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Boosting Campus Network Design Using Cisco Packet Tracer

Isa Shemsi
CSE Department, SIT, Symbiosis International University, Pune, India
isa.beriso@sitpune.edu.in /isashemsi@gmial.com

Abstract:-Campus Network (CN) is a set of Virtual Local Area network (VLAN), which covers the entire university. It provide difference service such as connect user to internet, data sharing among user, accessing different web service for different functionalities. As Campus Network (CN) provides students, teachers, and different university member for different application, to sustain different activities in the university, so it need to design in advance. To sophisticate the campus network service, this paper proposed Smart Campus Network Design(SCND) by integrating internet of thing device with classically network device in campus network and each smart device for different application must be registered to IOE server and controlled by legitimate user. To design the proposed campus network design, I used cisco packet tracer simulator software.

Keyword:-Campus Network (CN), Smart Device, Virtual Local Rea Network (VLAN), Internet of Things.

I. INTRODUCTION

Local area network (LAN) is a network that is controlled by single authority (e.g. CN). Campus network (CN) is set of virtual local area **networks (VLAN), which are** virtual divided for increasing the performance of network and increases campus network management with security.

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. [1] 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." To spread the coverage of IoT definition, Sarma et al. [2] defines the "Things" from physical objects to virtual objects which represents as the identities with Internet connectivity. Although IEEE IoT Initiative is proceeding to draft a white paper [3] for the formal definition of IoT there are still no common agreements for the definition of IoT.

In this paper, I define a "Smart Thing" on Internet of Things that indicates a physical object that registered on IOT server or Home Gatewayand controlled through web from remote/local network by legitimate user [4].

Smart Campus Network Design (SCND) is the proposed method to design campus network by integrate IoT device with networking device, to facilitate different activities in campus network. This design includes Hierarchical Network Design as a hierarchical design is used to cluster devices into multiple networks layers [5]. The networks are structured in a layered approach, those are Core layer, distribution layer and access layer. Each layer have their own functionalities that are Core layer: connect distribution layer to the internet Distribution layer: Interconnects the smaller local networks, Access layer: Provides connectivity for network hosts, smart things and end devices. To design Smart Campus Network Design (SCND) I used cisco packet tracer simulator software.

Cisco packet tracer is simulation software used to design, configure, troubleshoot different cisco device [6] [7] and currently included IOT device in Cisco packet tracer version 7.

II. MOTIVATION

Cisco currently release new version of cisco packet tracer that include IOE device with classically networking device.

III. METHODOLOGY

In order to design campus network I used cisco packet tracer .Cisco Packet Tracer is a networking simulator used for teaching and learning program by offering a unique combination of realistic[7][8].

Benefits of Packet Tracer are:

- Offers a realistic simulation and visualization
- Permits users to design, build, configure, and troubleshoot complex networks
- Allows students to explore concepts, conduct experiments,

Currently released cisco packet tracer included new feature like new device, sensor, and Programming Languages with classically networking device, those device stated below [4].

Things and Components available in Packet Tracer 7.0

- **Smart Things** are smart object attached to the Registration Server or Home Gateway through a network interface. They are divided into 4 subcategories: Smart City, Home, Industrial, and Power Grid.
- **Components** are smart objects that link to microcontroller (MCU-PT) or single boarded computers (SBC-PT). Not have a network interface and rely on the MCU-PT or SBC-PT for network access. This smart object can communicate through analog or digital slots.

A. New Future of Cisco Packet Tracer 7.0

- Registration server for IoT devices
- IOE devices and sensors in a new IoE devices category: solar panel, power meter, car, wireless home gateway, power meter, motion detector, temperature sensor, conveyor sensor,
- Programming languages for IoE.
- Single board Computer (SBC)
- Microcontroller Unit (MCU
- Wireless IOE RFID sensor.
- Wireless IOE RFID items.

