Green University of Bangladesh

Department of Computer Science and Engineering (CSE)
Faculty of Sciences and Engineering (FSE)
Semester: (Fall, Year: 2024), B.Sc. in CSE (Day)

IoT - Smart Home Automation

Course Title: Computer Networking Lab
Course Code: CSE-312
Section: 221 - D4

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Project Report Status	
Marks:	**Signature:**
Comments:	**Date:**

Contents

Smart Home Automation.

Simplify Our Living with Intelligent Control.

February 23, 2025

Chapter 1

Introduction

1.1 Overview

The rapid advancement of technology has prepared the way for IoT (Internet of Things) systems as Ill as transformed traditional homes into smart, automated environments. A smart home integrates various IoT devices, enabling automation and remote control of home systems, such as lighting, security, climate control, and appliances. This project, "IoT-Smart Home Automation," aims to create a cost-effective and user-friendly smart home system that enhances security, saves energy, and provides convenience. By leveraging IoT devices and advanced network protocols, homeowners can monitor and control their homes from anywhere in the world using their smartphones. [1] [2] [3] [4]

Figure 1.1: IoT - Smart Home

1.2 Motivation

The motivation behind this project arises from the increasing demand for smarter, safer, and more energy-efficient homes. Traditional home systems often lack automation and require manual intervention which leads to inefficiencies and increases energy consumption. Additionally, security is a greater concern in modern homes. The ability to remotely monitor and control home devices is an appealing solution to these challenges. This project combines innovation and practicality to simplify daily tasks, reduce energy waste, and provide peace of mind through enhanced security.

1.3 Tools & Technology

I use these Tools and Technologies in online and IoT-Systems:

1. Server.
2. Access Pointer.
3. Router.
4. Smart Phone.
5. Webcam.
6. Street Lamp.
7. Fan.
8. Blower.
9. Light.
10. Appliance Kitchen.
11. Motion Detector.
12. Switch.
13. Lawn Sprinkler.
14. Water Drain.
15. Wind Detector.
16. Car.
17. Air Conditioner.
18. LED Light.
19. Temperature Detector.

1.3.1 Simulator

- Cisco Packet Tracer.

1.4 Problem Definition

1.4.1 Problem Statement

Traditional home setups are inefficient and often fail to address modern needs for security, convenience, and energy management. Homeowners have limited control over their homes when away, and manual processes increase time and energy consumption. This project seeks to solve these issues by developing an IoT-based smart home system that automates tasks, improves security, and allows remote control of home devices.

1.4.2 Complex Engineering Problem

The project addresses a complex engineering problem, as summarized in Table 1.1 below:

Table 1.1: Summary of the attributes touched by the mentioned project

Name of the Problem Attribute	**Explanation of How It is Addressed**
P1: Depth of knowledge required	Requires understanding of IoT devices, networking protocols (DHCP, EIGRP), and automation logic.
P2: Range of conflicting requirements	Balancing energy efficiency, cost, and user convenience.
P3: Depth of analysis required	Requires extensive analysis of network configurations and device interoperability.
P4: Familiarity of issues	Tackles common issues like security, energy management, and automation in home systems.
P5: Extent of applicable codes	Adheres to IoT communication protocols and security standards.
P6: Extent of stakeholder involvement and conflicting requirements	Incorporates homeowner preferences and addresses conflicting requirements like low cost vs. high functionality.
P7: Interdependence	Integrates multiple systems like lighting, HVAC, and security for seamless automation.

1.5 Design Goals/Objectives

The design goals of this project are:

Automation

To create a fully automated home environment where devices operate based on real-time sensor inputs and predefined conditions. This includes automating:

- Lighting systems based on occupancy.

- Climate control based on room usage.
- Security systems such as motion detectors and Webcams.

Security

To enhance home security by integrating smart monitoring systems, including:

- Motion detectors and cameras for real-time surveillance.
- Automated alerts and notifications for suspicious activity.
- Remote access for monitoring and controlling security devices.

Energy Efficiency

To optimize energy consumption and reduce costs through intelligent device management, such as:

- Automatically turning off unused appliances.
- Adjusting heating, ventilation, and air conditioning (HVAC) systems based on environmental conditions and occupancy.
- Using energy-efficient IoT devices like LED lights.

1.6 Application

The IoT-Smart Home Automation project has a wide range of real-world applications, as outlined below:

Residential Homes

Smart homes provide convenience, security, and energy savings. Automation of lighting, HVAC systems, and security enhances the quality of living by reducing manual intervention and energy costs.

Rental Properties

Landlords can remotely monitor and manage properties, ensuring tenant safety and energy efficiency. Smart locks and monitoring systems provide better control over property access.

Healthcare and Elderly Care

Smart homes assist in healthcare by enabling remote monitoring of elderly or disabled residents. Automated reminders for medication, fall detection, and emergency alerts can improve their quality of life and safety.

Commercial and Office Spaces

In offices, smart IoT systems optimize energy usage, control lighting, and monitor security, leading to reduced operational costs and enhanced workplace safety.

Environmental Impact

By enabling precise control of energy consumption, smart homes contribute to environmental sustainability. Automated systems reduce unnecessary energy use, aligning with green energy initiatives.

Smart Cities

IoT-based smart home systems can integrate with smart city infrastructure, improving resource management, traffic control, and overall urban efficiency. Homes equipped with IoT can communicate with city systems for coordinated energy and water usage.

Disaster Management and Safety

Smart homes can provide real-time alerts for environmental hazards such as fire, gas leaks, or floods. Integration with local authorities ensures timely response and evacuation, reducing casualties and damage.

Chapter 2

Design/Development/Implementation of the Project

2.1 Introduction

The design and implementation of the IoT-Smart Home project focus on integrating IoT devices with network configurations to create a fully automated and remotely accessible home system. The project leverages advanced protocols, sensors, and user-friendly interfaces to enhance convenience, security, and energy efficiency.

2.2 Project Details

The project comprises multiple components and subsystems working together to automate various aspects of a home. The detailed structure is outlined below:

2.2.1 System Overview

The IoT-Smart Home system includes sensors, actuators, cameras, routers, and a server. It connects all devices via a network, allowing remote monitoring and control using a smartphone application.

2.2.2 Key Functionalities

- **Lighting Automation**: Lights turn on or off based on motion detection.
- **Security**: Motion detectors and Webcams provide real-time surveillance and notifications.
- **Climate Control**: HVAC systems adjust based on room occupancy.
- **Device Control**: Appliances like fans and coffee makers can be controlled remotely.

- **User Accessibility**: All features are accessible via a secure smartphone application, allowing homeowners to monitor and control their home from anywhere in the world.

2.3 Implementation

The implementation involves configuring hardware and software components to realize the smart home's functionalities.

2.3.1 The Workflow

The implementation follows these steps:

1. Configuring routers and switches for network communication using DHCP EIGRP protocols.
2. Integrating IoT devices like motion sensors, Webcams, and smart appliances.
3. Developing automation logic on the server for device behavior.
4. Enabling remote access through a smartphone app.

2.3.2 Tools and Libraries

- **Hardware**: Routers, IoT devices (motion sensors, Webcams, smart lights), and switches.
- **Software**: Cisco Packet Tracer for simulation, server-side scripting, and mobile app interfaces.
- **Protocols**: DHCP for IP configuration and EIGRP for dynamic routing.

