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Arab Open University

Faculty of Information Technology & Computing

IOT Smart Home Network & security Packet Tracer

Submitted to
Arab Open University

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Abstract.

This is a technological age, and we are constantly surrounded by it. People are becoming smarter, and they want to be able to control anything from their phone, laptop, or computer without having to leave their house. This is possible thanks to IOT devices. As a result, we have built a smart home with enhanced protection. We can control household items (fan, light, ac, and other applications) in a smart home. Door, windows, etc.) With the mobile. We design an IOT-based smart and secure home model in the latest released cisco packet tracer. Cisco packet is a network simulator that teaches students how to use a network. However, in Cisco Packet Tracer 7.2.1, there are more sensors, boards, programming languages, and IOE modules. This allows us to design, test, and observe the network/actual model's operation in real-time. Multiple electronic devices can be managed and monitored via smartphone in testing the IOT home network wireless network gateway system based on predefined configuration conditions. Different types of IOE devices are used to create a smart and stable home with improved security, house environment perspective, and protection.

Acknowledgements.

At the outset, I would like to express my sincere thanks and gratitude to **Dr. Mustafa Abdel Salam** who helped me a lot with this project.

There are no words that can express how I feel about my family who has truly helped me throughout my life, I thank God Almighty for granting me and giving me the strength to complete the long road that has not been completed now and the ability to be a human being. I would like to thank all the doctors in my college and especially I would like to thank **Dr. Hala Abbas** for helping me to progress, accept opinions and cooperate in solving all the problems facing the students, and I would like to thank **Dr. Sarah Nabil** for her great efforts that continued with our support, trust and love for the specialty that I am and I love to thank **Dr. Mahmoud Atallah** On his great efforts and assistance to us in the field of network and security, and on his many and useful advice that helped us over the years in our specialization, helped me in passing the largest number of academic courses, and helped me to be who I am now. I would like to thank my best friends

Eng. Salma Abu Zaid **Eng**. Jamal Mohammed Al-Bailey, **Eng**.Narmer Muhammad **Eng**. Muhannad **Eng**. Mustafa Ismail to help me be more creative and productive and to be more satisfied with my condition.

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Chapter 1
Introduction

1.1 Background Information

The internet of things (IOT) is a system that connects everything to the internet through remote sensor networks. Which can be used to automate home activities without the need for users to track the home environment using various sensors (Temperature, Humidity, Smoke, Wind, and Sound). If a sensor detects security problems, a smart home may have various features to provide automated security using various alarm systems, such as LCD displays and siren sounds, as well as sending emails to legitimate users. The main goal of IOT is to allow the development of a smart world and the presentation of self-aware objects, which is IERC's vision. There are a variety of IOT technologies that have major societal benefits. Smart homes, wellness to enhance people's health, smart transportation to help people travel from one place to another, and smart energy to ensure energy quality are some of the IOT applications. Smart health to enhance people's health, smart transportation to facilitate people's travel from one place to another, and smart energy to ensure energy quality. The majority of users have problems with being able to monitor home computers, sensors, and security cameras remotely.

1.2 The project Goals

1- Increase safety rates.

2- Remote control mechanism (start and stop) etc.

3- Connect home appliances together.

4- Multiple safety systems (manual and automatic).

5- Converting all home appliances into smart dealing devices
.

6- Saving energy consumption for the smart home.

1.3 Problem Definition

- Most of the users face some issues which they can't control home devices, sensors and home security cameras remotely.

- Some users face a problem if someone breaks into their home network and changes operating systems.

- maybe some disaster can happen in the house when the user is out like fire or water flood, then the smart home will contact the nearest possible security authority.

- Some people experience high temperatures outside the house and need to rest whilst the air conditioner is on.

1.4 Solution

- The sensors in the house will send a message to the owner of the house so that he can solve the problem as soon as possible.

- My technology allows the user to be connected to the devices inside the house without the need to go home.

- The smart home removes the user's role in monitoring home settings and running home devices by using various sensors in the automation of the home, and legitimate users receive an email.

- At the home gate, all smart devices are registered and controlled by a legal individual.

- A smart home can provide a variety of features that provide automated protection through the use of various alarm systems.

- Imposing complete security on home systems and taking appropriate measures in emergency situations.
  Complete improvements are made in safety, comfort, and efficiency.

- Make opportunities to learn how to monitor home appliances, alarms, and surveillance cameras from afar.

- Where the smart home will send temperature alerts to the people who live there.

- The Internet of Things now powers a wide variety of gadgets.

Thermostats, refrigerators, surveillance devices, and even dryers and kettles are among them.
With the passing of time, more devices with smarter features would undoubtedly be added.

1.5 System Description

What is CISCO packet tracer? CISCO packet tracer is simulation software developed by CISCO networking organization.

I'll use packet tracer to create a smart home with many IOT devices, such as coffee machines and air conditioners, as well as every other device that a typical home requires, and I'll build and manage the smart home's network to make every IOT device accessible via the owner’s or user's computer or mobile phone.

In packet tracer the simulation software there is a lot of IOT devices, I will use a lot of them to build my own smart home and configure them or configure the whole home to work probably to do the following things:

1- Controlling the devices remotely from the PC or mobile phone.

2- Alerting the owner if any security issue occurs.

3- Sending to the owner logs.

4- Accessing the devices remotely to manage the IOT devices like the air condition to warm up or cool down, etc.

All of this will be done using the simulation software packet tracer, but for sure one day I will be able to implement this simulation packet tracer file in the real life, hopefully in my own house.

1.6 The Near Future Work

- The time for smart home service will be measured, as well as the time for energy savings.

- I'll bring peace to the use of the devices in the future because they'll have sensors all over the house to provide the requisite protection.

- Over the next decade, health applications will drive at least some of the smart-home development. If people are reaching for sugary sodas too often, cameras and sensors installed in refrigerators will recommend healthier alternatives. Residents' prescriptions can be verified using similar technology in medication cabinets and sensors will even show up in toilets to check for signs of any potential health conditions by scanning human waste before it’s flushed.

- Homes will also have their own health sensors, which will monitor for issues such as water damage, insect infestation, and so on, alerting owners of any possible problems until they become even lower cost to fix

- The smart home will know when to take those steps and will do so automatically. This is where home automation and IoT will go in the future.

Chapter 2
Literature Review

2.1 Similar System Information

2.1.1 Smart Home

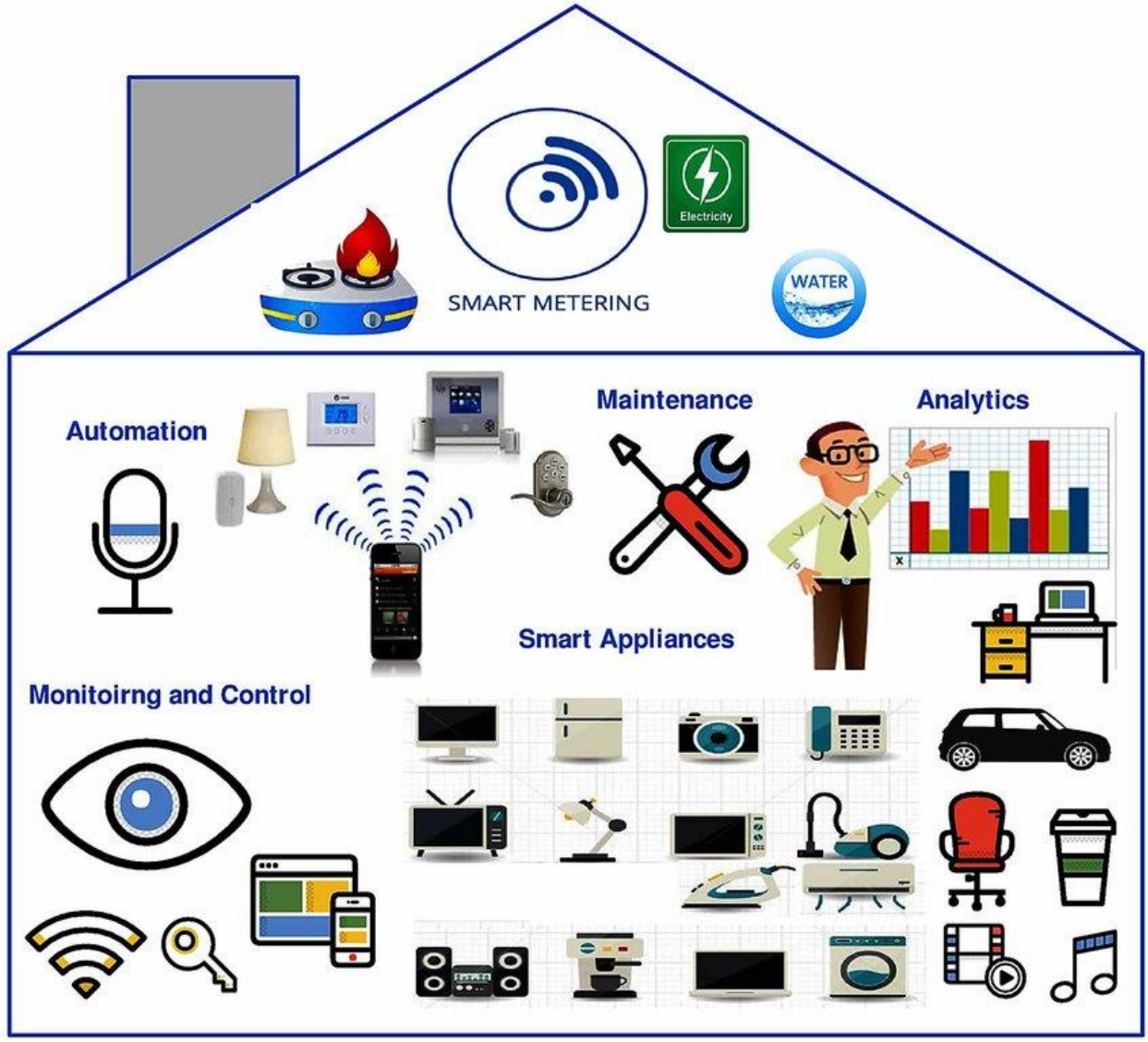


Figure 1_ A similar Smart Home components

(ResearchGate, 2021)

2.2 IOT Smart Home Application Requirements

The figure above summarizes some of the IOT Smart Home Application requirements. As with the application's requirements of the IOT in healthcare discussed in the section "IOT health application requirements", the requirements of the smart home system vary according to the application design and its specific requirements as well. Initially, as shown in Table 2, the application environment of smart home applications is indoor within the home building. Devices are mostly in the form of sensors and actuators in addition to smart appliances and consumer electronics which are generally stationary. Sensors and actuators will be deployed in the home in appropriate locations. A number of these devices are likely to be powered by batteries. The typical coverage of such a network of devices is the entire home, with an estimated maximum number of no more than few hundred devices per household (Basu, Moretti, Gupta, & Marsland, 2013). The payload data being transmitted can be estimated to be very small with no stringent latency or jitter requirements (Qin, Denker, Giannelli, Bellavista, & Venkatasubramanian, 2014). Multimedia real-time devices such as an IP camera will have specific requirements to their sensing device counterparts. Many wireless technologies such as ZigBee, and Wi-Fi can be employed in such IOT space.

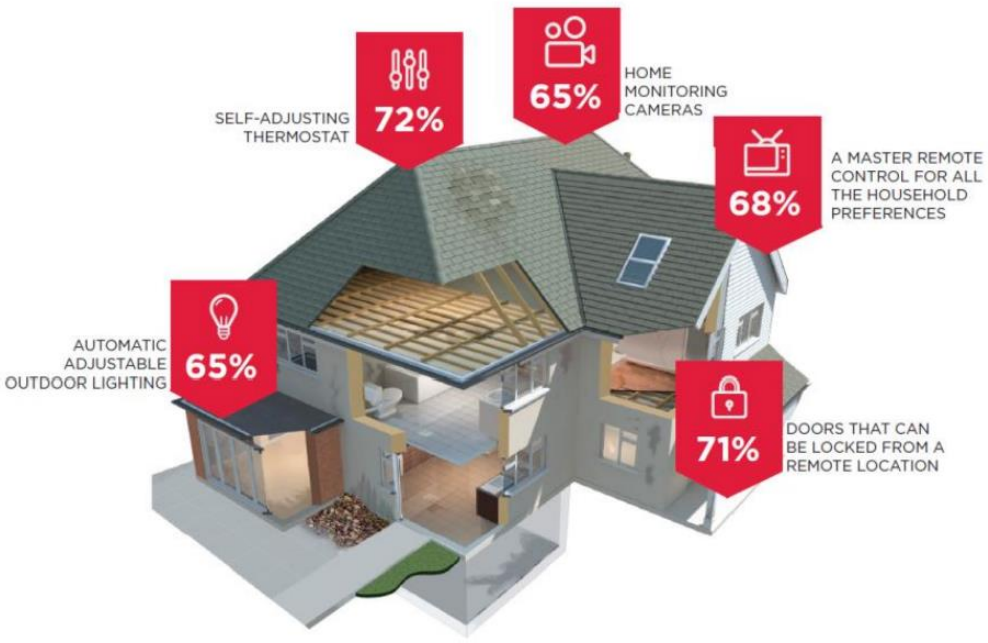


Figure 2_ Similar Smart Home design

(ResearchGate, 2021)

2.2.1 Home Automation System

2.1.2.1 Elements of Smart Home

Smart Home system controls and manages the integrated of many small systems at home. The small system can be a lamp switch, temperature monitoring, motion detection, home surveillance and other sensors. The sensors in these systems will be controlled by users using interface devices such as remote control, computer, and smartphone. By increasing the type of sensor to be controlled, the main system needs to be more specialized to integrate the sub-systems to become the Smart Home system. The networking of system can be wired or wireless depending on application.

Elements in Smart Home system

Example

Sensor Temperature monitoring, fire detection, home surveillance User interface devices Remote control, computer, Smartphone, tablet

Types of networking Wired-Fiber optic, coaxial cable Wireless-Bluetooth, WIFI, ZigBee, RF

Centralizing control Micro controller, PLC, computer, FPGA

- Home Automation Carrier Mode
- Wired and Wireless Home Automation Protocol
- Internet of Things
- Smart Home Application Framework

2.3 The new IOT Smart Home Design

2.3.1 Motivation

Most of the current I smart home designs lack a high level of security, thus making them vulnerable to cyber and physical attacks so my idea is to design a smart home with a high level of security. If the house is under a physical attack the sensors will detect it and the response would be to alert the owner via email or text message.

2.3.2 Design Differences

Most designs focus only on functionalities, adding features, and not paying attention to security so in my design I focus on enhancing both the cyber and physical security of the smart home to help keep it and the owners safe by sending immediate alerts to the owner once a threat is detected

2.3.3 System Details

- What makes the home smart?
  When you can control every device in your home like fans, coffee machines, air conditions, etc...
  In this case, we can consider the home as a smart home. The smart home project will be done using the packet tracer CISCO simulation software to simulate the smart home devices like Air conditioners, coffee machines, Light, and every IOT that can be used in the smart home. We will use some IOT devices to make it possible to make the home smarter. Also, I will design a network to connect all of these devices to make it possible to connect those devices remotely using some routers and switches and also home routers to connect those devices to the Internet because those devices commonly don't have any actual ports to connect them via those ports so they will be connected to the network using the wireless technologies. In addition, the home network will connect to the internet to manage them remotely from inside the home and from outside, to give an example of remotely management: if you are outside and want to connect to your coffee machine to heat until you come into the house do not worry it will be possible.

- For sure, I will use the IP version 6, so what is an IP? An IP addresses the device over the network and the internet; I will use IPv6 because it has a range that is more available more than the IPv4. Every IOT device can have an IP that means it can get into the network. I will use home routers to connect those IOT devices like Air conditioners, coffee machines, Light, PCs, mobile phones, Window, and more and more devices to connect them into the network using the wireless technologies and home also home gateways, and some access points to make the range of the wireless wider. The home network that manages the devices from in the home will have a default gateway and IP address from the DHCP server from the router to obtain their IPs and default gateway automatically because it will be harder if we write the IPs on each device manually. The default gateway will let the devices connect to the internet using the wireless home router to let the user manage those IOT devices remotely in any place.

2.3.4 System Details Photos

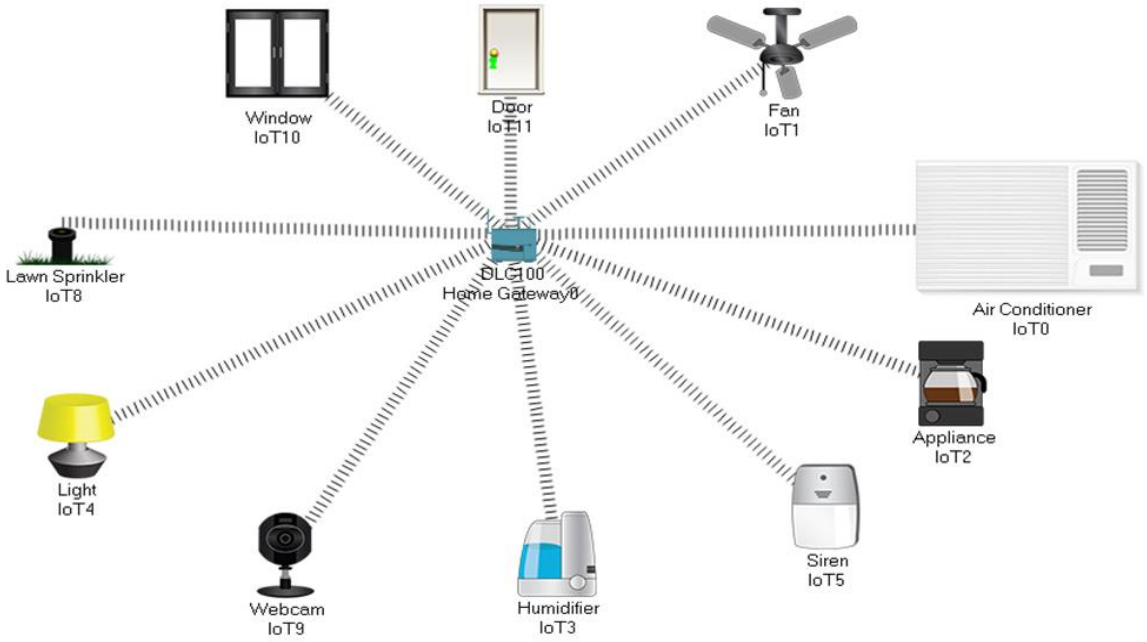


Figure 3_Some Packet Tracer IoT devices

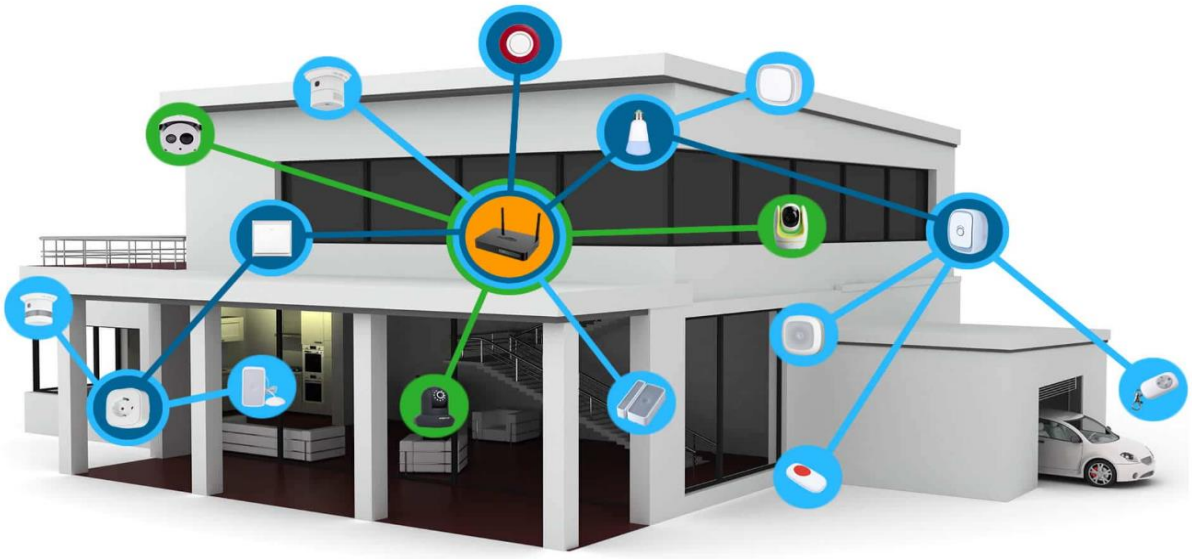


Figure 4 Similar Smart Home devices

2.3.5 Project Domain

- For the building & home / smart infrastructure domain our main objectives are

Provide dependable, energy-efficient, and reliable wireless systems that can be easily cross-connected to add value to end-users and reused across domains.

- In addition, I will make it easy for the user or the homeowner to access his home from anywhere in anytime to make anything over the network "Internet" using a mobile application or if in the near future it may have some more advanced technologies like glasses have, the software can also access the home from the glasses.

In addition, the homeowner can configure the devices remotely from anywhere to do what he wants at any time.

- For sure if it is easy to access the home remotely, it will be easier to manage the home from inside using the mobile application.(SCOTT, 2021)

2.3.6 Target Customer

In our smart, home the target customers will be the smart home companies who want to use this technology, or it is anyone who wants his home smarter.

2.3.7 Stakeholders

Smart homes need multi-level control over their various devices, which are essentially electronic appliances. The convergence of home appliances with mobile phone and tablet networking has revolutionized the field of home automation in terms of a rapidly increased degree of affordability and transparency. **There are a variety of stakeholders,** including technology investors, developers, and integrators. Depending on the actual smart home system, specific stakeholders will be involved. Smart houses, for example, are an example of IOT applications.

2.3.8 Smart Home Owner

- Homeowners who do not have a property owner have complete flexibility when it comes to making their homes smarter.

- Anyone can have a smart home, which can be anything from a small apartment with a smart speaker to a large house with automated devices built in. Remember: there are no small smart homes, only small devices!

- A significant portion of the smart homeowner landscape consists of homeowners seeking the best way to protect their properties, families, and belongings. This community is mainly driven by a desire to keep their property safe and protected from any type of danger, including burglary prevention, fire/carbon monoxide detection, and even water monitoring. However, the most popular justification for installing a smart security system is to secure homes from intruders. Fortunately, smart, wired, automated devices that provide owners with real-time information will easily provide peace of mind.

(Mysa, 2021)

Chapter 3
Requirement and Analysis

3.1 Functional Requirements:

- The network of the smart home will allow the user to send data.
- The network of the smart home will allow the user to receive data.
- This contains functionality that supports alarm systems, cameras, and smart door locks.
- The connection between devices and the homeowner must be fast and the range of the network must be huge and can expand to have the new devices the user adds.
- Also, the smart home functionality and its most important functionality is to make life easier on the homeowner and the family members
- In the home I added a new function in the doors of the rooms to automate the process of the door opening and locks, I used a motion sensor to detect the user motions what he comes from outside the door opens, the light, and the camera turns on.
- When there is anyone outside the home there is a motion sensor that detects his motion when that sensor detects any motion there is a camera outside the home to capture his movement if he is a threat or not.
- When the home user is ready to go outside with his car from the garage there is a carbon dioxide detector that connects to some alarms inside the home to alarm the users inside the home that there is someone is going out from the garage.

3.2 Non-Functional Requirements:

- connection time out should be within 15 seconds.
- disconnection from the network should be detected within 10 seconds.
- data sending timeout does not exceed 5 seconds.
- improving the smart home security for the network and devices.
- cost depends on the market price.
- The user's devices must have a fast response to the home owner's.
- Implement the basic security for the home network to ensure that the home network is as secure as possible from any threats, for example, making a secure login to the devices using a user name and a password and implementing a firewall.