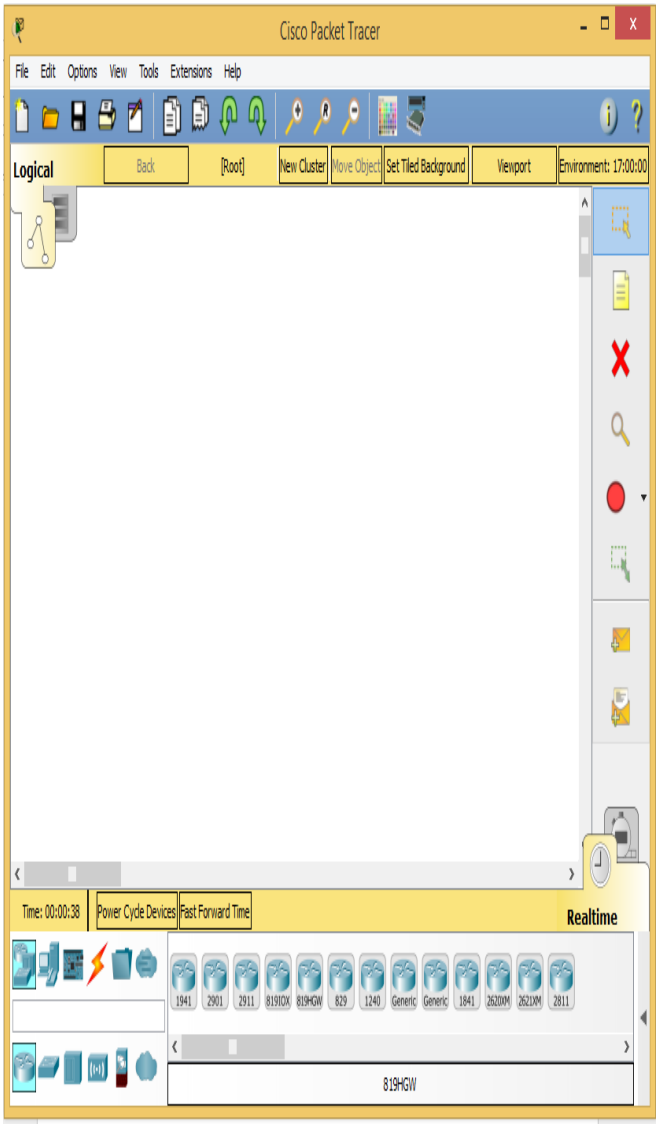

Fig. 1: First Lookup of Cisco Packet Tracer 7

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Fig. 2: Four Categories of Smart Thing

Each category has their own smart thing that is applicable in categories. Example: in home categories different smart things are there such as smart door, co detector, co2 detector, humidifier, home speaker, motion detector, humidity monitor, smoke detector, siren, webcam and smart window.

Fig. 3: MCU and SBC Microcontroller

This microcontroller provide programming environment (fig. 3) in order to control the smart things connected to this two boards.

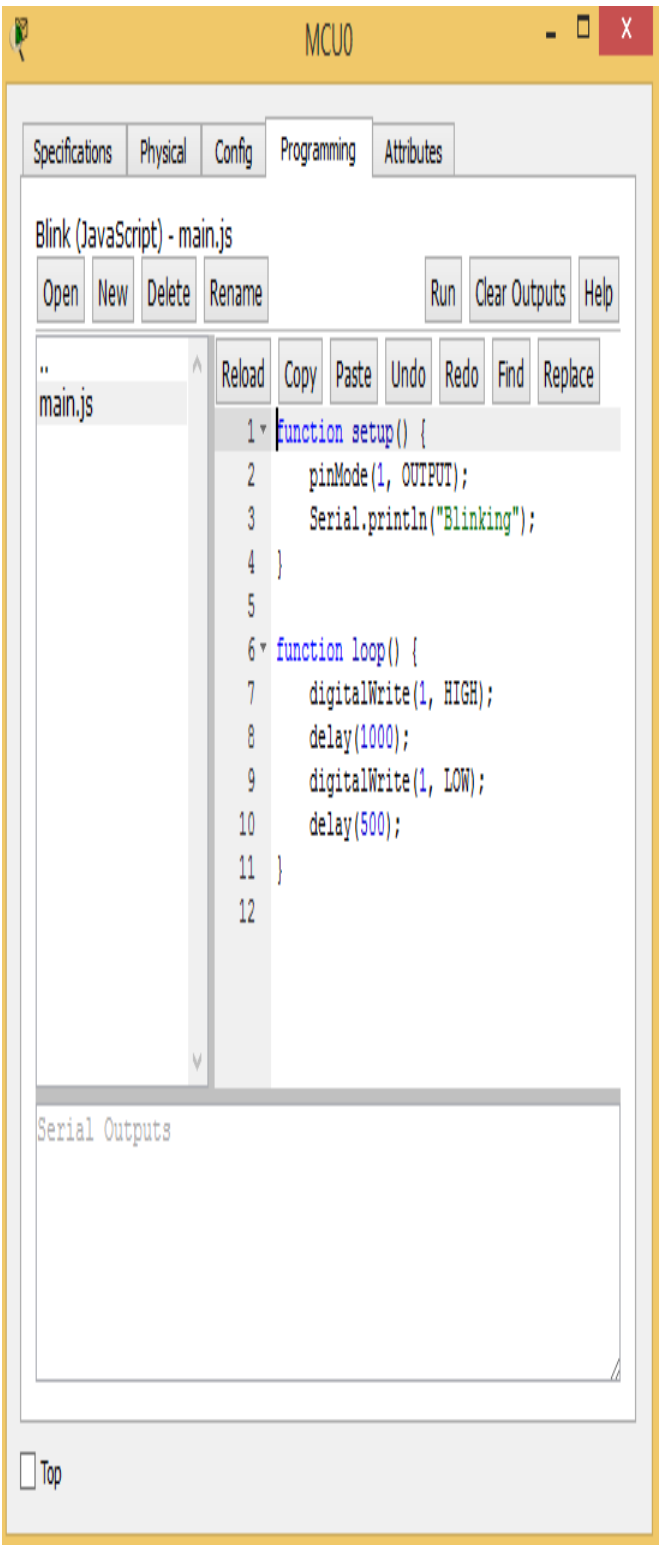

Fig. 4: Programming Environment Provided By MCU (Microcontroller)

