Design and implementation of Smart Campus Network

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***Abstract*: A Smart Campus is a combination of VLANs (Virtual Local Area Networks) that provide coverage to the entire campus. It provides different services such as connections, accessibility and different functionalities. In a campus network, it provides students, faculty and staff for various applications and to complete different tasks, so it needs to be designed beforehand. To enable this complex services, integration of Internet of things and Classic Network devices in the campus, this paper has been proposed. Each of these smart objects must be pre-registered in the IOE server and overseen by an Administrator. We use Cisco Packet Tracer for this proposed model. This is also termed as Smart Campus Network Design.**

Keyword: *Smart Campus, Virtual LAN, Internet of things, Smart Server Integration.*

1. INTRODUCTION

Local area Network is a which that is administered by a single network admin. Campus networks are designed as a group of VLAN [1] which virtually divide the performance of devices and increment the network management security.

While IOT was coined recently, the "Things" in IOT is referred to smart objects. Till recent years, many researchers and companies have tried to propose a clear meaning of IOT [2], one such scholar defined it as "Seamless Integration of physical objects into a Network of Information, where each device can be a part of the active process.

In this research, we consider the smart things to be the devices that are registered in the IOE server [3] and act as home gateway controlled via the web by an administrator.

Smart Campus Network Design (SCND) [4] is the proposed method to design campus network by combination of Internet of Things devices with networking devices, to make various campus network operations . This model contains Hierarchal Network Design [5] as this is used to group devices into various network frames. The network is organized in a layered mechanism, they are Central layer, layer of distribution and layer of access. Each layer has its capabilities, Core layer: link the layer of distribution to the web distribution [6]: interlinks smaller local networks, access layer: provides network hosts[7], smart objects, and end devices interconnection. I used the cisco packet tracer sim software to model Smart Campus Network Design (SCND).

2. METHODOLOGY

Cisco Packet Tracer is a simulation tool for networking and is used for education and learning applications Through integrating practical and virtual environments [8] in a unique way. I used cisco packet tracer to model the campus network. The strengths of Packet Tracer are:

• Offers real simulation and also virtualization

• Allowing users to construct, setup, and solving highly complex networks[9].

• To discover concepts, research conducted, actually published cisco packet tracer contains new features such as new device, new sensor, and programming languages with a conventional network device, as given below

Changelog of Packet tracer 7.0:

TABLE- I DEVICES IN IOE

No.	Device name	Function
1	Router (1941)	Used to connect campus network to the internet
2	Layer2 Switch (2960)	Used to distribute access to the lower layer
3	Layer3 switch (3560)	Used to perform intra VLAN routing
4	Server	To monitor intelligent things that are recorded on it and have specific database features.
5	Central server	Used to link the router with the cellular network
6	MCU	Used to connect various intelligent things.
7	PC	Connection to access layer
8	FAN	Used to ventilate the campus based on some condition
9	webcam	Control the campus
10	siren	Provide sound for some Program in the campus
11	light	Visible lights
12	Motion detector	provide Detection of motion
13	Smart door	provide Function based event
14	Cell tower	Provide cellular system coverage for different user
15	tablet	Used to control the campus from outside
16	LCD	To display text
17	Motion sensor	To sense motion by mouse movement

• Smart Things are smart objects that are connected via the Registry Server and Home Gateway network[10] interface. We are divided into four subcategories: Smart Cities, smart Home, Industry and smart Power plant.

• Components are (*MCU-PT*) or single board systems[11](*SBC-PT*) smart objects that Do not have an interface to the network and depend for network access on the MCU-PT or SBC-PT.

•IoT device registration server

• Table-I contains the devices which we use in the following implementation. IOE tools and sensors in the latest IoE category: solar panel, energy meter, car, wireless home gateway, power meter, motion detector, conveyor sensor, IoE programming languages.

• microcontroller (*MCU*)[12] .

