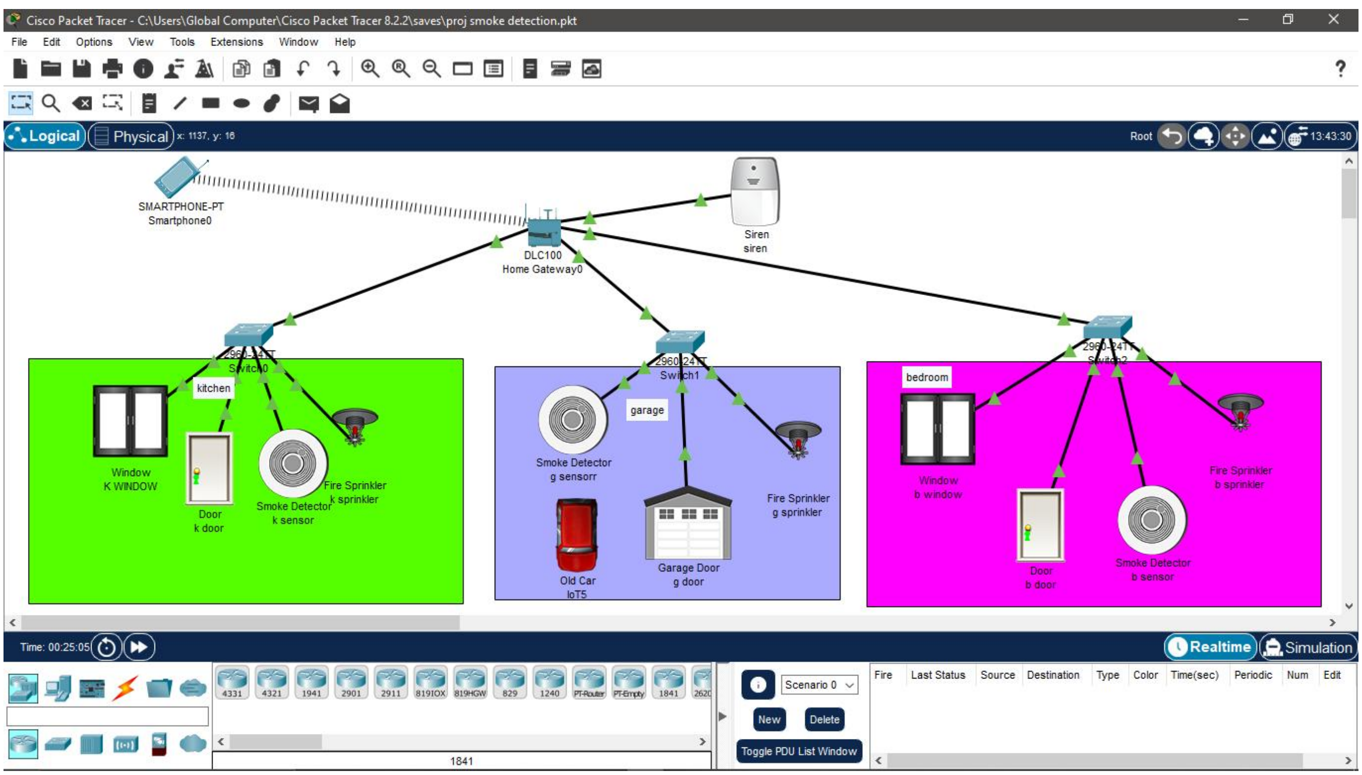
1. **Fast response time** reduces fire damage.
2. **Fully automated**, requiring no human intervention.
3. **Area-specific activation** saves energy and avoids chaos.

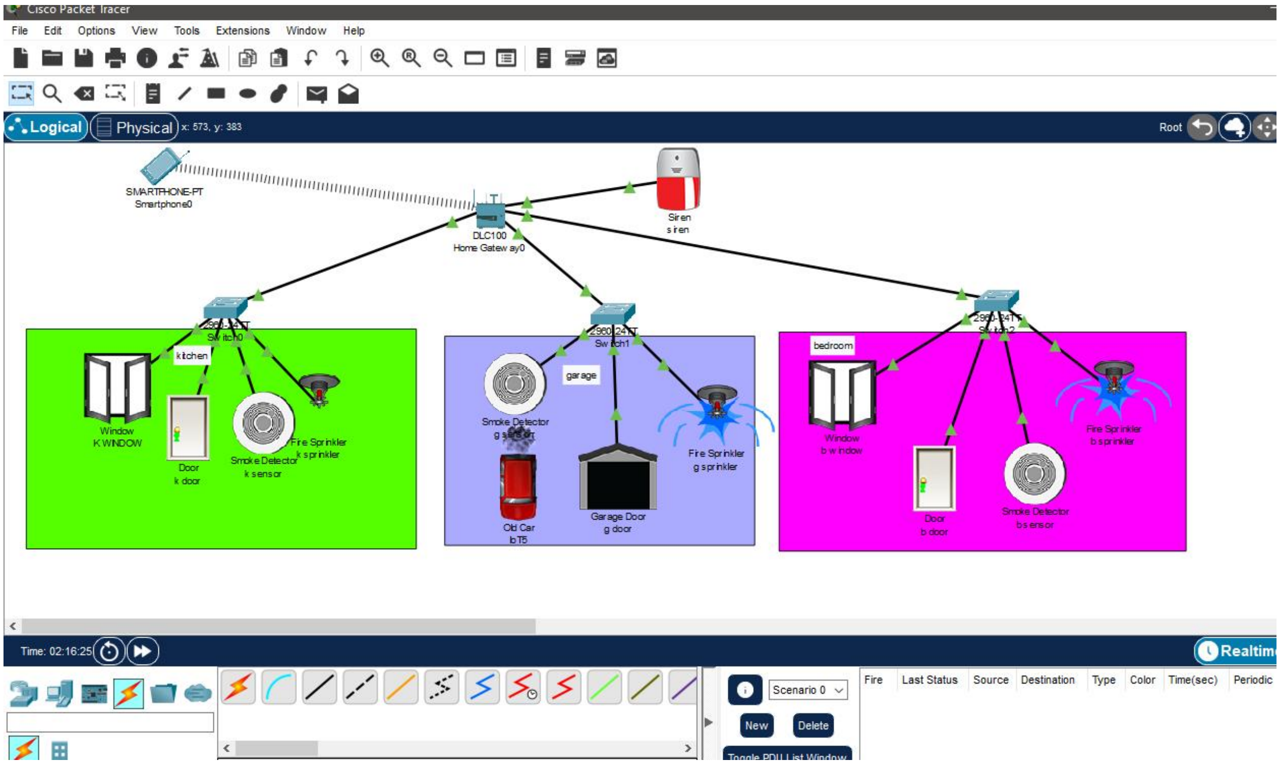
4. **Remote alerts** improve safety even when owner is away.
5. **Scalable design**—more rooms and devices can be added easily.

8. Limitations

- Simulation-based, so real hardware behavior may vary.
- Relies on stable IoT network connectivity.
- Limited types of sensors available in Packet Tracer.

IoT-Based Smoke Detection and Smart Home Safety System





9. Conclusion

This project successfully demonstrates a **complete IoT-based smart smoke detection and fire response system** using Cisco Packet Tracer. Through the integration of smoke sensors, sprinklers, smart doors, sirens, and a home gateway, the system provides immediate and automated protection in case of fire.

The simulation replicates real-world IoT behavior, showing how dangerous situations can be managed instantly and intelligently. The project highlights the importance of IoT in modern smart homes and showcases the power of automation in improving safety and emergency response.