2.3.3 Implementation Details

The server was programmed to handle all automation logic, including:

1. Taking server, IOT devices, routers, switches, smart phone, wires etc. for making IOT – Smart Home.
2. I will connect all the routers. After that I will connect the routers with the switches. Then I will connect all the switches & then all switches will connect with the all IOT devices/home devices, server & smart phone.
3. Now I will configure router 2 for giving dynamic IP address by using DHC Pprotocol in figure 2.1 & figure 2.2.

```
Router(config)#ip dhcp pool 10network
Router(dhcp-config)#network 1.1.1.0 255.0.0.0
Router(dhcp-config)#dns-server 1.1.1.2
Router(dhcp-config)#defa
Router(dhcp-config)#default-router 1.1.1.1
Router(dhcp-config)#exit
```

Figure 2.1: Configuration Of DHCP Protocol in Router 2

```
Router(config)#ip dhcp pool 20network
Router(dhcp-config)#network 10.0.0.0 255.0.0.0
Router(dhcp-config)#dns-server 10.0.0.2
Router(dhcp-config)#defa
Router(dhcp-config)#default-router 20.0.0.1
Router(dhcp-config)#exit
Router(config)#
```

Figure 2.2: Configuration Of DHCP Protocol in Router 2 .

4. Now I will configure router 2 for giving dynamic ip address by using DHCP protocol in figure 2.3 & figure 2.4.

```
Router(config)#ip dhcp pool 30network
Router(dhcp-config)#network 20.0.0.0 255.0.0.0
Router(dhcp-config)#defa
Router(dhcp-config)#default-router 20.0.0.1
Router(dhcp-config)#exit
Router(config)#
```

Figure 2.3: Configuration Of DHCP Protocol in Router 1.

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#ip dhcp pool 30network
Router(dhcp-config)#network 10.0.0.0 255.0.0.0
Router(dhcp-config)#dns-server 10.0.0.2
Router(dhcp-config)#defa
Router(dhcp-config)#default-router 10.0.0.1
Router(dhcp-config)#exit
Router(config)#
```

Figure 2.4: Configuration Of DHCP Protocol in Router 1.

5. Now I will configure routing protocol EIGRP in router 2 so that owner of the house can access his home from any where in the world over the internet by using his smart phone in figure 2.5.

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router eigrp 1
Router(config-router)#network 1.1.1.0
Router(config-router)#network 10.0.0.0
Router(config-router)#
```

Figure 2.5: Configuration Of EIGRP Routing Protocol in Router 2 .

6. Now I will configure routing protocol EIGRP in router 2 so that owner of the house can access his home from any where in the world over the internet by using his smart phone in figure 2.6.

```
Router(config)#router eigrp 1
Router(config-router)#network 20.0.0.0
Router(config-router)#network 10.0.0.0
```

Figure 2.6: Configuration Of EIGRP Routing Protocol in Router 1.

7. It is main server which control all digital devices.

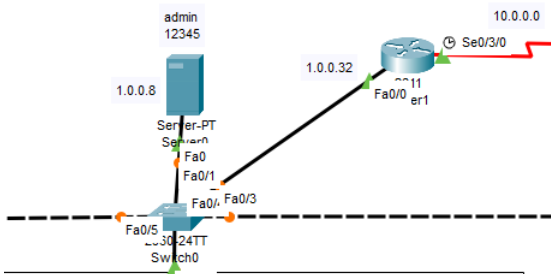


Figure 2.7: Main Server For IoT Smart Home System.

8. Smart phone accessing the server by using EIGRP routing protocol.

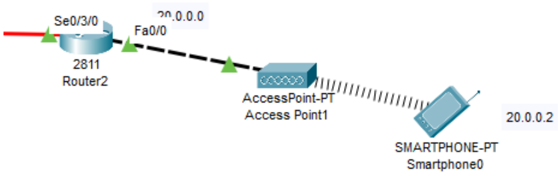


Figure 2.8: Phone Accessing The Server By Using EIGRP Routing Protocol.

9. Now I will register an account in the server for connecting all the IOT devices/home devices by giving User name & Password.

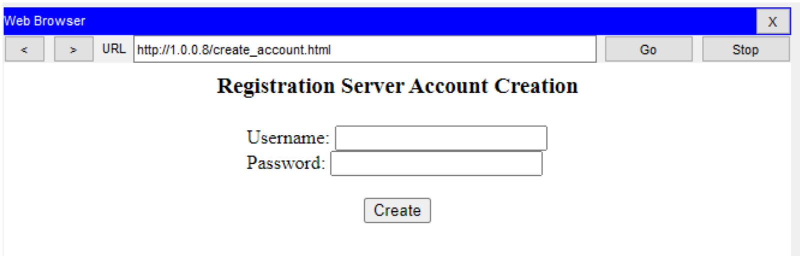


Figure 2.9: Registration Of an Account in The Server.

10. Smart phone accessing the home by sign in to the server.

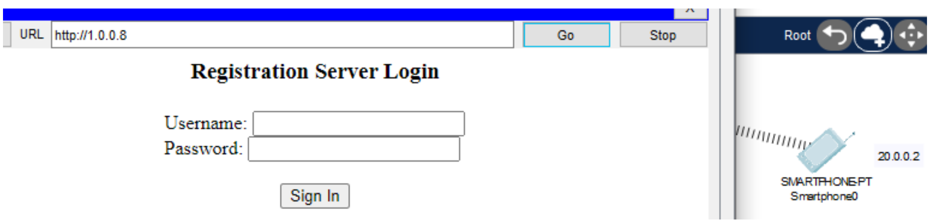


Figure 2.10: Smart Phone Accessing The Home By Sign in To The Server.