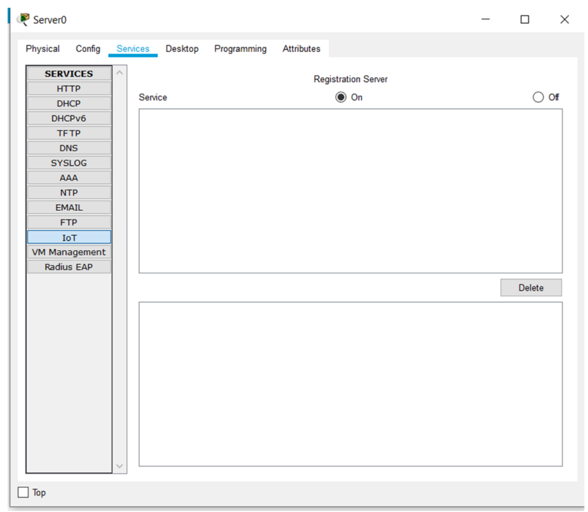

Fig. 1. IOE Regisitration Server

Fig.1 Represents the IOE server in Cisco Packet Tracer. This is the backbone of our registration server. All the devices registered are controlled from here. Every class has its own clever thing to use in categories. Example: Intelligent door, co2 detector, refrigerator, home speaker, activity detection, humidity meter, smoke alarm, siren, CCTV and home class intelligent gate.

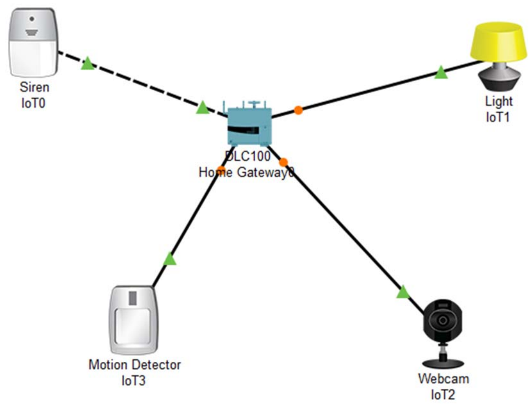

Fig. 2. Home gateway Network

Fig.2 is a basic design of a home network gateway and this can be implemented for basic understanding of the working model. Smart items can register directly with the IoE service configured to IOE Server or a Home Gateway. In To protect the WEP / WPA-PSK / WPA2 access point installed with the "Home Gateway" SSID. wireless link company, Home Gateway has 4 Ethernet ports. The figure below demonstrates four devices linked to a home gateway through the internet available via the home gateway.

3. IMPLEMENTATION

In order to execute the design of the campus network I suggested Smart Campus Network Design (SCND), distinct networking devices are used to design this suggested technique. These devices are cisco 1941 router, 2960 switch, 3560 switch, central office server, cell tower and some intelligent things are also included in this design.

Device Configuration:

I used class A IP address 192.168.10.0/24 and this subnet split into eight subnets from these eight subnets to execute the network layout on cisco packer tracer, used four of them and the remainder are reserved for future scalability.

