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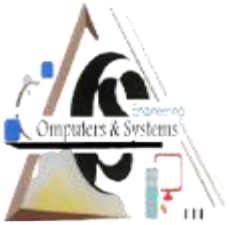
FACULTY OF ENGINEERING



COMPUTERS & SYSTEMS DEPARTMENT

IoT Solutions for Smart Cities

Graduation Project Submitted to the department of Computers and Systems Engineering as a partial fulfillment of Bachelor of Science degree in Engineering.

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ABSTRACT

The rapid advancements in technology, particularly the rise of the Internet of Things (IoT), have opened countless possibilities for creating smarter and more efficient cities. This project delves into the realm of IoT and its practical implementation in the context of building a smart city.

The project primarily focuses on utilizing Cisco Packet Tracer, a powerful network simulation tool, to design and simulate IoT-based solutions for various aspects of a smart city. By leveraging the capabilities of Cisco Packet Tracer, this project explores the integration of different IoT devices, sensors, and network infrastructure to create a cohesive and interconnected urban environment.

The book begins by providing a comprehensive overview of IoT and its relevance to smart cities, emphasizing the potential benefits and challenges associated with the deployment of IoT solutions. It then delves into the theoretical underpinnings of Cisco Packet Tracer and the essential concepts of network simulation.

The subsequent chapters showcase practical case studies and simulations, with an emphasis on using Cisco Packet Tracer to implement IoT applications within a smart city framework. Examples may include intelligent transportation systems, smart energy management, environmental monitoring, public safety, and waste management. Each case study explores the design, implementation, and evaluation of IoT solutions, showcasing the versatility of Cisco Packet Tracer as a valuable tool for simulating real-world scenarios.

Furthermore, the book discusses key considerations such as security, privacy, scalability, and interoperability in the realm of IoT-enabled smart cities, highlighting the challenges and potential solutions associated with these aspects.

Ultimately, this project aims to provide a comprehensive understanding of IoT application development in the context of smart cities using Cisco Packet Tracer. It serves as a practical guide for students, researchers, and practitioners interested in exploring the potential of IoT and its integration with Cisco networking technologies to build smarter and more sustainable urban environments.

LIST OF ABBREVIATIONS

Abbreviation	Definition
NAT	NETWORK ADDRESS TRANSLATOR
DHCP	DYNAMIC HOST CONFIGURATION PROTOCOL
DNS	DOMAIN NAME SERVER
VoIP	VOICE OVER INTERNET PROTOCOL
EIGRP	ENHANCED INTERIOR GATEWAY ROUTING PROTOCOL
RIP	ROUTING INFORMATION PROTOCOL
OSPF	OPEN SHORTEST PATH FIRST
BGP	BORDER GATEWAY PROTOCOL
OSI	OPEN SYSTEMS INTERCONNECTIONS
ISOI	NTERNATIONAL STANDARDS OF ORGANISATION
CPU	CENTRAL PROCESSING UNIT
Wi-Fi	WIRELESS FIDELITY
CIDR	CLASSLESS INTER DOMAIN ROUTING
VLSM	VARIABLE LENGTH SUBNET MASKING
ACL	ACCESS CONTROL LISTS
NIC	NETWORK INTERFACE CARD
VLAN	VIRTUAL LOCAL AREA NETWORK
LAN	LOCAL AREA NETWORK
WLAN	WIRELESS LOCAL AREA NETWORK
CLI	COMMAND LINE INTERFACE
TTL	TIME TO LEAVE
HTML	HYPER TEXT MARKUP LANGUAGE
DOD	DEPARTMENT OF DEFENSE

CONTENT

Chapter 1
Introduction

1.1 IoT (Internet of Things)

1.1.1 What is IoT?

IoT (Internet of Things) refers to the network of physical objects, devices, vehicles, buildings, and other items embedded with sensors, software, and connectivity to exchange data over the internet. These "things" can range from simple household appliances to complex industrial machinery.

The concept behind IoT is to enable these objects to connect and communicate with each other, collect and share data, and perform various tasks without human intervention. This connectivity allows for the seamless exchange of information, remote control, and automation of processes, resulting in increased efficiency, convenience, and improved decision-making.

IoT relies on various technologies such as sensors, actuators, embedded systems, cloud computing, and communication protocols. Sensors collect data from the physical environment, while actuators help control and operate physical systems based on received instructions. The collected data is transferred to the cloud or other platforms where it is analyzed, processed, and utilized to derive valuable insights or trigger specific actions.

IoT

1.1.2 What are the Components of IoT ?

The Internet of Things (IoT) comprises various components that work together to enable connected devices to communicate and exchange data. Here are some key components of IoT:

1. **Devices** or Things: These are physical objects or devices embedded with sensors, actuators, and connectivity capabilities. Examples include sensors, wearable devices, connected appliances, industrial machinery, and vehicles.

2. **Sensors**: Sensors collect data from the environment and convert it into digital signals. They can measure various parameters like temperature, light, humidity, motion, pressure, and more.

3. **Connectivity**: IoT devices need connectivity to communicate and transmit data. This can be achieved through various technologies such as Wi-Fi, Bluetooth, cellular networks, Zigbee, or even satellite connections.

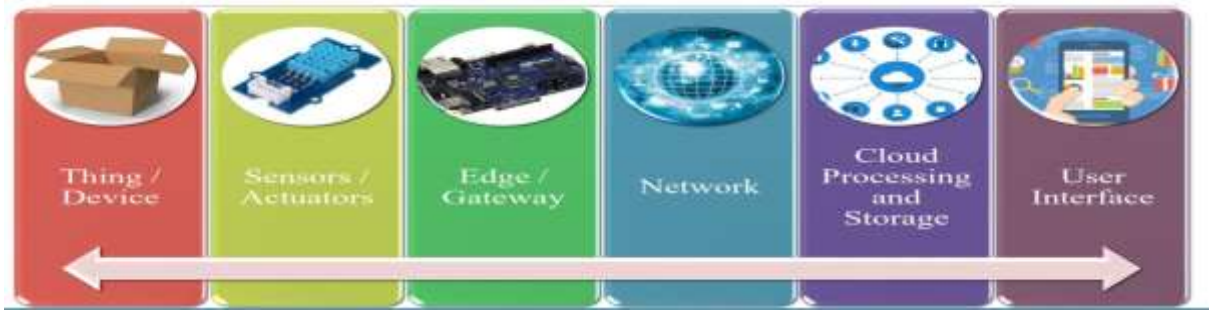
4. **Data Processing**: Once data is collected from sensors, it needs to be processed and analyzed. Edge computing, cloud computing, or a combination of both can be utilized for this purpose.

5**. Networks**: IoT devices rely on networks to transmit data from one point to another. This includes both local networks (e.g., LAN, WLAN) and wide-area networks (e.g., Internet, cellular networks) depending on the scale and reach of the IoT deployment.

6. **Cloud Platforms**: Cloud platforms store and process the collected IoT data. They provide analytics, data storage, and other services required for IoT applications. Cloud platforms also facilitate device management, security, and scalability.

7. **Applications and Services**: The ultimate goal of IoT is to leverage the collected data to provide valuable services and insights. These can range from smart home automation, industrial monitoring and control, healthcare systems, transportation management, and more.

8. **Security**: Security is a critical component of IoT. It involves safeguarding devices, networks, and the data exchanged between them from unauthorized access, cyber threats, and privacy breaches.



IoT components

1.1.3 IoT Architecture

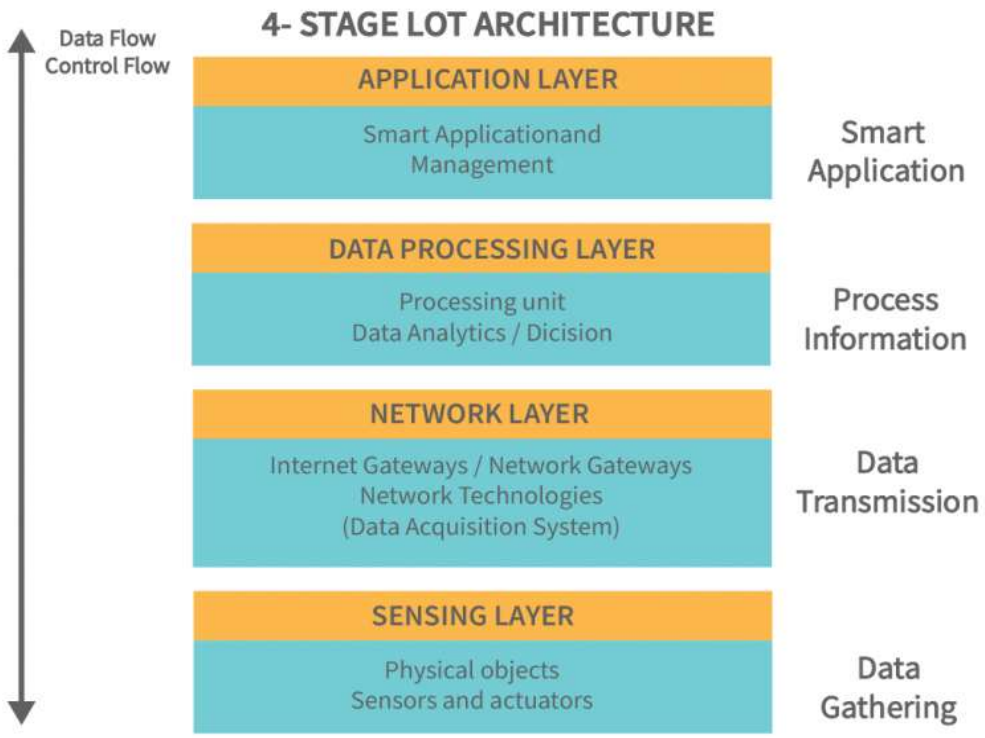
- **IoT Architecture**

IoT architecture refers to the structure of interconnected devices, software, and services that work together to enable IoT systems to function effectively. There are different approaches to IoT architecture, but most follow a similar basic structure and flow. IoT architecture requires four main components: connected hardware "things" collecting and processing data via sensors and controlling devices at the edge, a communications link (sometimes more than one) to transport data to/from the cloud, a processing system (often part of a cloud platform offering), and a cloud-based or local data center to store, manage, and analyze the data.

- **Layers of IoT Architecture**

IoT architecture can be divided into different layers, depending on the specific use case. Here are some examples of the layers of IoT architecture:

1. Perception layer: This layer hosts smart things, such as sensors and actuators, that collect data from the physical world.
2. Connectivity or transport layer: This layer transfers data from the perception layer to the cloud or other processing systems.
3. Processing layer: This layer processes the data collected from the perception layer and provides insights and analytics.
4. Application layer: This layer provides the user interface and enables users to interact with the IoT system.



IoT Architecture

- **Challenges of IoT Architecture**

There are several challenges associated with IoT architecture, including:

1. Lack of standardization: IoT is a heterogeneous technology, which means every device is different. This makes it difficult to establish a hard and fast structure for IoT architecture.
2. Connectivity: The soul of any IoT device is its connectivity to other devices. Ensuring reliable and secure connectivity can be a challenge.
3. Mobility: IoT devices are often mobile, which can make it difficult to maintain connectivity and ensure data security.
4. Vulnerability: IoT devices are vulnerable to cyber-attacks, which can compromise the security of the entire system.
5. Malware attacks: Malware attacks can infect IoT devices and cause them to malfunction or become part of a botnet.

- **Security Architecture in IoT**

Security is a critical aspect of IoT architecture. An IoT security architecture uses IoT security solutions to protect IoT devices. Companies deploy IoT solutions for various reasons, and some IoT deployments are more formal and structured than others. Industrial IoT architectures are usually structured based on the Purdue model for industrial control system (ICS) networks, while consumer IoT solutions typically operate under a four-tier architecture model.

In conclusion, IoT architecture is a complex system that involves multiple layers and components. Understanding the different layers and challenges associated with IoT architecture is essential for designing and implementing effective IoT solutions. Additionally, ensuring the security of IoT devices and systems is crucial for protecting sensitive data and preventing cyber-attacks.

1.1.4 How IoT works

IoT works by connecting devices to the internet and allowing them to communicate with each other using sensors, software, and network connectivity. The sensors collect data from the environment or device and send it to the cloud where it is processed and analyzed. The analyzed data is then used to make decisions or trigger actions that can be performed by other devices connected to the network.

For example, a smart thermostat can collect data on temperature and humidity in a room and send it to the cloud. The cloud can then analyze this data and determine if the temperature needs to be adjusted. If so, it can send a signal back to the thermostat to adjust the temperature accordingly.

IoT has many applications in various industries such as healthcare, transportation, agriculture, manufacturing, and more. It has the potential to revolutionize how we live and work by making our lives more efficient and convenient.

1.1.5 IoT advantages and disadvantages

IoT has the potential to revolutionize many industries and aspects of our lives, but it also comes with some challenges.

Advantages of IoT

- **Improved efficiency and productivity**: IoT can help businesses to improve their efficiency and productivity by automating tasks, collecting data, and providing real-time insights. For example, IoT-enabled sensors can monitor the performance of machines and equipment and send alerts when there is a problem. This can help to prevent costly downtime and improve output.
- **Cost savings**: IoT can help businesses to save money by reducing the need for human intervention, optimizing resources, and preventing accidents. For example, IoT-enabled smart meters can track energy usage and send alerts when there is a spike in consumption. This can help businesses to identify and fix energy leaks, which can save them money on their energy bills.
- **Enhanced communication and connectivity**: IoT can help to improve communication and connectivity between people, devices, and systems. For example, IoT-enabled wearable devices can track the location and health of employees and send alerts if there is a problem. This can help to improve safety and productivity.
- **Real-time monitoring and control**: IoT can enable real-time monitoring and control of assets, processes, and systems. This can help businesses to improve their response times to problems and make better decisions. For example, IoT-enabled smart traffic lights can collect data on traffic flow and adjust the timing of the lights accordingly. This can help to reduce congestion and improve traffic flow.

Disadvantages of IoT

- **Security risks**: IoT devices are often connected to the internet, which makes them vulnerable to cyberattacks. If an attacker gains access to an IoT device, they could potentially steal data, disrupt operations, or even cause physical harm.
- **Complexity**: IoT systems can be complex to design, develop, and maintain. This is because they often involve a wide range of different devices, networks, and protocols.

- **Compatibility issues**: IoT devices may not be compatible with each other or with existing systems. This can make it difficult to integrate IoT devices into existing systems and can lead to data silos.
- **Data overload**: IoT devices can generate a large amount of data. This can be difficult to manage and analyze and can lead to decision fatigue.
- **Privacy concerns**: IoT devices collect a lot of data about people's activities and habits. This data could be used to track people's movements, monitor their health, or even influence their behavior. This raises privacy concerns about how this data is collected, used, and stored.

1.1.6 IoT Features

We have listed some of the features that make IoT what it is in the present digital scenario. IoT devices have several sets of features that are common. They are:

IoT features

- **Connectivity**: IoT devices need to be able to connect to each other and to the internet in order to share data.
- **Scaling**: IoT systems need to be able to scale up or down as needed, depending on the number of devices and the amount of data being generated.
- **Sensing**: IoT devices need to be able to sense their surroundings and collect data about them.
- **Analyzing**: IoT devices need to be able to analyze the data they collect in order to extract insights.
- **Artificial intelligence**: IoT devices can be enhanced with artificial intelligence to make them more intelligent and capable.
- **Smaller devices**: IoT devices are becoming smaller and more powerful, which makes them more affordable and easier to deploy.
- **Integration**: IoT devices can be integrated with other technologies to create more powerful and useful applications.
- **Automation**: IoT devices can be used to automate tasks, which can save time and money.
- **Security**: IoT devices need to be secure to protect the data they collect.

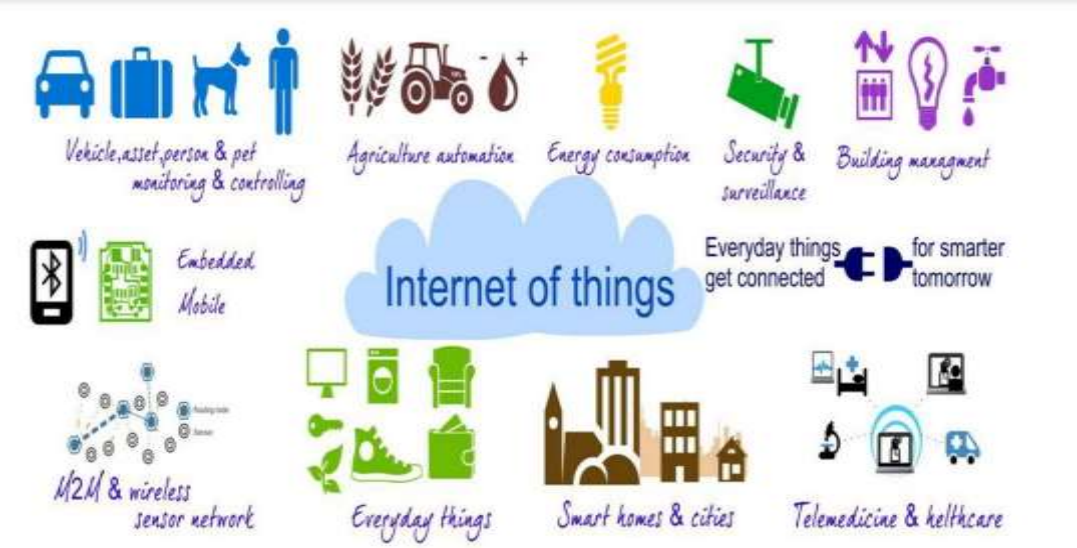
- **Endpoint management**: IoT devices need to be managed to ensure that they are functioning properly.

1.1.7 IoT applications

The Internet of Things (IoT) is a rapidly growing field with new applications being developed all the time. Some of the most common applications of IoT include:

- **Smart homes**: These homes use IoT devices to control everything from the thermostat to the lights. For example, you can use your voice to turn on the lights or adjust the thermostat. You can also use IoT devices to monitor your home security and make sure that your doors and windows are locked.
- **Smart cities**: These cities use IoT devices to monitor traffic, manage waste, and improve public safety. For example, IoT devices can be used to track traffic flow and adjust traffic lights accordingly. They can also be used to collect data on waste disposal and identify areas where there are problems. This data can be used to improve waste management and reduce pollution.
- **Industrial automation**: IoT devices are used to automate industrial processes, such as manufacturing and logistics. For example, IoT devices can be used to monitor the performance of machines and equipment and send alerts when there is a problem. This can help to prevent costly downtime and improve output.
- **Healthcare**: IoT devices are used to monitor patients' health and provide remote care. For example, IoT devices can be used to track patients' vital signs and send alerts to doctors if there is a problem. They can also be used to provide remote care to patients who live in rural areas or who are unable to travel to a doctor's office.
- **Transportation**: IoT devices are used to track vehicles and improve traffic flow. For example, IoT devices can be used to track the location of vehicles and send alerts if they are driving too fast or if they are in an accident. They can also be used to collect data on traffic flow and adjust traffic lights accordingly. This data can be used to improve traffic flow and reduce congestion.
- **Agriculture**: IoT devices are used to monitor crops and livestock, and to improve the efficiency of agricultural operations. For example, IoT devices can be used to track the moisture levels in soil and adjust irrigation accordingly. They can also be used to track the health of livestock and send alerts if there is a problem. This data can be used to improve crop yields and reduce the risk of livestock diseases.
- **Wearables**: Wearable devices are IoT devices that are worn on the body. They can be used to track fitness, sleep, and other health data. They can also be used to control smart home devices and receive notifications.

- **Logistics**: IoT devices are used to track the movement of goods and improve the efficiency of logistics operations. For example, IoT devices can be used to track the location of goods in transit and send alerts if they are delayed. They can also be used to collect data on the temperature and humidity of goods in transit and ensure that they are being stored properly.



IoT Applications

These are just a few of the many applications of IoT. As the technology continues to develop, we can expect to see even more innovative and exciting applications emerge in the years to come.

1.2 Smart City

1.2.1 What is a Smart City

A smart city is an urban area that uses various technologies and data-driven solutions to enhance the quality of life for its residents. It involves the integration of different sectors, such as transportation, energy, healthcare, and communication, to create a sustainable and efficient city infrastructure. Smart cities leverage advanced sensors, IoT devices, and data analytics to collect and analyze information, enabling city administrators to make informed decisions and provide improved public services. The goal is to enhance resource utilization, optimize urban operations, reduce environmental impact, and ultimately improve the overall well-being of citizens.

Smart City

1.2.2 The relation between Smart cities and IoT

Smart cities and the Internet of Things (IoT) are closely related concepts. IoT refers to a network of interconnected physical devices embedded with sensors, software, and connectivity to collect and exchange data. Smart cities, on the other hand, leverage IoT technology to enhance the quality of life, sustainability, and efficiency of urban environments.

In a smart city, IoT devices can be deployed across various sectors, such as transportation, energy, infrastructure, public safety, waste management, and more. These devices gather vast amounts of data, which is then utilized to improve city operations, optimize resource allocation, and create innovative services for residents.

For example, IoT sensors can monitor traffic patterns and adjust traffic signals to optimize traffic flow. Smart grids, enabled by IoT, can efficiently manage energy distribution, reducing wastage and promoting sustainability. IoT devices in waste management can optimize garbage collection routes based on real-time data, minimizing costs and environmental impact.

1.3 Objective of the Project

The objective of the Smart City project using Cisco Packet Tracer is to create an integrated and efficient urban environment by leveraging technology and connectivity. The project aims to improve various aspects of urban life, such as education, workplaces, and energy management, by implementing smart solutions.

1. Smart University Module: This module focuses on transforming the traditional university setting into a technologically advanced and connected campus. It may include features like smart classrooms with interactive displays, IoT-based attendance systems, campus-wide Wi-Fi, virtual libraries, and digitized administrative processes.

2. Smart Office Module: The Smart Office module aims to enhance the efficiency and productivity of workplaces by leveraging smart technologies. It may include features like smart lighting and climate control systems, occupancy sensors, energy management systems, video conferencing solutions, and cloud-based collaboration tools to optimize the use of resources and improve communication.

3. Smart Grid Module: The Smart Grid module focuses on achieving efficient energy management and conservation. It involves integrating renewable energy sources, smart meters, energy monitoring systems, and demand-response mechanisms to manage electricity distribution effectively. This module aims to reduce energy consumption, lower carbon footprints, and ensure a reliable power supply in the city.

By implementing these modules and incorporating them into the overall Smart City infrastructure, the objective is to create a sustainable, connected, and technologically advanced urban environment that improves the quality of life for its residents.