11. After sign in to the server by using Smart Phone.

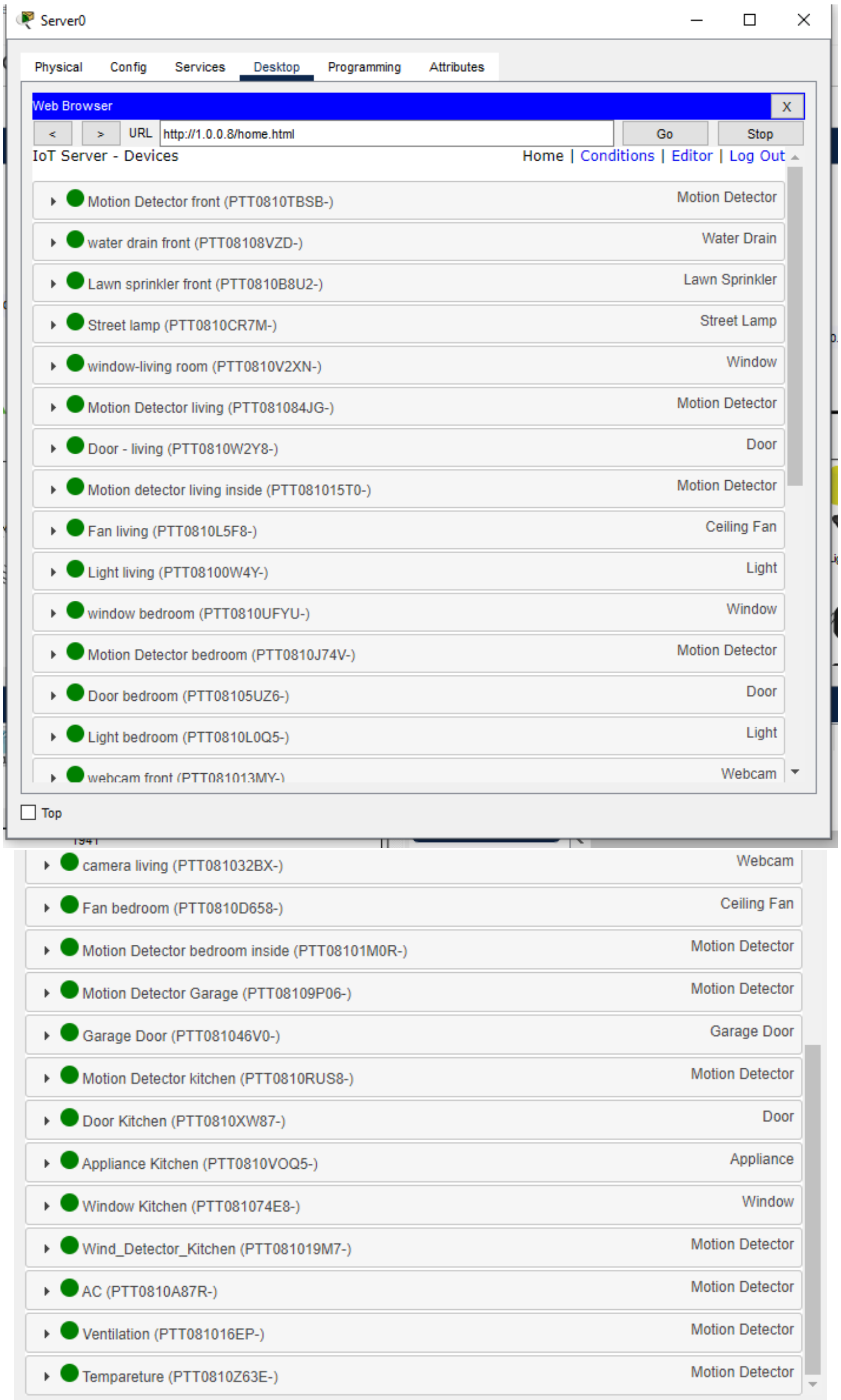


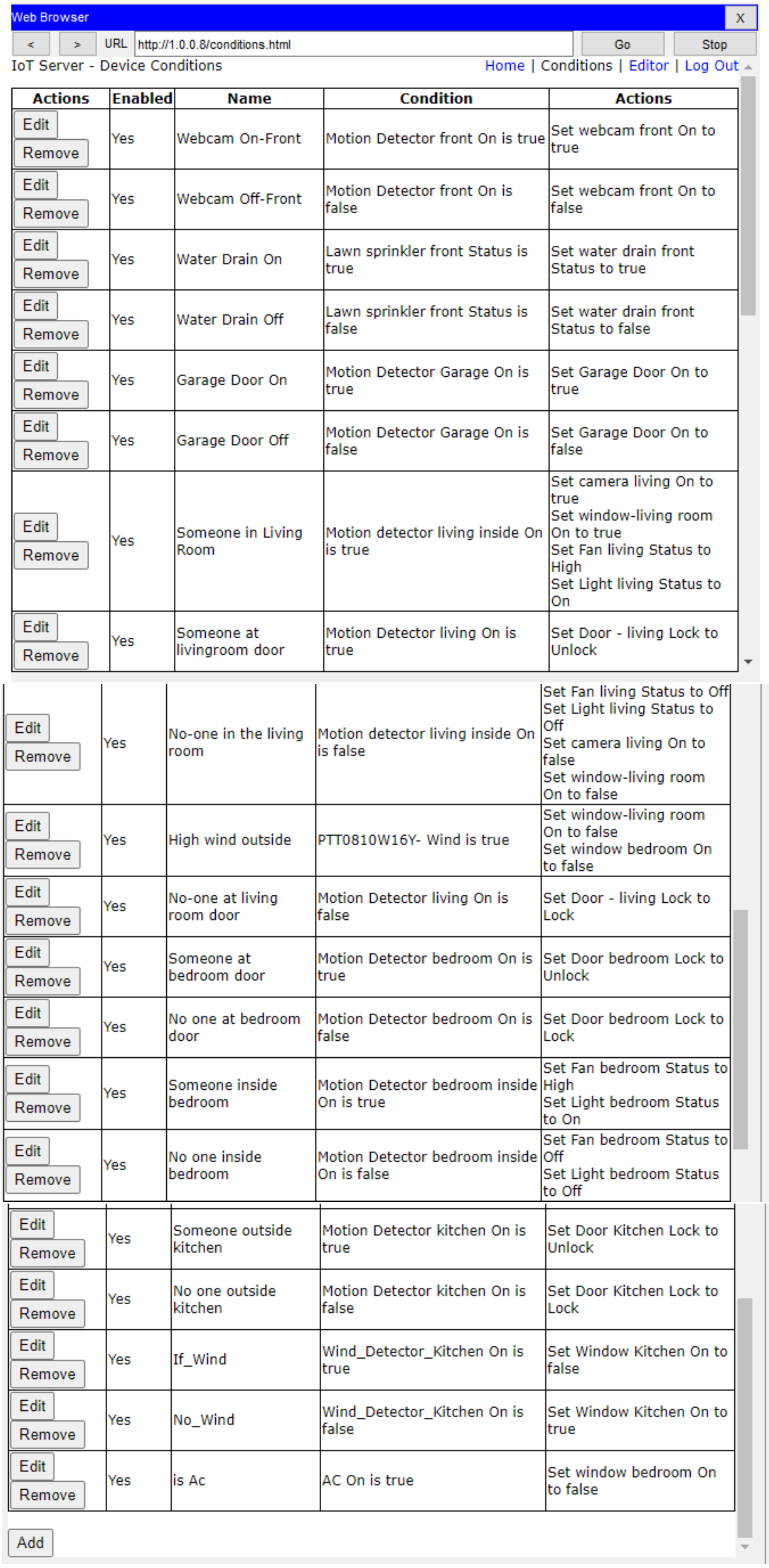
Figure 2.11: After Sign in To The Server By Using Smart Phone.

2.4 Logic/Conditions

Now I will implement all the logics/conditions in the server for making an automated house:

1. In front of the house when there will be someone,motion detector will detect that and webcam will be automatically on.
2. In front of the house when there will be nobody,motion detector will be off and also webcam will be automatically off.
3. In front of the house when lawn sprinkler will be on then automatically water drain will be on.
4. In front of the house when lawn sprinkler will be off then automatically water drain will be off.
5. In front of the house when wind detector detect high wind then all the windows of the Kitchen will be off.
6. When there will be someone in the front of the door of the living room then motion detector will detect that & the door of living room automatically will be on.
7. When there will be nobody in the front of the door of the living room then motion detector will be off & the door of living room automatically will be off.
8. When there will be someone in the living room then motion detector of the living room will detect that & all the fan ,light ,window & Webcam of the living room will be automatically on.
9. When there will be nobody in the living room then motion detector of the living room will be off & all the fan ,light ,window & webcam of the living room will be automatically off.
10. When there will be someone in the front of the door of the bed room then motion detector will detect that & the door of bed room automatically will be on.
11. When there will be nobody in the front of the door of the bed room then motion detector will be off & the door of bed room automatically will be off.
12. When there will be someone in the bed room then motion detector of the bed room will detect that & all the fan ,light & window of the bed room will be automatically on.
13. When there will be nobody in the bed room then motion detector of the bed room will be off & all the fan ,light & window of the bed room will be automatically off.
14. When air conditioner of the bed room will be on then the window of the bed room will be automatically off.

15. When there will be any car or any one in the front of the garage then motion detector will detect that & the door of garage automatically will be on.
16. When there will be no car or nobody in the front of the garage then motion detector will be off & the door of garage automatically will be off.
17. When there will be someone in the front of the door of the kitchen then motion detector will detect that & the door of kitchen automatically will be on.
18. When there will be nobody in the front of the door of the kitchen then motion detector will be off & the door of the kitchen automatically will be off.
19. When the kitchen will be overheated , the Blower will be on automatically.
20. When the kitchen will be come into room temperature , the Blower will be off automatically.



