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A Case Study Using Internet of Things to Save Power at The Faculty of Computer Technology

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Abstract
The Internet of Things (IoT) has emerged as a crucial component of the modern world. Many IoT devices are being connected to IoT networks by accessing a server or home gateway. In this paper, we illustrate how IoT devices can connect to a server and be controlled to save power using the PPDIOO research approach and Cisco Packet Tracer V8.0. Depending on the status of the motion detector that has been enabled in the device settings, the status of the IoT devices (camera, air conditioner, and Lamp) changes from off to on and vice versa. It is also possible to control devices that support IOT through the server or a laptop connected to the network. Energy saving is one of the results that have been achieved when using IOT technology.
Key Words: Internet of things, IOT characteristics, PPDIOO phases, Save power, Cisco Packet tracer.

الملخص
يعد انترنت الاشياء جزء مهم من عالمنا الحالي, العديد من أجهزة IOT يتم توصيلها بالشبكات عن طريق server أو Home gateway , في هذه الورقة اعتمدنا توصيل أجهزة IoT بالخادم للتحكم بتلك الاجهزة بهدف توفير الطاقة , حيث تم تصميم الشبكة باستخدام برنامج المحاكاة Cisco packet tracer v8.0 كما تم استخدام منهجية البحث PPDIOO . حيث تتغير وضعية أجهزة IoT (camera, air conditioner and Lamp) تتغير من الوضع off إلى الوضع on و العكس بناء على حالة ملتقط الحركة Motion detector التي تم اعتمادها في اعدادات الجهاز. كما يمكن التحكم في أجهزة IoT عن طريق الخادم Server أو باستخدام جهاز كمبيوتر محمول Laptop متصل بالشبكة. يعد توفير الطاقة من النتائج التي تم التوصل إليها عند استخدام تقنية انترنت الاشياء.

1. Introduction
The current era has witnessed many developments in several areas, the most significant of which are in the technical aspects, especially the technology of communications and networks, which led to the abolition of many difficulties. Through the emergence of the Internet revolution in the nineties, communication and information exchange became easy and available to everyone. Today, Internet of Things technology changing all our lives and all our concepts of technological progress due to the revolution of the Internet of Things, or what is known as IoT. It means the new generation of networks, which allow people to free themselves from the limits of space and control tools from a distance. The main vision of the Internet of Things is to create a smart world by putting intelligence into everyday objects, transportation, industries, buildings and many other fields[1]. The Internet of Things is a novel paradigm that is rapidly gaining ground in the scenario of modern wireless telecommunications. The basic idea of this concept is the pervasive presence around us of a variety of things or objects such as Radio-

Frequency Identifications (RFID) tags, sensors, actuators, mobile phones, etc. which, through unique addressing schemes, are able to interact with each other and cooperate with neighbors to reach common goals [2]. Actually, many challenging issues still need to be addressed and both technological as well as social knots have to be untied before the IoT idea being widely accepted. Central issues are making a full interoperability of interconnected devices possible, providing them with an always higher degree of smartness by enabling their adaptation and autonomous behavior, while guaranteeing trust, privacy, and security. Also, the IoT idea poses several new problems concerning the networking aspects. In fact, the things composing the IoT will be characterized by low resources in terms of both computation and energy capacity. Accordingly, the proposed solutions need to pay special attention to resource efficiency besides the obvious scalability problems.

2. Internet of things Concepts

The Internet of things can be simply defined as connecting all items to the internet through radio frequency identification (RFID) and other information by sensing equipment to achieve intelligent identification and management[3]. In other words, The Internet of things is an interconnected system of distinctively address able physical items with various degrees of processing, sensing, and actuation capabilities that share the capability to interoperate and communicate through the Internet as their join platform[4].

3. Layers architecture of IOT

1- Perception layer.
2- Network layer.
3- Processing layer.
4- Application layer.

Application Layer (smart home, smart cities, healthcare, etc.)
Processing Layer (Cloud computing, Big data processing)
Network Layer (Network communication software and physical component)
Perception Layer Sensors(RFID, Infra-red, QR code, Zigbee)

Figure 1. Four layers architecture of IOT[5][6].

4. Internet of Things characteristics:

1- Heterogeneous devices.
2- Semantic Sharing.
3- Autonomous Process.
4- Interconnectivity.
5- Flexible Structure.
6- Business Process Improvement.
7- Intelligent.
8- Dynamic network and no infrastructure.
9- Participants forming a closed loop environment[7].