Chapter 2

discusses the use of Cisco Packet Tracer

2.1 What is Cisco Packet Tracer?

Cisco Packet Tracer is Cisco's simulation software. It can be used to produce complicated network typologies, as well as to test and pretend abstract networking generalities. It acts as a playground for you to explore networking and the experience is veritably close to what you see in computer networks. They also give their service in languages similar as Russian, German, Spanish and French. Packet Tracer enables scholars to produce complicated and huge networks, which is constantly insolvable with physical tackle due to cost considerations. Packet Tracer is available for Linux, Windows, MacOS, Android, and iOS. Packet Tracer allows druggies to drag and drop routers, switches, and other network bias to produce simulated network topologies. However, you can download it for free if you have a Netacad account. The stylish way to learn about networking, according to Cisco, is to do it. This program cannot replace tackle routers or switches because the protocols are enforced solely in software. This tool, still, doesn't just contain Cisco tackle but also a wide range of other networking bias.

2.2 Who Uses Cisco Packet Tracer?

This is primarily intended to train campaigners for the CCNA instrument, which professionals extensively use. It's substantially used by Networking Curious & suckers, CCNA, CCNA Security and CCNP scholars along with masterminds, preceptors, & Coaches. Before enforcing any protocol, masterminds like to test it on Cisco Packet Tracer. In addition, masterminds who want to emplace any revision in the product network prefer to use Cisco Packet Tracer to test the changes first and emplace if everything works as planned.

2.3 Benefits of Packet Tracer

• Cisco Packet Tracer supports a multi-user system that allows numerous druggies to connect colorful topologies across a computer network. preceptors can also make exercises for scholars to perform using Packet Tracer.

• Supports point expansion via fresh programs that use an API to ameliorate Cisco Packet Tracer's capabilities in areas including class and assessment delivery, gaming, availability, and interacting with real- world outfit.

• The Enhanced Physical Mode transports you to a virtual lab where you can pretend cabling bias on a rack. Refresh crucial chops similar as device placement (Rack & mound), on- device power switching, device harborage- to- harborage cabling (including string selection and operation), troubleshooting, and more.

• It can be downloaded for free through a Netacad account.

• It enables its druggies to pretend the configuration relating to the Cisco routers and can be penetrated anywhere anytime.
• The Network Controller allows you a centralized dashboard to see the network's state, incontinently discover and diagnose issues, and push configuration changes to all managed bias at formerly, whether you use its Web GUI or its APIs. You may also use real- world programs on your computer to pierce the Network Controller and run your own structure robotization scripts.
• It can be penetrated through unlimited bias.
• Provides an interactive and tone- paced terrain.
• furnishing a realistic, simulated, and imaged literacy terrain that complements classroom outfit, including the capability to see real- time internal processes that would typically be hidden on real tackle
• Real- time multi-user collaboration and competition for dynamic literacy
• produce and restate structured literacy conditioning like lab exercise demonstrations, quizzes, tests, and games.
• Enable scholars to explore generalities, conduct trials and test their understanding of erecting networks.
• Allow scholars and preceptors to design, make, configure, and troubleshoot complex networks using virtual machines.
• Support a variety of tutoring and literacy openings similar as lectures, groups, individual lab exercises, schoolwork, games, and competitions.

2.4 What's new in Packet Tracer 8.2?

Packet Tracer8.1 enables Packet Tracer (PTTA) learning conditioning, a new type of exertion that continuously provides tips for learners if they so ask. Packet Tracer Learning Conditioning (PTTA) is designed to give a more individualized and fair literacy experience. In addition, Cisco Packet Tracer8.1 Networking Impersonator software includes bug fixes and advancements in availability, usability, and security. Version8.1 is grounded on Cisco Packet Tracer8.0 network simulator. Version8.0 was a introductory interpretation that features two cool new updates The bettered physical mode invites you to a virtual lab to get a realistic experience of the string setups on the rack. Enhance introductory chops like device placement (Rack & mound), device power on, harborage- to- harborage device cabling (including string selection and operation), troubleshooting, and more. Network press, like real- world SDN consoles similar as Cisco DNA Center and APICEM. You can exercise a centralized network operation approach using the Network Console model. Managed using the web plates stoner interface or its APIs, the network press gives you a central dashboard to view network status, snappily identify and troubleshoot problems, push configuration changes to all managed bias at formerly, and access to a network press from real- world operations running on your computer, similar as a cybersurfed, Python, or Postman, to execute scripts to automate your structure.

2.5 Platforms Support Packet Tracer

- Microsoft Windows 8.1, 10, 11 (32-bit and 64-bit)
- Ubuntu 20.04 LTS (64-bit)
- macOS 10.14 or later (64-bit)
  To successfully install and run Packet Tracer 8.1 Network Emulator, the following minimum prerequisites must be met:

  ==> Cisco Packet Tracer 8.2 Network Emulator (64-bit):

- A computer with one of the following operating systems: Microsoft Windows 8.1, 10, or 11 (64-bit), Ubuntu 20.04 LTS (64-bit), or macOS 10.14 or later.
- amd64 CPU (x86-64)
- 4 GB empty RAM
- 1.4 GB free disk space
  ==> Cisco Packet Tracer 8.1 Network Emulator (32-bit):

- A computer with one of the following operating systems: Microsoft Windows 8.1, 10, or 11 (32-bit version)
- x86 compatible CPU
- 2 GB empty RAM
- 1.4 GB free disk space

Chapter 3
Smart University

3.1 Introduction to Smart University

Welcome to the world of Smart IoT University, a cutting-edge educational institution that embraces the power of Internet of Things (IoT) technology to revolutionize learning and campus life. Powered by Cisco Packet Tracer, our university leverages advanced networking and simulation capabilities to provide an immersive and hands-on experience for students and faculty alike.

At Smart IoT University, we believe that IoT is the future of connectivity and automation. Through our innovative approach, we integrate IoT devices and technologies into every aspect of university life, from classrooms and laboratories to residential halls and outdoor spaces. This creates a dynamic and intelligent learning environment that equips our students with the skills needed for the digital era.

With the help of Cisco Packet Tracer, our students get the opportunity to design, implement, and troubleshoot intricate IoT networks in a virtual environment. This powerful simulation tool allows them to experiment with various IoT devices, sensors, and protocols, ensuring a comprehensive understanding of real-world IoT deployments without the need for physical hardware.

Imagine walking into a Smart IoT University classroom where students engage in interactive lectures, collaborating with their peers and professors through IoT-enabled communication systems. They can monitor and control the temperature and lighting levels in real-time, optimizing the environment for better focus and productivity.

In our state-of-the-art laboratories, students can experiment with IoT-enabled robotics, automation systems, and environmental monitoring. Cisco Packet Tracer provides a safe yet realistic environment for them to conceptualize, simulate, and analyze innovative solutions to real-world problems.

Beyond the classroom, our campus-wide network of IoT devices enables a seamless and personalized experience for students. Connected sensors and smart buildings ensure energy efficiency, while personalized schedules and device integration enhance the overall student experience.

At Smart IoT University, our dedicated faculty and staff are committed to staying at the forefront of IoT technology and its applications across various disciplines, such as healthcare, agriculture, transportation, and more. We strive to ignite creativity,

critical thinking, and entrepreneurial spirit among our students as they shape the future of the IoT ecosystem.

Discover the limitless possibilities of IoT-driven education at Smart IoT University, where Cisco Packet Tracer empowers our students to become the IoT leaders of tomorrow. Join us on our journey into the interconnected world and be part of a transformative learning experience that prepares you for the challenges and opportunities of the digital age.

3.2 Objective:

The objective of Smart University is to provide conducive environment to the students and researchers helping them in their research and learning opportunities to keep pace with 21st century.

3.3 Problem Statement:

- To avoid the wastage of electricity
- Sometimes we forget to switch off the AC and Fan Lights.
- To minimize the chances of fire accidents
- To solve the university parking places problems.
- To ensure the use of internet everywhere
- To provide automated and smart education environment
- To minimize disruption of concentration in activities
- To improve the security system of university.

3.4 Benefits of Smart University

There are several benefits of using Cisco Packet Tracer in a smart IoT college setting:

1. Simulation: Cisco Packet Tracer enables students to create and simulate complex IoT networks without the need for physical devices. This allows for cost-effective and scalable implementation of IoT solutions.

2. Hands-on Experience: Students can gain practical, real-world experience by designing and configuring IoT devices, sensors, and connectivity protocols within the simulation environment.

3. Collaboration: Packet Tracer provides a collaborative platform where students can work together on IoT projects, share designs, and troubleshoot network configurations. This fosters teamwork and enhances problem-solving skills.

4. Multi-vendor Support: Cisco Packet Tracer supports a wide range of IoT devices and protocols from various vendors. This ensures students get exposure to diverse technologies commonly used in IoT implementations.

5. Visualizations: The interactive graphical interface of Packet Tracer allows students to visualize network topologies, sensor data, and traffic flows. This aids in understanding the concepts and operations of IoT systems.

6. Security Testing: Packet Tracer enables students to study and implement security measures for IoT networks and devices. They can learn about encryption, access control, and threat mitigation strategies to protect IoT infrastructures.

7. Resource Availability: Packet Tracer provides a vast library of pre-built devices, enabling students to quickly deploy and configure IoT elements. This saves time and allows more focus on learning concepts and experimenting with different scenarios.

Overall, Cisco Packet Tracer empowers smart IoT colleges to offer a hands-on, immersive learning experience while reducing costs and mitigating potential risks associated with physical deployments.

3.5 Smart University Features

- Smoke and Fire detection system.
- Human presence detection system using motion sensor.
- Smart security system where solar panel is used.
- Smart parking system using RFID.
- Smart university campus where internet is everywhere.
- Smart classroom and lab.

3.6 Elements of Smart University

1. **Server Room**
2. **Library Room**
3. **Classroom**
4. **Parking Area**
5. **Computer Lab**
6. **Playing Room**
7. **Campus Area**
8. **University Field**
9. **IT Room**

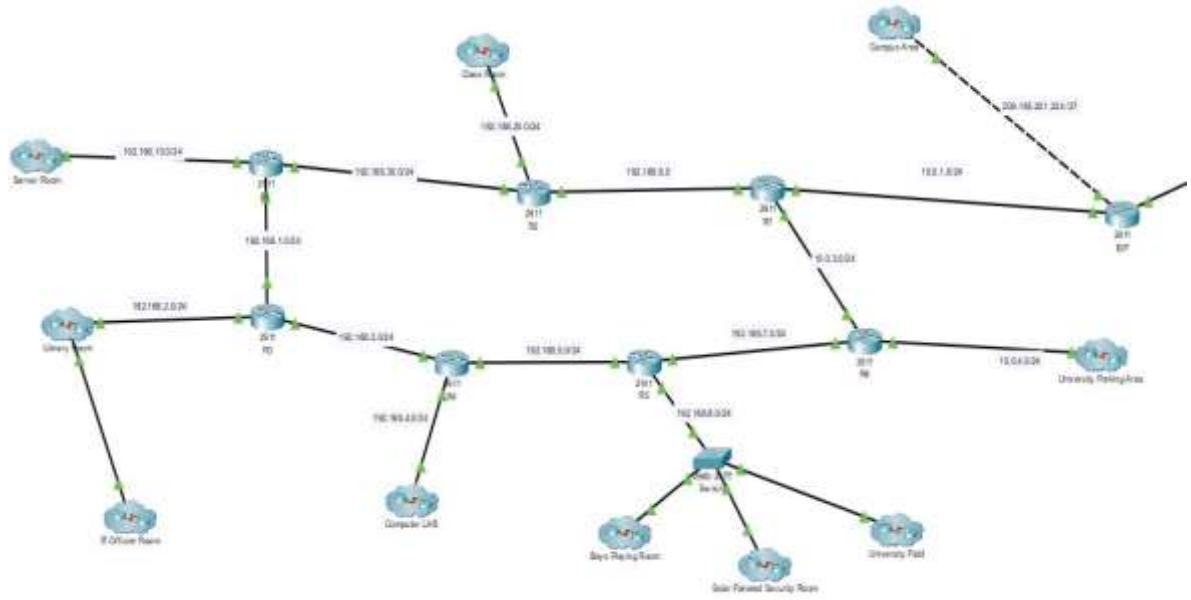


Figure 1 Smart University simulation topology

3.7 IOT Devices Used In Smart University

- **Sensors:**

  Temperature sensor, Smoke sensor, IR sensor, Motion detection sensors, furnace, Humidity sensors

- **IT Components:**

  Trip sensor, Camera, Light, Alarm, Door, RFID Reader, Window, Fan, Fire Monitor, Fire Alarm, AC, Street Lamp, Wind Detector.

- **Others:** MCU, SBC, Router, Switch, Home Gateway, Home Router, Cell Tower, Central-office Server

- **Actuators:**

Air Cooler, Alarm

- **Home Gateway**

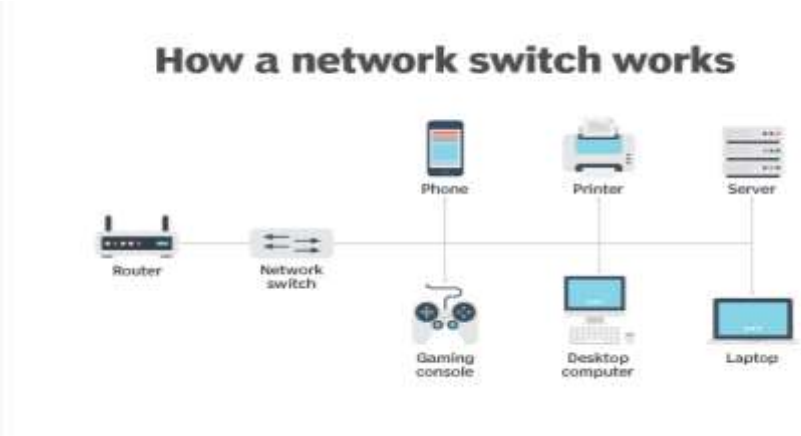
A home gateway is a small consumer-grade gateway that bridges network access between connected local area network (LAN) hosts to a wide area network (WAN) via a modem or directly connects to a WAN while routing. It acts as a single point of access to or from a home or residential computer network. A residential gateway can be a simple modem or a more robust piece of equipment providing routing and security features for a home network.

- **Router**

A router is a device that connects two or more packet-switched networks or subnetworks. It serves two primary functions: managing traffic between these networks and determining the best path for data packets to travel. Routers can combine the functions of network hubs, modems, or network switches. They guide and direct network data, using packets that contain various kinds of data such as files, communications, and simple transmissions like web interactions. Routers connect employees to networks, both local and the Internet, where just about every essential business activity takes place.

- **Switch**

A network switch connects devices in a network to each other, enabling them to talk by exchanging data packets. Switches can be hardware devices that manage physical networks or software-based virtual devices. They allow two or more IT devices to communicate with one another and can be connected to other switches, routers, and firewalls, all of which can provide connectivity to additional devices.



3.8 Implementation and Configuration

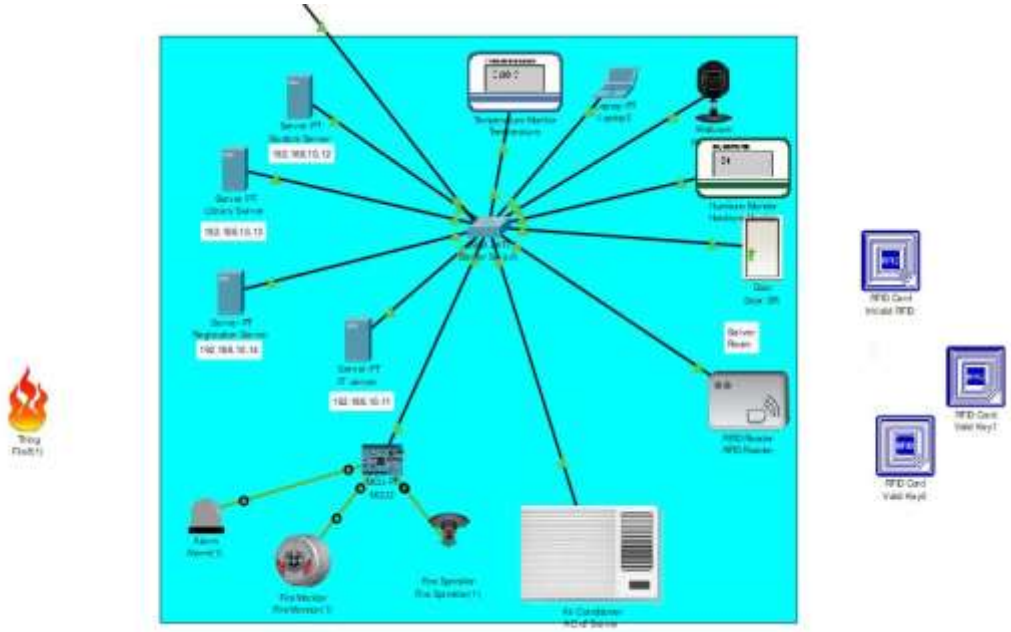
steps for emplementation and configuration:-

- Setting up Registration Server
- Connect a wireless router and complete routing configuration.
- Connect the necessary sensors with the MCU and SBC
- Necessary coding implementation
- Connect the MCU and other IoT components with the router.

- Provide necessary condition on the registration server for having IoT devices interconnectivity.

Server Room

- **Implementation**



Server Room

In a smart university IoT setup, the server room plays a crucial role in managing and controlling various IoT devices across different areas of the campus. To simulate this system using Cisco Packet Tracer, we can design a comprehensive server room that incorporates IoT servers for multiple LANs while also integrating various IoT devices for enhanced functionality and security.

Starting with the physical layout, the server room consists of racks for holding the servers and networking equipment. The IoT servers are responsible for managing and processing data from different LANs, such as the classrooms and library. These servers ensure seamless communication and coordination among the IoT devices across the campus.

The IoT devices within the server room include fire detection systems, fire sprinklers, webcams, air conditioners, and various other sensor-based devices. These devices help monitor and control the environment within the server room to ensure optimal conditions for the servers and networking equipment.

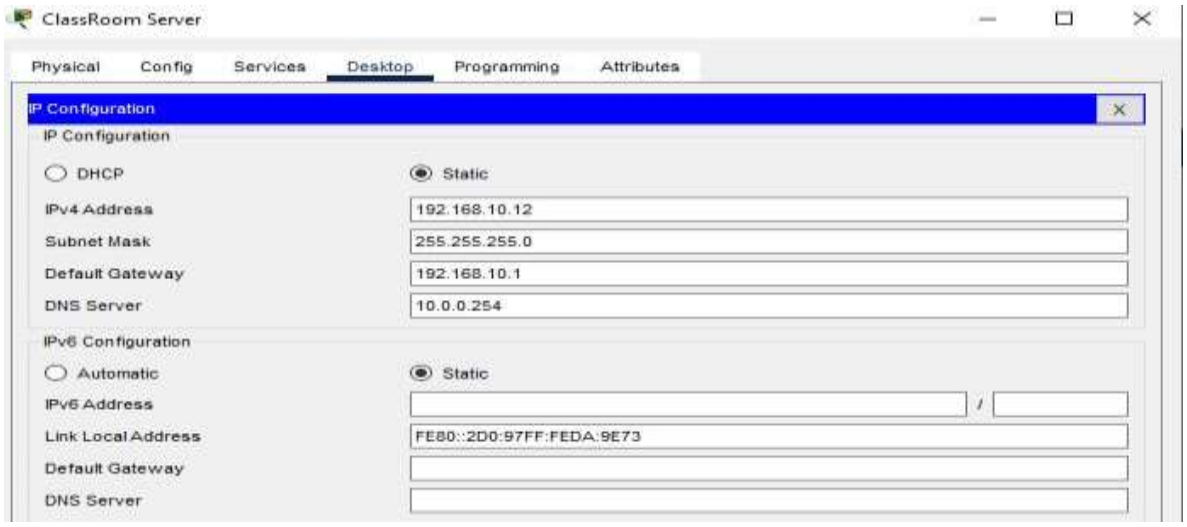
To enable remote access and control of the IoT devices, there are laptops placed within the server room. These laptops are connected to the IoT servers and provide a user-friendly interface to manage and monitor the IoT devices' operations from within the server room itself.

The server room also incorporates RFID card-enabled access control systems. The RFID door detector readers are strategically placed at the entrance of the server room. Users can gain access to the server room by swiping their authorized RFID cards, ensuring secure entry to the sensitive area.

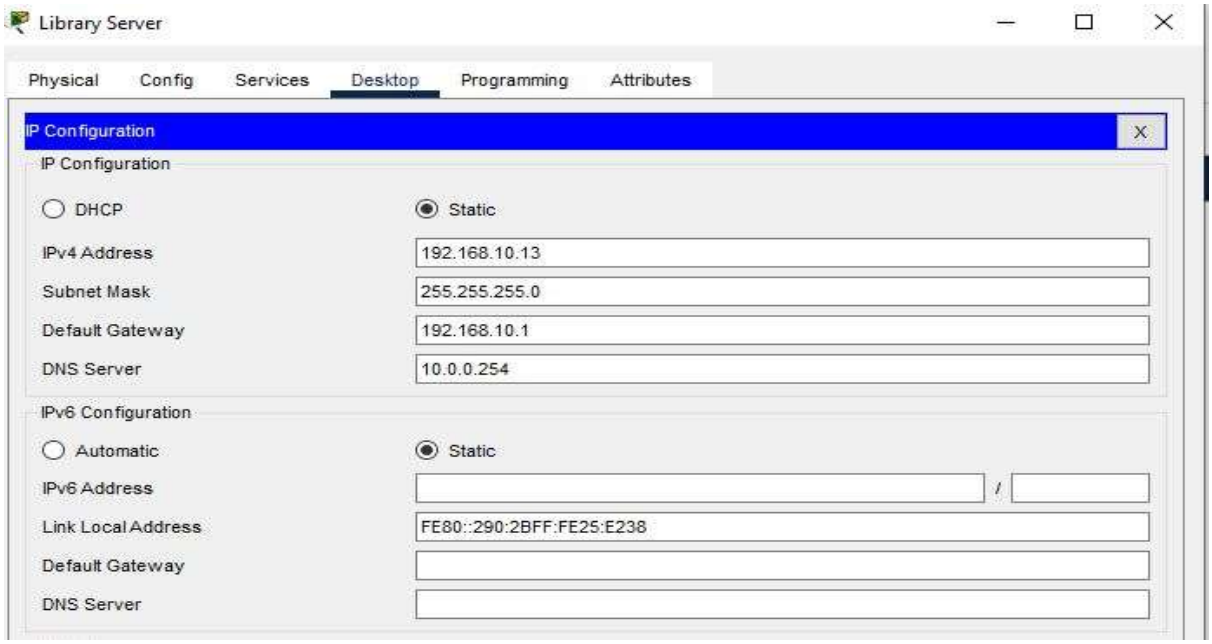
In terms of network connectivity, the server room is connected to the various LANs present in the university campus. This connectivity allows the IoT servers to communicate and exchange data with the IoT devices located in different areas, including classrooms, library rooms, and other designated zones.