Web Browser
URL http://1.0.0.8/conditions.html
IoT Server - Device Conditions
Home | Conditions | Editor | Log Out

Actions	Enabled	Name	Condition	Actions
Edit Remove	Yes	Webcam On-Front	Motion Detector front On is true	Set webcam front On to true
Edit Remove	Yes	Webcam Off-Front	Motion Detector front On is false	Set webcam front On to false
Edit Remove	Yes	Water Drain On	Lawn sprinkler front Status is true	Set water drain front Status to true
Edit Remove	Yes	Water Drain Off	Lawn sprinkler front Status is false	Set water drain front Status to false
Edit Remove	Yes	Garage Door On	Motion Detector Garage On is true	Set Garage Door On to true
Edit Remove	Yes	Garage Door Off	Motion Detector Garage On is false	Set Garage Door On to false
Edit Remove	Yes	Someone in Living Room	Motion detector living inside On is true	Set camera living On to true Set window-living room On to true Set Fan living Status to High Set Light living Status to On
Edit Remove	Yes	Someone at livingroom door	Motion Detector living On is true	Set Door - living Lock to Unlock
Edit Remove	Yes	No-one in the living room	Motion detector living inside On is false	Set Fan living Status to Off Set Light living Status to Off Set camera living On to false Set window-living room On to false
Edit Remove	Yes	High wind outside	PTT0810W16Y- Wind is true	Set window-living room On to false Set window bedroom On to false
Edit Remove	Yes	No-one at living room door	Motion Detector living On is false	Set Door - living Lock to Lock
Edit Remove	Yes	Someone at bedroom door	Motion Detector bedroom On is true	Set Door bedroom Lock to Unlock
Edit Remove	Yes	No one at bedroom door	Motion Detector bedroom On is false	Set Door bedroom Lock to Lock
Edit Remove	Yes	Someone inside bedroom	Motion Detector bedroom inside On is true	Set Fan bedroom Status to High Set Light bedroom Status to On
Edit Remove	Yes	No one inside bedroom	Motion Detector bedroom inside On is false	Set Fan bedroom Status to Off Set Light bedroom Status to Off
Edit Remove	Yes	Someone outside kitchen	Motion Detector kitchen On is true	Set Door Kitchen Lock to Unlock
Edit Remove	Yes	No one outside kitchen	Motion Detector kitchen On is false	Set Door Kitchen Lock to Lock
Edit Remove	Yes	If_Wind	Wind_Detector_Kitchen On is true	Set Window Kitchen On to false
Edit Remove	Yes	No_Wind	Wind_Detector_Kitchen On is false	Set Window Kitchen On to true
Edit Remove	Yes	is Ac	AC On is true	Set window bedroom On to false

Add

Figure 2.12: Showing All Conditions.

Chapter 3

Performance Evaluation

3.1 Simulation Environment/Simulation Procedure

The simulation was performed using Cisco Packet Tracer to model the IoT-Smart Home system. The simulation included:

- Setting up routers and switches with DHCP EIGRP configurations.
- Connecting IoT devices to the network.
- Testing device behavior based on automation logic.

3.1.1 Testing Scenarios

- Motion detection triggers lights and cameras.
- Smartphone app controls device states.
- Network stability and speed under varying loads.

3.2 Results Analysis/Testing

3.2.1 Project View

In my smart home I am taking the front of the house, living room, bedroom, garage, and kitchen and also making them automated. I am using the server for the main connection, and to connect the smartphone, I am using the router for routing.

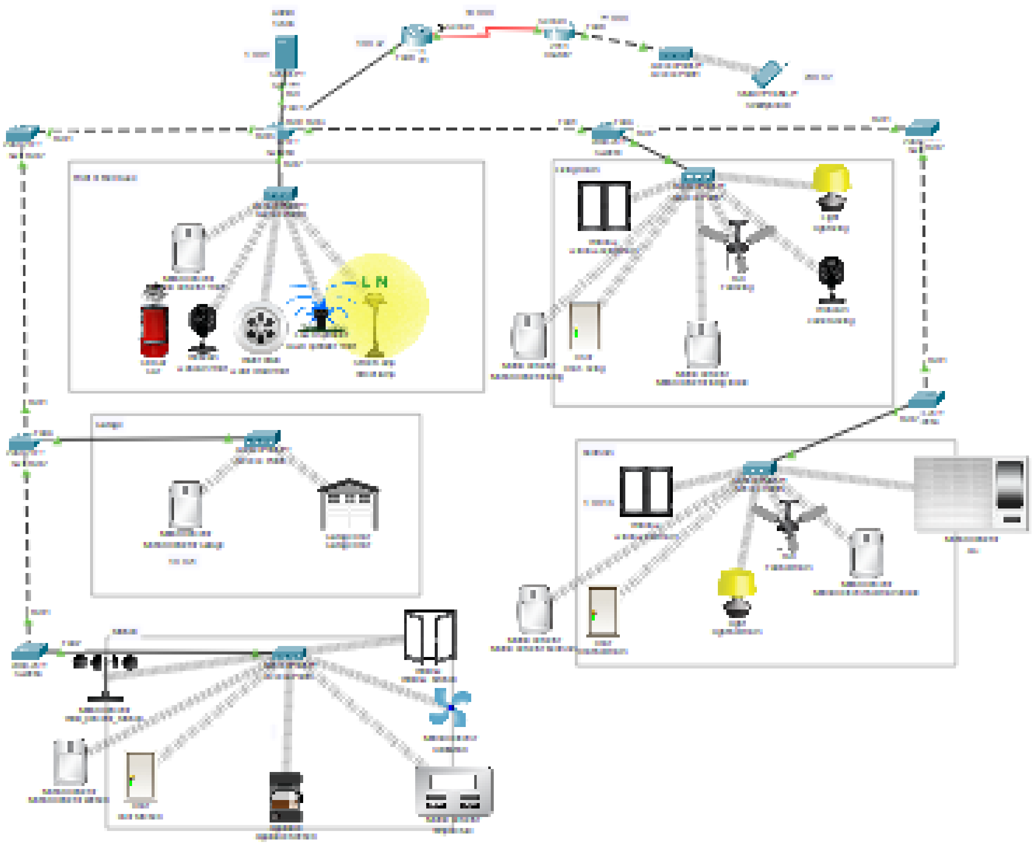


Figure 3.1: IoT - Smart Home View.

3.2.2 Front of the House

- **In the front of the house have:**

1. Motion Detector.
2. Webcam.
3. Wind Detector.
4. Street Lamp.
5. Lawn Sprinkler.
6. Water Drain.
7. Car.

- **Initially all things are off.**

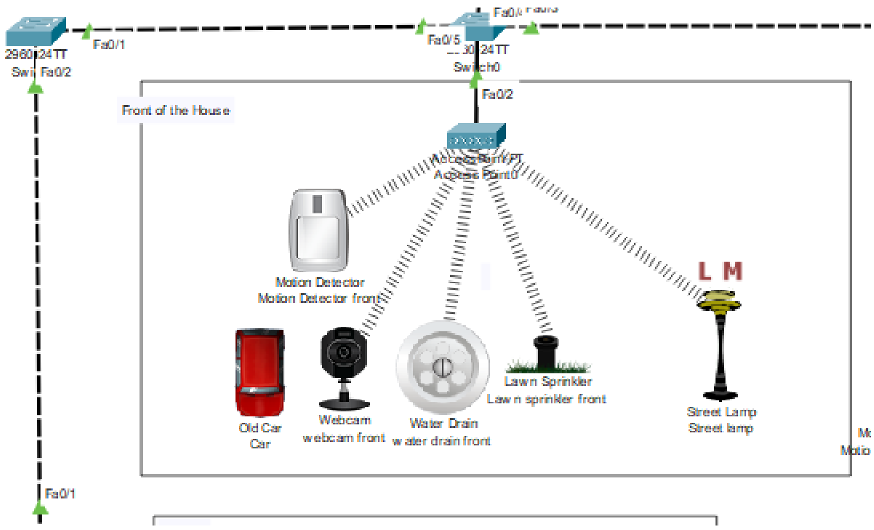


Figure 3.2: Front Of The House Before Turned On.

