IMPLEMENTATION OF IoT BASED SMART HOME

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Electronics and Telecommunication Engineering

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APPROVAL

This Project titled **"Implementation of IoT Based Smart Home"**, submitted by Nusrat Doula Eshan and Al-Muhaimen Bashar to the Department of Information and Communication Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Electronics and Telecommunication Engineering and approved as to its style and contents. The presentation was held on January, 2019.

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We hereby declare that, this project has been done by us under the supervision of **Md. Taslim Arefin, Associate professor & Head, Department of ICE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

A smart home is an advantageous home setup where all home appliances and gadgets can be automatically controlled remotely from any web associated place in the world via smartphone or computer. Internet of Things (IoT) is an emerging technology that allow user to make a smart home to operate electronic gadgets and appliances through cell phone or computer. In this project, A smart home has been designed and presented using newly launched CISCO packet tracer-version 7.2 which included different smart object used for home automation such as smart window, smart fan, smart light, smart door, smart garage door, lawn sprinkler, fire sprinkler etc and different sensors. To governance these smart objects and sensors, Home Gateway and microcontroller (MCU-PT)-Single Board Computer(SBC) has been used, since it give programming environment for occupying smart object attached to it and give controlling methods by registering these smart device to Home Gateway respectively. Registration server is to be store all of the configuration and recognize all these devices so it could take action. When something happens registration server response quickly. After all of the IoT gadgets, sensors and appliances are linked to the home network wired or wirelessly and registered with the registration server, anyone will be capable to manage the IoT devices at home or away from home through the registration server.

LIST Of FIGURES

Table of Contents

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1.1 Introduction

The concept of "automated home/smart home" was first introduced over 80 years ago, and has been facing different technical limitations since then. Recently, service providers and home appliance manufacturers have launched a new initiative to bring the concept of smart homes to reality. [1]Much research in recent years has concentrated on the Internet of Things (IoT) which relates physical objects to network and maintains information of the things. Especially, the home domain is the most major field of IoT. Because the research survey reported that the number of connected devices will grow to nearly 8 billion devices for the year 2020 excepting mobile phone, and home devices have the biggest portion of them about 3.7 billion [2]. It means they will generate huge data such as sensory data, usage information and so on.

Home service providers want to develop various and advanced service using the data, but there remains a need for an efficient method that can analyze the data. Home automation has turned out to be one of the up and coming fields that present different advances for making the things simple to get to and with great execution. A home automation framework that enables the client to control the electrical and electronic gadgets. These days home automation plays an extensive variety of undertaking gotten to by web to decrease the physical work. In the current framework, very much created home automation is controlled utilizing Wired Communication. Here we are utilizing a Wireless Communication to control home automation to be advantageous with the propelled remote advances, for example, ZigBee, PIC microcontroller in the ongoing past, the Wireless framework is utilized all over the place. In recent years, remote frameworks like ZigBee have turned out to be increasingly more typical in home systems administration.

The Wireless Home Automation System (WHAS) is an incorporated framework to make simpler for elderly and incapacitated individuals with a simple to-utilize home automation framework that can be completely worked dependent on the web application. The framework is built in a way that is anything but difficult to introduce, arrange, run, and keep up. Moreover, a solid motivation behind why Hass is getting to be famous is that they are a lot of alluring highlights for debilitated individuals to control gadgets less demanding. In this paper, the home automation framework is

fundamentally utilized for debilitated individuals to control the electrical and Electronic gadgets. The gadgets in the house might be associated with a portable system to access those gadgets and may likewise permit remote access through the web. The clients can without much of a stretch access the android application by examining tapping the catches present on the touch screen of the Android gadget.

According to Coldwell Banker , 45 percent of the Americans either own smart home applications or plan to invest in them. Seventy percent of people with smart home technology said buying their first smart home product made them more likely to buy another one. Over 55% of Americans think a home can be considered smart if it has security (e.g., locks and alarm systems - 63 percent), temperature (e.g., thermostats and fans - 63 percent), lighting (e.g., light bulbs and lighting systems - 58 percent) and safety (e.g., fire/carbon monoxide detectors and nightlights - 56 percent). Sixty percent of Americans consider a house as smart if it owns at least three categories of smart products. [3]

1.2 Research Motivation

The internet of Things (IoT), a quickly increasing technology space that's shaping up to bring the subsequent revolution in data systems and computing technologies normally. This tutorial explores the key ideas of IoT and describes, however, ideas from multi agent systems, together with cooperative data systems, will support the IoT. It describes some further analysis advances required within the relevant areas to assist notice the IoT. We will focus on the connection between IoT and multi agent systems (MAS) research. We will present the advancements that empower IoT alongside a scope of agent applications. From these applications, we will digest out the real difficulties in understanding the vision of IoT. These incorporate detail of calculations; asset sharing; participation; sanctioning; building; and administration. Specific parts of the IoT that are pertinent to MAS incorporate the heterogeneity of IoT segments; power, availability, and computational asset limitations; offbeat and deferral tolerant correspondence; different managerial spaces with self-sufficient suppliers and shoppers; numerous partners with assorted and conceivably clashing prerequisites, including for asset utilization and protection.

The Internet of Things (IoT) has arrived. Sensors and embedded devices in vehicles, phones, watches, supermarkets, homes, roads and bridges, appliances and industrial and farm instrumentation, and wearable technology are already creating new style of info obtain able and dynamic the means info is made, consumed, and fully fledged. IoT clearly represents an excellent chance for advances in info analysis. The connections between IoT and knowledge storage and process yet as machine learning are obvious and gaining attention already.

FIGURE 1: REASON FOR RESEARCH ON IOT HOME AUTOMATION

The significant goal of this instructional exercise is to urge participants to comprehend IoT applications as decentralized multi agent frameworks built of heterogeneous and self-sufficient elements. Doing as such will empower them to efficiently approach reasonable difficulties that the IoT presents, for example, coordination among gadgets and crosswise over associations, and specialist concerns, for example, security and protection, and to distinguish new research propels that will help address these difficulties better.

1.3 Research Objectives

Various applications of home automation will makes our life easier and save our huge time. The objectives of this thesis are:

- To reduce power consumption
- To work time to time and successfully to save our time.
- To help the autistic peoples and helpful for the security purpose.

- To automate light, ceiling fan, coffee pot, door, window, controlling the temperature, automate lawn sprinkler, fire sprinkler and so on.
- To improve comfort-Monitoring Home From anywhere.
- To enhance activity-develop a Home automation remote system.

1.4 Research Outline

This project has been divided into this following chapters:

In chapter 1, we have discussed about introduction of Internet of things, motivation of our research, the main objectives of our research and research outline of our project.

In chapter 2, we have described about background of IoT and problem definition of our project. It has included IoT definition, Elements, Application, History, Characteristics, Cloud server, Network connectivity, Storage and IoT in the Perspective of Bangladesh.

In chapter 3. we have discussed about problem statement of this research.

In chapter 4 Highlights the methodology part of our project. It has included design procedure of sample home automation system, register with IoT server and install or configure IoT device.

In chapter 5, we have showed the results of our proposed model with screenshot and further investigation.

In chapter 6, we have described conclusion and the future scope of our project. It has also included the advantages and challenges of our project.

CHAPTER 2

BACKGROUND STUDY

2.1 IoT

The most important and crucial part of IoT is communication, as the main purpose of IoT is to communicate with various devices connected to the internet. The ability to communicate is important to label a device IoT enabled devices. All though there can be many other features such as sensing, mobility, memory, image processing and many more.

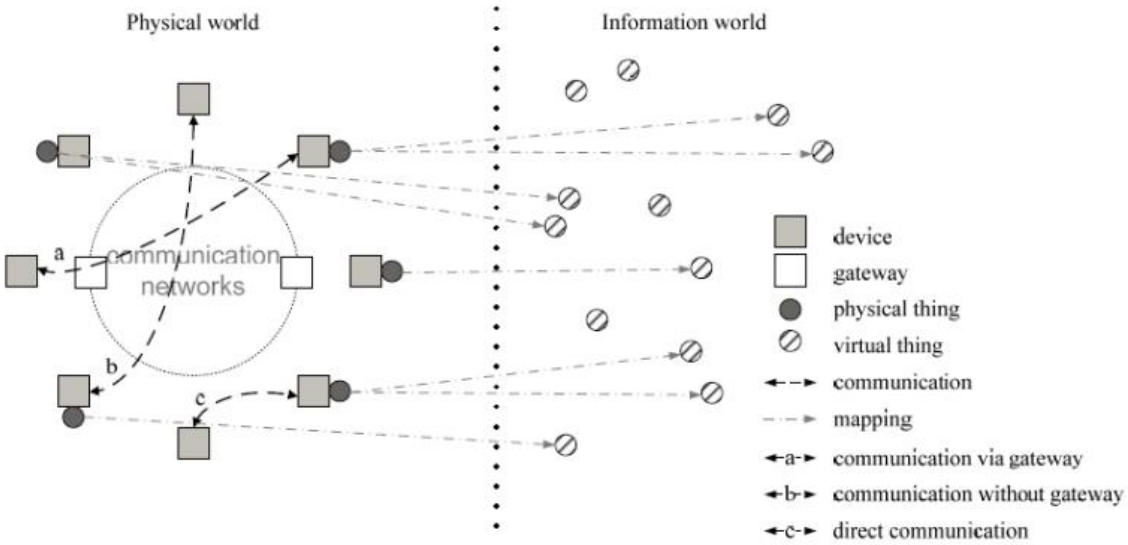


FIGURE 2. 1: OVERVIEW OF INTERNET OF THINGS [4]

The following figure is an example of an IoT prototype taken from [4]. From the picture it is evident that devices are not always required to connect to internet for transfer of data between them. If devices are close enough, protocols like Bluetooth and ZigBee can be used to transfer data

between devices easily. In case A, a device might communicate via gateway using IPv6 protocol 5 and then afterwards gateway can use another protocol such as IPv4 to communicate with internet. In case B it is shown that two devices can be communicate with each other directly without gateway since they are connected to same network. Not all virtual devices can be called IoT. There are some distinct features of an IoT device. The following table states the fundamental characteristics of IoT as per recommendation of IUT [4] .

TABLE1 : CHARACTERISTICS OF THE INTERNET OF THINGS

Characteristics	Description
Interconnectivity	Anything can be connected to the global information and communication highway.
Heterogeneity	Devices in IoT have different network and hardware with in them but still they can communicate with each other.
Dynamic changes	The condition of a gadget can change progressively; in this way the quantity of gadgets can fluctuate. (Device states: connected, disconnected, waking up, and sleeping)
Enormous scale	The quantity of gadgets working and imparting will be bigger than the quantity of gadgets in the present Internet. The vast majority of this correspondence will be gadget to gadget rather than human to gadget.
Things-related Services	Gives things-related administrations inside the limitations of things, for example, protection and semantic consistency amongst physical and virtual things.

2.1.1 History of IoT

Kevin Ashton, co-founder of the Auto-ID Center at MIT, first mentioned the internet of things in a presentation he made to Procter & Gamble (P&G) in 1999. Wanting to bring radio frequency ID (RFID) to the attention of P&G's senior management, Ashton called his presentation "Internet of Things" to incorporate the cool new trend of 1999: the internet. MIT professor Neil Gershenfeld's book, When Things Start to think, also appearing in 1999, didn't use the exact term but provided a clear vision of where IoT was headed. [5]

The idea of IoT started to gain some popularity in the summer of 2010. News leaked that Google's StreetView set had not only made 360 degree views but had also collected tons of data of people's Wifi networks. People were arguing whether this was the start of a new Google strategy to not only index the internet but also index the physical world. [6]

The same year, the Chinese government announced it would make the Internet of Things a strategic priority in their Five-Year-Plan. [6]

In 2011, Gartner, the market research company that invented the famous "hype-cycle for emerging technologies" included a new emerging phenomenon on their list: "The Internet of Things". [6]

The next year the theme of Europe's biggest Internet conference LeWeb was the "Internet of Things". At the same time popular tech-focused magazines like Forbes, Fast Company, and Wired starting using IoT as their vocabulary to describe the phenomenon.
In October of 2013, IDC published a report stating that the Internet of Things would be an $8.9 trillion market in 2020.

The term Internet of Things reached mass market awareness when in January 2014 Google announced to buy Nest for $3.2bn. At the same time the Consumer Electronics Show (CES) in Las Vegas was held under the theme of IoT. [6]

2.1.2 IoT Definition

The definition of the Internet of things has evolved due to convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems. [7] Sensors and

actuators embedded in physical objects are linked through wired and wireless networks, often using the same Internet Protocol (IP) that connects the Internet. [6]

The internet of things, or IoT, is an arrangement of interrelated figuring gadgets, mechanical and computerized machines, items, creatures or individuals that are furnished with one of a kind identifiers (UUIDs) and the capacity to exchange information over a system without expecting human-to-human or human-to-PC collaboration. A thing in the internet of things can be a man with a heart screen embeded, a homestead creature with a biochip transponder, a vehicle that has worked in sensors to alarm the driver when tire weight is low or some other regular or man-made protest that can be relegated an IP deliver and can exchange information over a system.

Progressively, associations in an assortment of enterprises are utilizing IoT to work all the more proficiently, better comprehend clients to convey upgraded client benefit, enhance basic leadership and increment the estimation of the business.

2.1.3 IoT in the Perspective of Bangladesh

The arrival of the Internet of Things (IoT) has opened the door of a new era to solve several types of problem in our every day's life. To keep pace with the modern technology, Bangladesh has already started so many projects based on IoT. The study says, within 2020 almost 30 billion objectives will be under the Internet of Things (IoT) [6].

Bangladesh is dreaming to be a part of this new system and solve countless problems and touch the dream of 'Digital Bangladesh'. As we know that IoT devices use a Subscriber Identification Module (SIM) based sensor or Non-SIM Based sensor to collect the data of mobile operators. They also use Short Range Device (SRD) and Industry Scientific and Medical (ISM) frequency. According to the National Frequency Allocation Plan (NFAP) and for maintaining the echo-system of IoT devices around the world, Bangladesh the government considers the following bandwidth for IoT device:

433.05-434.19 MHz
866-868 MHz
922-925 MHz
2400-2483.5 MHz

5'725-5875 MHz

This allocation will be reconsidered with the increased use of IoT devices. The maximum power output of the IoT devices will be 1~ 2 Watt/30~33.01 dBm. One possible interference can be, if any other allocated bandwidth frequency face any types of obstacle due to excessive use of IoT devices then IoT devices will remain closed until getting the permission from Bangladesh Telecommunication Regulatory Commission (BTRC).

