Design and Implement IoT Smart Home via Cisco Packet Tracer: Applications & Simulations

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Abstract

The Internet of Things (IoT) plays an important role in our daily life. It has become applicable to many aspects of our lives such as homes, colleges, universities, and has been expanded to cover even cities. One of the IoT applications is a designing of smart home. Smart home can be defined as a collection of IoT devices connected via home gateway, and can be controlled remotely using smart phone. Such these smart homes contain devices which have the ability to communicate with each other, and with their material environment. The smart home gives the owners the ability to customize, monitor, and track the home environment which in turn increase security, and manage energy in efficient and effective manner. The aim of this paper is to model and simulate an IoT system for smart home that uses different IoT devices that are addressable to allow the transmission of valuable information. The designing of smart home was effectively implemented using new released version of Cisco Packet Tracer simulator 7.3 that includes different kind of sensor and actuator and having different types of smart device used for automation.

Keywords: IoT technology, Cisco Packet Tracer, Smart Home, Home Gateway.

1. Introduction

The Internet of Things (IoT) can be defined as a connection of millions of smart devices and sensors via the Internet. The connected devices and sensors can be utilized to collect and share data. The collected data are used for evaluation by many organizations such as include homes, businesses, cities, governments, hospitals and individuals.

The IoT has been partly possible. This is due to the advent of cheap processors and wireless networks. The inanimate objects such as doorknobs, light bulbs, fans, etc. can now be equipped with an intelligent sensor that can collect and transfer data to a network [1][2].

The concept of IoT aims to connect billions of new devices to the Internet. According to an IoT publication from Cisco Academy, A third of connected devices will be computers, Smartphone, tablets, and smart TVs. The remaining two-thirds will be other kinds of "things": such as sensors, actuators, and newly invented intelligent devices that monitor, control, analyze, and optimize our world. Some examples of intelligent connected sensors are: smart doorbells, garage doors, thermostats, sports wearable, pacemakers, traffic lights, parking spots, and many others [3]. The following are some of useful applications of IoT [4]:

- **Smart energy**: the concept of smart energy is to use electricity efficiently when needed and help individuals to conserve energy according to their needs. Smart energy is achieved by an automated IoT monitor device that allows users to see how much energy they are consuming whenever an appliance is switch on.
- **Smart health**: smart health is considered to be an important application of IoT. Smart health monitoring devices are used to to monitor and evaluate the health condition of patients.
- **Smart manufacturing**: IoT applications have participated significantly in manufacturing. for example, an automated system runs by an IoT monitoring device can be used to restock raw materials in a manufacturing warehouse
- **Smart city**: there are many IoT applications used to improve urban intelligence. These include applications to monitor parking spaces, street lights, wind detector, and many others.
- **Smart Home:** there are a wide variety of IoT devices available to be used at home to make it smart. Such these devices are motion detector, lawn sprinkler, smart door, solar panel, and many other devices. These devices can be connected using home gateway to the Internet in order to be controlled remotely by smart phone.

2. Related works:

There are many scientific studies have been conducted in the field of the Internet of Things (IoT) in recent years. These studies aimed to apply the idea of IoT to various fields of our daily life. For example, Cisco Packet Tracer simulation software was used to create and implement the idea of a smart home [4]. The aim of the study was to find out the extent to which IoT can be applied to smart

homes, taking into account the provision of the necessary protection for the data sent between devices.

Other studies aimed at implementing the smart university using IoT technologies, relying mainly on version 7.3 of the Cisco Packet Tracer simulation program, which in turn contains new features of IoT devices [4][5].

Another study was aimed to design smart city where smart webcams can remotely transmit data packets. The study indicates that when the smart webcam are connected in a wireless medium, they can send and receive data packets via a 6LowPAN gateway which can be access by users in the Internet [4].

In contrast to previous studies which mainly focused on designing smart home as in [4, 5, and 6] or studies that relied on one type of IoT device to design a smart city as in [3], the focus of this paper is to model and simulate an IoT system for smart home. Different IoT devices are connected and addressed in such a way to allow the transmission of valuable information. In addition to that, the IoT devices are connected using home gateway to the Internet in order to be controlled remotely elsewhere by smart phone.