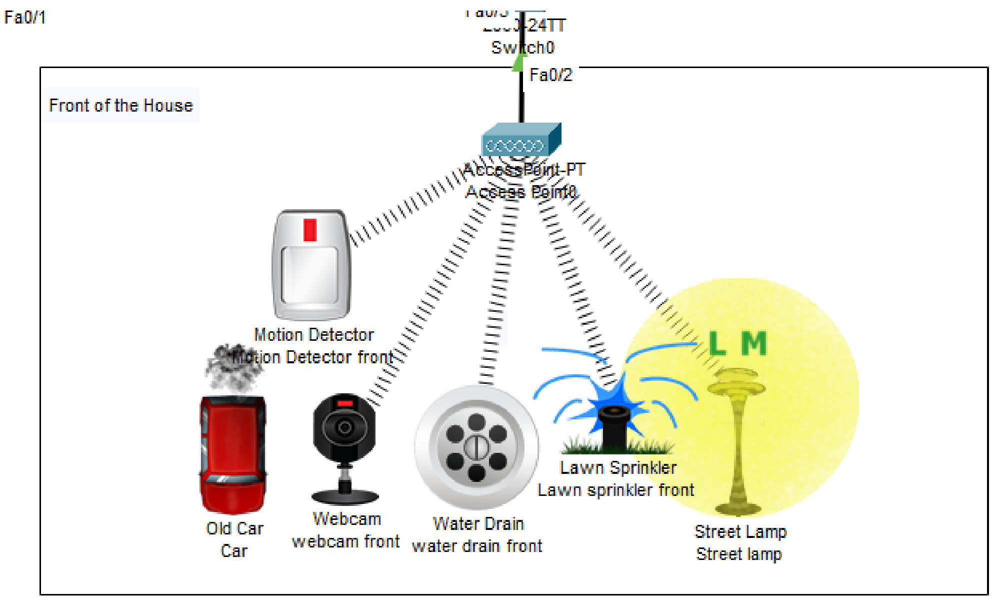


Figure 3.3: Front Of The House After Turned On.

- The motion detector activates the webcam when it detects presence near the house, while turning on the water machine also activates the water drain. Lights can be controlled via a smartphone, and when the user is away, the lamp and webcam automatically turn off. However, starting the old car increases emissions of carbon dioxide, carbon monoxide, and smoke.

3.2.3 Living room

- **In the living room have:**

1. Motion Detector.
2. Door.
3. Webcam.
4. Fan.
5. Window.
6. Light.

- **Initially all things are off .**

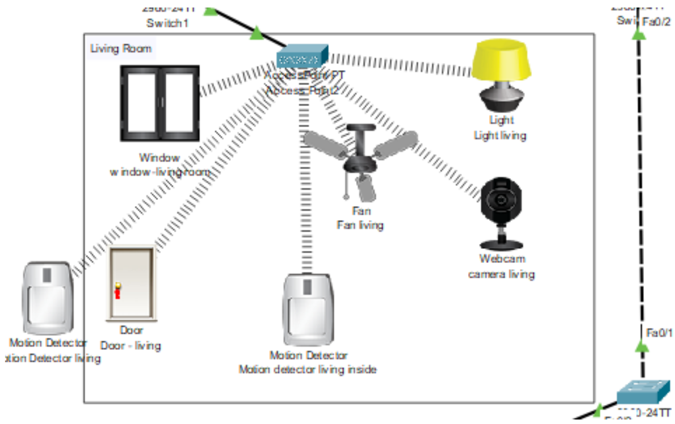


Figure 3.4: Initial State Of Living Room.

- When the motion happens in front of the door of the living room, the door itself is open automatically. After entering the room, light, fan, Webcam and window will run. If it needed then user can control light, fan by his smart phone.When I will be out of the room, the lamp, fan, window, Webcam will then turn off itself.

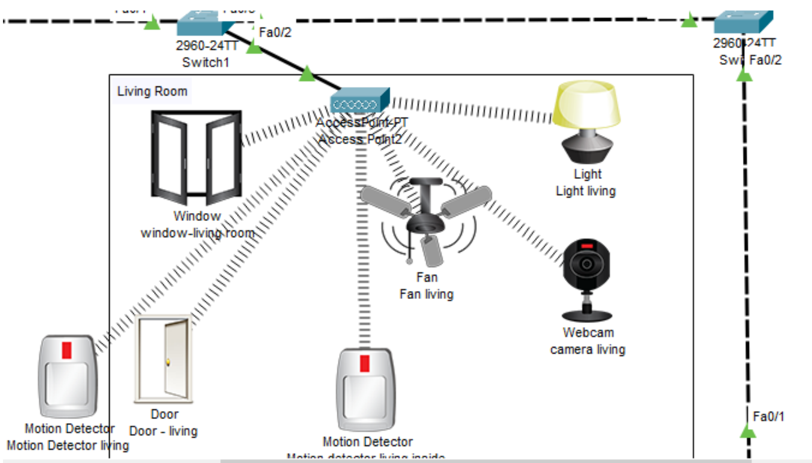


Figure 3.5: Living Room Fan, Light, Webcam is Running & Window is Open.

3.2.4 Bedroom

In bed room I am taking:

1. Motion Detector.
2. Door.
3. Window.
4. Light.
5. Fan.
6. Air conditioner.
7. Webcam.

At the first point all the IOT device will stay in turn off.

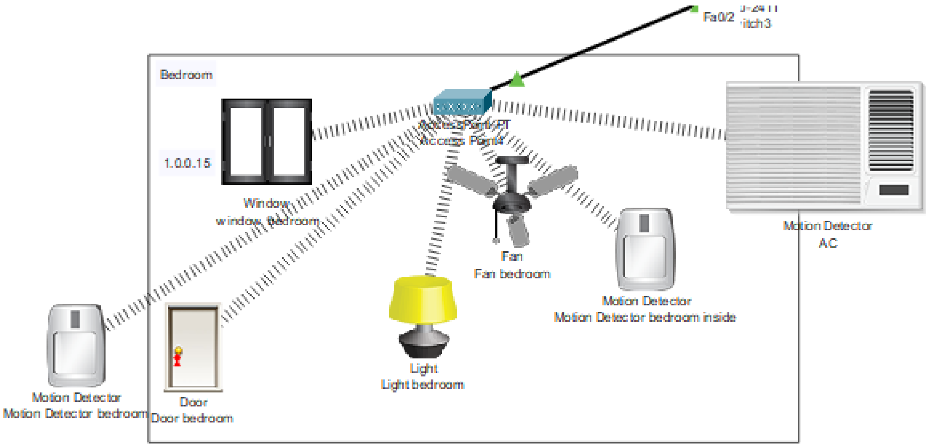


Figure 3.6: Initial State Of Bedroom.

- When the motion happens in front of the door of the living room, the door itself is open automatically. After entering the room, light, fan will run.In bedroom window will not open automatically.Because Bedroom is secure and personal place.If owner of the house willing to open it then he open it by it smart phone. But when he turn on the AC the window will automatically close.