2.1.4 IoT Application

There are various genuine uses of the internet of things, extending from buyer IoT and undertaking IoT to assembling and modern IoT (IIoT). IoT applications range various verticals, including car, telco, vitality and the sky is the limit from there. The extensive set of applications for IoT devices[23] is often divided into consumer, commercial, industrial, and infrastructure spaces. [8]

In the customer portion, for instance, smart homes or home automation that are furnished with intelligent indoor controls, keen machines and associated warming, lighting and electronic gadgets can be controlled remotely by means of PCs, smartphones or other mobiles phones. IoT devices are a part of the larger concept of home automation, which can include lighting, heating and air conditioning, media and security systems. [9]

Wearable gadgets with sensors and programming can gather and analyse client information, forwarding messages to different advances about the clients with the point of making clients' lives simpler and comfortable. Wearable gadgets are likewise utilized for open wellbeing - for instance, enhancing specialists on call's reaction times amid crises by giving upgraded courses to an area or by following development labour's or firefighters' essential hints at unsafe destinations.

In medical services, IoT offers numerous advantages, including the capacity to screen patients all the more closely to utilize the information that is created and break down it. Doctor's facilities regularly use IoT frameworks to finish undertakings, for example, stock administration, for the two pharmaceuticals and medical instruments. The Internet of Medical Things (also called the internet of health things) is an application of the IoT for medical and health related purposes, data collection and analysis for research, and monitoring. [9]

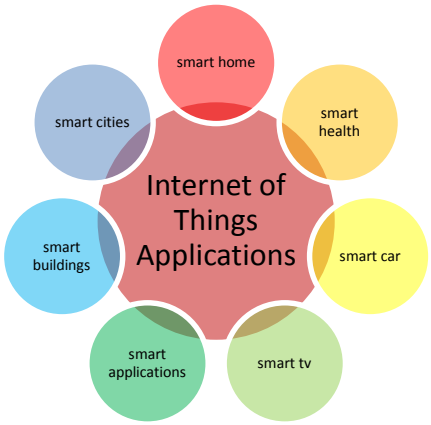


FIGURE 2. 2: SOME APPLICATIONS OF IOT

Smart buildings can, for example, lessen energy costs utilizing sensors that detect what number of tenants are in a room. The temperature can modify consequently - for instance, turning the climate control system on if sensors recognize a gathering room is full or setting the temperature down if everybody in the workplace has gone home. Building automation is an example of a distributed control system – the computer networking of electronic devices designed to monitor and control the mechanical, security, fire and flood safety, lighting (especially emergency lighting), HVAC and humidity control and ventilation systems in a building. [10] [11]

In agribusiness, IoT-based brilliant cultivating farming can encourage screen, for instance, light, temperature, mugginess and soil dampness of yield fields utilizing associated sensors. IoT is additionally instrumental in mechanizing water system frameworks. There are numerous IoT applications in farming such as collecting data on temperature, rainfall, humidity, wind speed, pest infestation, and soil content. This data can be used to automate farming techniques, take informed decisions to improve quality and quantity, minimize risk and waste, and reduce effort required to manage crops. [12]

In a smart city, IoT sensors and organizations, for example, intelligent streetlights and smart meters, can help mitigate traffic, preserve vitality, screen and address natural concerns, and enhance sanitation.

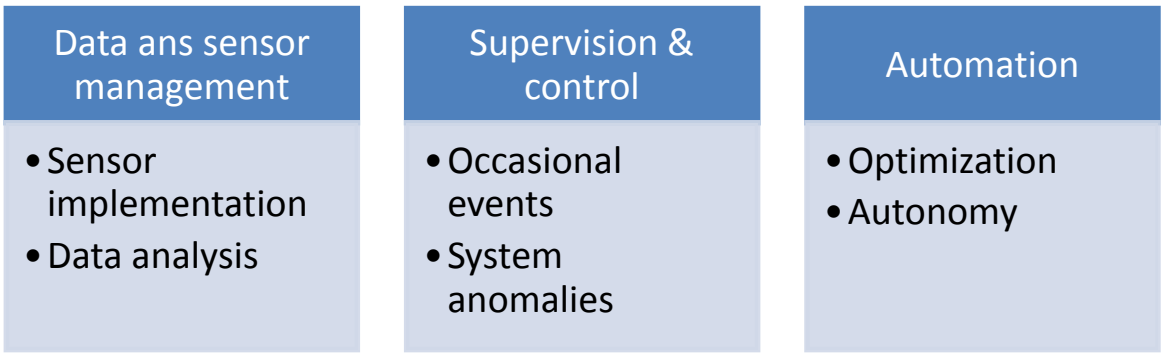


FIGURE 2. 3: APPLICATION OF IOT

CHAPTER 3

PROBLEM STATEMENT

3.1 Problem Definition

Since the invention of IoT, energy efficiency of IoT connected devices has been a concern for both researchers and inventors of this field. As the number of devices connected to internet is rising day by day, providing enough energy to all these devices has become a challenging issue. Many researchers have proposed various energy efficient scheme to tackle this problem. As our energy is limited and number of digital devices are increasing in manifold, it is necessary to think about a realistic approach that can make these smart devices power saving and energy efficient at the same time. IoT is now playing an important role in our day to day life. From smart wearable which can detect our fitness statistics to smart home, IoT is vibrant everywhere. Integration of IoT on our home appliances can make our life much more safe and smooth. For example, if a smart juice maker can prepare our juice with proper nutritious value or warn us against any harmful element in the juice then it can be a crucial element of daily lifestyle. Another important application of IoT is in health sectors. Nowadays, doctors can track the patient's heartbeat, pulse, temperature etc. just from his smart watch. Sensors built in the machine which is tracking patient's statistics continuously sending the signal to both nurse and doctors, they both are always updated with patient's condition. All these miracles are only possible by the help of IoT.

Sometimes we forget to turn off our electric devices at home and sometimes we wish to run our electric devices automatically when they needed. In a single sentence, we can say that "we just need smart devices who can understand our need in time". This is the era of information. We always want to get information about everything. We can't get information about our home devices all the time when we are not in touch with them. Surveillance is another major issue of our daily life. The world is getting smarter day by day that's why we also feel the need for a smart surveillance system. How it would be if any such devices keep an eye all the time to keep our home scrutinized. Another salient need is security, I mean smart security system. We feel the need for a smart secured authentication system to keep our home secure.

3.2 Set up Cloud Server

3.2.1 What are cloud servers?

Cloud servers offer great benefits over the traditional options of shared or dedicated servers.

In some respects cloud servers work in the same way as physical servers but the functions they provide can be very different.

When opting for cloud hosting, clients are renting virtual server space rather than renting or purchasing physical servers. These are often paid for by the hour, depending on the capacity required at any particular time.

3.2.2 The IoT server

When building up the IoT equipment and programming, one doesn't have to stress for setting up any servers or configuring a network or conveying databases as it is conceivable to utilize standard Virtual Private Servers (VPS). A VPS keeps running with its very own working framework; it enables its clients to have super user-level access so they can install software that keeps running on the OS. As these are software-defined, it can be quickly made and configured. Most IoT cloud server suppliers like Amazon or Microsoft Azure, give an electronic UI to deal with the server. The board offers simple access to administrations, for example, the establishment of the OS, and so on.

In order to collect and store data from the WSN via the IoT gateway an internet connected server is required. Controlling the WSN via the IoT gateway must also be performed by the server. To access the stored data and control the WSN a website hosted on the server is required. [13]

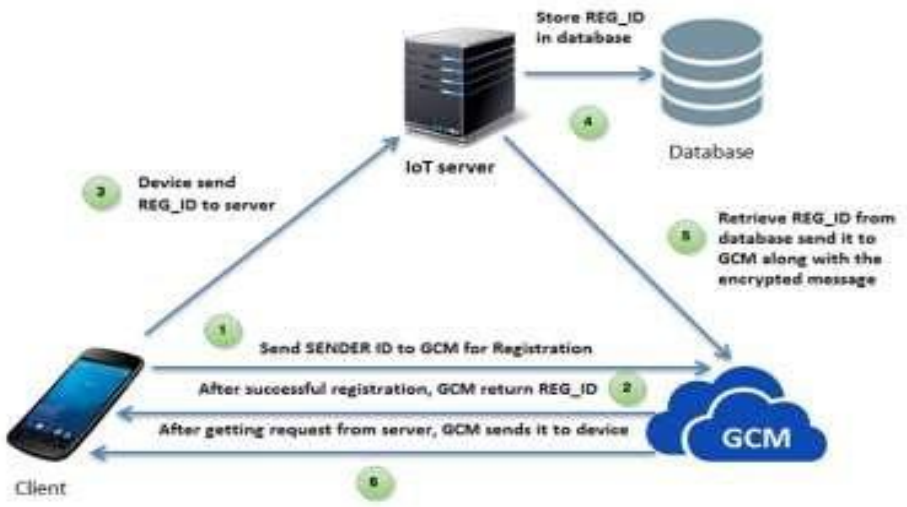


FIGURE 3.1: IOT SERVER

3.2.3 Minimum Requirements

A server is a computer running a customized software service for the integrated platform. In order to support the operating system and customized service the following minimum requirements need to be met :

- 1 GHZ processor.
- 512 mb of RAM
- 20 GB hard drive for the storage.
- Ethernet port or WiFi for internet connectivity. [13]

If we can not fill this minimum requirement we can never install a cloud server. We can use higher configuration computer for the better performance.

3.2.4 Network Connectivity

An internet connection is necessary to communicate with iot gateway and provide the access to the website. The internet connection must support high download and upload rates in order to decrease network delay and handle traffic generated by the IoT gateways and websites.

The iot gateways will connect to the server using a Virtual Private Network over Internet. The VPN connection must be secure in order to protect the communication between the server and IoT gateway from the intrusion and attempts to acquire sensor data or disrupt the network. [13]

3.2.5 Data Reception, Storage and Web server

A custom softer service on the server is required to collect and store data from the WSN via IoT gateways. The service must receive and unpack sensor data, and then store this data accordingly in database. Sensor data must be stored in a way that the sensor that produce the data, and the time the data was produced can be retrieved. Additional information such as conversion formula and sensor information must also be stored in the database.

The sensor data stored in the data base must be accessible from a website hosted on the server. The website is required to display. Graphed sensor data must be in the unit the sensor measures, which requires the conversation formulae stored in the database to be used. [13]

3.3 Current Problem And How to Solve

There are numerous issues, issues and key difficulties could be come in the Smart Home framework. As the uses of IoT are expanding quickly it is hard to handle every one of the

applications in IoT condition. It comes out issues that how to oversee and control these different expanding applications. The entire framework could not be progressively agreeable, secure if these expanding applications not controlled proficiently and helpfully [16]. Security is less on the server side as no uncommon technique for validation is utilized. This could prompts the uncertain framework. An assailant can gain admittance to unfortunate casualties home and he would break the entire Smart home framework. Availability is likewise the issue could happen [17]. It likewise comes into challenge that how to accomplish network at wherever whenever [17]. For correspondence towards web 3G administrations are utilized [18]. Be that as it may, it could have flag issue thus it won't associated unfailingly. The working of the savvy home framework in IoT condition ought to be done in real time. RF distinguishing proof is utilized at 433MHz [19] [16] [17]. It might cause the issue of impedance.

Standards: Standardization is extremely fundamental for IoT condition as it is growing all inclusive. Difficulties are comes related which standard ought to be utilized, which will give secure medium, how it will make framework more solid.

Identification: Identification is required for each gadget so every device can distinguish remarkably.

Privacy: The client's information ought to be classified. Association ought to be finished with giving protection.

Authentication: Authentication is must to anchor Keen Home framework from an assailant. Server needs to give get to just authentic clients.

Security: The framework should ready to take suitable activities on security dangers. What's more, framework ought to have the capacity to reconfigure independent from anyone else after assaults.

Integration: The principle challenge with IoT is to incorporate applications in IoT condition.

Coordination: Coordination is required between the universally associated articles, people, programs, process, and so forth.

Data Storage: As utilizations of IoT are expanding, the measure of information getting gathered is tremendous. The test is the place to capacity the tremendous information. Enormous database can explain this issue. Man-made reasoning calculations must be connected to remove meaning information from excess information.

Network Self-Association: Network structure ought to be made so that each gadget associated with it could self - sort out them. All things considered it is organize which ought to have the capacity to self - sort out.

CHAPTER 4

METHODOLOGY

4.1 Introduction

To implement smart home we used new released cisco packet tracer, which included different smart object used for home automation such as smart window, smart fan, smart light, smart door, smart garage door, lawn sprinkler, fire sprinkler and different sensor is included. To governance these smart objects and sensors, microcontroller (MCU-PT),SBC and Home Gateway used, since it give programming environment for occupying smart object attached to it and give controlling methods by registering these smart device to Home Gateway respectively .

4.1.1 Home Gateway

Home Gateway have four Ethernet ports in summation to a wireless access point construct with the "Home Gateway" SSID. To secure wireless connection WEP / WPA-PSK / WPA2 enterprise can be construct on home gateway. The following figure shows seven internet of Things device attached to a Home Gateway by using Ethernet and wireless. To attached the Home Gateway to the Internet its Internet WAN Ethernet port available on home gateway. The IoT device can be remotely operate through a web interface hosted by the Home Gateway. 192.168.25.1 is The Home Gateway internal (LAN) IP address but it can also be accessed through its Internet facing IP address.

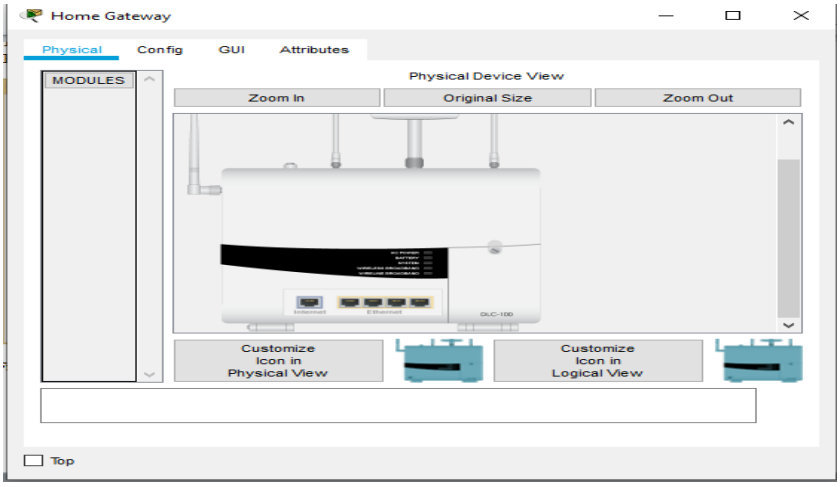


FIGURE 4. 1: HOME GATEWAY

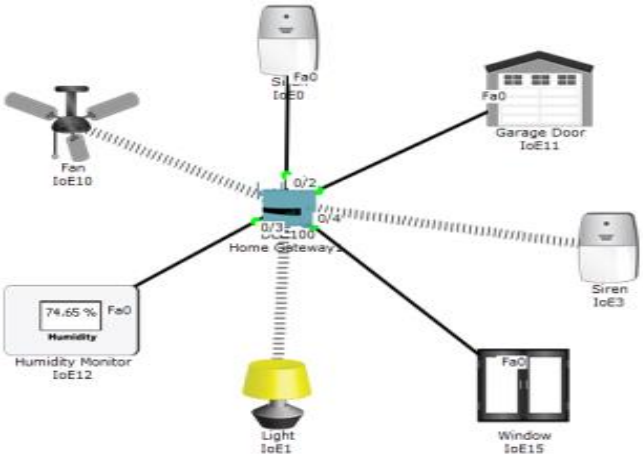


FIGURE 4. 2: HOME GATEWAY CONNECTED WITH SMART OBJECT

The above figure shows that the smart object is attached with the home Gateway using Ethernet cable and wireless medium to operate smart device local and remotely. Home gateway is work as DHCP server by put in IP address to each smart device that connected to it.

