



## CCNA BASED SMART INTERACTIVE OFFICE USING IOT

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### Abstract

In today's world, Networking have become extremely necessary for providing communication, security, chat and others services. In these services, computer networks play very important role to communicate, administrate, automate. And process the information from point to another points. Hence Computer networks considered the basics of proper functionally in most of the companies and organizations. In this paper, cisco packet tracer is used as a network simulator tools to simulate and design a network project of company. The paper discusses interconnection between routers, switches and other components in data communication network and how are programmed and configured. Smart office uses IOT technology to automate different activities of office. IOE devices connected to the internet, to allow the distant monitoring and controlling of different appliances such as light, fan, air conditioner, siren etc. In this paper, I implemented smart office using new released cisco packet tracer simulation software, since different IOT device used for automation is included in this new version simulator. The previous software has only networking device, but in new released simulator IOT device is included those are sensor, board, IOE device and Programming Languages with classically networking device. To design smart office I used different device used for security, safety and environment prosperity. **Keywords:** IOE, Smart office, Packet tracer, IOT

### 1. INTRODUCTION

Smart office is a office that include smart objects to improve office activities in

advance, that can be automate activities of office without users involvement such monitoring, controlling of the electronic appliances(light, fan, webcam, siren etc.) Smart office can provide different function rather than providing safety that is security using different alarm system such siren sound, if security issue is detected by sensor. managing and controlling of office objects is done by using micro-controller or computer technology[3]. Automation is popular because it provides ease, efficiency and secure environment. In this paper all smart appliance is registered to home gateway and controlled by legitimate person[1]. This paper presents if smoke is detected the fire sprinkler automatically 'on' to ventilate the environment and window is open. While the term "Internet of Things" (IoT) was first announced, the primary question might be what is considered as "Things". Till current years, groups of scholars and organizations tried to make clear the definition of IOT. Haller et al proposed a definition of IoT with "A world where physical objects are seamlessly integrated into the information network, and where the physical objects can become active participants in business process" IOT is an abbreviation of Internet of Things which refers to uniquely identifiable objects (things) and their virtual representations in an Internet-like structure. Internet of Things (IoT) is currently released technology to automate communication by connecting different objects around us as part of internet. IOT objects integrated with networking technology to control from remote and local. This paper deals about implementing smart office. here I used new released cisco packet tracer simulation software to design and configure IOE device with classically networking device because this feature include sensor and different

smart device used for automation. Some of the device are smart window, smart light, smart door, smart fan with different detector and sensor.

Computer network can be defined as a number of computer systems and other computing hardware devices that linked together for sharing information in form message, files, data bases in organization that may be in one building or other. Switches, Routers, Gateways and Modems. Each one of these devices has various properties[2]. This paper is highlighted on the VLANs (Virtual Local Area Network) as well as EIGRP (Enhanced Interior Gateway Routing Protocol). VLAN is simply a subset of switch ports that are formed to be in the same broadcast domain. EIGRP is a Cisco proprietary classless routing protocol that is essentially an enhanced distance vector protocol. Cisco Packet Tracer (CPT) is a multi-tasking network simulation software that can be used to perform and analyse[2]. various network activities such as implementation of different topologies, selection of optimum path based on various routing algorithms, creation of appropriate servers, subnetting, and analysis of various network configuration and troubleshooting commands.

**2. MOTIVATION**

Currently cisco released new version of packet tracer (version 7.3.0.0838) includes IOE device with classically networking device. Boards is also added to this version those are microcontrollers (MCU-PT), single boarded computers (SBC-PT) that provide programming environment to control connected object.

**Benefits of new released Packet Tracer are:**

- Offers a realistic simulation and visualization of IOT device
- Permits users to design, build, configure smart office by providing different smart object used for them.
- Provide board to control smart object and detector for sensor
- Allows students to explore concepts IOE

**3. OBJECTIVE**

In this paper we are implementing a CCNA based smart interactive office using IOT and cisco packet tracer simulation software.

And following are the objectives of this project:

- Implement smart office consisting of electronic appliances which are monitored and controlled automatically using IOT.
- connecting two offices of a same company in a city via internet using cisco packet tracer software and observing the interactions between these offices.

**4. BLOCK DIAGRAM**

- A.** To implement smart office consisting of electronic appliances which are monitored and controlled automatically using IOT.