3.3 Figures

3.3.1 System Model Diagram

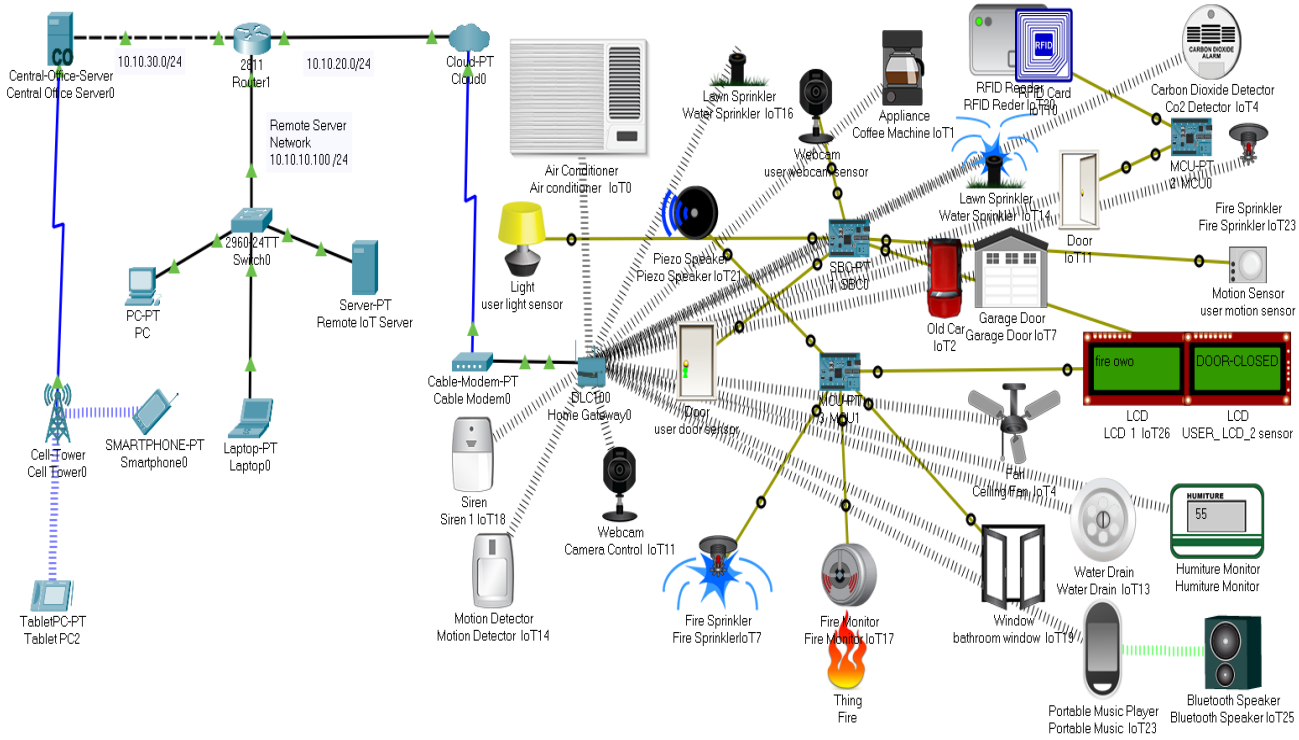


Figure 5_System Model

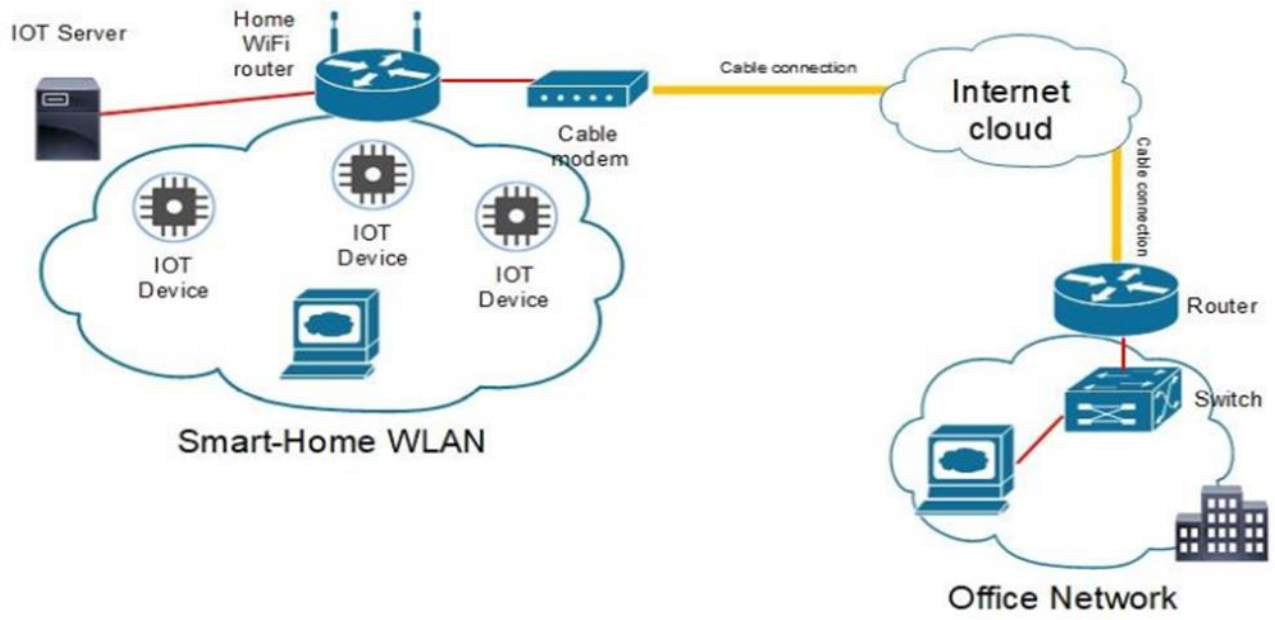


Figure 6 _Another System Model

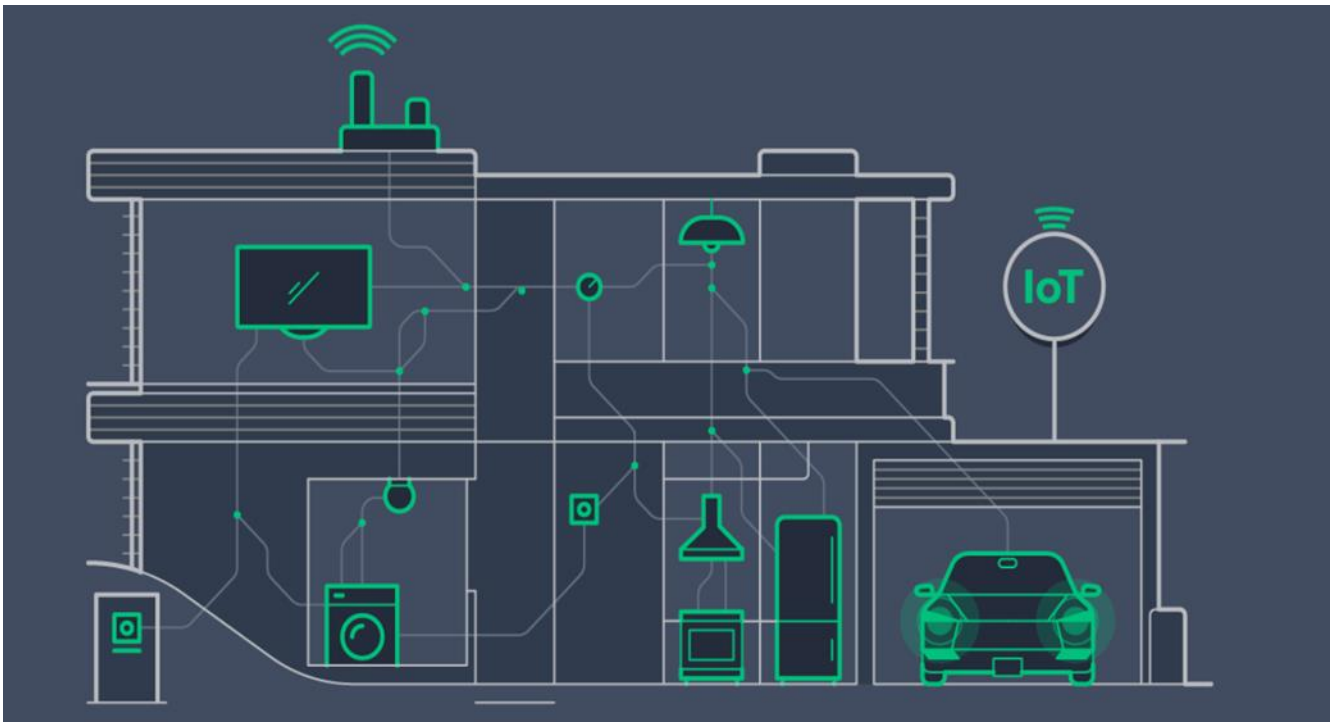


Figure 7_Another System Model

3.3.2 Flowchart and User Diagram

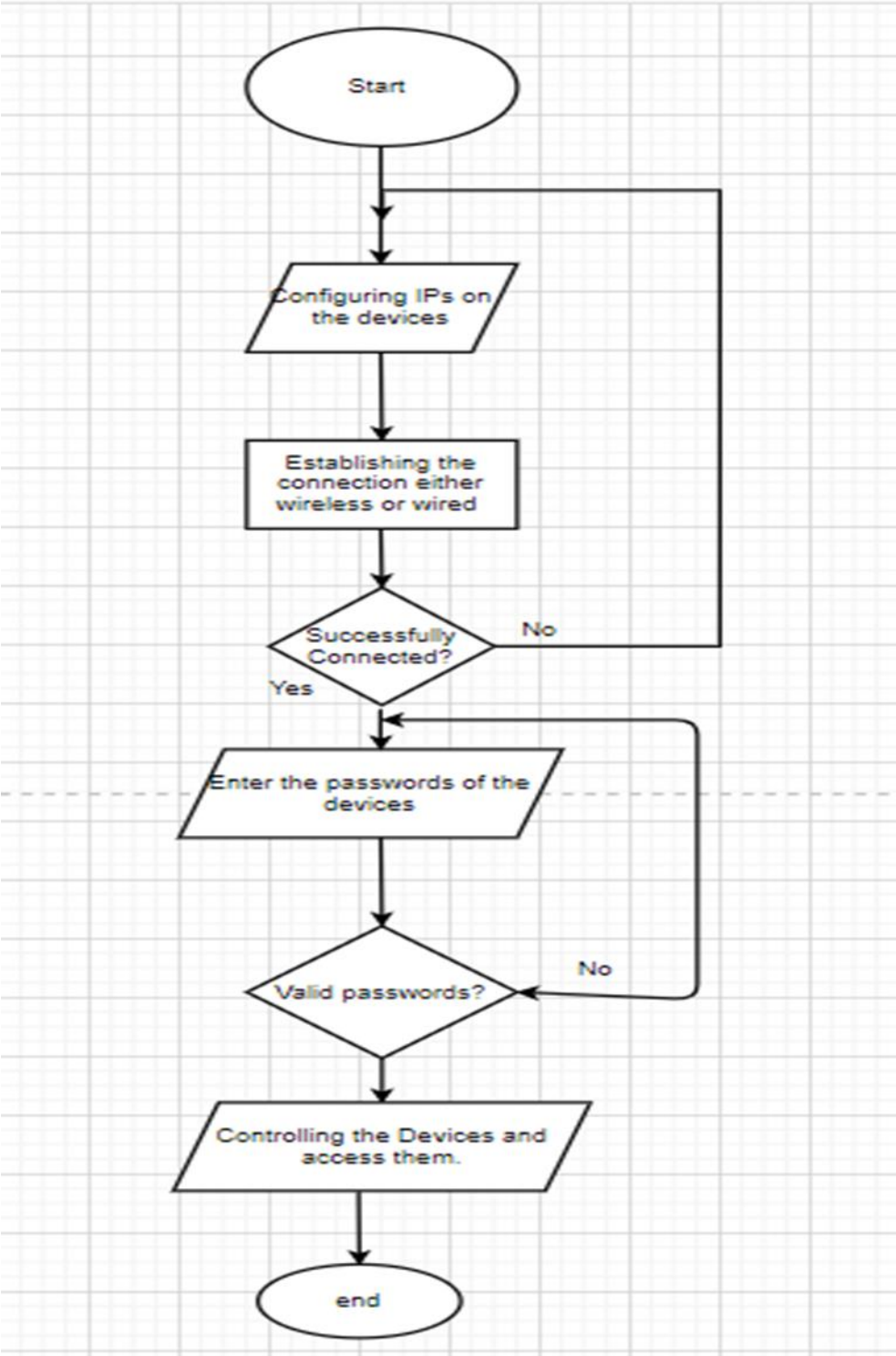


Figure 8_Flow Chart Diagram

3.3.3 Activity Diagram

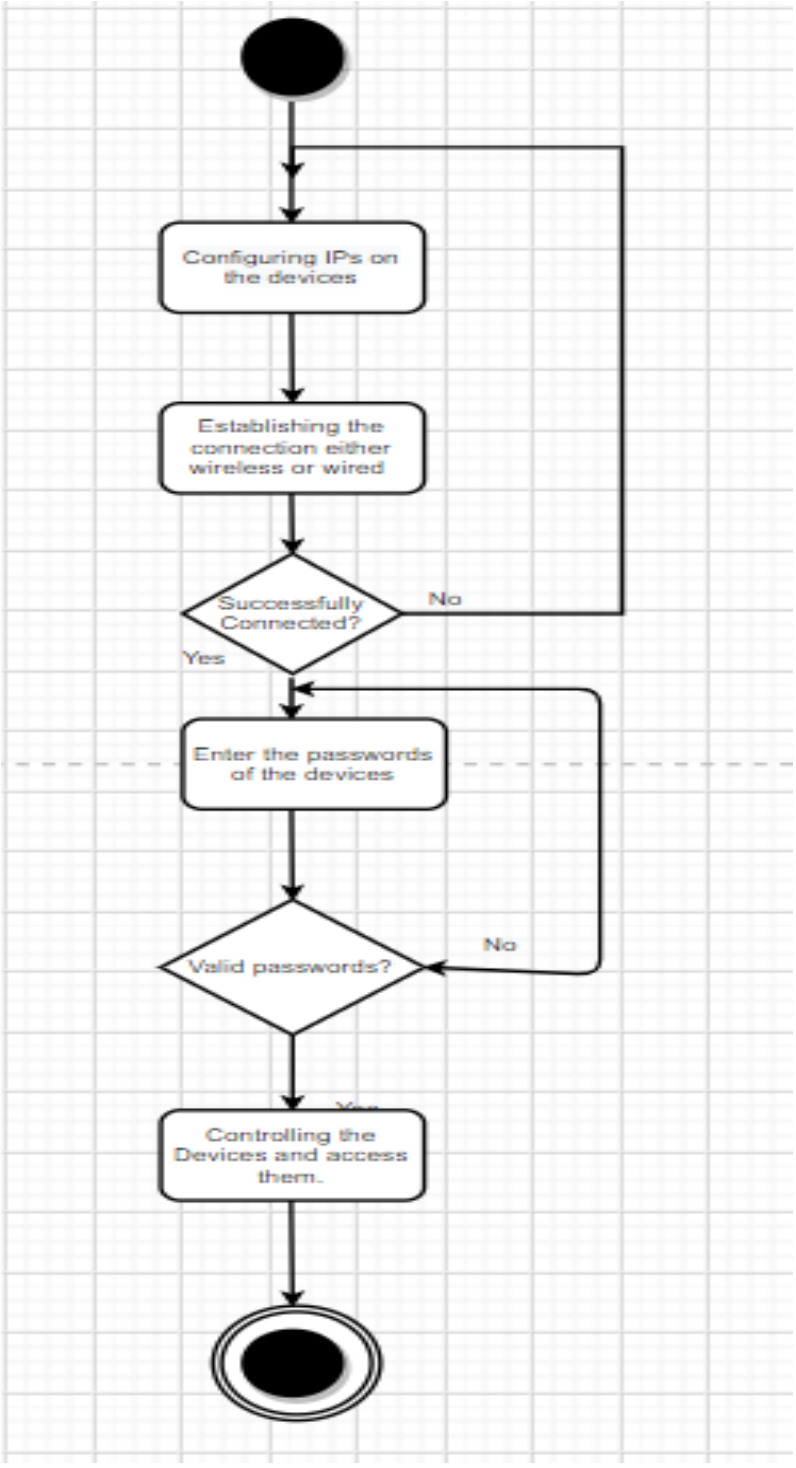


Figure 9_Activity Diagram

3.3.4 User and Admin Use Cases

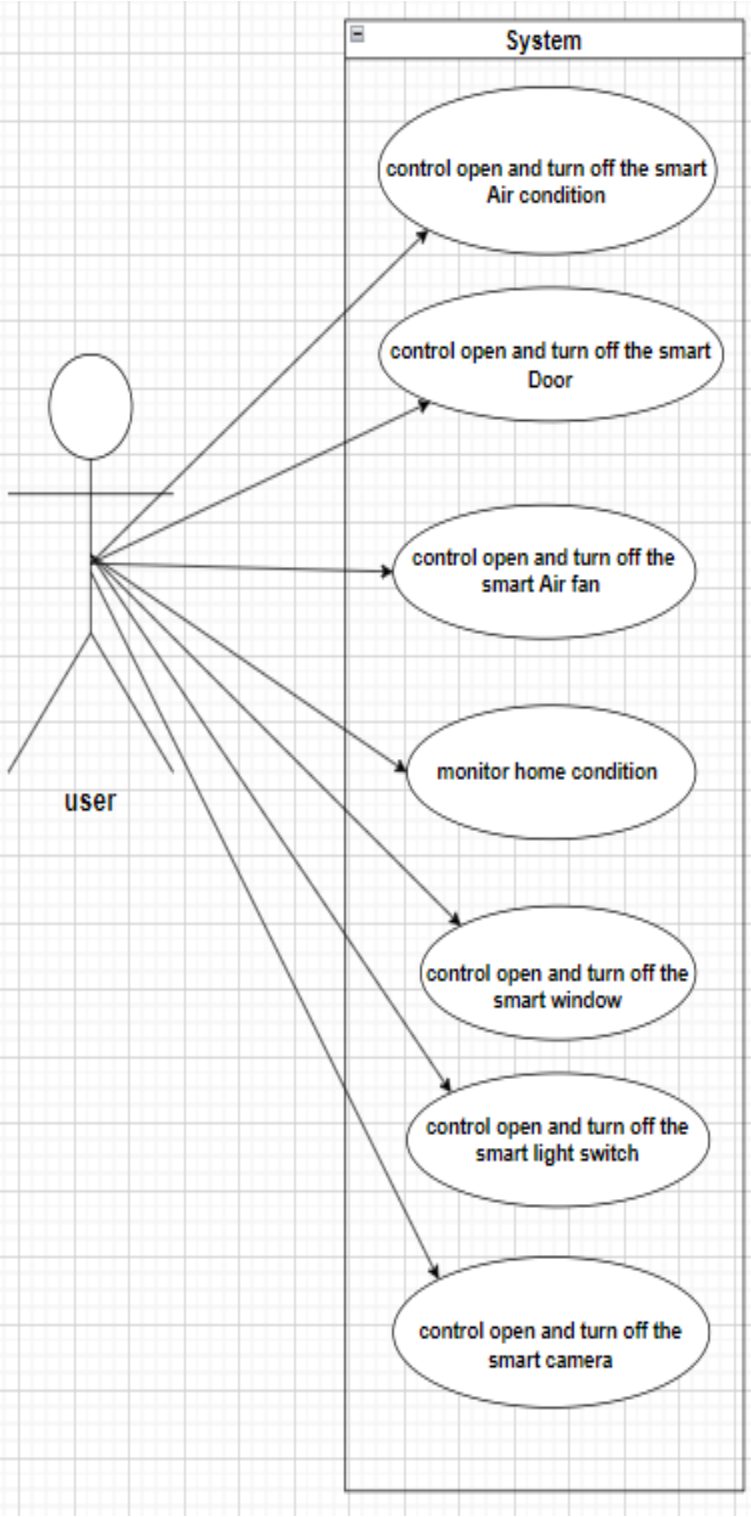


Figure 10_Use Case Diagram

3.3.5 Gantt Chart Diagram

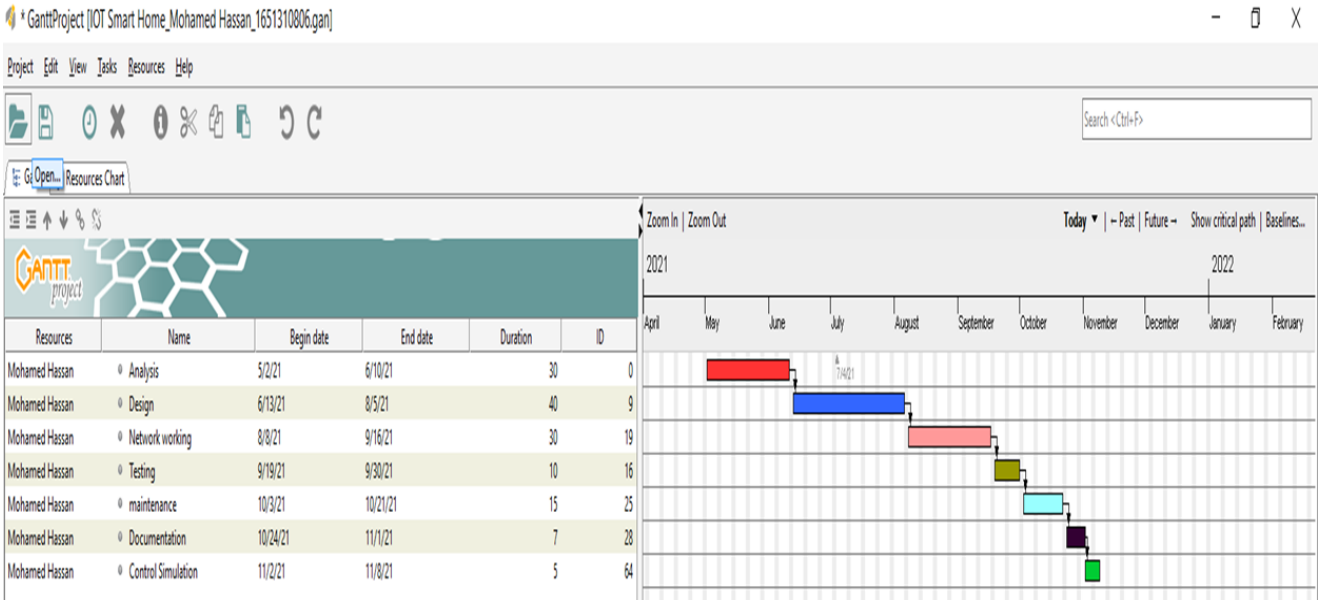
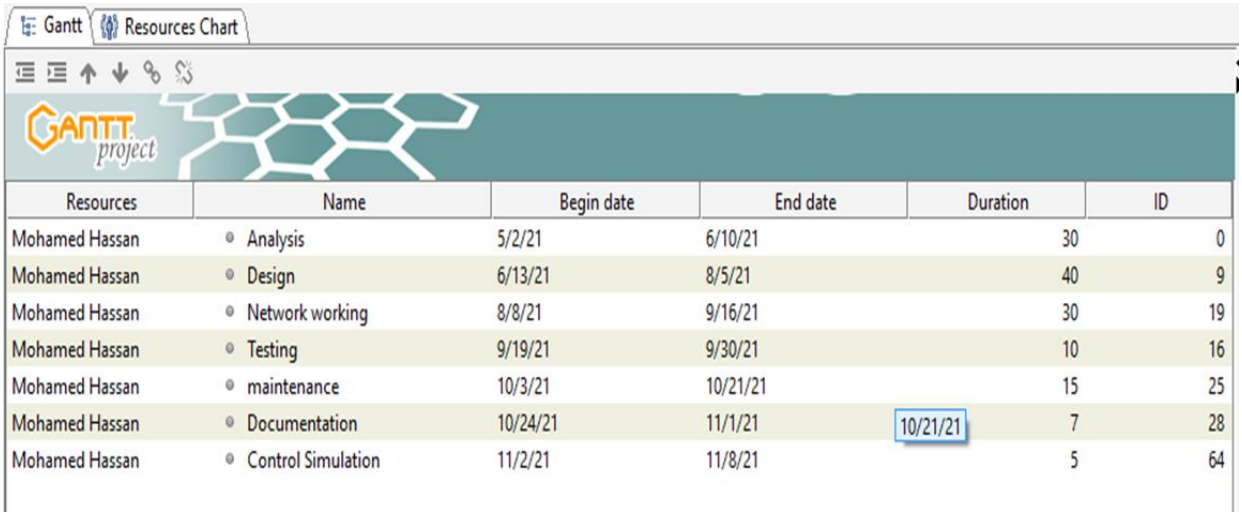


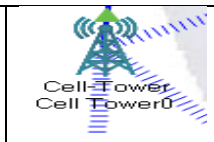
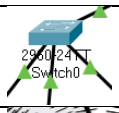
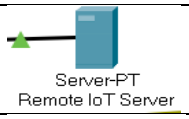
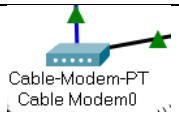
Figure 11_Gantt Chart Diagram



Resources	Name	Begin date	End date	Duration	ID
Mohamed Hassan	Analysis	5/2/21	6/10/21	30	0
Mohamed Hassan	Design	6/13/21	8/5/21	40	9
Mohamed Hassan	Network working	8/8/21	9/16/21	30	19
Mohamed Hassan	Testing	9/19/21	9/30/21	10	16
Mohamed Hassan	maintenance	10/3/21	10/21/21	15	25
Mohamed Hassan	Documentation	10/24/21	11/1/21	7	28
Mohamed Hassan	Control Simulation	11/2/21	11/8/21	5	64

Figure 12_Time Table Diagram

3.3.6 cost average

cell tower cost average		**The average cost to build a cell tower is about $175,000,** [Accessed 13 December 2021]
cost average routers cisco 2811		**$132.**00 [Accessed 13 December 2021].
cost average switch 2960-24TT cisco		**$512.**00 [Accessed 13 December 2021]
cost average DLC100 cisco		**$65.54** [Accessed 13 December 2021].
cost average server-PT cisco		**US$859.00** [Accessed 19 may 2010].
cost average laptop		**$600** [Accessed 19 may 2010].
cost average cable modem cisco		**$48.97** [Accessed 19 may 2010].

Chapter 4

Design, Implementation and testing

4.0 Design

4.1 Network Design Approach

4.1.1 Used Approach

For implementing my project I had to utilize one of the Network Design Life Cycle or NDLC
approaches Figure 13. Which is a series of phases or actions that designers or implementers must take and accomplish in order to establish the desired balance of the system. availability,
flexibility, quality, and deliver the desired design.

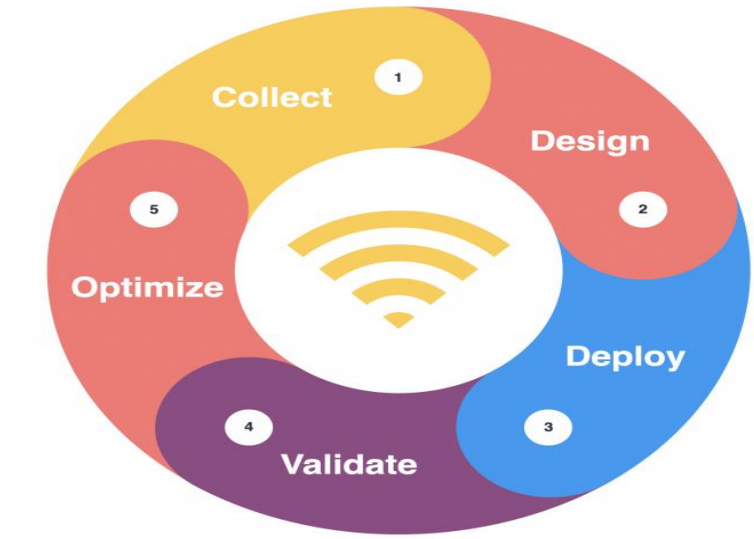


Figure 13_Used Approach

Since NDLC is used to design, build, and optimize networks, it must be employed as a first step before creating new or enhanced networks. Choosing an approach first leads to a successful project plan, as well as lower overall network costs, increased network availability, faster access to applications and services, and more business agility.

Since there are numerous design models to choose from. It might be difficult to select the best NDLC technique for my project. Since constructing a network is no longer distinguishable from designing any huge complicated system, I drew on my prior experience as well as searching the internet and reading more in-depth about them. Finally, I enlisted the support of my friends who have experimented with it. After conducting research and consulting, I thoroughly examine and comprehend my proposal. Finally, PPDIOO is one of my alternatives. Figure 14

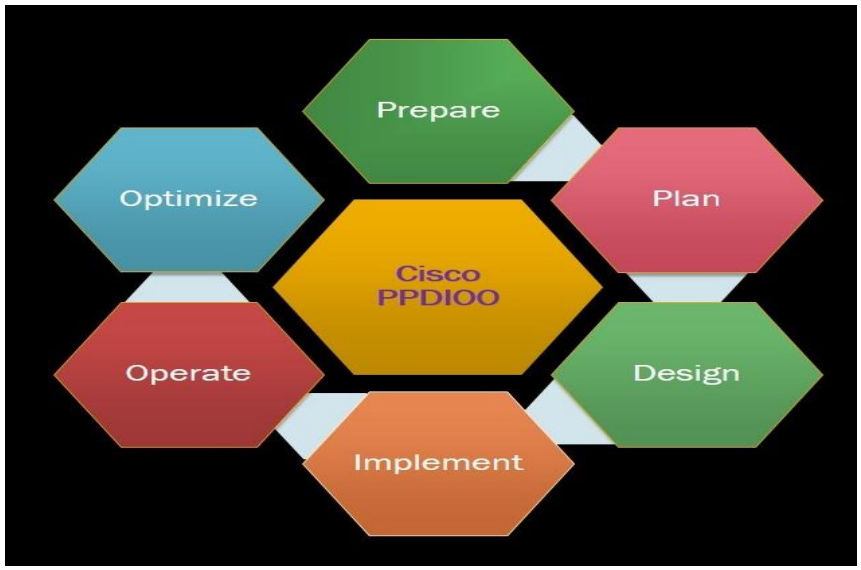


Figure 14_The PPDIOO life Cycle

PPDIOO network lifecycle approach stands for prepare plan design implementation operate
optimize. It is an approach that cisco recommends to design networks.
It fundamentally consists of 6 stages, as follows:

1. prepare
2. plan
3. design
4. implement
5. operate
6. Optimize

- **Prepare stage:**

It's a high-level design that considers a company's or business's large picture, including its goals, vision, and future directions. We identify financial rationale and organizational demands, as well as technology, requirements, and strategies, at this point.

Provide a (CRD) (customer requirements document) that specifies what consumers want from the network. So it's more about gathering needs from the customer's standpoint.

At this point, we should have a good grasp of how the business's fundamental operating processes work.

- **Plan stage:**

This stage gets through more details than the prepare stage. At this stage, we conduct an

official financial and physical examination of resources and allocate budgets. characterize

existing network if any.

identify goals and baseline that want to achieve and the Network Infrastructure Solutions like

network size, Routers that provide wan edge connectivity, Switches that provide LAN

infrastructure, Security appliances that defined the branch devices and end-user device ...etc.

Start plan and Drawdown the project schedule based on customer timelines and business

requirements. Also planning the policies like network security policy and identify what is

important for customers and end-user requirements

- **Design stage:**

It comes before the implementation stage. It is the low-level design

that is the main stage of the network design process. At this stage, It will be developing or

updating the overall network design. And by using the information gathered from the

previous phases strategy and analysis solutions will be identified and Verified the address

business and technical goals. At this stage, it will provide the logical and functional design of

each module of the network for example data center module.

- **Implement stage:**

Or the production phase. At this stage, start to Break the larger design into smaller

deployments and do a testbed to simulate in network design modules to find unexpected

errors and resolve them before affecting the end-user. the test also will examine services like

hardware circuits, for example, Jetter delay and some other network services. In the end, we

will gain more insurance about the design and move to full-scale deployment.

- **Operate stage:**

Since it is a maintenance phase, the Operate phase is the longest of the lifespan. It includes a monitoring network that can be proactive or reactive, as well as network management. It also focuses on network health management and detects network issues at this point, allowing modest improvements to be made. However, if a significant modification is required, the network lifecycle process should be restarted and the network redesigned.

- **optimize stage:**

It's the last step in the network design procedure. Initial and current requirements are evaluated at this stage to see what needs to be changed within the network and whether there are any technical or commercial requirements that cannot be met with the present network. From here, the lifecycle repeats itself, and a new project is started.

4.1.1.2 Justification of the used approach

This is the method I've selected for my network architecture. Because this method assures that the design is available, flexible enough to suit current and future business needs, and includes a design and implementation process that can ensure a successful network deployment.

4.1.1.3 Alternative Approaches:

As the PPDIOO (prepare plan design implement operate optimize) approach seemed to be the best approach for my project requirements I was

hesitating between this approach and the iterative one.

Plan, Build, Manage (PBM) simple lifecycle model by Cisco

this model is much simpler than PPDIOO.

PMM has 3 phases Plan, Build, and Manage.

So the Plan phase covers the preparation and plan and design phases from the PPDIOO model

where the Strategy and Analysis Assessment of the current network and the Design of the network. And the Build phase covers the implementation phase which is deploying the network and validating the network solutions. Finally, the manage phase covers the operation and

optimize phase, and here where Optimization and Operations Management happen and start

the lifecycle all over again. Figure 15

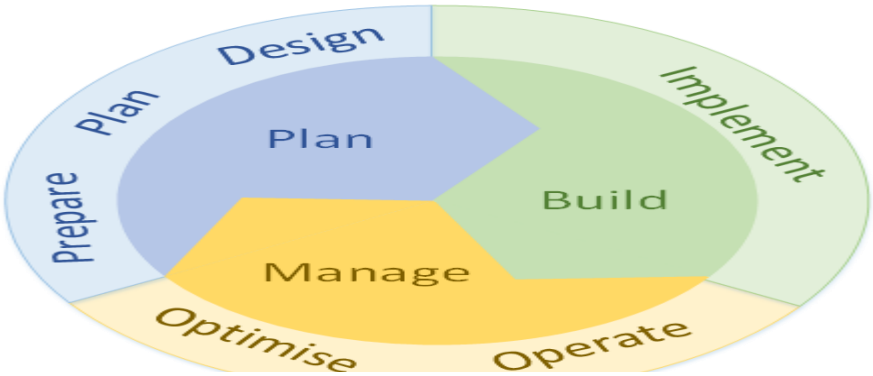


Figure 15 _The PMM Life Cycle

4.1.1.4 Why is better than others

PPDIOO provides a lot of information on the life cycle.

So I decided to utilize the PPDIOO model to build the project in order to validate each stage of the network design process since PPDIOO includes a lot of information and gives a clear difference between each phase, which helps to avoid mistakes and makes making the right decisions simpler. It also minimizes complexity by breaking down tasks into smaller chunks.

Although the PPM method is a wonderful paradigm for simplifying network architecture and getting the job done, it is not without flaws. However, because of its high degree of view, it was disqualified. I believe that for my design, I will need clear processes to follow in order to avoid as many difficulties as possible and to be able to recognize any problems that develop throughout the process and address them as quickly as feasible.

4.1.2 In the Software requirements

In the Software requirements, the focus was on tools that been used for designing and

implementing the projects. Figure 16 shows.

NAME	DESCRIPTION	USAGE
Windows 10	Microsoft Windows **operating system.**	**Manage and execute** softwares.
Packet Tracer	Cisco visual **simulation tool.**	**Draw** the topologies and **Implement** the network.

Figure 16_Software Requirements

4.2 **Implementation**

shows the full implementation of the smart home network

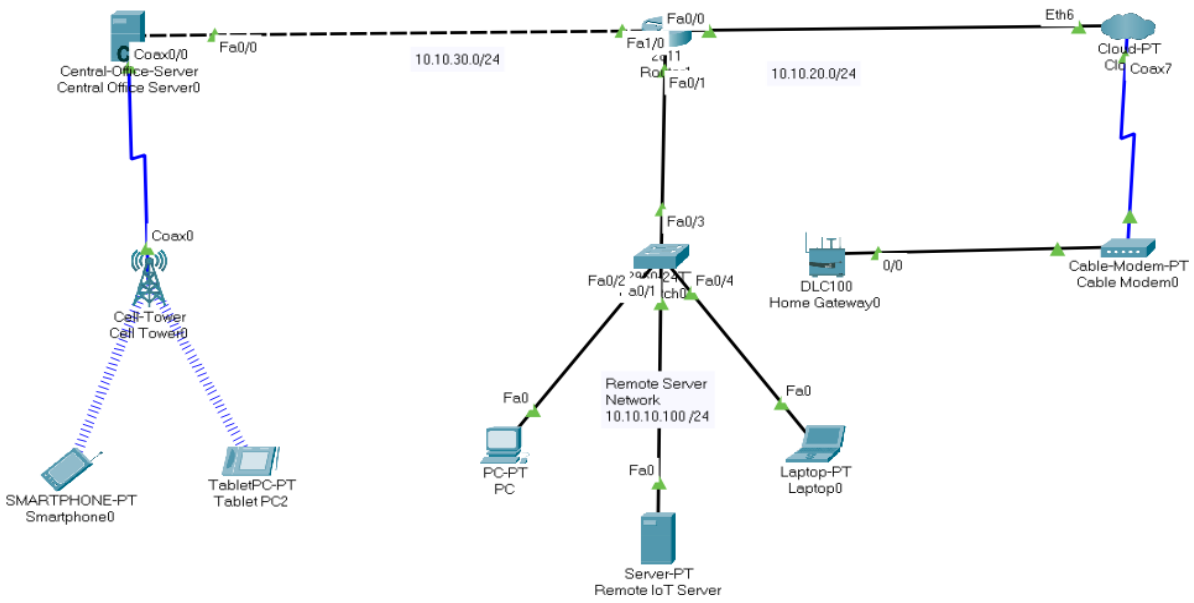


Figure 17_The figure above shows the whole network with its subletting IPs and each device interface, the whole network was developed and configured using many devices and many IPs networks.

List of used devices:

1- Smart devices (smartphone, tablet, etc….)

packet tracer smartphones and tablets can access the home remotely using the cellular system by using the cell tower from anywhere.

2- A cell tower:

enables the user to use the cellular system to connect the home remotely using smartphones. The connection between the smart devices and the cell tower is wireless.

3- A Central Office Server:

that gets all IPs after configuring the DHCP in the ISPs (Internet Service Providers). The connection between the cell tower the Central Office Server has been done using a coaxial server to allow to connection between the cell tower and the router.

4- A 2811 Cisco router:

it's the ISP router, used to connect all the network interfaces also, I configured the DHCP server on the router to assign an IP address to every connected device dynamically, the configuration has been done using the Cisco packet tracer CLI (Command Line Interface), the router connects to the cloud and the ISP internal network (the first device after the router in the internal ISP network is a Cisco switch) using the "Copper Straight-through" cable and the router connects to the Central Office Server using the "Copper Cross-Over" cable and the primary difference between the two cables is that straight-through used for connecting unlike devices and crossover cables used for connecting unlike devices to alike devices.

Figure 18_The figure above shows the whole router configurations

5- A cable modem:

that converts the digital data signals to analog data signals and vice versa and it is used to make a connection between the home and the internet to provide the internet connection, there is no configuration for this device in the simulation and it connected to the internet using the coaxial cable.

6- A wireless home gateway:

that configures the IPs on the smart home devices and connecting them wirelessly.

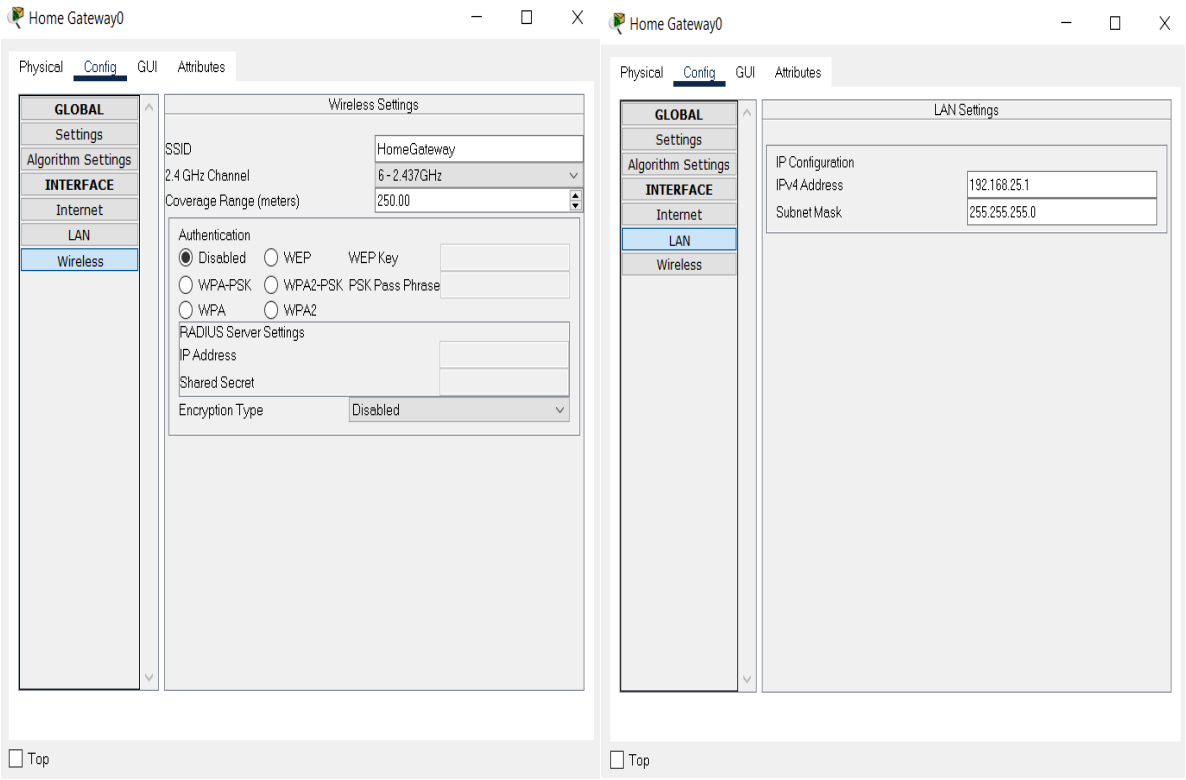


Figure 19_The two figures above show the home gateway configurations

7- The ISP internal network:

- **Switch:**

  it's a 2960 switch model, the primary function of the switch is to enable a small LAN (Local Area Network) within the ISP network.

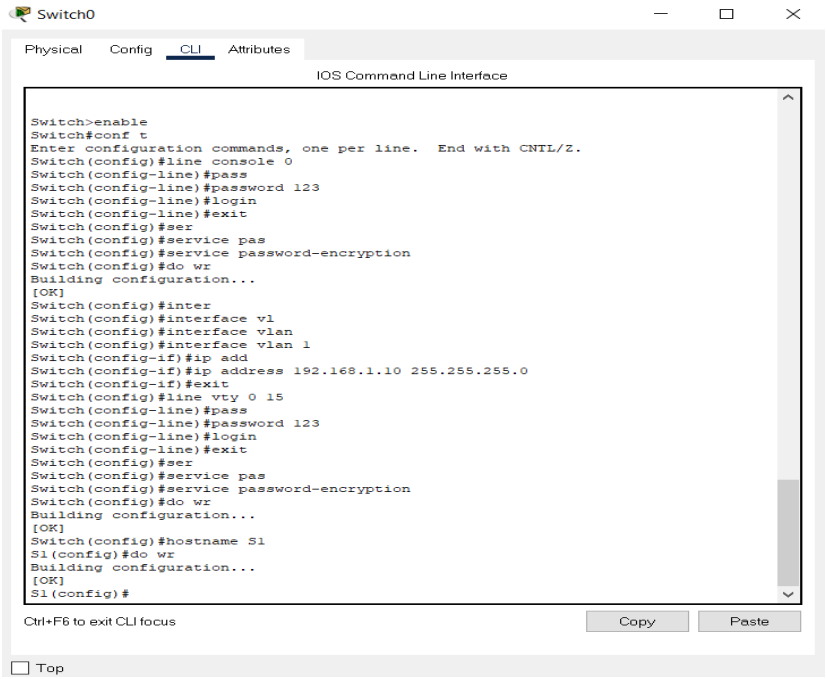


Figure 20_The figure above shows the switch S1 configurations, I added some basic security configurations on it.

- **Laptop:**

  I used a Packet Tracer laptop to test connectivity in the network and if any want to make configuration through the laptop

- **Personal Computer (PC):**

  Also, the Personal Computer (PC) is used to test connectivity and to do any necessary configurations, the test connectivity is used through the ICMP protocol by using the ping command.

- **Remote IoT Server:**
  I configure the server to enable the user to connect the home remotely from anywhere and also I configured the AAA (Authentication, authorization, and accounting) protocol to ensure that there is authentication and authorization and accounting on the networks and also, I tested connectivity using the (ping) command to ensure that the network is working properly by using the PC and the Laptop.