4.1.2 Microcontroller (MCU-PT) Board

Microcontroller board is used to connect different smart object at one point and provide programing condition with different language those are JavaScript, python and visual basic, to operate the connected smart object.

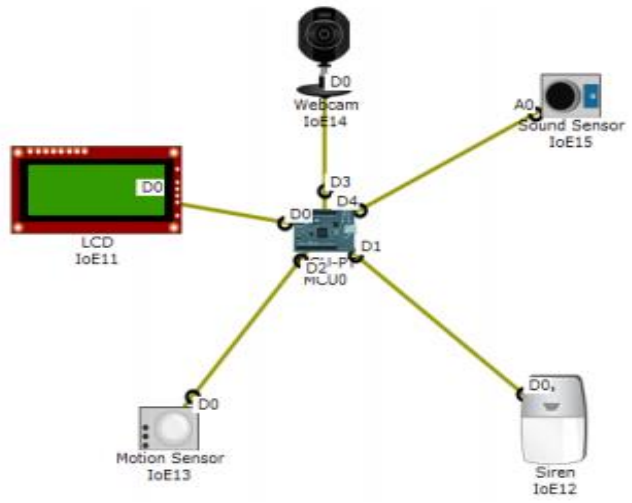


FIGURE 4. 3: IOT DEVICE CONNECTED WITH MCU

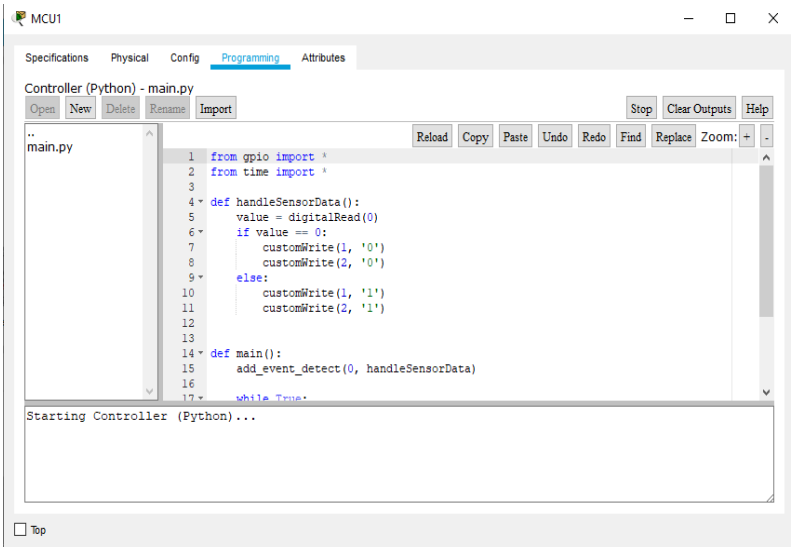


FIGURE 4. 4: MCU PROGRAMMING ENVIRONMENT

4.2 Design Procedure

In this chapter we'll discuss how to design a smart home using IoT devices in Packet Tracer 7.2 .As we know, with the automation and collaboration the devices in our home will be smarter. It makes our life become comfortable.

The first device need is the Home Gateway. This device is control point of other devices. The location of the Home Gateway is Network Devices- Wireless devices-Home Gateway.

Now design a living room by using a rectangular shape. In living room, there are a ceiling fan and window. Now, Let drag a ceiling fan and window on the workspace. These located at End Devices-Home-Fan, Window. Display name of these device may be exists as IoT1 or IoT2.So, For better understand, we'll change the display name in their CONFIG tab. Move fan and window to the rectangle shape and named it as living room.

To connect these devices (Fan, Window), We have to use wireless connection. To do that, first go to ceiling fan. Click on it. Go to CONFIG tab then ADVANCE. On the I.O CONFIG tab, we choose the wireless card as PT-IoT-NM-1W in network adaptors. Now a wireless connection between Ceiling Fan and Home Gateway is established. Do the same Process with the window.

Now use a smartphone to control these devices. The first step is connect the smartphone with Home Gateway. Let drag smartphone on workspace. Its located at End devices-End devices-Smart device. After placing smartphone on workspace, Click smartphone, click CONFIG, click WIRELESS0 then SSID.SSID is now as default. Now minimize this tab and click Home Gateway-Config -Wireless. See the SSID name here. Copy this and paste it on Samrtphone's SSID. Now a connection between smartphone and Home Gateway established.

The second step is to access Home Gateway. For this click these serially Smartphone-Desktop-IoT monitor. Minimize it. Click serially Home Gateway- Config - Lan. See the ip address here match with smartphone's IoT monitor. If match, the login. After login, no device are connected with this server Because we haven't register these device with Home Gateway.

4.2.1 Register IoT Device To Home Gateway

To register go to Ceiling Fan and click serially Ceiling Fan-Config. Select IoT server as Home Gateway. Do the same for window.

Then Click on Smartphone and open IoT monitor. Now fan and window are shown in the list. Expand Ceiling Fan and Window. See their status. By this, we can turn on the fan, change the speed .Also we can turn on the window, close the window.

Now we can install one and more sensor; Thermostat to get the temperature of the living room and we have rule that if temperature is over 15 degree Celsius, the fan will be turn on. If under 15 degree Celsius , fan will be turned off.

Click End devices-Home-Thermostat and drag it on workspace .Now Connect the Thermostat as Fast Ethernet0 and Home Gateway as Ethernet1 using Copper Straight Through cable.

Now click on Thermostat. Change the display name as your wish in CONFIG tab, and set the IoT server as Home Gateway. Then Click on Fast Ethernet and select DHCP from Static as IP configuration.

Now click Smartphone-Desktop-IoT monitor-Conditions-Add

Add condition as you want the output. Command works as what your conditions.

Examples:

Name-Turn on Ceiling fan

Match-Any

Thermostat-temperature- >= -15

Then set Ceiling fan status low

Now save it and add another role

Another role example

Name- Turn off ceiling fan

Match-any

Thermostat-temperature- <= 15

Then set Ceiling fan status off

So if in living room temperature is 15 degree Celsius or above, the fan will on, if under 15 degree Celsius, Fan will off.

A ceiling fan has three status; low speed, high speed and off. So we can change condition for change the speed status also.

Now we'll setup a smoke detector, alarm and a fire sprinkler. If the smoke level is above in your preset level. Then the alarm is activated and if situation is uncommon that means smoke level is high, fire sprinkler then activated and will give water.

Create a box by using rectangular shape. Name it as GARAGE.

Now drag smoke detector and rename it as smoke detector. Its located at End devices-Home. Connect the smoke detector with home gateway using copper straight cable where Fa0 in smoke detector and Ethernet1 in Home Gateway. Set IoT server as Home Gateway by clicking Smoke detector-config-IoT server. Then click Fast Ethernet-IP configuration. Select DHCP as IP configuration.

Then Drag a SIREN. Rename it as your wish in Config which anyone can understand. Set IoT server as Home Gateway. Select IP configuration as DHCP in the panel of FastEthernet0.this process is same as previous smoke detector setting.

Now drag a car on workspace to make smoke. Car will be find at End Device-Smart City-Car.

So the full diagram will be following this

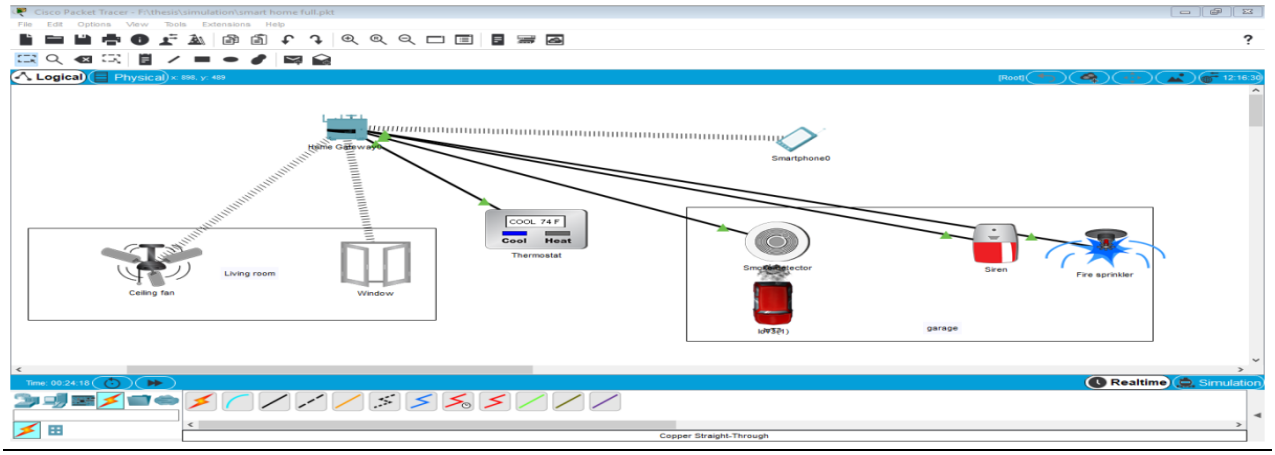


FIGURE 4. 5: DESIGN A SAMPLE

NOTE: You can attach many more device and sensor. This is just sample.

Now click on Smartphone-Desktop-IoT Monitor serially. See the all connected devices.

Now set condition as per your demand.

Example

Name-Alarm on

Match-any

Smoke detector level >= 0.00001

Then set siren on true.

So if smoke level is greater than or equal 0.0001, then the siren will be activated automatically.

Add Another rule

Name-Fire sprinkler on

Match –any

Smoke detector level >=0.00009

Then set Fire sprinkler status to true

In this example, if smoke detector level is arise ant when it will be greater than or equal 0.00009 the fire sprinkler is activated

Add many rule as this way what you want.

4.3 Install and Configure IoT Device

4.3.1 Background

In this section, we will discuss how to connect the computing and IoT devices to the home network. All the IoT devices have been configured to work with rocker switches connected to single-board computer (SBC) in Packet Tracer. In the workspace of Packet Tracer, the IoT devices need to be connected to the Home Gateway and registered with the registration server (www.register.pka).

SBC: A full computer with all functions like I/O, Processor, Memory. It's positioned in one board. SBC are very lighter in weight, compact in size, more reliable and much more power efficient then multi-board computers. It's mainly used in embedded applications. It's also used in applications for process control. It's often considered an replacement microcontrollers.

Let we have an account with the registration server already.

Server Address: **www.register.pka**

User Name: **admin**

Password: **admin**

Registration server is to be store all of the configuration and recognize all these devices so it could take action .When something happens registration server response quickly.

After the IoT gadgets are linked to the home network and registered with the registration server, you will be capable to manage the IoT devices at home, or away from home, through the registration server.

We'll install and configure the IoT gadget on the basis of following figure .

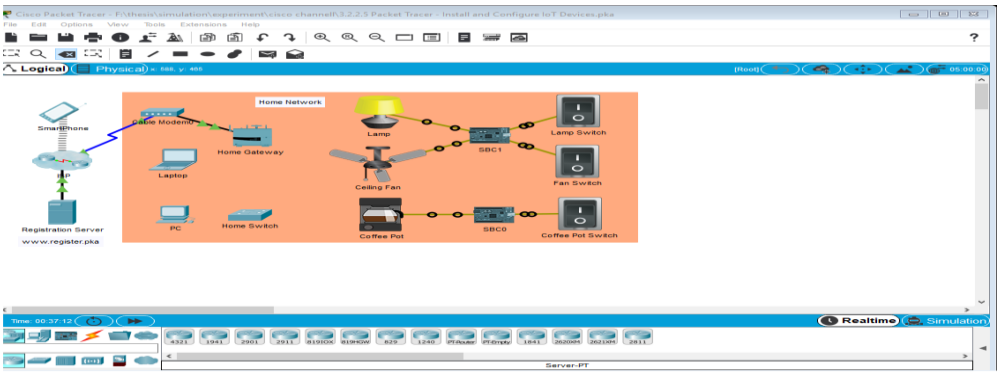


FIGURE 4. 6: TOPOLOGY FOR CONFIGURATION

4.3.2 Setting up the Home Network

In this part we have to set up home network. In step 1 we have to set up the wireless network and step 2, we'll set up wireless network

4.3.2.1 Setting up the wired network

Connect Home Switch to any available Ethernet port on Home Gateway using a copper straight-through cable. Where Home Switch is any available Fast Ethernet port and Home Gateway is any available Ethernet port.

a. Connect PC to any available Fast Ethernet port on Home Switch using a copper straight-through cable where PC will be FastEthernet0 port.

b. Now Click PC then Desktop and then IP Configuration.

c. Mark DHCP for the IP Configuration.

See now IP configuration change to DHCP from Static. A DHCP request is also successful.

First step is done here.

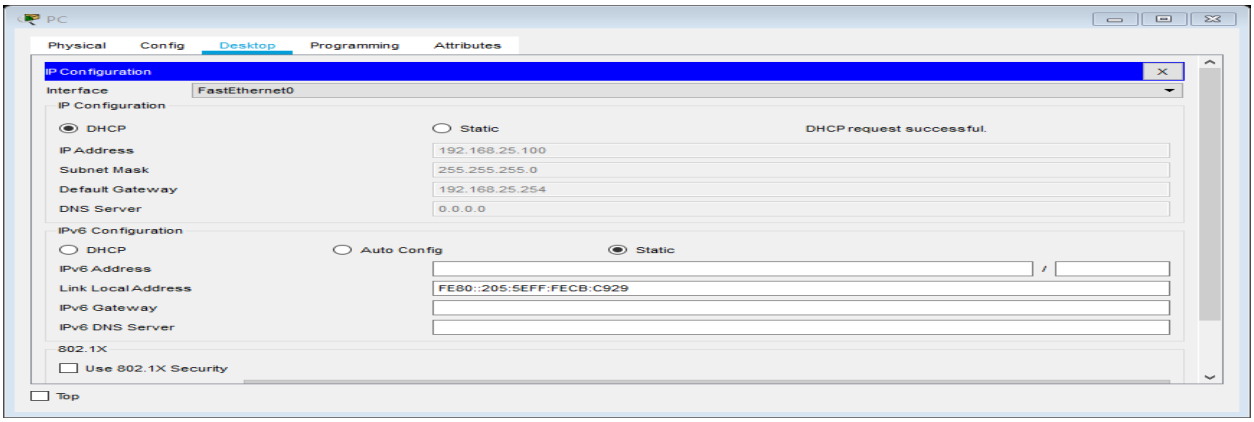


FIGURE 4. 7: SETTING UP WIRED NETWORK

4.3.2.2 Setting up the wireless network

a. In this part,first Click Home Gateway then click the Config tab. After that click Internet in the left panel.

b. Mark DHCP under Internet Settings. The Home Gateway will receive the settings from the ISP now. Observe a IP address is automatically appeared.

c. Again in Home Gateway, click Wireless

d. Edit the SSID as MyHomeGateway. Change the Authentication to WPA2-PSK as security purpose and write CiscoIoT as the PSK Pass Phrase.