3. Methodology

In this study, packet tracer version 7.3 was used to model and simulate smart home. Packet Tracer is a visual simulation program designed by Cisco. It allows users to create and design computer networks that simulate real networks. Also, Cisco packet tracer provides a lot of IoT devices which can be used to create smart home. Figure 1 shows the Graphical User Interface (GUI) of Cisco Packet Tracer 7.3. [7] [8]

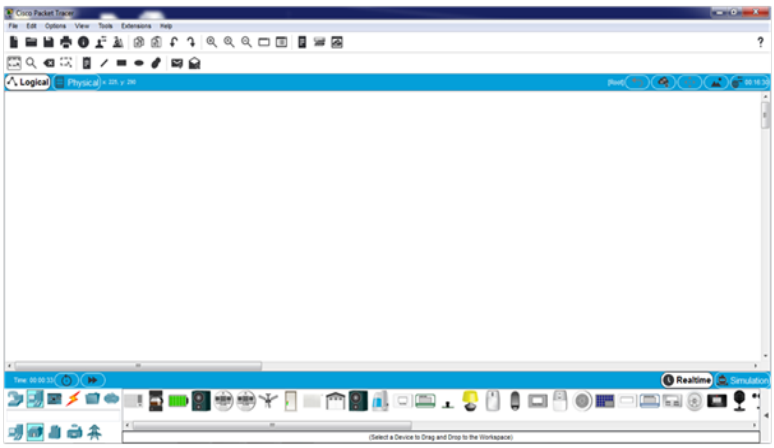


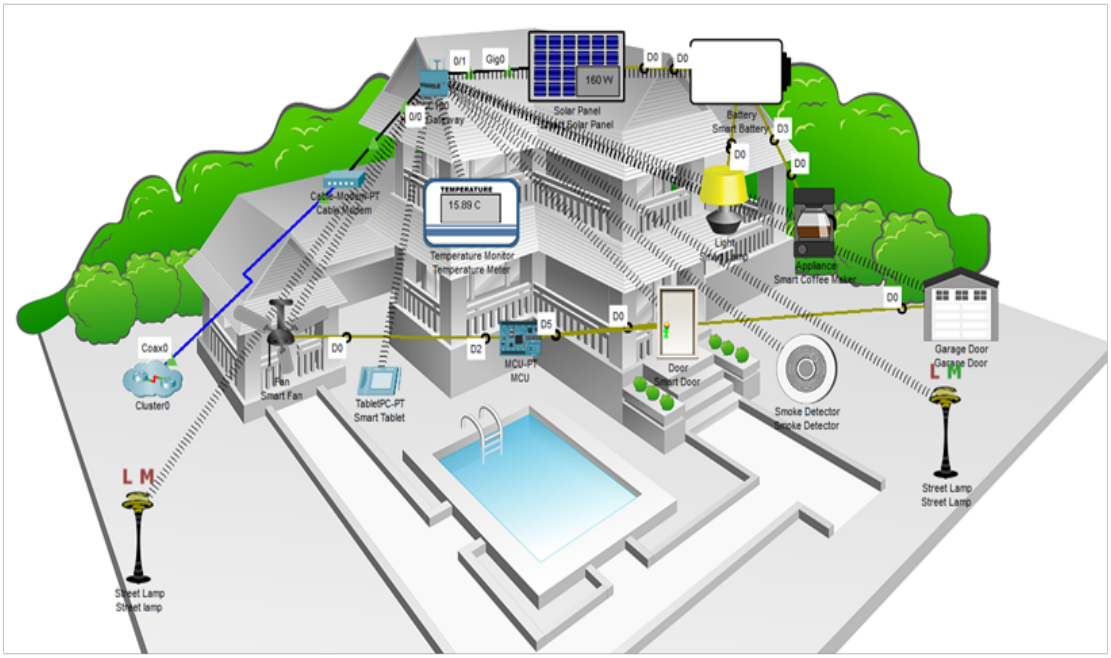
Figure 1:GUI of Cisco Packet Tracer [7]

Packet tracer simulation software was chosen in this study because of its characteristics as it distinguishes from other simulation programs as follows:

- It allows users to design complex networks.
- Users are allowed to explore Internet of Things concepts.
- It allows users to build, design and configure a smart city and smart home.
- Provides a realistic visualization and simulation of IoT devices

4. Implementation and Results:

Figure 2 shows the scenario of designed and simulated smart home. The smart home includes solar panel, smart battery, smart light, street lamp, smart door, smart fan, smoke detector, smart coffee maker, garage door, and temperature monitor. As shown in the Figure, all IoT devices are connected to the home gateway which in turn connected to the Internet through Cluster0.



Figures 2: Smart Home Network

The IoT devices connected to Home gateway obtained their network configuration settings from DHCP server which configured at the home gateway. This is achieved by changing the Network adapter to wireless and changing the IoT server for each IoT device to the Home Gateway as shown in Figure 3(a)-3(b) respectively.