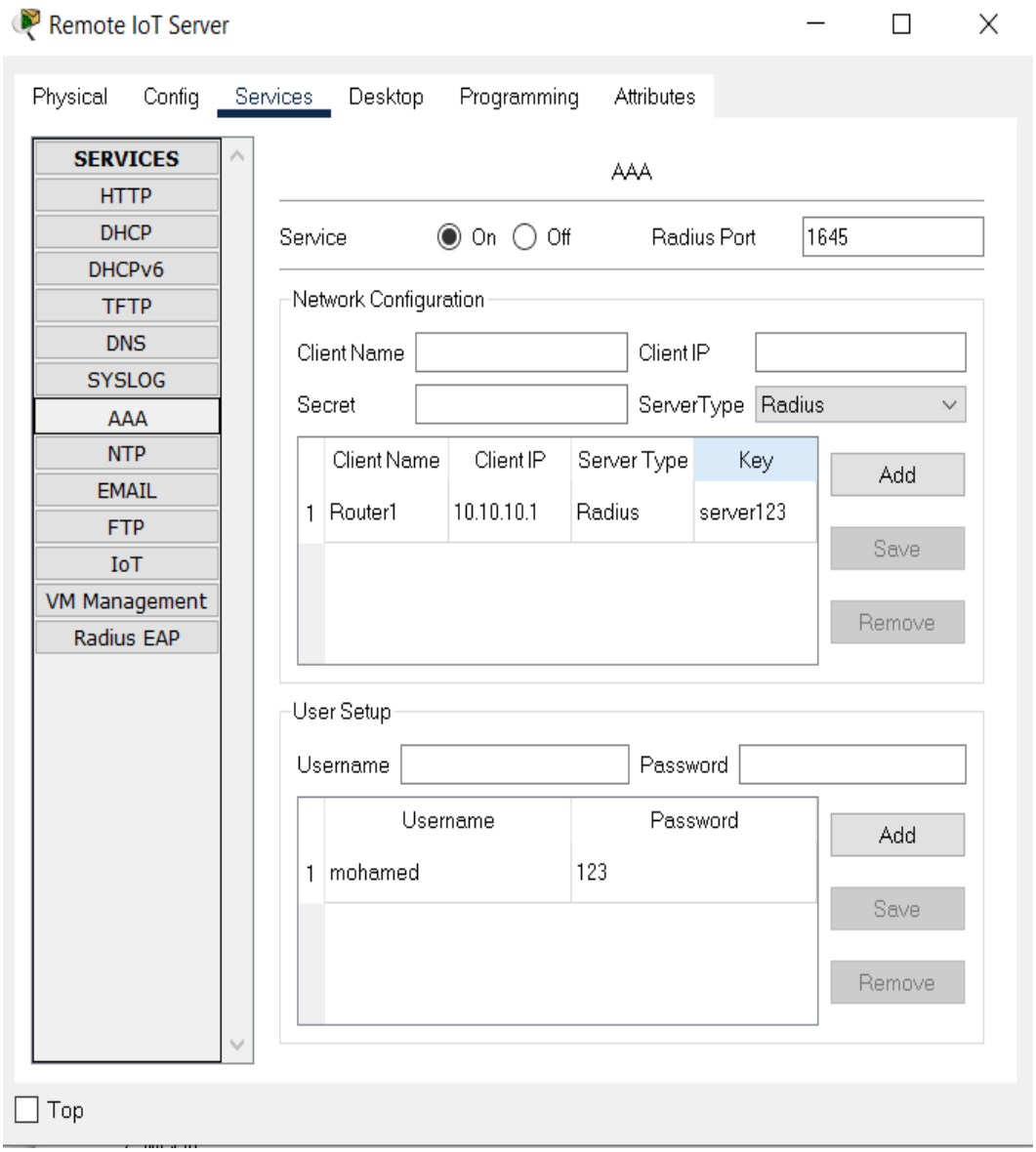


Figure 21_The figure above shows the AAA security protocol configurations on the server

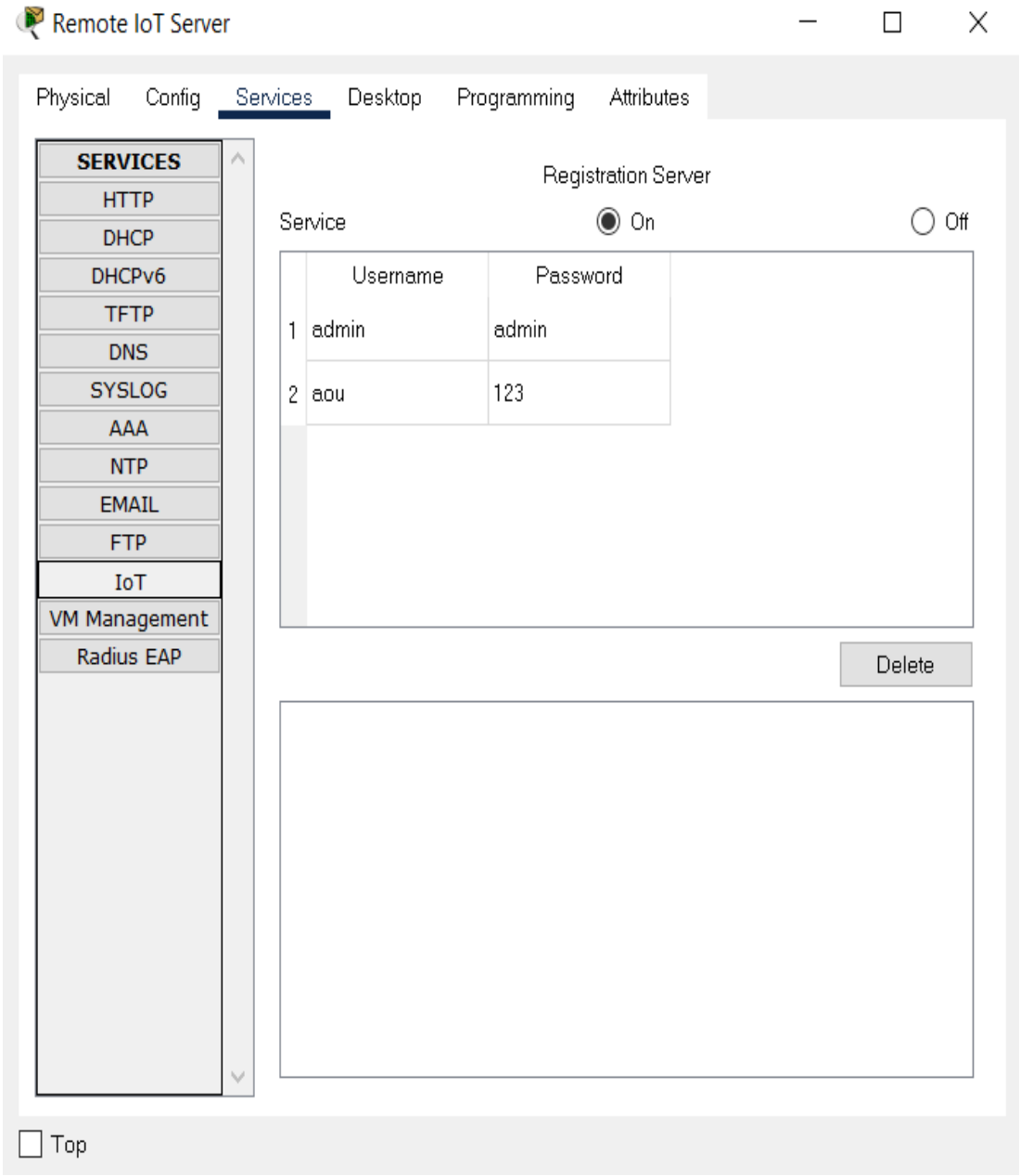


Figure 22_The figure above shows the IoT configurations on the server

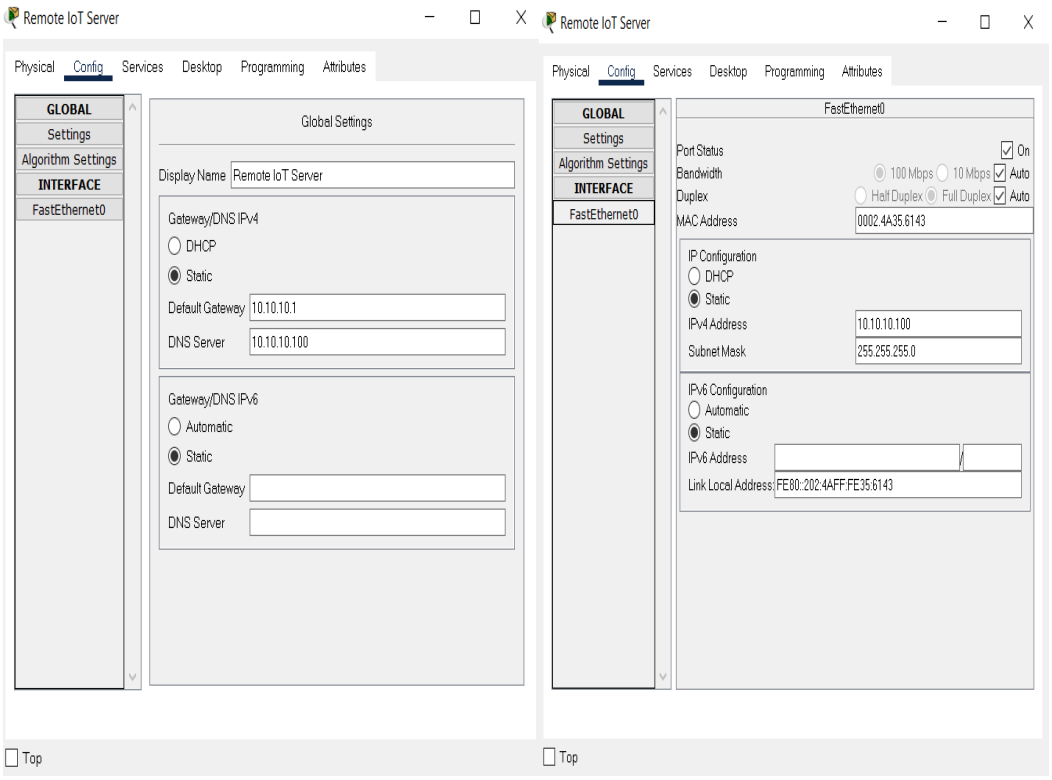


Figure 23_The two figures above show the server configurations

8- IoT Cloud(WAN):

is used to transfer the collected data by the smart devices from the home to the IoT server in order to be store also, the smart devices assigned with their IP address from the home gateway through the cloud. There is no must configuration on the WAN; we associate the Ethernet interface from the router to the coaxial interface to the cable modem.

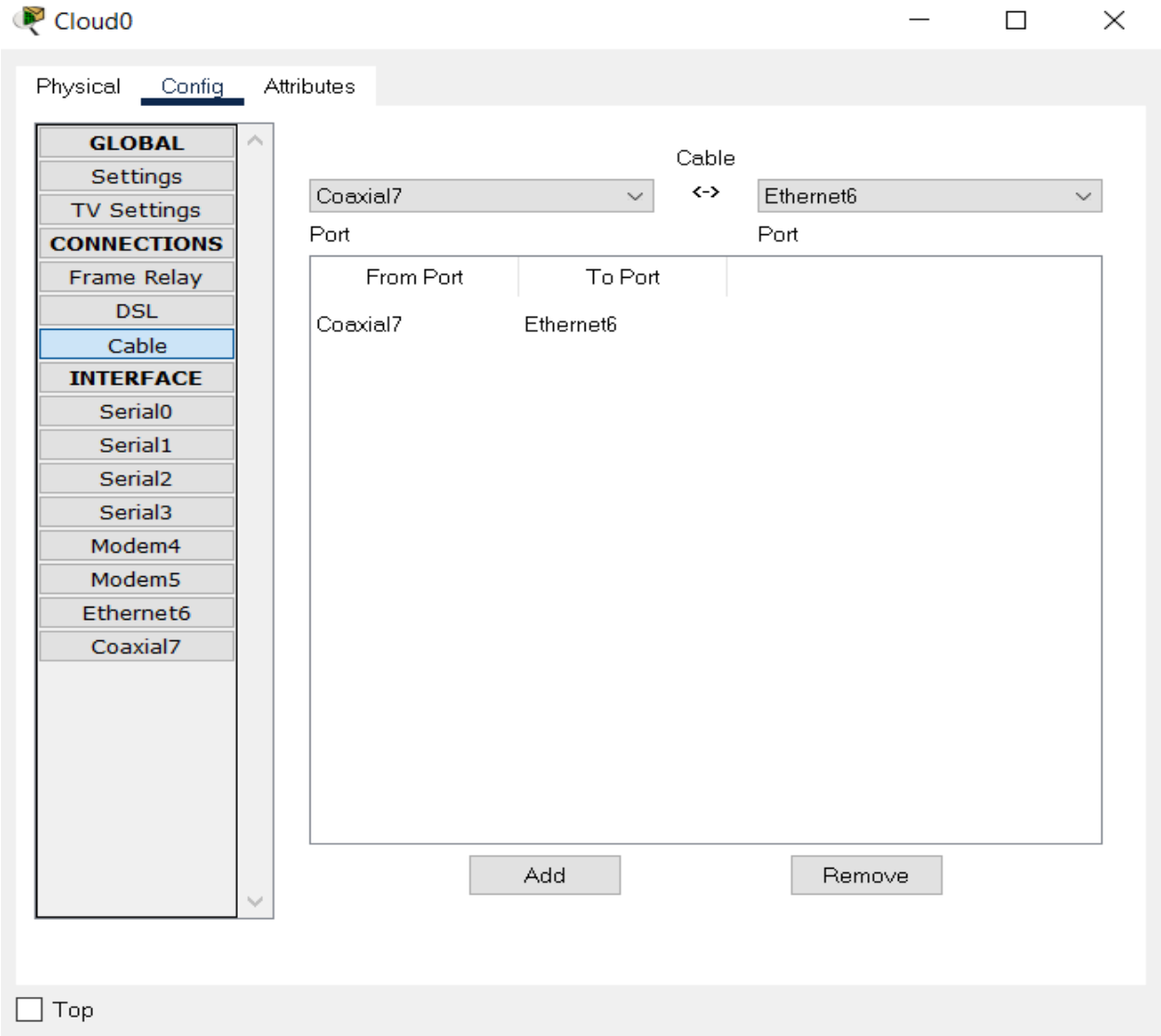


Figure 24_The figure above shows the WAN configurations

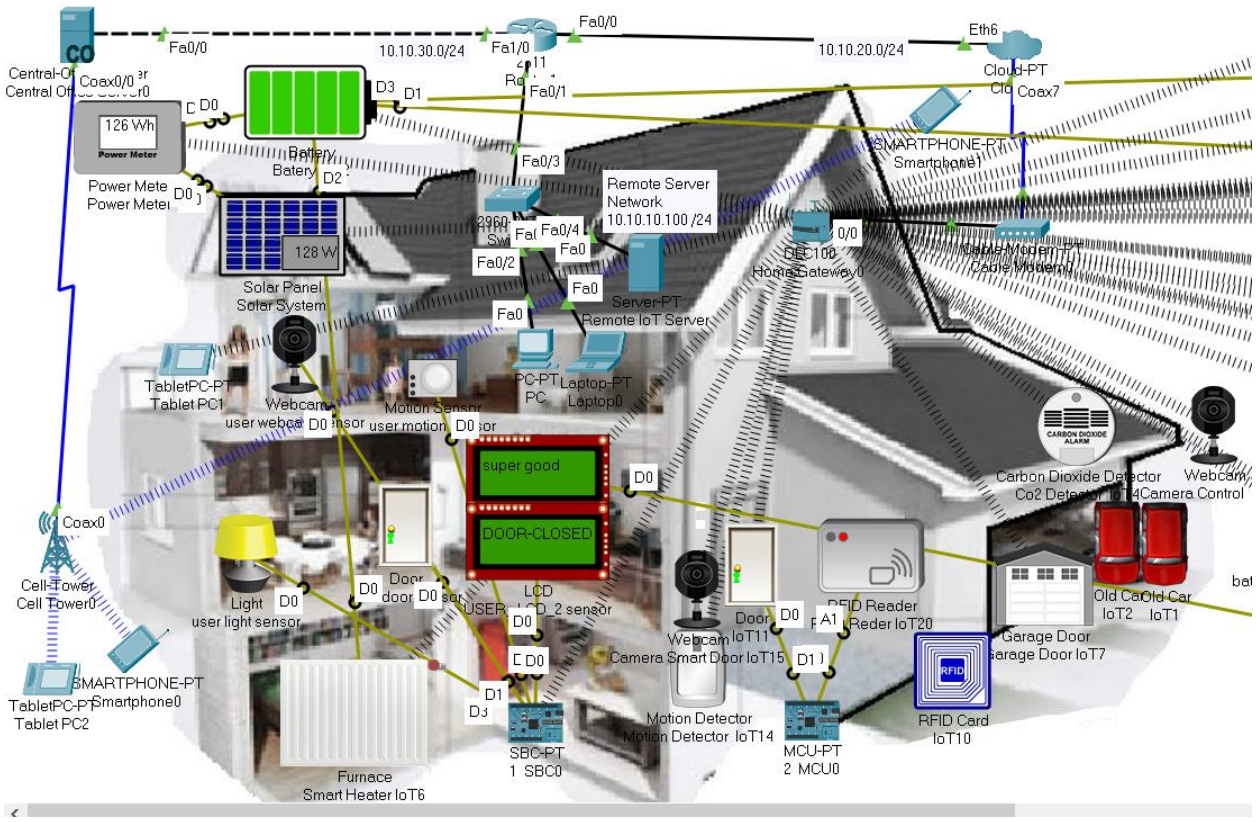


Figure 25_the full home systems

After knowing the whole network and the ISP internal network and know what each device can do. I connected IoT smart devices within the home itself to apply the smartness on the home.

I used many devices to make the home smarter and smarter.

List of the IoT devices:

1- **Packet Tracer IoT main door:**

it's a smart door that have the IoT features to control it from the IoT server and I added a more advanced physical security feature on it by using a microcontroller to control a RFID Reader and give the user a RFID card. So, if the user wants to open the door remotely to anyone who doesn't have the RFID card; he can do it and to ensure the security you must go the main house's door you must go with your RFID card.

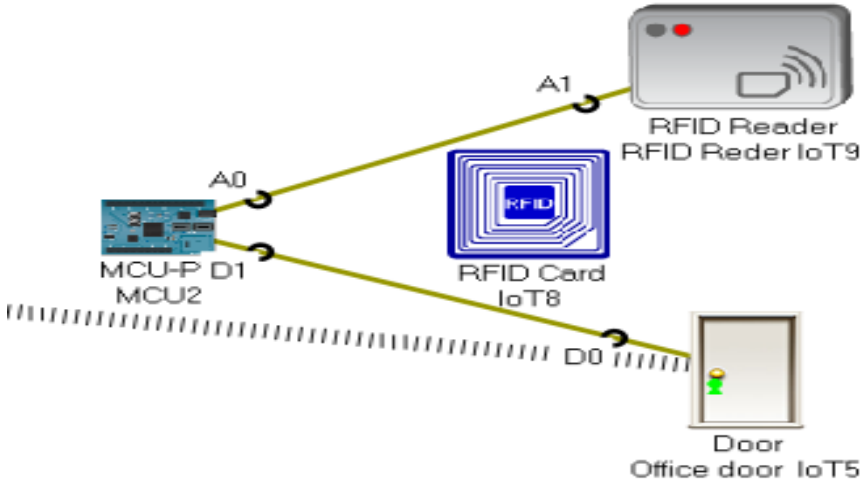


Figure 26_The figure above shows the process of the door system.

- ✓ The door is an IoT door that connects to the home gateway wirelessly, but the microcontroller is connecting to the RFID Reader and to the door using the IoT Custom Cable to connect the door to the microcontroller and to the RFID Reader.

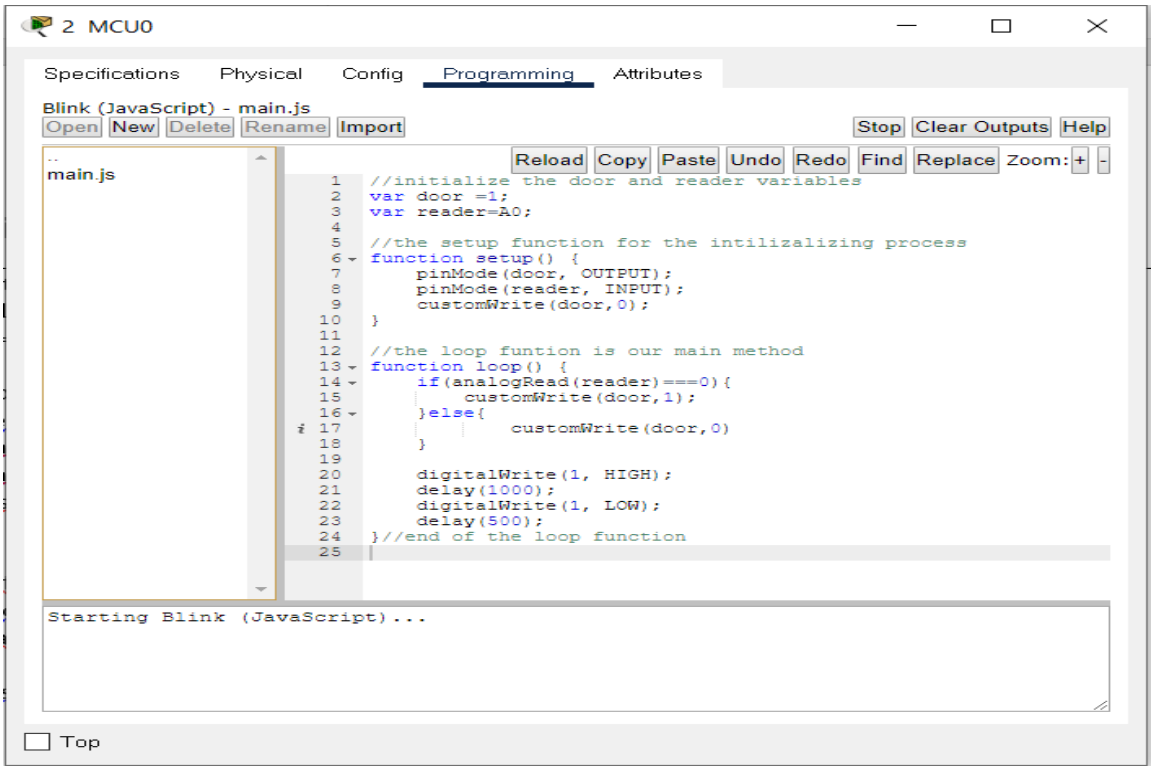


Figure 27_The figure above shows the code of the microcontroller.

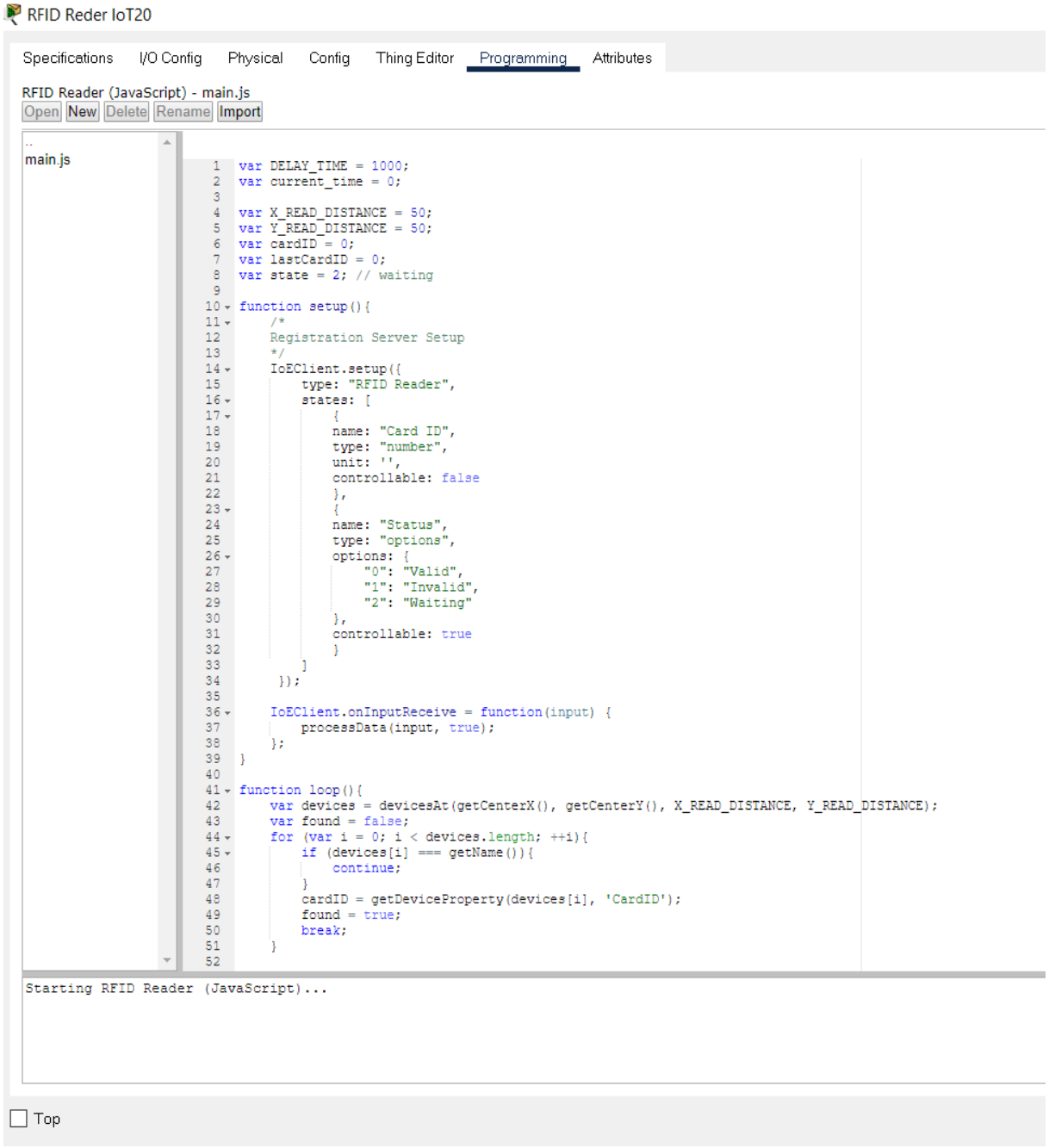


Figure 28_The figure above shows the code of the RFID.

Figure 29_The figure above shows the code of the RFID.

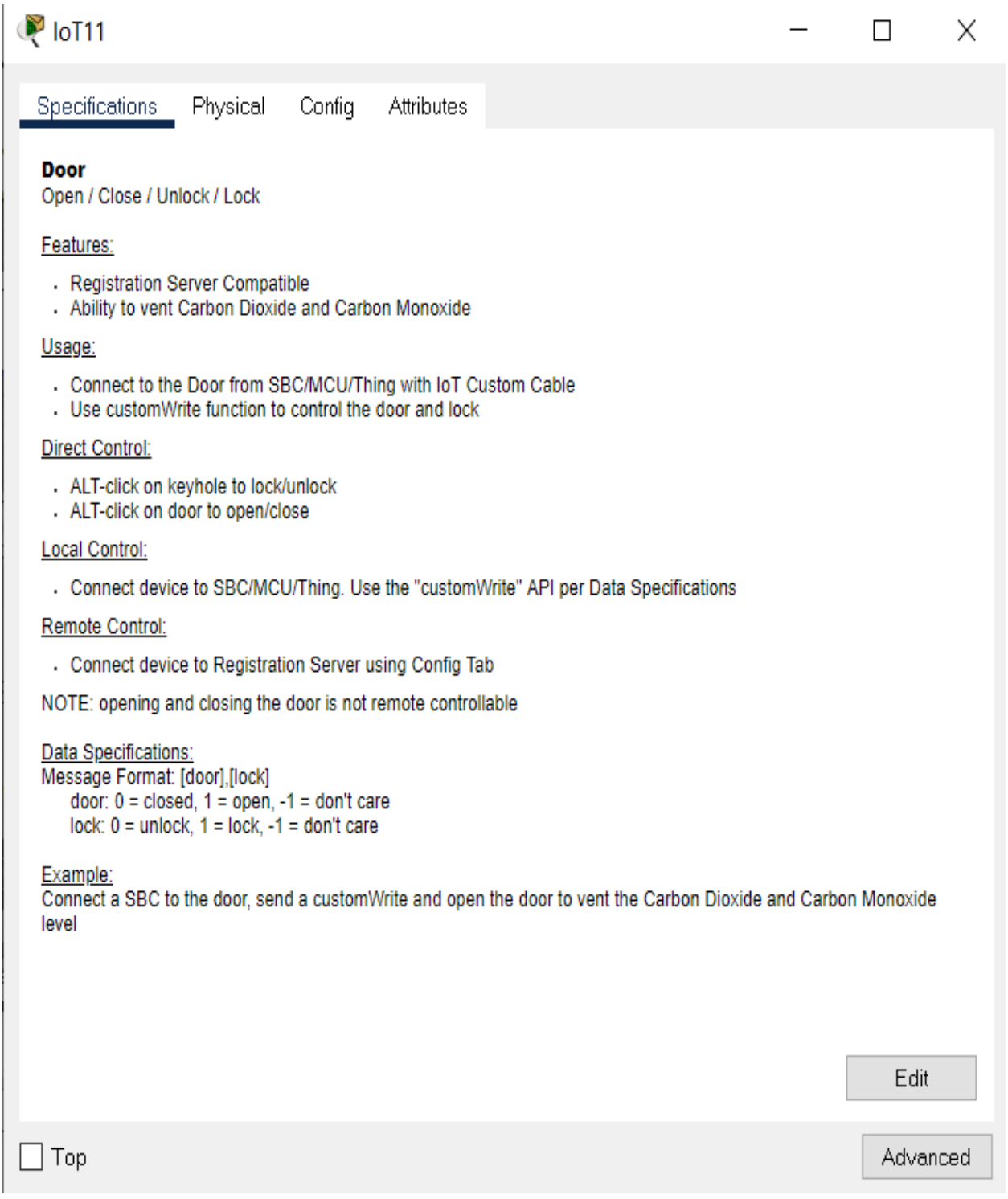


Figure 30_The figure above shows the door specifications

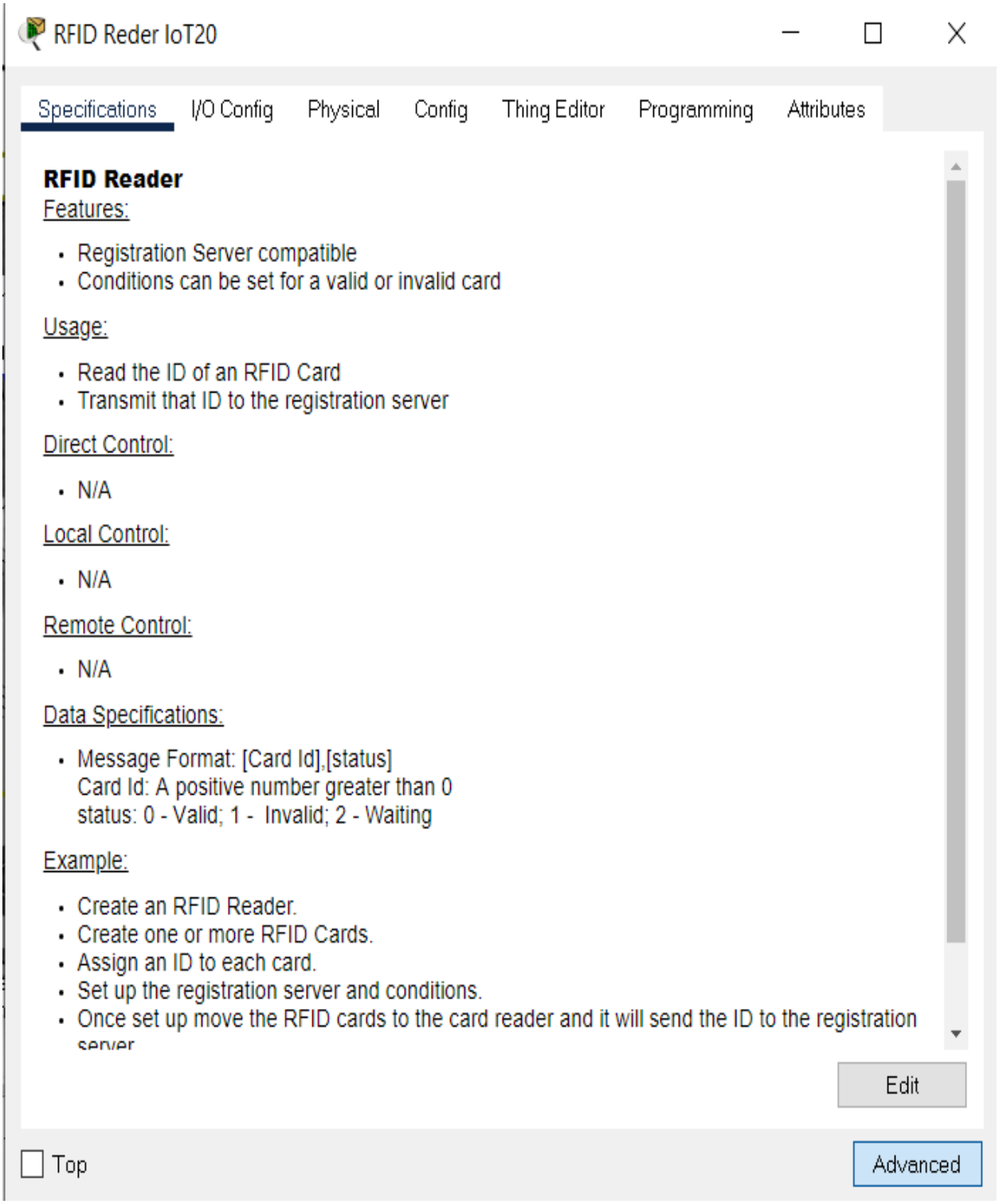


Figure 31_The figure above shows the RFID Reader specifications

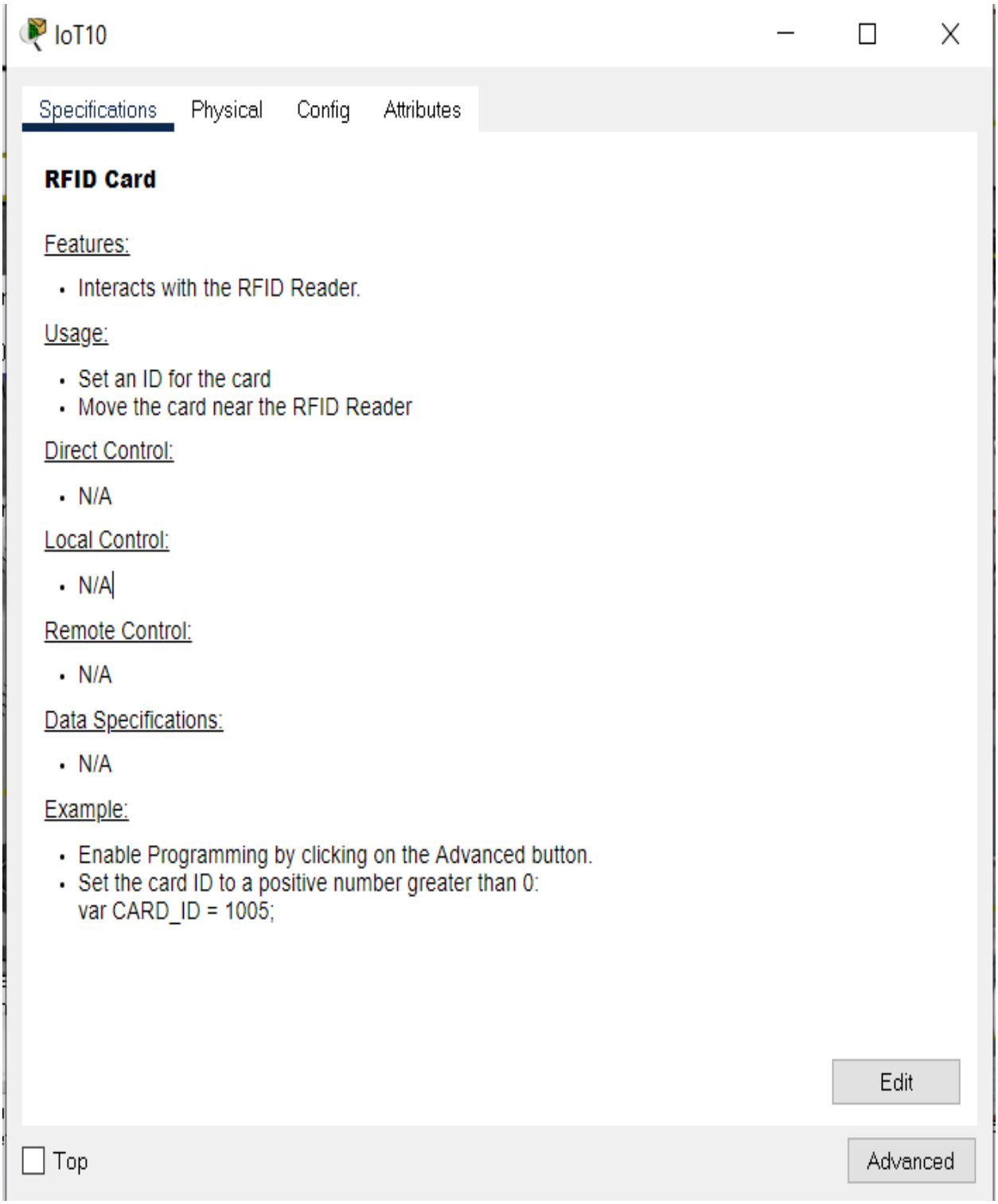


Figure 32_The figure above shows the RFID Card specifications

2- **Packet Tracer Motion Detector and Camera:**

If any person is going in front the door of the house, the Packet Tracer Motion Detector will detect his motion and the Packet Tracer Camera will record a video to what happen. The video will have recorded and sent to the home owner and also, that process is recorded and the user can watch it from any connecting to the camera. This process added a new security feature to the home security system. This small system connects to the home gateway wirelessly.