5. Methods used in designing network projects

There are three methodologies for designing network projects. The most important methodologies for designing computer networks for Cisco are :
1- (PDIOO) which stands for Prepare, Plan, Design, Implementing, Operate, Optimize[8].
2- Intelligent Information Network (IIN.).
3- Service-Oriented Network Architecture (SONA)[9].
In this paper, the researchers adopted the PPDIOO methodology, which is a methodology that was produced by Cisco in 2005, as it is considered one of the most powerful methodologies that support the design of computer networks (of various sizes). The life cycle of this methodology consists of six basic stages shown in Figure 2.

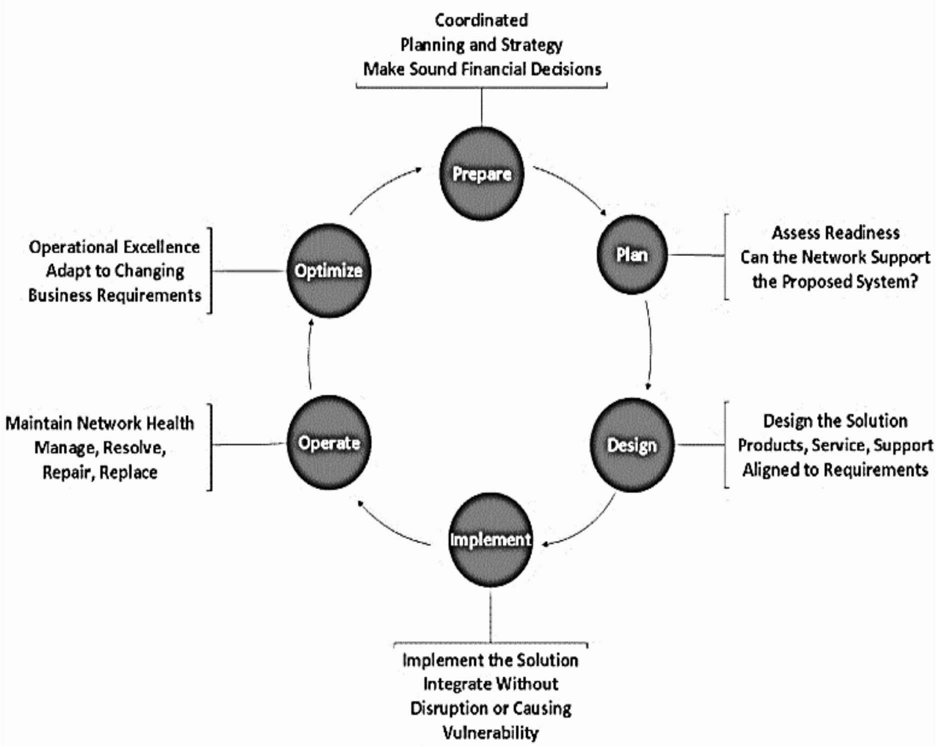


Figure 2. PPDIOO life cycle[10].

6. The PPDIOO phases are described as follows:

6.1. Prepare
Define the needs, strategies, and architectural concepts by adjusting the finances of the organization or company.

6.2. Plan
Identify network requirements based on purpose, facilities, and user needs.

6.3. Design
Designing network designs in accordance with needs, technical requirements and analysis results that are comprehensive and detailed.

6.4. Implement
Applying all things that have been designed in accordance with the design and analysis that has been done before.

6.5. Operate

Real-time testing of the system is carried out whether the system built is in accordance with the design. If there are things that are still lacking, it will be used as a reference for improvement in improving service quality.

6.6. Optimize

It involves proactive awareness of network management to identify and resolve problems that arise in the future [11].

7. Preparation phase

During this phase, as researchers we work on solving the problem of wasting power by creating a network based on Internet of Things. The target institute for establishing the network consists of several buildings, the most important of which are: The theoretical department, the laboratory departments and the college registration office, where there is a Local Area Network to connect these buildings without providing any control over the devices in all the mentioned buildings, which leads to the depletion of electrical energy, which is the problem that the researchers are working on.