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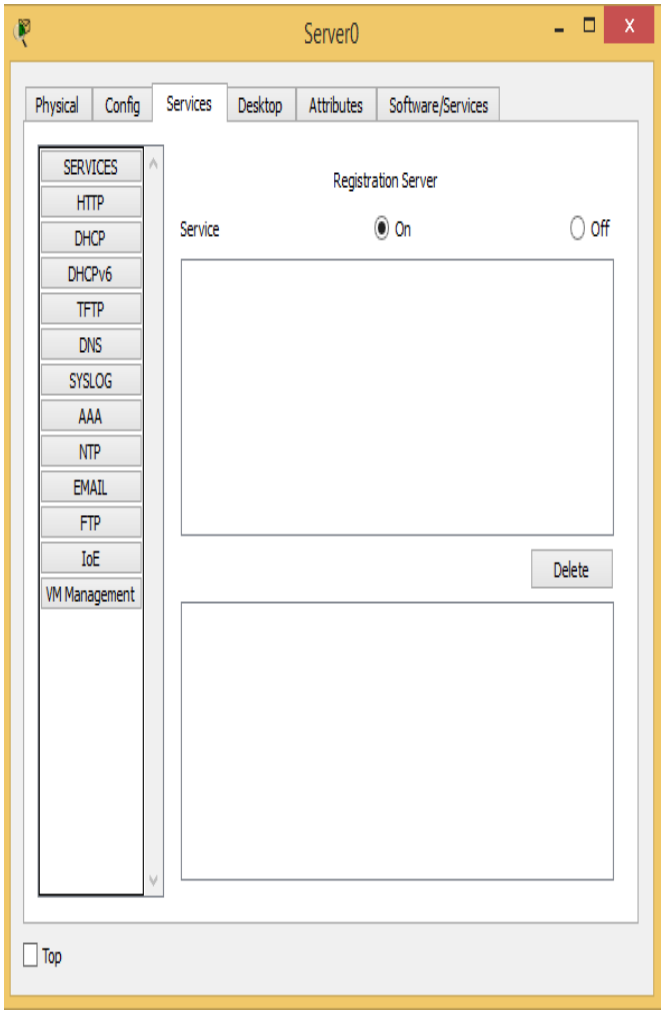

Fig. 5: IOE Registration Server

Smart things can directly register to IOE Serverora Home Gateway configured with the IoE service. Home Gateway have 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. The figure below shows four internet of Things device connected to a Home Gateway by using Ethernet cable and wireless. To connect the Home Gateway to the Internet its Internet WAN Ethernet port available on home getaway.

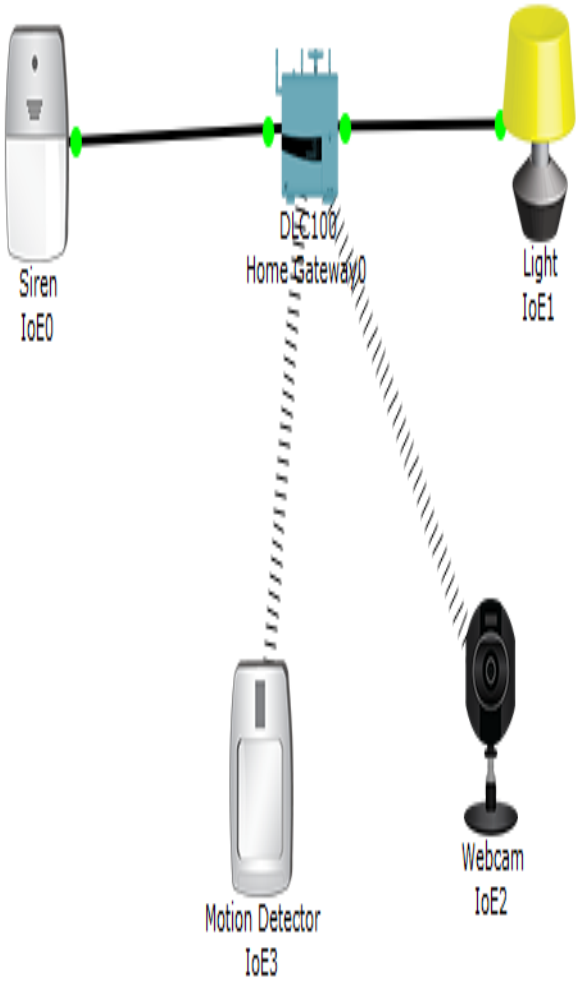

Fig. 6: Home Gateway with Four Smart Things Connected To Home Gateway

IV. IMPLEMENTATION

To implement campus network design I proposed Smart Campus Network Design (SCND), to design this proposed method different networking device are used , those device are cisco 1941 router , 2960 switch, 3560 switch, central office server , cell tower and some smart thing is also included in this design.Furthermore about the device is elaborated in table 1.