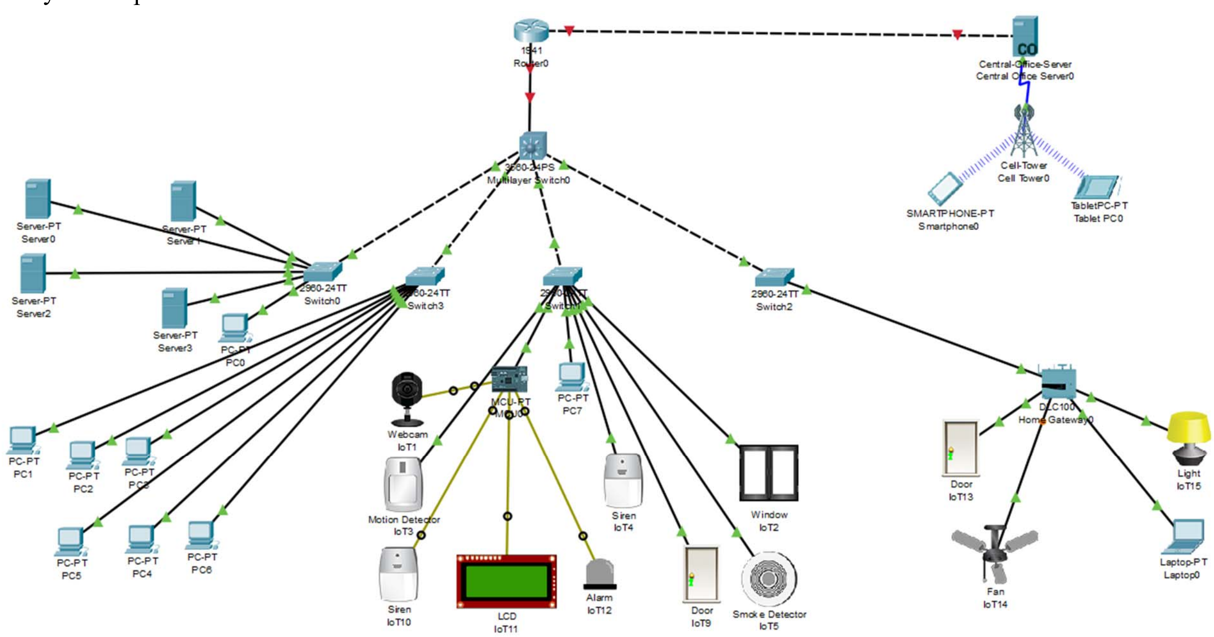

Fig. 3. Proposed Architecture

• Core Router

Router(config)#hostname corerouter

corerouter(config)#interface g0/0

corerouter(config-if)#ip address 192.168.10.1 255.255.255.224

corerouter(config-if)#no shutdown

corerouter(config)#int g0/1

corerouter(config-if)#ip add 209.165.20.225 255.255.255.224

corerouter(config-if)#no sh
corerouter(config)#ipdhcp excluded-address
209.165.20.225 209.165.20.229
corerouter(config)#ipdhcp pool tell
corerouter(dhcp-config)#network 209.165.20.224
255.255.255.224
corerouter(dhcp-config)#default-router
209.165.20.225
corerouter(dhcp-config)#dns-server 192.168.10.40

Command for checking running configuration

```
corerouter#show running-config
Building config...
Current configuration : 1072 bytes
!
version 15.1
no service timestamps log datetimemsec
no service timestamps debug datetimemsec
service password-encryption
!
hostname corerouter
!
enable secret 5
$1$mERr$Me19uJMtOy6/CjrWm.7sd1
!
ipdhcp excluded-address 209.165.20.225
209.165.20.229
!
ipdhcp pool tell
network 209.165.20.224 255.255.255.224
default-router 209.165.20.225
dns-server 192.168.10.35
!
!
!
ipcef
no ipv6 cef
!
license udipid CISCO1941/K9 sn
FTX1524UANM
!
spanning-tree mode pvst
!
interface GigabitEthernet0/0
ip address 192.168.10.1 255.255.255.224
duplex auto
speed auto
!
interface GigabitEthernet0/1
ip address 209.165.20.225 255.255.255.224
duplex auto
speed auto
!
interface Vlan1
no ip address
shutdown
!
ip classless
ip route 192.168.10.0 255.255.255.0 192.168.10.2
ip route 192.168.10.0 255.255.255.224 192.168.10.2
!
ip flow-export version 9
!
no cdp run
!
!
```

line con 0

password 7 08224D43190C16

!

line aux 0

!

line vty 0 4

password 7 08224D43190C16

login

line vty 5 15

password 7 08224D43190C16

login

!

end

Device Setup

After setup, the device will dynamically receive IP address and IOE device will be recorded with the IOE server or home getaway.