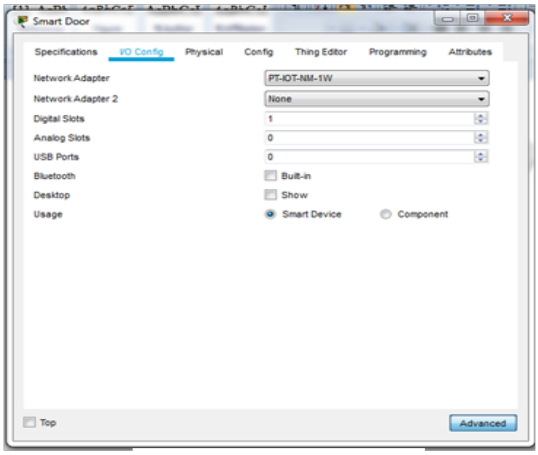


Figure 3(a)

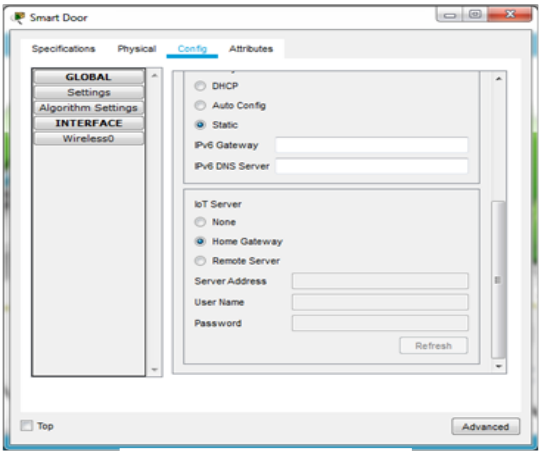


Figure 3(b)

Figures 3: (a) wireless adapter of IoT device, (b) change IoT server to Home Gateway

After connecting IoT devices to the Home Gateway, each IoT device obtains the IP settings from the IoT server (i.e. Home Gateway) as shown in Table 1.

Table1: network settings of IoT devices

IoT device	Connection Port	IP address	Home Gateway	DNS server
Solar Panel	GE0	192.168.1.110	192.168.1.1	200.0.0.1
Smart battery	Wireless0	192.168.1.108	192.168.1.1	200.0.0.1
Smart light	Wireless0	192.168.1.100	192.168.1.1	200.0.0.1
Street Lamp	Wireless0	192.168.1.105	192.168.1.1	200.0.0.1
Figure	Wireless0	192.168.1.112	192.168.1.1	200.0.0.1
Smart door	Wireless0	192.168.1.113	192.168.1.1	200.0.0.1
Temperature Monitor	Wireless0	192.168.1.117	192.168.1.1	200.0.0.1
Smart fan	Wireless0	192.168.1.118	192.168.1.1	200.0.0.1
Smoke detector	Wireless0	192.168.1.114	192.168.1.1	200.0.0.1
Garage door	Wireless0	192.168.1.116	192.168.1.1	200.0.0.1
Coffee Maker	Wireless0	192.168.1.115	192.168.1.1	200.0.0.1

The function of smart Tablet is to verify and monitor the IoT devices. This is achieved by logging into the Home Gateway using URL: http://192.168.1.1 as shown in Figure 4(a). In the Home Gateway Login screen, the username, and password are required which in our scenario is "admin". After successful login, all registered IoT devices with IoT server should appear as shown in Figure 4(b).

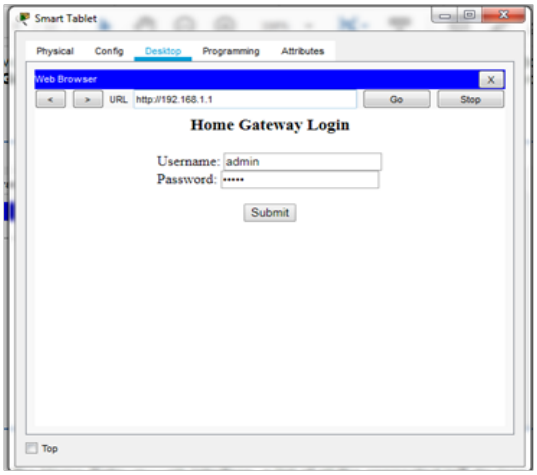


Figure 4(a)