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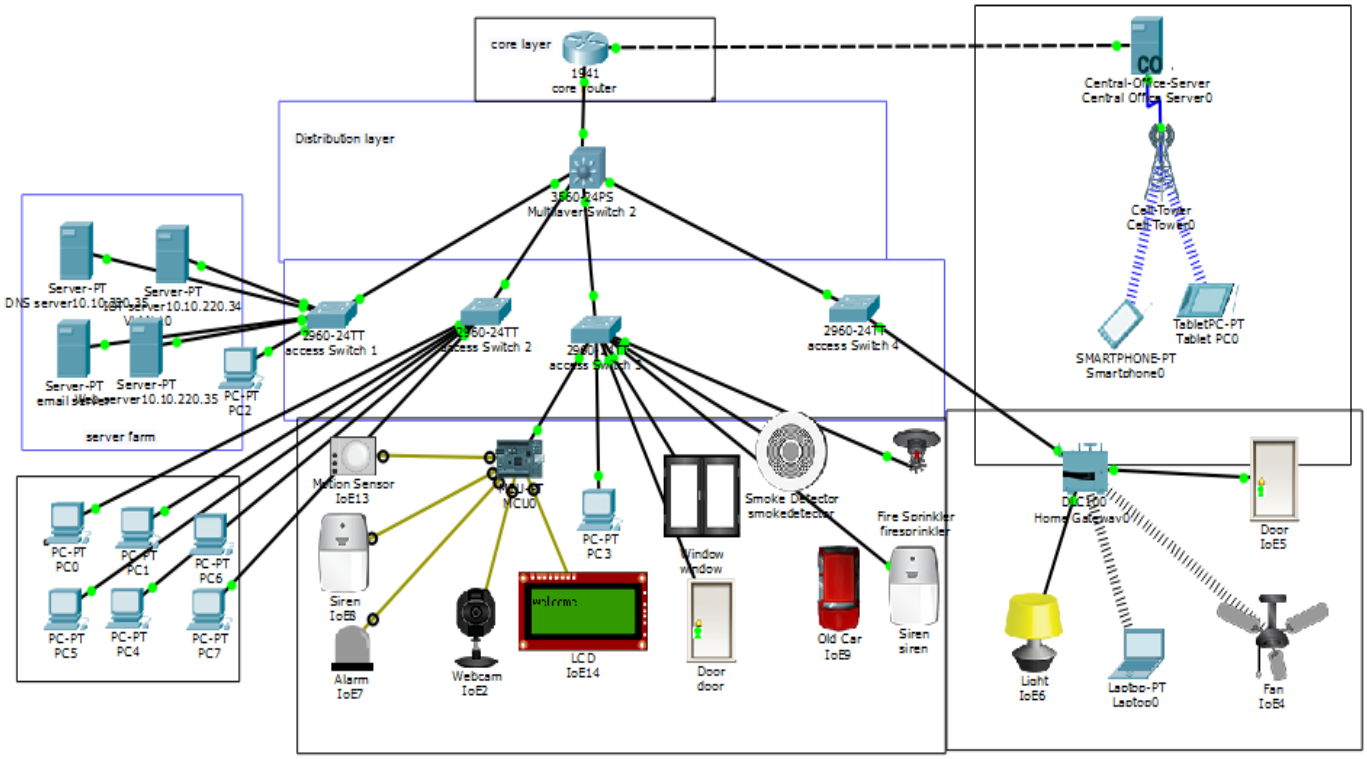

Fig. 7: Proposed Architecture

A. *Device Used for Design*

No	Device	Function
1	Router(1941)	Used to connect campus network to the internet
2	layer two switch (2960)	Used to distribute access to the lower layer
3	Layer three switch(3560)	Used to perform intra VLAN routing
4	Server	To control smart thing registered on it and provide difference server functionalities
5	Central office server	Used to connect cellular system to the router
6	MCU	Used to interconnect different smart thing
7	Pc	Connect 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 event in the campus
11	Light	Provide light
12	Motion detector	Connect to home getaway and provide Detection of motion
13	Smart door	Connect to home getaway and provide Function based event
14	Cell tower	Provide cellular system coverage for different user
15	Tablet	Used to control the campus from outside
16	Old car	To detect smoke
17	LCD	To display text
18	Motion sensor	To sense motion by mouse movement

Table 1: Device Used for Implementation

B. Device Configuration

To implement the campus network design on cisco packer tracer , I used class A IP address that is 10.10.220.0/24 subnet and this subnet divided into eight subnet from this eight subnet, I used four of them and the rest are reserved for future scalability.

- *Core Router*

```
Router(config)#hostname corerouter
corerouter(config)#interface g0/0
corerouter(config-if)#ip address 10.10.220.1
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 10.10.220.40
```

Command for checking running configuration

```
corerouter#show running-config
Building configuration...

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 10.10.220.35
!
!
!
ipcef
no ipv6 cef
!
license udipid CISCO1941/K9 sn
FTX1524UANM
!
spanning-tree mode pvst
!
interface GigabitEthernet0/0
ip address 10.10.220.1 255.255.255.224
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 10.10.220.0 255.255.255.0 10.10.220.2
ip route 10.10.220.0 255.255.255.224 10.10.220.2
!
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
```

- *Distribution Layer Device*

```
Switch(config)#hostname multlayerswitch
multlayerswitch(config)#vlan 10
multlayerswitch(config-vlan)#name serverfarm
multlayerswitch(config-vlan)#vlan 20
multlayerswitch(config-vlan)#name admin
multlayerswitch(config-vlan)#vlan 30
multlayerswitch(config-vlan)#name
MCUsmartthing
multlayerswitch(config-vlan)#vlan 40