8. Plan phase

At this phase the hardware and software requirements used to create the network are illustrated as follows:

8.1. Hardware requirements

Table 1. Hardware Requirements

N0	Devices	Function
1	Pc	Connect to access Layer
2	Server	Control smart devices that registered on it
3	Layer2 Switch 2960	Connect devices at access Layer
4	Camera	Building monitoring
5	Lamp	Building lighting
6	MD	Connect to L2switch and provide motion detection
7	Motion Sensor	To sense motion

*PC = Personal Computer & MD = Motion Detection

8.2. Software requirements

Cisco Packet Tracer 8.0 is simulator software used to design, Implement and operate the proposed network, as this version supports Internet of Things technology[12].

9. Design phase

Figure 3 shows the current status of the network

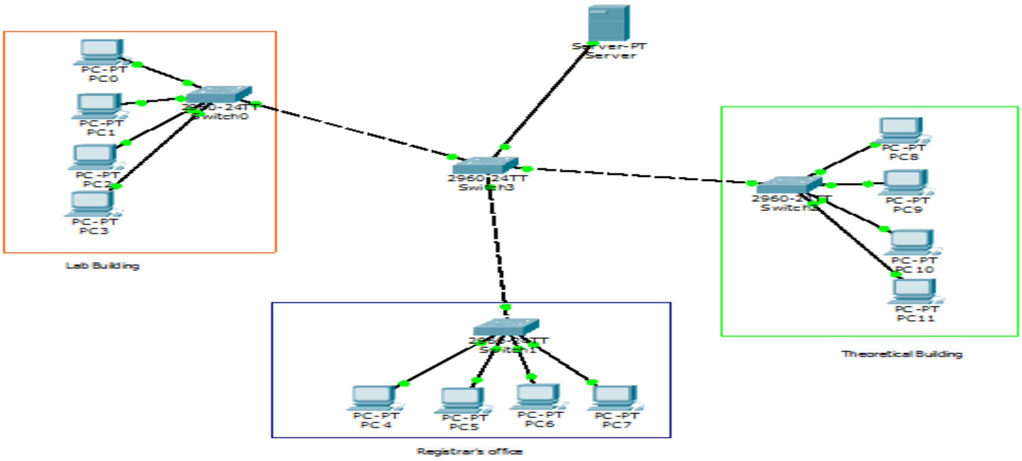


Figure 3. Current status of the network

Figure 4 shows the proposed status of the network

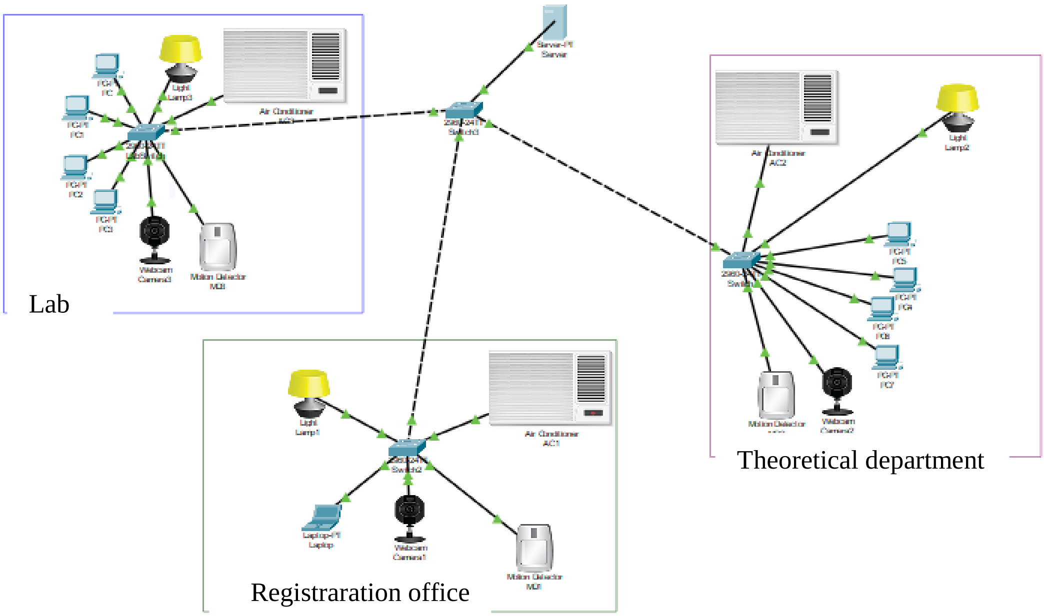


Figure 4. Proposed status of the network

We note that the current network is a local area network without using the Internet of Things. In the proposed system the network has been developed by adding Internet of Things devices, so that it becomes possible to control these elements through one of the devices within the network by using user name and password to control the settings and conditions operating these devices as we will explain in the next phase.