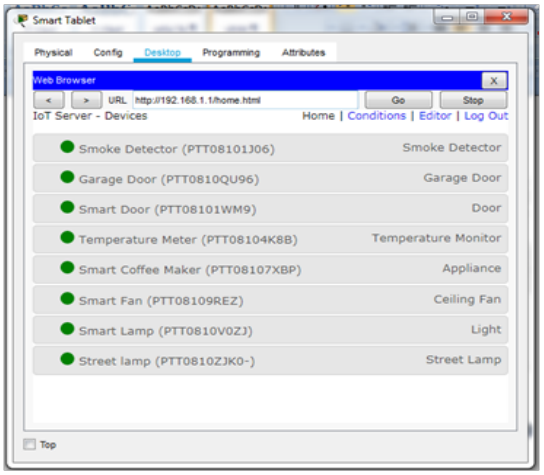


Figure 4(b)

Figures 4: (a) Home Gateway credential verification, (b) IoT devices registered at IoT server

The smart tablet can control all the IoT devices remotely. For instance, the tablet can OPEN and CLOSE the garage door by switch its status between ON and OFF as shown in Figure 5(a) - 5(b).

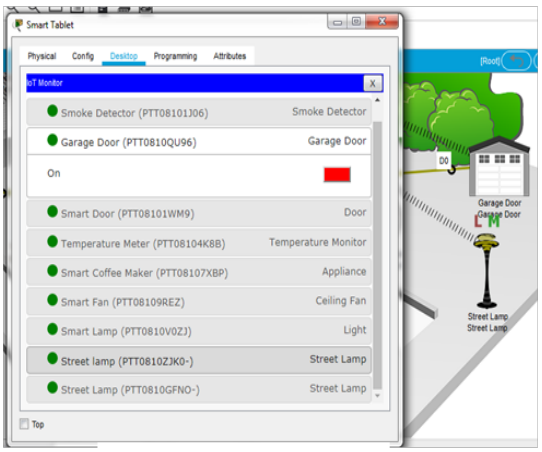


Figure 5(a)

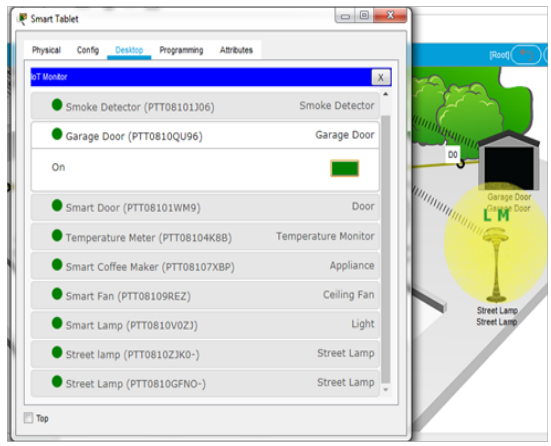


Figure 5(b)

Figures 5: (a) Red button indicates garage door is closed, (b) Green button indicates garage door is open

Another function which can be performed using IoT smart tablet is to control IoT device based on the condition of other IoT device. For instance, the status of smart lamp can be ON whenever the door is OPEN and vice versa. In other words: *IF* the condition "Smart Door Lock is Unlock" *THEN* the action "set

Smart Lamp status to ON", and *IF* the condition "Smart Door Lock is Lock" *THEN* the action "set Smart Lamp status to OFF". Figure 6 (a) - 6(b) shows the action taken of Smart Lamp based on the condition of Smart Door.

Figure 6(a)

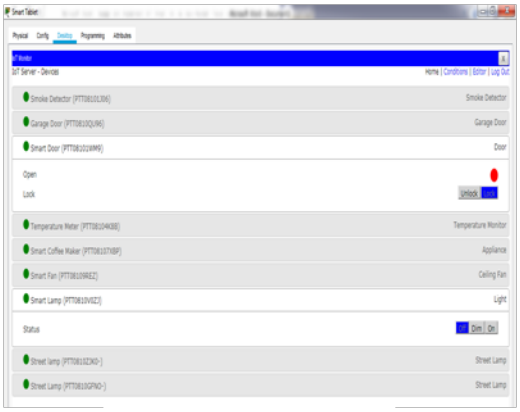


Figure 6(b)

Figures 6: action of smart Lamp based on Smart Door condition: (a) Smart Door OPEN, Light is ON, (b) Door CLOSED, Light is OFF

5. Conclusion and future work

In this study, smart home network was designed and implemented. New released version of Cisco packer trace 7.3 was used in this study because it includes new features of IoT devices. IoT Home Gateway functions as IoT server and a connection point between IoT devices. Smart tablet was used to control and monitor the IoT devices remotely. In addition to that, some IoT devices were automatically controlled based on the condition of other IoT devices. In future work, the focus will be on the adaption of IoT status based on the environmental conditions around the smart home

6. References

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