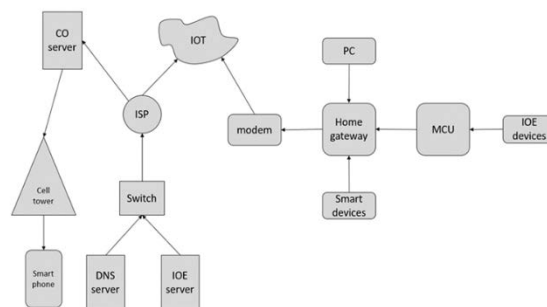


Fig 1 : Smart office architecture using IOT

- B.** Connecting two offices of a same company in a home city via internet using cisco packet tracer software

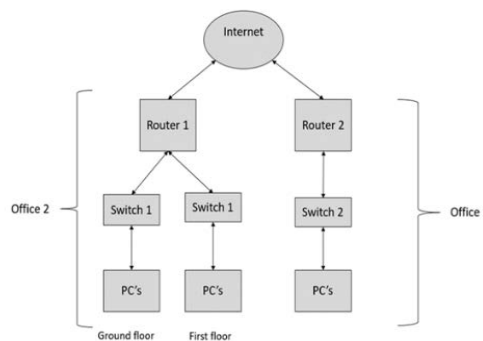


Fig 2 : Network topology of offices

**5. METHODOLOGY**

**a. SMART OFFICE USING IOT**

In order to implement smart interactive office. we used new released cisco packet tracer, which included different smart object used for automation. To

control this smart objects and sensor, microcontroller (MCU-PT) and Home Gateway used, since it provide programming environment for controlling smart object connected to it and provide controlling mechanisms by registering smart device to Home Gateway respectively.



Fig 3 : Smart things and microcontroller connected to home gateway

A. HOME GATEWAY

Home Gateway have an internet port and 4 Ethernet ports in addition to a wireless access point configured with the "Home Gateway" SSID. To secure

wireless connection WEP / WPA-PSK / WPA2 enterprise can be configured on home gateway. Fig3 shows internet of Things, where devices connected to a Home Gateway by using Ethernet cable and wireless to manage smart device local and remotely. Home gateway also works as DHCP server by assigning IP address to each smart device that connected to it[1]. To connect the Home Gateway to the Internet its Internet WAN Ethernet port available on home gateway. The IoE device can be remotely managed through a web interface hosted by the Home Gateway.

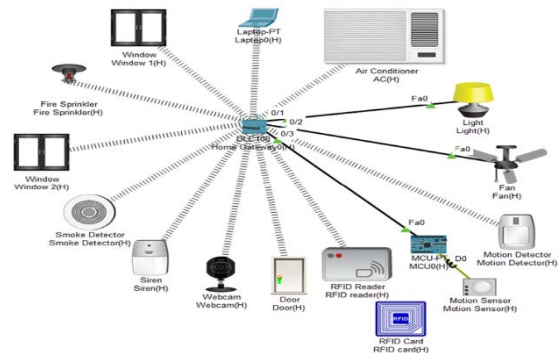


Fig 4 : Registered IOE device on Home Gateway

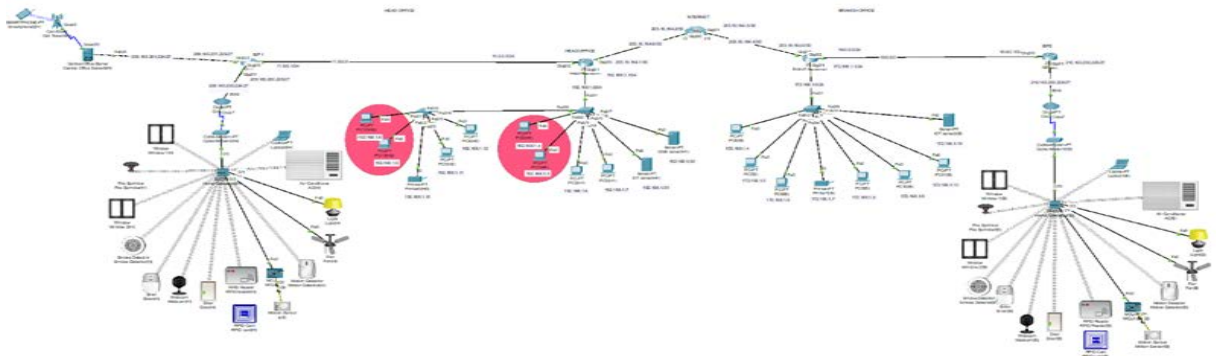


Fig 5 : CCNA BASED Smart interactive office using IOT (logical view)