10. Implementation phase

In order to apply the proposed network we connected a number of computers to the server via a switch at a distributed layer and used a Motion detecors in each class and office connected directly to the switch. To implement the network design on cisco packer tracer, we used class

C IP address that is 192.168.1.0/24[13][14], no Domain Name Server had been used, and that's why the value of DNS is 0.0.0.0 in all the devices. Since the same devices are present in all classrooms and office, they will be configured only once in this paper.

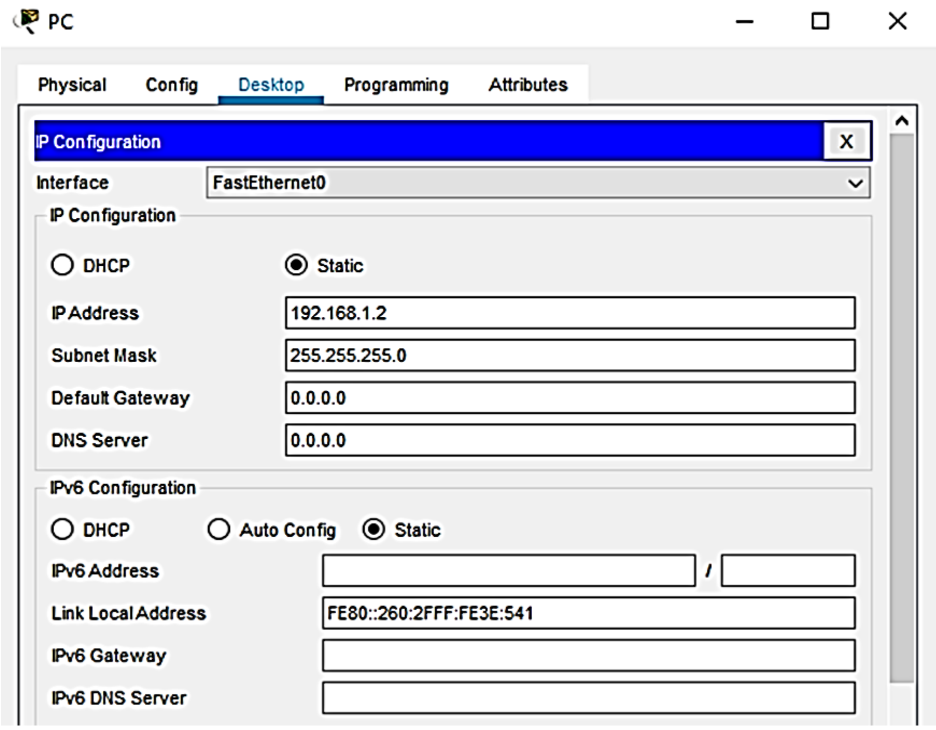


Figure 5. Assign IP address to PC

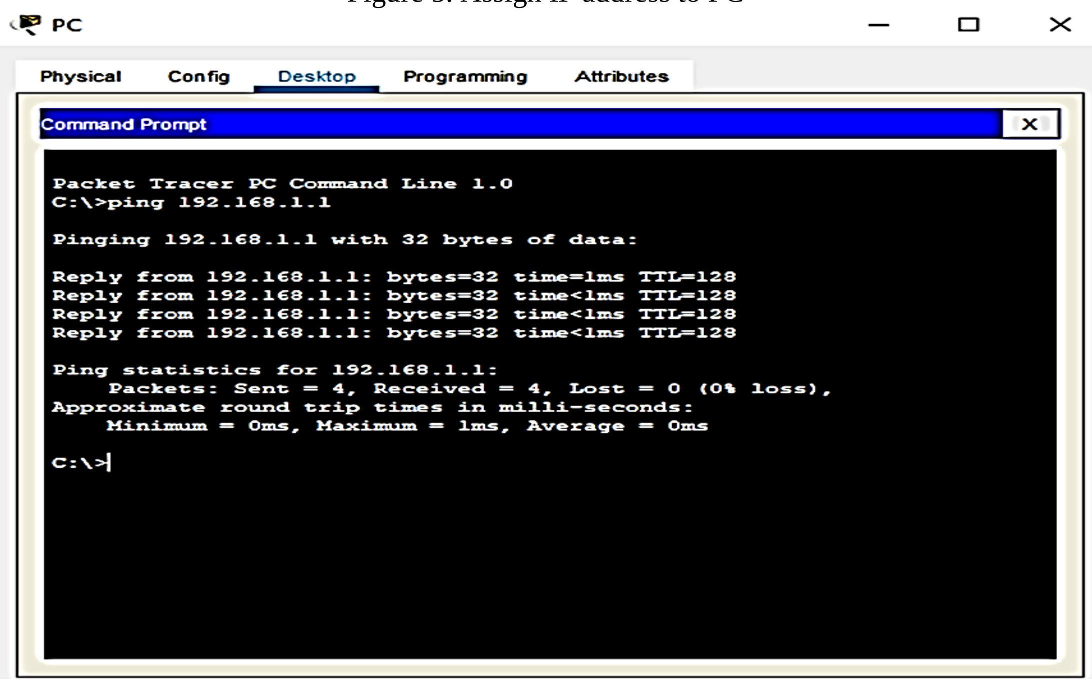


Figure 6. Checking connecting between PC and Server

Figure 7 shows how to turn the regular server into a registration server[15].

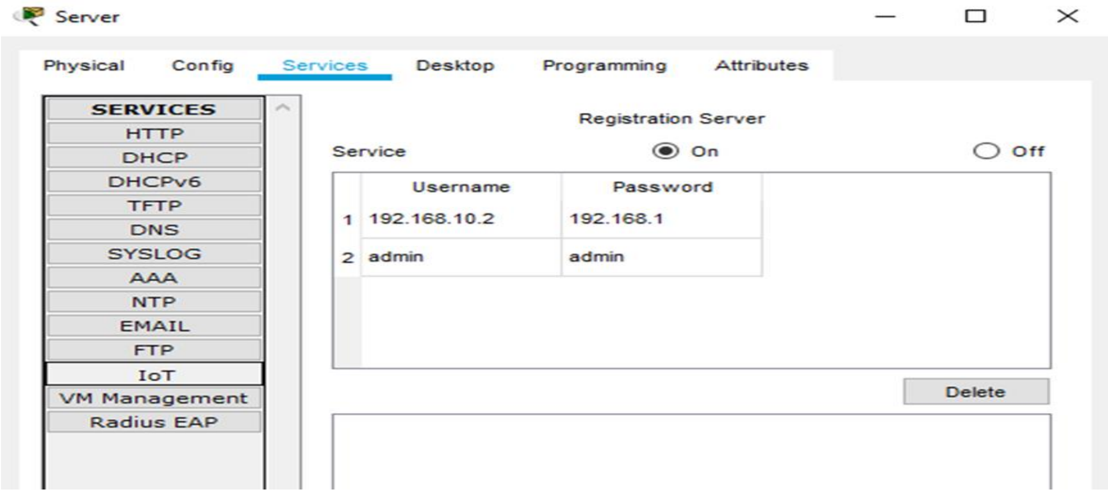


Figure 7. Registration server

All devices must use the same IoT credentials. The same credentials were also used by the network administrator for passing the authentication when connecting via browser to the main IoT monitoring homepage as shown in the Figure 8.