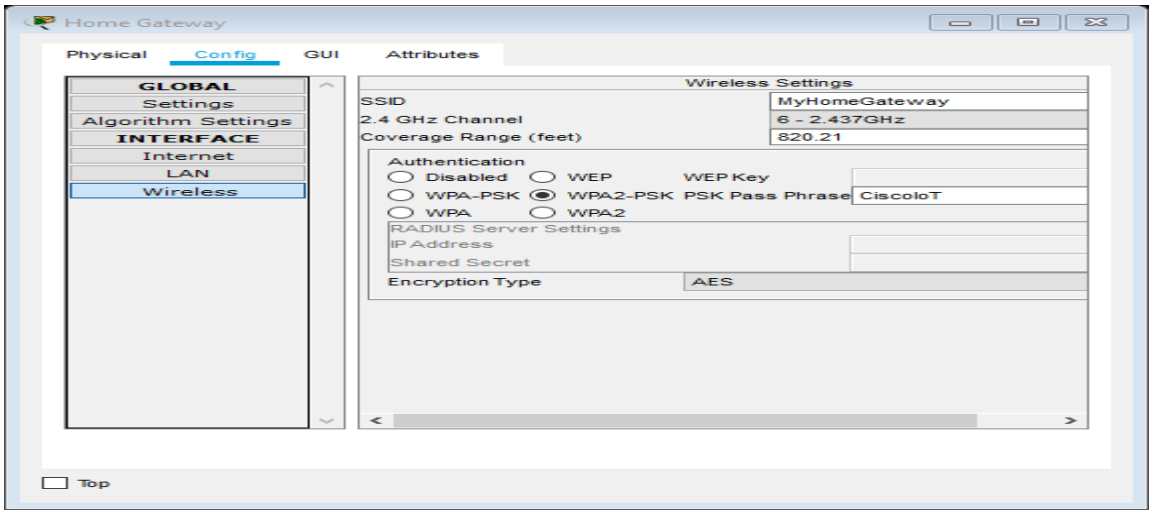


FIGURE 4. 8: WIRELESS SETTING CONFIG

e. Now click Laptop then Desktop then PC Wireless and Click Connect tab.

f. Select MyHome Gateway network. If wireless network name is not displayed, click Refresh.

g. Click Connect. Enter CiscoIoT as Pre-shared Key. Click Connect. After that , click Link Information tab and see successful connection status.

FIGURE 4. 9: LAPTOP LINK INFORMATION

4.3.2.3 Link the IoT devices to the network

IoT devices mainly linked through wires or wirelessly. The coffee pot will be linked to the network using Ethernet cables. The lamp and the ceiling fan will be linked wirelessly.

a. Connect the Coffee Pot to any available FastEthernet port using a copper straight-through cable with home switch.

b. Now click Coffee Pot for configure it. Go to Config and Click FastEthernet0. Mark DHCP for the IP Configuration.

c. Then click Lamp-Config-Wireless0. Write MyHomeGateway as the SSID. Select WPA2-PSK as security and write CiscoIoT as the PSK Pass Phrase. Now mark DHCP for the IP Configuration.

d. Run over step (c) for Ceiling Fan.

4.3.3 Interacting with IoT Gadget

The IoT gadgets can be configured to be managed directly, with switches, or via a web interface. In Part 2, you will join the IoT devices to a registration server so you can control the IoT gadgets via a web interface.

4.3.3.1 Approach the IoT devices locally

You can controlling the IoT devices directly by pressing **Alt** and clicking device at the same time.

a. Click Alt + Lamp a few times. How many settings does the Lamp have, and what are the settings?

-The lamp has 3 settings off, on, dim

Click Alt + Lamp Switch a few times. How many settings does the Lamp Switch have, and what are the settings?

-The lamp switch has two settings off. on

b. Repeat with the Ceiling Fan and Coffee Pot.

4.3.3.2 Configure the IoT devices for remote access

To monitoring the IoT gadgets remotely via a web interface, the gadgets must be registered with a registration server.

a. Click Lamp. Click Config.

b. You see Remote Server under the IoT Server heading. Select it and provide the following information to connect to the registration server.

Server Address: **www.register.pka**

User Name: **admin**

Password: **admin**

b. Click Connect to connect to the server.

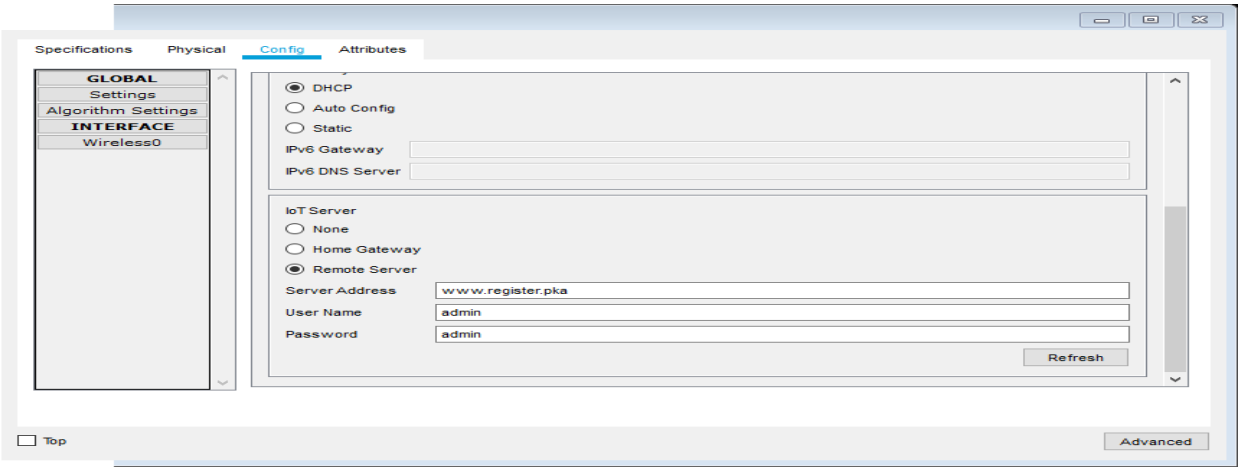


FIGURE 4. 10: CONNECTION SERVER

When you see refresh, that means it connected with server

c. Repeat steps a - c for **Ceiling Fan** and **Coffee Pot**.

Okay now all IoT gadgets (lamp, light, coffee pot) are connected to the server.

4.3.3.3 Approach the IoT devices remotely

a. Click on Laptop –then Desktop.

b. Click on Web Browser. Enter www.register.pka . Write admin as the Username and Password and then click Sign In.

Now you see ceiling fan, lamp and coffee pot are shown as IoT server-Devices.

d. Click the each device to view the device status and controllers. Ceiling Fan have three controller-off, low, high. Lamp has three controller-on, off, dim and coffee pot has one rectangle button. we can add condition as our wish.

d. Now turn on Lamp by clicking Dim. What happen to Lamp in the topology?

-Lamp turn on as Dim condition

What do you click to turn on the Coffee Pot from the Laptop?

-Red rectangle button

That means, in this server we can control IoT devices remotely. We can operate device by changing status. See the figure below for better understand. When fan status is low, you see fan status is also low in workspace. Coffee also turn on light when press the red rectangle button.

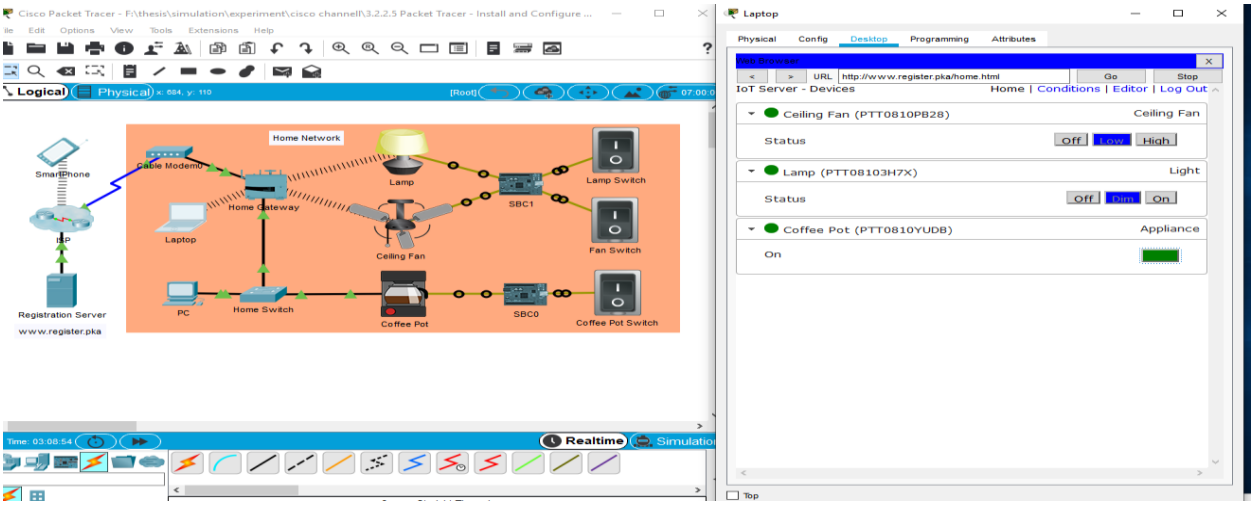


FIGURE 4. 11: CONNECTED DEVICE STATUS

e. You can also monitor the devices while you are away from home by entering the registration server. For that you have to go SmartPhone click on Desktop. Then click on Web Browser. Write www.register.pka in server area. Enter admin as the Username and Password and click Sign In.

CHAPTER 5

HOME IoT IMPLEMENTATION AND RESULTS

5.1 Scenario

In this packet tracer, we have to implement an IoT solution in an ideal home. You will investigate the diversity of devices and control environmental factors to see the influence on sensors and security settings for the gateway router. Finally, we will verify that all the devices in the home have IP connectivity.

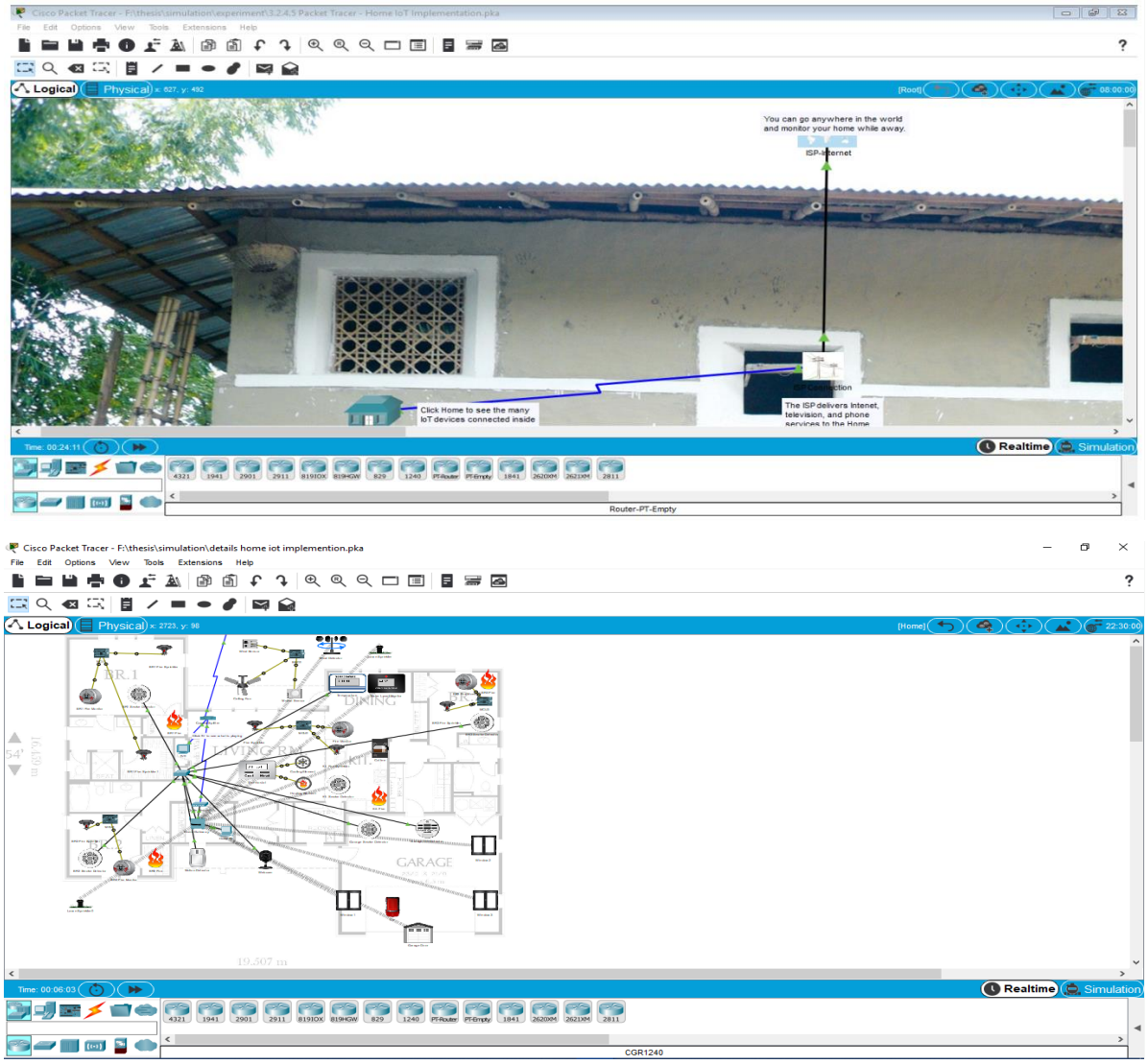


FIGURE 5. 1: PROPOSED HOME AUTOMATION MODEL

In Home cluster we have setup our implement our model like above topology(FIG 4.1)

In the above topology, we are set up our model like that. Smoke Detector(BR1,BR2,BR3),Motion Detector, Temperature, Webcam, Garage CO Detector and smoke detector, Home Gateway are interconnect with a switch via a copper straight-through. That means all things are connected with Home Gateway. Home PC is connected with Home Gateway via copper straight-through. Home Gateway is connected with an ISP via coaxial cable. All window, Lawn Sprinkler, Garage Door, Kitchen Smoke Detector, Coffee, Water Level Monitor, Wind Detector are connected to Home Gateway via wirelessly. Heating element and cooling elements are connected with Thermostat via

IoT cable. Fire Sprinkler and Fire Monitor are connected to MCU via IoT cable. Wind sensor, Motion sensor and Ceiling fan are connected to SBC via IoT cable.