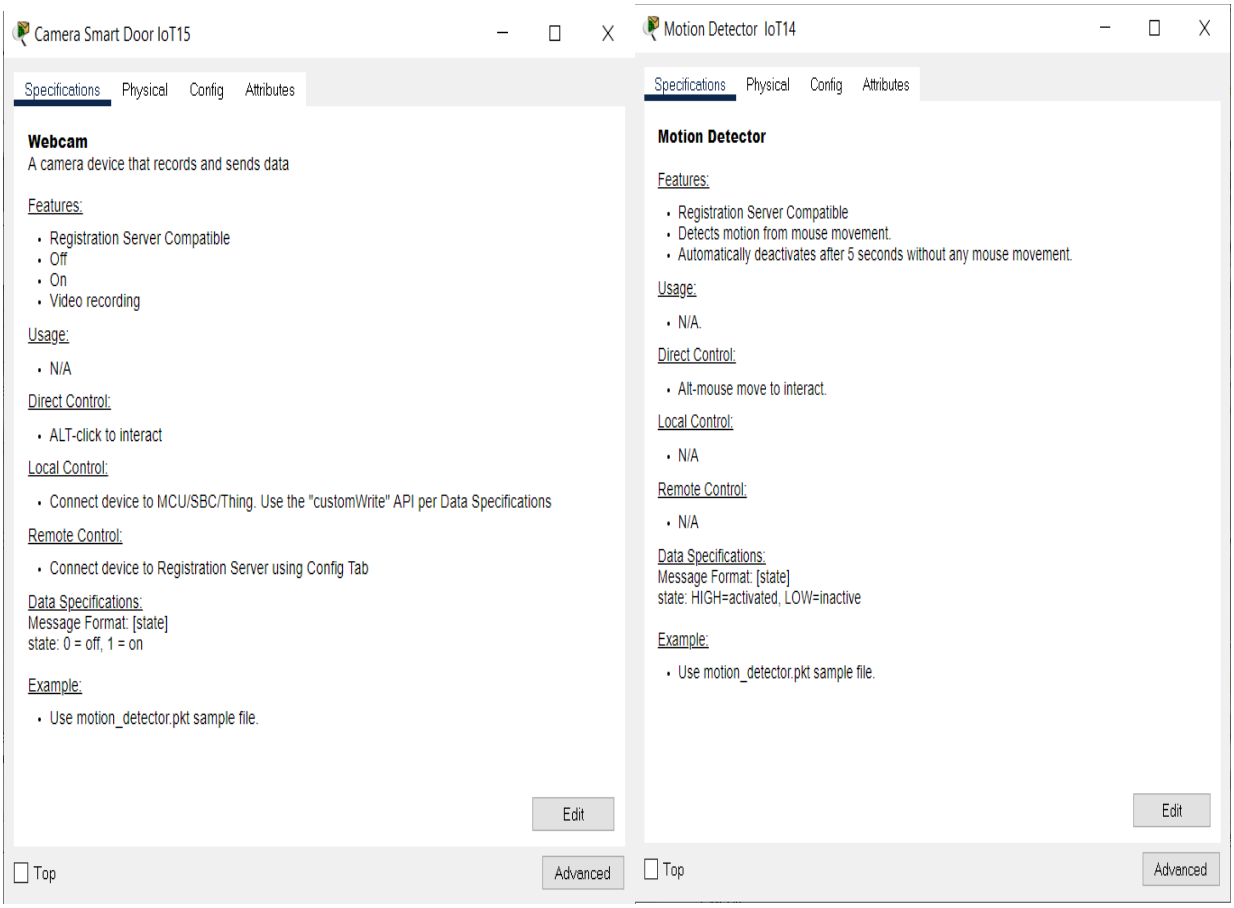


Figure 33_The figures above show the Camera and the Motion Detector specification

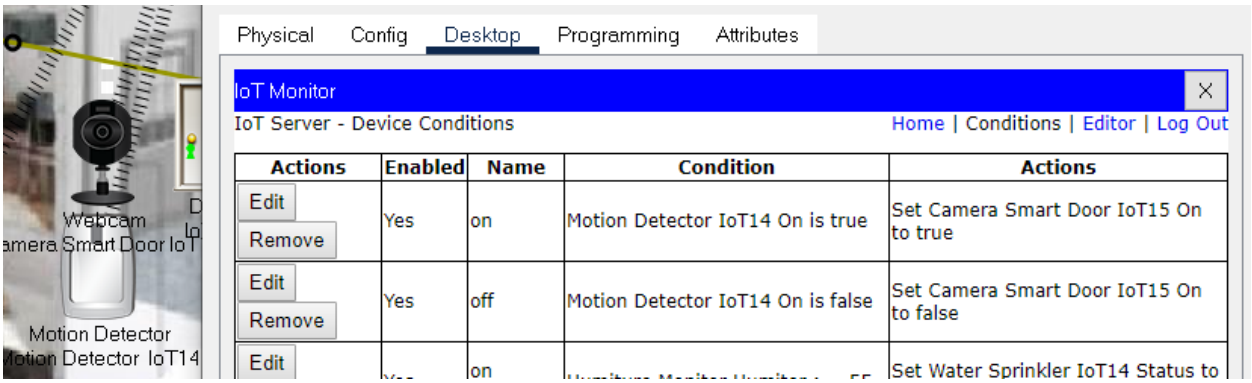


Figure 34_The figure above shows the connection between the smartphone, motion detector and the camera.

3- Packet Tracer Garage Small System:

The Packet Tracer Garage small system there is a smart IoT garage that connects to the home gateway wirelessly and a smart IoT Carbon Dioxide Detector that detects any Co2 from the smart Packet tracer car when going out of the garage, the Carbon Dioxide Detector also connects to the home gateway wirelessly. When the car is going out of the garage the detector detects the Co2 and there is a smart IoT Siren in the home itself that warns the home user that there is someone who is going out using the car also, there is a camera record a video in the garage. It is another security feature added to the security system in the home.

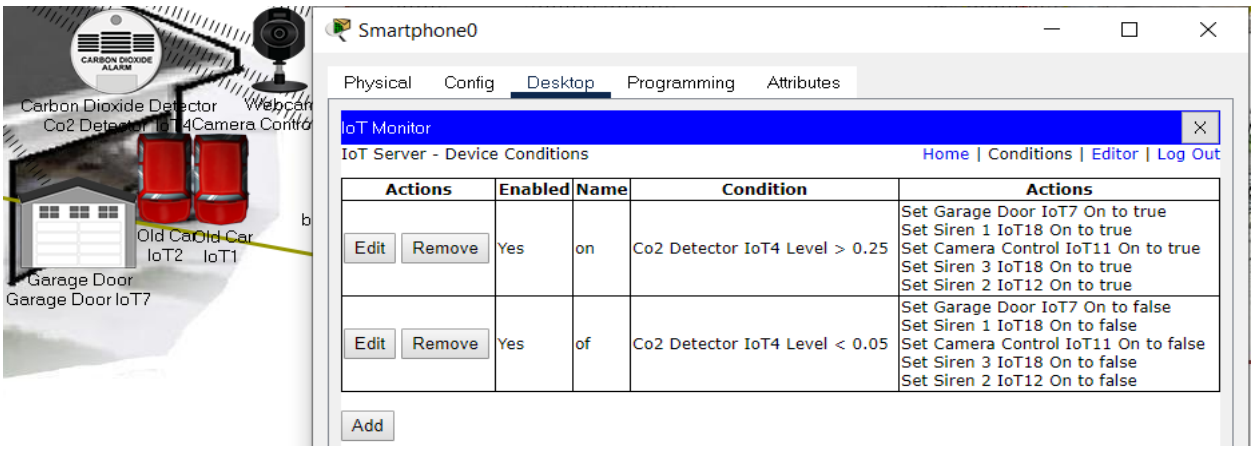


Figure 35_The figure above shows the connections between the garage system and the smartphone.

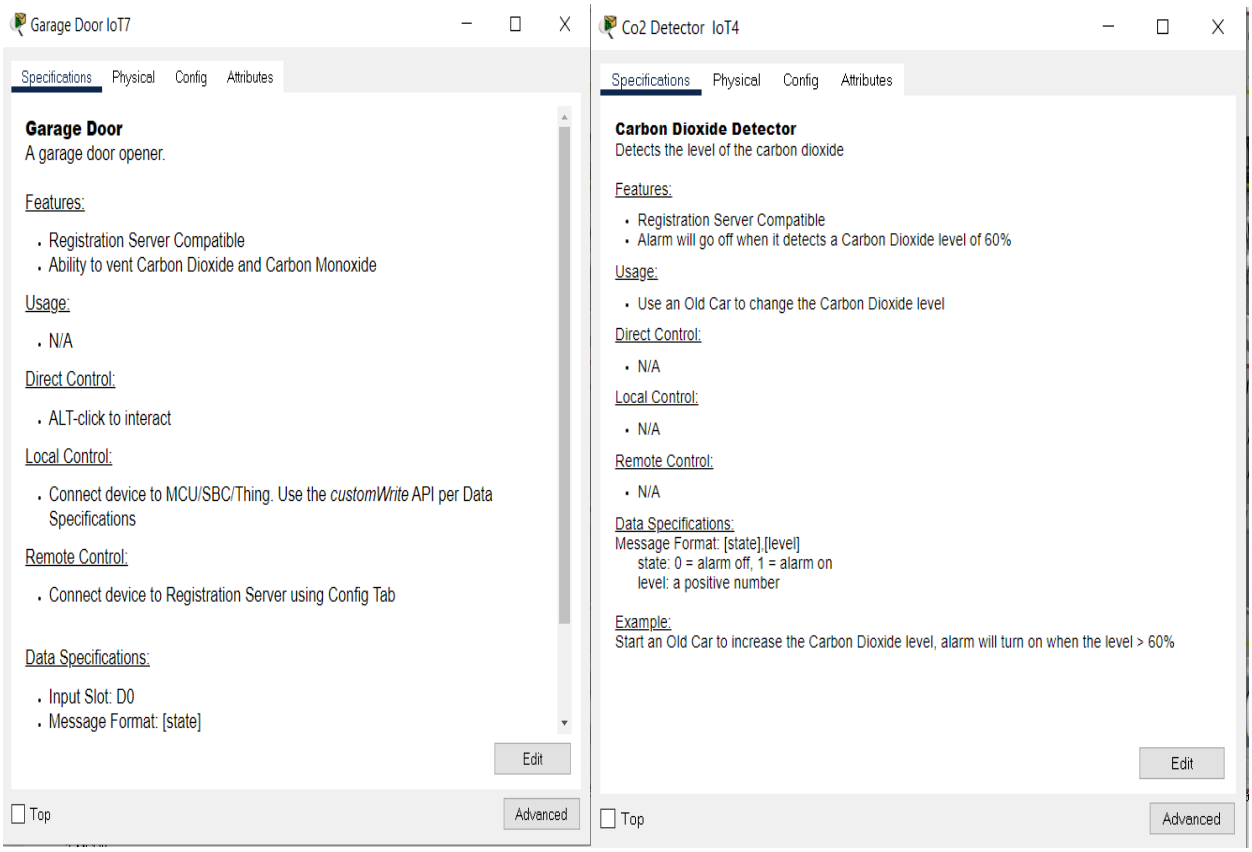


Figure 36_The two figures above show the Co2 and the Garage Door specifications .

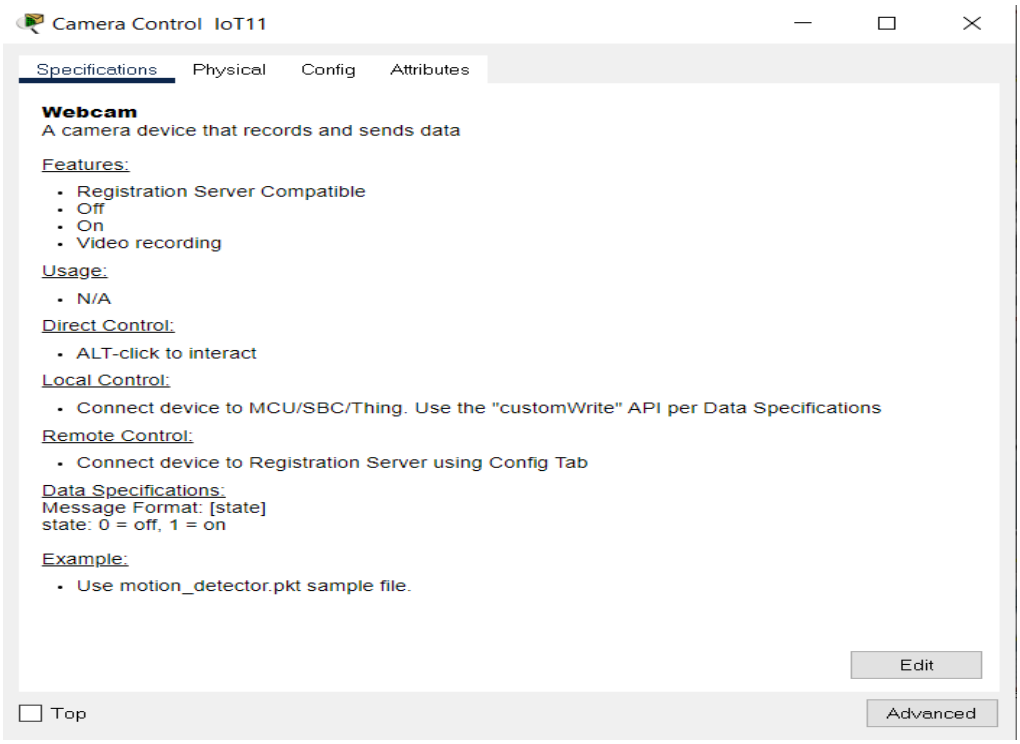


Figure 37_The figure above shows the Siren and the Camera specification

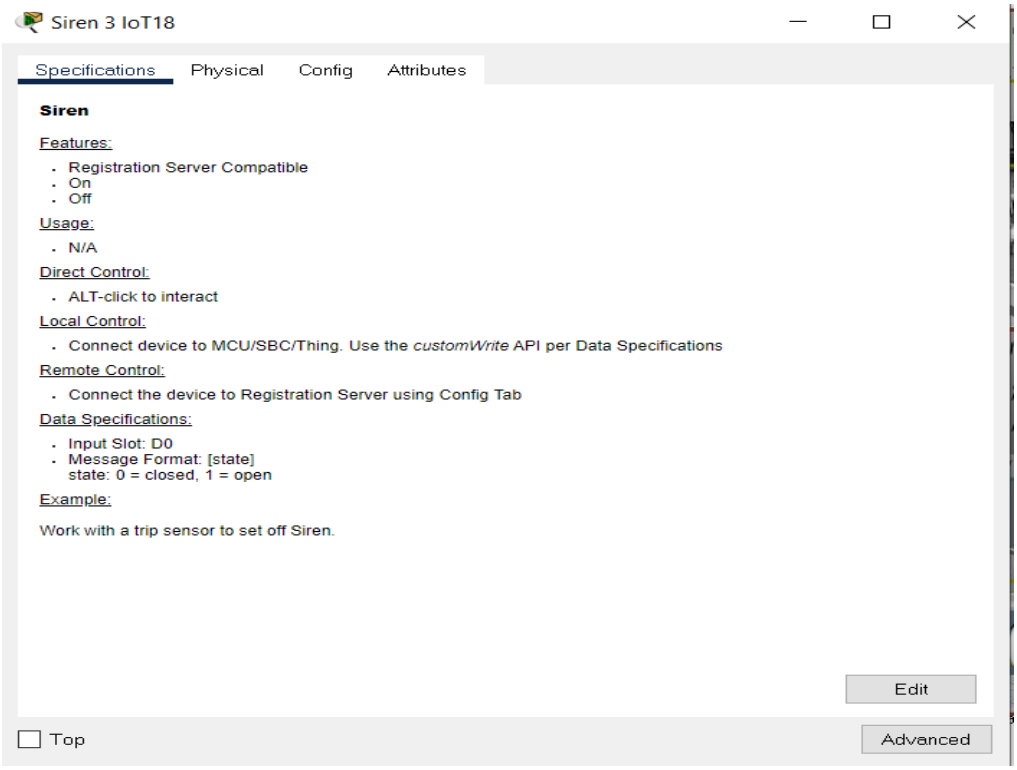


Figure 38_The figure above shows the Siren and the Camera specification

4- Packet Tracer Solar System:

There is a solar system that has a Power Meter and a Battery that gives power to the air conditioner, a water boiler, and a smart heater in the house, this feature added a power-saving feature to the smart home; the user can have an alternative power.

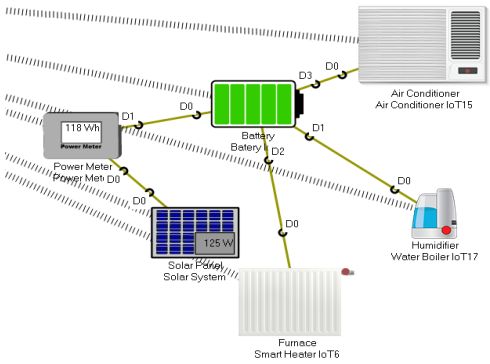


Figure 39_The figure above shows the Solar System

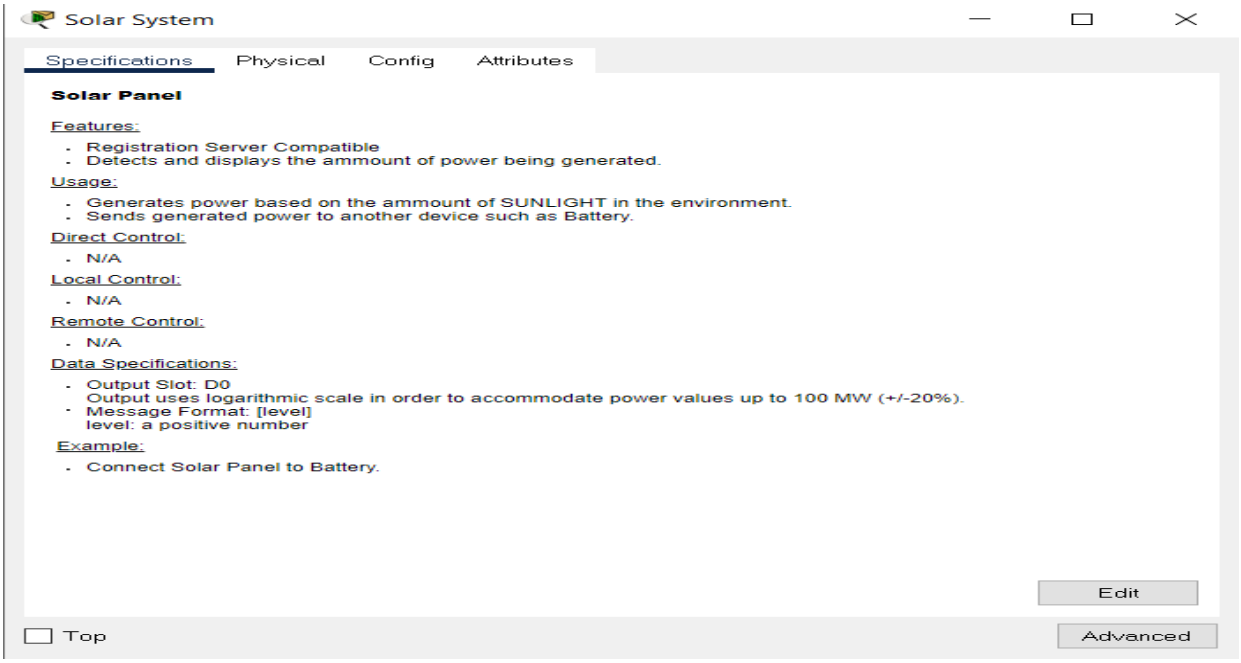


Figure 40_The figure above shows the solar system specification

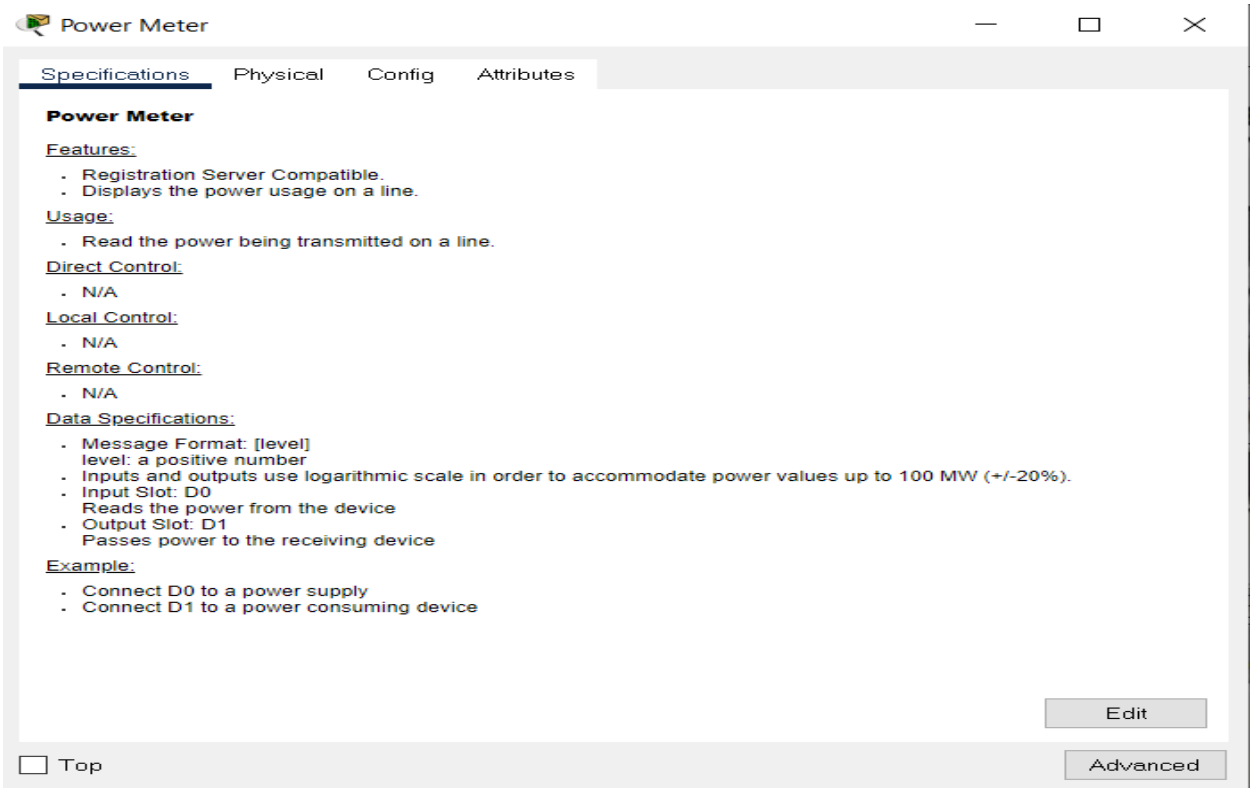


Figure 41_The figure above shows the Power Meter specification

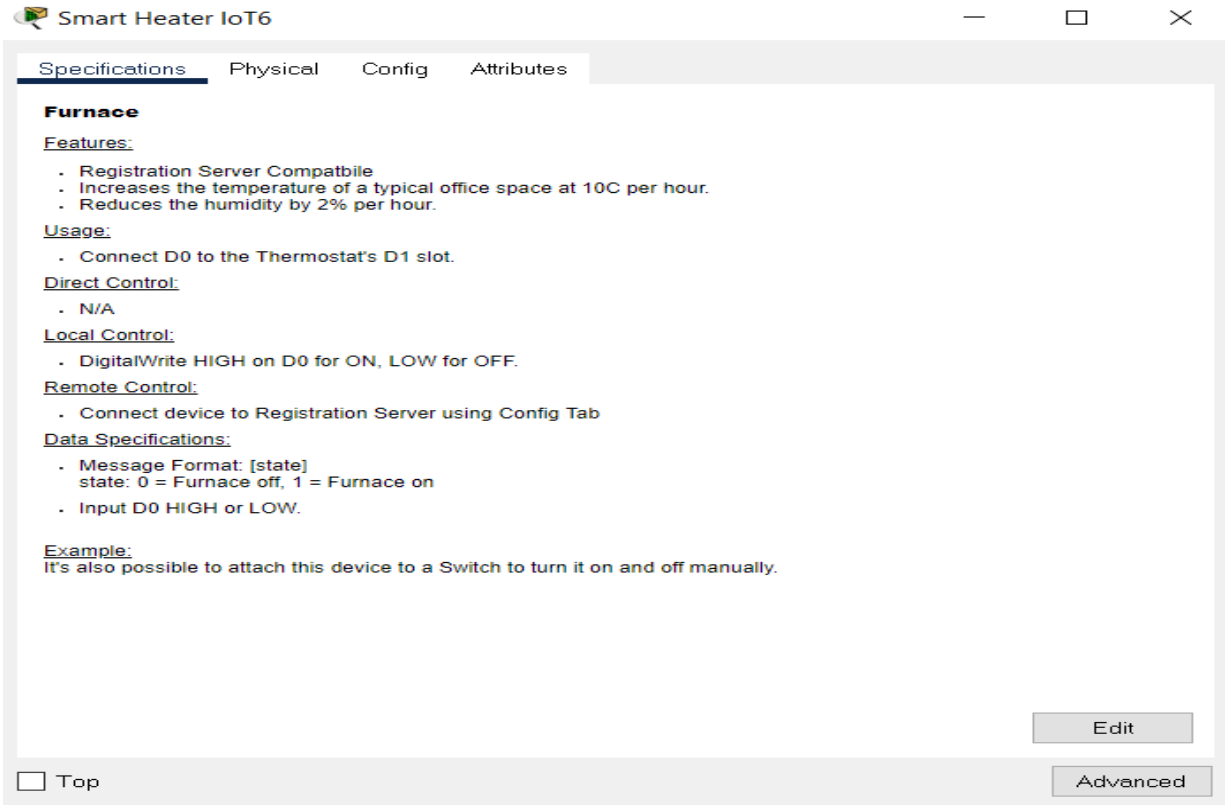


Figure 42_The figure above shows the Smart Heater specification

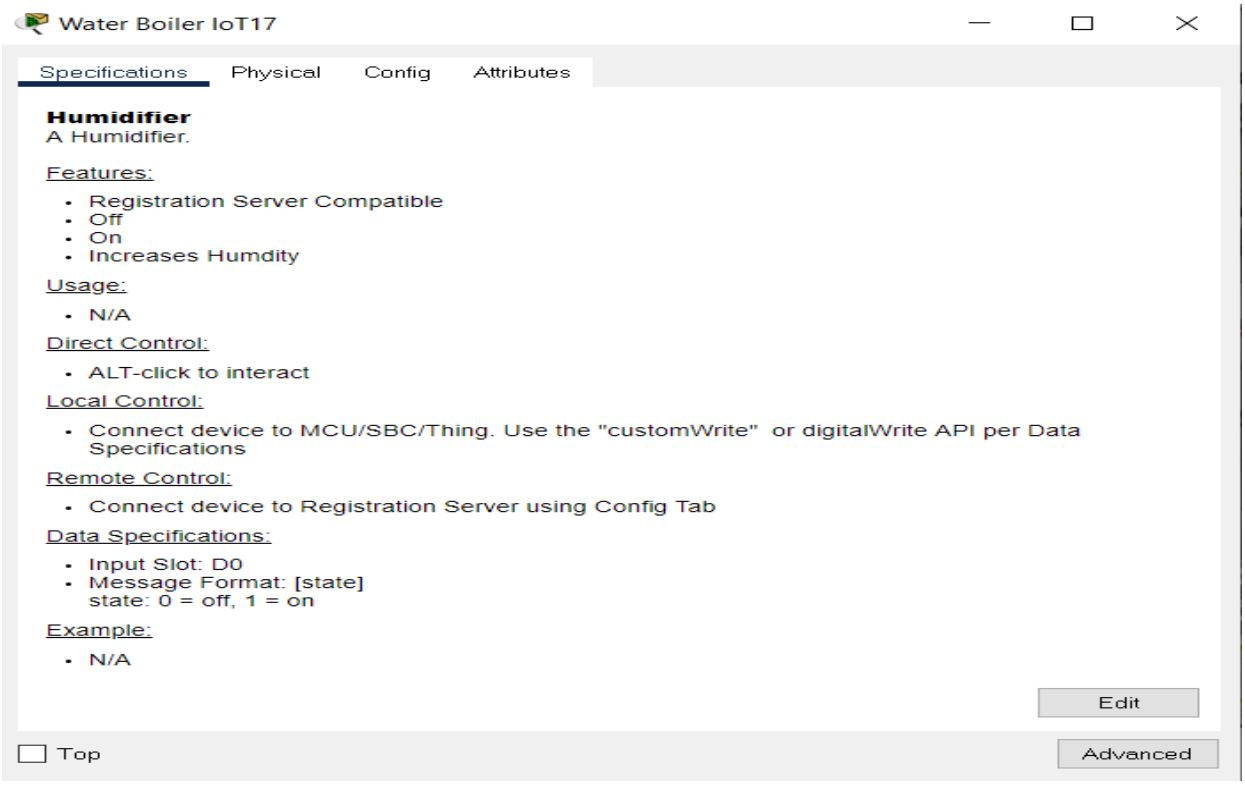


Figure 43_The figure above shows the Water Boiler specification

5- Welcoming home system:

I added a welcoming home system using a microcontroller with an LCD, motion sensor, light, and a webcam. The purpose of this system is when the user goes inside the home the motion sensor detects the motion of the user the door will open the camera will record a video to the entrance, the LCD will display to the use welcome home and the light will have turned on. The microcontroller has been programmed to control this whole small system.