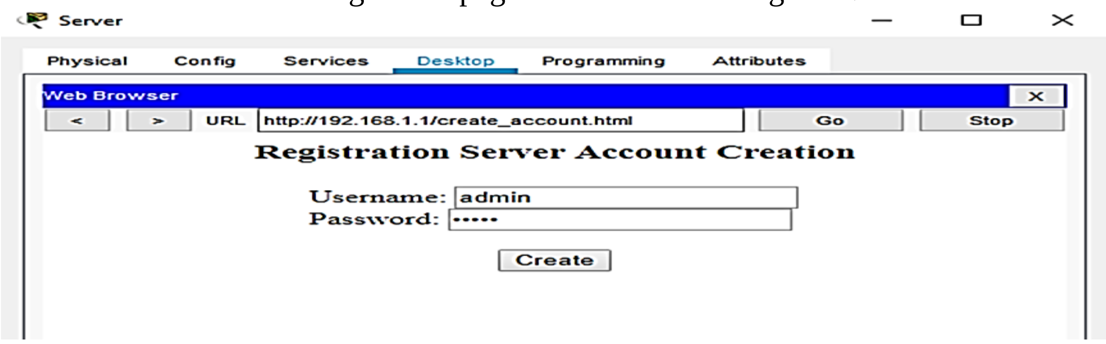


Figure 8. Registration on server login/sign up page

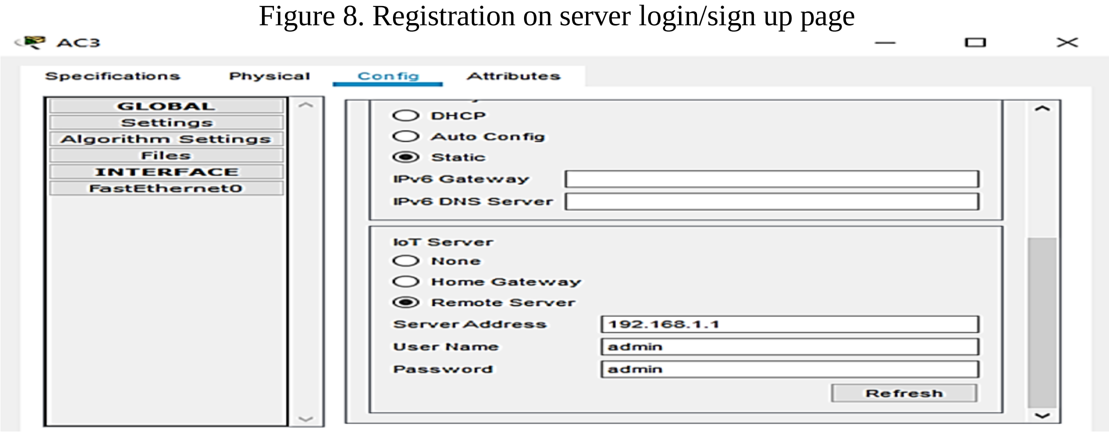


Figure 9. IoT setup on air conditioner

The following figure shows all IoT devices connected to the server where they were accessed remotely using a laptop computer and can be controlled remotely by turning them on or off.

Creating the IoT connection provided the possibility for the users to check the status of the IoT devices from an IoT browser homepage[16].

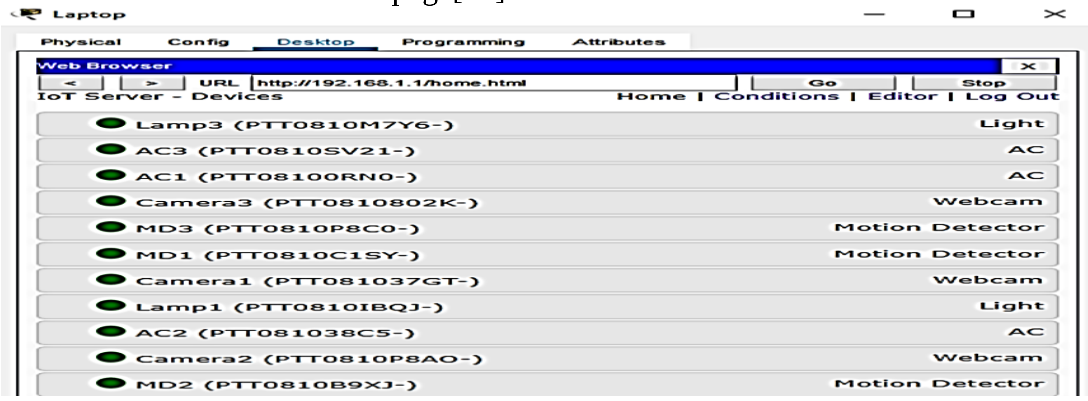
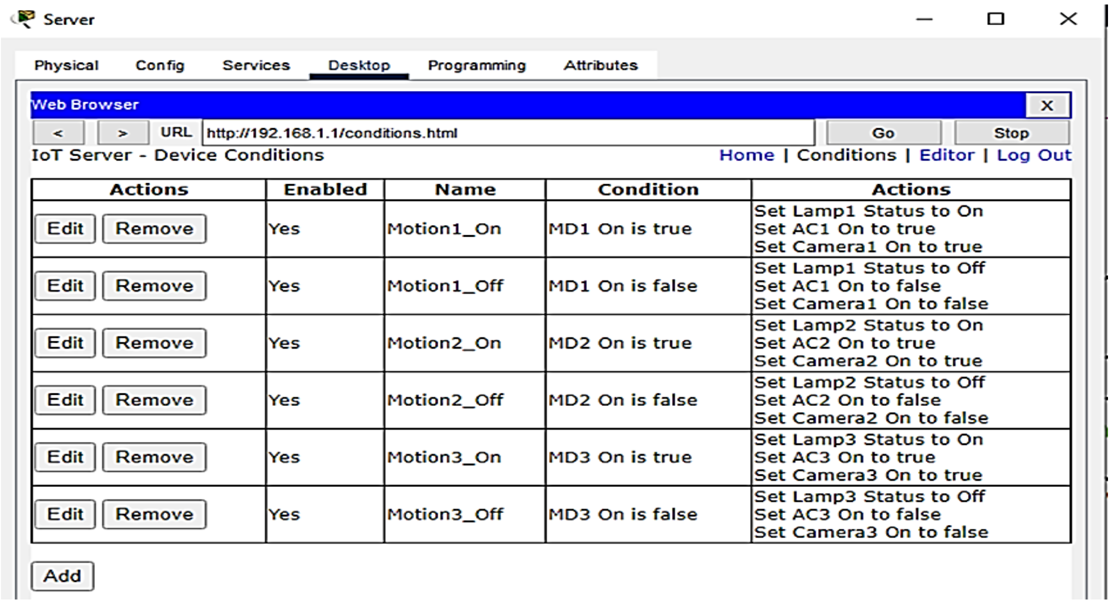