multlayerswitch(config-vlan)#name
gatewaysmartthing
multlayerswitch(config-vlan)#
multlayerswitch3(config)#ipdhcp excluded-
address 10.10.220.96 10.10.220.99
multlayerswitch3(config)#ipdhcp pool
mcusmartthing
multlayerswitch3(dhcp-config)#network
10.10.220.96 255.255.255.224
multlayerswitch3(dhcp-config)#default-router
10.10.220.97
multlayerswitch3(dhcp-config)#dns-server
10.10.220.40
multlayerswitch3(config)#ipdhcp excluded-
address 10.10.220.128 10.10.220.130
multlayerswitch3(config)#ipdhcp pool
getwaysmartthing
multlayerswitch3(dhcp-config)#network
10.10.220.128 255.255.255.224
multlayerswitch3(dhcp-config)#default-router
10.10.220.129
multlayerswitch3(dhcp-config)#dns-server
10.10.220.40
multlayerswitch#show running-config
Building configuration...

Current configuration : 2742 bytes
!
version 12.2
no service timestamps log datetimemsec
no service timestamps debug datetimemsec
no service password-encryption
!
hostname multlayerswitch
!
ipdhcp excluded-address 10.10.220.64
10.10.220.68
ipdhcp excluded-address 10.10.220.96
10.10.220.100
ipdhcp excluded-address 10.10.220.128
10.10.220.130
ipdhcp excluded-address 10.10.220.33
10.10.220.35
!
ipdhcp pool serverroom
network 10.10.220.32 255.255.255.224
default-router 10.10.220.33
dns-server 10.10.220.35
ipdhcp pool admin
network 10.10.220.64 255.255.255.224
default-router 10.10.220.65
dns-server 10.10.220.35
ipdhcp pool mcusmartthing
network 10.10.220.96 255.255.255.224
default-router 10.10.220.97
dns-server 10.10.220.35
ipdhcp pool getwaysmartthing
network 10.10.220.128 255.255.255.224
default-router 10.10.220.129
dns-server 10.10.220.35
!
!
ip routing
!
spanning-tree mode pvst

interface FastEthernet0/1
switchport access vlan 10
switchport mode access
!
!
interface FastEthernet0/3
switchport access vlan 30
switchport mode access
!
interface FastEthernet0/4
switchport access vlan 20
switchport mode access
!
!
interface Vlan1
no ip address
shutdown
!
interface Vlan10
mac-address 00e0.f9c0.0001
ip address 10.10.220.33 255.255.255.224
!
interface Vlan20
```

```
mac-address 00e0.f9c0.0002
ip address 10.10.220.65 255.255.255.224
!
interface Vlan30
mac-address 00e0.f9c0.0003
ip address 10.10.220.97 255.255.255.224
!
interface Vlan40
mac-address 00e0.f9c0.0004
ip address 10.10.220.129 255.255.255.224
!
ip classless
ip route 209.165.20.224 255.255.255.224
10.10.220.1
!
ip flow-export version 9
!
no cdp run
!
line con 0
!
line aux 0
!
line vty 0 4
login
!
!
!
end
```