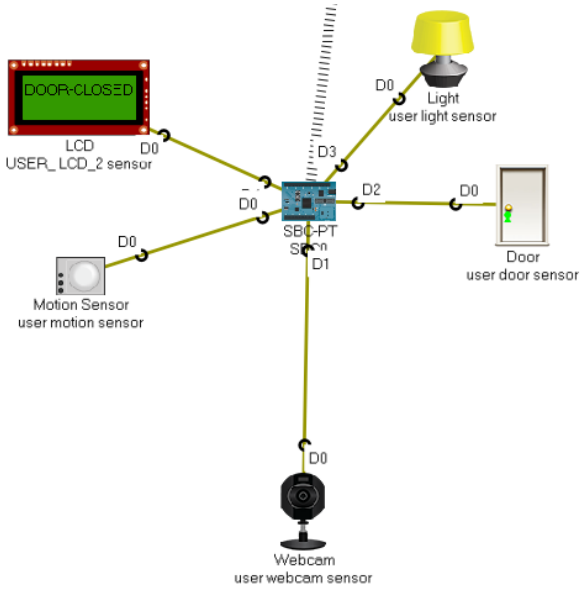


Figure 44_The welcoming home small system

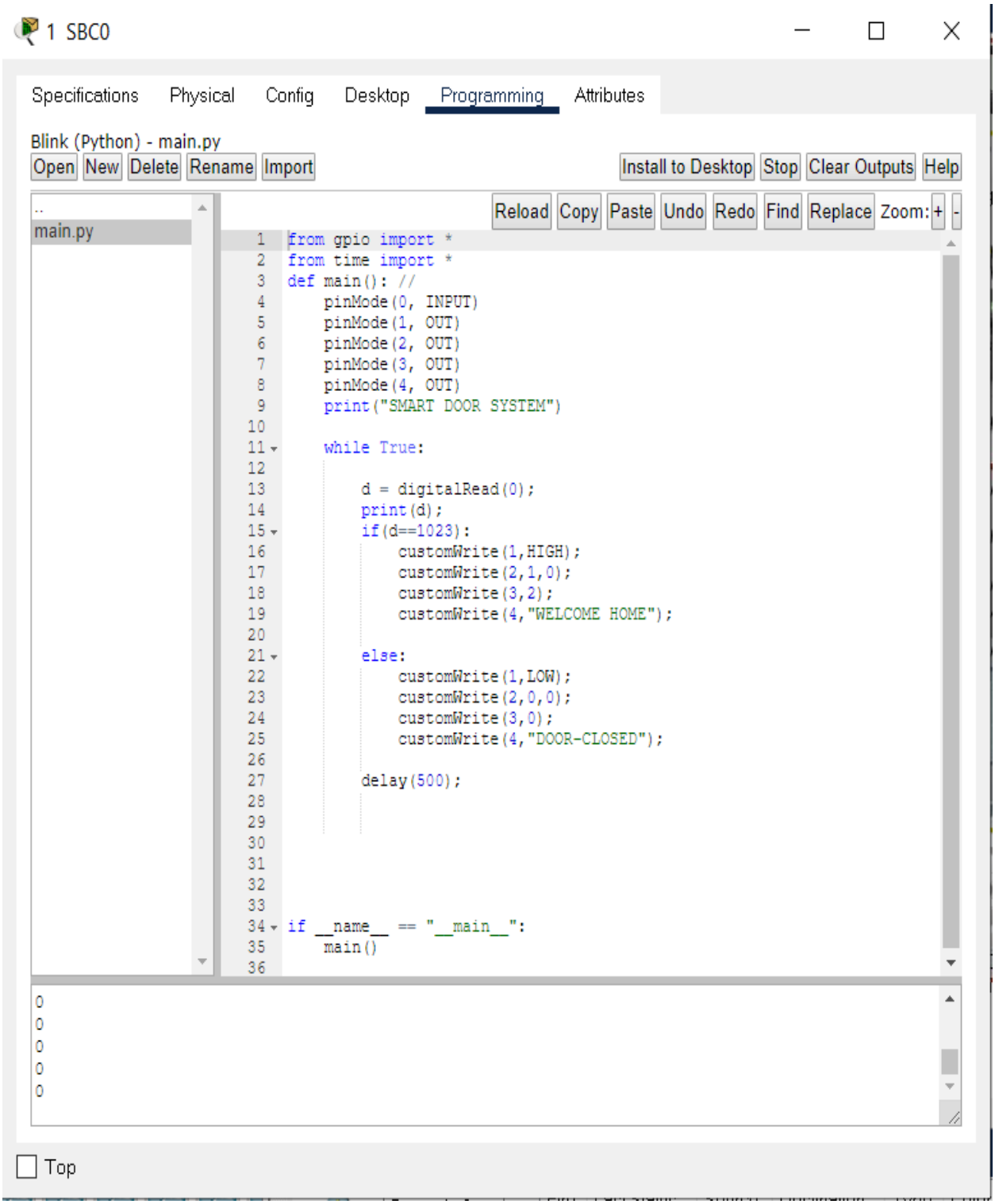


Figure 45_The welcoming home microcontroller code

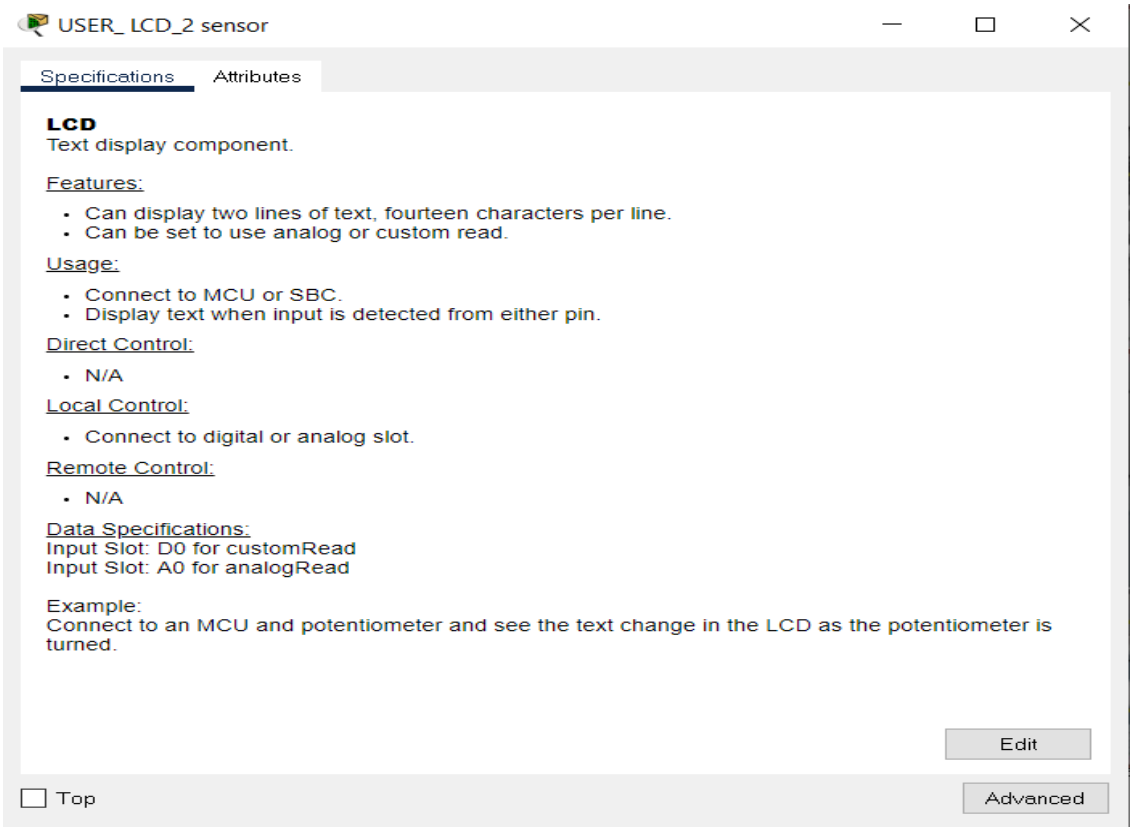


Figure 46_The LCD specification

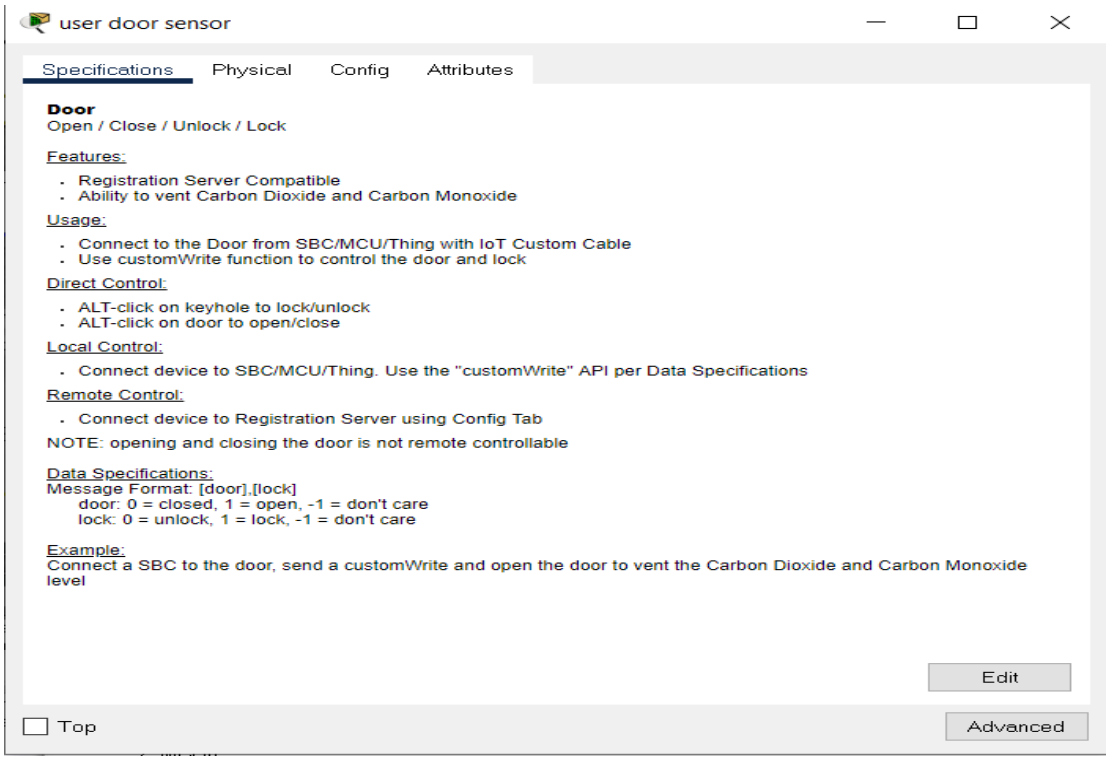


Figure 47_The door specification

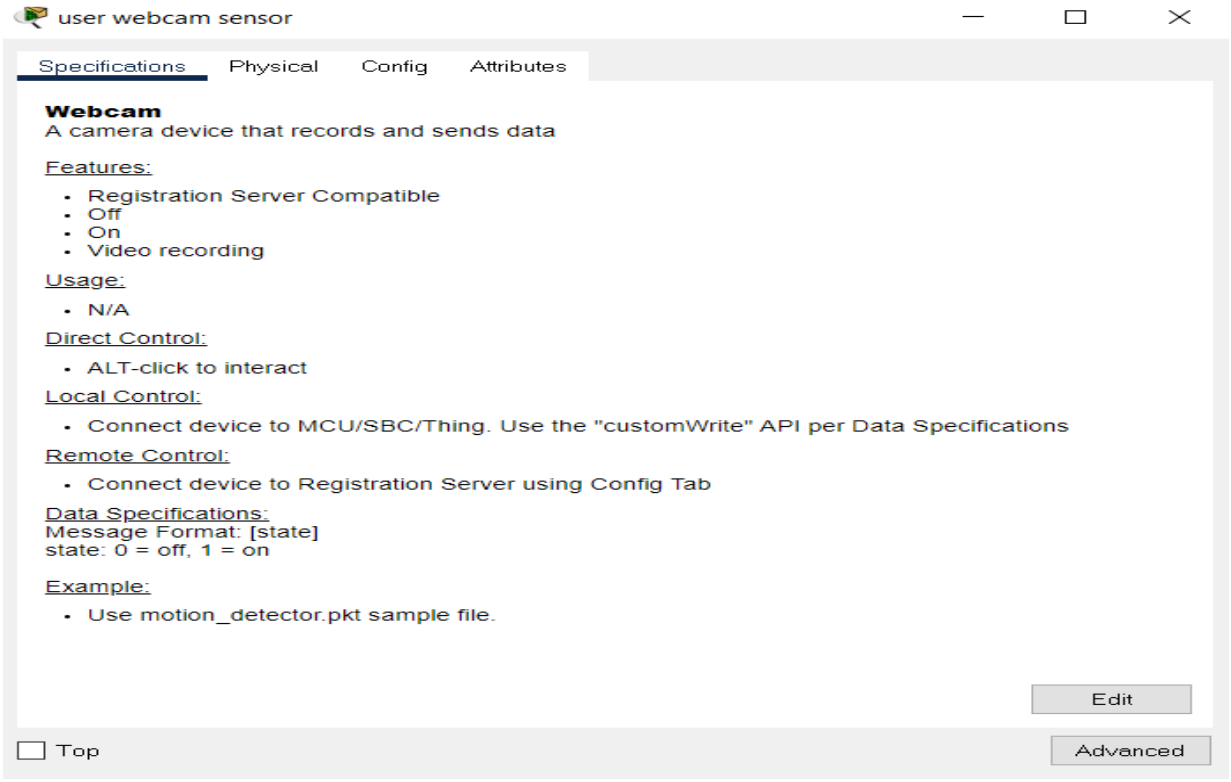


Figure 48_The webcam specification

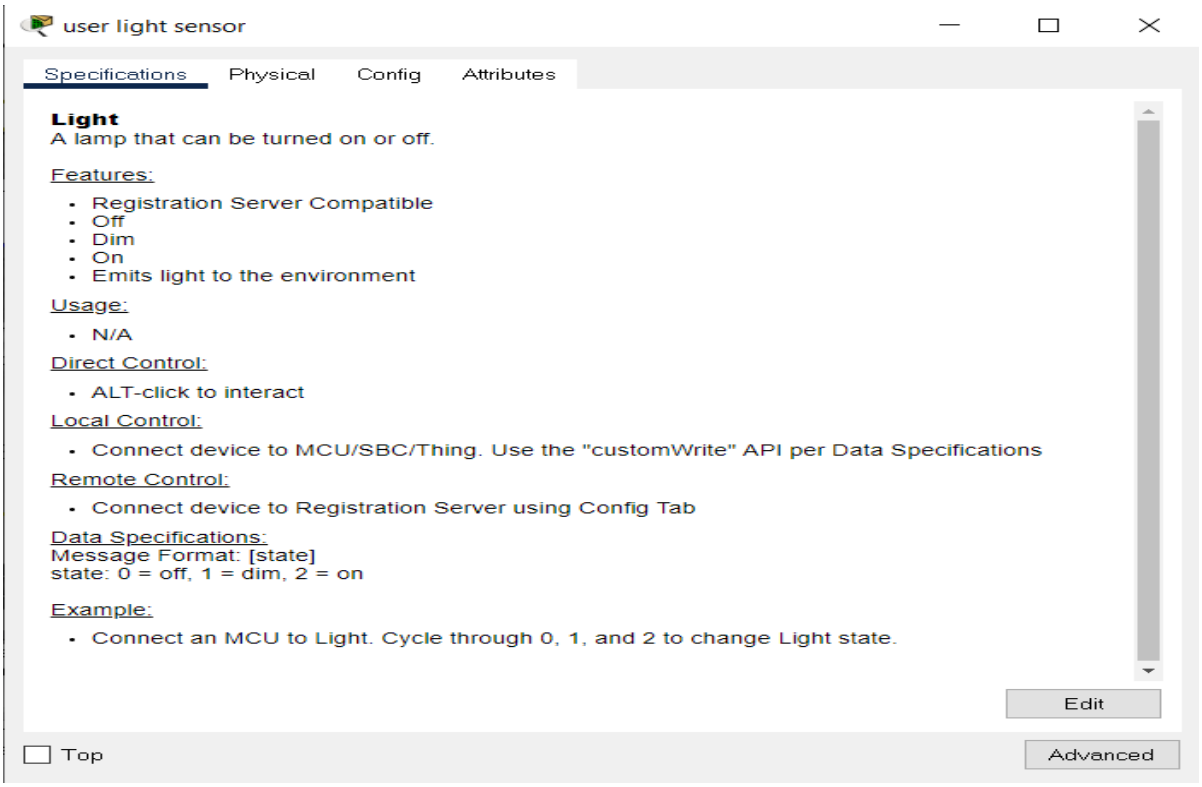


Figure 49_The light specification

6- Packet Tracer Fire Small System:

I added a new security feature to the home by using another microcontroller with an LCD, window, Piezo Speaker, Fire Monitor, and Fire sprinkler. What the Packet Tracer Thing Fire goes front of the Fire Monitor the Speakers will make noise and the LCD will display that there is fire in the home and finally the window will open automatically. Of course the microcontroller chip has been programmed to control this small fire system.

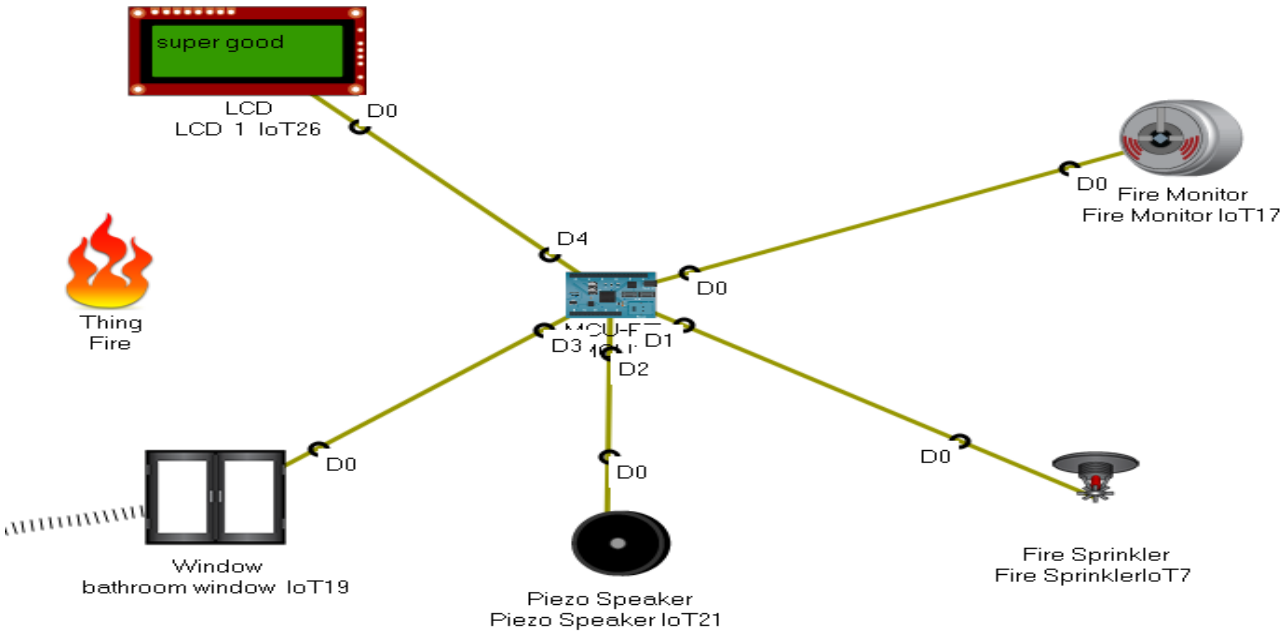


Figure 50_The figure above shows the fire system.

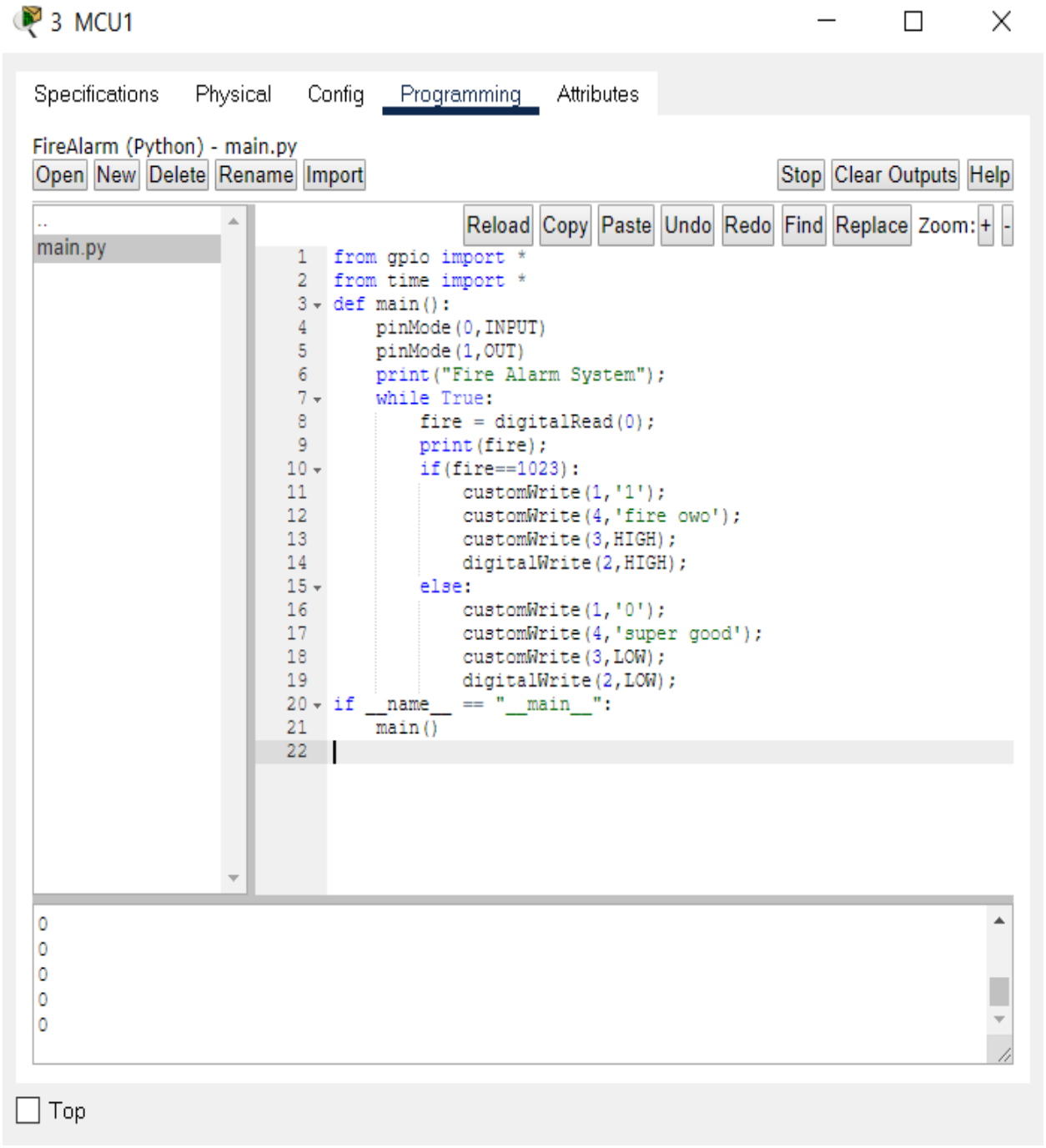


Figure 51_The figure above shows the fire system microcontroller code.

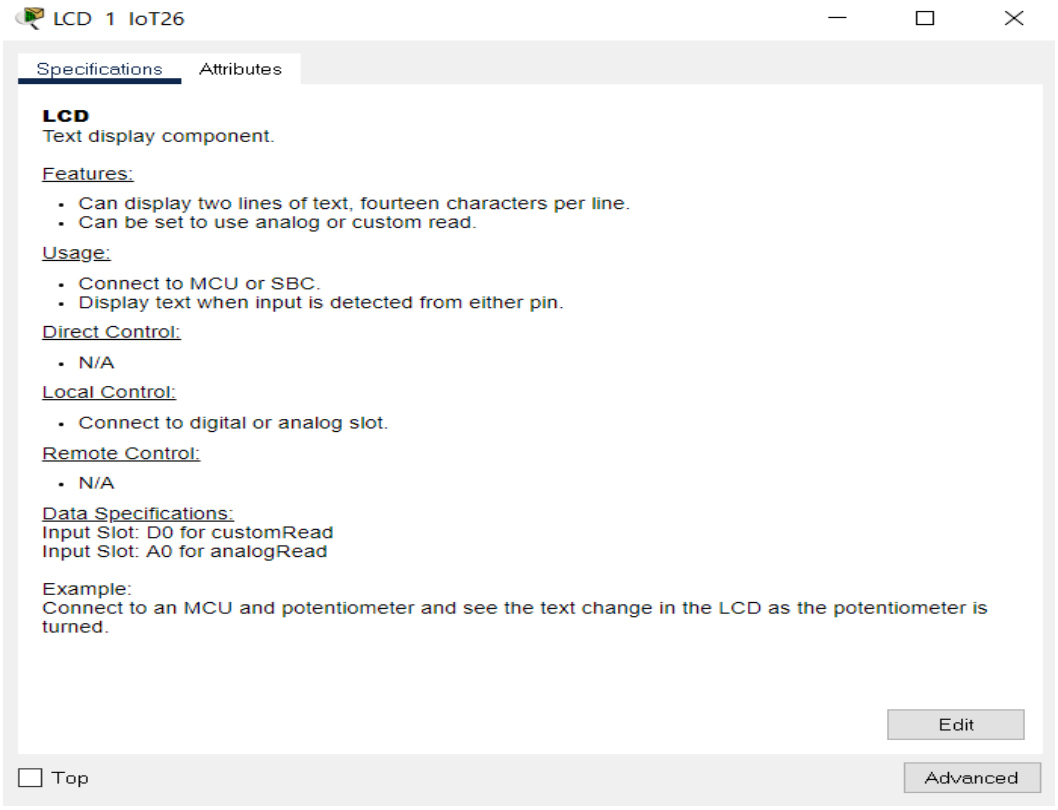


Figure 52_The figure above shows the LCD specification

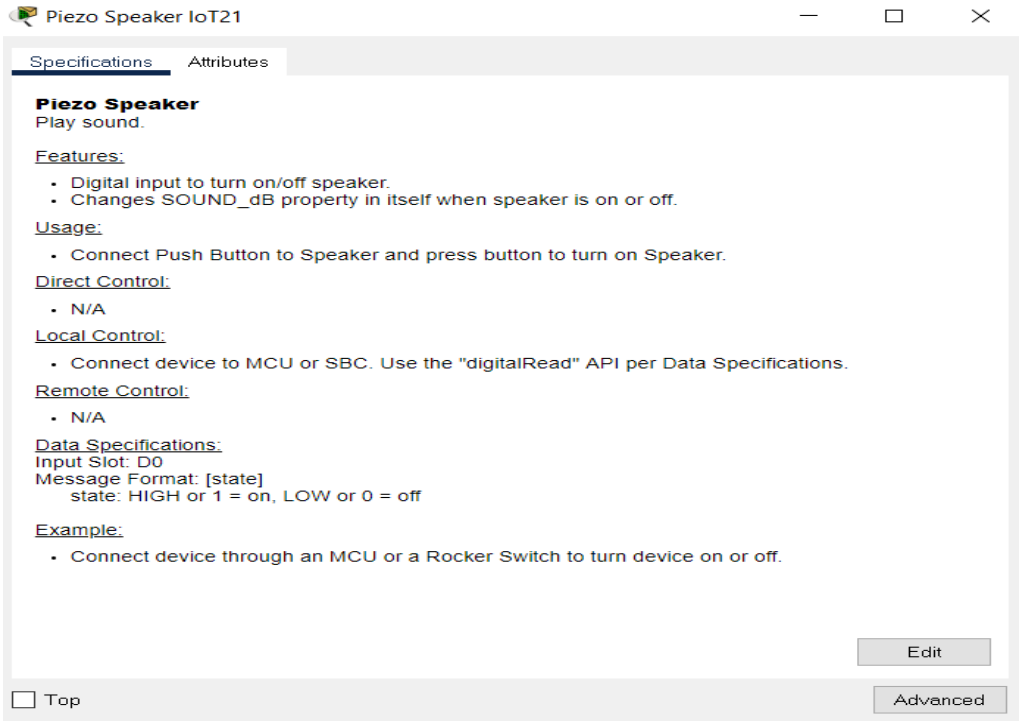


Figure 53_The figure above shows Piezo Speaker specification

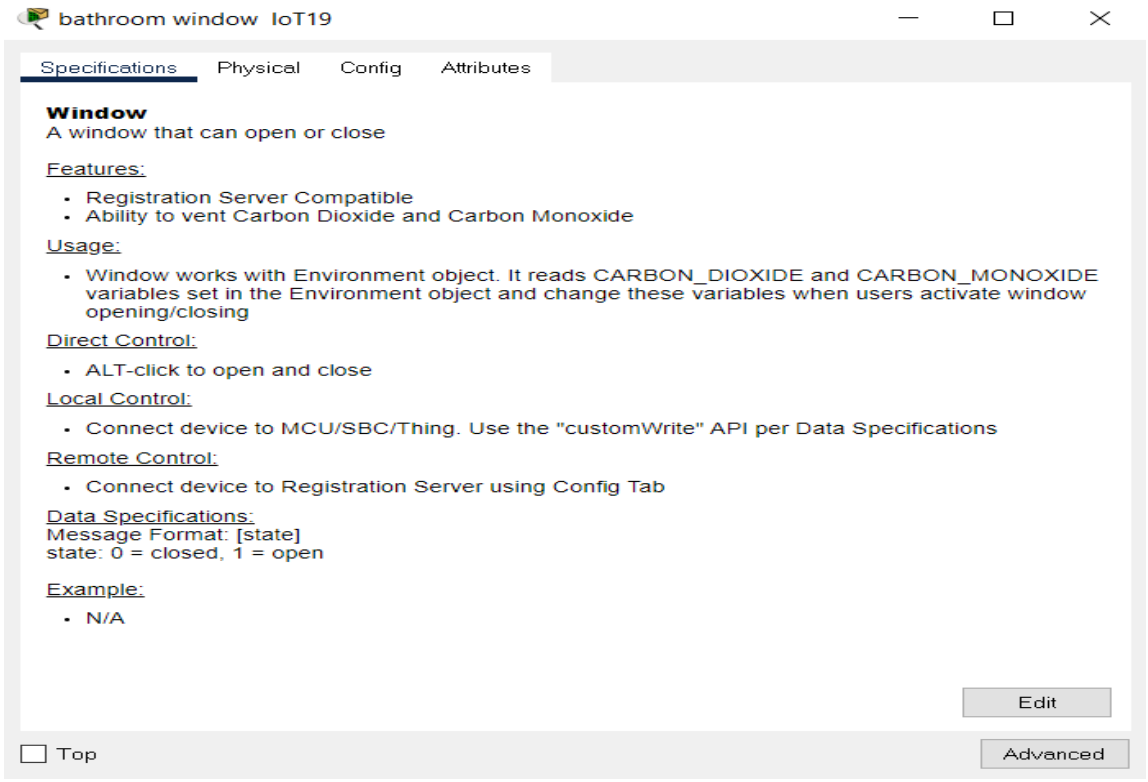


Figure 54_The figure above shows the window specifications

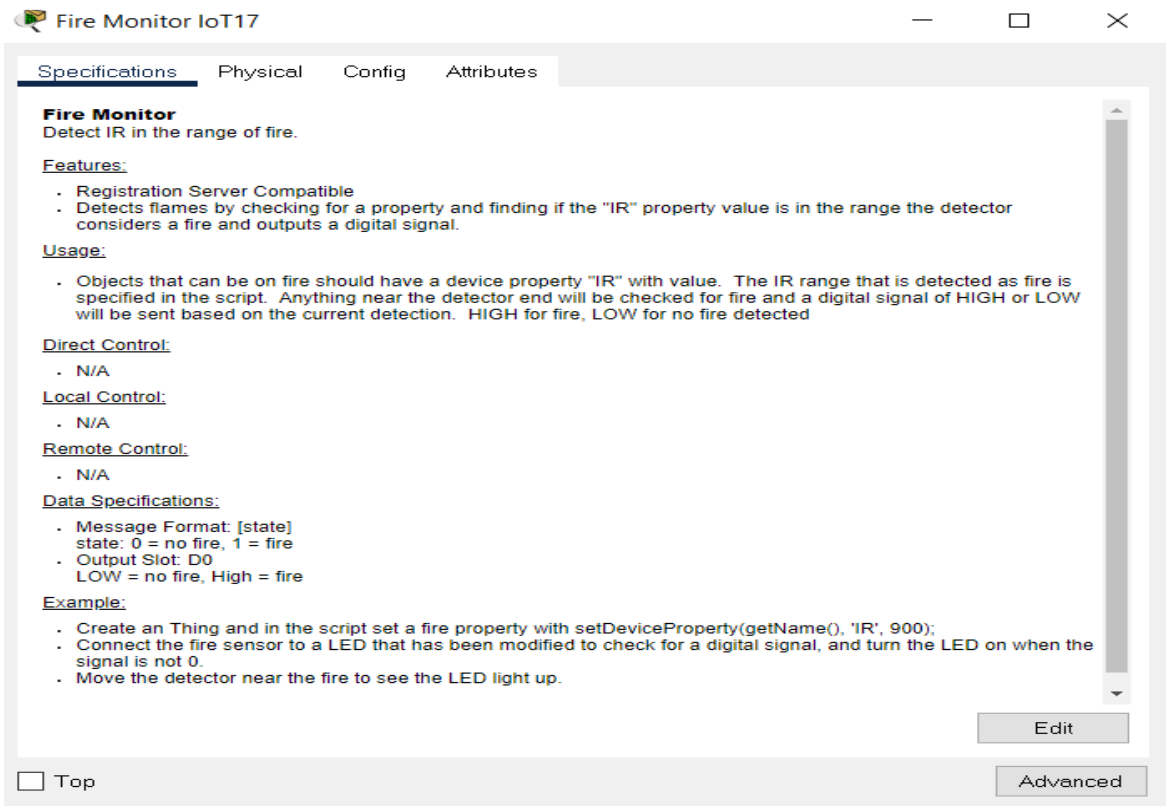


Figure 55_The figure above shows the Fire Monitor specifications

7- Door-Locking System:

Another door-locking system similar to the main door-locking system, I used another microcontroller programmed to control the RFID Reader to authenticate with the RFID Card to open the door. It's another security system that ensures that the door will not open to anyone who doesn't have the RFID Card.

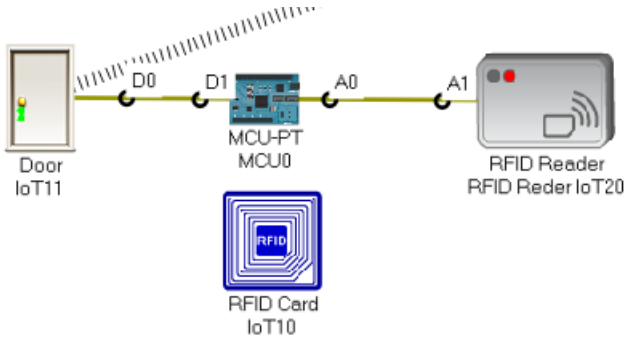


Figure 56_The figure above shows the room door locking system

Figure 57_The figure above shows the room door locking system microcontroller code.

8- Living Room:

In the living room, I added a smart IoT fan, Air Conditioner, light, and Siren.

The siren will warn the users inside the home that there is someone who goes out with the car from the garage.

The air conditioner will turn on when the user makes an order from his smartphone and it has its power from the solar system.

The fan and the light will also, turn on when the user takes any action from his smartphone.

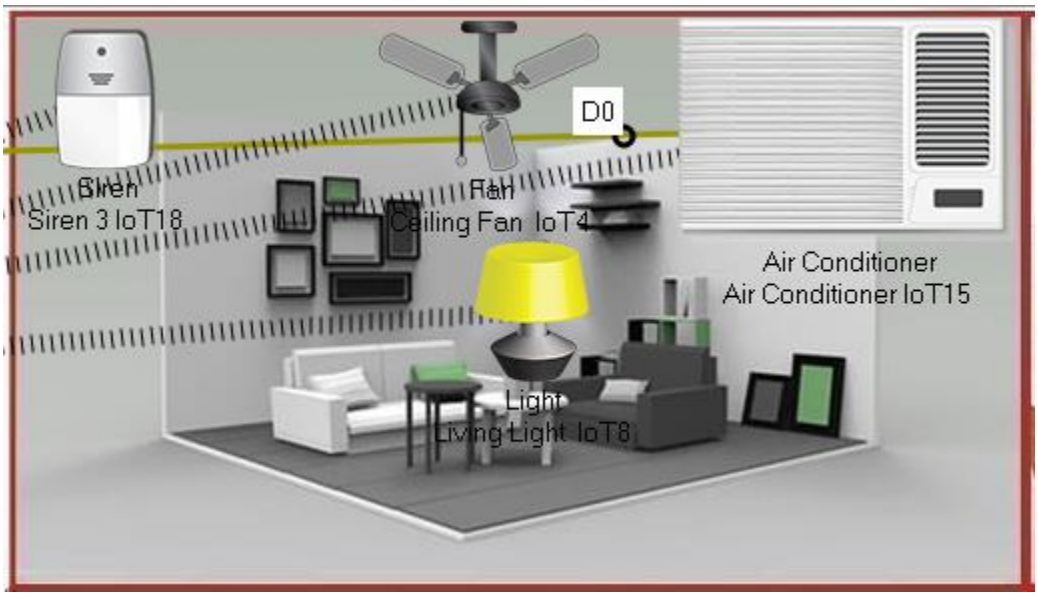


Figure 58_The figure above shows the living room components

9- The Bathroom:

In the bathroom, I used a Water Drain, Fire Sprinkler, smart window, and the microcontroller used if there is any fire in the house.

The Fire Sprinkler the user can control remotely from his smartphone.

The user can control the water flow by using the Water Drain.

Also, the window can be controlled remotely by using his smartphone.

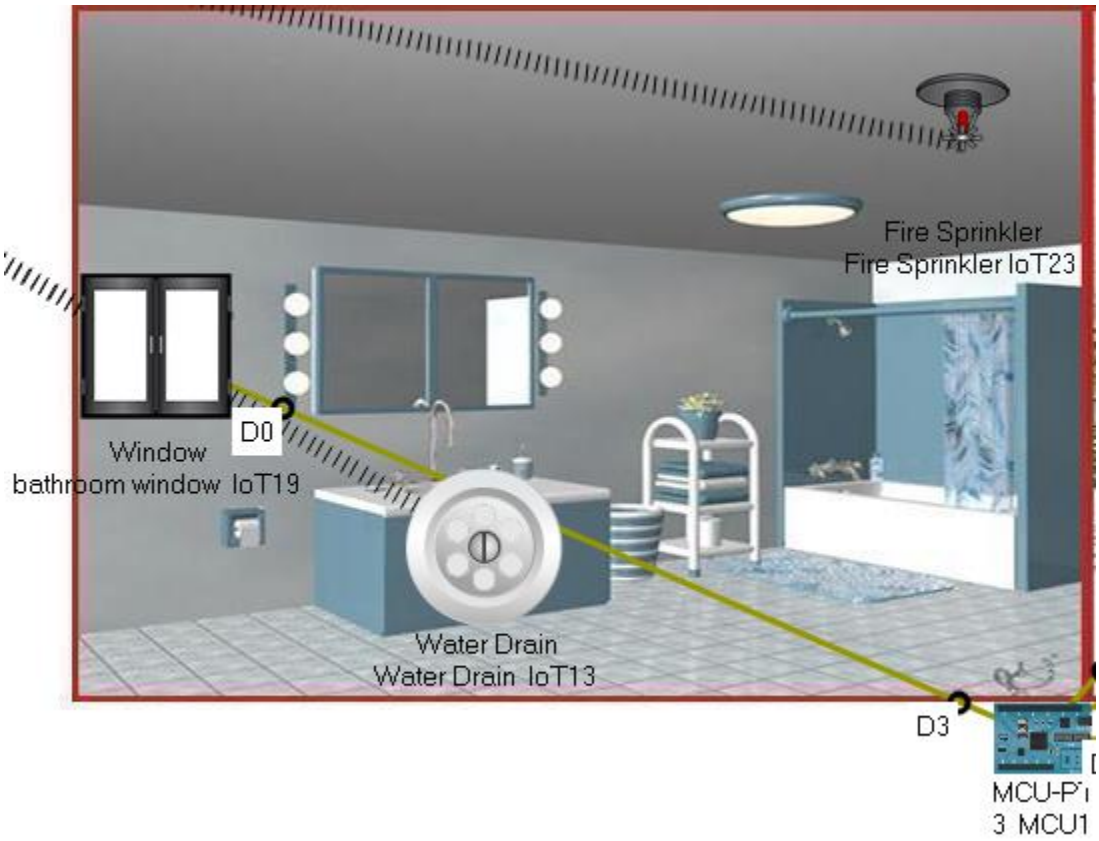


Figure 59_The figure above shows the bathroom components

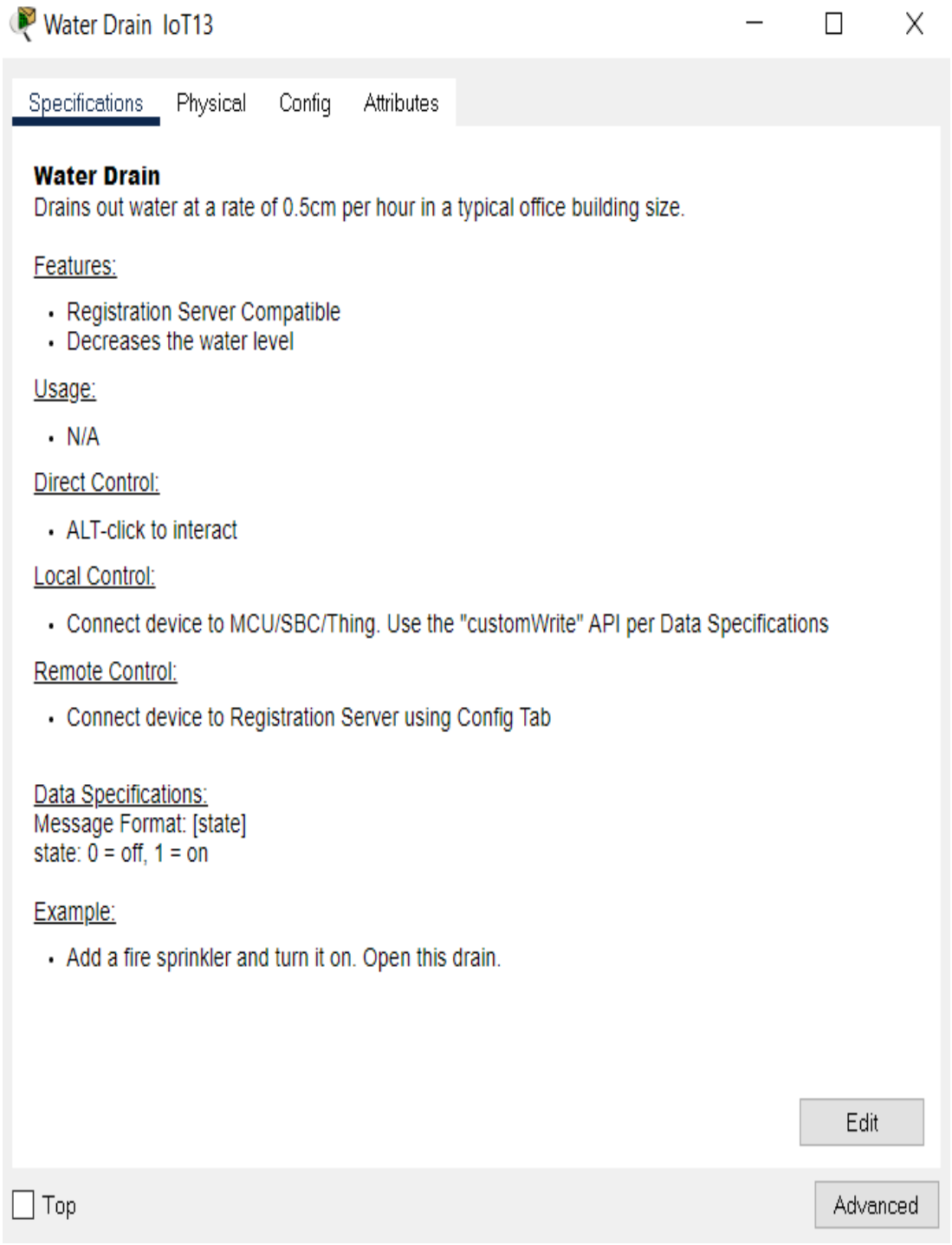


Figure 60_The figure above shows the Water Drain specification

10- The Garden:

In the garden I used three Lawn Sprinkler, the user has full access to control them remotely, but one of them was automated to work automatically by using a Humiture Monitor.