Figure 10. List of IOT devices connected

Figure (11) shows the three motion detection settings in each building[17], for example, the motion detection in the theoretical department, which is abbreviated as Motion_1.
Motion1_On: there is movement inside the building, accordingly the state of the devices is changed as follows:
-set lamp1 status on.
-set Ac1 status on.
-set Camera1 status on.
Motion1_Off: there isn't movement inside building, accordingly the states of the devices is changed as follows:
-set lamp1 status off.
-set Ac1 status off.
-set Camera1 status off.



Actions	Enabled	Name	Condition	Actions
Edit Remove	Yes	Motion1_On	MD1 On is true	Set Lamp1 Status to On Set AC1 On to true Set Camera1 On to true
Edit Remove	Yes	Motion1_Off	MD1 On is false	Set Lamp1 Status to Off Set AC1 On to false Set Camera1 On to false
Edit Remove	Yes	Motion2_On	MD2 On is true	Set Lamp2 Status to On Set AC2 On to true Set Camera2 On to true
Edit Remove	Yes	Motion2_Off	MD2 On is false	Set Lamp2 Status to Off Set AC2 On to false Set Camera2 On to false
Edit Remove	Yes	Motion3_On	MD3 On is true	Set Lamp3 Status to On Set AC3 On to true Set Camera3 On to true
Edit Remove	Yes	Motion3_Off	MD3 On is false	Set Lamp3 Status to Off Set AC3 On to false Set Camera3 On to false

Figure 11. Pre-set conditions

11. Operation phase

At this stage, we test the work of the network to ensure that it is working properly, and if any errors found, it is used as a reference for network development and updating.

11.1. Motion detector 3 work testing

The Motion detector becomes deactivated in case there is no movement within its field and as a result, all of the IOT devices associated become deactivated according to the configurations set up during the implementation phase as illustrated in (Figure 12).

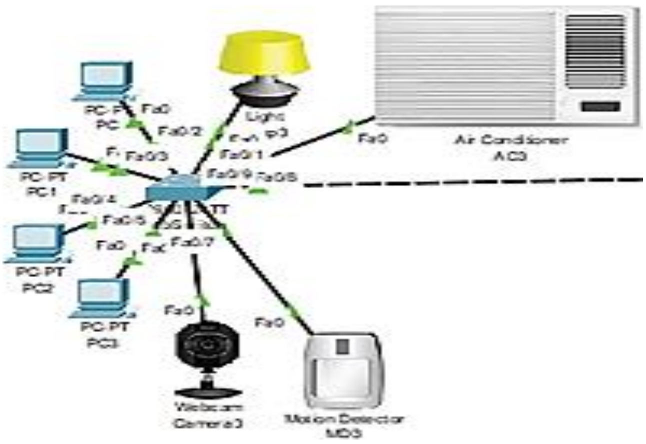


Figure 12. Motion detector 3 deactivated

The Motion detector MD becomes activated in case there is a movement within its field and as a result, all of the IOT devices associated become activated according to the configurations set up during the implementation phase as illustrated in (Figure 13).