B. MICROCONTROLLER(MCU-PT) BOARD

Microcontroller board is used to interconnect different smart object and provide programming environment with different language those are JavaScript, python and visual basic, to control the connected smart object. Fig 4 shows after registering smart device to home gateway all device are accessed through web by

legitimate user. And IOE device registered to Home gateway those all are controlled through web by legitimate person.

5.2. SMART OFFICES CONNECTED TO INTERNET

In order to implement smart interactive office we are connecting two offices of a same company in a city via internet using cisco packet tracer

software. And the router(2911) acts as INTERNET as shown in the fig 5.

And we are considering two offices namely HEAD OFFICE and BRANCH OFFICE in the home city. Where head office consists of 2 floors and branch office is single floor. We are having separate routers for each office named Head office router and Branch office router. And we are having separate ISP's (internet service provider) named ISP1 and ISP2, along with a CO server(central office) and the rest all connections are done as shown in Fig 5. In the HEAD OFFICE each floor have individual switches, and the branch office is having single switch. And PC's, printers, servers are connected to these switches (see figure 5).

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## 6. PROTOCOLS

The protocols used in implementing smart interactive office are as follows :

- ROUTING & SWITCHING PROTOCOL
- DHCP PROTOCOL.
- TELNET
- EIGRP PROTOCOL

- VLAN TRUNKING PROTOCOL

## 7. IP ADDRESSING AND SUBNETTING

### A. IP ADDRESSING

Addressing is a critical function of network layer protocols. Addressing enables data communication between hosts, regardless of whether the hosts are on the same network, or on different networks. Both Internet Protocol version 4 (IPv4) and Internet Protocol version 6 (IPv6) provide hierarchical addressing for packets that carry data.

### B. SUBNETTING OF IP NETWORK

Designing, implementing and managing an effective IP addressing plan ensures that networks can operate effectively and efficiently. This is especially true as the number of host connections to a network increases. Understanding the hierarchical structure of the IP address and how to modify that hierarchy in order to more efficiently meet routing requirements is an important part of planning an IP addressing scheme.

List of IP addresses we used are :

<https://drive.google.com/file/d/1zoUMjjPJjamMB-dyTED1iJvfUndbS5Uu/view?usp=drivesdk>

## 8. CONFIGURATIONS

<https://drive.google.com/file/d/1zhBmlRBAsEmAVToRtL8CLqHLde81irUN/view?usp=drivesdk>

## 9. CODE

<https://drive.google.com/file/d/1zeQcVlwZ-48sYN4791ehJEaYTCcEYy81/view?usp=drivesdk>

## 10. RESULT

As this paper deals with two objectives as mentioned in section 3. And we use cisco packet tracer which has both logical and physical view simulation. here we consider a home city, where we have 2

offices namely head office and branch office connected to each other via internet with the help of EIGRP protocol. Head office has 2 floors while branch office is single floored.

The logical view is shown in Fig 5 and physical view is shown in Fig 6



Fig 6 : home city with 2 offices connected via internet( Physical view)

As both the offices are connected via internet authorised person can access any of the end devices or reconfigure the routers remotely with the passwords(see Fig 7& 8)