- **Configuration**

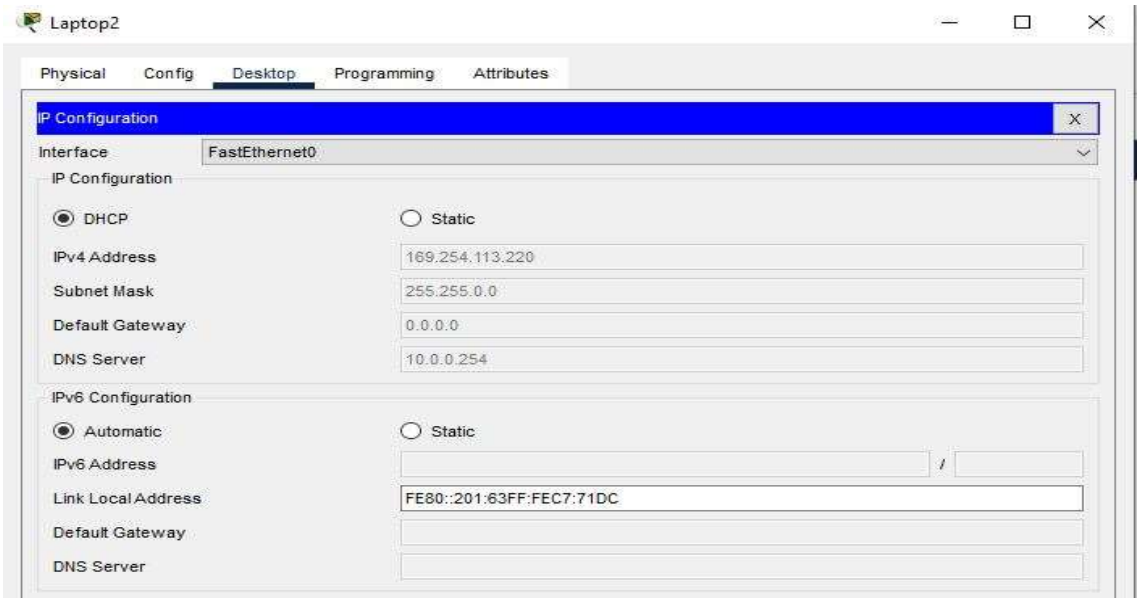
1. Classroom server



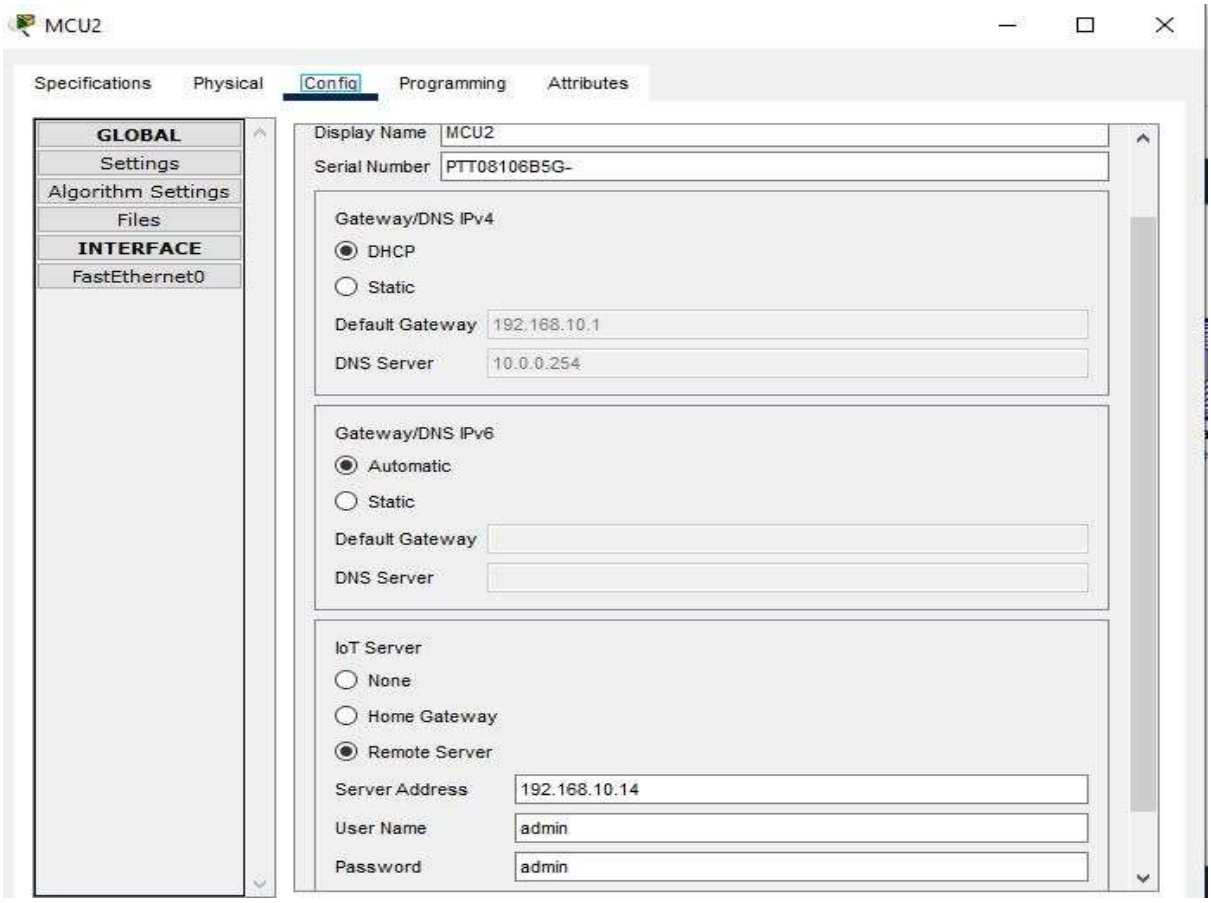
2. Library Room Server



3. Lab Top



4. MCU



Library Room

- **Implementation**

The library room is a part of the smart university IoT network. It is equipped with a variety of IoT devices, including:

- Smart coffee appliance: This device can be controlled remotely to brew a fresh cup of coffee.
- Windows: The windows in the library room can be opened and closed remotely, depending on the temperature and CO2 levels in the room.
- Light dimmer: The light dimmer can be used to adjust the brightness of the lights in the library room.
- Air conditioning: The air conditioning can be turned on or off remotely, depending on the temperature in the room.
- Smoke detection system: The smoke detection system will send an alert if there is smoke in the library room.
- Webcam: The webcam can be used to monitor the library room remotely.
- Smart LED: The smart LED can be used to create different lighting effects in the library room.
- Firefighting system: The firefighting system will activate automatically if there is a fire in the library room.
- Motion detection: The motion detection system will send an alert if there is any movement in the library room after hours.

All these devices are connected to a home gateway, which allows them to communicate with each other and with the outside world. The home gateway can be accessed remotely using a smartphone, a laptop, or any other internet-connected device. This allows users to control the IoT devices in the library room from anywhere in the world.

The use of IoT in the library room has a number of benefits. It can help to improve the comfort and convenience of library users, and it can also help to improve the security of the library. For example, the smoke detection system can help to prevent fires, and the motion detection system can help to deter theft.

The use of IoT in the library room is still in its early stages, but it has the potential to revolutionize the way that libraries operate. In the future, we can expect to see even more IoT devices being used in libraries, such as self-checkout machines, smart shelves, and interactive displays.

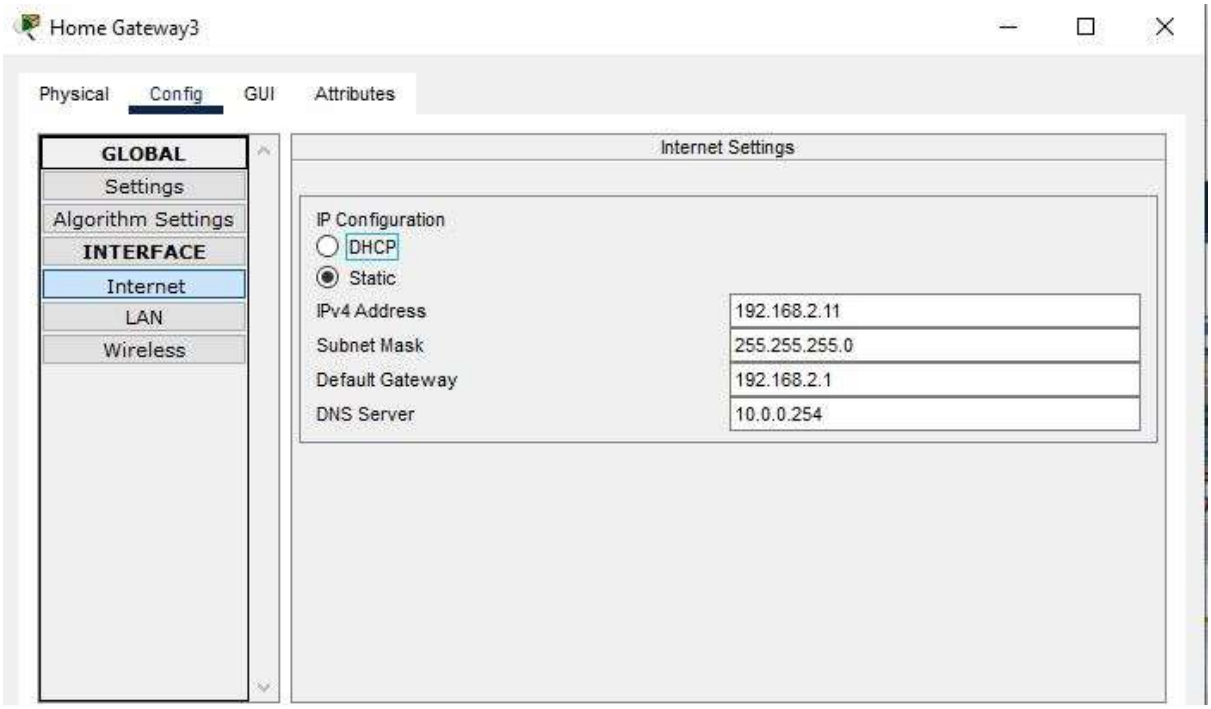
Here are some additional details about the IoT devices in the library room:

- The SBCs (Single Board Computers) are responsible for controlling the individual IoT devices. They are connected to the MCUs (Microcontroller Units), which are responsible for processing the data from the sensors and sending commands to the actuators.
- The home gateway is a router that connects the IoT devices to the internet. It also provides a secure way for users to access the IoT devices remotely.
- Smartphones, laptops, and other internet-connected devices can be used to control the IoT devices in the library room. They can also be used to monitor the status of the devices and to receive alerts if there are any problems.

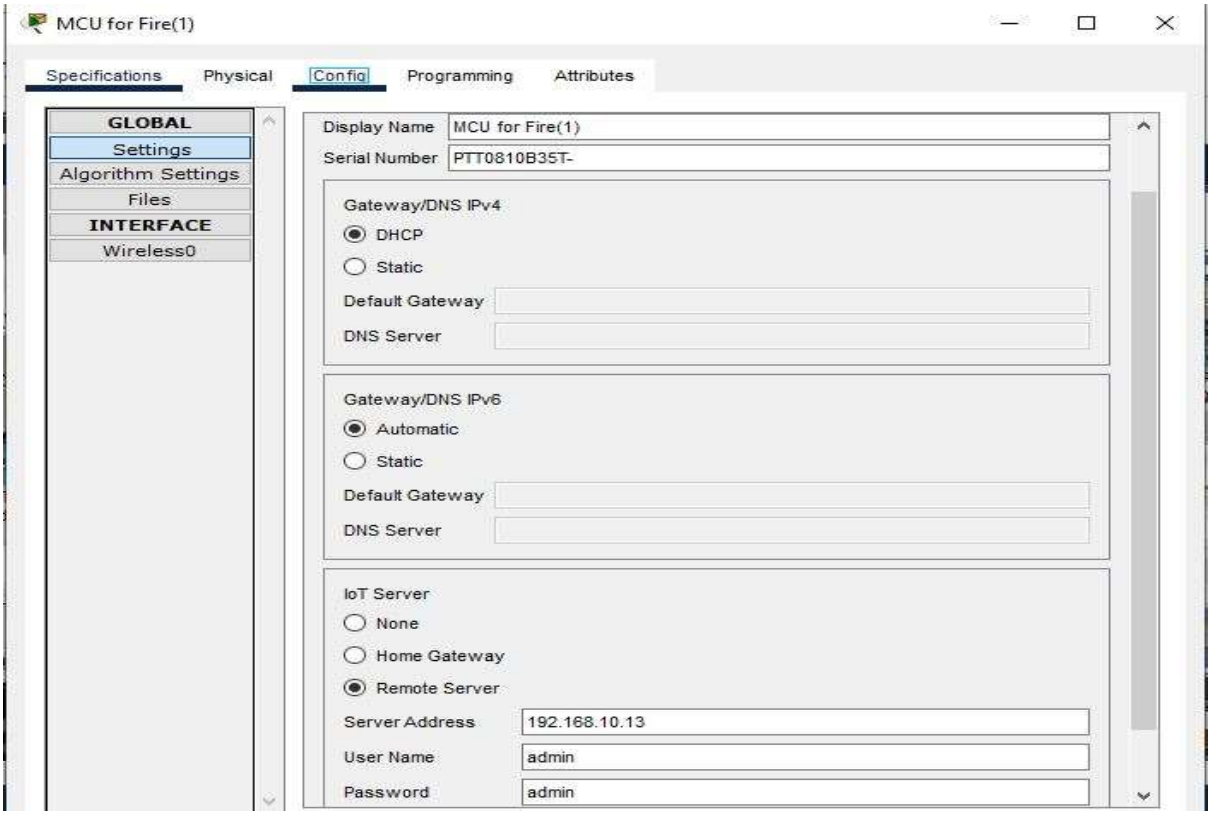
The library room is just one example of how IoT can be used to improve the efficiency and functionality of a university campus. As IoT technology continues to develop, we can expect to see even more innovative applications of IoT in the future.

- **Configuration**

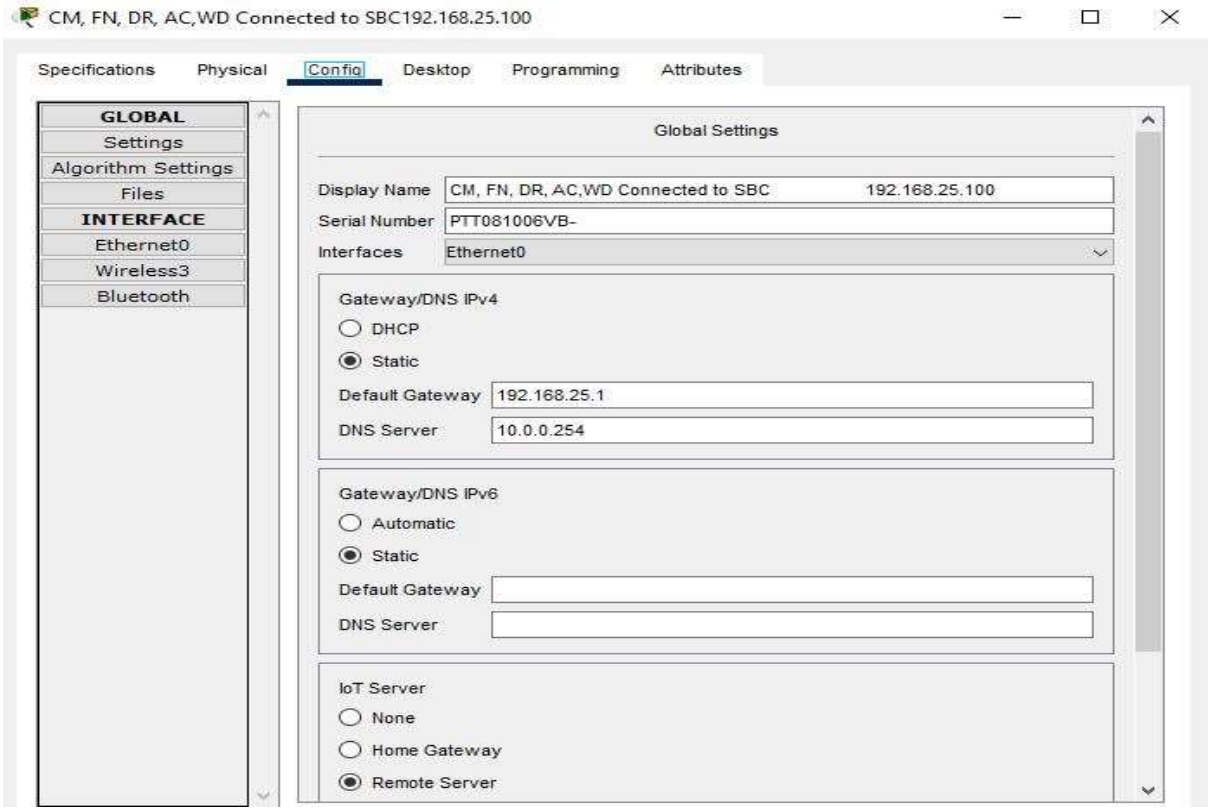
1. Home Gateway



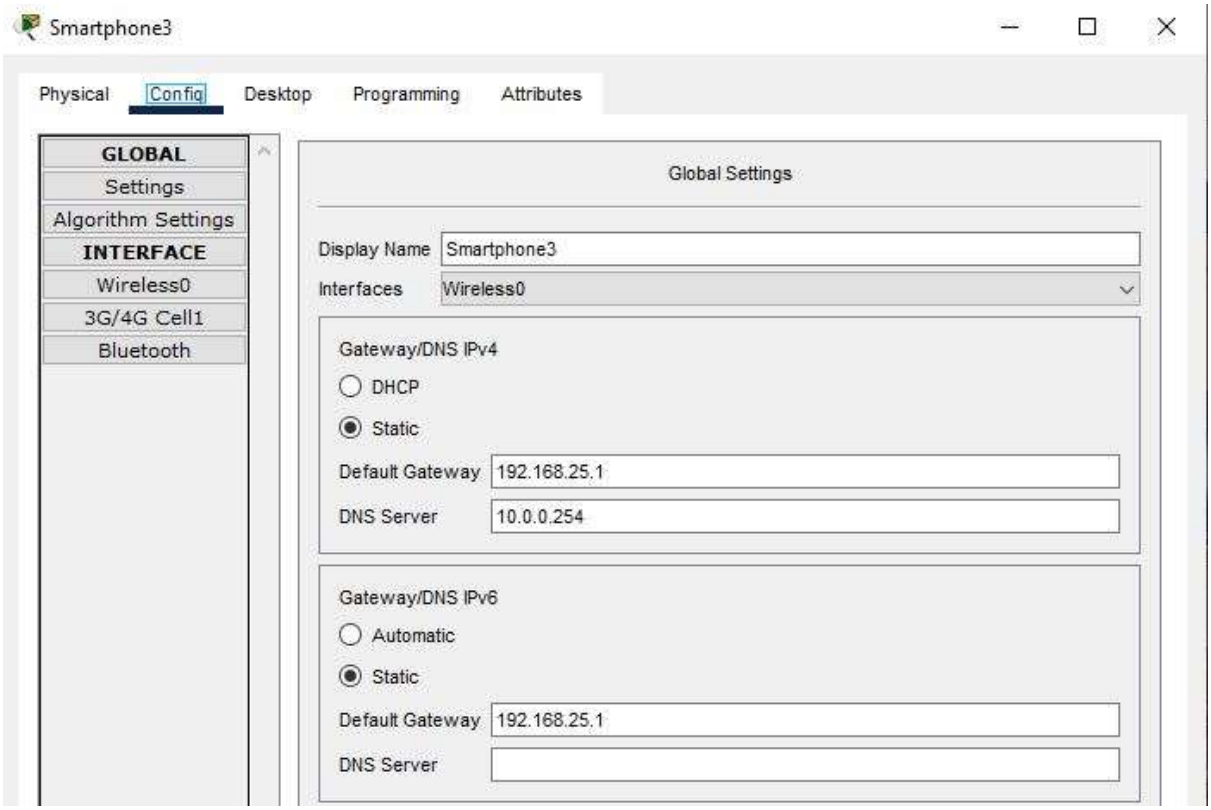
2. MCU - PT



3. SBC – PT

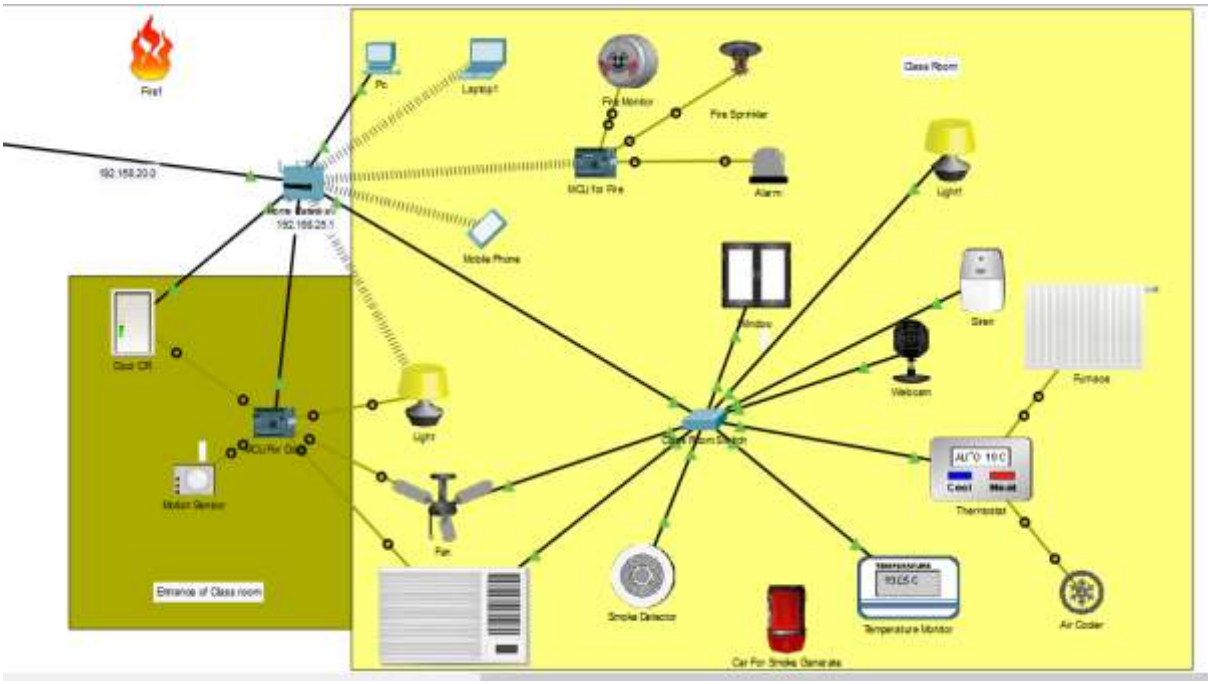


4. Smart Phone



Classroom

- **Implementation**



The classroom includes a MCU-PT to control IoT devices such as a fire sprinkler, fire monitor, alarm, door, motion sensor, fan, air conditioning, smoke detection system, webcam, smart LED, furnace, cooler, siren, and firefighting system. All these components are connected to a home gateway with a password. They can be controlled remotely through a smartphone, laptop, or PC.