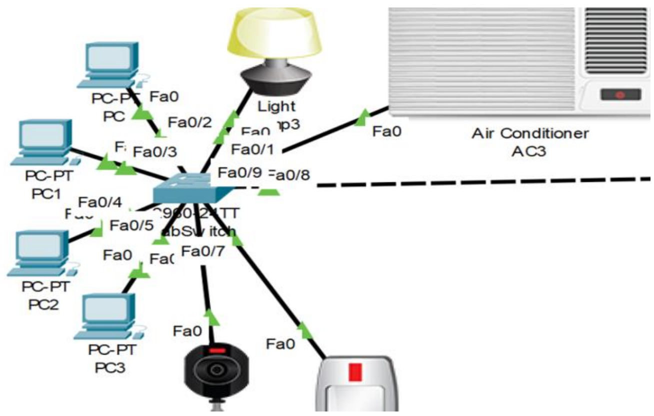


Figure 13. Motion detector 3 activated

Figure (14) shows that, there is movement caught on detectors 1,2 and 3 area therefore all IoT devices are activated.

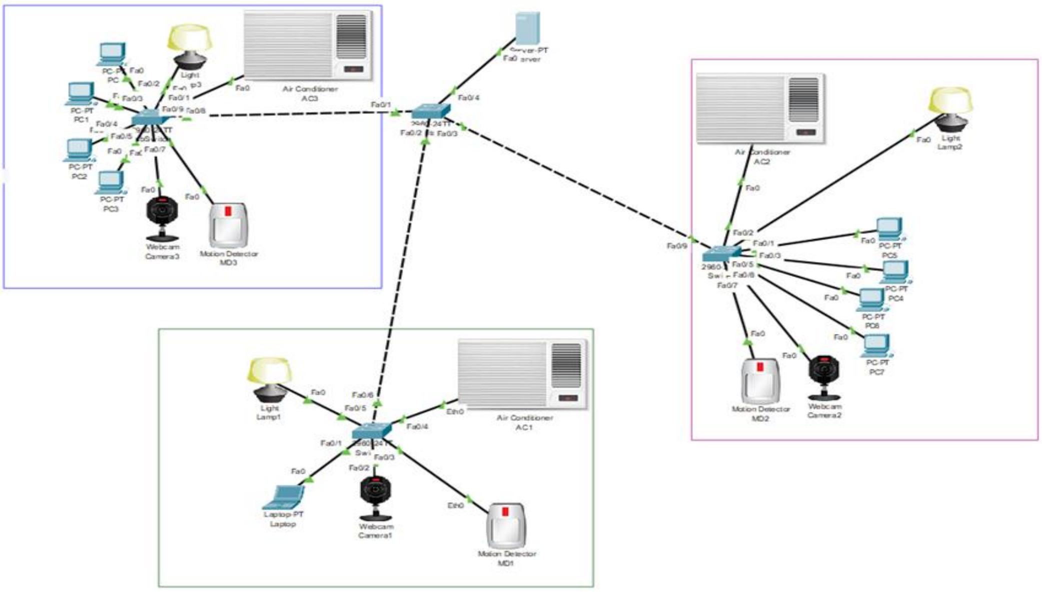


Figure 14. Motion detectors1,2 and 3 activated

12. Optimization phase

This stage incudes improving and updating the network. Adding heat sensor is one of the most significant network updates. The air conditioner associated with the network works only in two cases. The firs is once a movement is detected by the sensor and the second is when the room temperature exceeds a specific degree.

13. Conclusion

This paper proposed the use of IoT to save power in the collage of Information Technology .During the study we connected IOT devices to IOT server controlled by network administrator. The PPDIOO was adopted as research methodology. Cisco packet tracer software was used in all stages. This study has achieved the goal of saving power by using the internet of things.

14- Refernces

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