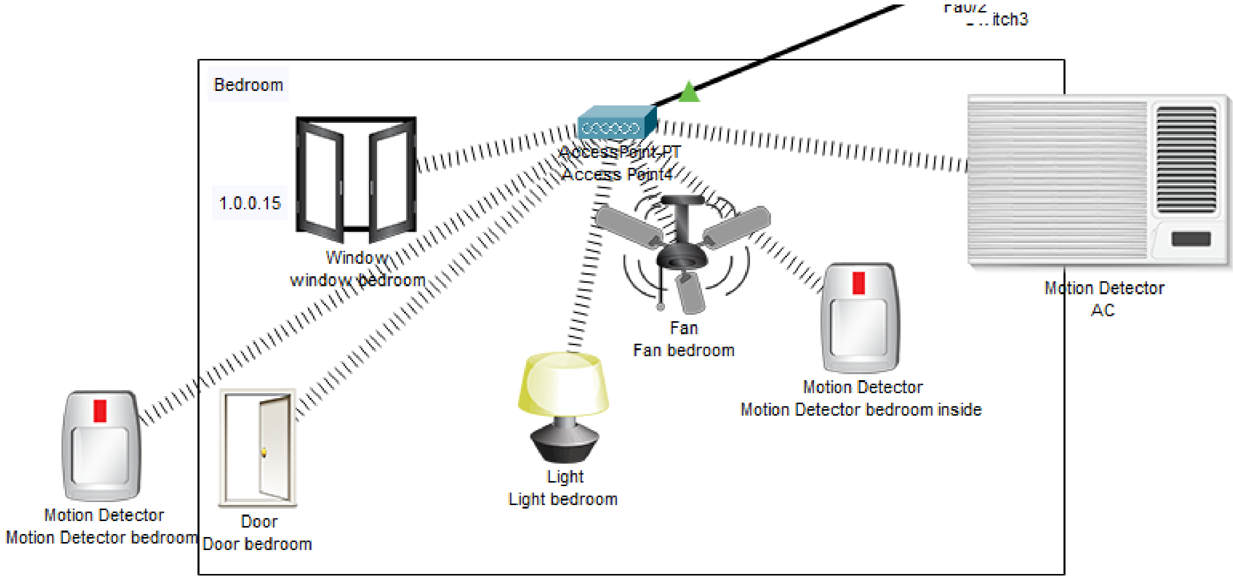


Figure 3.7: Bedroom, Door,Light, Fan & Window On.

- But when the users turn on the air conditioner, the bedroom window will automatically turn off.

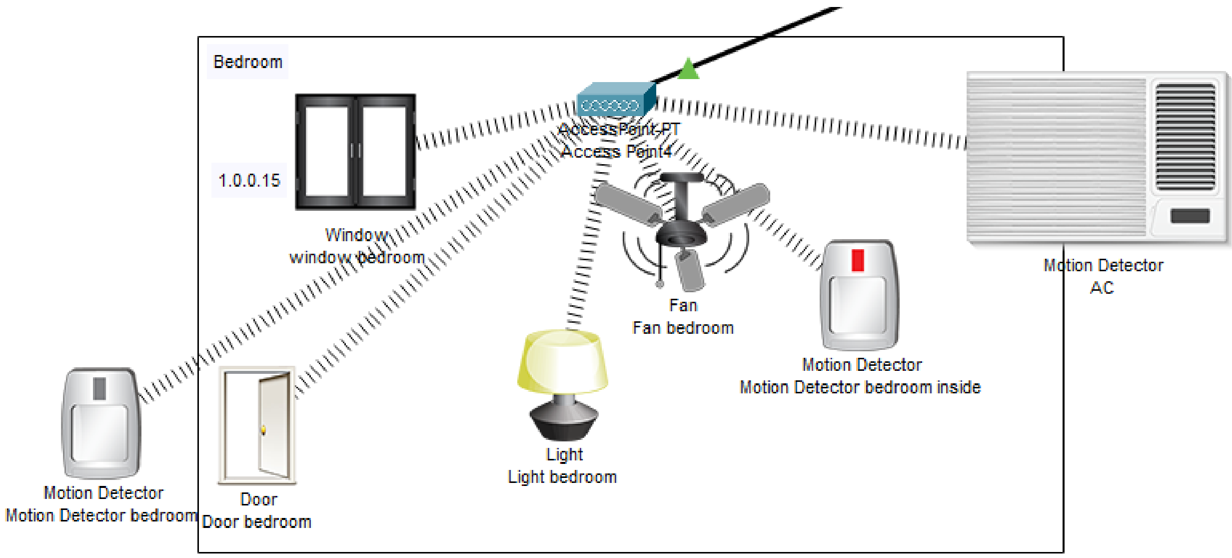


Figure 3.8: Bedroom AC On & Window Off.

3.2.5 Garage

In garage have:

1. Car.

2. Garage Door.
3. Motion Detector.

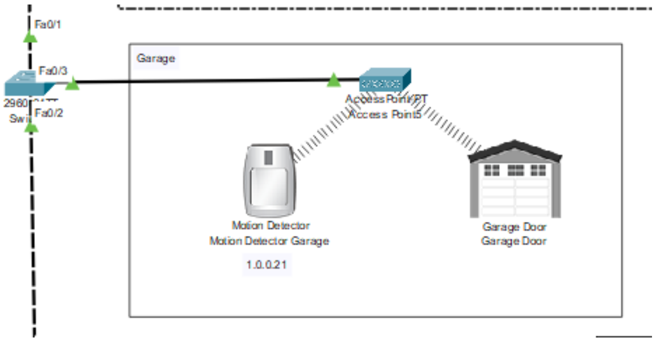


Figure 3.9: Initial State in Garage.

- If the car stays In front of the door of the garage, the garage door will open itself.

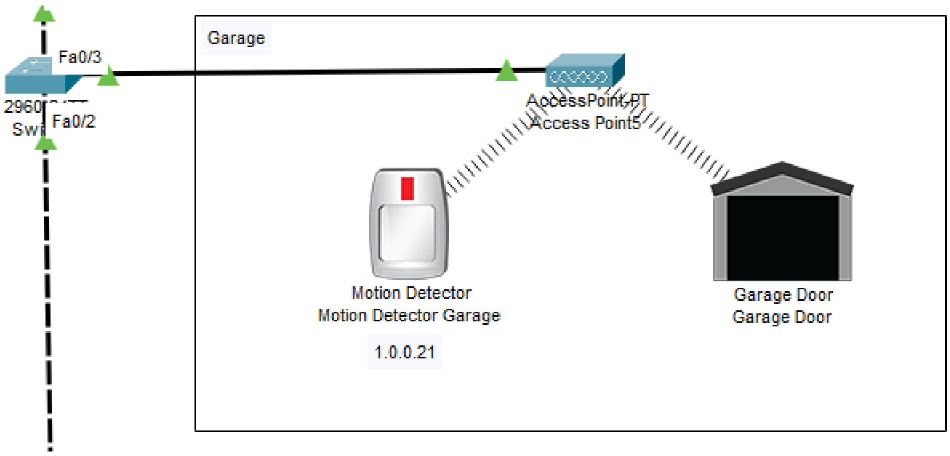


Figure 3.10: Garage door OPEN

3.2.6 Kitchen

Kitchen Have:

1. Motion Detector.
2. Kitchen Door.
3. Wind Detector.
4. Window.
5. Temperature Detector.
6. Blower.

7. Appliance Kitchen.

- Initially, In Kitchen all IoT devices are off except window. Because. In kitchen have a gas cylinder or electric stoves. So, the window is kept open initially as a precaution. Later the owner can close it if he wants.