The MCU-PT for the fire sprinkler and fire monitor is connected to a switch. The switch is then connected to the home gateway. The MCU-PT for the door, motion sensor, fan, air conditioning, smoke detection system, webcam, smart LED, furnace, cooler, siren, and firefighting system is also connected to the switch.

The fire sprinkler and fire monitor are connected to the MCU-PT through a serial port. The door, motion sensor, fan, air conditioning, smoke detection system, webcam, smart LED, furnace, cooler, siren, and firefighting system are connected to the MCU-PT through a USB port.

The home gateway is configured with a password. This password is required to access the IoT devices in the classroom. IoT devices can be controlled remotely through a smartphone, laptop, or PC.

To control the IoT devices, the user must first connect to the home gateway. Once they are connected, they can access the web interface of the MCU-PTs. The web interface allows the user to control the IoT devices in the classroom.

The smart classroom IoT system can be used to improve safety and security in the classroom. The fire sprinkler and fire monitor can be used to extinguish a fire. The alarm can be used to alert people in the classroom of a fire. The door, motion sensor, fan, air conditioning, smoke detection system, webcam, smart LED, furnace, cooler, siren, and firefighting system can be used to improve the comfort and safety of the classroom.

The smart classroom IoT system can also be used to improve the learning experience. For example, the system could be used to deliver personalized instruction or to provide students with access to additional resources.

A smart classroom IoT system offers a number of benefits, including:

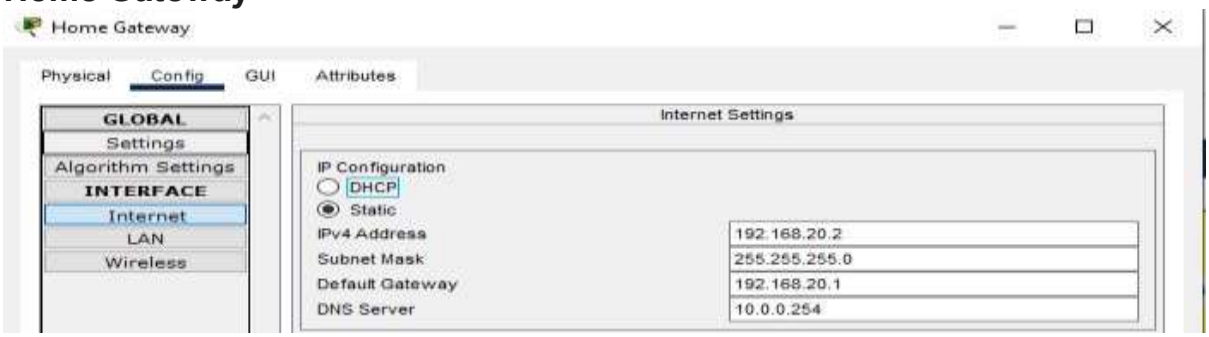
- **Improved safety and security:** The fire sprinkler and fire monitor can be used to extinguish a fire, and the alarm can be used to alert people in the classroom of a fire. The door, motion sensor, fan, air conditioning, smoke detection system, webcam, smart LED, furnace, cooler, siren, and firefighting system can be used to improve the comfort and safety of the classroom.
- **Increased efficiency:** The smart classroom IoT system can be used to automate tasks such as turning on the lights and adjusting the temperature. This can save time and energy.
- **Enhanced learning experience:** The smart classroom IoT system can be used to provide students with a more interactive and engaging learning experience. For example, the system could be used to deliver personalized instruction or to provide students with access to additional resources.

The smart classroom IoT system is a promising technology that has the potential to improve safety, security, efficiency, and learning experience in classrooms. Cisco

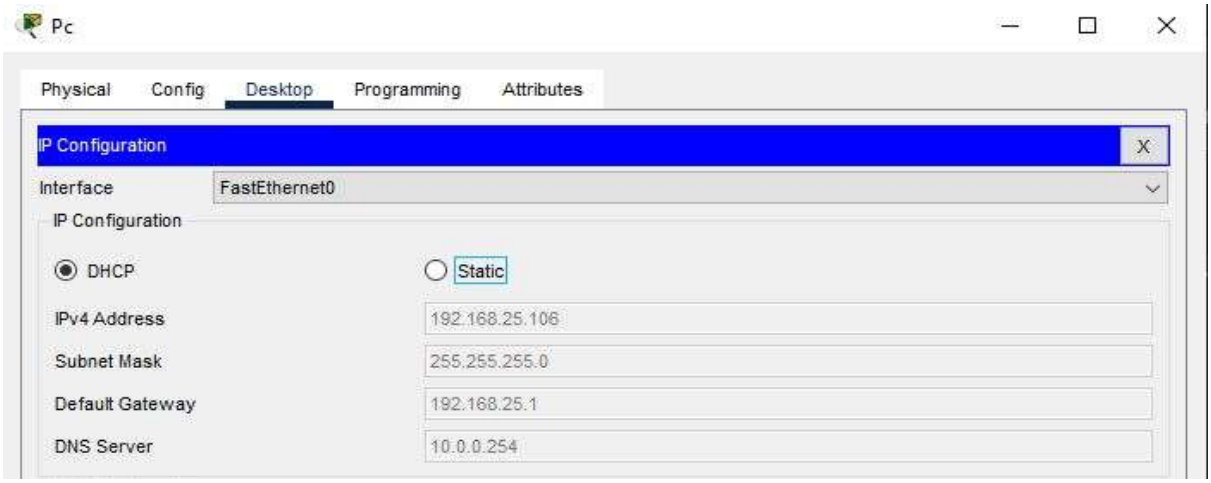
Packet Tracer is a valuable tool for simulating and testing smart classroom IoT systems.

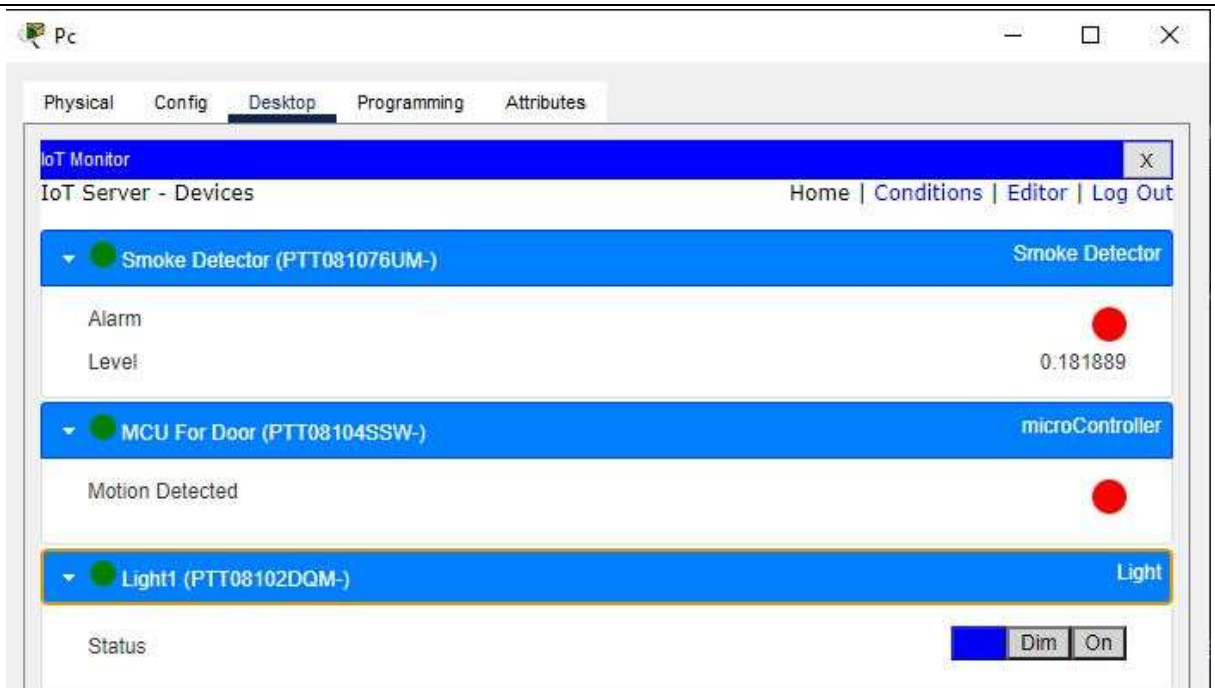
- **Configuration**

1. Home Gateway

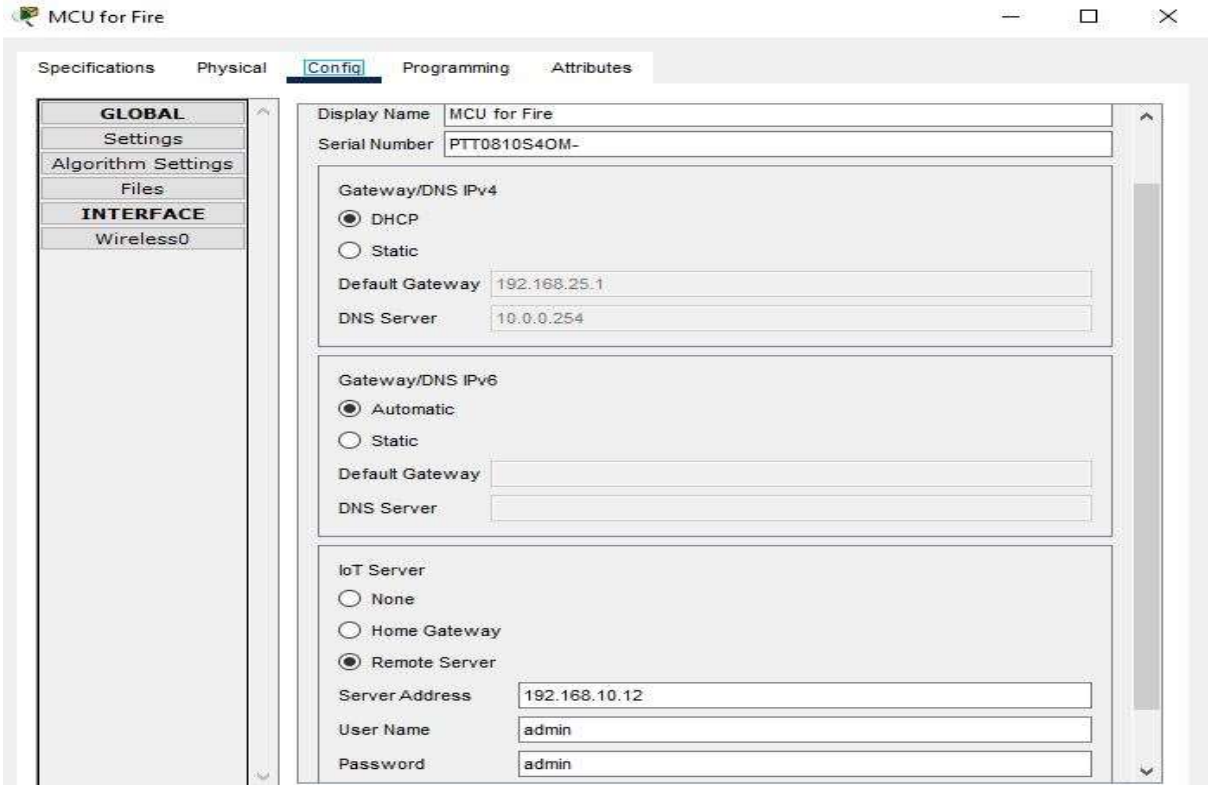


2. PC

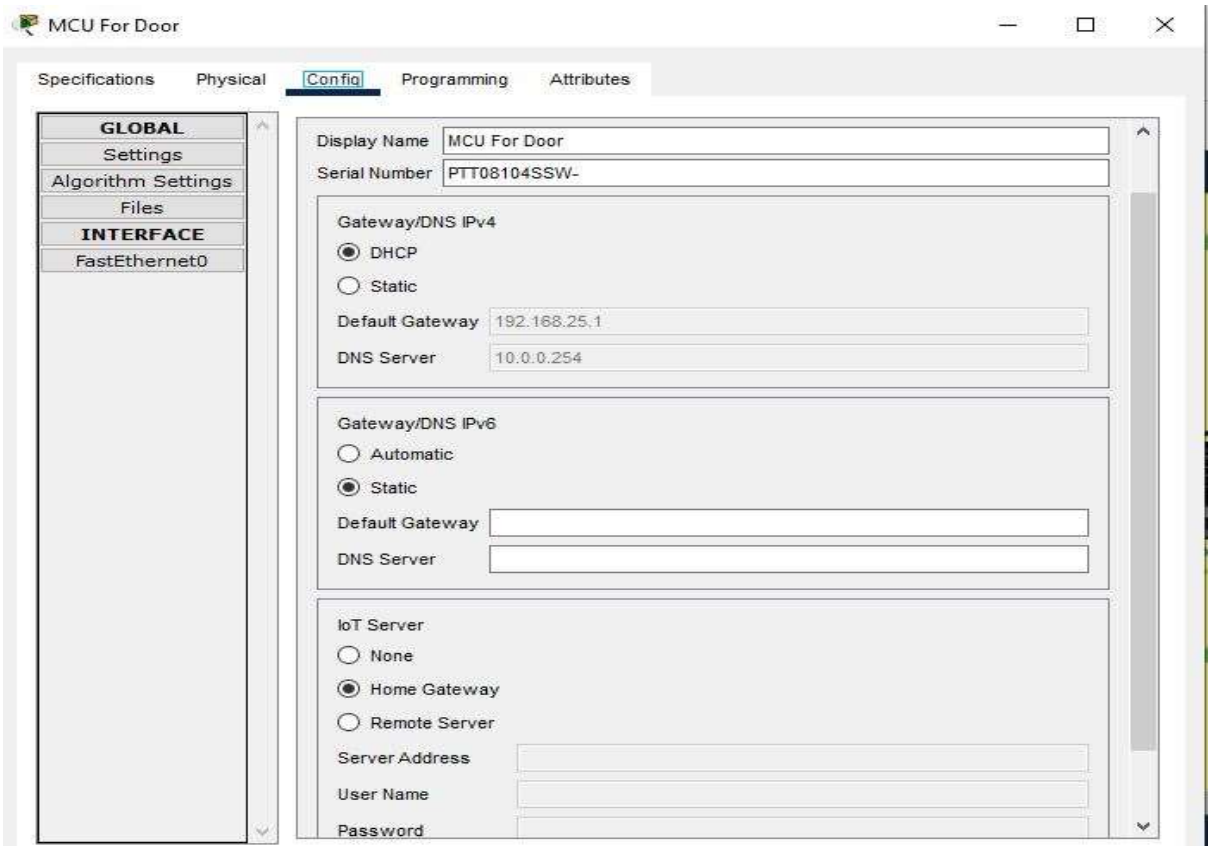




3. MCU for Fire

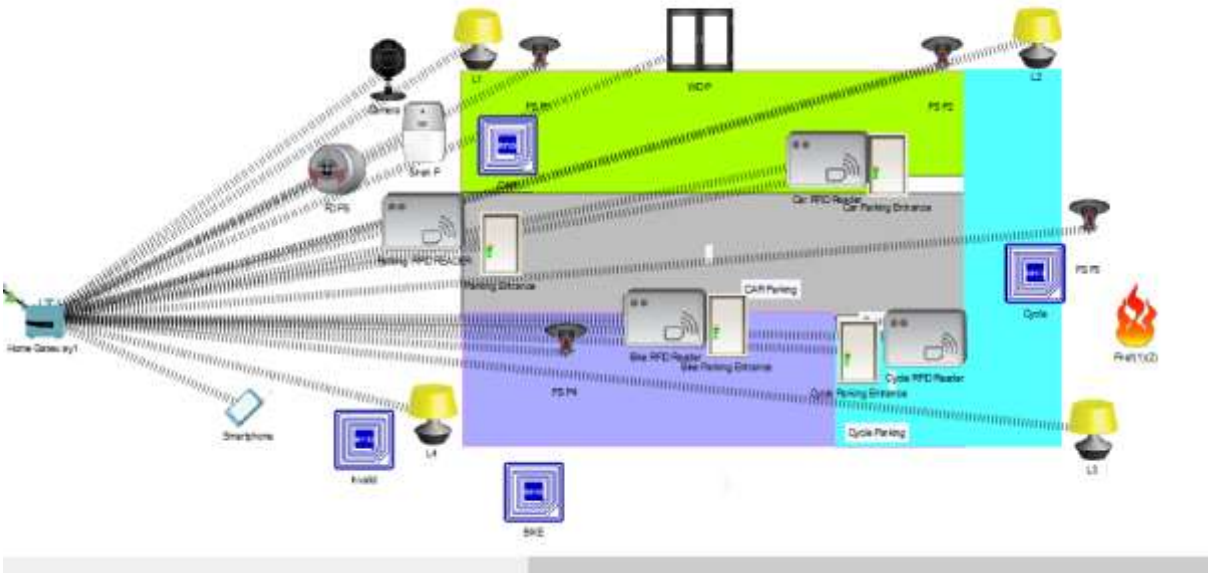


4. MCU for Door



Parking Area

- **Implementation**



The parking area in the smart IoT university is equipped with a variety of IoT devices to ensure the safety and security of students and faculty. These devices include:

- **RFID readers and RFID cards:** These devices are used to control access to the parking area. When a student or faculty member swipes their RFID card at the reader, the door to the parking area will open.
- **Firefighting system:** The firefighting system includes fire sprinklers, fire monitors, and an alarm siren. The fire sprinklers will automatically activate if there is a fire, and the fire monitors will detect the fire and send an alarm to the alarm siren.
- **Smoke detection system:** The smoke detection system uses sensors to detect smoke. If smoke is detected, the system will automatically open the windows to ventilate the area and reduce the CO2 levels.
- **Automatic lighting system:** The automatic lighting system uses sensors to detect darkness. If it is dark outside, the system will automatically turn on the lights in the parking area.
- **Webcam:** The webcam is used to monitor the parking area for security purposes. The webcam can be accessed from a smartphone or computer, so that security personnel can check on the parking area remotely.

All these devices are connected to a home gateway, which allows them to be controlled from a smartphone or computer. This means that students and faculty can use their smartphones to open the door to the parking area, check the status of the firefighting system, and view the live feed from the webcam.

This smart IoT parking area is a great example of how IoT technology can be used to improve the safety and security of a university campus. By using IoT devices, the university can ensure that students and faculty are safe and secure, even when they are in the parking area.

Here are some additional benefits of using IoT devices in a parking area:

- **Improved efficiency:** IoT devices can help to improve the efficiency of a parking area by reducing the amount of time that drivers spend looking for a parking spot. For example, a smart parking system can use sensors to track the occupancy of parking spots, and then provide drivers with real-time information about where to find a free spot.

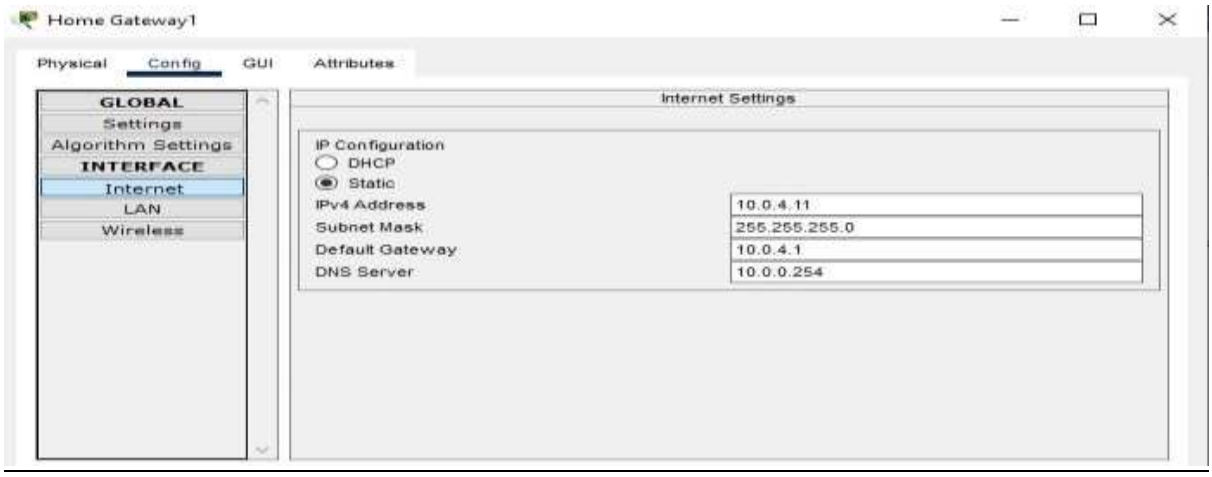
- **Increased revenue:** IoT devices can also help to increase the revenue generated by a parking area by charging drivers for parking by the minute or hour. This can be done by using sensors to track the time that a vehicle is parked in a spot, and then billing the driver accordingly.
- **Improved security:** IoT devices can also help to improve the security of a parking area by detecting and deterring crime. For example, a smart parking system can use cameras to monitor the parking area for suspicious activity, and then alert security personnel if something is amiss.

Overall, IoT devices can be a valuable tool for improving the safety, security, and efficiency of a parking area. By using IoT devices, universities can create a more convenient and secure parking experience for students and faculty.