In ISP Internet cluster we implement like as following fig(FIG 4.2) which isn't important in our project.

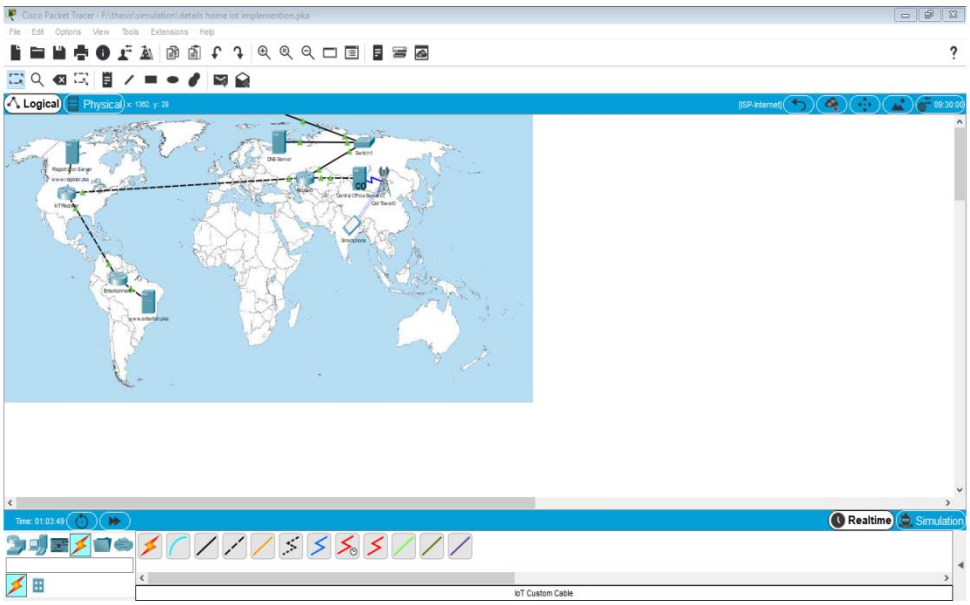


FIGURE 5. 2: ISP CLUSTER

Here we see that, all registration server are connected with central office server vaia router and IoT register where cooper crossover cable used. Central office server will be connected with cell tower.For this cell tower, we can operate our home via smartphone.

TABLE2: DEVICE USED FOR DESIGN

No	Device	Function
01	Router(1941)	Used to connection between home and cellular network.
02	Central Office Server	Used to connect between cellular network and router.
03	IoT Server	To control smart thing registered on it and provide difference server functionalities
04	Cell Tower	Distribute cellular coverage for home user to control the home appliance form remote.
05	DNS Server	DNS represents Domain Name System. This server imparts through convention which makes an interpretation of IP address into host name or host name into its IP address making it simple for both the client and the PC.
06	IoT Register	Register IoT device with IoT server.
07	Switch	It's the point for many connectetion with gateway
08	Home Gateway	Register and give IP address to smart objects.
09	Smartphone	Used to operate home from outside.
10	Home PC	Used to operate home inside of house.
11	MCU	Used to interconnect smart devices support proggraming.
12	Fire	Simulates fire.
13	Fire Sprinkler	A Sprinkler that puts out fire and raises the water level.
14	Fire Monitor	Monitor the amount of fire.
15	Smoke Detcetor	Detect any smoke.
16	Window	Ability to vent carbon dioxide and carbon mono oxide.
17	Garage Door	Registration Server Compatible Ability to vent Carbon Dioxide and Carbon Monoxide

18	CO Detector	Detect CO
19	Old Car	Increases Carbon Dioxide, Carbon Monoxide and Smoke
20	Water Level Monitor	Detect water level. It works with environmental objects.
21	Lawn Sprinkler	A Sprinkler for Lawn. Raises water level.
22	Motion Detector	Detect motion from mouse movement. Automatically deactivates after 5 seconds. Registration server compatible.
23	Webcam	A camera that record and send data. Video recording. Off-On. Registration server compatible.
24	Thermostat	Registration Server Compatible Off Mode Cooling Mode Heating Mode Auto Mode
25	Heating Element	Increases the temperature of a typical office space at 10C per hour. Reduces the humidity by 2% per hour.
26	Cooling Element	Cools the temperature of a typical office space at -10C per hour. Reduces the humidity by 2% per hour.

27	Temperature	Temperature Monitor is a device that gathers data concerning temperature from the environment and converts it to a readable form of data. Registration Server Compatible Detects and displays the temperature
28	Motion Sensor	A sensor that detects motion. Detects motion from mouse movement. Automatically deactivates after 5 seconds without any mouse movement.
29	Wind Sensor	A sensor that detects wind in the environment. Wind sensor works with Environment object; It reads "Wind Speed" variable set in the Environment object.
30	SBC	The SBC with the use of motion and wind sensors controls the status of the ceiling fan.
31	Ceiling Fan	Registration Server Compatible Off Low Speed High Speed Connect to the Fan with custom cable from MCU/SBC/Thing In the script, write the data to the Fan with custom. Write function to turn Fan off, set low speed/high speed

32	Wind Detector	Detects wind in the environment. Registration Server Compatible. Wind sensor works with Environment object; It reads "Wind Speed" variable set in the Environment object.
33	Coffee	Registration Server Compatible On-Off Connect Appliance to SBC or button and send a custom Write to turn on/off the Appliance

5.2 Associate Devices to the Home Gateway

We have to connect all the devices to the Home Gateway.

5.2.1 Set Up Home Gateway

In first step we have to configure the Home Gateway

a. First click on Home to enlarge the cluster.

b. Now click HomeGateway. Then click Config.

c. Now click on Internet. Mark DHCP for IP Configuration.

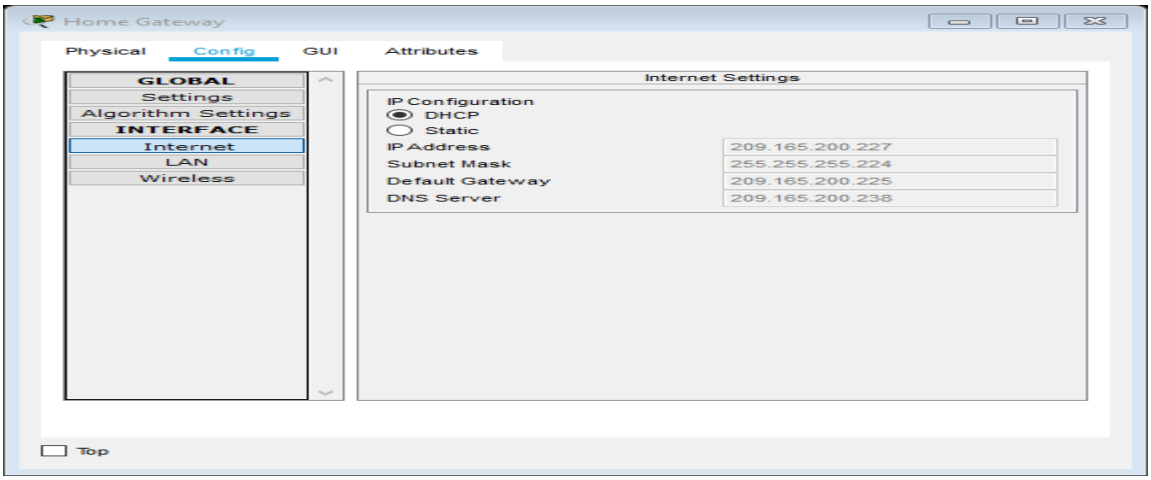


FIGURE 5. 3: HOME GATEWAY CONFIG

c. After then click on Wireless. Write MyHomeGateway as the SSID. Mark WPA2-PSK as the authentication. Write CiscoIoT as the PSK Pass Phrase.

Now you see all the IoT devices are connect with Home gateway via wireless.

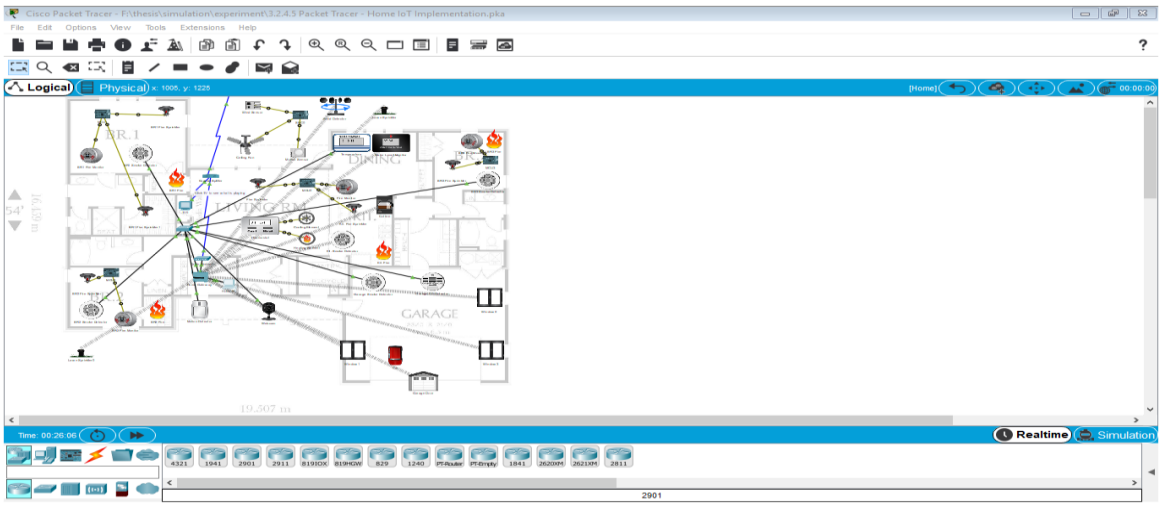


FIGURE 5. 4: IOT DEVICE CONNECTED WIRELESSLY

d. Lastly go back in expanded home cluster. click on Home PC, click Desktop and click IP Configuration. Select DHCP for IP Configuration for finishing this step.

You can see a DHCP request successful.

5.2.2 Prove Home Gateway connectivity to registration server

In this step have to verify the Home Gateway connectivity to registration server

a. From this Home PC, go to www.register.pka in the Web Browser. Write admin as the Username and the Password to log in to the remote registration server.

Note: It may take some minutes for all the IoT devices to be listed.

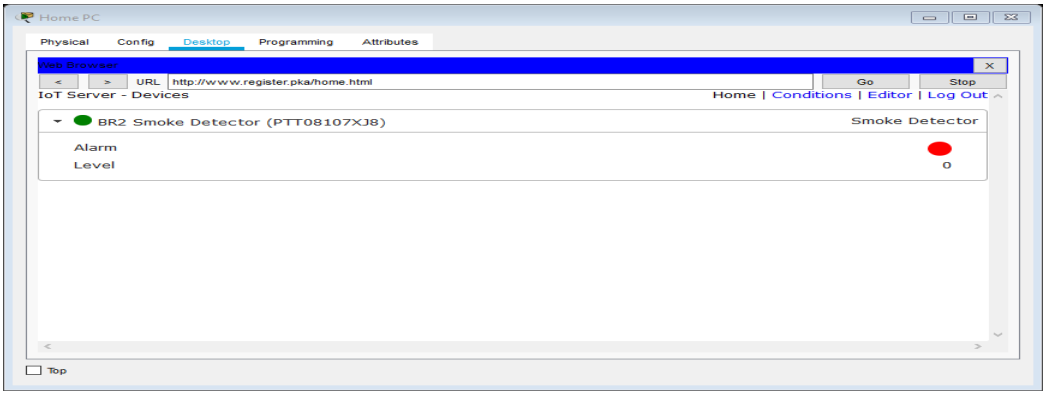


FIGURE 5. 5: LISTED IOT DEVICE

List some of the IoT devices:

-BR2 Smoke Detector

What are some available actions for these IoT devices?

See the above figure. There is a red dot mark and under this mark 0 is shown. So there is no action.

If you facing trouble in this section restart your packet tracer and follow (b)

b. Now From Home PC, Go to 192.168.25.1 in the Web Browser. Write admin as the Username and the Password to log into the local IoT server hosted on Home Gateway.