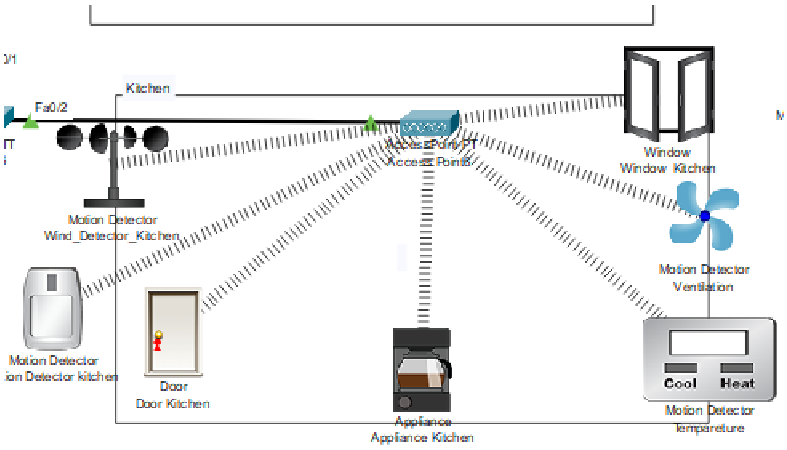


Figure 3.11: Kitchen- Initial State.

- In the Kitchen Room, when the motion detector detects any presence, the door will open automatically, allowing the owner to enter. If the room overheats, the Blower will automatically turn on to regulate the temperature. Once the kitchen returns to room temperature, the blower will automatically turn off. The windows in the kitchen are initially open, but if the wind detector detects strong wind, the windows will automatically close.

- **When Wind Detector Detect Strong Wind , then Window Automatically Closed.Here other IoT devices are on Likes Room temperature detector,Blower,Appliance Kitchen are On.**

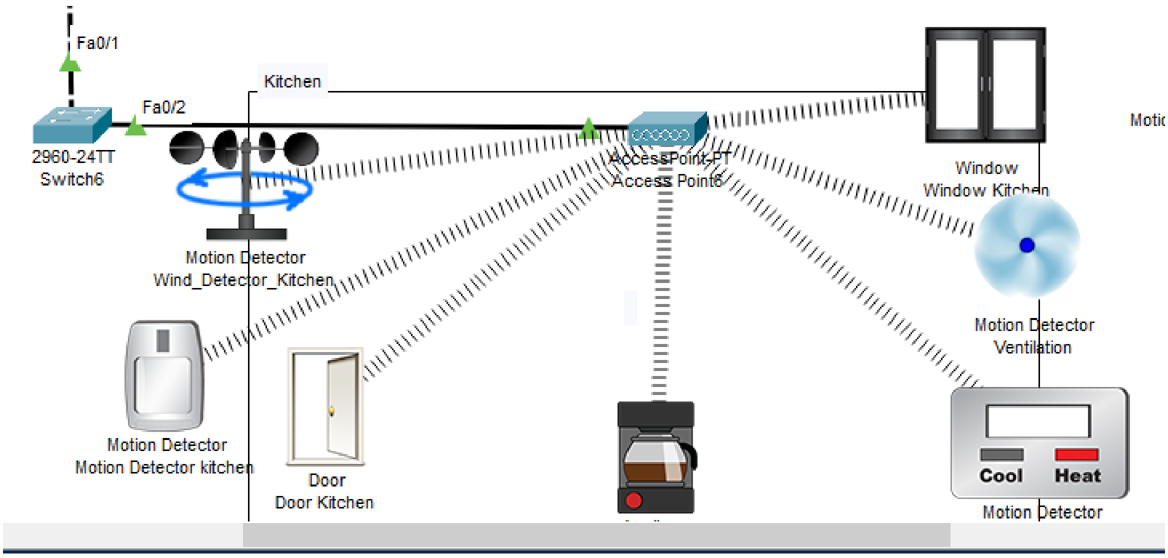


Figure 3.12: Kitchen Room View At The Time Of Strong Wind.

- **At The Time Of No Strong Wind. When Window is Open.**

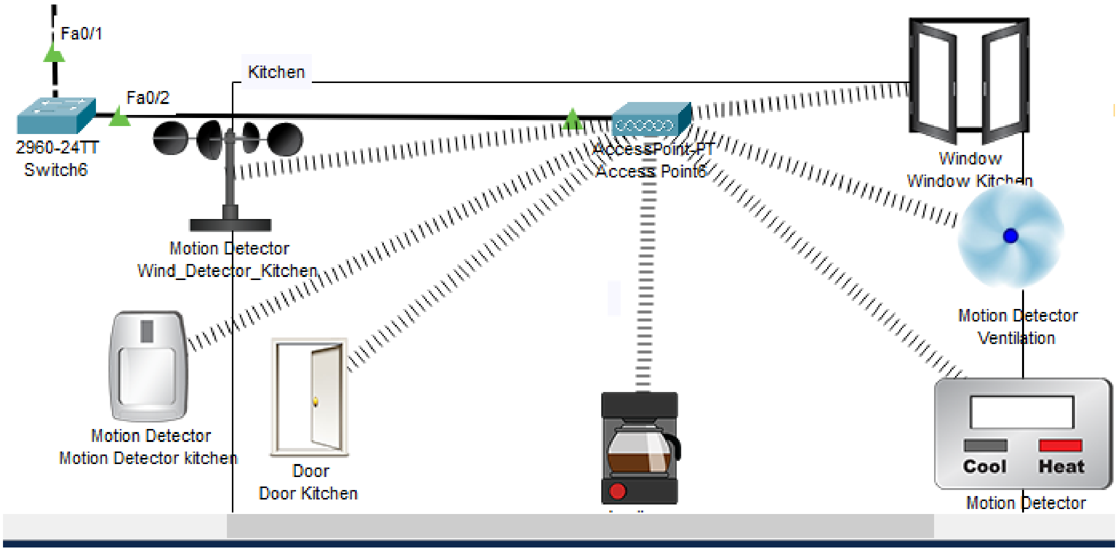


Figure 3.13: Kitchen Room View Without Strong Wind.

3.3 Control Of IoT Devices

3.3.1 Control By The Main Server

- **The house owner can Control and check all IoT devices activity from the main server.**

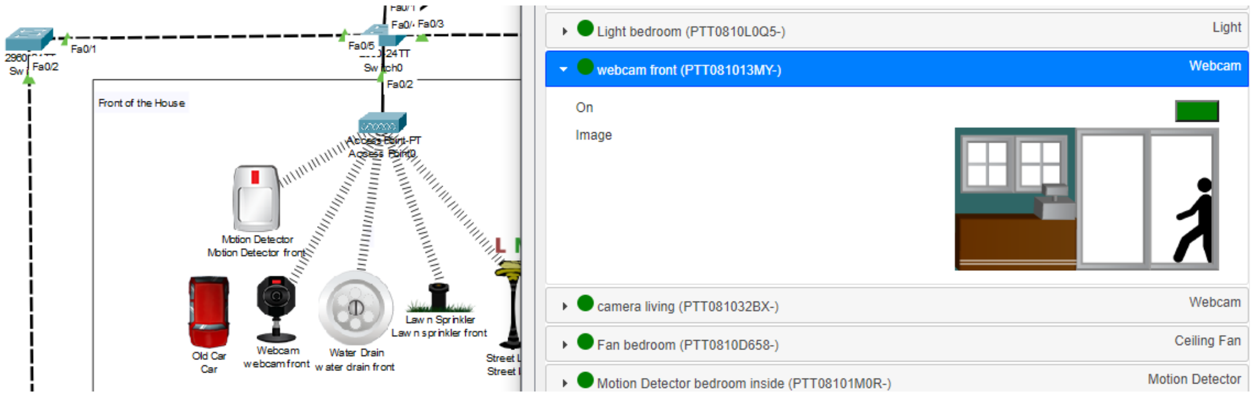


Figure 3.14: Check Front Side Webcam Activities By Main Server.