▪ Configuration

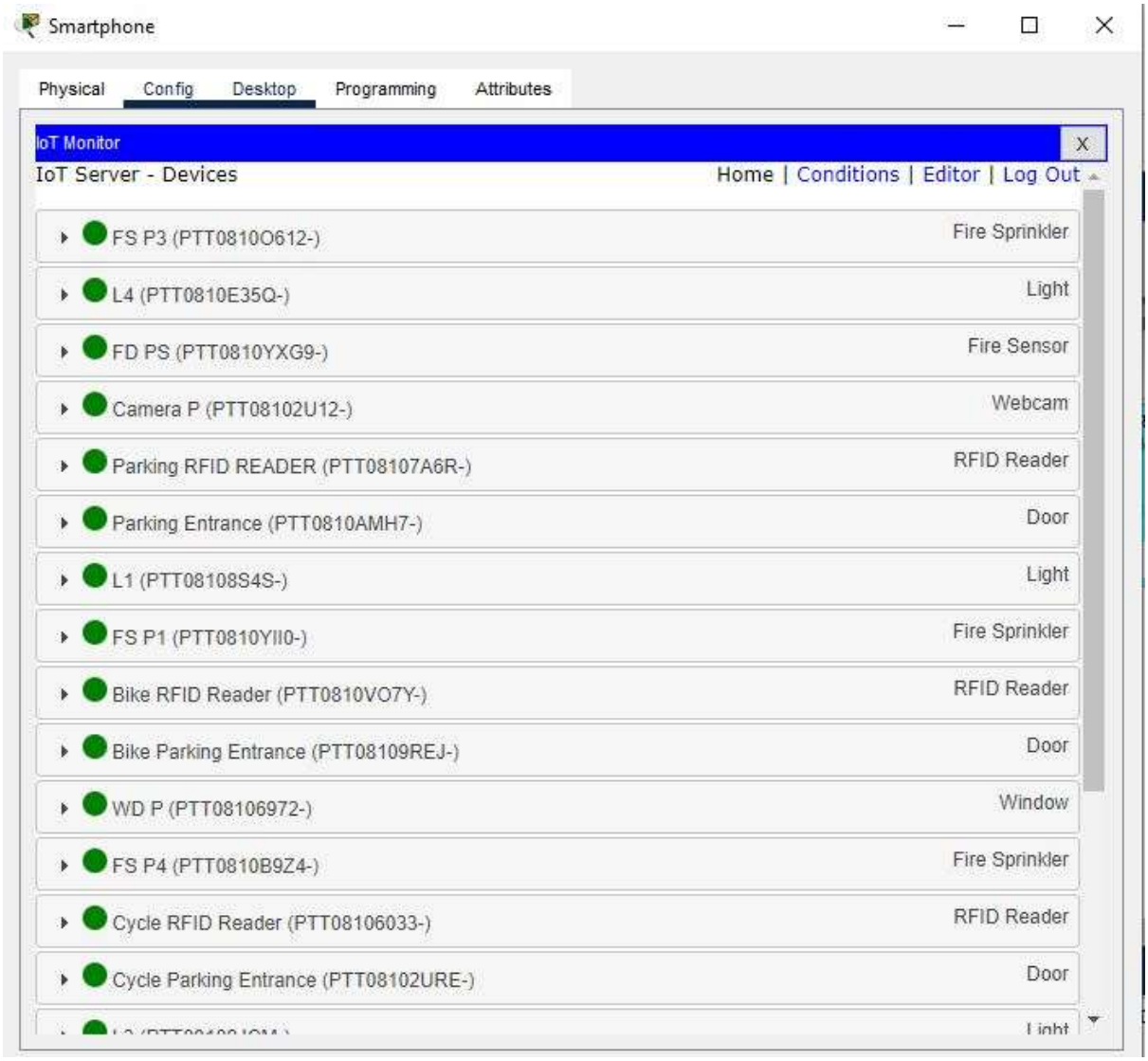
1. Home Gateway

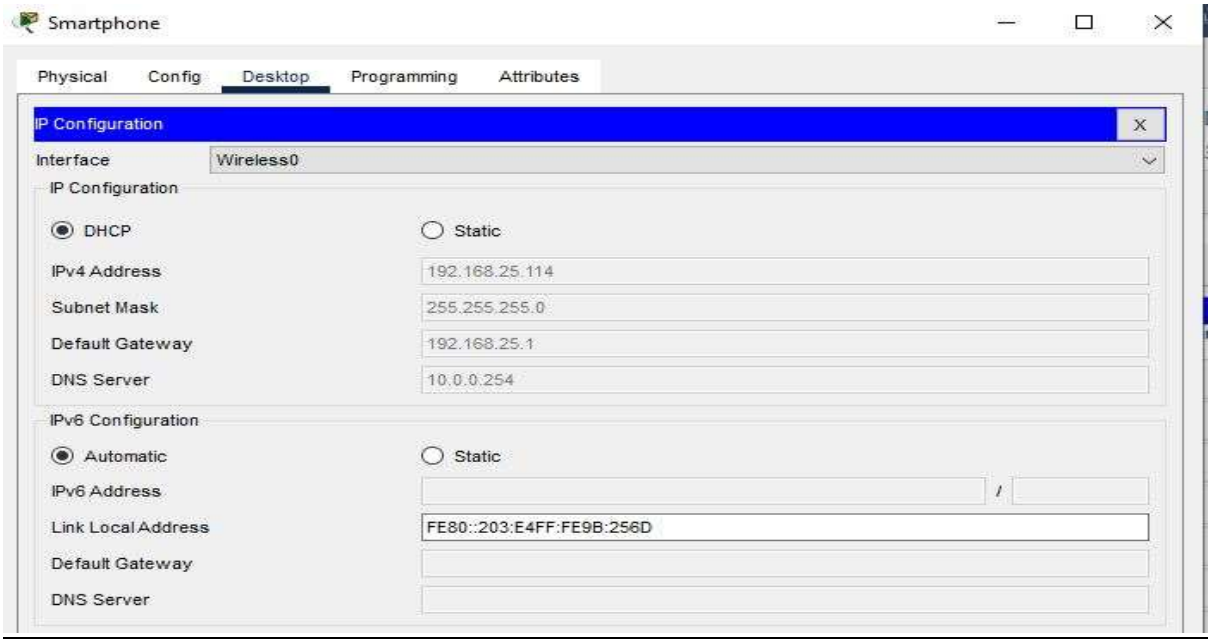
wireless configuration



internet configuration

2. Smartphone





Computer Lab

- **Implementation**

A smart computer lab is a laboratory that uses Internet of Things (IoT) devices to automate tasks, improve efficiency, and reduce energy consumption. In a smart computer lab, IoT devices such as fans, lights, temperature monitors, air conditioners, smoke detectors, windows, doors, and fire sprinklers are connected to a network and can be controlled remotely. This allows students and staff to control the environment of the lab without having to physically be there.

For example, students can use their laptops to turn on the fans or adjust the temperature of the lab. Staff can use a mobile app to monitor the lab's environmental conditions and receive alerts if there are any problems.

In addition to automating tasks, IoT devices in a smart computer lab can also help to improve efficiency and reduce energy consumption. For example, the lights in the lab can be automatically turned off when the lab is empty. This can help to save energy and money.

The IoT devices in a smart computer lab can also help to improve safety. For example, smoke detectors can be connected to a network and send alerts if smoke is detected in the lab. This can help to prevent fires and protect students and staff.

Here are some specific examples of how IoT devices can be used in a smart computer lab:

- **Fans:** Fans can be controlled remotely to maintain a comfortable temperature in the lab. This is especially important in hot climates, where students and staff can become uncomfortable if the temperature is too high.
- **Lights:** Lights can be turned on and off automatically based on the occupancy of the lab. This helps to save energy and money.
- **Temperature monitors:** Temperature monitors can be used to track the temperature in the lab and send alerts if the temperature goes outside of a safe range. This helps to prevent heat-related illnesses.
- **Air conditioners:** Air conditioners can be connected to a network and controlled remotely. This allows staff to adjust the temperature of the lab as needed.
- **Smoke detectors**: Smoke detectors can be connected to a network and send alerts if smoke is detected in the lab. This helps to prevent fires and protect students and staff.
- **Windows:** Windows can be opened and closed remotely to control the airflow in the lab. This helps to maintain a comfortable temperature and reduce energy consumption.
- **Doors:** Doors can be locked and unlocked remotely to control access to the lab. This helps to improve security and prevent unauthorized access.
- **Fire sprinklers:** Fire sprinklers can be connected to a network and controlled remotely. This allows staff to activate the sprinklers in the event of a fire, even if they are not physically present in the lab.

A smart computer lab is an asset for any university. It can help to improve the efficiency of the lab, reduce energy consumption, improve safety, and enhance the user experience. As IoT technology continues to develop, we can expect to see even more innovative ways to use IoT devices in smart computer labs.

Internet Service Provider

ISP is an Internet service provider that uses Internet of Things (IoT) devices and technologies to provide internet access to a smart university. The ISP includes a number of servers, such as a DNS server, IoT server, DHCP server, web server, mail server, and FTP server. These servers are essential for providing internet access to the university's students, faculty, and staff.

Protocols of the servers

The following are the protocols used by the servers mentioned above:

- **DNS server:** The DNS server uses the Domain Name System (DNS) protocol to translate domain names into IP addresses.
- **IoT server:** The IoT server uses the Constrained Application Protocol (CoAP) to communicate with IoT devices.
- **DHCP server:** The DHCP server uses the Dynamic Host Configuration Protocol (DHCP) protocol to assign IP addresses to devices on the network.
- **Web server:** The web server uses the Hypertext Transfer Protocol (HTTP) protocol to serve web pages.
- **Mail server:** The mail server uses the Simple Mail Transfer Protocol (SMTP) protocol to send and receive email messages.
- **FTP server:** The FTP server uses the File Transfer Protocol (FTP) protocol to transfer files between the university's servers and users' computers.

How these servers are very important in smart IoT university

The servers mentioned above are all essential for providing internet access to a smart IoT university. They allow students, faculty, and staff to access websites, send and receive email messages, and transfer files. In addition, these servers can also be used to manage the university's IoT devices.

For example, the DNS server allows users to easily access websites by typing in their domain names. The IoT server allows the university to monitor and control IoT devices remotely. The DHCP server allows devices to be easily connected to the network. The web server allows users to access the university's website. The mail server allows users to communicate with each other via email. The FTP server allows users to access the university's resources, such as course materials and research papers.

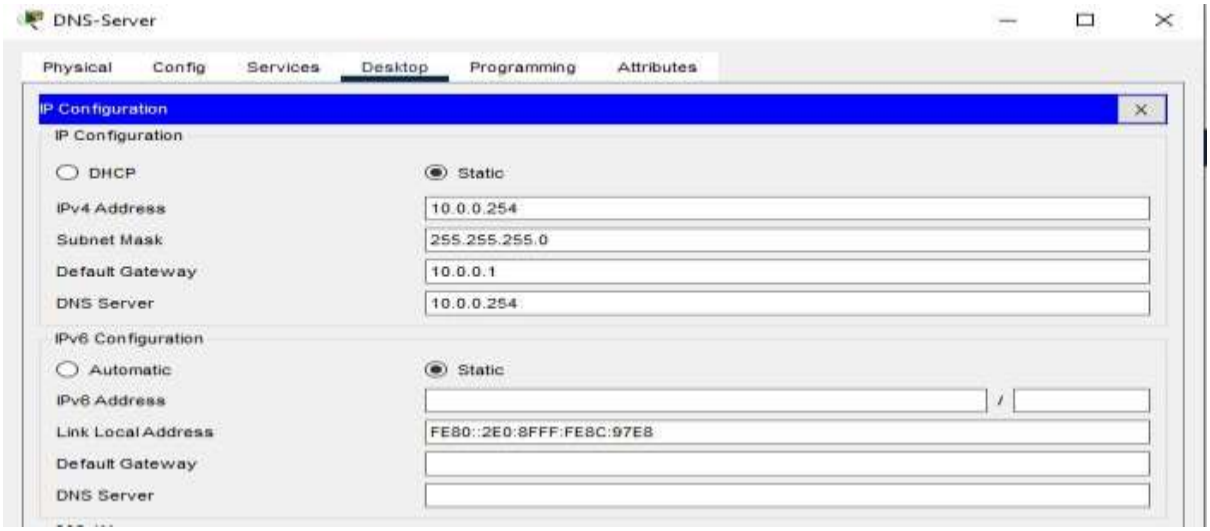
Using Cisco Packet Tracer to simulate a smart ISP.

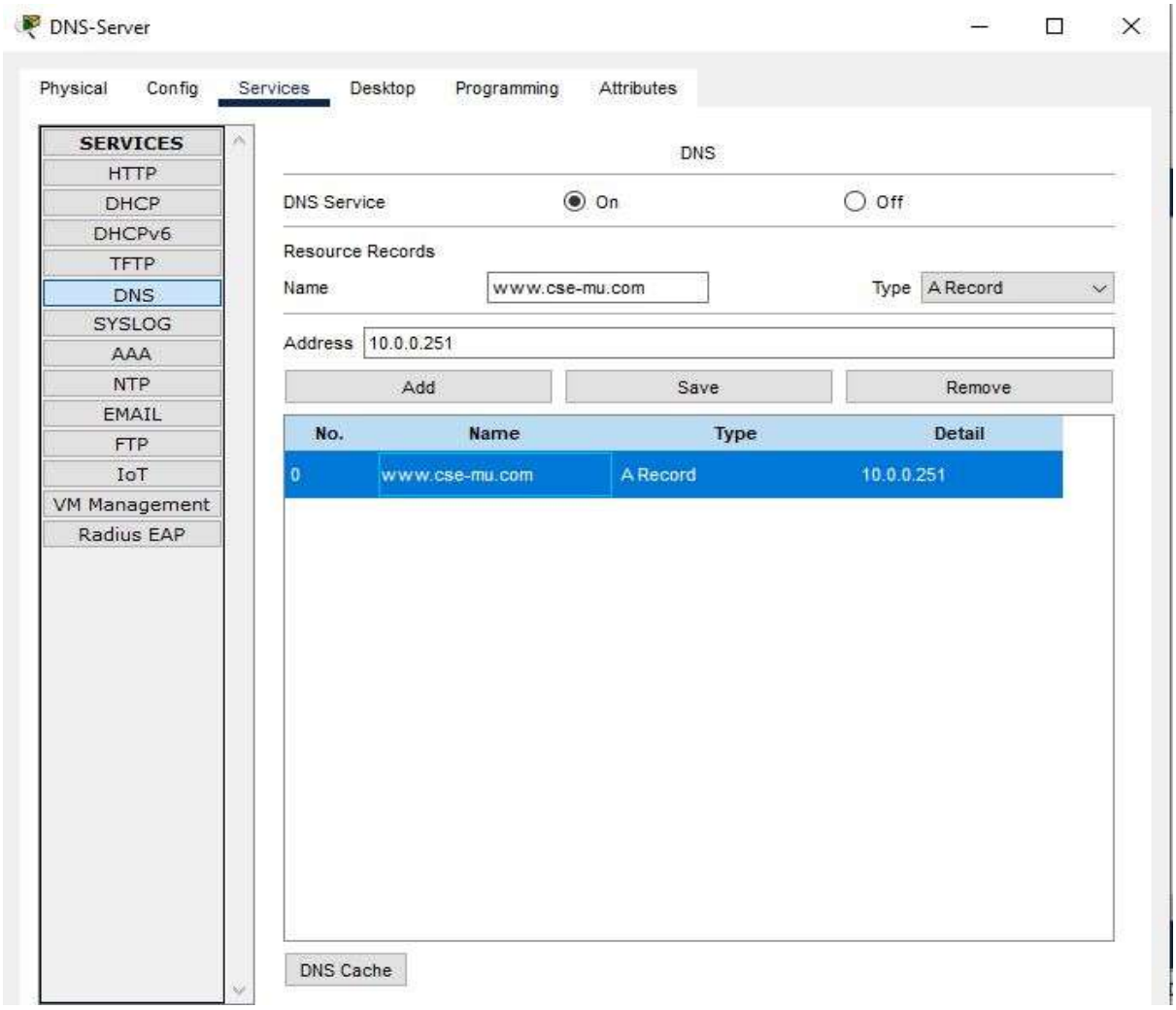
Cisco Packet Tracer is a network simulator that can be used to simulate a smart ISP. Packet Tracer allows users to create a virtual network and to configure the

devices on the network. This allows users to test different configurations and to troubleshoot problems.

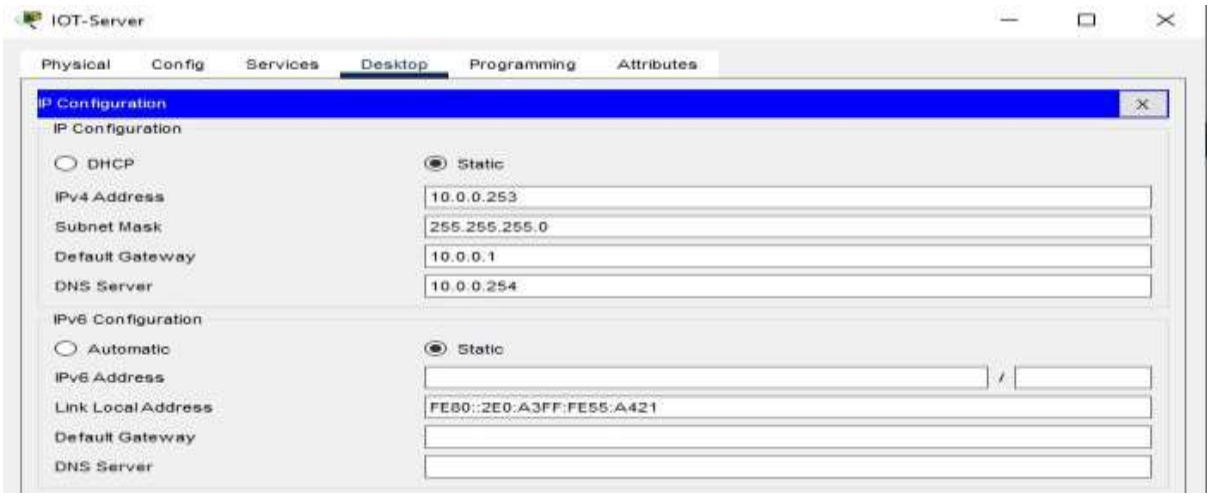
To simulate a smart ISP in Packet Tracer, users would need to create a network that includes the following devices:

- **A DNS server**

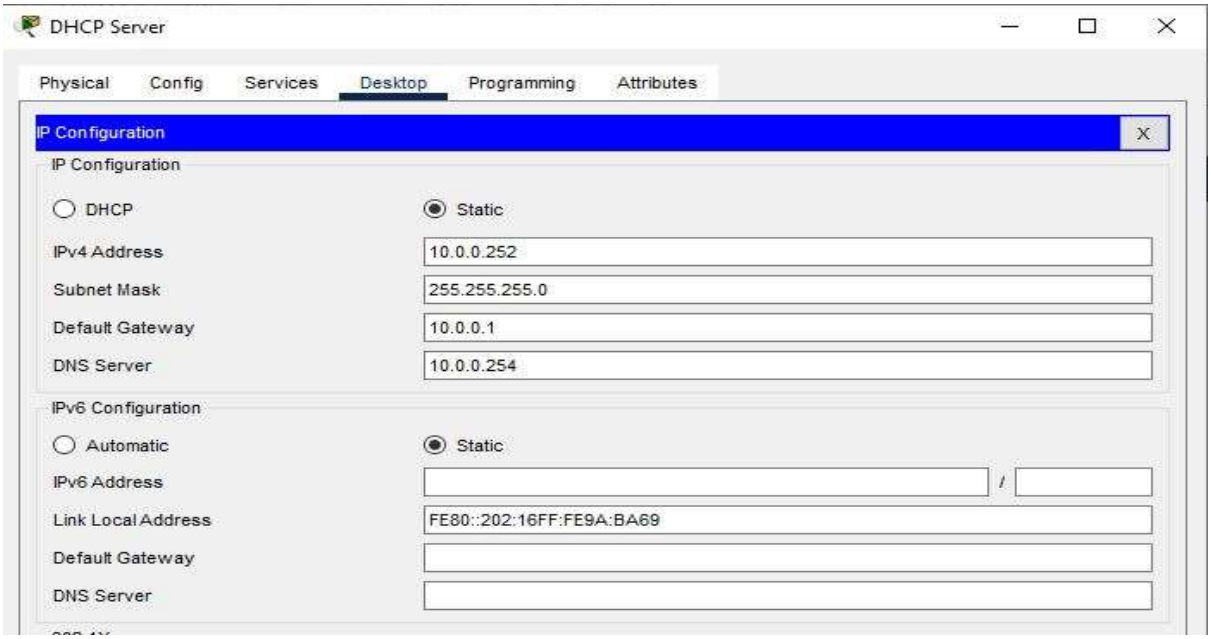


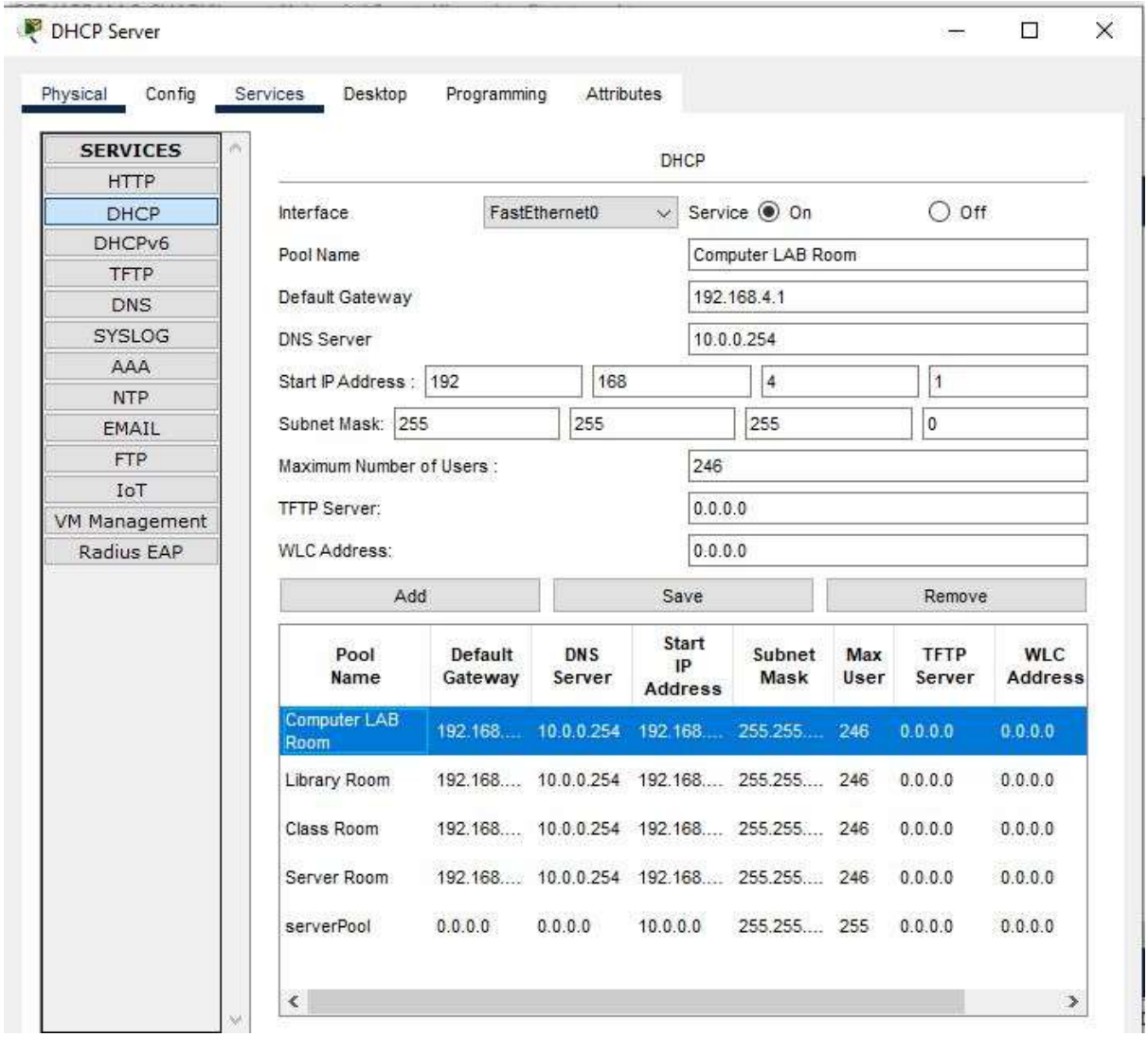


- **An IoT server**



- **A DHCP server**




DHCP Server
Physical
Config
Services
Desktop
Programming
Attributes
SERVICES
HTTP
DHCP
DHCPv6
TFTP
DNS
SYSLOG
AAA
NTP
EMAIL
FTP
IoT
VM Management
Radius EAP
DHCP
Interface
FastEthernet0
Service
On
Off
Pool Name
Computer LAB Room
Default Gateway
192.168.4.1
DNS Server
10.0.0.254
Start IP Address :
192
168
4
1
Subnet Mask:
255
255
255
0
Maximum Number of Users :
246
TFTP Server:
0.0.0.0
WLC Address:
0.0.0.0
Add
Save
Remove
Pool Name
Default Gateway
DNS Server
Start IP Address
Subnet Mask
Max User
TFTP Server
WLC Address
Computer LAB Room
192.168....
10.0.0.254
192.168....
255.255....
246
0.0.0.0
0.0.0.0
Library Room
192.168....
10.0.0.254
192.168....
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246
0.0.0.0
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Class Room
192.168....
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Server Room
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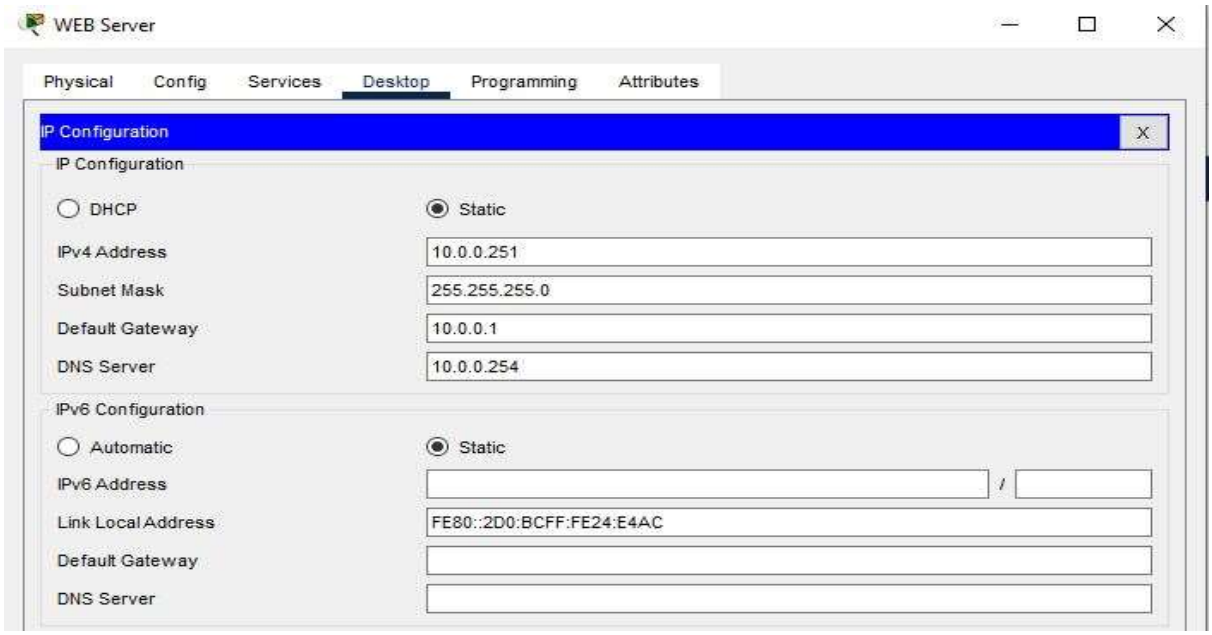
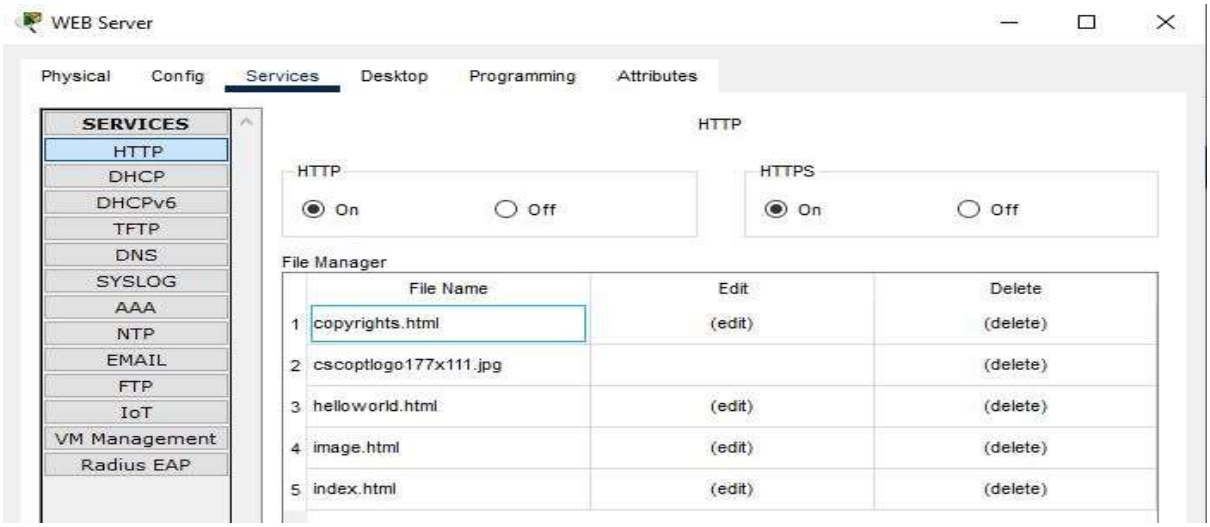
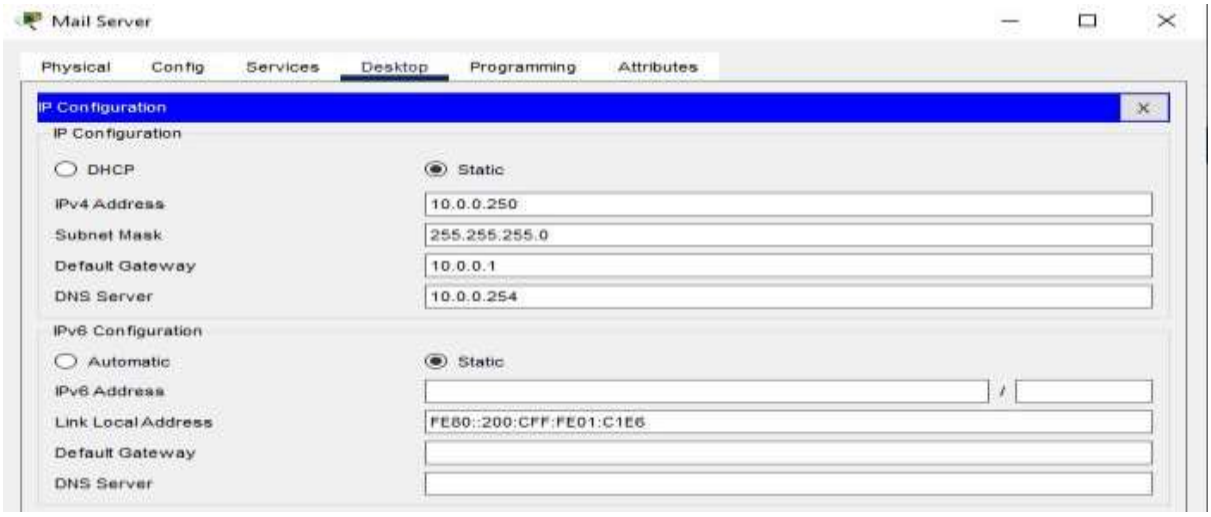
serverPool
0.0.0.0
0.0.0.0
10.0.0.0
255.255....
255
0.0.0.0
0.0.0.0

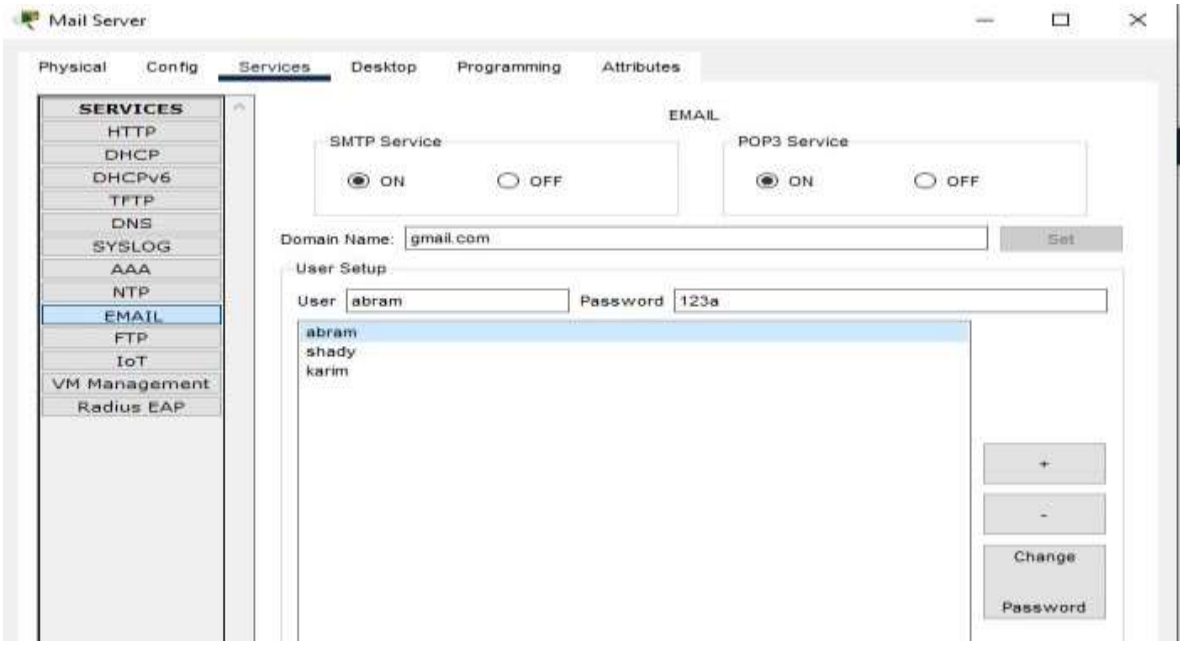
- **A web server**


WEB Server
Physical
Config
Services
Desktop
Programming
Attributes
IP Configuration
X
IP Configuration
DHCP
Static
IPv4 Address
10.0.0.251
Subnet Mask
255.255.255.0
Default Gateway
10.0.0.1
DNS Server
10.0.0.254
IPv6 Configuration
Automatic
Static
IPv6 Address
Link Local Address
FE80::2D0:BCFF:FE24:E4AC
Default Gateway
DNS Server

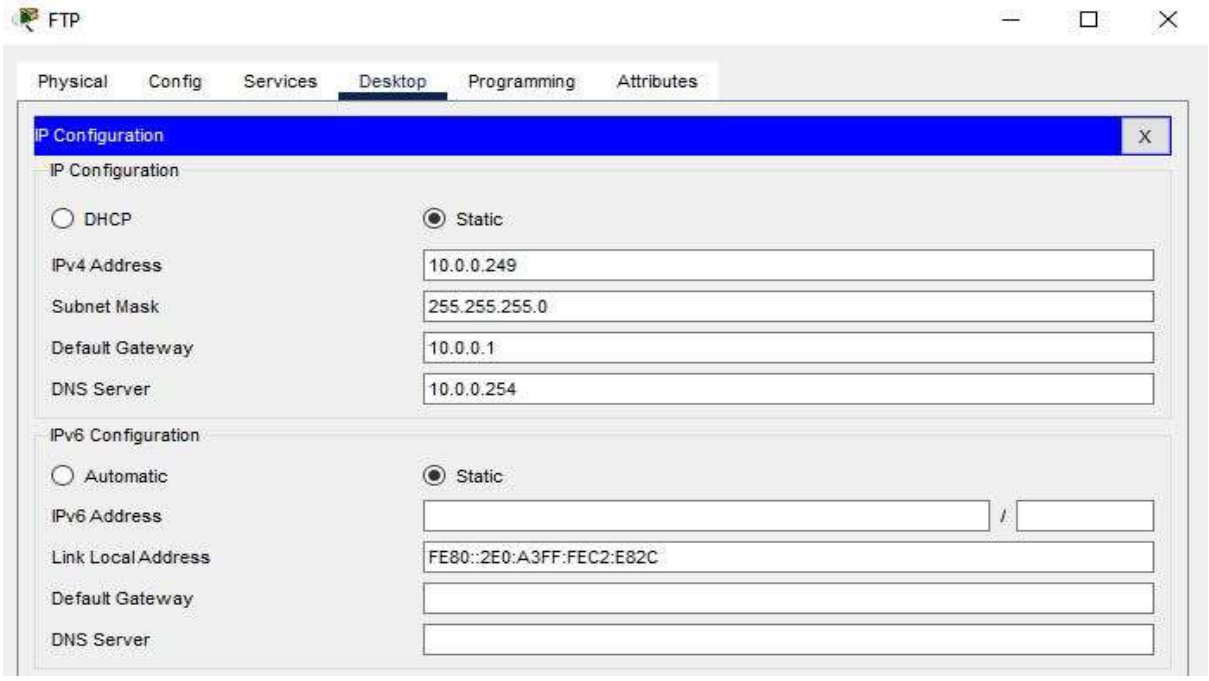


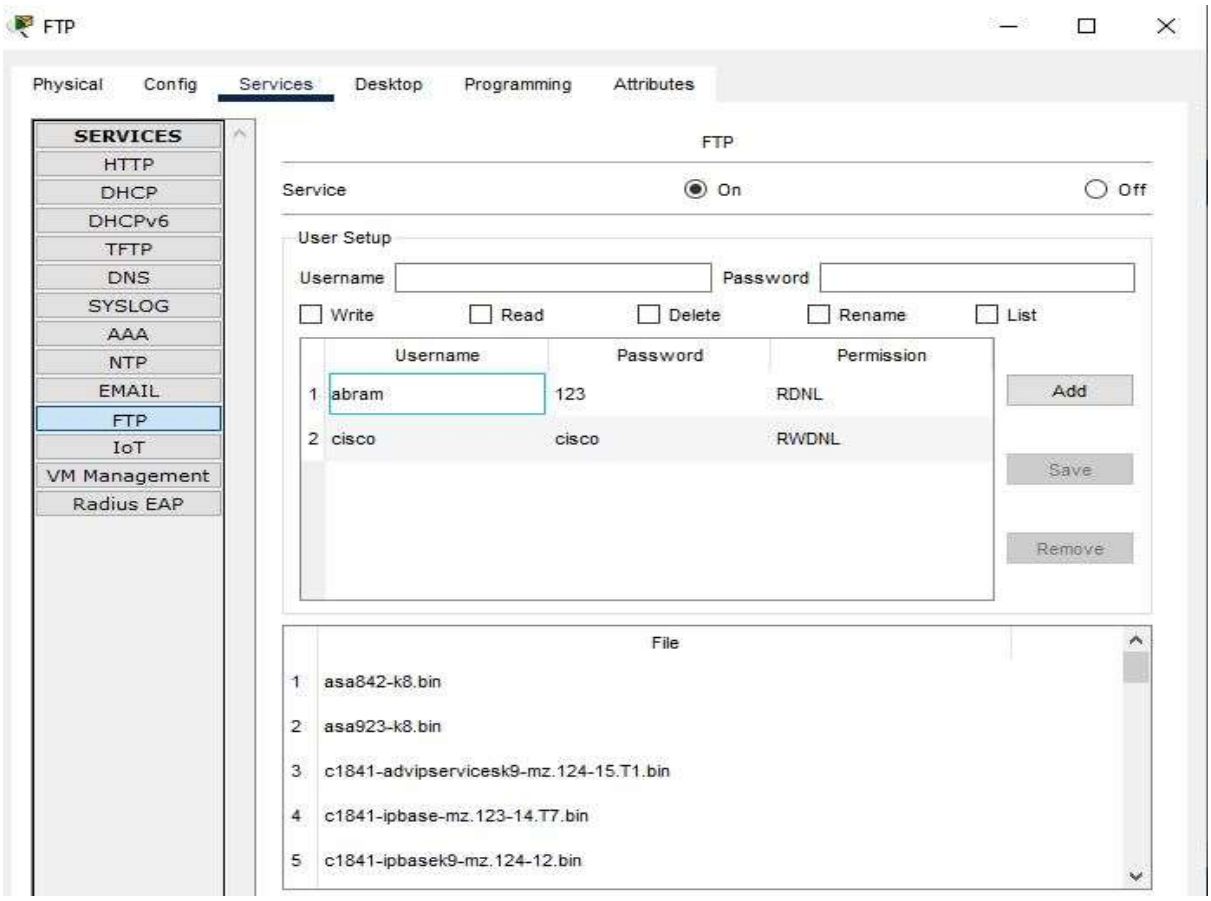
- **A mail server**





- **An FTP server**





Users would also need to configure the devices on the network to ensure that they are able to communicate with each other.

Once the network is configured, users can test the network by accessing websites, sending, and receiving email messages, and transferring files. Users can also

monitor the network to ensure that it is operating properly.

3.9 Future Work

- Real-life implementation
- Alert nearest fire brigade
- Automated system in management levels

Chapter 4
Smart Office

4.1 What is a Smart Office

So, what's a smart office? A smart office or a smart office result is an office space that incorporates ultramodern technology to increase and boost hand productivity, experience, and effectiveness by optimizing the office terrain while contemporaneously keeping the office space environmentally friendly and cost-effective. This is generally managed in two different ways, originally by introducing tools that support workers in finding, using, and uniting in their office space, secondly by furnishing logical capabilities and tools for installation directors to optimize space operation with smart systems. Smart office technology frequently includes videotape conferencing software and tackle tools, meeting room and office booking software, and office analytics tools to give sapience into how different office spaces are being used. This technology smart office technology adapts to the communication styles of the evolving plant and provides data, coffers, and tools to make the future of work

4.2 Functions controlled by a smart office

• Lighting

Lighting is the most important and most habituated electrical thing in your home. With a smart office system, you're suitable to control all kind of lights, in on/ off or darkening mode, choosing the stylish interface suitable for you (a simple lever or a remote interface, for illustration using your smartphone or a remote regulator). You can decide which beacon or group of lights to turn on or off, you can set a certain time of the day when you want the beacon to turn on, you can decide some " scenes "(the first beacon at 100 of its intensity, the alternate at 50 and the third

bone at 20) or also some lighting biographies(for 1 hour the beacon is at 70, also for 25 twinkles is at 40, also for 5 twinkles is at 15.) You can also use another point for the same thing, as your office wireless network always knows where you're because you always have your smartphone with you. Smart lighting is frequently the first step that companies take when contemporizing their office terrain. according to Gartner. Smart lighting consists of five key features LED lighting, IoT detectors and controls, connectivity, analytics, and intelligence. IoT detectors describe stir in a room and turn the lights on or off consequently. Lighting luminance controls also automatically acclimate the lighting situations relative to the position of daylight available within spaces. The coming generation of smart lighting is completely connected and puts indeed further control into the hands of druggies who can turn lights out and on, control the lighting intensity, and indeed acclimate lighting color from their smartphones.

• Presence simulation

A smart office system can give a presence simulation point by recording your commands during any day, similar as • When individual lights in the house are turned on and off • Changed light luminous in apartments. • Changed color of RGB LED lights When you leave office for a long time e.g., vacation, you can spark the presence simulation function by pressing a single key before leaving the office. This bone will play all the saved commands so that on the outside it'll look like you're still physically at office. This way, you can record what's going on for a day, a week, or indeed a month just to make the playback of the recording look as real as possible. The described operation represents a great advantage in terms of safety compared to simple timekeepers that turn the lighting on and off every day at the same time. An implicit burglar can observe your office before the burglary and find that the hangouts go over and down, the lights turn on and off at completely different times during the day or week. This can formerly make a difference whether he'll break into your office or not the described operation represents a great advantage in terms of safety compared to simple timekeepers that turn the lighting on and off every day at the same time. A implicit burglar can observe your office before the burglary and find that the hangouts go over and down, the lights turn on and off at completely different times during the day or week. This can formerly make a difference whether he'll break into your office or not.

• robotization

It seems like there's a way out to make everything smart and hi- tech these days. Originally, there were home robotization systems, and now it's office robotization. Well, have you ever wondered why you need to apply smart office robotization? We’re mortal beings, and we tend to forget a many essential effects like switching off the lights, printers, coffee machines, AC, etc. This increases energy consumption which leads to paying further electricity bills. Business possessors will want to reduce similar costs. What's office robotization? Designing a smart office isn’t crazy presently. Where office robotization has answered multiple issues for

numerous companies, these smart office systems using IoT extend help to specialized systems and help in operation, erecting access, and other internal systems.