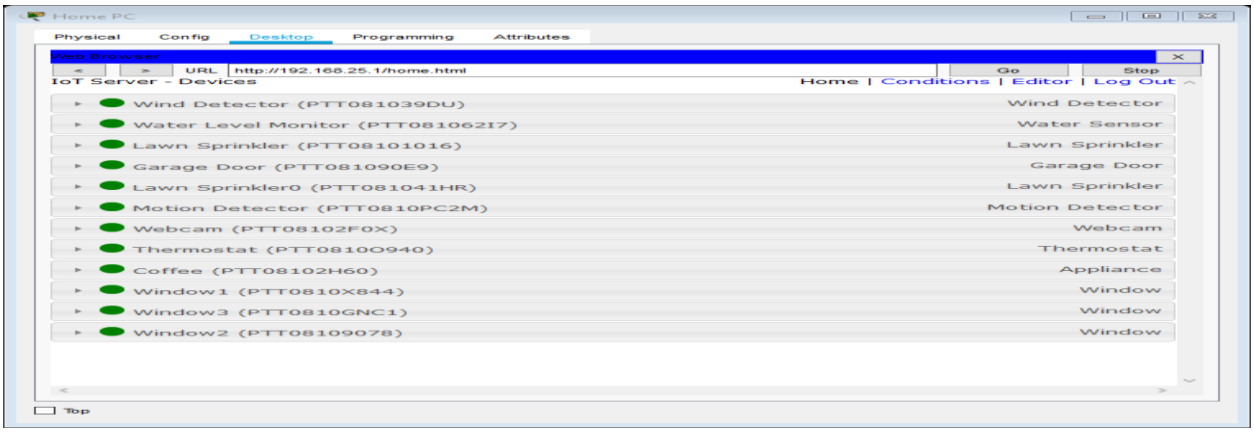
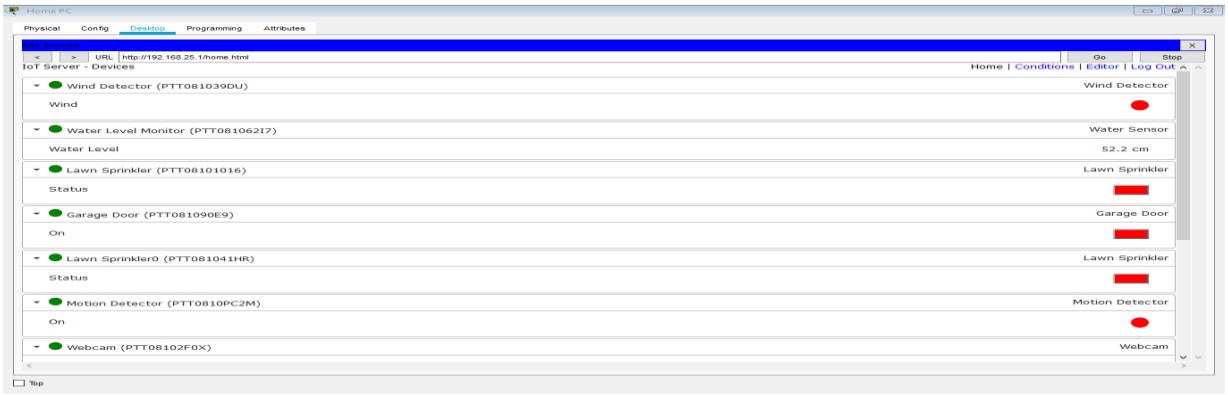


FIGURE 5. 6: LIST OF DEVICE CONNECTED WITH SERVER



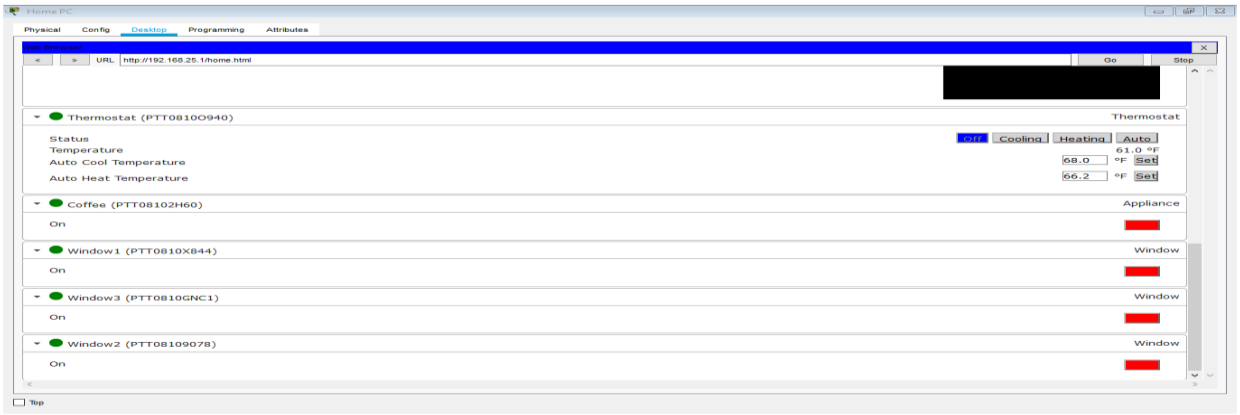


FIGURE 5. 7: AVAILABLE ACTIONS

5.3 Results-Interacting with IoT Devices

In this part we see the result that all devices are works or not step by step

5.3.1: Automate temperature control

Currently the Thermostat is off. So set the Thermostat to automatically adjust to the aimed setting.

a. First extend the Thermostat status bar and set it to Auto. Write the desired auto heating and auto cooling temperatures and click Set.

b. Now notice the Heating Element and Cooling Element as they adjust the temperature

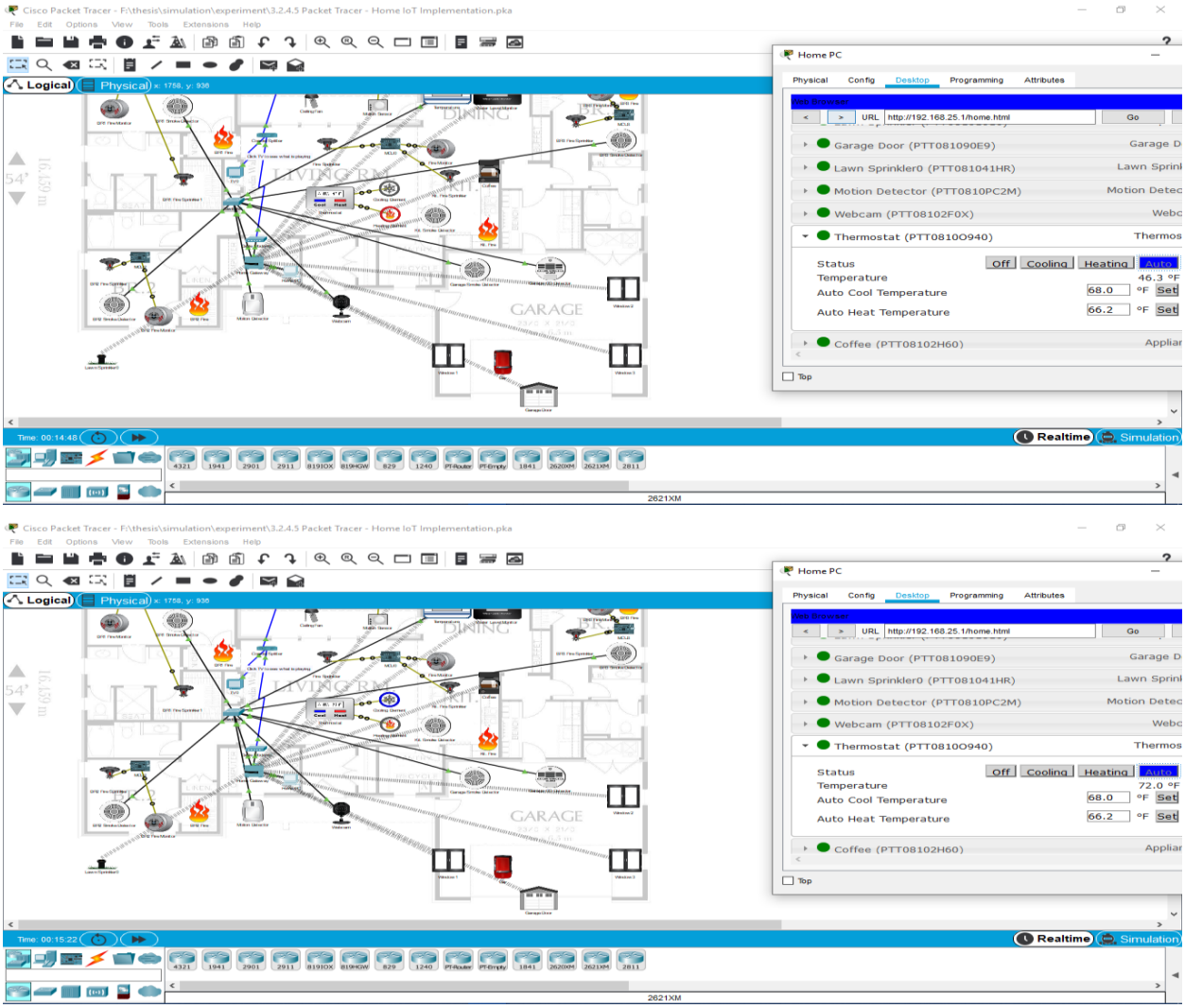


FIGURE 5. 8: AUTOMATE TEMPERATURE

You can see the heating element and cooling element change their color depending on temperature. Heating element as red color and cooling element as green color.

5.3.2 Automate the Ceiling Fan

The Ceiling Fan is set-up to turn on only when motion is detected and no wind detected. This SBC0(SINGLE BOARD COMPUTER) with the use of motion and wind sensors controls the status of the ceiling fan.

Alt + Click the Motion Sensor close the Ceiling Fan. It will turn on the Motion Sensor.

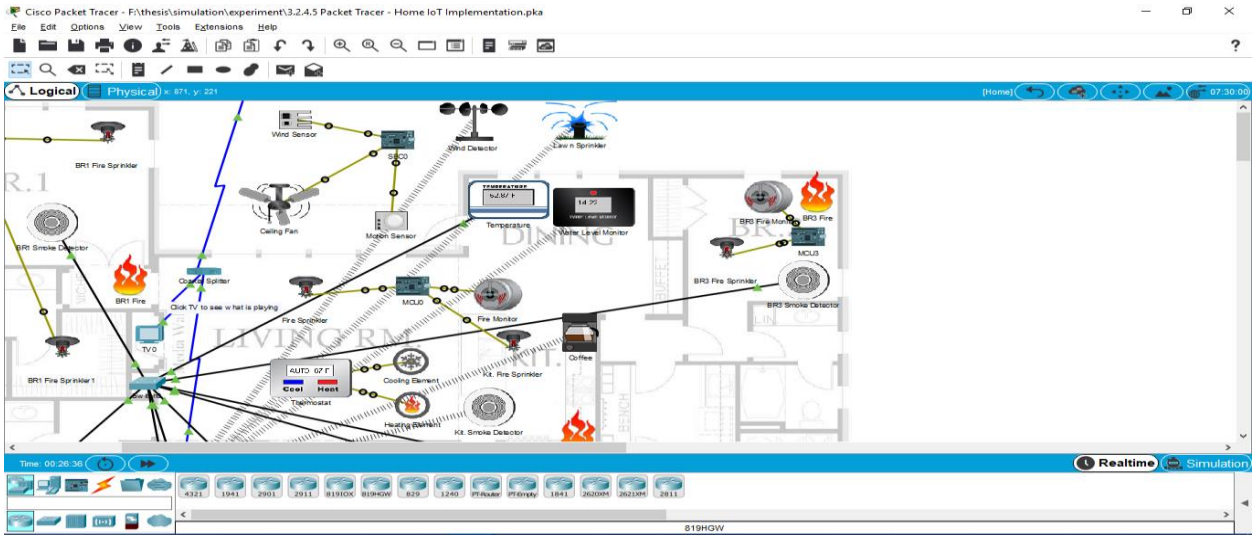


FIGURE 5. 9: AUTOMATE CEILING FAN

We see that Fan is now turn on. If we connect the fan with temperature and set an another condition in which temperature fan speed will be high and low, you can set it also.

5.3.3 Automate Coffee Pot

In this step we can operate our coffee maker using Home PC

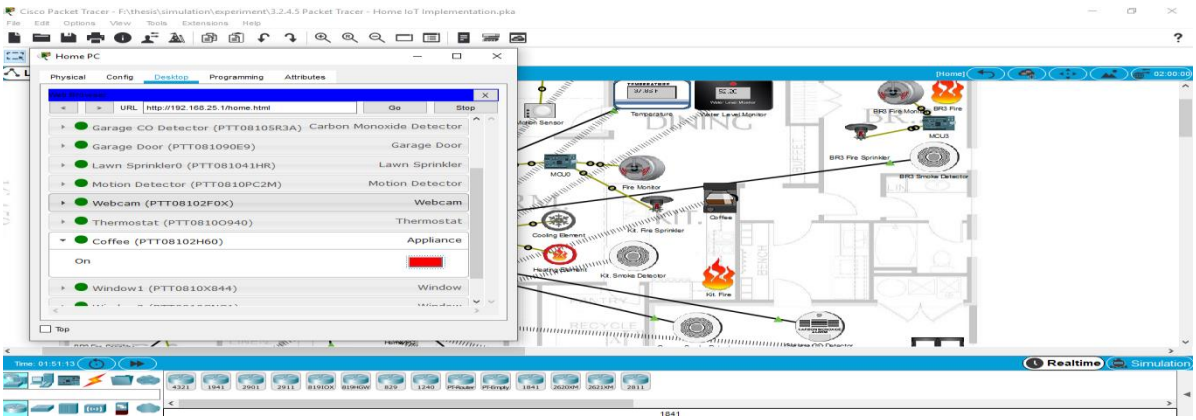


FIGURE 5. 10 : DEFAULT COFFE POT STATUS

We observe that when coffee switch is in red color on Home PC's server, Coffee pot's indicator is off that means coffee pot is off.

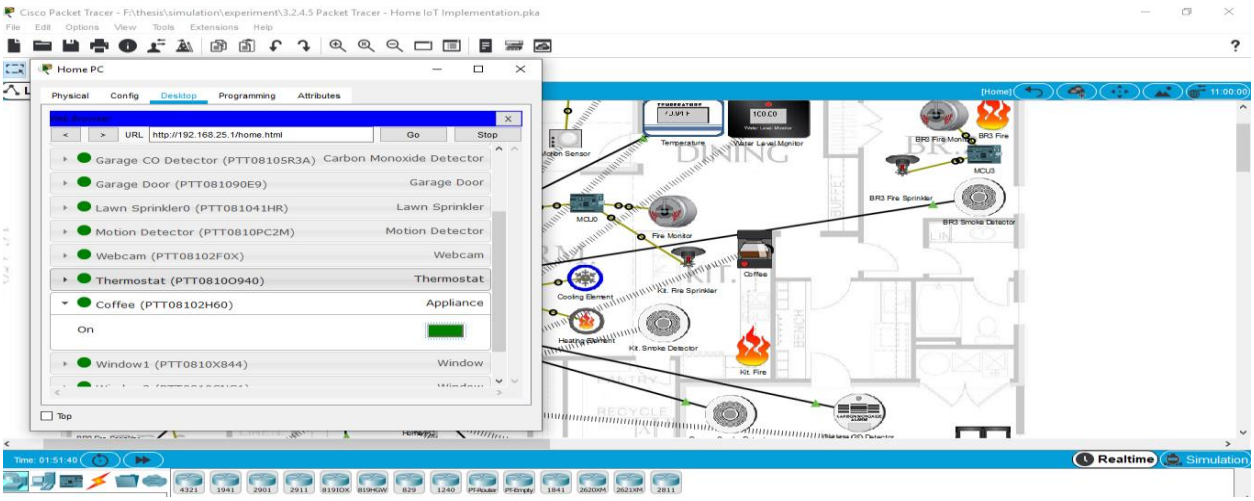


FIGURE 5. 11 :AUTOMATE COFFEE POT

Now in this figure when we turn on the switch from home pc, Coffee pot on the workspace also on. Notice that the coffee pots indicator light is on.

5.3.4 Automate Lawn Sprinklers

Watering the lawn could be an activity controlled through conditional statements configured in the local IoT server on Home Gateway.

a. Expand the status for Lawn Sprinkler, Lawn Sprinkler0, and Water Level Monitor. Observe the relationship between the water level and the status of the lawn sprinklers.

What condition triggers the lawn sprinklers to turn on?