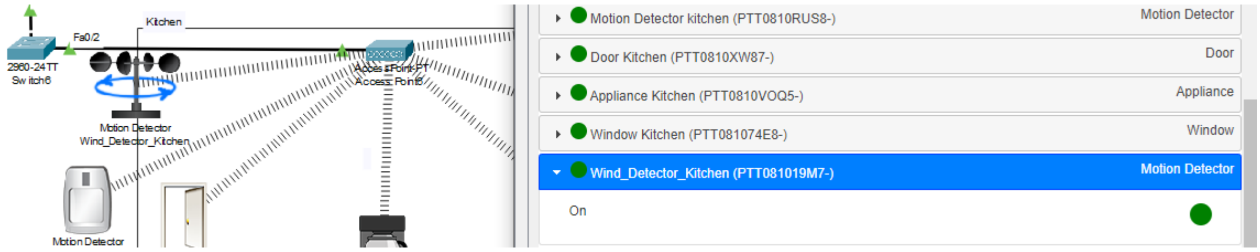


Figure 3.15: Check Wind Detection Activities By Main Server.

3.3.2 Control By The Smart Phone

The owner can monitor all IoT device activities using their smartphone, even when outside the house.

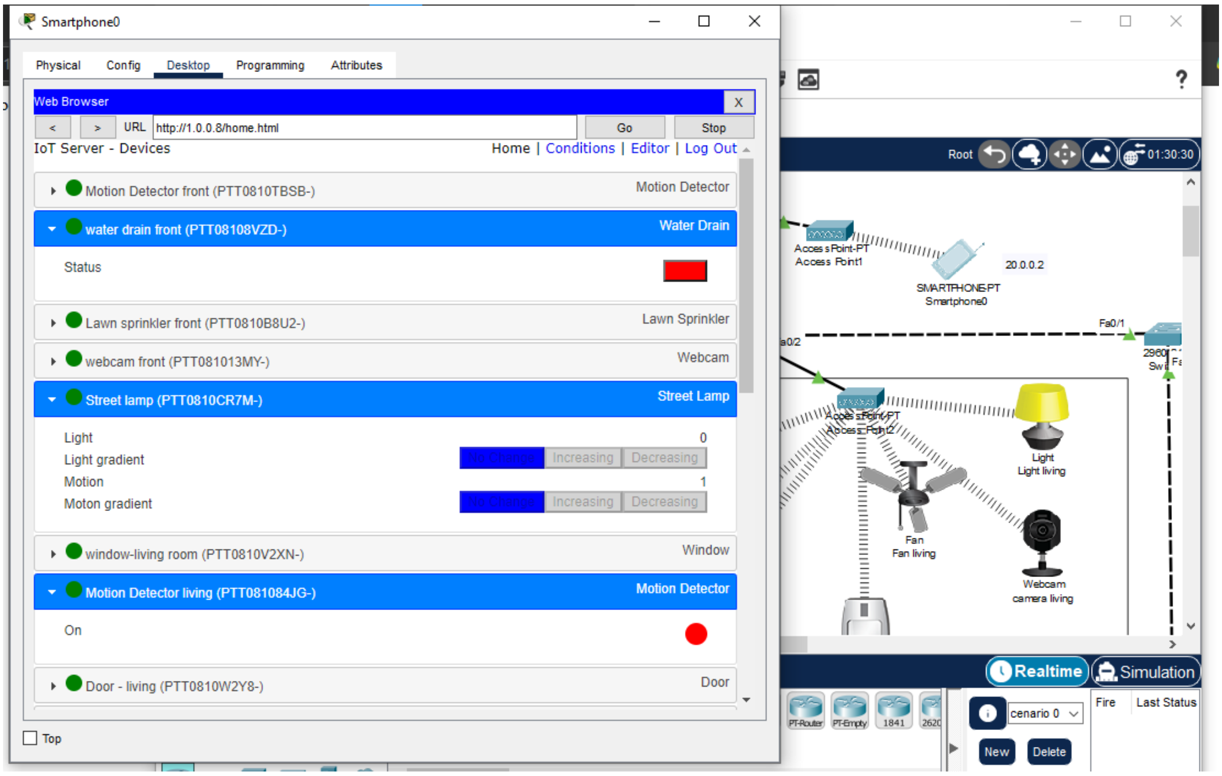


Figure 3.16: Monitor IoT Device Activities Using Smartphone.

3.4 Results Overall Discussion

The system achieved all its objectives with efficient automation, security enhancement, and energy optimization. Minor latency was observed in network communication under high loads. Further optimization of network configurations could address the latency issue and enhance efficiency under heavy loads.

Chapter 4

Conclusion

4.1 Discussion

This project successfully shoId a properly working Internet of Things (IoT)-based smart home system that combines several devices to automate different tasks, improve security, and minimize energy use. The implementation shoId how easily IoT devices and network configurations can work together to give users simplicity and manage them via a smartphone application. During testing, the system's reliability and flexibility of use Ire shown, making it an acceptable choice for modern-day life. These results also point to a great deal of promise for improving home security and energy efficiency in practical applications.

4.2 Limitations

While the project successfully met its objectives, it also highlighted certain limitations:

- **High Initial Setup Costs:** The cost of IoT devices, sensors, and networking hardware is substantial, making the system less accessible for budget-conscious users.
- **Limited Scalability:** The system is currently dependent on specific hardware configurations which limits its capacity to easily connect new devices or adapt to a variety of situations.
- **Network Latency:** During testing, minor latency was observed under heavy device loads, which could impact the performance of time-sensitive applications, such as real-time surveillance or critical automation tasks.
- **PoIr Dependence:** The system relies heavily on continuous poIr supply and internet connectivity, making it vulnerable to outages or disruptions.
- **Security Risks:** Even with the implementation of basic security measures, IoT systems are still vulnerable to cyberattacks, requiring the use of stronger defenses.

4.3 Scope of Future Work

To enhance the system's capabilities and address its limitations, future developments could focus on the following areas:

- **Expanding Device Compatibility:** Integrate support for a broader range of IoT devices and platforms to make the system more flexible and adaptable for diverse use cases. This could include devices from various manufacturers and emerging IoT standards.
- **Enhancing Security:** Implement advanced security measures, such as end-to-end encryption, multi-factor authentication, and anomaly detection systems, to protect user data and devices from cyberattacks.
- **Cost Reduction:** Develop cost-effective solutions by exploring the use of low-poIr and affordable IoT devices, along with optimizing network infrastructure for efficiency without compromising functionality.
- **Voice and AI-based Control:** Introduce AI-driven automation and voice recognition technologies, allowing users to control and interact with the system naturally and intuitively.
- **Improved Scalability:** Redesign the architecture to allow easy integration of additional devices and functionalities without significant reconfiguration, enabling the system to grow with user needs.
- **Resilience to Outages:** Incorporate backup poIr options and offline operational capabilities to ensure continuous functionality during poIr or internet outages.
- **Environmental Monitoring:** Add features for monitoring air quality, humidity, and temperature to enhance comfort and safety within the home.
- **Integration with Smart City Infrastructure:** Expand the system's scope to communicate with smart city frameworks, enabling coordinated energy management, traffic control, and emergency response systems.

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