- **Safety**

Really, the safety of those close to us is more important to everyone than plutocrat and material goods. guarding your office is necessary moment, as it provides you with compensation in the event of a fire, burglary. Still, you must do everything you can to help similar accidents. colorful events detected by detectors in the smart office as well as data on heating, room temperature, light status, ventilation and so on are reused in real time. This means that the system will notify the stoner of the event as soon as it occurs and not latterly. At the same time, all these events can be automatically stored in the event database, for the requirements of possible after analysis. When you get to the office, you can watch these events or not, and you can admit the most important effects on your smartphone indeed when you aren't at office. The smart office system provides a connection between colorful important functions about safety. With the alarm system you can connect the electrical installation as well as detectors of movement, bank, CO2, water slip, open windows and doors, energy consumption measures. With their help, you can cover your office from damage and reduce side goods due to accidental events.

- **Solar energy**

This is an important thing as when electricity is off, we can use solar energy, we had stored it latterly we also can save plutocrat by using this energy as a business proprietor, one of the loftiest outflow costs facing you is the cost of electricity. Being reliant on the marketable power grid also means you ’re subject to electric rate oscillations. Unforeseen price increases add query to your business, especially to your cash inflow operation. perhaps it’s time to lessen that cargo and look at how. your business can profit from solar panel installation.

•Temperature control

Temperature monitoring forms part of your comprehensive building management solution. Smarter Technologies' active RFID wireless temperature sensors use a thermistor to measure ambient temperatures accurately.

These temperatures are measured against pre-configured temperature ranges. The data is transmitted to your central management dashboard via our award-winning Orion Data Network. If a temperature rises or dips below predefined thresholds, the system will send an instant alert to the relevant party so that the problem can be dealt with swiftly. The smart temperature monitoring system can also be set to automatically adjust temperatures to the correct levels.

4.3 Devices used for Smart office

The smart devices connected in the smart office environment are:

• Smoke detector to detect an increased level of smoke.
• Garage door.
• Smart door lock.
• Temperature meter to measure temperature.
• Smart coffee maker to check when coffee is made.
• Smart ceiling fan
• Smart Lamp to show sleeping and waking hours.
• Motion sensor to indicate movement in a particular office.
• Security Cameras like there is a way out to make everything
• solar panel
• smart window
• rain sensor
• serin.

• Fire Sprinkler

1- Smoke detector

A bank detector is a device that senses bank, generally as an indicator of fire. marketable bank detectors affair a signal to a fire alarm control panel as part of a fire alarm system and generally no alarm from the detector itself, still, some detectors have erected- in sounders. Household bank detectors, also known as bank admonitions, generally issue an audible or visual alarm from the detector itself or several detectors if there are multiple bias connected. Bank detectors are generally available in plastic holders and shaped like a scrap about 150 millimeters (6 in) in fringe and 25 millimeters (1 in) thick, but shape and size vary. All bank detectors use one of two types of sensors to describe fires. Ionization- type sensors are best at detecting presto- burning fires, while photoelectric sensors are generally more at detecting slow burning fires. Both types of admonitions should be in your office.

2- Garage door

For a regular garage door, the proprietor needs to push or pull a trolley that connects to an essence bar, called a J- arm that's fixed to the garage door. The noise generated by essence- to- essence contact and vibration may be a nuisance. In smart homes you can fluently control your garage door with one click from your smart phone by connecting the garage door nature to the office gateway and you also you can access it with your smart phone

3- Smart door lock

Smart cinches are crucial door cinches that allow you to open your door without a physical key. They can be controlled ever using a smartphone app. numerous models feature a numeric keypad on the cinch for entering a unique access law. A smart cinch connects to your office's Wi-Fi network, which allows it to admit the law or smartphone command to lock or unleash. While some smart cinches bear you to fully replace your entire cinch system, others fit right over your being cinch system or only bear a many variations. When smart cinches are integrated into a complete smart office, they can also integrate with other bias, like a smart speaker or your security system. still, they need to be connected to a smart office mecca that enables all the bias to work together.

4- Temperature sensor

A temperature detector is a device that records, observers, or sends signals for changes in temperature. It does this by measuring the temperature of its surroundings and converting the input values into electronic data.

5- Smart coffee machine

The smart coffee maker connects to Wi- Fi and generally includes a smartphone app that allows you to control your coffee pot from anywhere, making it useful for those who are extremely busy but can't live without one or more mugs of coffee. Combined with advanced features like scheduling and automatic grinding, you can enhance your coffee- timber experience. Coffee makers with Wi- Fi connectivity make it easier to ensure your hot coffee is ready when you need it by allowing you to control it via your smartphone. They frequently come with other advanced features like an applicable sludge and the capability to program your favorite brewing cycle.

6- Smart ceiling fan

Smart ceiling suckers operate like any regular ceiling addict, only knowing when to spin and when to keep the air still. This means that you can program a preset temperature for it to acclimate to, or a schedule within which the ceiling addict should operate for some of the more advanced performances residency detectors and geolocation settings make sure it's only spinning when demanded. Unlike your regular ceiling addict where the only connection is a pull cord or wiring in your wall, smart ceiling suckers operate via Wi- Fi or Bluetooth. This means you can control and program them to operate within a given setting and schedule while you're down from the office from your iOS or Android device.

7- Light switch

One of the stylish smart light switches is a provident way to make all your ceiling lights connected to your smart office. A smart light switch works just like a regular light switch, but because the switch is linked to the pall, you can also control it ever from your phone. This allows you do to set a schedule for when lights will turn on

and off, and control them with a voice adjunct like Alexa, Google Assistant, or Siri. still, you can indeed set some smart light switches to turn on and off aimlessly, to make it look like your office, if you go on holiday.

But further than just safety, they can make sure you are not leaving your lights on, which makes them one of the stylish smart office widgets to save you plutocrats. We're using the GE C- Start Smart Switch Motion seeing Dimmer. It's compatible with the utmost smart office capitals, including Alexa and Google office and features erected- in stir detectors, so the lights will automatically switch on when you come to the office. It also comes with an ambient light detector, which means it'll tone-acclimate the brilliance if there's daylight or sun in the room, eventually saving you plutocrat.

The dimmer switch even works with a wide range of bulb types.

8- Motion Sensor

A stir detector (or stir sensor) is an electronic device that's designed to describe and measure movement. stir sensors are formerly a part of our lives, whether you know it or not. Your mind presumably drifts towards security when you suppose of them. After all, it's the situation which we are most familiar with them. And you'd be right. A lot of smart admonitions are calculated on them, and you can make some important security Flows with just a stir sensor. Still, detecting stir can have numerous further uses. It's used in simple mechanisms like cesspools in public bathrooms. You know, those gates that automatically turn on when they describe your hands moving towards it. The stir sensor is one of the most important corridors into making your office smart. You would be surprised how effective one little stir detector can be. Some other uses of stir detector are - Automatically switching lights Opening doors automatically Saves money and energy.

9- Security Camera

Smart home security cameras integrated with videotape analytics results will enhance intrusion discovery and border security in domestic areas. The camera cautions consumers in real- time on any unauthorized intrusion. Videotape analytics offers the capability of assaying a videotape to describe and determine events while furnishing information related to events in real- time. Real- time videotape analytics in smart home security cameras helps in security advancements, identification of suspects, discovery of trespassers into confined or sensitive areas, identification of these trespassers in addition to visionary trouble position assessment, and identification of predefined events & gets.

Consumers are notified on their smartphones when an intrusion Figure 23- stir Detector occurs. Smart cameras if set- up inadequately can also turn into incredibly sophisticated hacking doors for hackers, enabling them to view everything, hear to everything that's passing in a home, and record anything Due to the advancement in technology, the features of smart home security cameras are evolving extensively. The features include a camera with 360- degree gyration and

ultramodern solar powered which solves the problem of battery charging. It also reduces manufacturing cost of camera. furnishing cameras with night vision backing will help smart homeowners to identify an intrusion. Exploring advancements in machine literacy with smart home cameras also gives a huge occasion for this request in terms of product invention. Wireless cameras are fleetly espoused among consumers due to their low cost and adaptability & trust ability factors. The Wi- Fi connectivity also. helps in getting continued videotape feeds.

10-A Rain Sensor and A Smart Window

When it rains, we need to close the windows to ensure that our room does not get swamped. We generally do not suppose much of analogous goods that we do without important study. Still, for the bloodied, getting to the windows and closing them can be a great fire. It would be nice if the windows could close themselves at the press of a button. How about going one step further? What if we did not indeed need to press the button? When it rains, automatically close the windows. When it's dry, automatically open the windows again

11-fire detection

Detectors are stationed in areas the fire department wants to cover, generally at a height of one cadence and 50 measures piecemeal, forming a virtual low- power electronic hedge. These detectors picked up the presence of the fire one by one as it spread. When the detector detects a fire, it sends this information to the gateway, which will shoot the data back to the palm. And the platform cautions original authorities when it detects an implicit fire.

4.4 Benefits of Smart office

1. Keeps Your office Secure

One of the greatest benefits of a office automation system is automated door locks. You can lock your doors with your smartphone or tablet from literally anywhere – even your office automation systems that have video surveillance are even more beneficial. You can easily keep an eye on your office and be aware of anyone coming in or leaving your property.

2. Saves Time

Gone are the days when you had to run office to let your daughter in because she forgot her keys. Or wake up to check if you switched off the stove. You can now control basic functions from another room or even another office, saving the time with office automation is easy and convenient.

3. Saves Money and Energy

With office automation, you never have to worry about appliances or lights being left ON when not in use. All you need is your smartphone!

4. Ensures Your Children's Safety

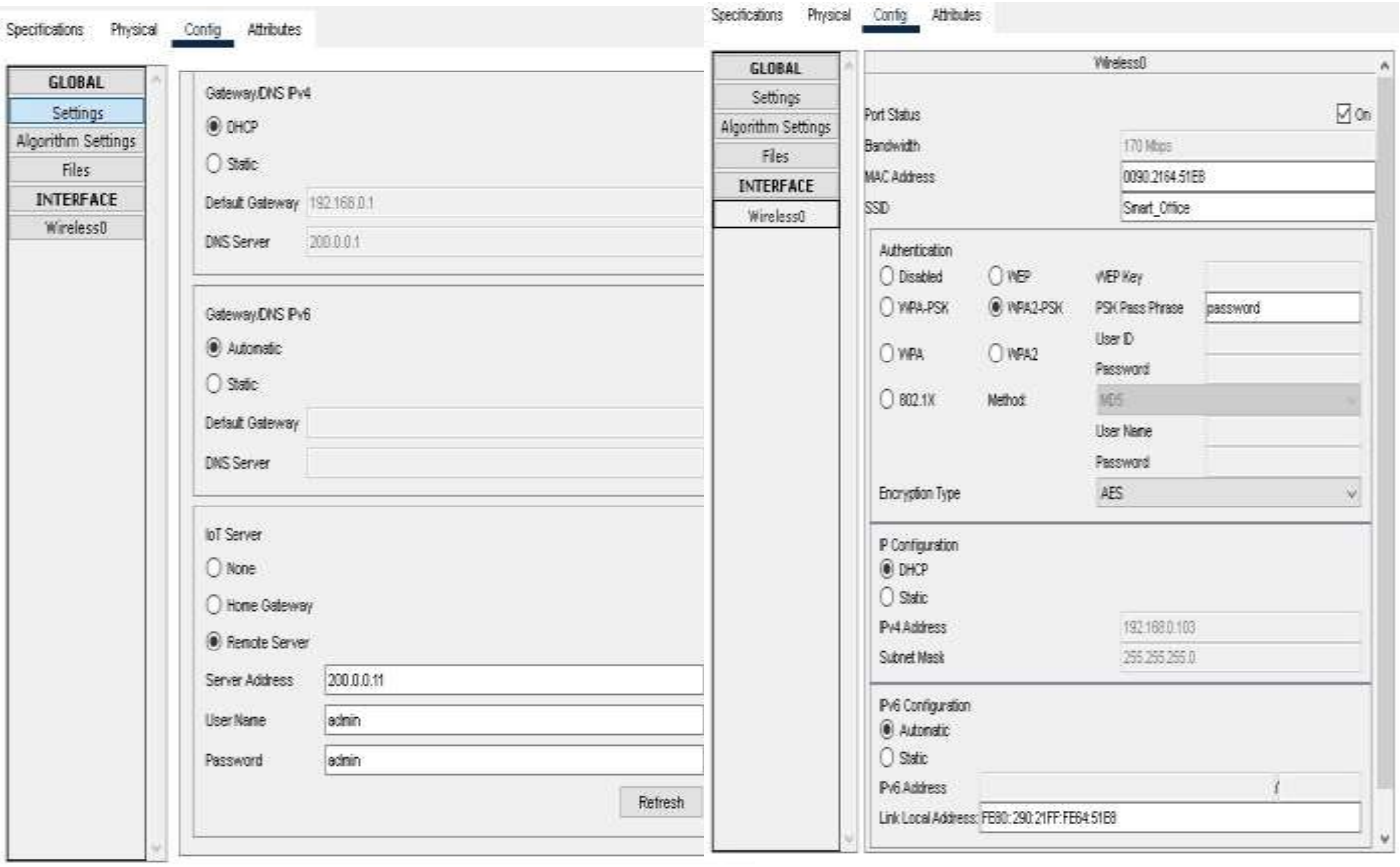
With office automation system, you can easily keep an eye on your children and help them keep safe. You need not worry about their returning office safely or opening doors to strangers.

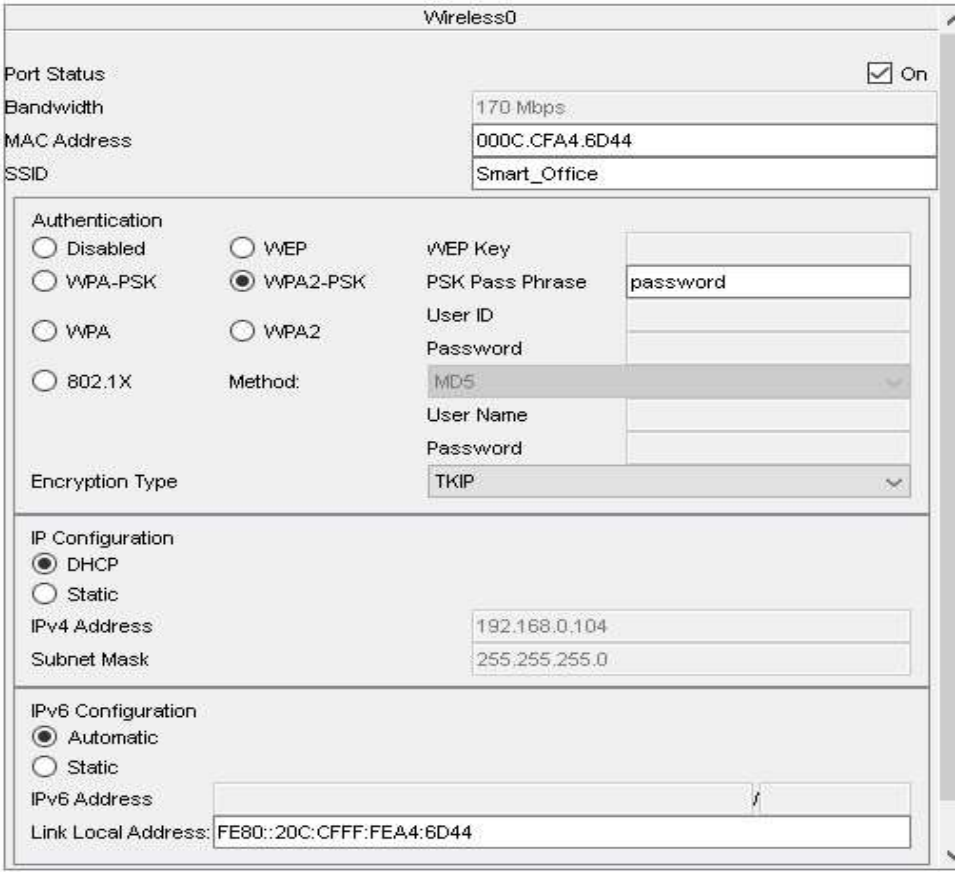
5. Gives You Complete Peace of Mind

Say goodbye to worries of any kind! You don't have to worry about whether you turned off the lights, locked the door, or turned off the television.
So, if you're a smart homeowner, you can always rest assured knowing that everything is under control!