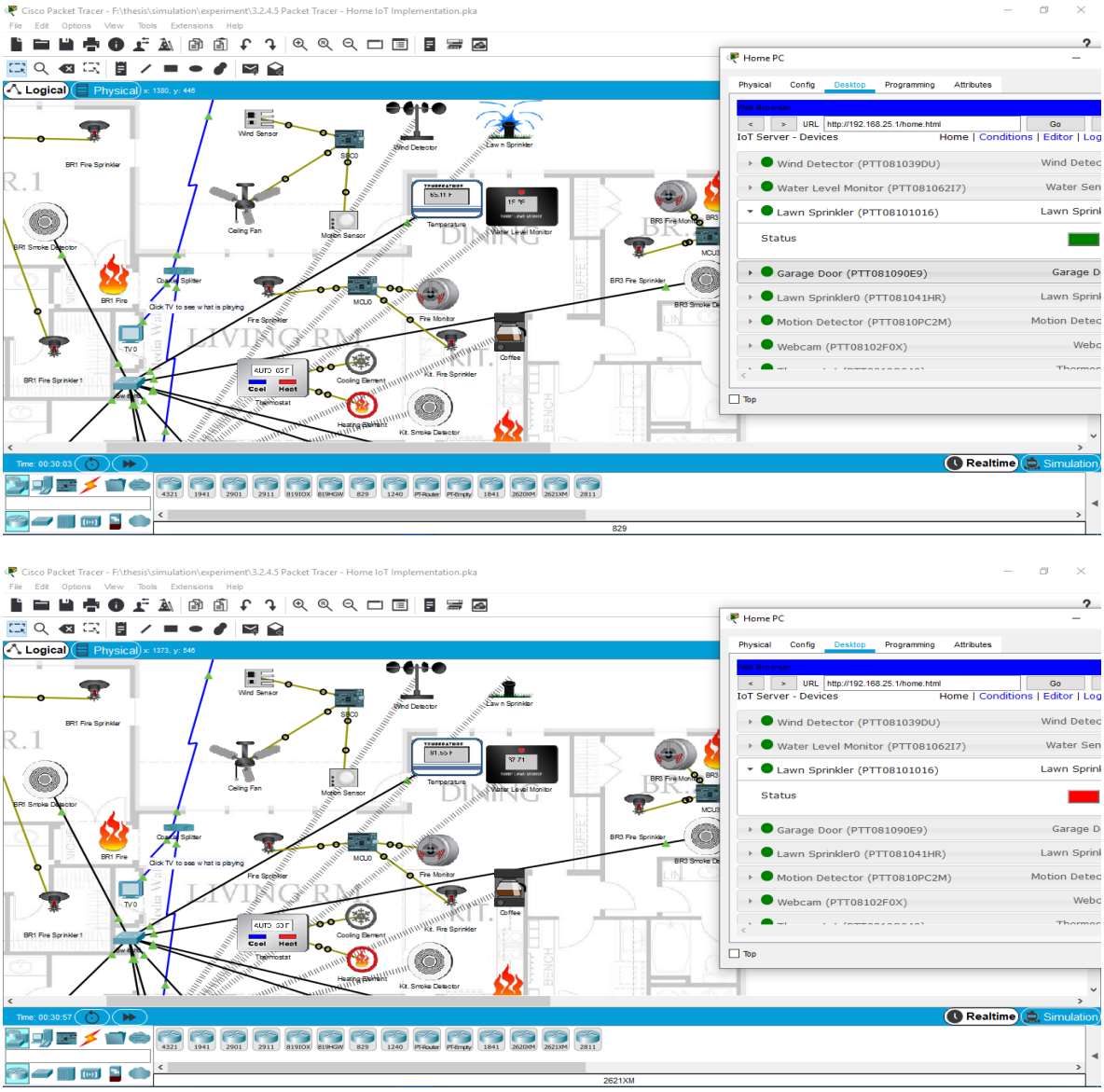


FIGURE 5. 12: LAWN SPRINKLER OBSERVATION

If water level is under 20 cm then lawn Sprinkler will be on.

What condition triggers the lawn sprinklers to turn off?

If water level is above 20 cm, Lawn Sprinkler will be turn off

b. Go to Conditions at the top of the webpage. Locate the conditional statements.

See how many conditional statements control the lawn sprinklers.

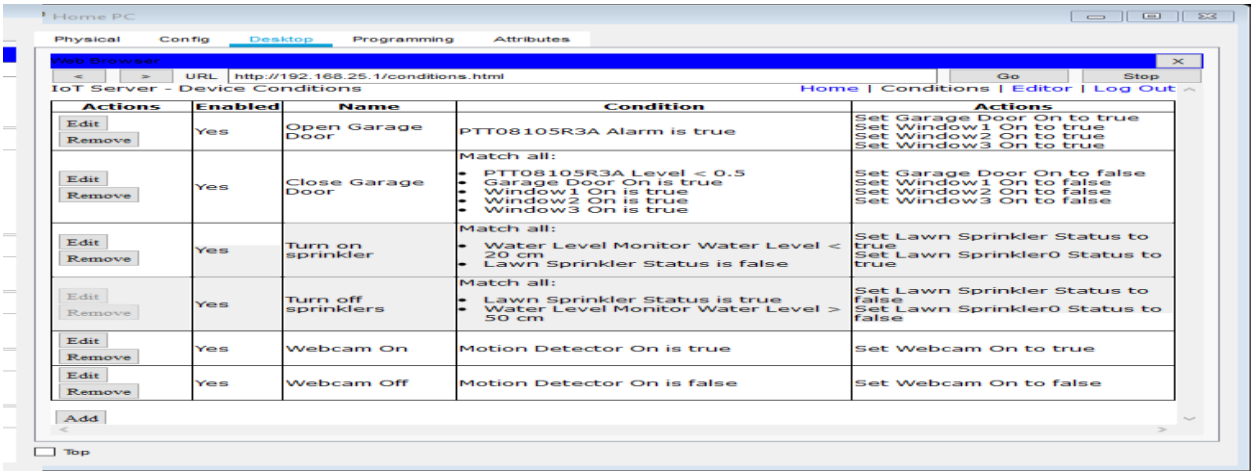


FIGURE 5.13: CONDITIONS FOR LAWN SPRINKLER

We have set two conditions You can set it your desired setting.

5.3.5 Automate Web Camera

The Web Camera is currently set to only turn on when the Motion Detector is triggered.

a. Extend the status for Motion Detector and Web Camera. Notice the relationship between the Motion Detector and the status of the Web Camera.

b. Alt + Click Motion Detector in the workspace. Make sure to click the one which is close to the Webcam.

What did you see on Webcam in the webpage?

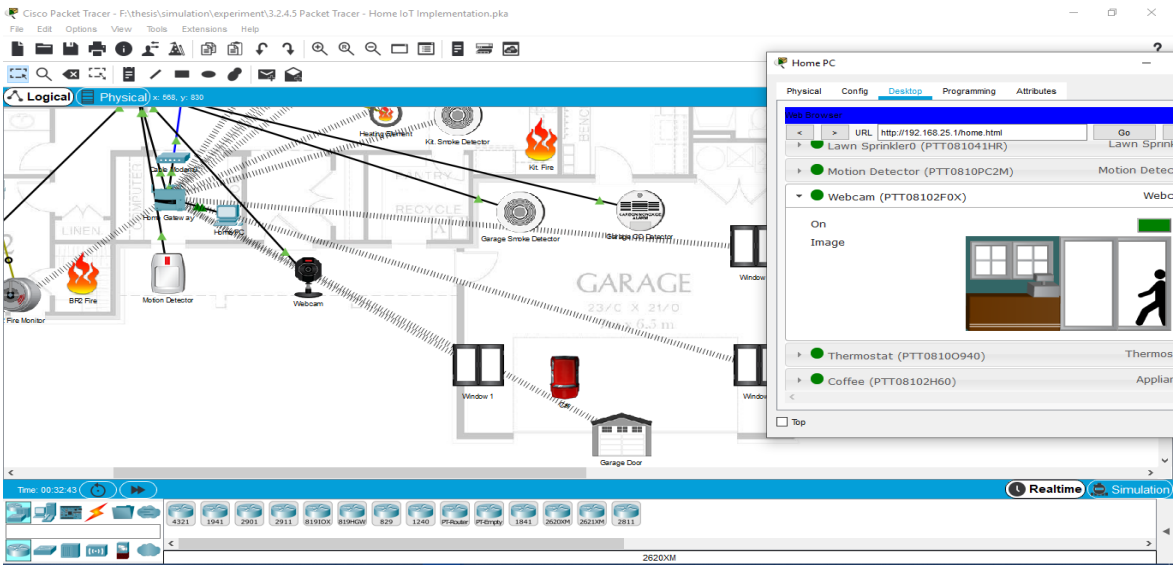


FIGURE 5. 14: AUTOMATE WEBCAME

A person is walking.

5.3.6 Open Windows and Garage Door

Suppose an ruined car is being repaired in the garage. A Carbon Mono-Oxide detector, garage door, and windows have been installed and set to prevent CO poisoning.

a. Extend the status for all the windows, Garage Door, and the Garage CO Detector.

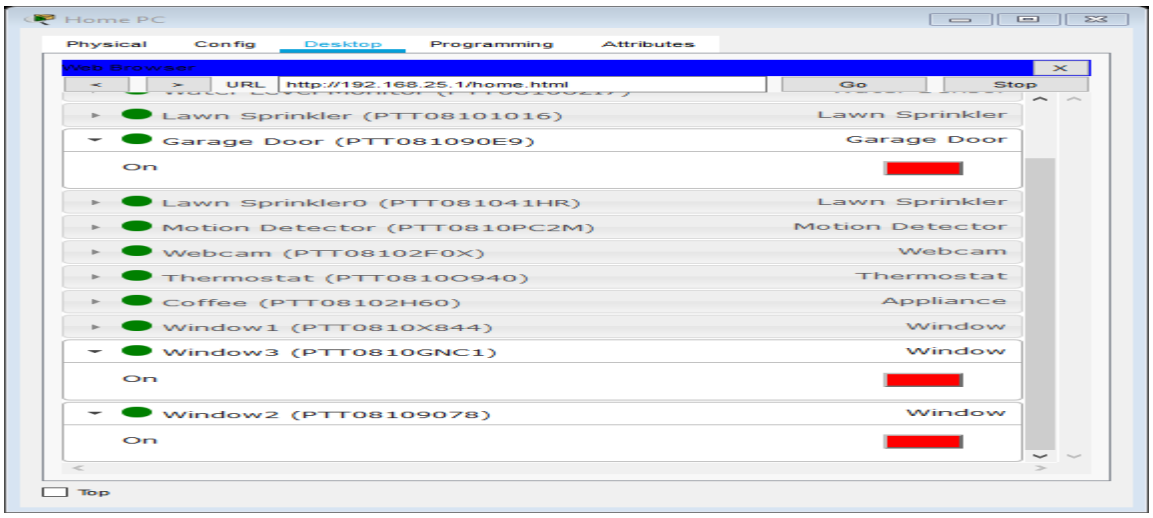


FIGURE 5. 15: CONNECTED DEVICE OBSERVATION(CO DETECTOR MISSING)

Are any devices missing from the list?

Yes garage co detector.

If any device missing that means that device didn't configure correctly.

b. For the unconnected device, Make sure that it is configured to connect to the Home Gateway for the IoT Server, and that DHCP is enabled for the IP Configuration settings.

So go back to the workspace .Click Garage CO detector. Click Config tab and then Fast Ethernet0 and mark DHCP as IP configuration

Now u can see that Garage CO detector appear in the server webpage.

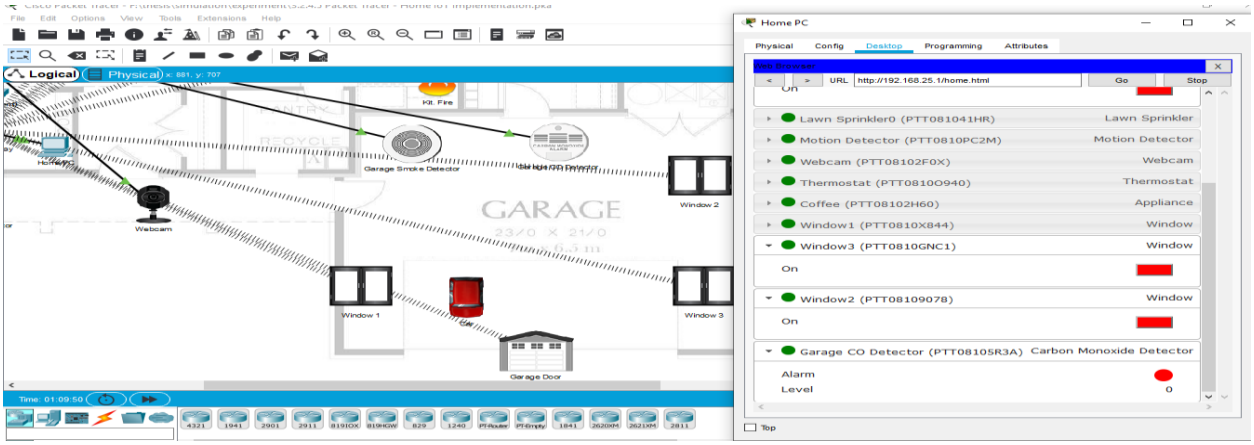


FIGURE 5. 16: CONNECTED CO DETECTOR

c. Start the old car by Alt + Click in the garage and observe the CO level rise in the garage.

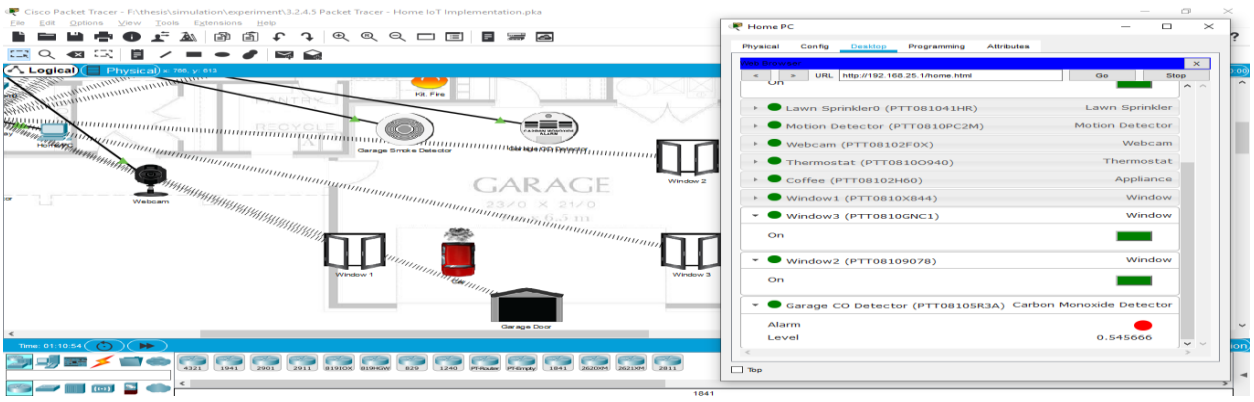


FIGURE 5. 17: AUTOMATE WINDOWS AND DOOR

d. Press Alt + Click the Car to turn off the old car.
e. Notice how the windows and garage door interact with the CO level in the garage.