C. Device Setup

After configuration is done the device get IP address dynamically and IOE device registered to IOE server or home getaway.

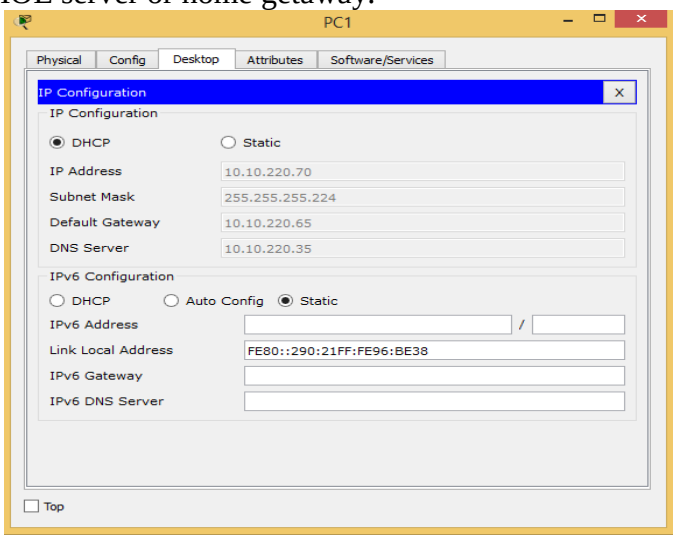

Fig. 8: Pc Gets IP Address Dynamically

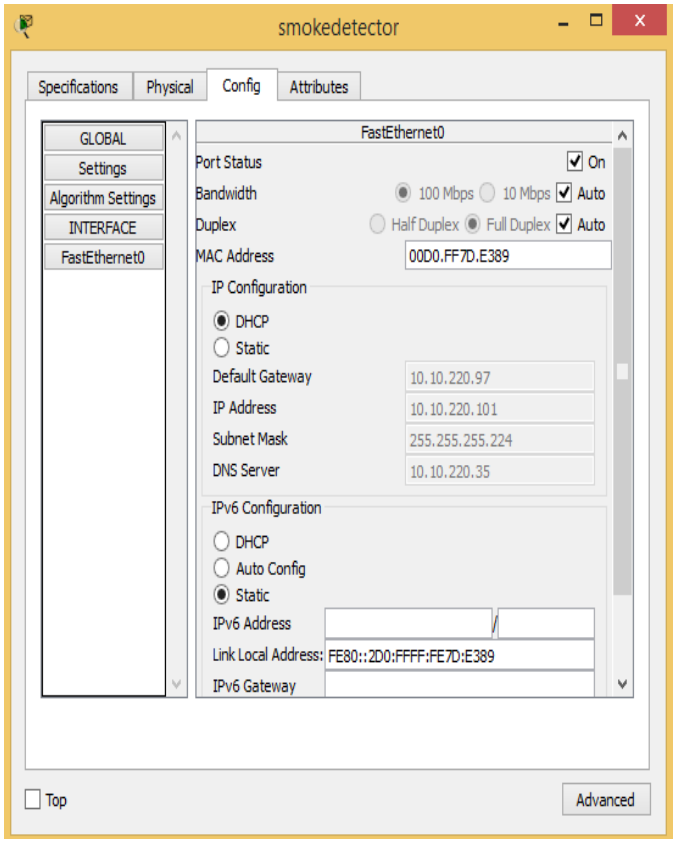

Fig. 9: IOE Device Get IP Address Dynamically

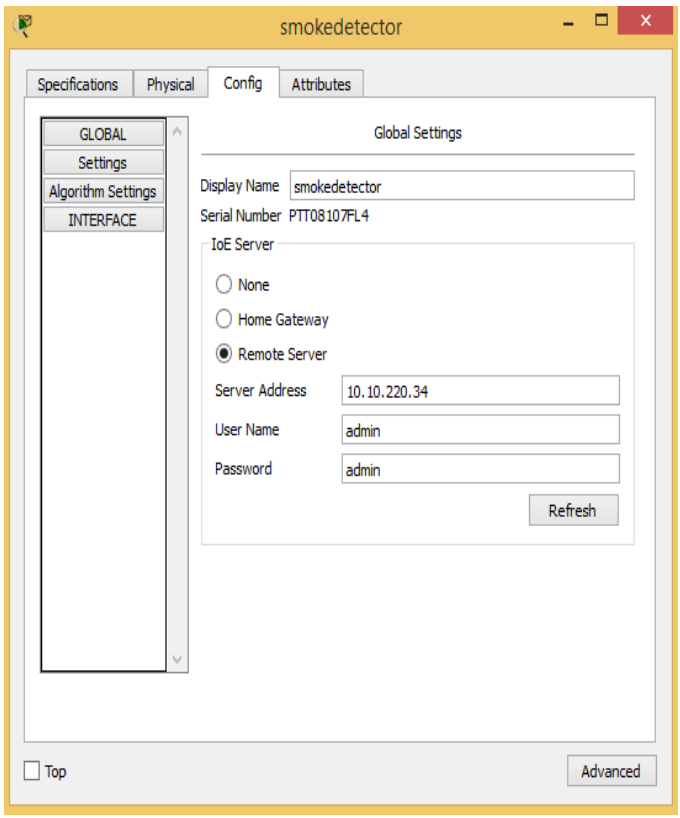

Fig. 10: Registering Smart Thing to IOE Server

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The above Fig shows Registering IOE device to IOE server to control IOE device form remote or local by legitimate person that have username and password.

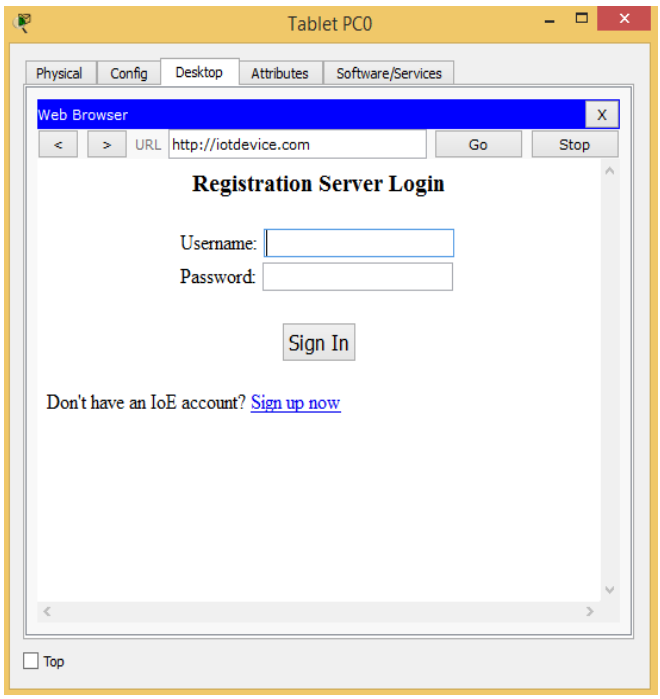

Fig. 11: Login page for IOT Register Server

Legitimate user can log the system from remote or local to control smart thing registered on the system.

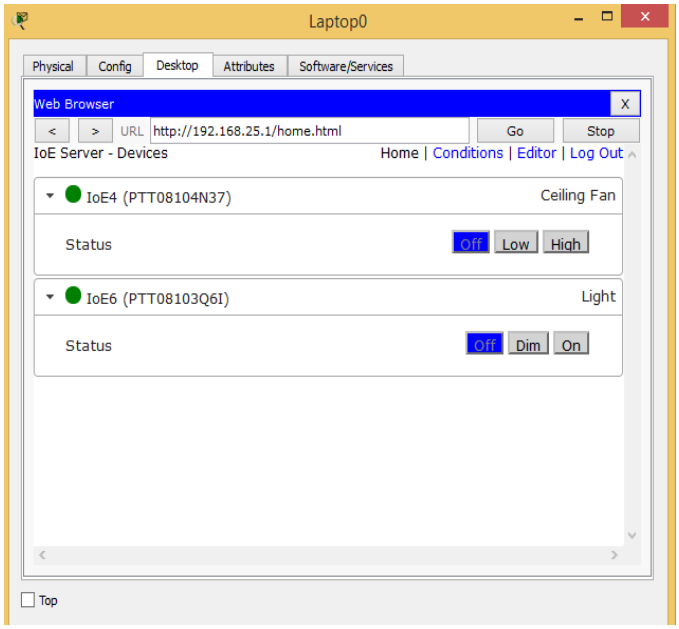

Fig. 12: Controlling Smart Thing Form Local

Above fig shows Controlling ceiling fan by making off/low/high and also control light by making on/dim/off.