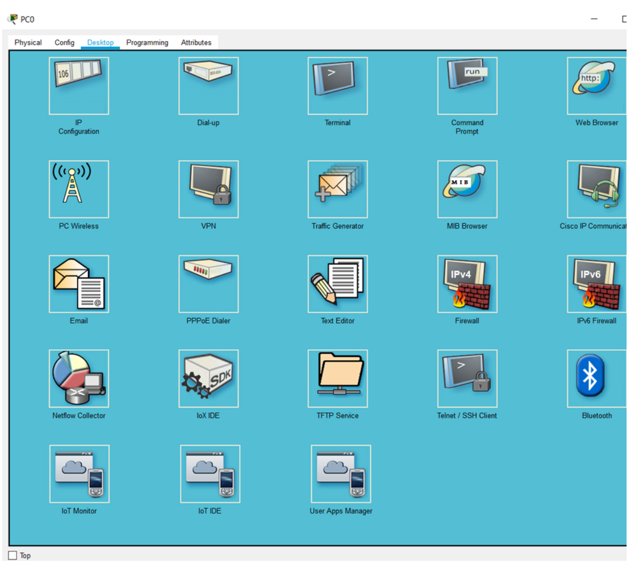

Fig. 4 Device Config

The above Fig.4 demonstrates IOE device registration to IOE server for remote or local control of IOE device type by lawful individual with username and password in order to control smart objects recorded on the network, authorized users can access the device from remote or local. Controlling ceiling fan displays above figure by creating off / low / high and also by creating on / dim / off light control.

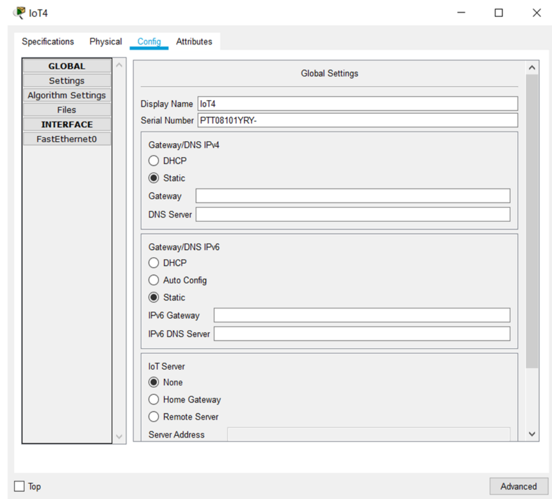

Fig. 5. Server Setup

Fig.5 is the server setup which requires input of various IP addresses so that the server can be interconnected within different networks.

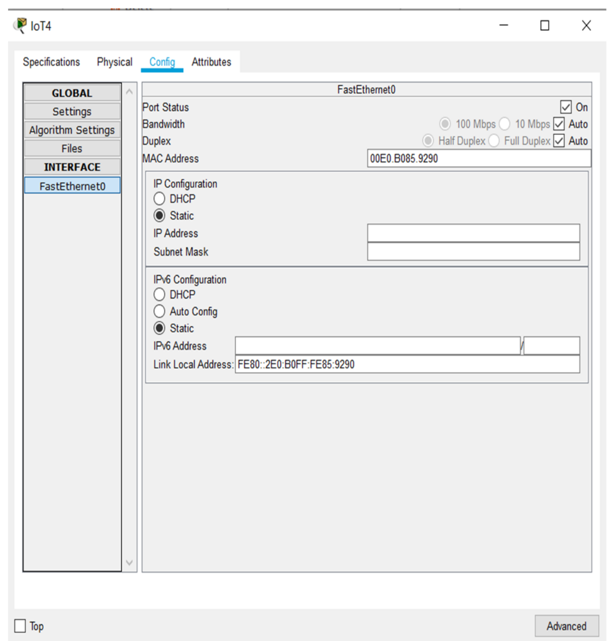

Fig. 6. IoT device Registration

Fig.6 represents the registration procedure for each IOT device and this needs to be registered in order to be listed in the IOE server.

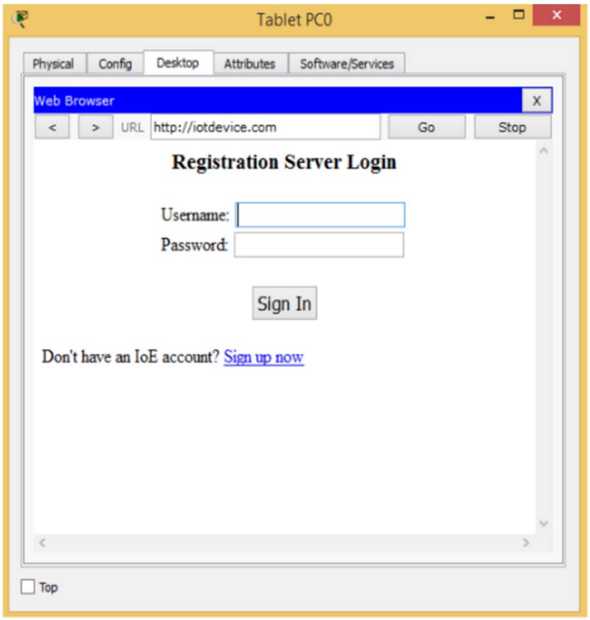

Fig. 7. IoE Server Login Webpage

Fig.7 is the login page of the server. Only the Admin of the server has access to the network devices. The system used is the Microcontroller Unit (MCU) to link intelligent thing and sensor to control and to provide programming environment to handle the linked stuff.