Figure 61_The figure above shows the garden components

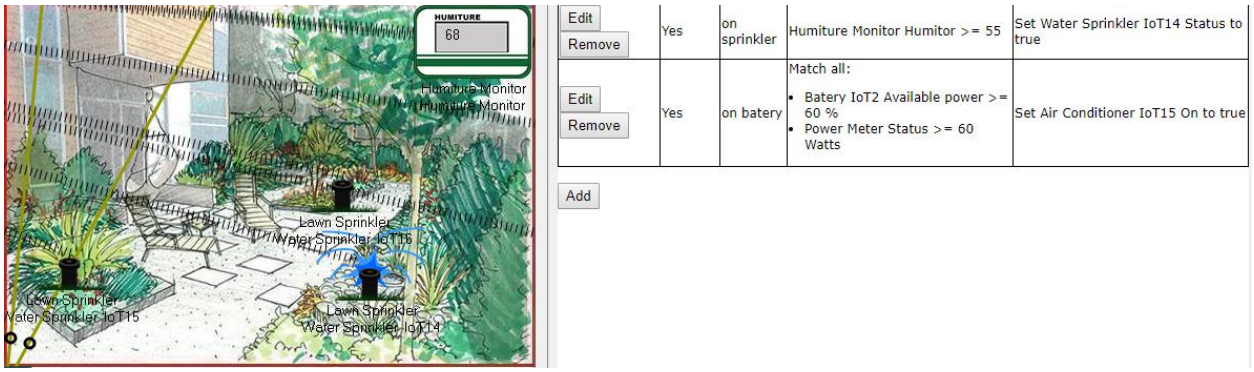


Figure 62_The figure above shows the connection between the devices and the smartphone and also.

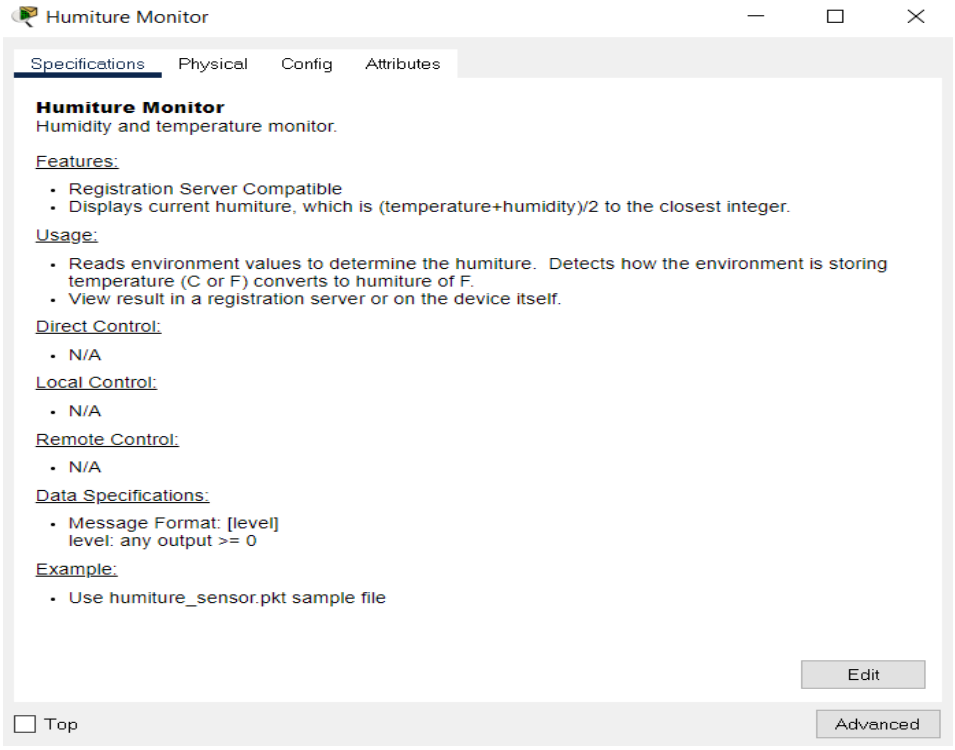


Figure 63_The figure above shows the Humiture Monitor specifications

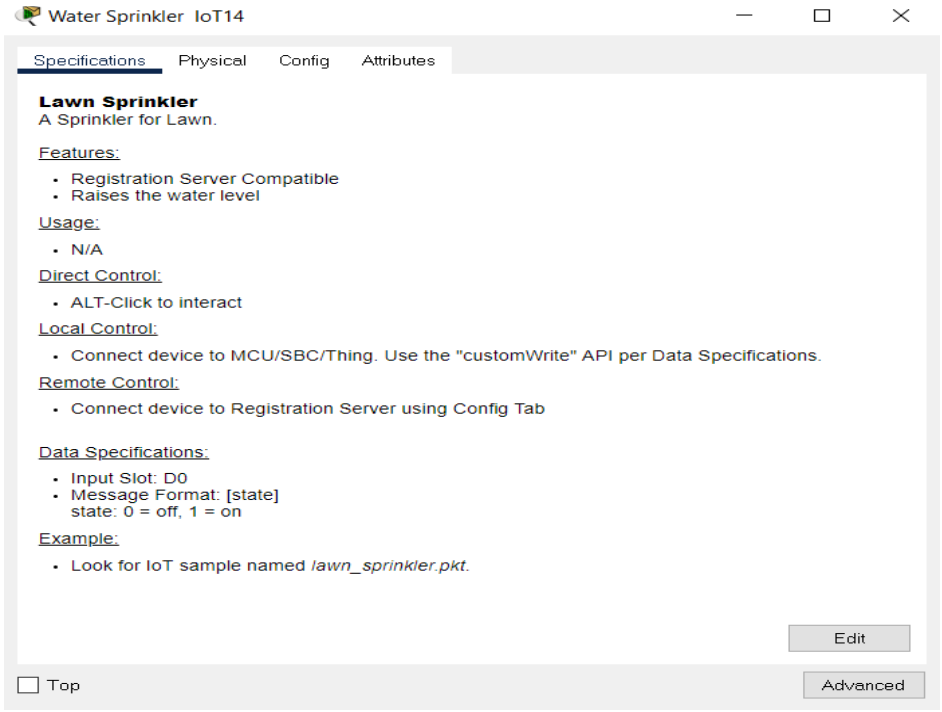


Figure 64_The figure above shows the Water Sprinkler specifications

11- The Kitchen:

In the kitchen, I used an Appliance Coffee Machine, Humidifier Water Boiler, a fire monitor, and a fire sprinkler.

The fire monitor is connecting to the fire system to detect if there is any fire in the house so if there is any fire the fire sprinkler will flow the water.

The coffee machine and the boiler is the kitchen basic devices and the user can connect to them remotely by using a smartphone.

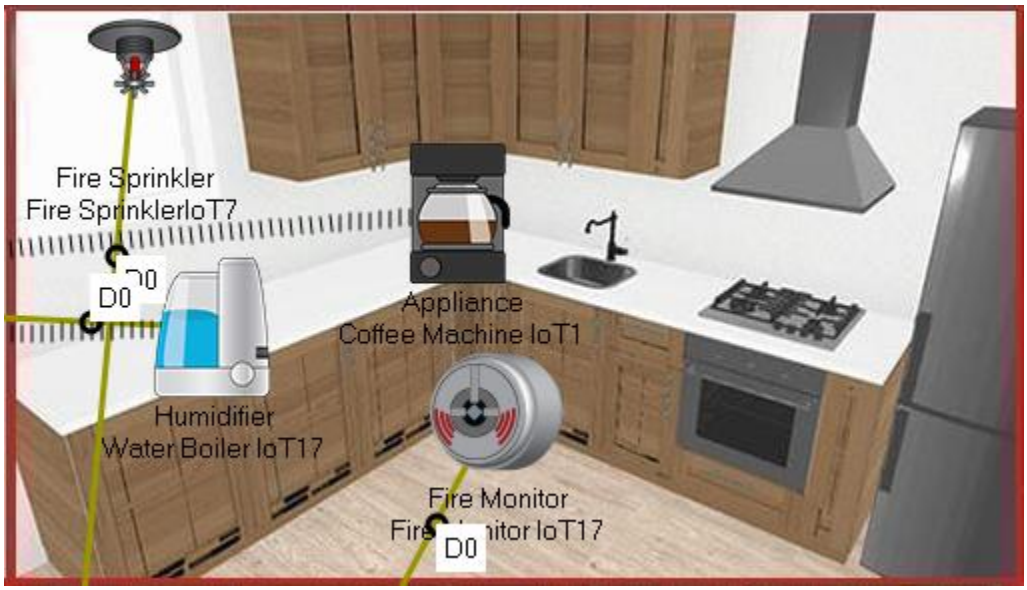


Figure 65_The figure above shows the kitchen components

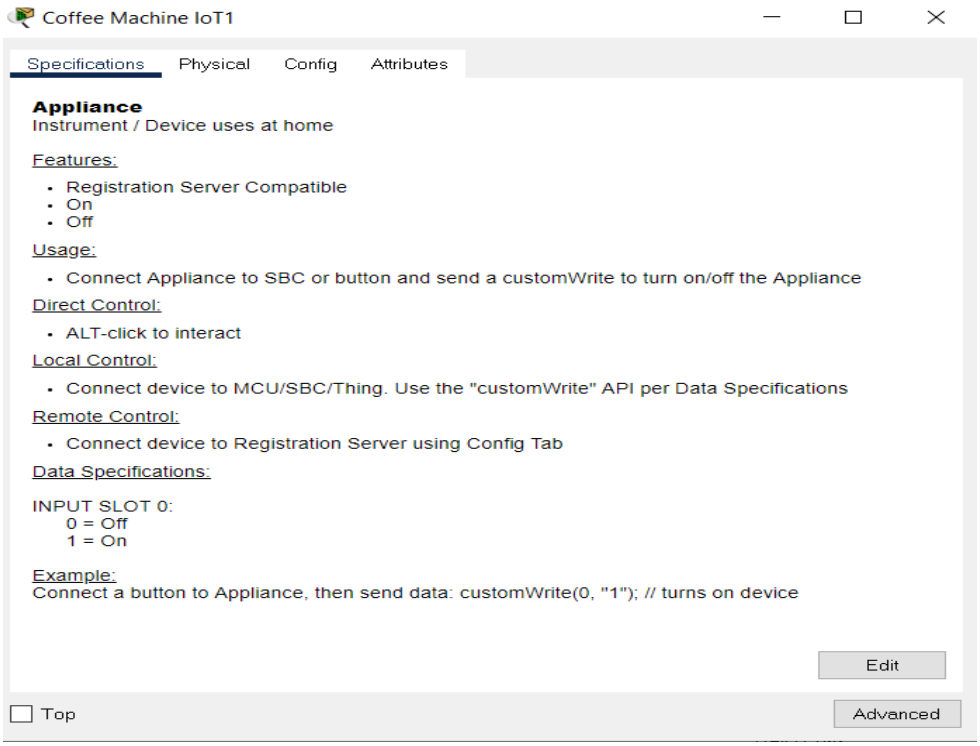


Figure 66_The figure above coffee machine specifications

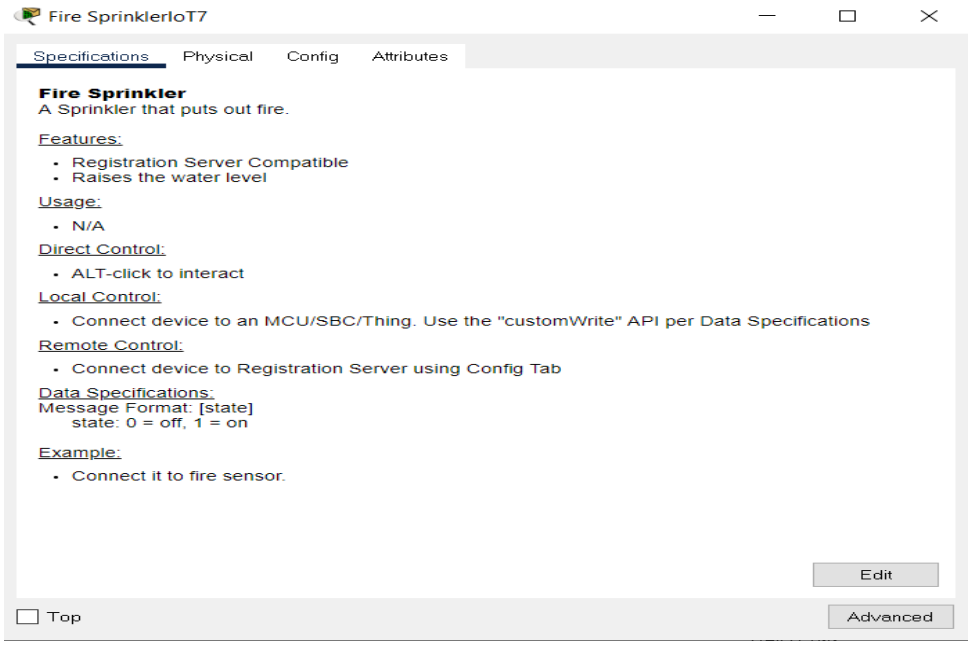


Figure 67_The figure above shows the Fire Sprinkler specifications

12- The Bedroom:

In the bedroom, there are the basic devices you need in every bedroom but smarter.

There is a smart air conditioner, window, two-light, and Siren for any unexpected fire.

For all of those devices, the user can connect them remotely.

Imagine that you may one day have a smart bedroom like that one!

Figure 68_The figure above shows the bedroom components

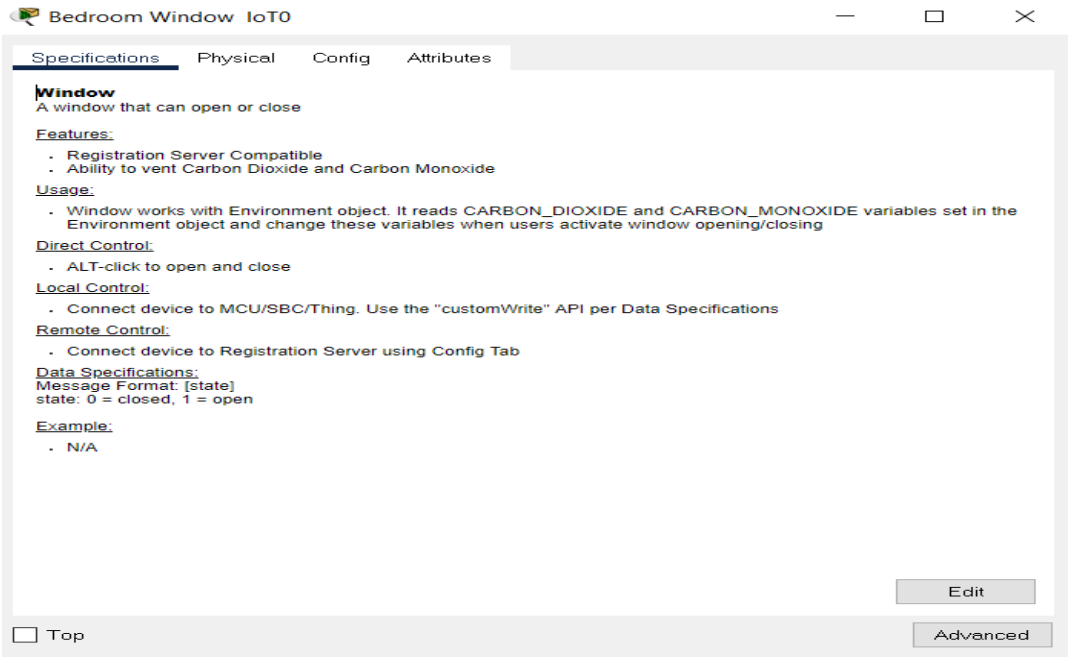


Figure 69_The figure above shows window specifications

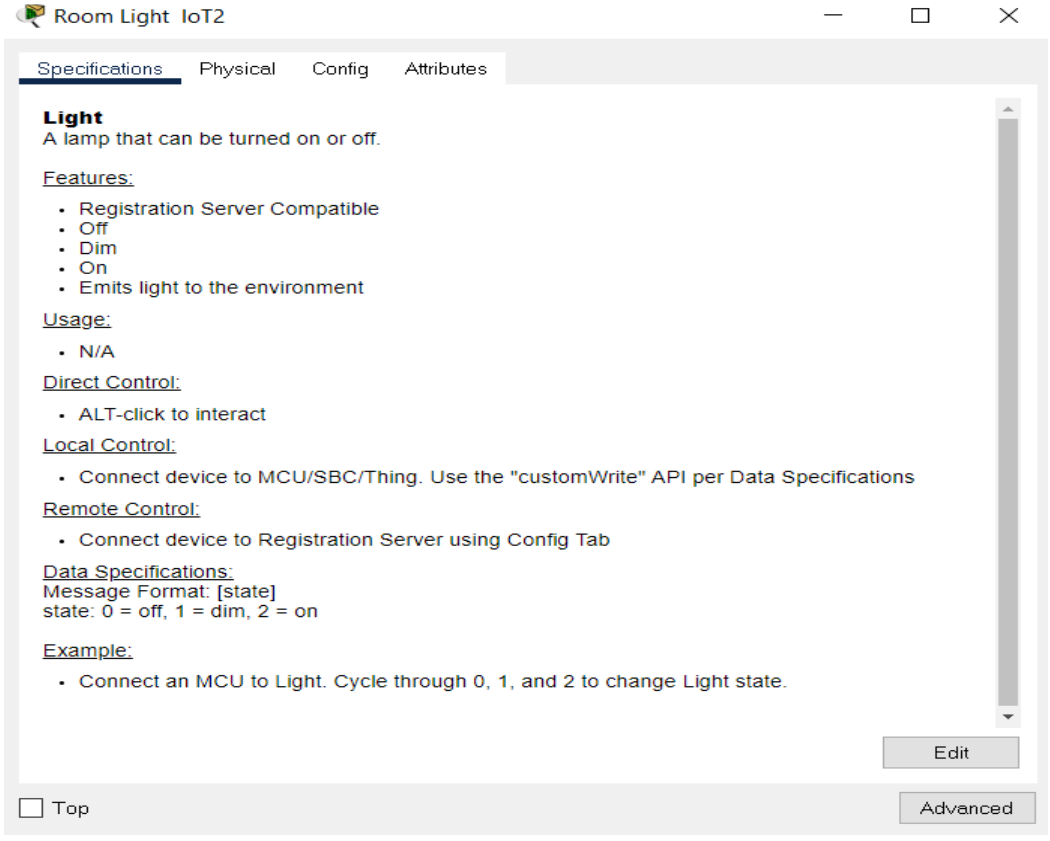


Figure 70_The figure above shows the room light specifications

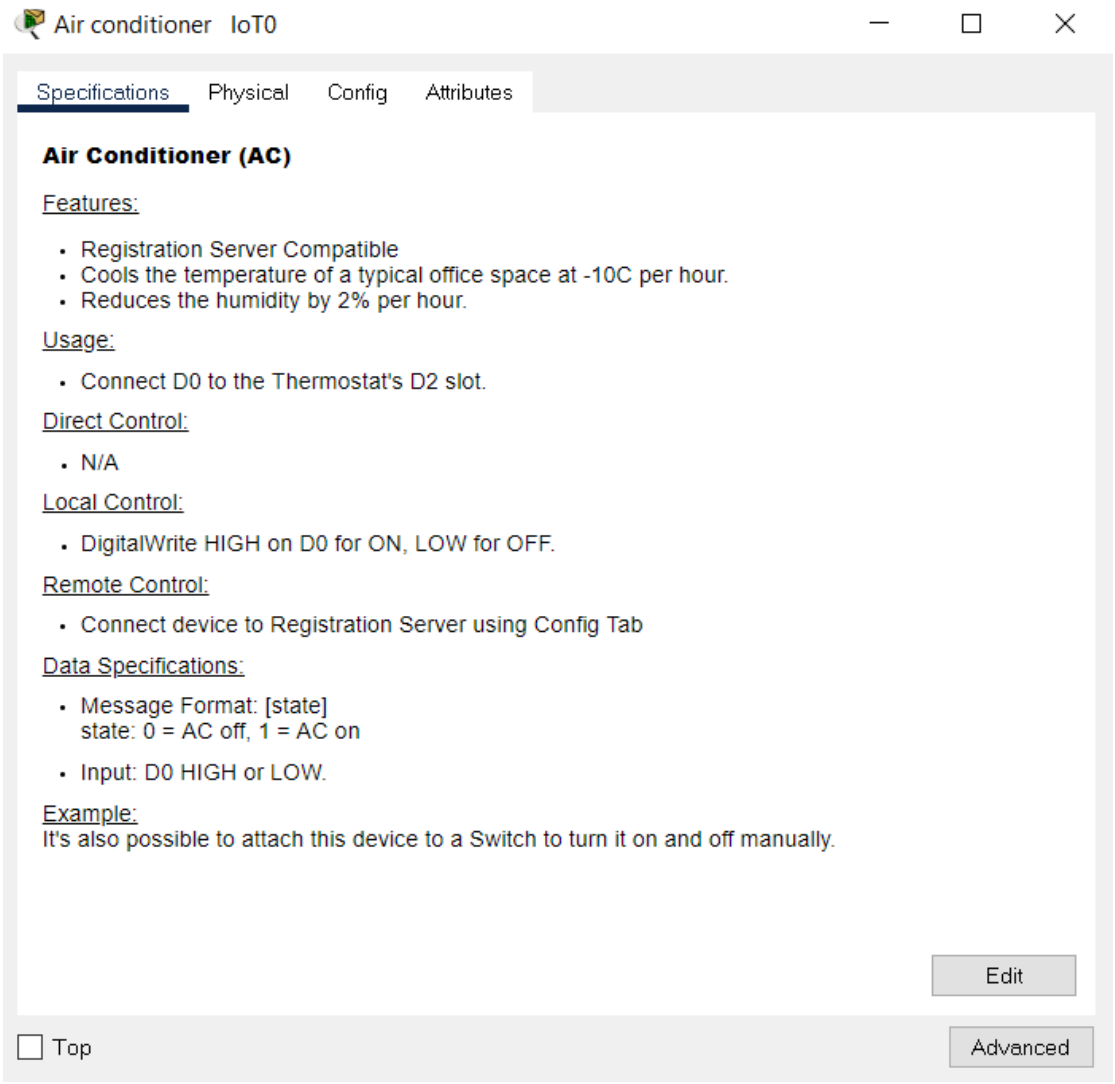


Figure 71_The figure above shows the Air conditioner specifications

13- The Home Office Room:

In the Office Room, there are some cool features, the Siren and the door-locking system are the basics in the office room; the cool thing is the Portable Music Player, and the Bluetooth Speaker.

The Portable Music Player is programmed to play music on the Speakers.

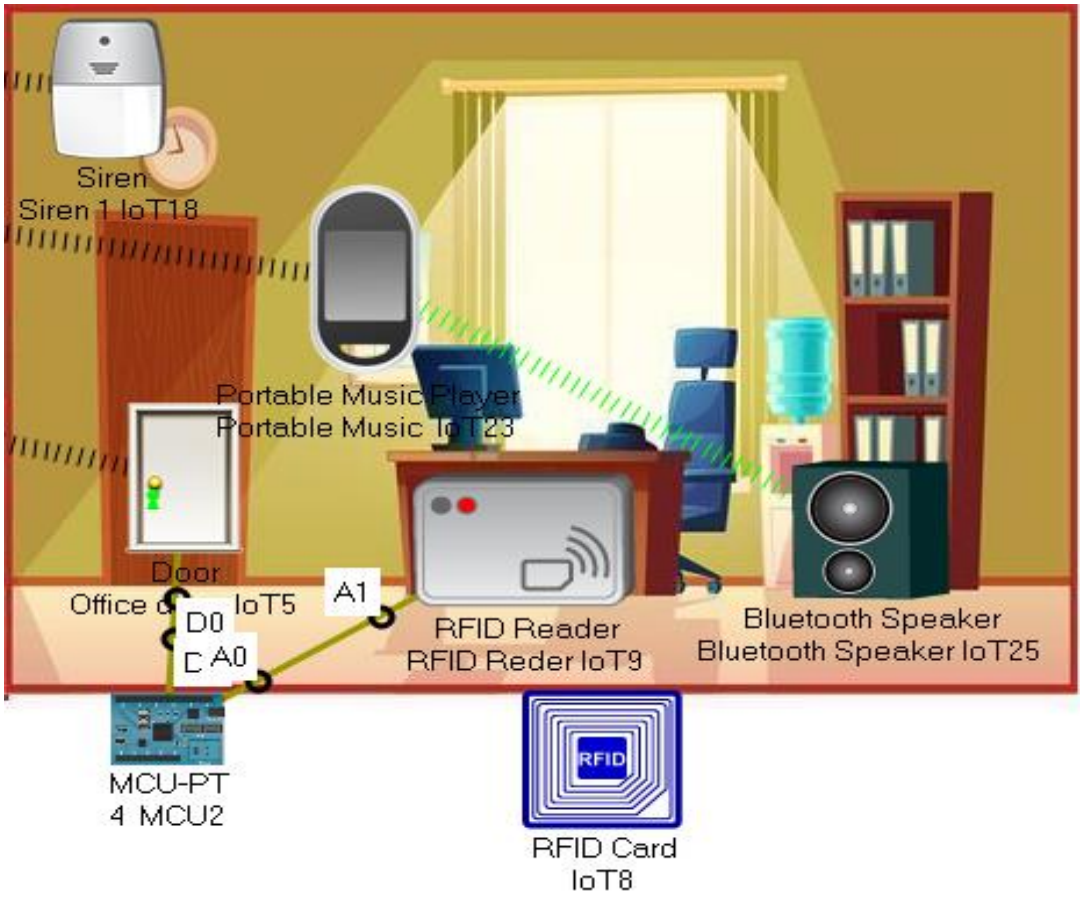


Figure 72_The figure above shows the Home Office Room components

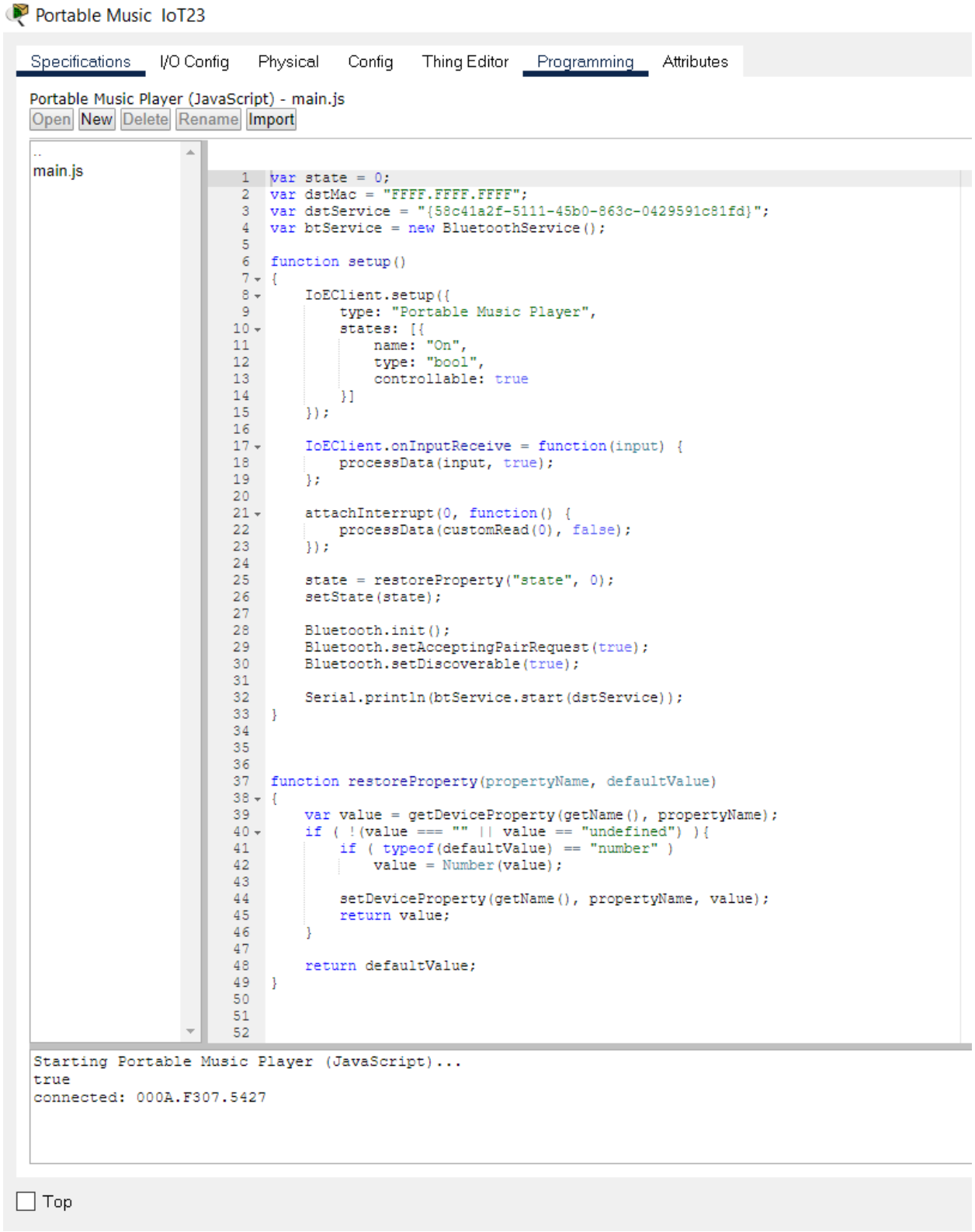


Figure 73_The figure above shows the Home Office Room portable music code

Figure 74_The figure above shows the Home Office Room portable music code

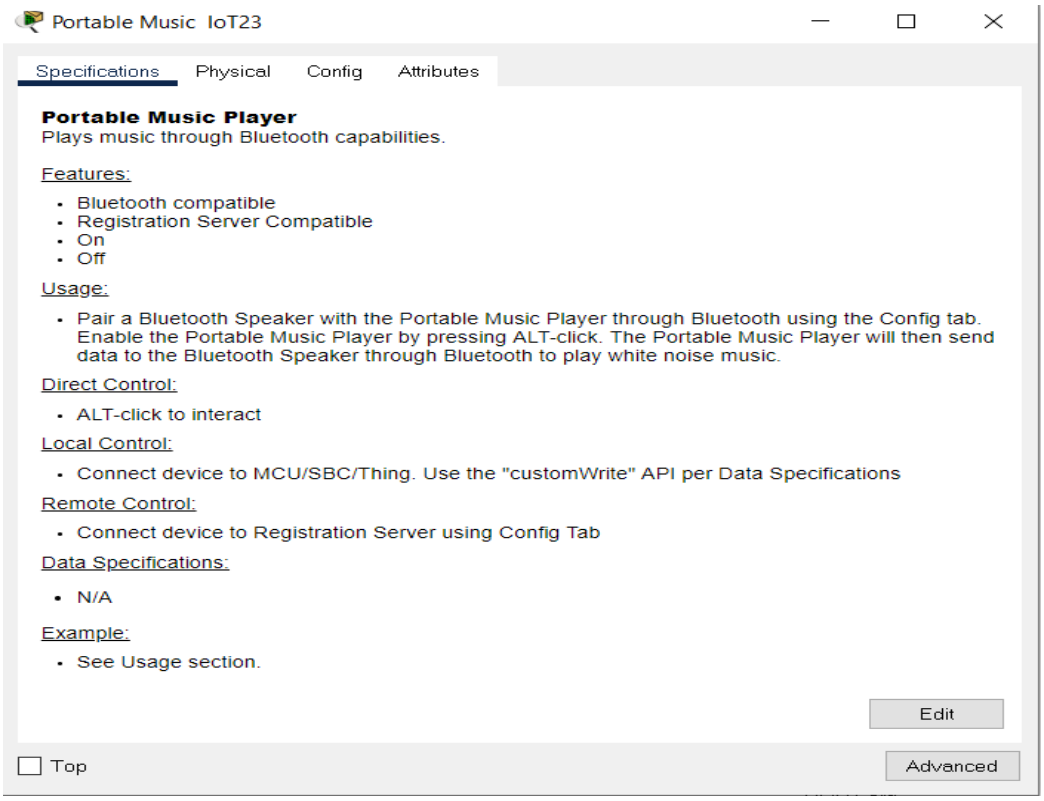


Figure 75_The figure above shows the Portable Music specifications

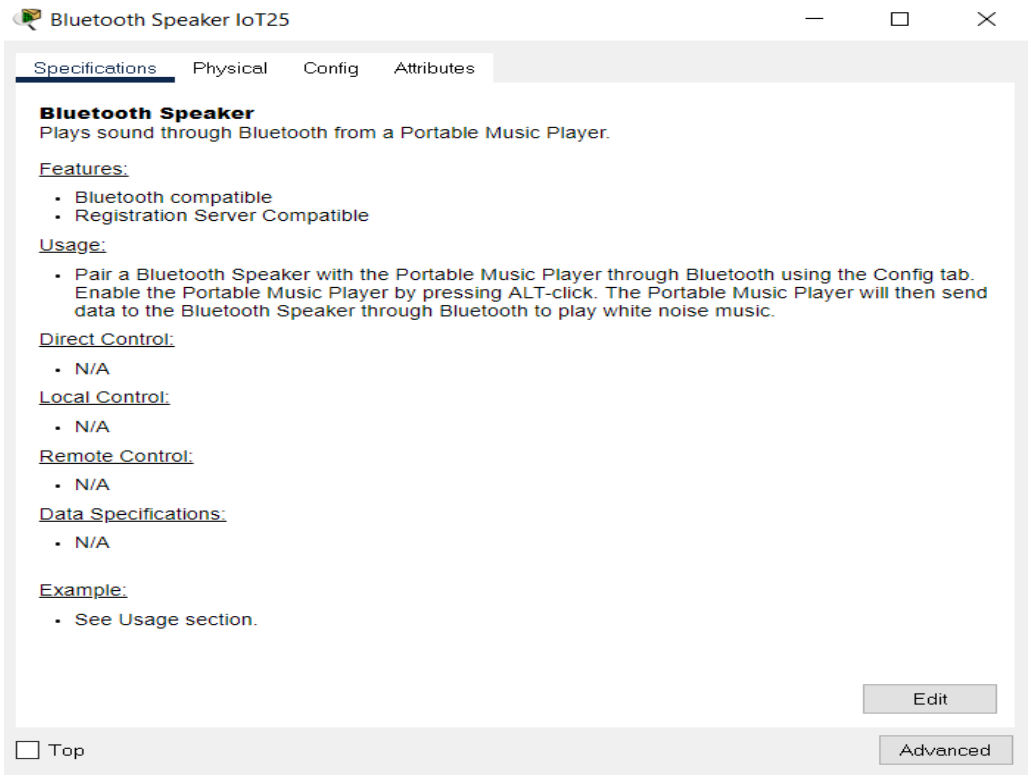


Figure 76_The figure above shows the Bluetooth Speaker specifications

4.3 Testing:

In the previous section I talked about the whole network system, in this section, I will test the network connectivity and test every system mentioned in the previous section.