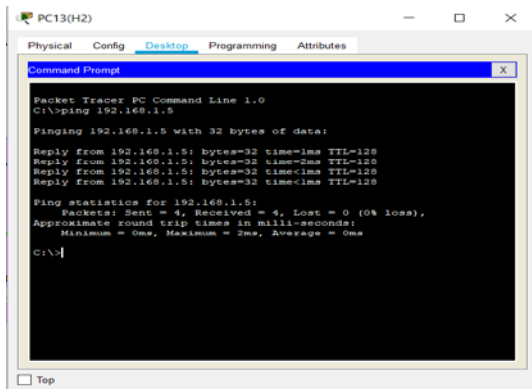


Fig 7 : accessing the end device of other network remotely

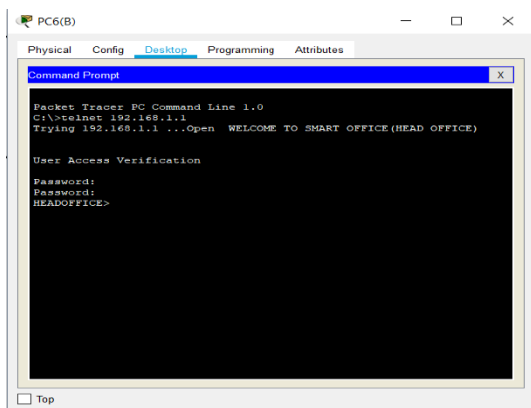


Fig 8: accessing router remotely

And this happens by the EIGRP PROTOCOL which allows communication between two different networks.

End devices located within the pink coloured circles(see Fig 8) are reserved devices and these devices are able to ping with each other. But not able to/with other PC's and this is done by VLAN trunking.

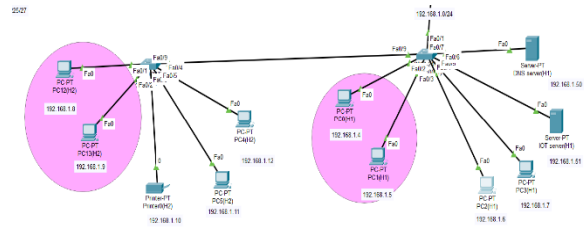


Fig 8: concept of VLAN

Trunk

Once all the IOE devices are registered in Home Gateway, DNS and IOT servers are configured. And all the end devices are assigned with IP addresses, then the authorised person can access them.

DNS AND IOT SERVERS

DNS translates domain names to IP addresses so browsers can load Internet resources. Each device connected to the Internet has a unique IP address which other machines use to find the device. DNS servers eliminate the need for humans to memorize IP addresses.

IOT platform plays a pivotal role for smart device vendors and startups, who can use it to equip their products with remote control and real-time monitoring functions, configurable alerts and notifications, pluggable cloud services, and integration with consumers' smart phones and other devices.

The authorised person can access the IOE devices and the end devices. To access IOE devices go to IOT monitor app within smart phone, PC or laptop. Every time while accessing these devices we need to enter the server IP address in IOT monitor app, as memorising IP address is a difficult task we move with DNS concept. And we create website with the

help of HTML and thereby we directly enter website name instead of IP address. As this is a private network which is accessed by authorised person ,we secure it with a password. And directly with the website you can't access it, as you need IOT monitor app. So when you visit the website it says “ Use IOT Monitor APP to Manage IOE Devices” (see Fig 9 )

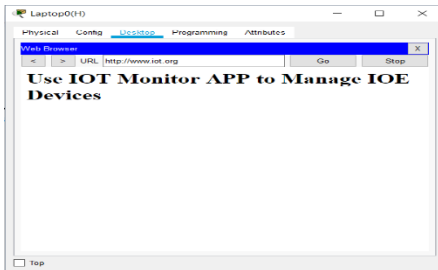


Fig 9 : message displayed in website

Smart interactive office is incomplete without automation

Hence in this paper we aim at 4 automations to be carried out using IOT, they are as follows:

- 1) Whenever there is smoke inside the office, the smoke detector detects the smoke then windows will be automatically opened, siren and fire sprinkler turned on. Here we are using old car as smoke generator for demonstration.

Fig 10 : Windows, Fire Sprinkler &Siren is turned on when smoke is detected

- 2) Whenever there is motion inside the office, motion detector detects this motion and thereby fans and lights inside the office will be automatically turned on.

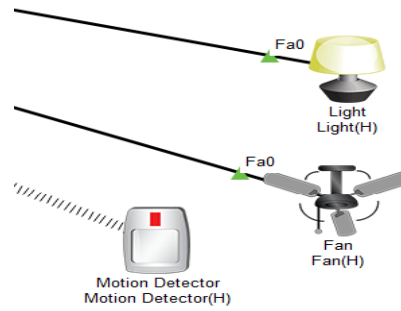
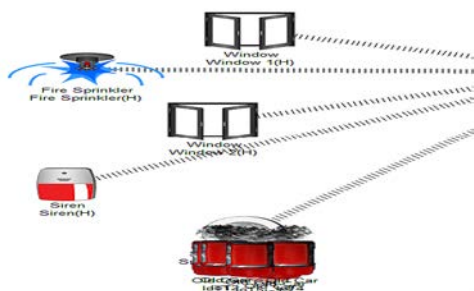


Fig 11 : Light & fan turned on when motion is detected

- 3) Whenever there is any motion inside the office apart from office hours, the motion sensor senses this motion, and then the siren and webcam will be automatically turned on. Here we are using microcontroller to control the sensor.