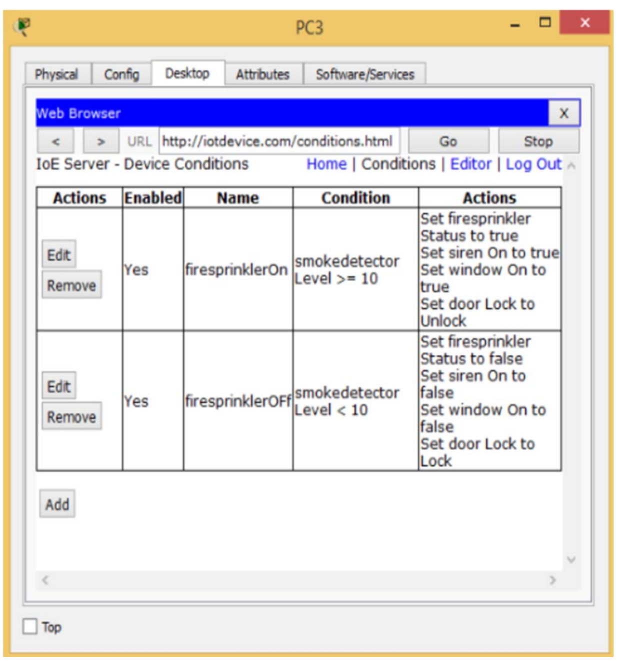

Fig. 8. Smoke Detector Conditions

The Fig.8 above demonstrates When smoke is above 10, the fire sprinkler or siren is on to ventilate the site and warn the surrounding area .Old car was used to detect smoke.

Program:

```
from gpio import *
from time import *
def main():
 pinMode(0, OUT)
pinMode(1, OUT)
pinMode(2, OUT)
pinMode(3, IN)
pinMode(4, OUT)
```

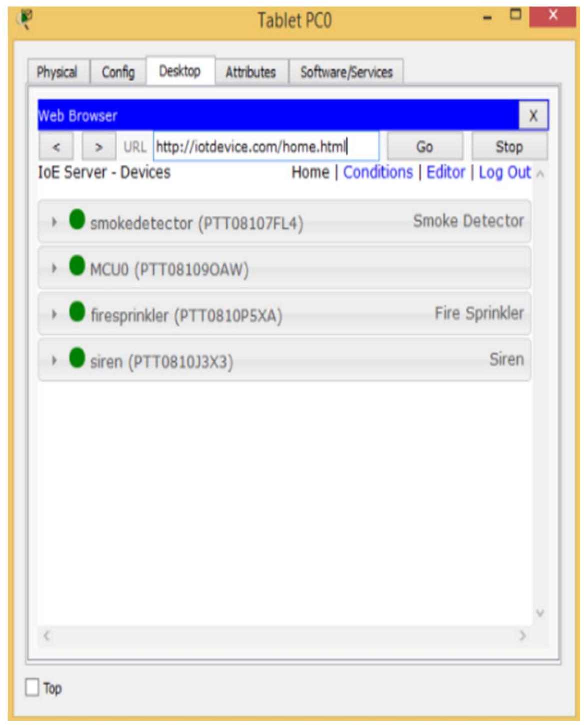

Fig.9. Registered devices List

```
print("BLINKING")
 while True:
customWrite(1, "wel come");
 digitalWrite(2, LOW);
customWrite(0, 0);
  customWrite(4, 0);
if (digitalRead(3)):
customWrite(3, 0);
customWrite(0, 1);
```

```
customWrite(1,
"Warning");
digitalWrite(2, HIGH);
customWrite(4, 1);
print("ALERT")
delay(1000)
 if __name__ == "__main__":
 main()
```

Fig.10 is the configuration window for access modes for other users. This provides limited/admin level access to other users who are in need to use it in approval.