5.3.7 Fire Grip

An IoT fire grip system has been attached in each of the bedrooms and the kitchen. In this IoT structure, there will be a simulated fire when you are away from home, and you can notice how the fire grip manages using the status of the smoke detectors.

a. Exit the Home cluster by clicking Back root and click the ISP-Internet cluster to enter it.
b. So now from Smartphone, Go to www.register.pka in the Web Browser. Enter admin as the Username and admin as the Password to log in to the local IoT server hosted on Registration Server.

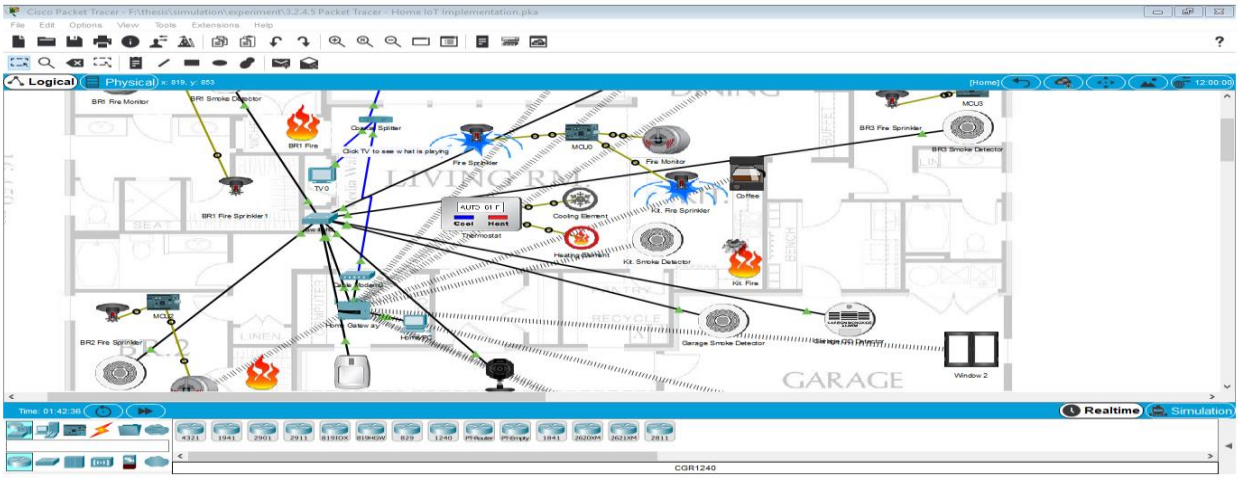
   Note: It may take a few tries before the web page displays.

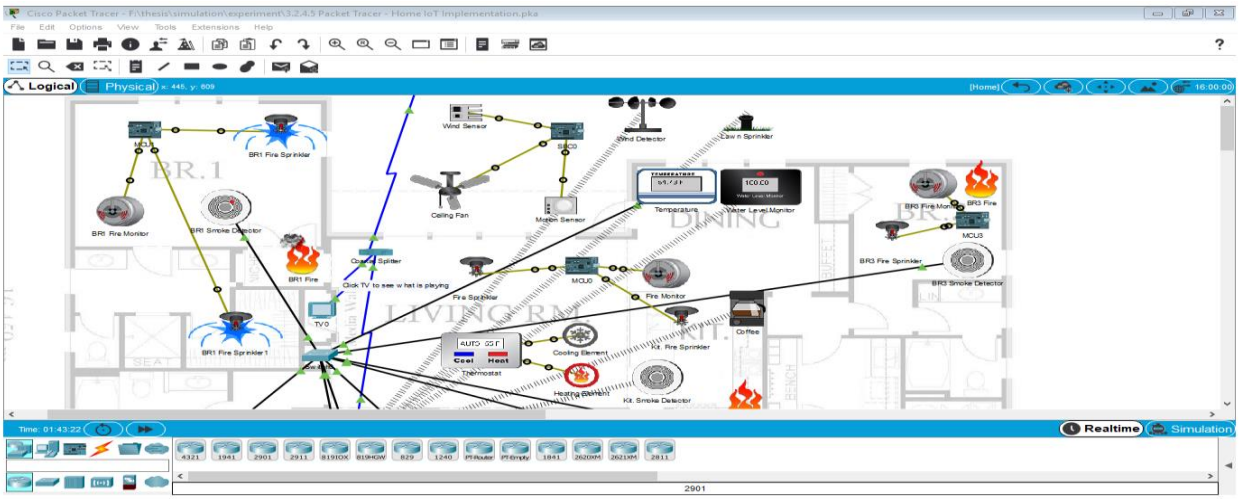
c. See all the statuses for the smoke detectors. Are any devices missing from the list? If any device is missing then check their config. Set DHCP as IP configuration and Iot server as Remote server.
   Set Server address as www.register.pka and set admin as username and password.

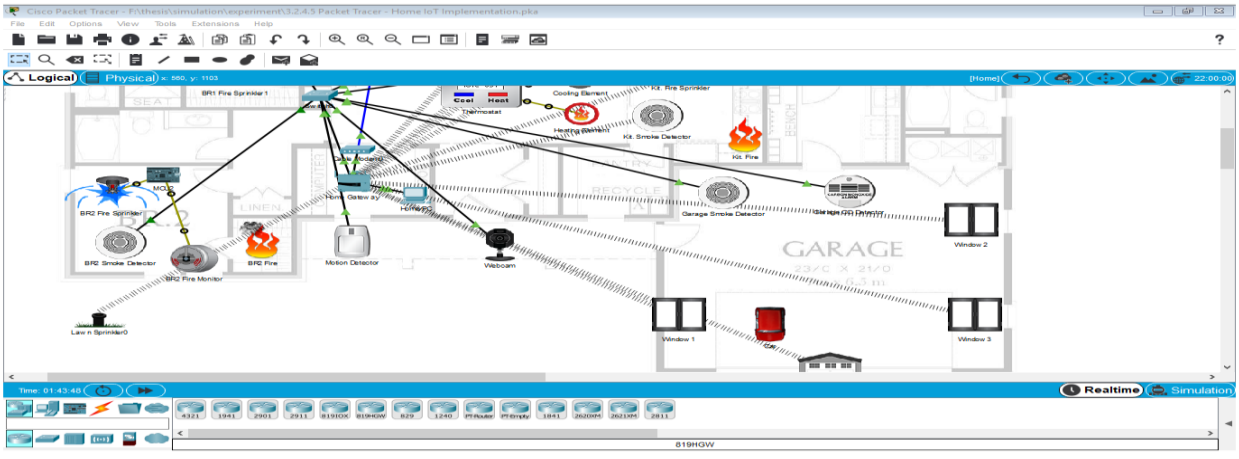
d. Now simulate a fire in the kitchen. Observe what happens to the smoke detector

   Press ALT+Click on mouse button to on Fire. When fire on, Smoke Detector detect it. When it cross the level in fire monitor which condition you set, then Fire Sprinkler ON.

e. Do the same thing in Bedroom 1 ,2 and 3 respectively.







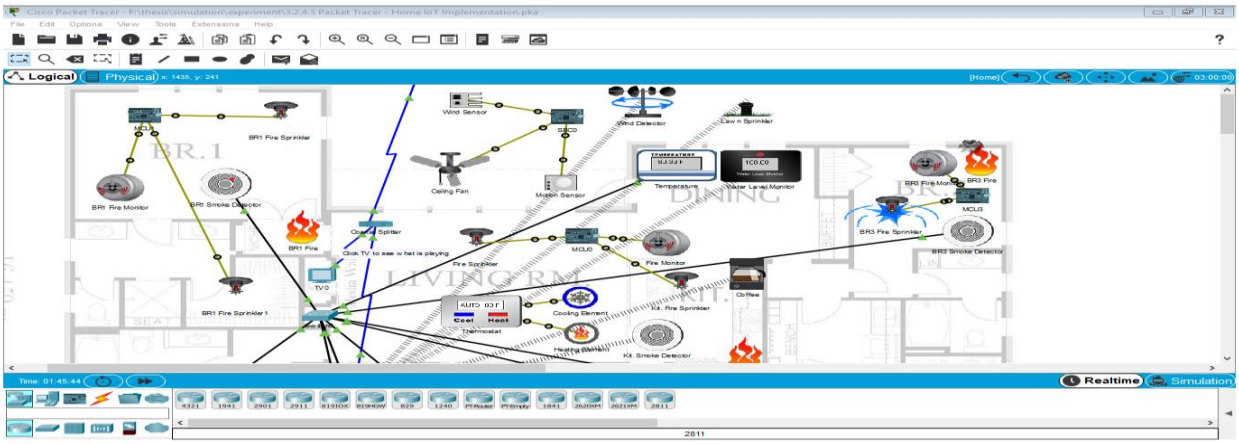


FIGURE 5. 18: AUTOMATE FIRE SPRINKLER

5.4 Further Observation

In previous step, we notice that Home Gateway and Registration Server can be used to operate the IoT devices remotely. We can change how these devices are connected remotely.

1) For this click the device.
2) From the Device tab, mark Home Gateway, None or Remote Server. For the work, the server address will be www.register.pka(209.165.201.10) and the username and password will be as admin
3) From this server, you can now add conditional statements for devices efficiency of actionable settings.

If you are attracted in programming the IoT end devices, click on the devices and click Advanced. Click on Programming and select the designed files and check the codes.

CHAPTER 6

CONCLUSION & FUTURE SCOPE

6.1 Conclusion

Many of previous research did home data analysis, but they almost had the dependency on specific service or device. We designed the resource model based on the domain that can accept various source, and model-driven analysis platform based on resource. Furthermore, the result of the analysis is stored on the knowledge map. Knowledge map consists of resource information,

relation information, and the result of analysis related to what user/service want to discover knowledge. As time goes on, knowledge map has cumulative effects about home and residents. Our future works are to research to infer new knowledge using knowledge map.

As smart home administration has progressively been included clients, the issue of security danger has risen. Most brilliant gadgets in a smart home condition neglect to guarantee security with the goal that they are presented to numerous threats. Thusly, this thesis proposed an interior security system for brilliant gadgets in a smart home with regards to information respectability, the intrusion of non-allowed gadgets, and accessibility. The proposed system gives the security administration to guaranteeing gadget verification, respectability, and accessibility. The system can have a constrained range, for it needs to offer security benefit in the range where the one of a kind elements of a savvy gadget is disintegrated. Later on, it will be important to propose a more enhanced security system for shrewd gadgets, make it lightweight, and boost its accessibility.

6.2 Advantages

There are a plenty of advantages in our proposed system. The advantages of our project are discussed below:

1. Intelligent home automation system
2. Home appliances can be controlled in just one click
3. Android based application to control appliances
4. Easy user interface of the android application
5. Multiple modes to control and run appliances when necessary
6. Optimum mode for saving consumption of power and also let the appliances to run on its own intelligence.
7. Auto mode to let the appliances run on its own intelligence where users need not to worry about the appliances and also gives comfort
8. Sleeping mode for night time where users can sleep without tensing about temperature controlling
9. Individual appliances can be controlled from the app
10. Home appliances can be controlled from any remote places
11. This system turns a home into a smart home

6.3 Challenge and Limitation

There are some limitations observed throughout our project:

1. Since our project is internet based, our home appliances are totally controlled through internet access. Home controlling devices must be connected to internet with a good bandwidth otherwise controlling could be disrupted. As we control the whole system through internet, we need to confirm high speed of internet. Otherwise, the system delay will occur as Ethernet shield will not be working as a network provider to the circuit. In Bangladesh it is a big challenge to get high speed internet.
2. The project relies on power supply. So if the power supply fails, the internet connection will be halted. Then database access will be stopped. For this, without security system the whole system will not be worked. So we also need to include a backup like generator. In our project, security system is powered by another power source for security safety.
3. Though it needs less circuitry but its cost is not in minimal range. To get facility, users need to expense for this. The cost of installing a home automation system can be to a certain extent expensive. So it is a big challenge for a country like Bangladesh. The more sophisticated the system is the more expensive it will be.
4. This real time server base system is limited to only one person which means only one person can operate the system at a time. To increase the limitation it can be more expensive.
5. If there is any break due to rupturing of cables or the fibers then the total system will be crashed. So, this will not be the case of radio signals or the other signals. There will be a difficulty of receiving signal. Therefore we also include a redundancy system.
6. If the individual does not handle the equipment safely or make use of the exact key to carry out the operations, human error can occur. Human faults also direct to the destructions of the device. Then there will be system collides.
7. Home automation has numerous drawbacks. For having home automated system, people will be lazier. That ultimately might end up with making great harm in human social and professional life.
8. In exceptionally uncommon cases, the unwavering quality of the home computerized gadgets fluctuates (decreases). It depends generally on the innovation utilized and the progressions being finished.
9. User have to give IP addresses of the controller every time it connects with a new network. It waste a lot of time to re-configure.

10. If no internet is available in the client side or in the home devices user side than this system cannot be controlled but it will keep executing the last command that was received by the controller.

6.4 Future scope

As we have mentioned earlier this thesis is not a complete project. This is just a basic structure of another complete system. We have done all the basic necessities of a typical house. The tasks that we have done are not the only tasks the components are able to do. There are a lot of other scopes for this project.

More appliances can be added in this system with a powerful relay module. Garage automatic door system can be added for extra security. The automatic door will give access only to a registered agent. If there come any new person home owner need to accept for entry. All available smart devices can interface with this system including a car.

DS1307 Real Time Clock module is a very important device. This project could have a cloud database to save all the data. Readings from all the sensors with date and time can be saved. It can give better performance to the user.

Room air purifier can be added to this system to make it more efficient. We need to use air purifier for balancing the air inside the room. The purifier will suck the particle of the air and then trap them so that they can not float it back it to the air.

We can add a surveillance camera outside the house for extra security. The camera can be wireless or wired which can be control with wifi.

Solar power system can make this system extra cheap and durable. Then the system can run with the solar power. The solar power is a renewable energy so we can save evergy.

This system has huge opportunities to upgrade in future. As we mention earlier this is the first generation of home automation. It can upgrade to second generation by storing and analyzing data on the cloud servers.

6.5 Where this research can be applied?

1. Any house or work place and.

2. For any kind surveillance.
3. Monitoring business and offices from remote distance.
4. 4. School/college/university can use this project to count attendance automatically and notify guardian.
5. To make the city smarter this project can be highly demanding.

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