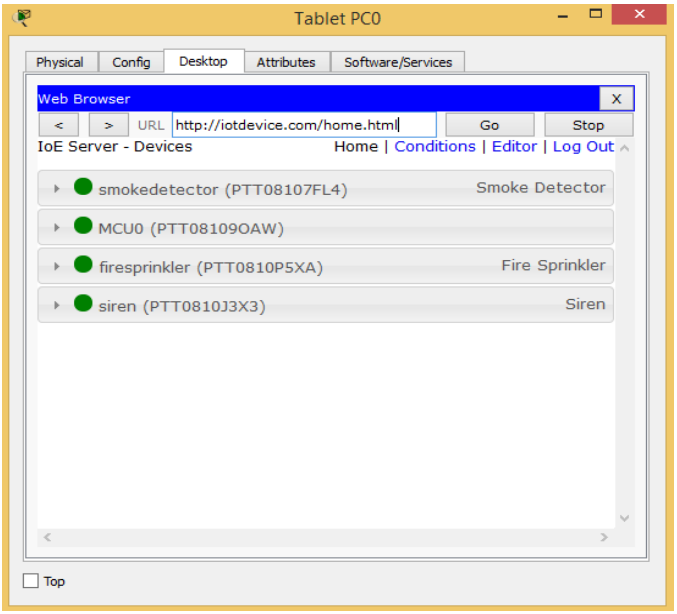

Fig.13: Controlling Smart Thing Form Remote Network

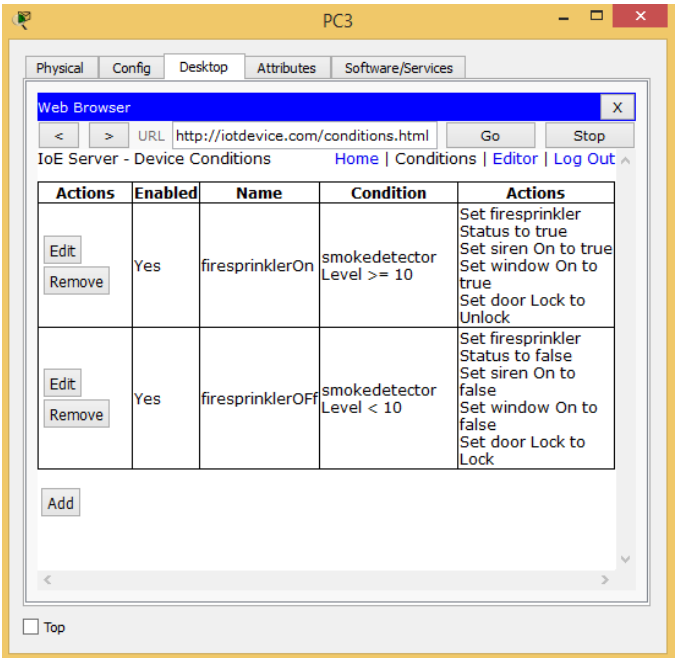

Fig. 14: Condition Making For Smart Thing on Server

The Fig. 14: shows condition made for fire sprinkler and smoke detector. If smoke levels above 10 the fire sprinkler, window, door and siren are on else off.

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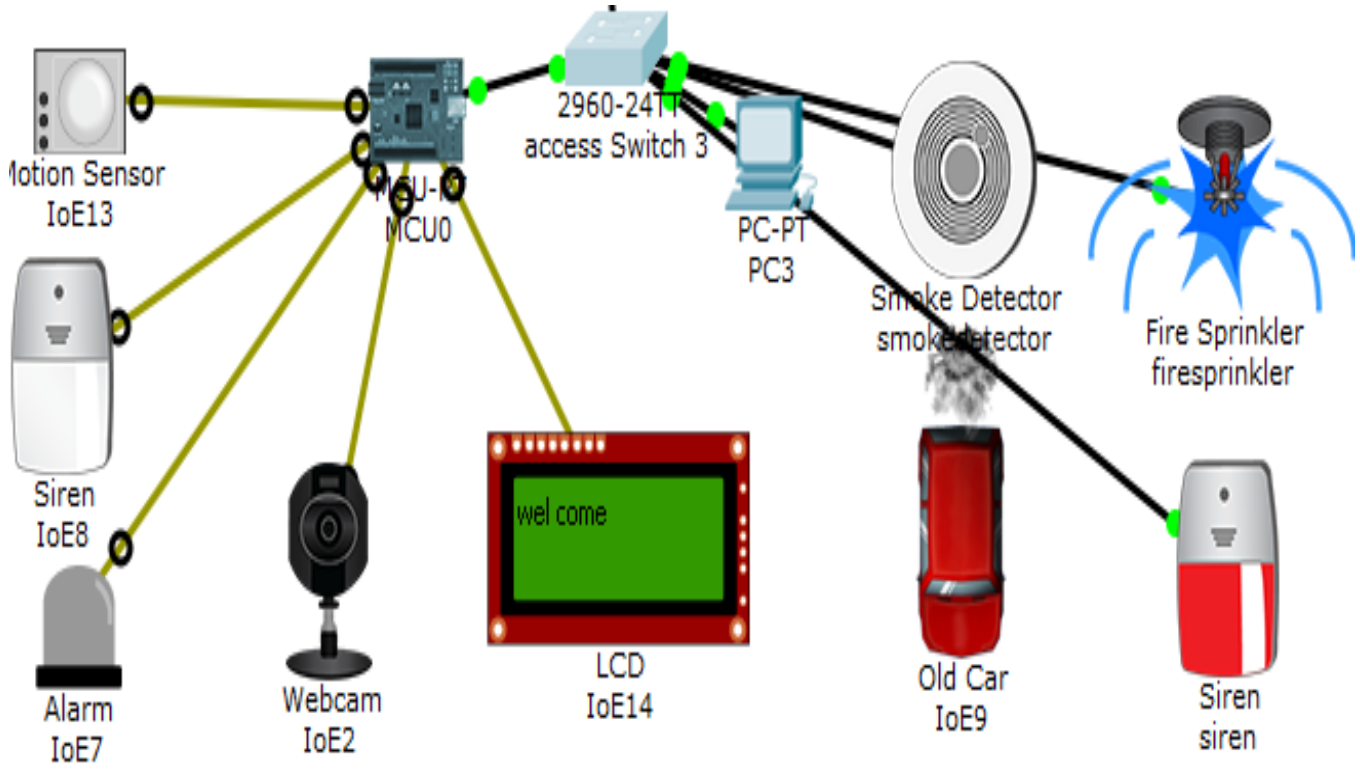

Fig.15: Shows Fire Sprinkler and Siren Are on

The above fig shows Fire sprinkler and siren are on when smoke level above 10 to ventilate the place and alarm the surrounding. To detect smoke old car was used. As old car has a lot of problem.