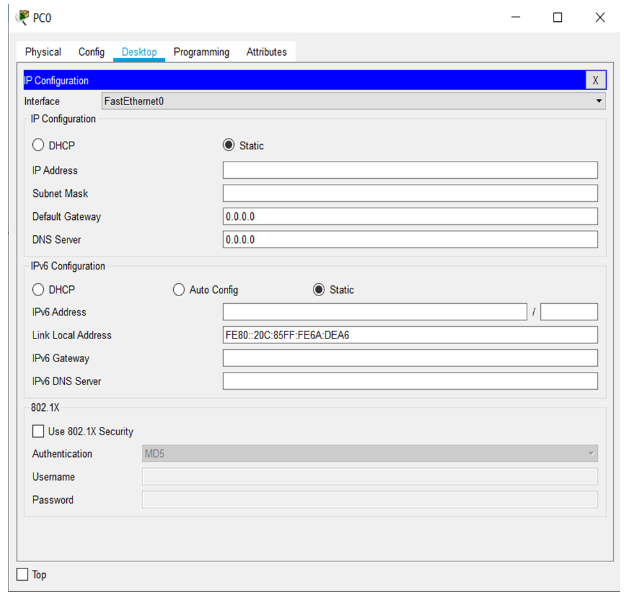

Fig. 10. PC config For Access

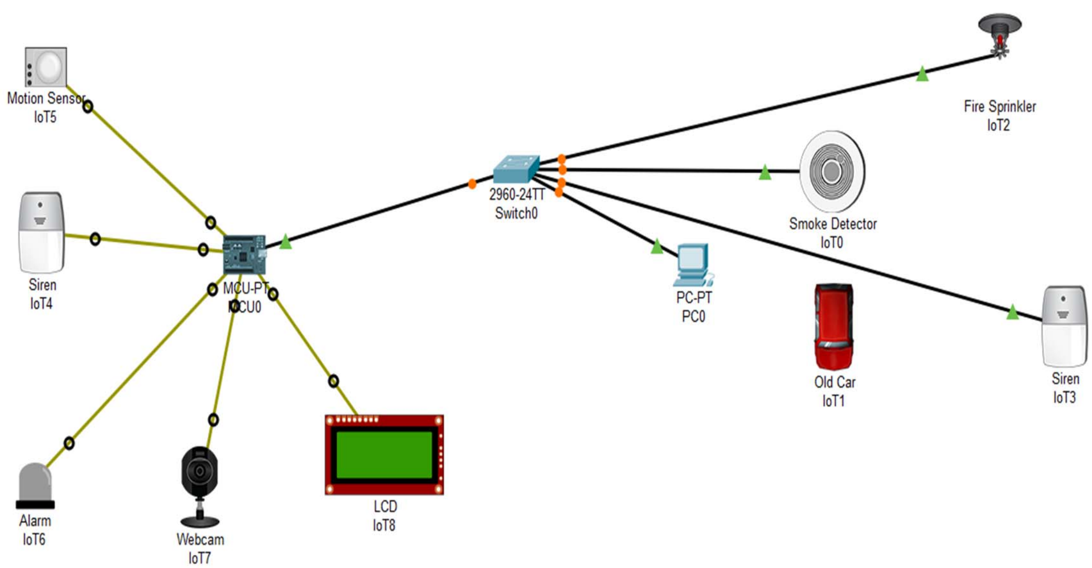

Fig.11. LCD module for message display(from connected devices)

The above Fig.11 demonstrates If the alarm, horn, monitor and display are shown in the text alert are detected in case of safety. The above python program introduced on central MCU to regulate these occurrences.

CONCLUSION

In order to improve the service of the network, this paper proposed a conventional networking system to assimilate the Internet of Things. Each smart device registered with an IOT server or home getaway and regulated by an authentic user. This network simulation can be implemented via hardware for actual working with extra constraints in place. The results will be almost the same.

This article also presents about the Microcontroller Unit (MCU), which used coding to interconnect and regulate separate IOE devices. Used cisco packet tracer simulator software to design the suggested campus network architecture.

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