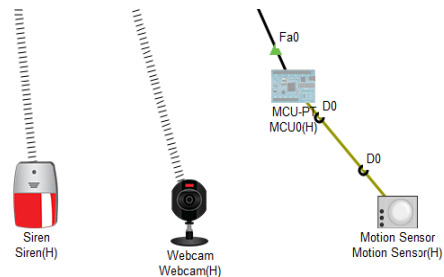


Fig 12 : Siren & Webcam turned on when there is motion apart from office hours

- 4) Door of the data room will be opened using RFID Card, which is validated by RFID reader.

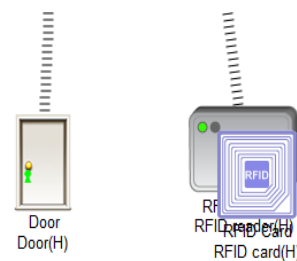
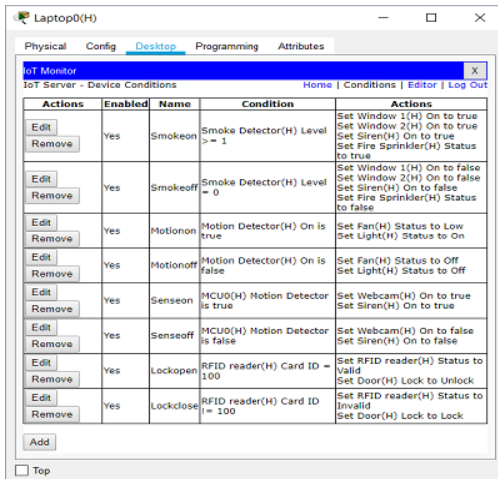


Fig 13 : Door is unlocked once RFID Card is valid

## CONDITIONS TO CONTROL IOE DEVICES



Actions	Enabled	Name	Condition	Actions
Edit Remove	Yes	Smokeon	Smoke Detector(H) Level >= 1	Set Window 1(H) On to true Set Window 2(H) On to true Set Siren(H) On to true Set Fire Sprinkler(H) Status to true
Edit Remove	Yes	Smokeoff	Smoke Detector(H) Level = 0	Set Window 1(H) On to false Set Window 2(H) On to false Set Siren(H) On to false Set Fire Sprinkler(H) Status to false
Edit Remove	Yes	Motionon	Motion Detector(H) On is true	Set Fan(H) Status to Low Set Light(H) Status to On
Edit Remove	Yes	Motionoff	Motion Detector(H) On is false	Set Fan(H) Status to Off Set Light(H) Status to Off
Edit Remove	Yes	Senseon	MCU0(H) Motion Detector is true	Set Webcam(H) On to true Set Siren(H) On to true
Edit Remove	Yes	Senseoff	MCU0(H) Motion Detector is false	Set Webcam(H) On to false Set Siren(H) On to false
Edit Remove	Yes	Lockopen	RFID reader(H) Card ID = 100	Set RFID reader(H) Status to valid Set Door(H) Lock to Unlock
Edit Remove	Yes	Lockclose	RFID reader(H) Card ID != 100	Set RFID reader(H) Status to Invalid Set Door(H) Lock to Lock

Fig 14 : conditions mentioned to control IOE devices

## 11. CONCLUSION

In this paper, we implemented smart interactive offices using new released cisco packet, because this version included different IOE device used for home automation. I used home Gateway to register smart device on it to control them and Microcontroller (MCU) to interconnect different sensor and IOE device. Also MCU provide programming environment to manage different device, different programming language available on MCU

but I used JavaScript to control the device. The packet tracer is also used to implement the network of the project and clarify the conception of the VLANs, DHCP, EIGRP, phone, website, IOT, DNS servers and router configurations. Networking devices are expensive so the packet tracer is easy and best to implement structure of the network before implementing it on the real ground.

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