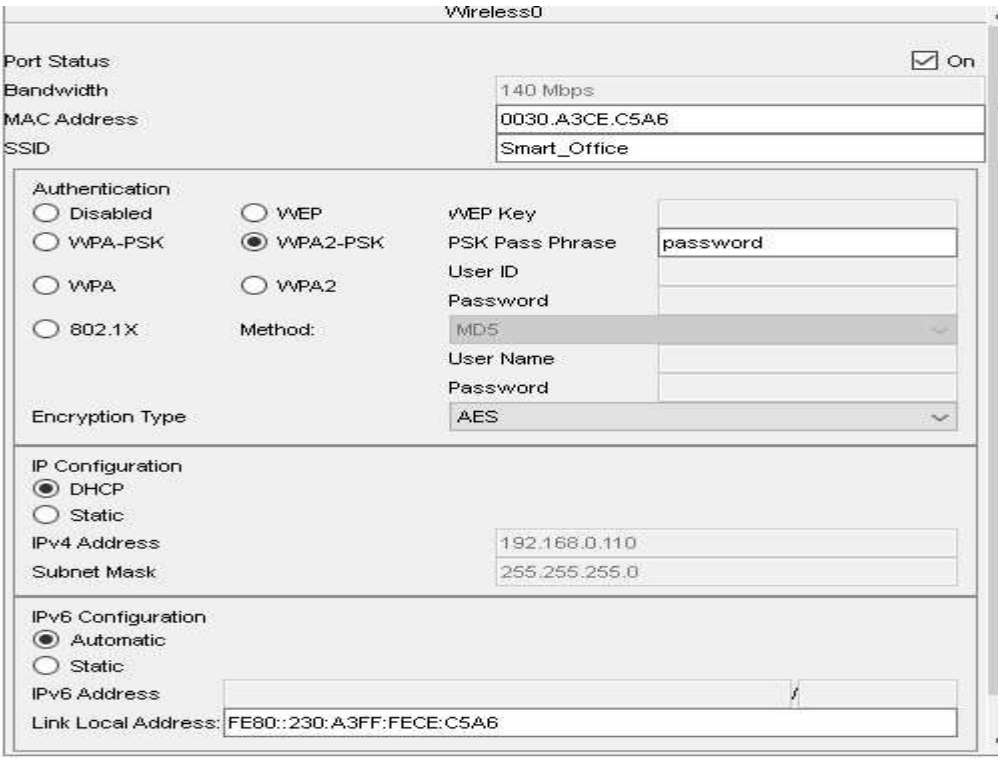
4.5 Implementation

1-close door

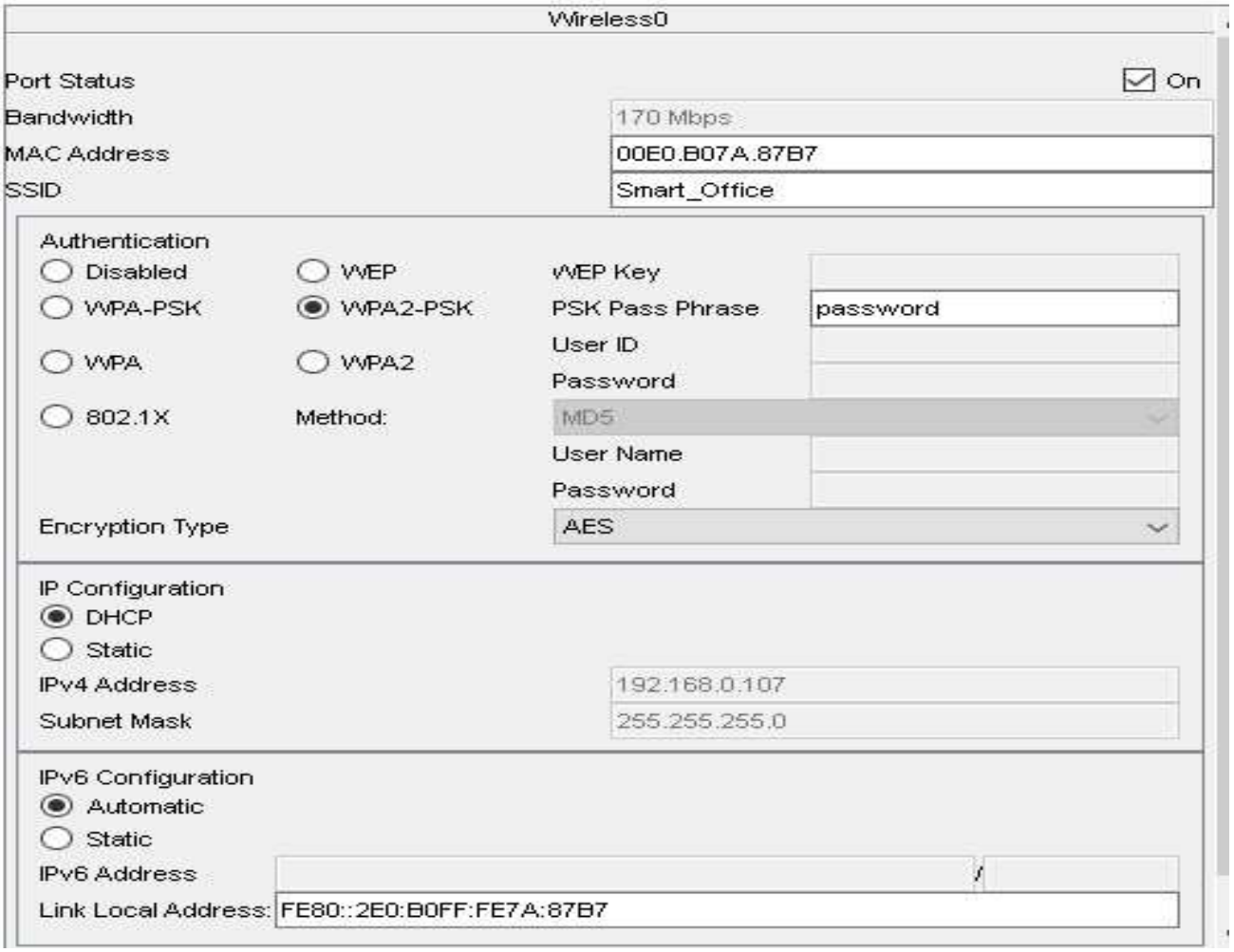




2-smart phone and laptop

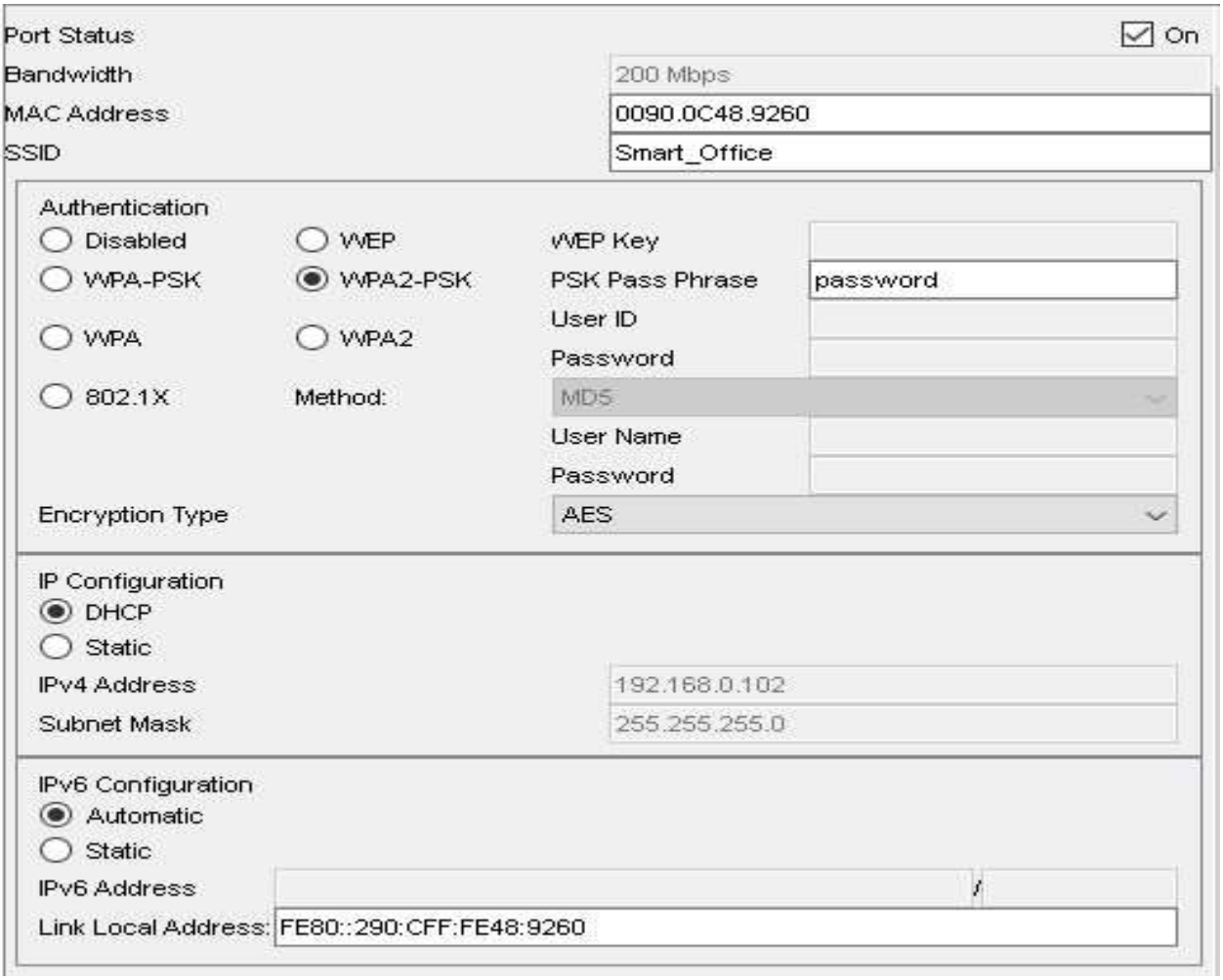


3-fire detection



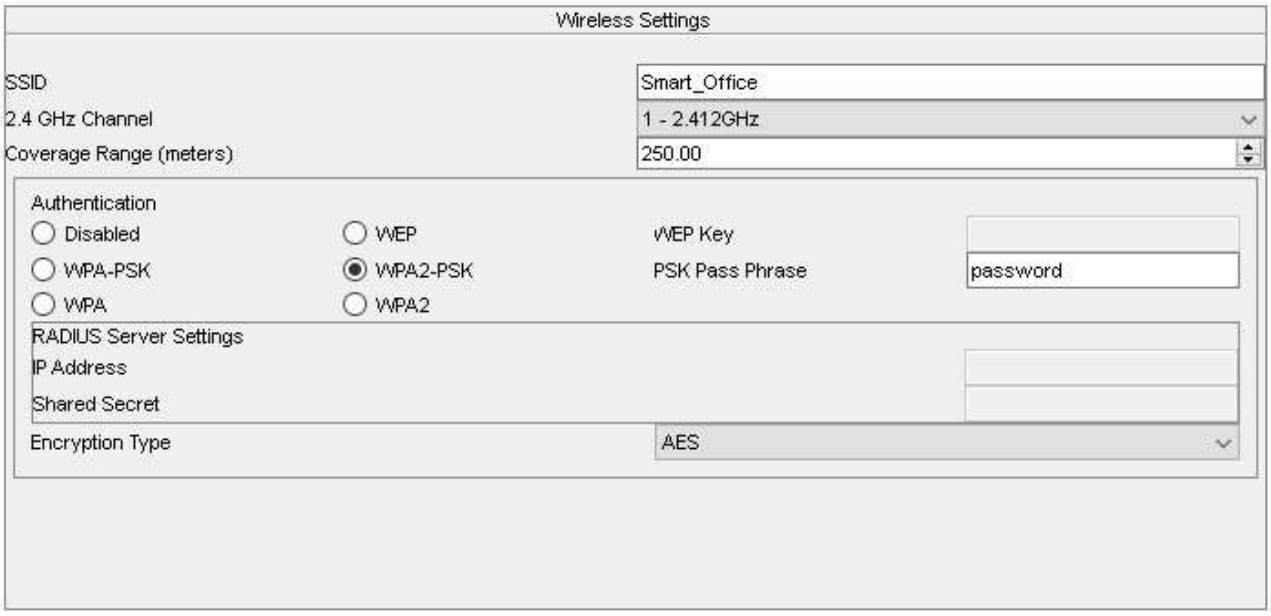
```
from gpio import *
from time import *

def handleSensorData():
    value = digitalRead(0)
    if value == 0:
        customWrite(1, '0')
    else:
        customWrite(1, '1')


def main():
    add_event_detect(0, handleSensorData)

    while True:
        delay(1000)

if __name__ == "__main__":
    main()
```

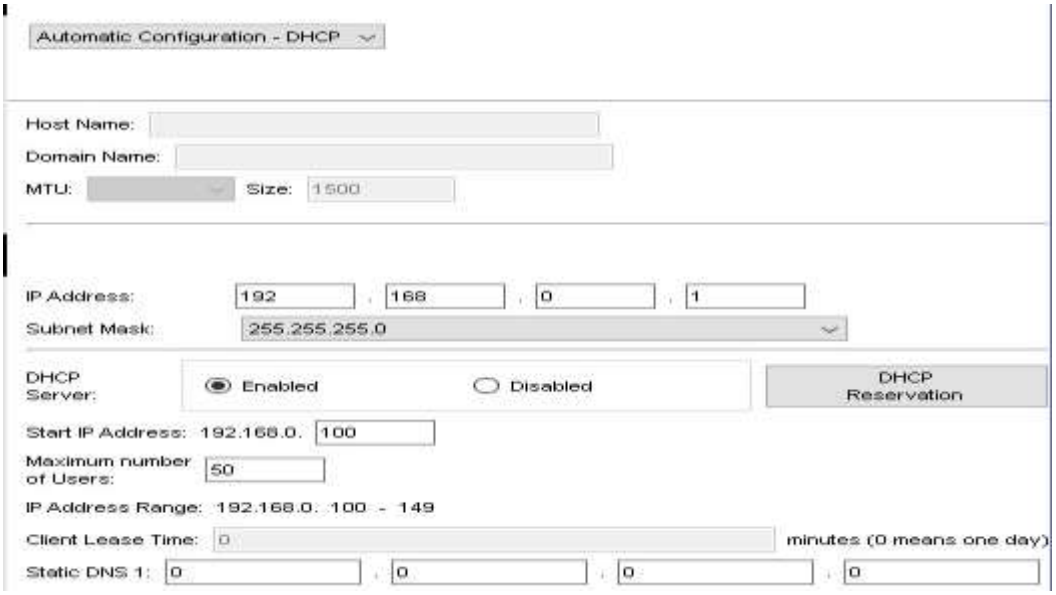
4-rain detection



```
from time import *
from gpio import *


def setup ():
    pinMode(0, INPUT)
    pinMode(1, OUTPUT)


def loop ():
    digitalWrite(1, digitalRead(0))
    delay(1000)


if __name__ == "__main__":
    setup()
    while True:
        loop()
        idle()
```

6-Home gateway





Chapter 5
Smart Grid

5.1 What is a Smart Grid

A smart grid is an electricity network that uses digital and other advanced technologies to cover and manage the transport of electricity from all generation sources to meet the varying electricity demands of end stoners. Smart grids coordinate the conditions and capabilities of all generators, grid motorists, end stoners and electricity request stakeholders to operate all corridor of the system as efficiently as possible, minimizing costs and environmental impacts while maximizing system responsibility, rigidity, strictness, and stability.

Smart Grid is a generality regarding digital technology operation and electric power network. It offers a lot of precious technologies that can be used within the near future or are formerly in use moment. Smart Grid includes electric network, digital control appliance, and intelligent monitoring system. All of these can deliver electricity from directors to consumers, control energy flux, reduce the loss of what, and make the performance of the electric network more reliable and controllable. In the short term, a smarter grid will serve more efficiently, enabling it to deliver the position of service we have come to anticipate farther affordably in a period of rising costs, while also offering considerable societal benefits – analogous as lower impact on our terrain. In longer term, we can anticipate the Smart Grid to goad the kind of transformation that the internet has formerly brought to the way we live, work, play and learn.

5.2 benefits of smart grid

1.Improve reliability of power quality and transmission
2.Increased power distribution efficiency and conservation
3.Reduced costs for electric utilities
4.Reduced expenditures on electricity by households and businesses
5.Lower Greenhouse Gas (GHG) and other gas emissions

5.3 Functions of Smart Grid

1-Self-healing from power disturbance events
tone- mending from power disturbance events As Anderson notes," The problems that have caused the recent alluvion of knockouts will propagate slinging failures of the grid more and more constantly, unless we produce a farther intelligent grid control system. The system must become automated, because decision favas increasingly are getting too presto for humans to manage. This is a vital public security interest. The operation of the smart grid will bear digital control, automated

analysis of problems, and automatic switching capabilities more familiar to the Internet." motorists or directors can use the real- time information which comes from bedded sensors and automated controls to anticipate, descry, and respond to system problems to automatically avoid or palliate power outages, knockout, power quality problems, and system collision. Smart Grid will presumably have a control system that can anatomize its performance using distributed, independent underpinning literacy controllers that have learned successful strategies to govern the behavior of the grid in the face of an ever- changing terrain analogous as outfit failures. Such a system might be used to control electronic switches that are tied to multiple substations with varying costs of generation and responsibility.

2- Enabling active consumers participation and operating resiliently against attack

Smart Grid allows consumers to change their conduct around variable electric rates. It incorporates consumer outfit and behavior in grid design, operation, and communication system. Consumers can control the appliances of Smart Grid in homes or businesses. The connection between energy operation systems enables consumers to manage energy more and helps them access real- time pricing. The real- time, two- way dispatches available in Smart Grid will enable consumers to be compensated for their sweats to save energy and to sell energy back to the grid through net- metering. Smart grid can identify and respond to hacker attacks or natural disruptions more. Real- time information enables both grid motorists and directors to isolate affected areas and redirect power overflows around damaged installations.

3-Providing power quality and optimizing assets

furnishing power quality and optimizing means Smart Grid can optimize capital means by minimizing operations and maintaining lower costs. Optimizing power overflows can make full use of lowest- cost generation resources and reduce waste. Harmonizing original distribution and transmission of interregional energy flows improves use of grid installations and reduces grid logjams, which can ultimately save consumer capitalism.

4-Accommodating all generation and enabling new products, services, and markets

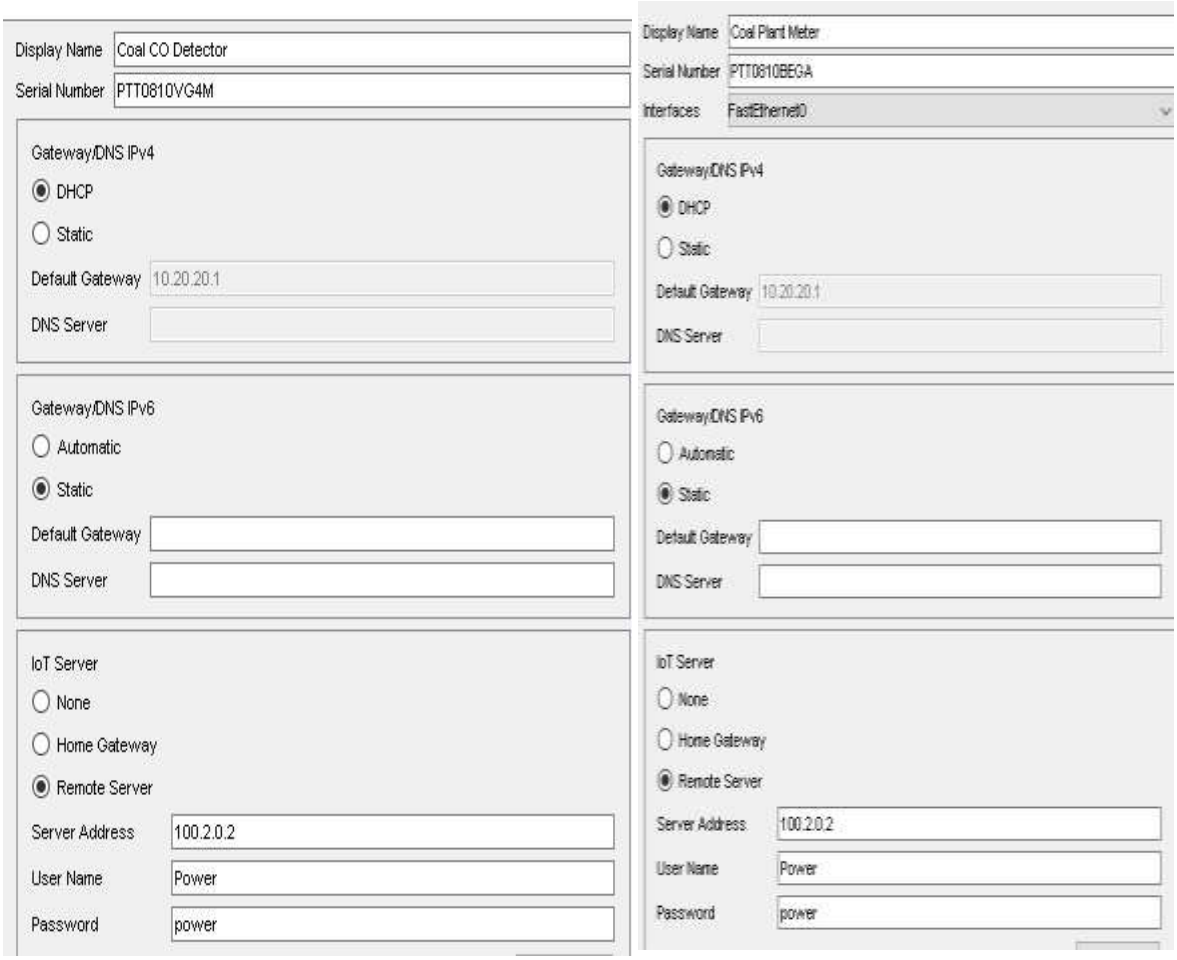
Accommodating all generation and enabling new products, services, and requests as smart grids continue to support traditional power loads, they also seamlessly connect energy cells, - turbines, and other distributed generation technologies at original and indigenous situations. Integration of small- scale, localized, or on- point power generation allows domestic, marketable, and artificial guests to tone induce and sell spare power to the grid with minimal technical or nonsupervisory walls. This also improves responsibility and power quality, reduces electricity costs, and offers farther customer choice. Significant increases in bulk transmission capacity will bear advancements in transmission grid operation. analogous advancements are aimed at creating an open business where necessary energy sources from geographically distant locales can easily be sold to guests wherever they are located.

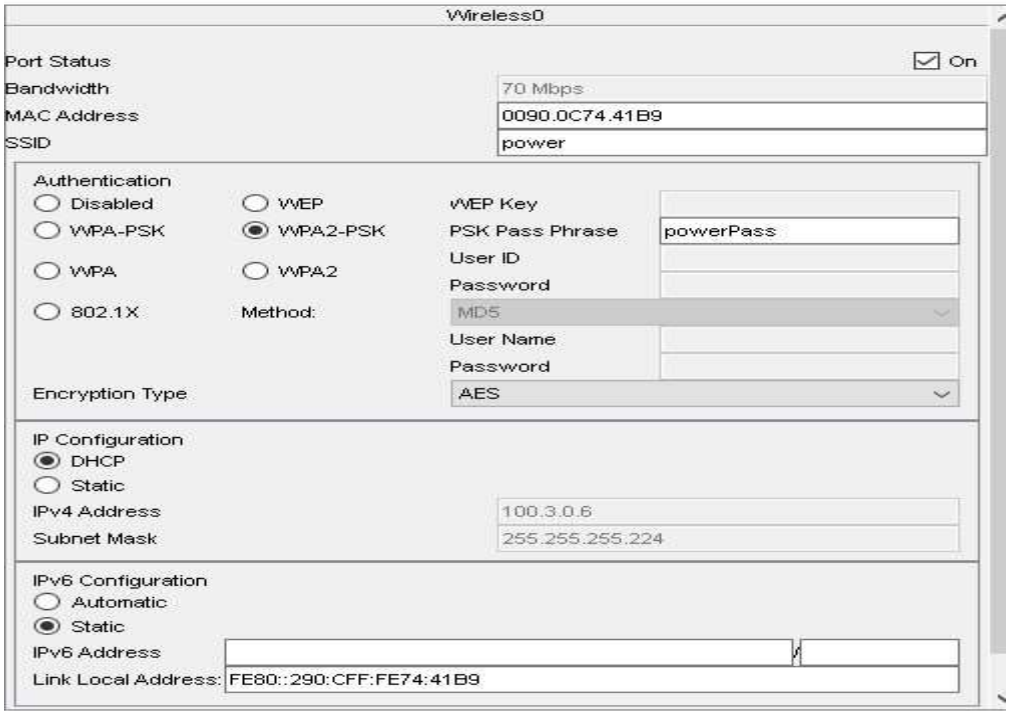
5.4 Devices used for Smart grid

- coal power plant
- smart power grid switch
- coal plant meter
- solar meter
- solar cells
- routers
- wind turbines
- wind power meter
- coal co detector

5.5 implementation of smart grid

1- coal power



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%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan20, changed state to down

%LINK-5-CHANGED: Interface Vlan20, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan20, changed state to up

%LINK-5-CHANGED: Interface Serial0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet2, changed state to up

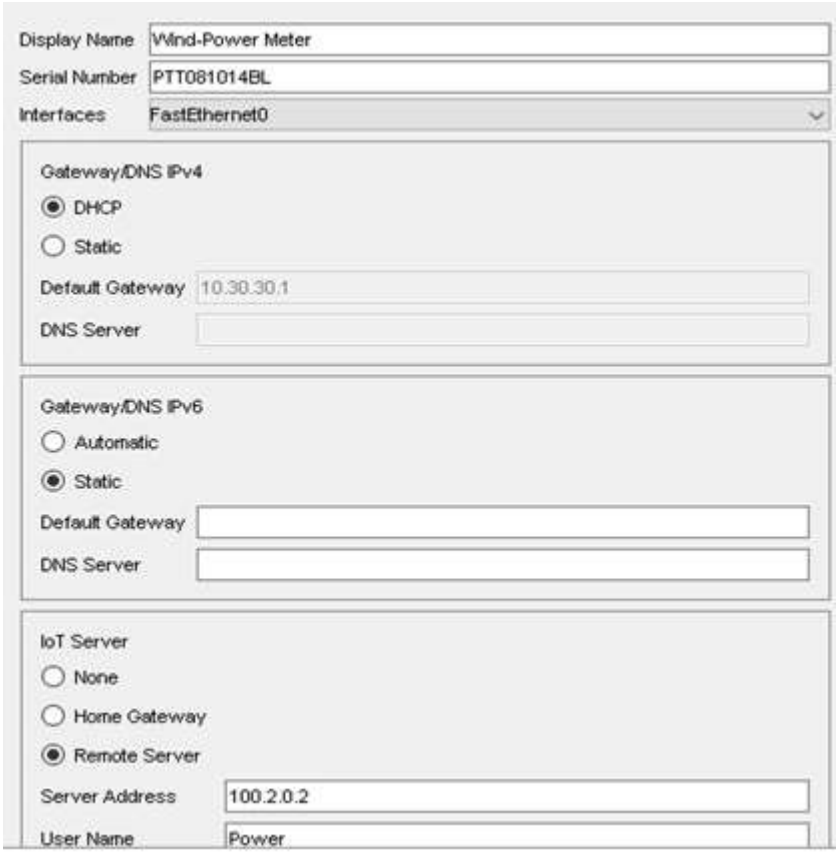
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0, changed state to up


PS-Fossil-RT>enable
PS-Fossil-RT#
PS-Fossil-RT#vlan database
% Warning: It is recommended to configure VLAN from config mode,
  as VLAN database mode is being deprecated. Please consult user
  documentation for configuring VTP/VLAN in config mode.

PS-Fossil-RT(vlan)#
PS-Fossil-RT(vlan)#exit
APPLY completed.
Exiting....
PS-Fossil-RT#configure terminal
Enter configuration commands, one per line.  End with CNTL/2.
PS-Fossil-RT(config)#interface GigabitEthernet0
PS-Fossil-RT(config-if)#
PS-Fossil-RT(config-if)#exit
PS-Fossil-RT(config)#interface FastEthernet0
```

2- solar energy



3-wind power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%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1, changed state to up

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%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0, changed state to up
```

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