Microcontroller unit (MCU) is a board used to inter connect smart thing and sensor for controlling and provide programming environment to manage the things connected to it. The following python program are written on MCU to control and safe resource used by difference smart things.

```
from gpio import *
from time import *

def main():

        pinMode(0, OUT)
        pinMode(1, OUT)
        pinMode(2, OUT)
        pinMode(3, IN)
        pinMode(4, OUT)
        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()
```

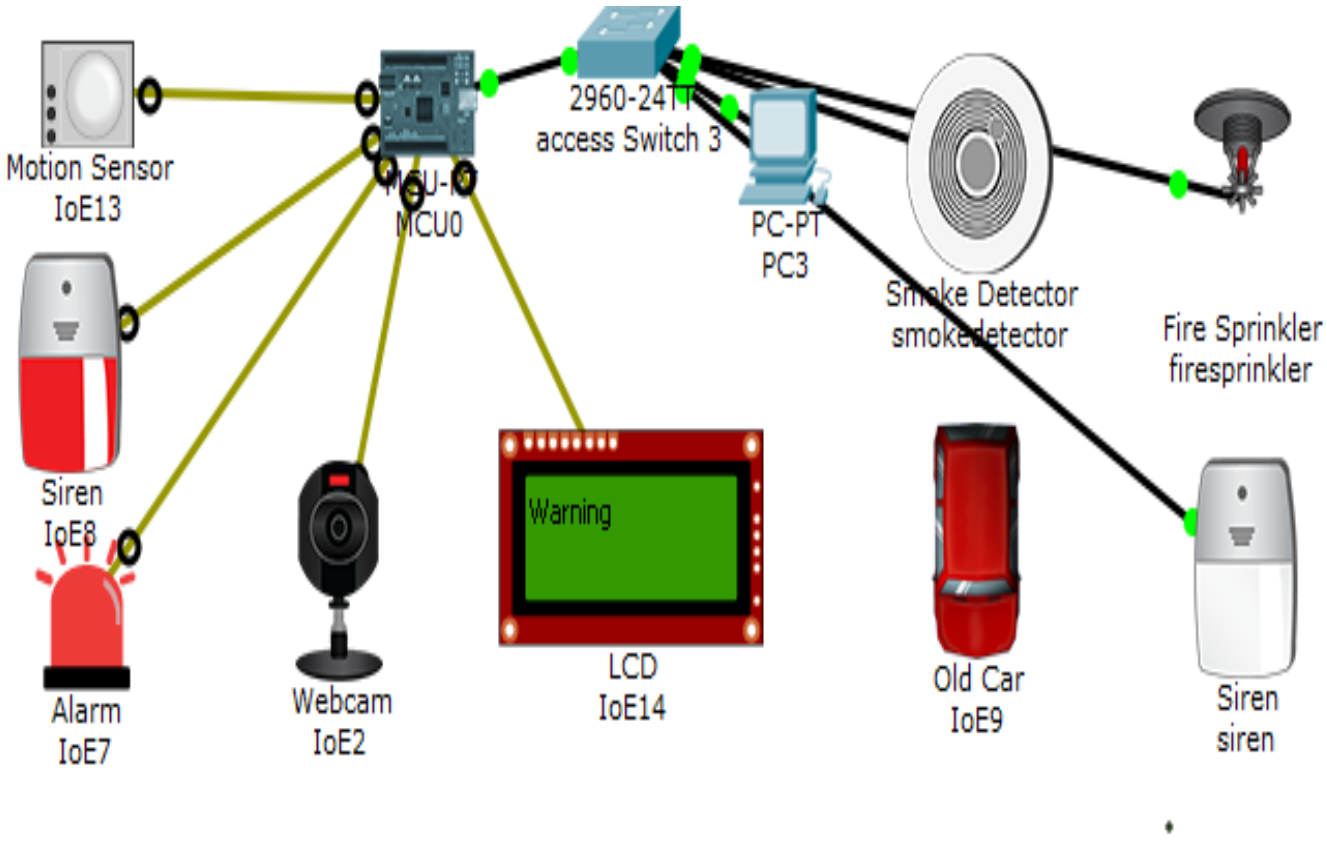

Fig.16: Shows MCU Control the Smart Thing and Sensor Connected To It.

The above Fig shows if motion is detected in case of security the siren, alarm, webcam are on and LCD display warning text. To control this events the above python program implemented on central MCU.

V. CONCLUSION

To improve the campus network service, this paper proposed Smart Campus NetworkDesign (SCND) by assimilating internet of thing device with classically network device.Each smart device registered to IOT server or home getaway and controlled by legitimate user.This design also include Hierarchical Network Design as a hierarchical design is used to group devices into multiple layers. This paper also present about Microcontroller unit (MCU) that used to interconnect different IOE device and control them by coding.To design the proposed campus network design I used cisco packet tracer simulator software.

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