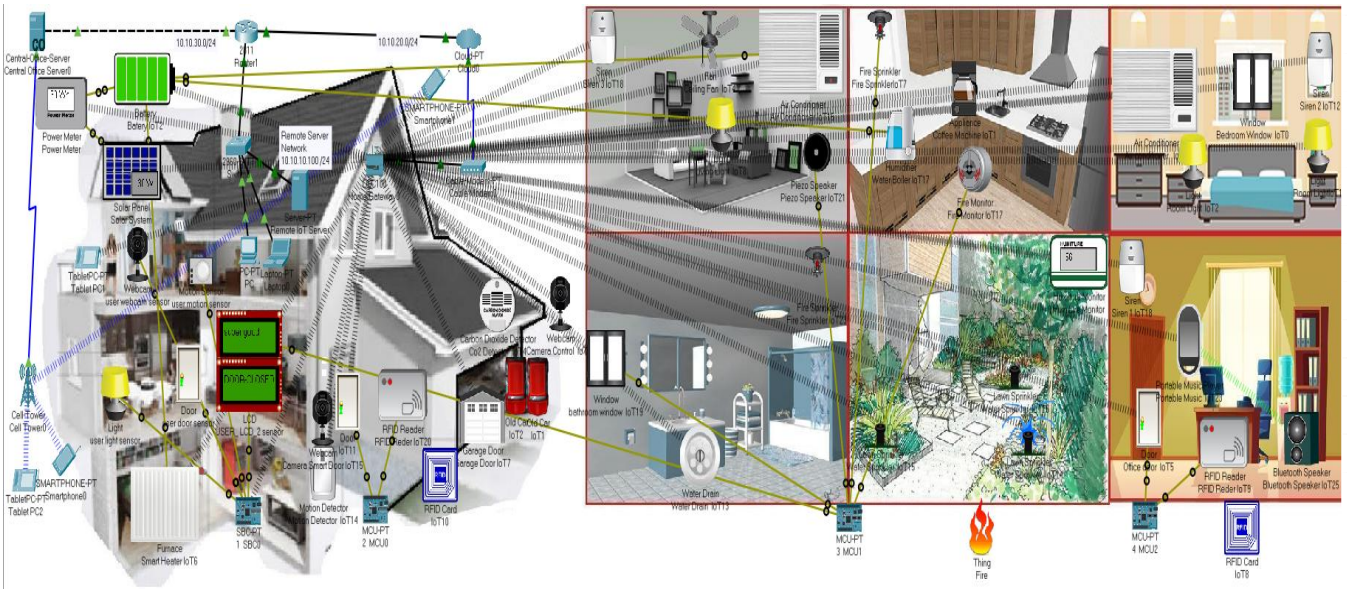


Figure 77_The figure above shows the smart home with the devices.

1- Checking connectivity of the ISP internal network:

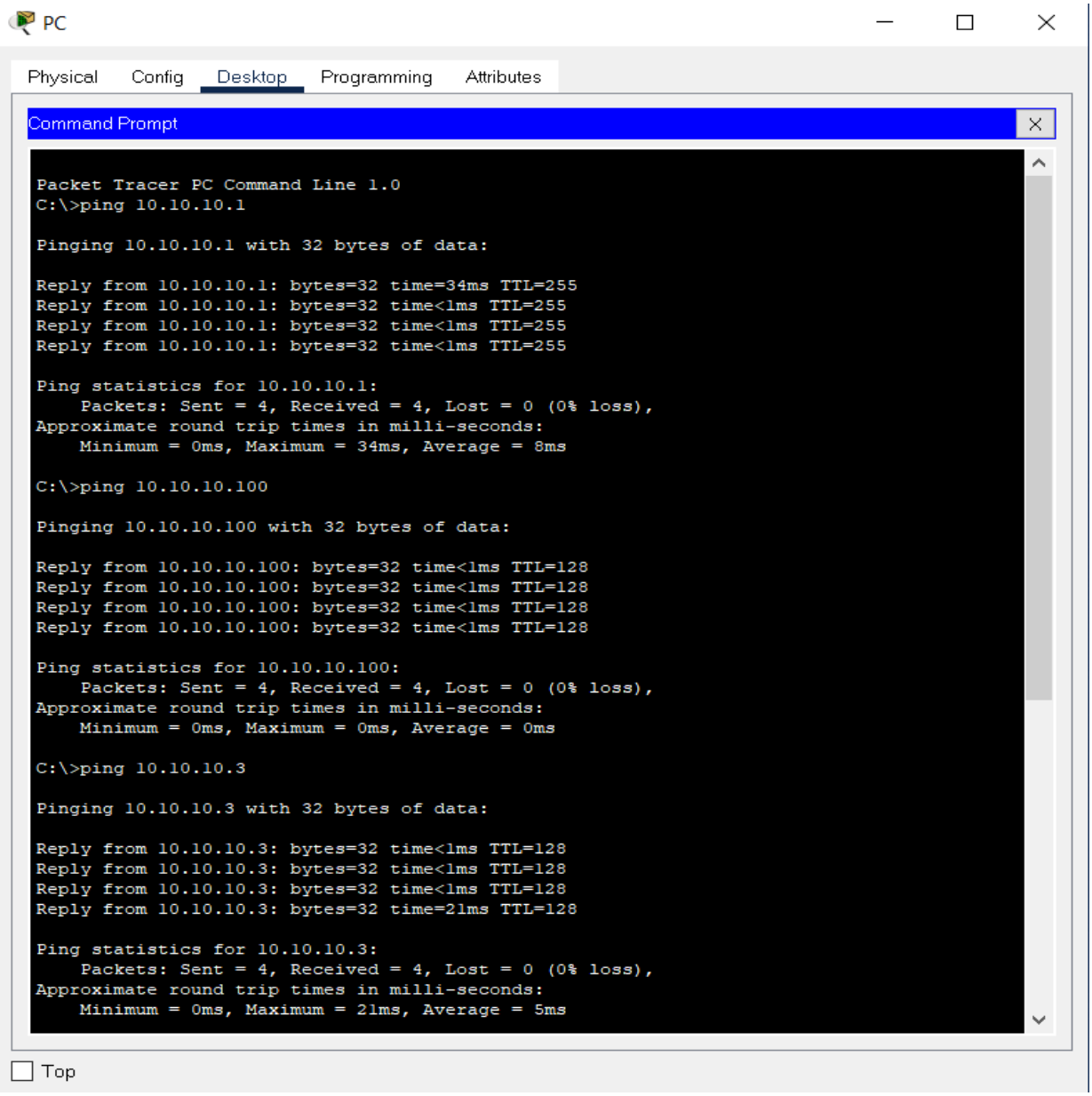


Figure 78_In the above figure show the pinging between the PC and the server, router and the laptop.

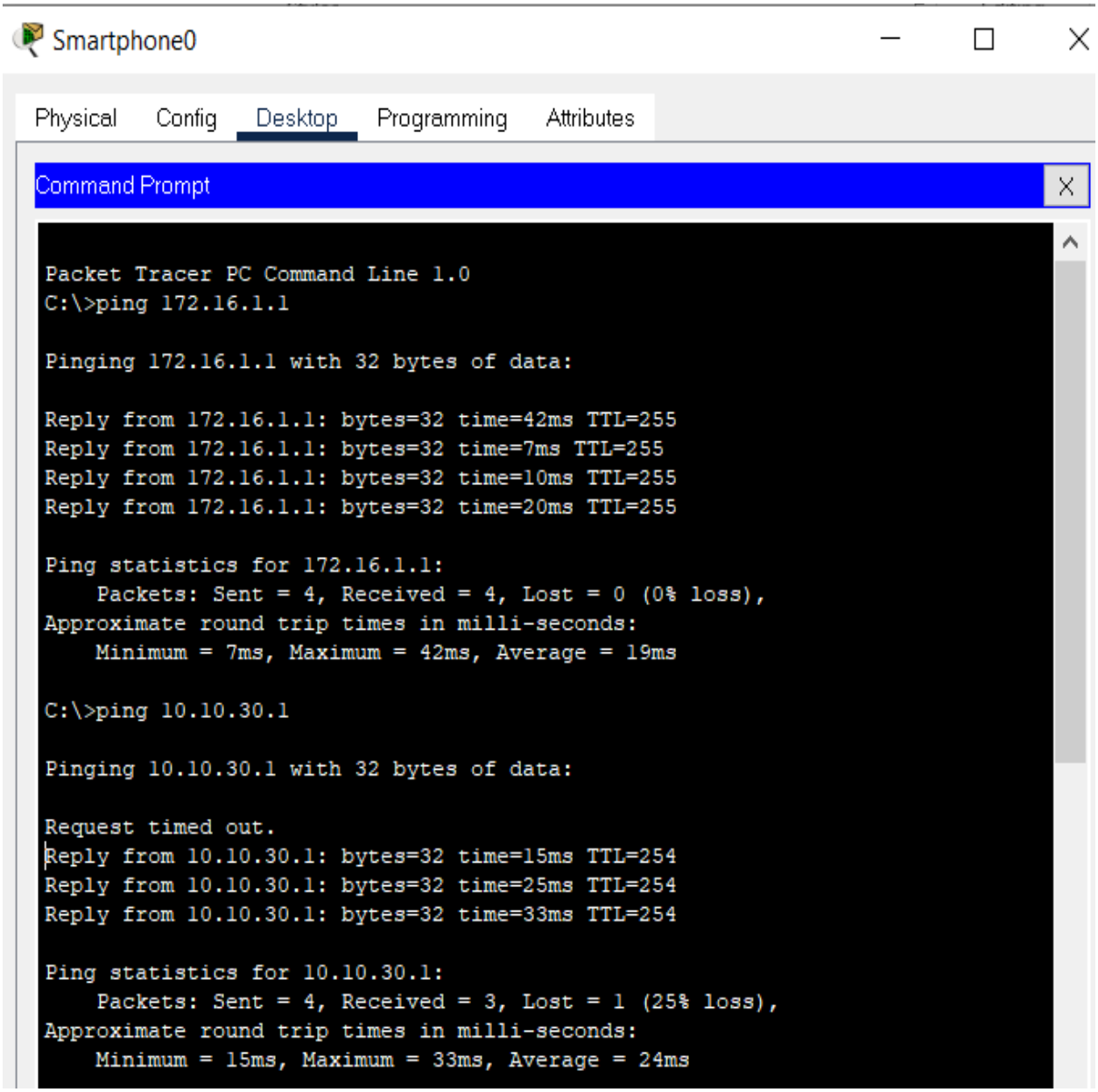


Figure 79_The figure above shows the pinging process between the smart phone and Central server and the router.

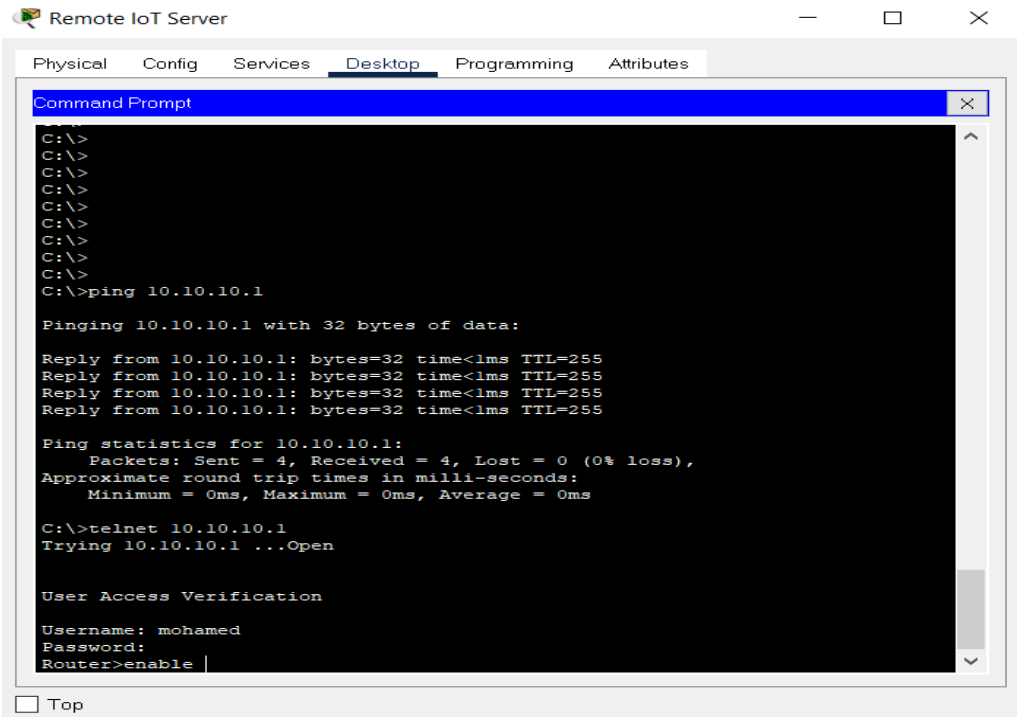


Figure 80_The figure above shows the pinging process from the server to the router and connecting remotely on the router using the telnet command (username = Mohamed, password = 123).

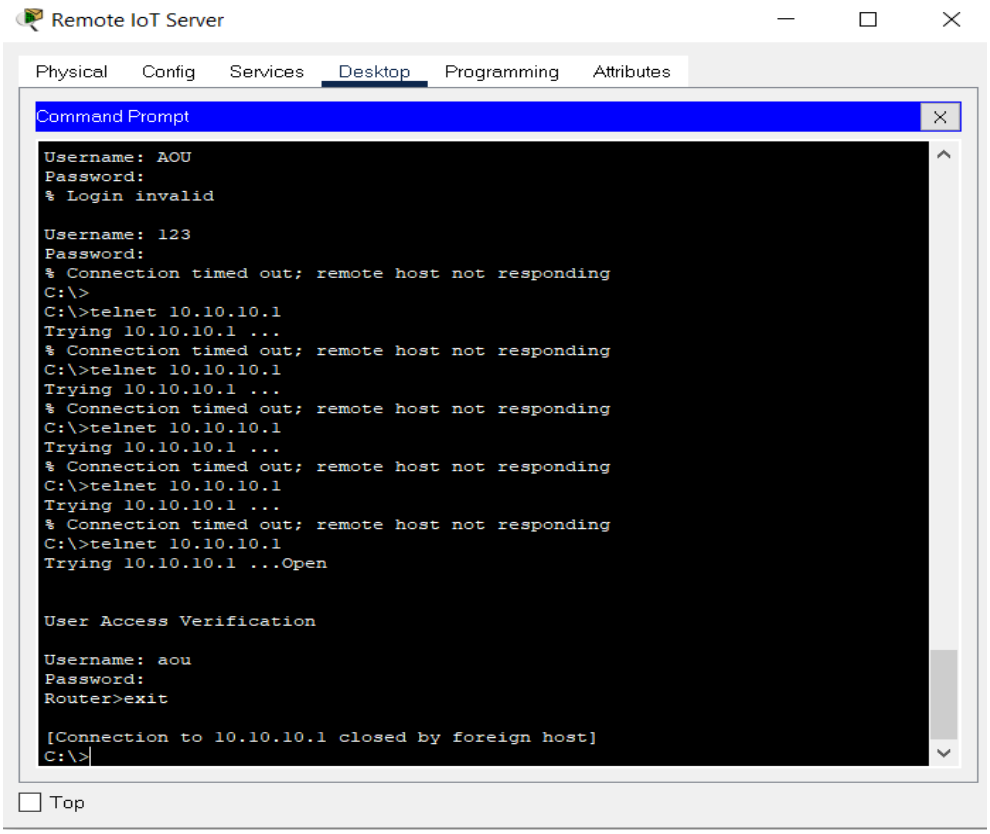


Figure 81 pinging and making a telnet connection between the server and the router

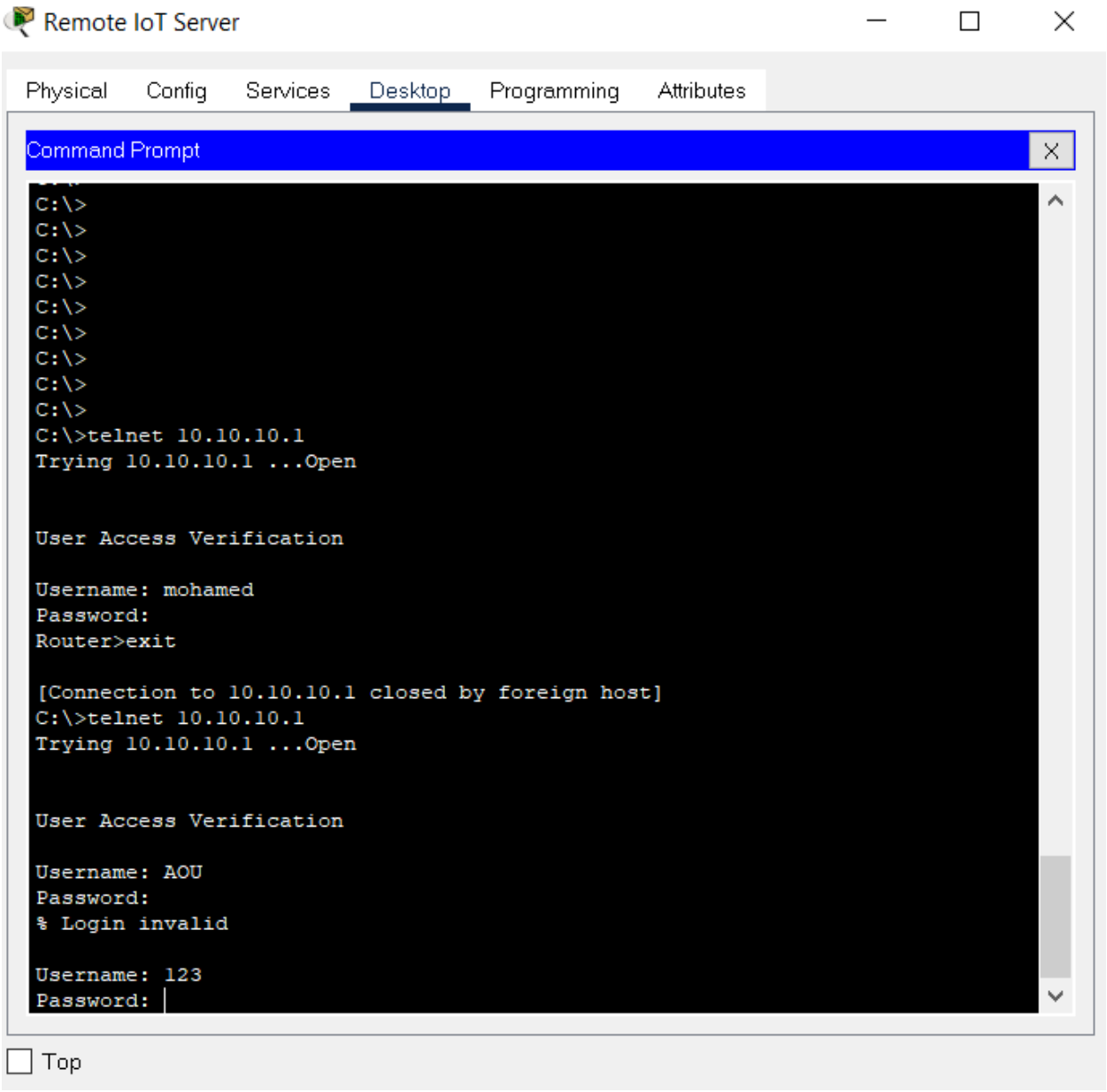


Figure 82_The figure below shows that there is two users "Mohamed, and AOU".

That the user can connect with Mohamed user when the server is on, but if the server is down the user can connect using the AOU account. All of these features is done by using the AAA protocol.

After checking the connectivity of the whole network, now it's the time to control each system using the smartphone. Here is smartness shows up.

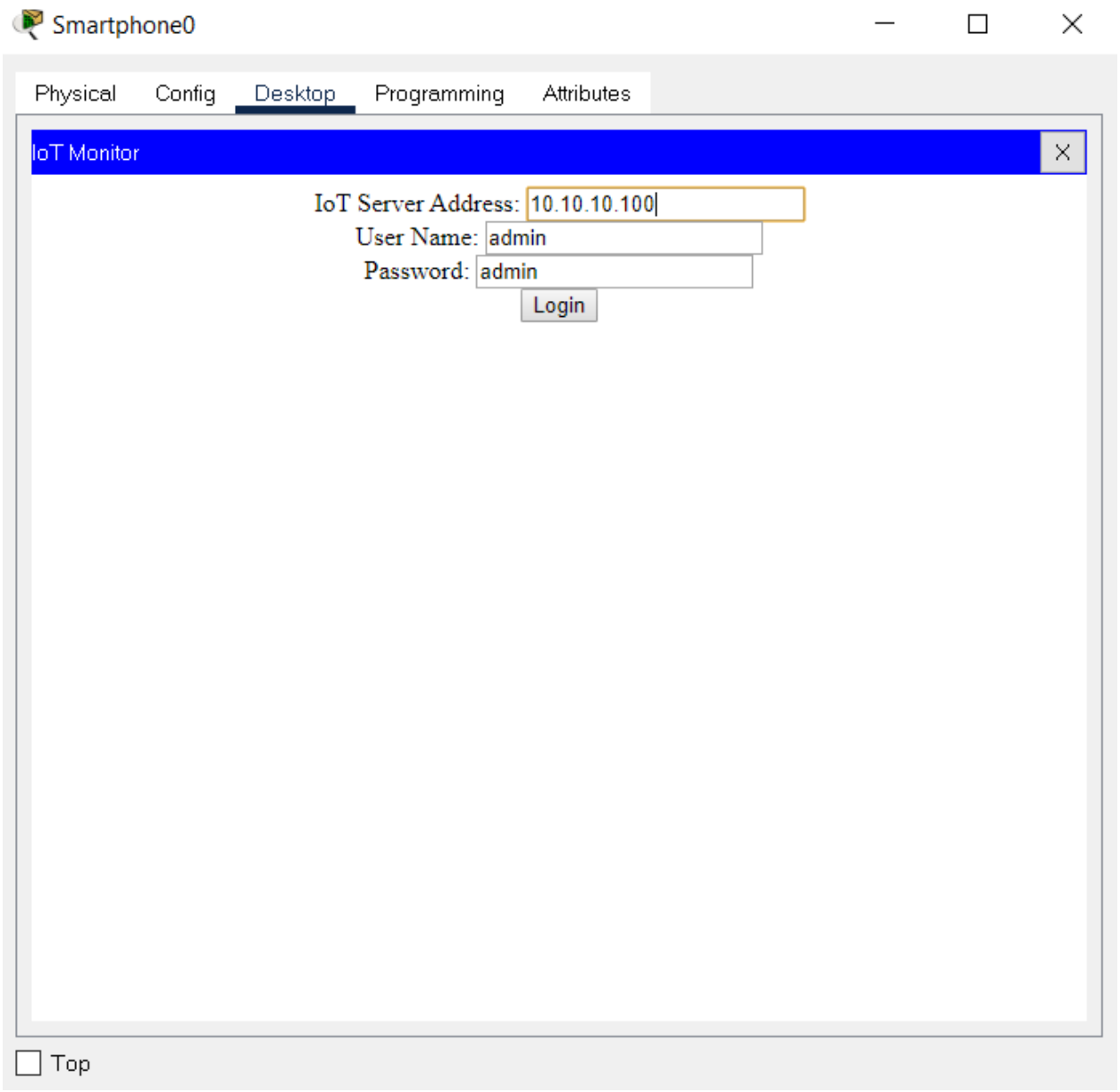


Figure 83_The figure above shows the process of connecting to the IoT Server using the smartphone

2- Controlling each system using the smartphone (on, off) cases:

- **Controlling the main door-locking system:**

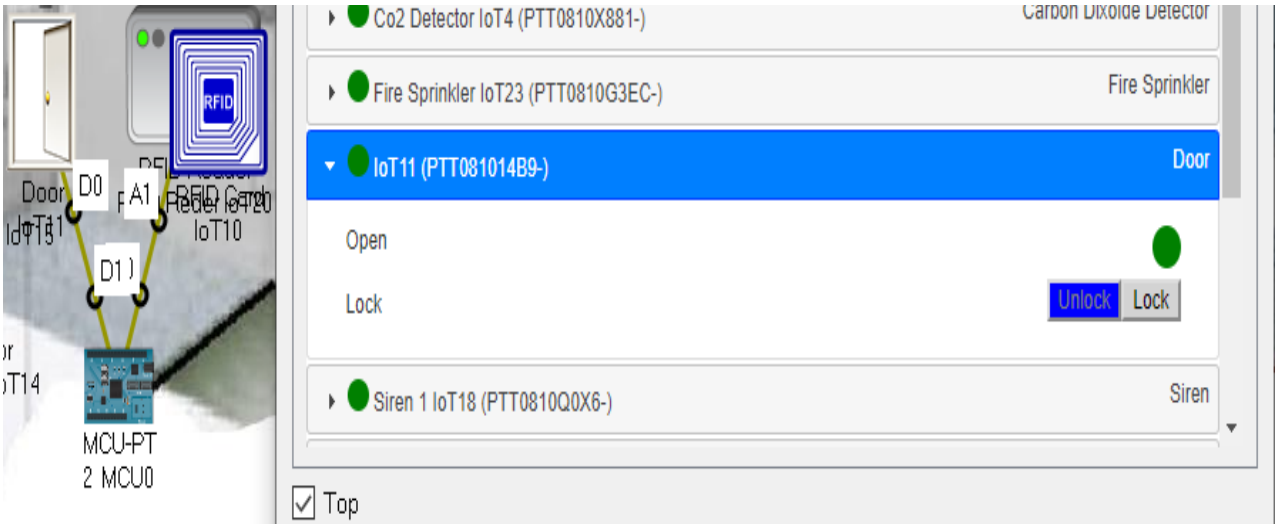


Figure 84_On case

Figure 85_Off case

- **Controlling the Motion Detector and Camera:**

Figure 86_On case

Figure 87_Off case

- **Controlling the Garage Small System:**

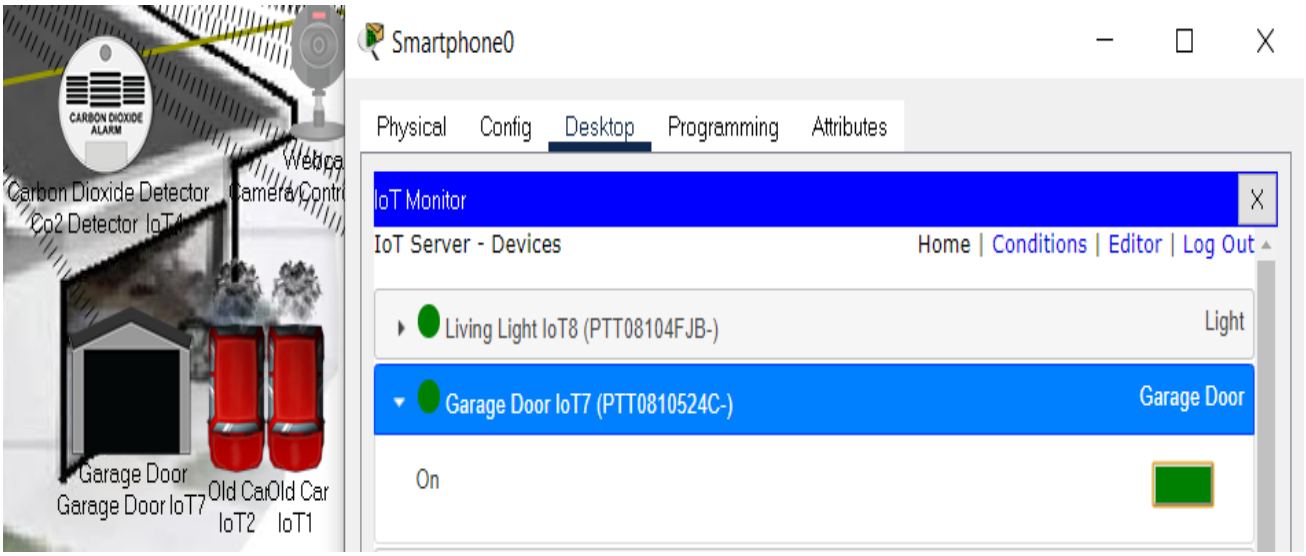


Figure 88_On case

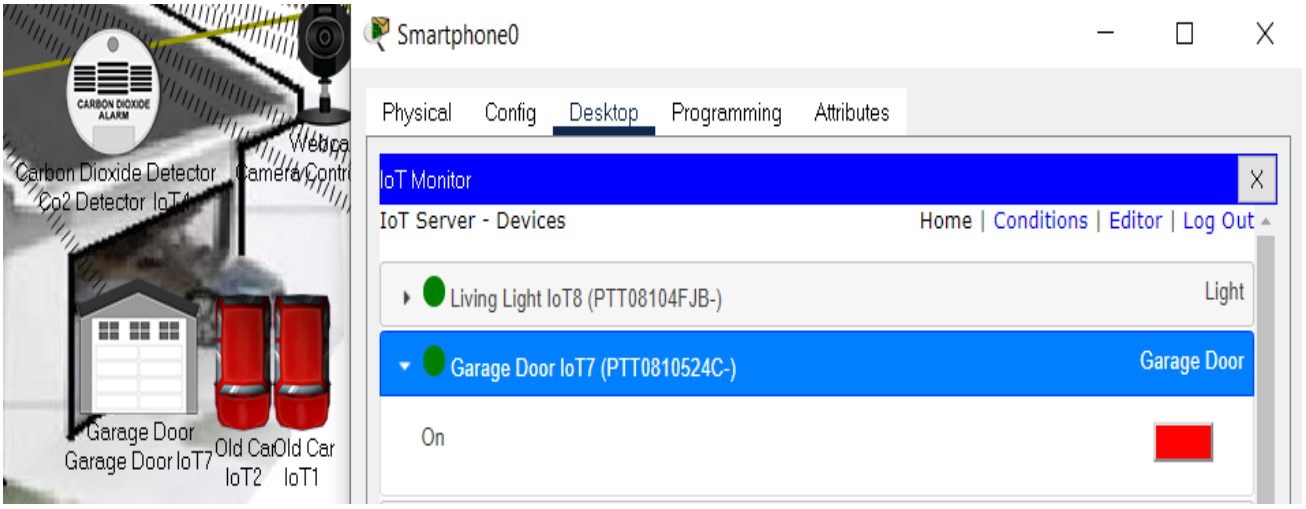


Figure 89_Off case

- **Controlling the Solar System:**

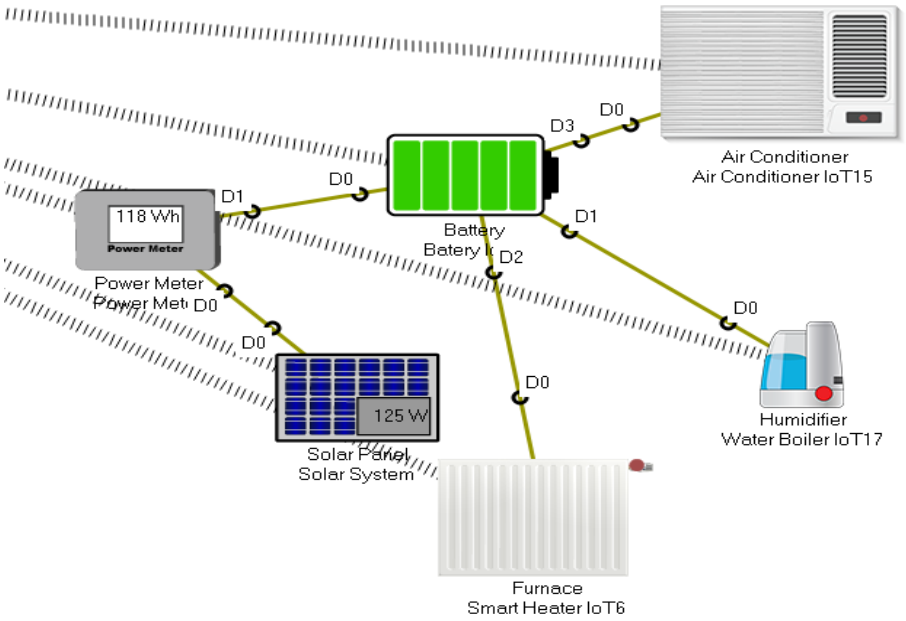


Figure 90_On case

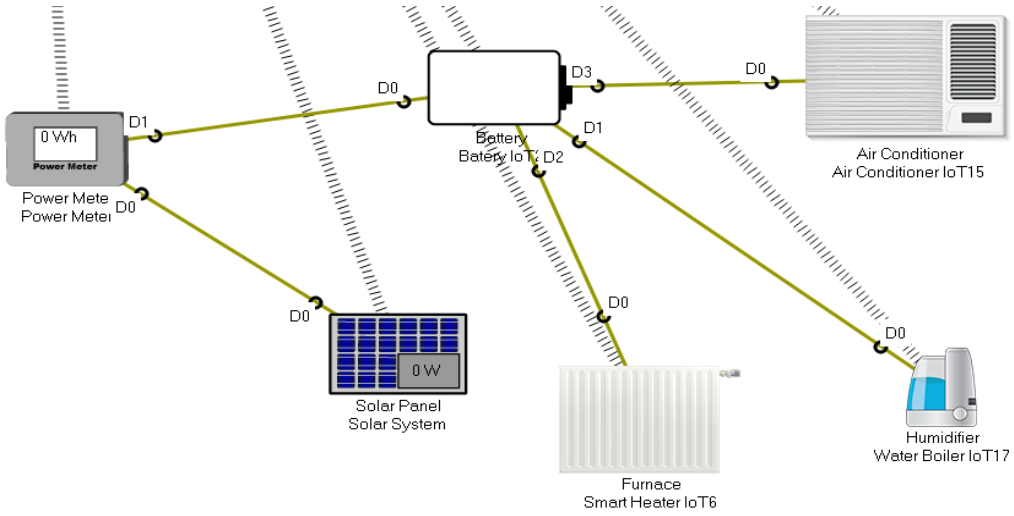


Figure 91_Off case

- **Controlling the Living Room:**

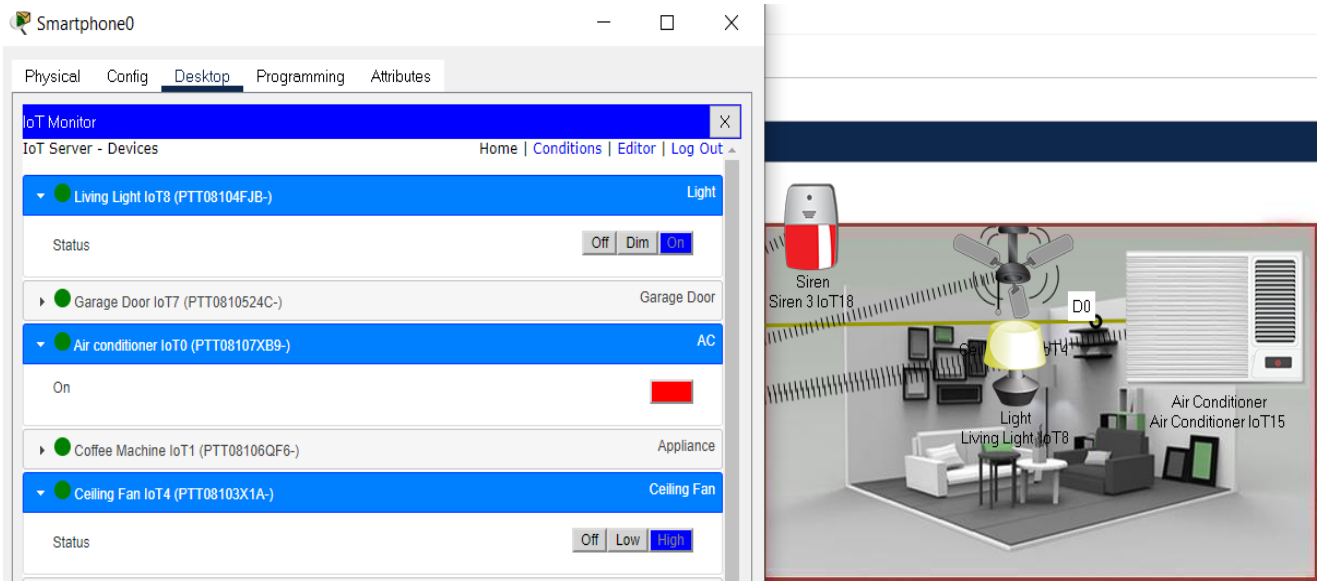


Figure 92_On case

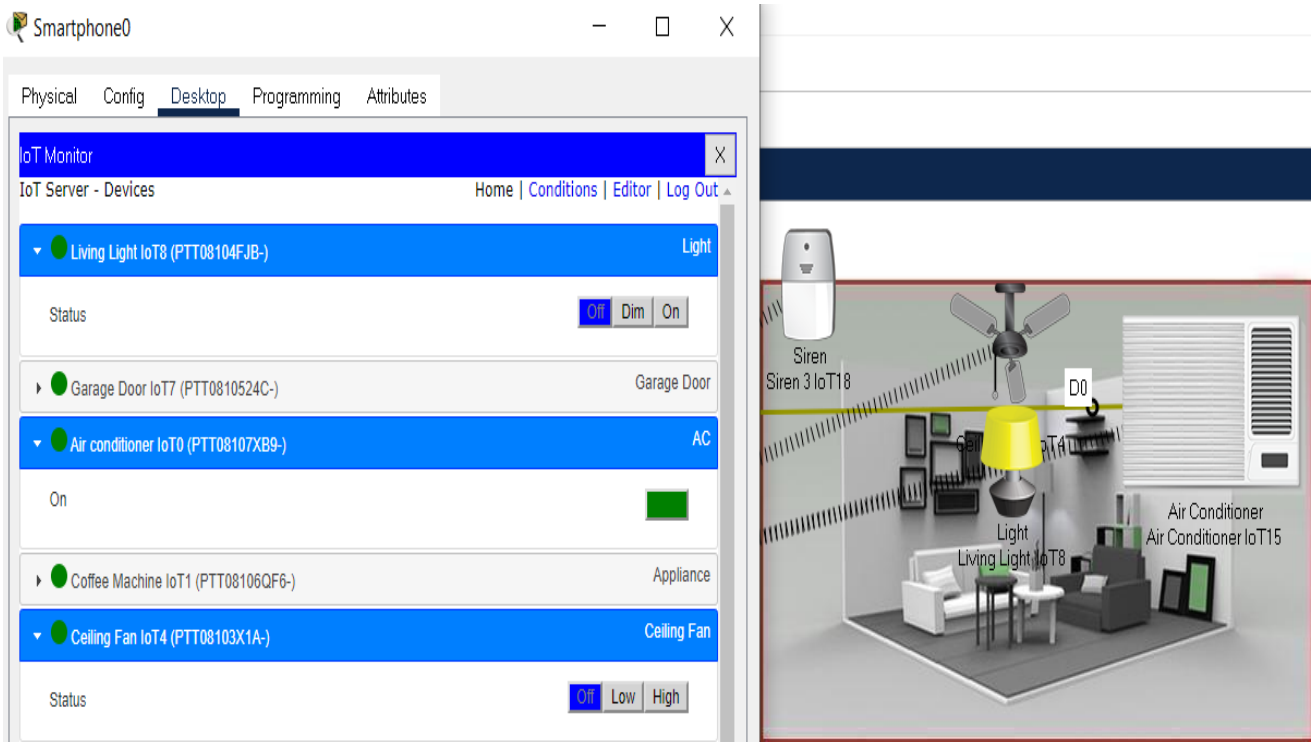


Figure 93_Off case

- **Controlling the bathroom:**

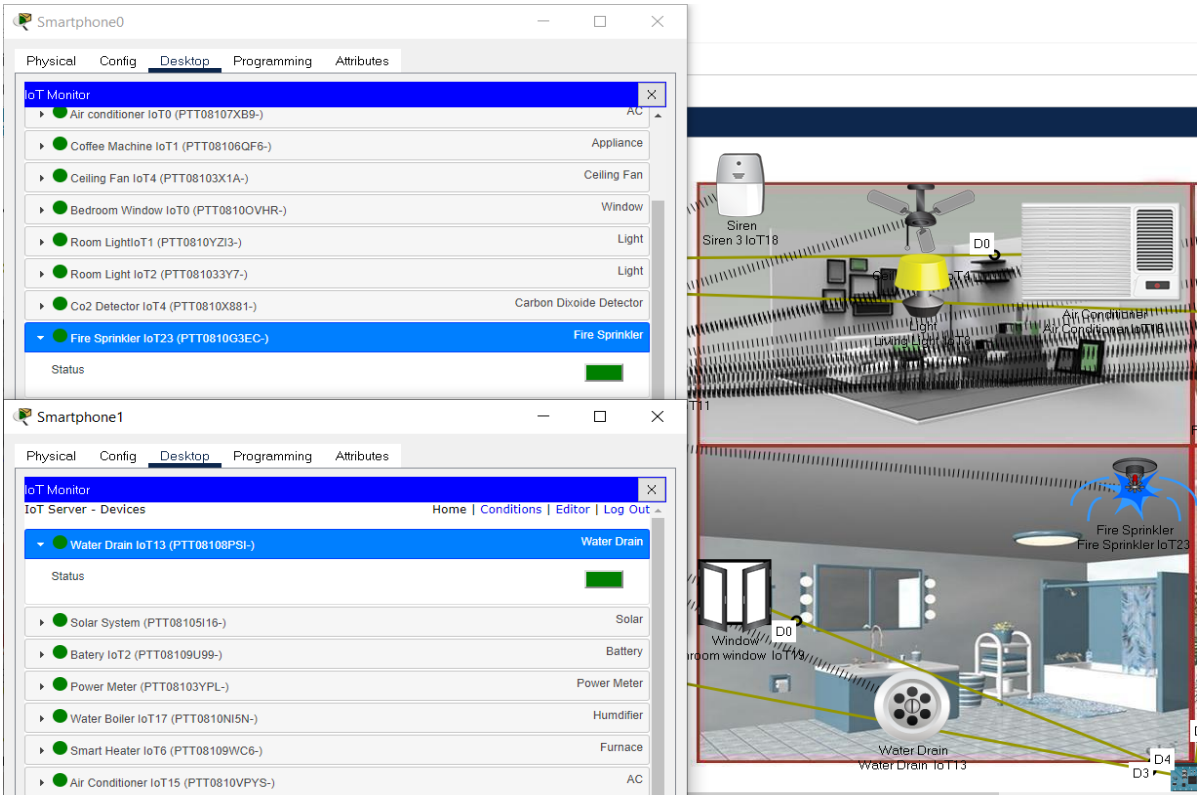


Figure 94_On case

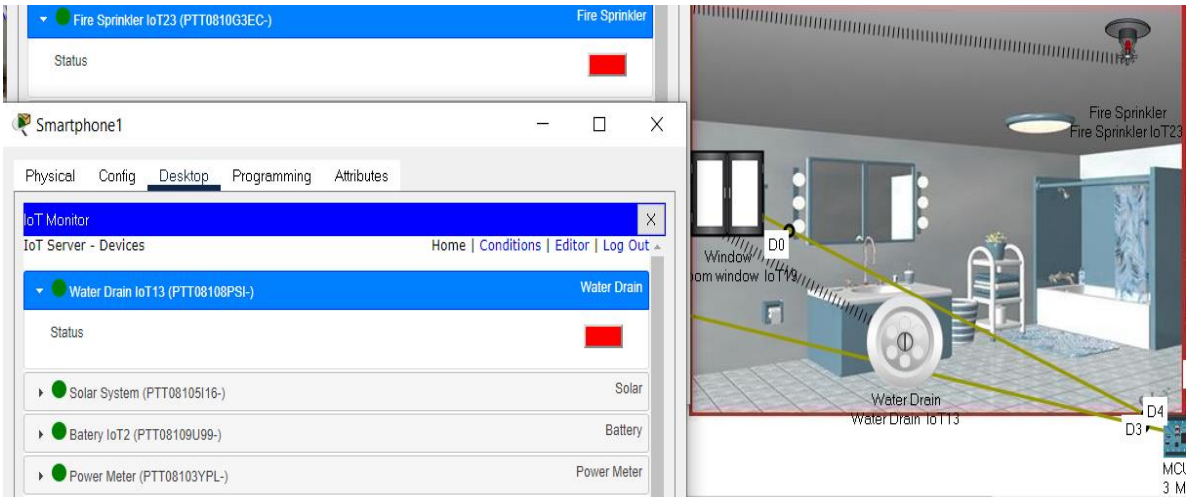


Figure 95_Off case

- **Controlling the Garden:**

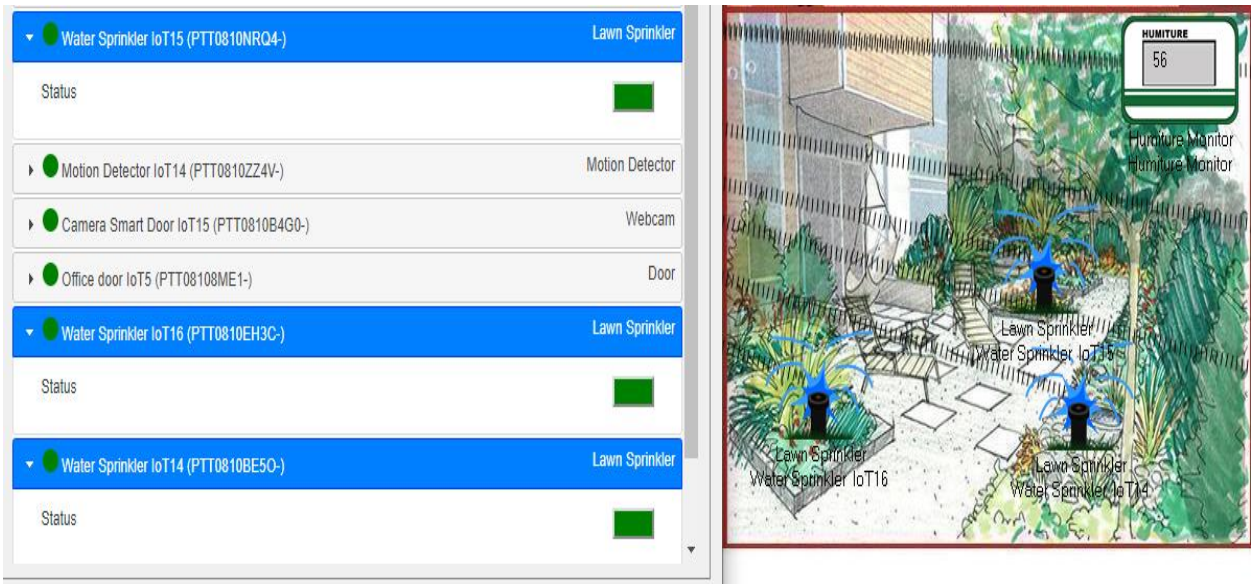


Figure 96_On case

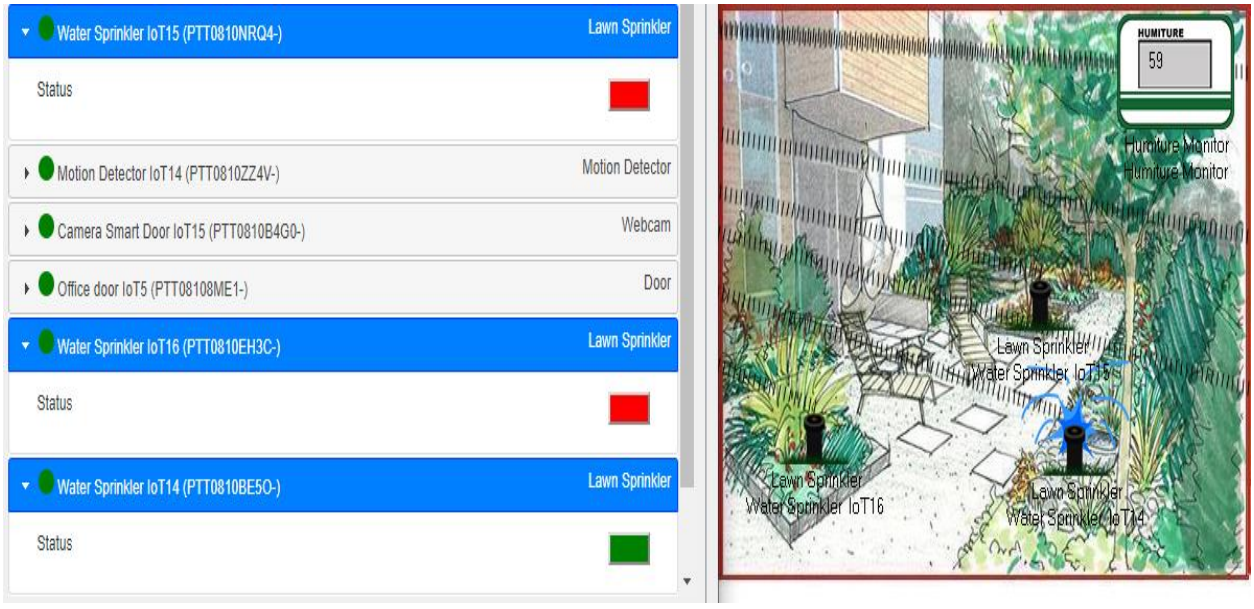


Figure 97_Off case

- **Controlling the Kitchen:**

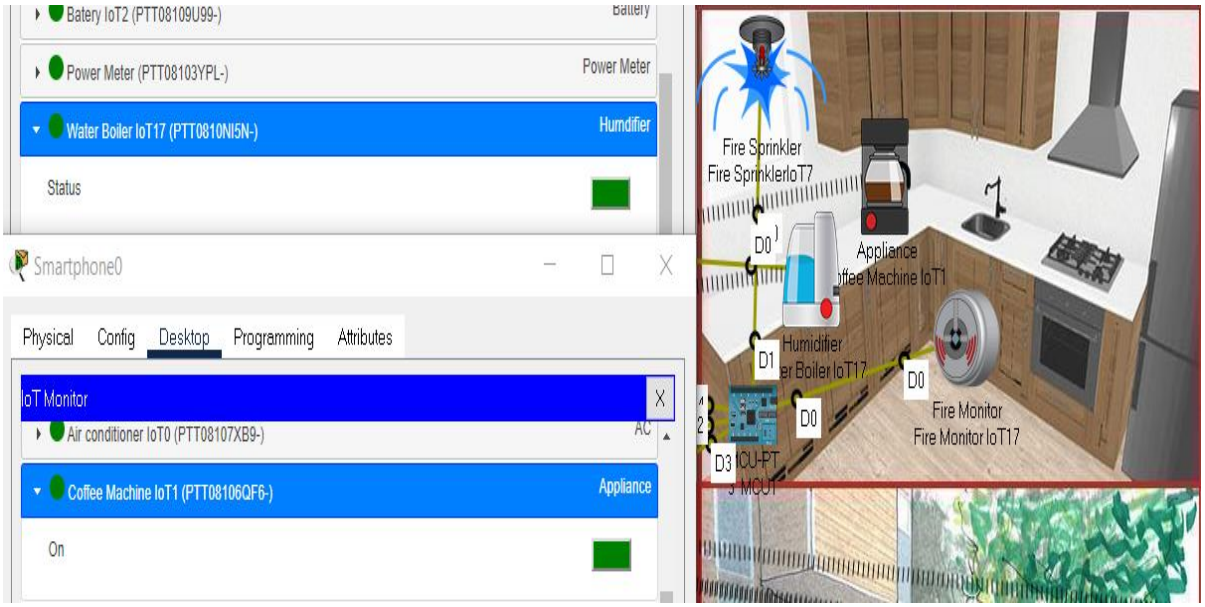


Figure 98_On case

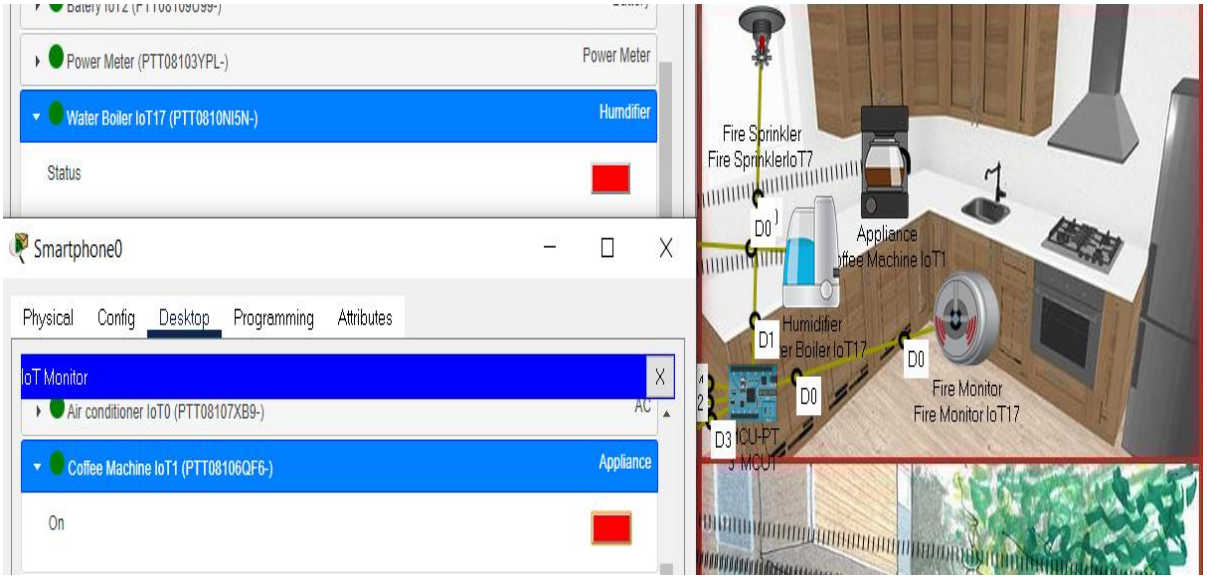


Figure 99_Off case

- **Controlling the bedroom:**

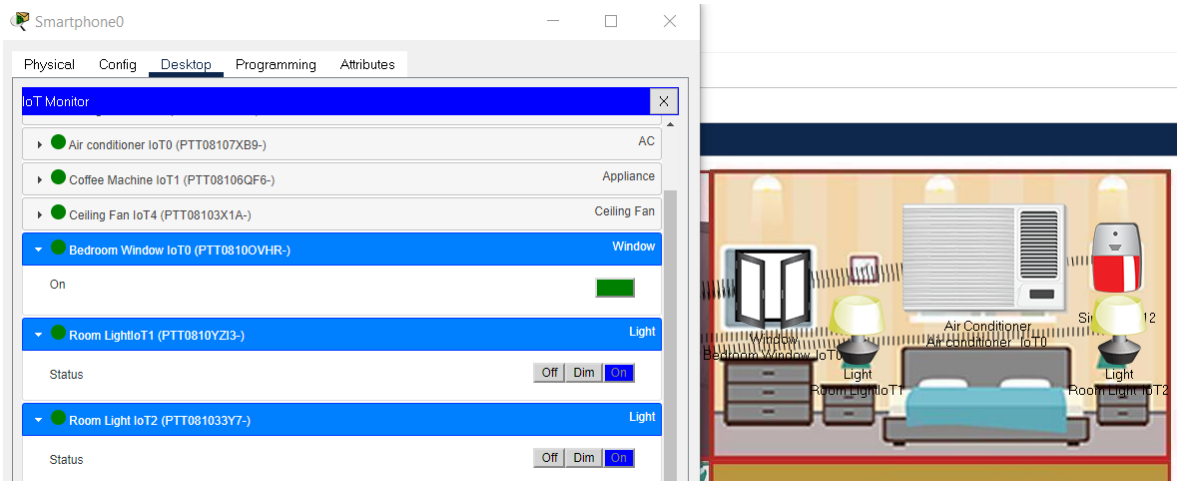


Figure 100_On case

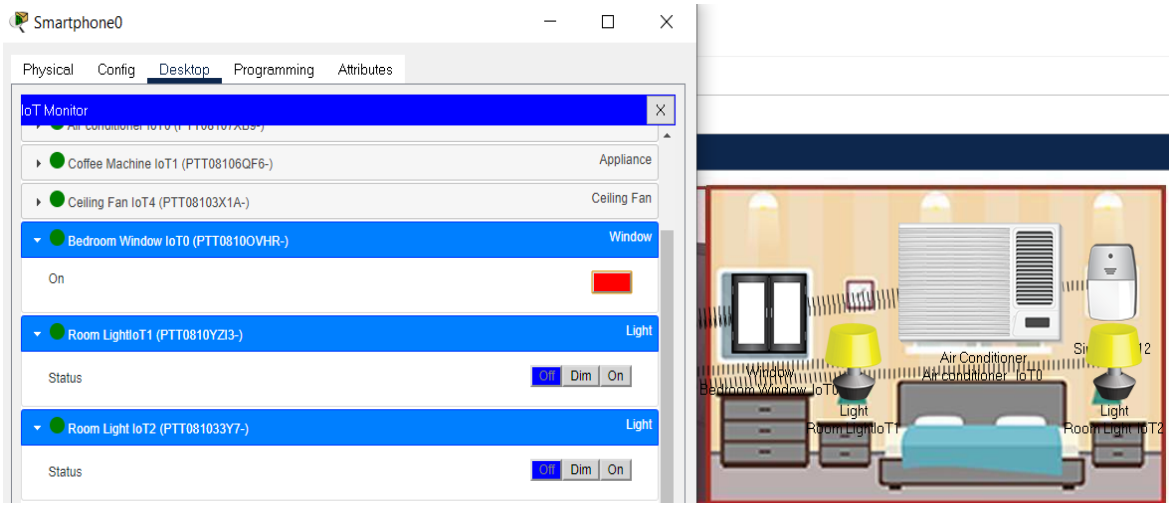


Figure 101_Off case

- **Controlling the Home Office room:**

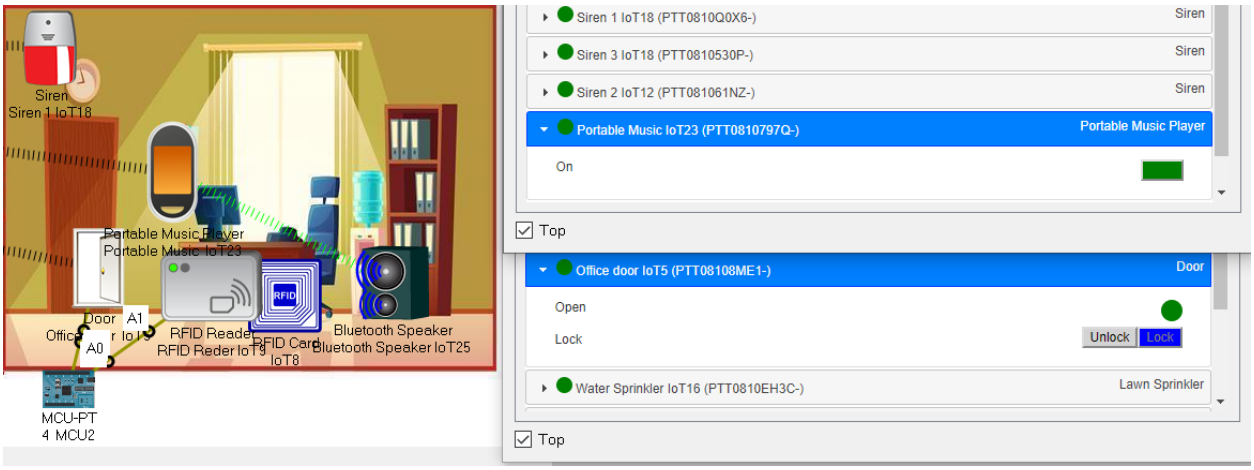


Figure 102_On case

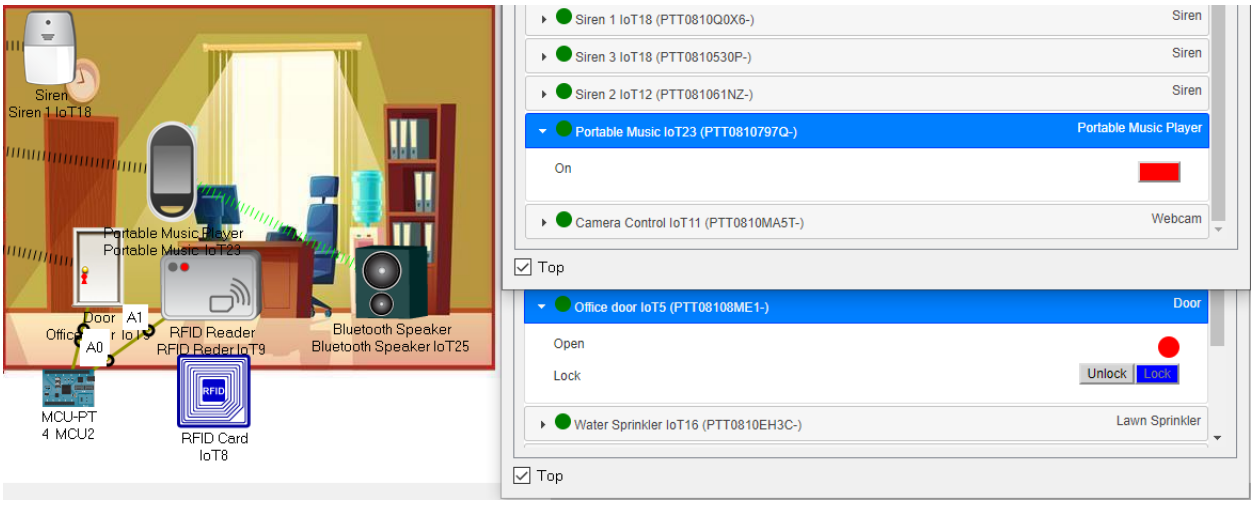


Figure 103_Off case

3- Testing the microcontrollers systems:

- **Testing the welcoming home system:**

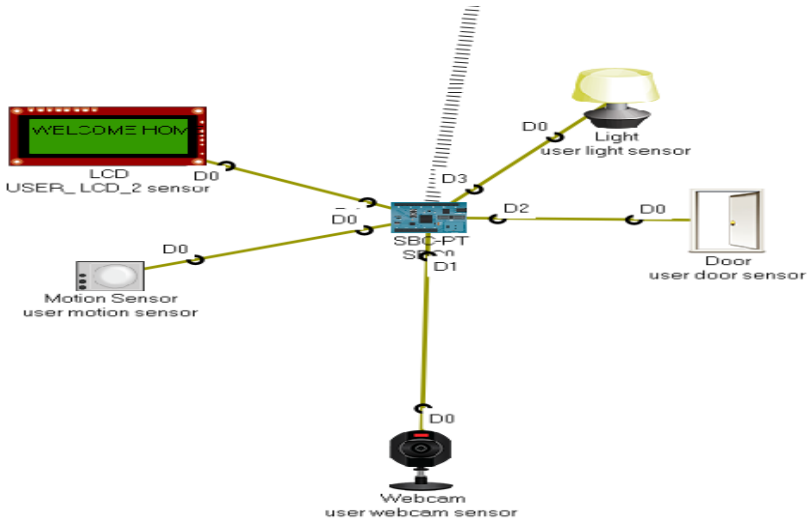


Figure 104_On case

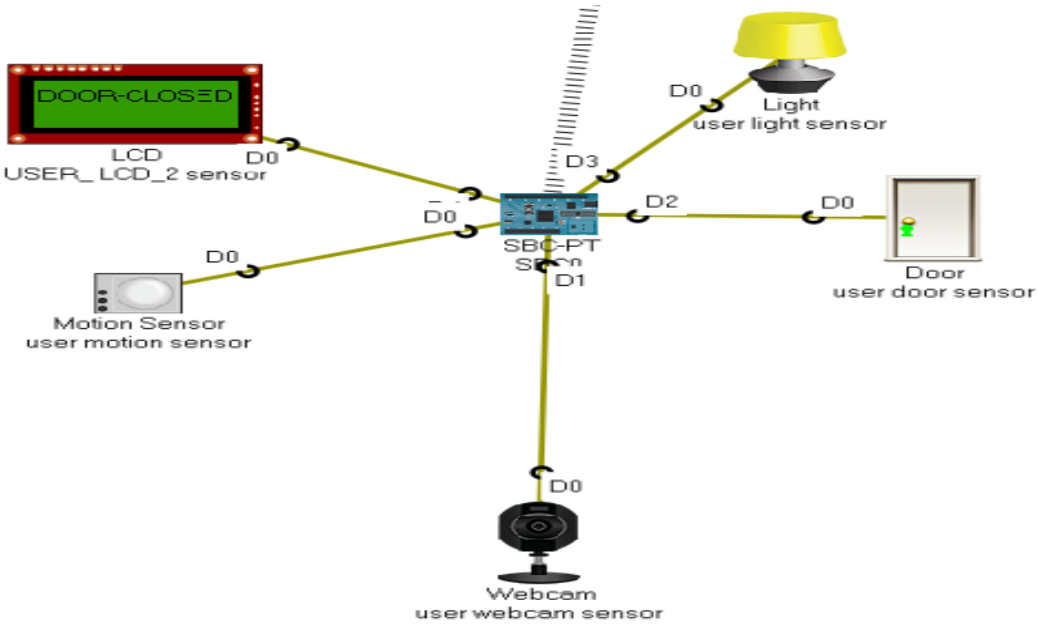


Figure 105_Off case

- **Testing the fire system:**

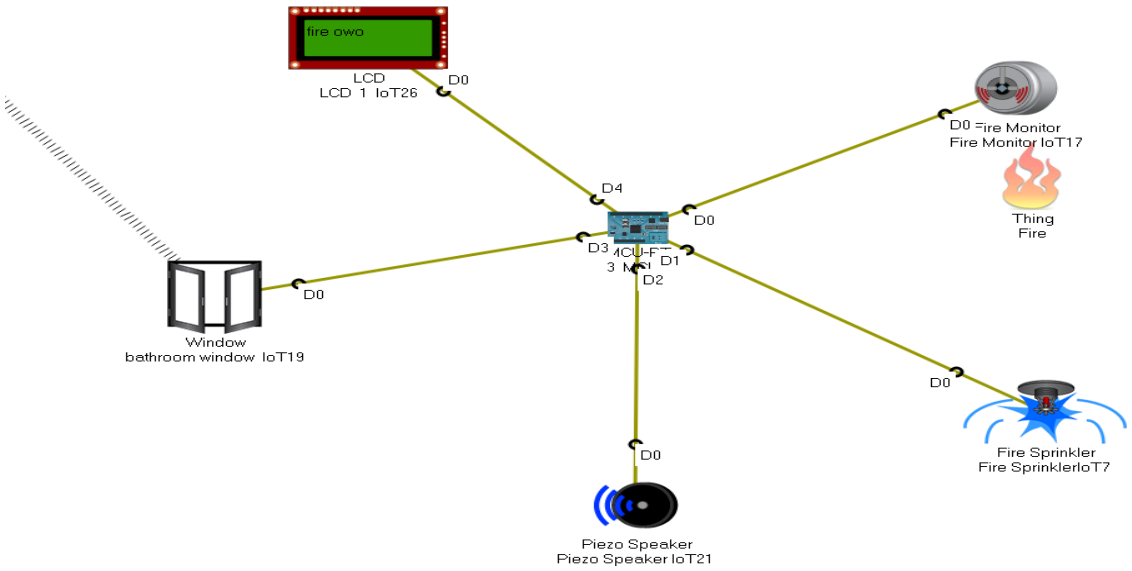


Figure 106_On case

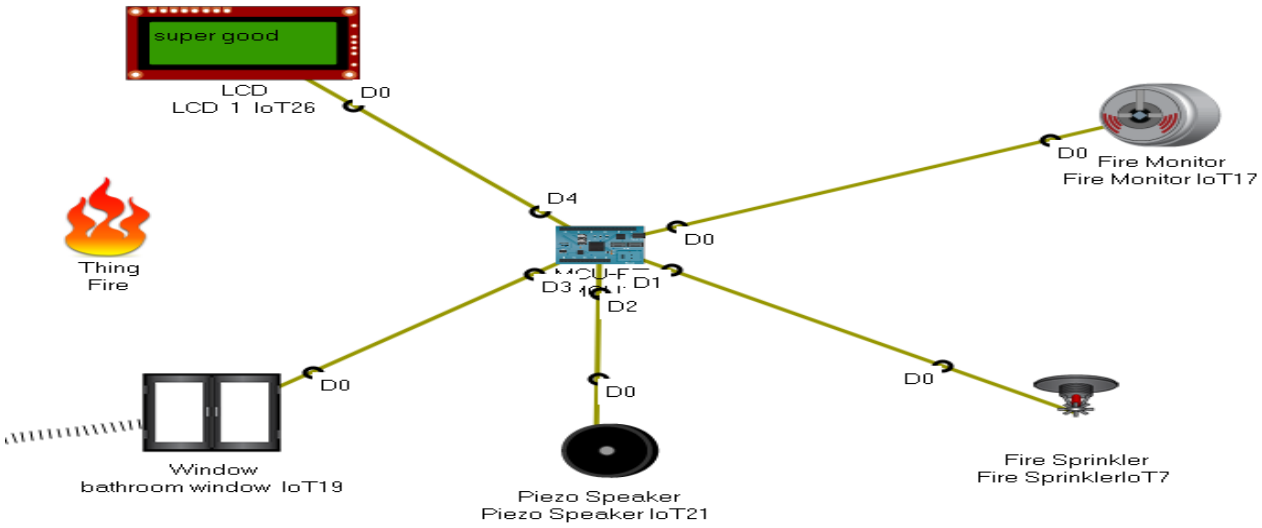


Figure 107_Off case

- **All the devices I used in the smart home in the below figure.**

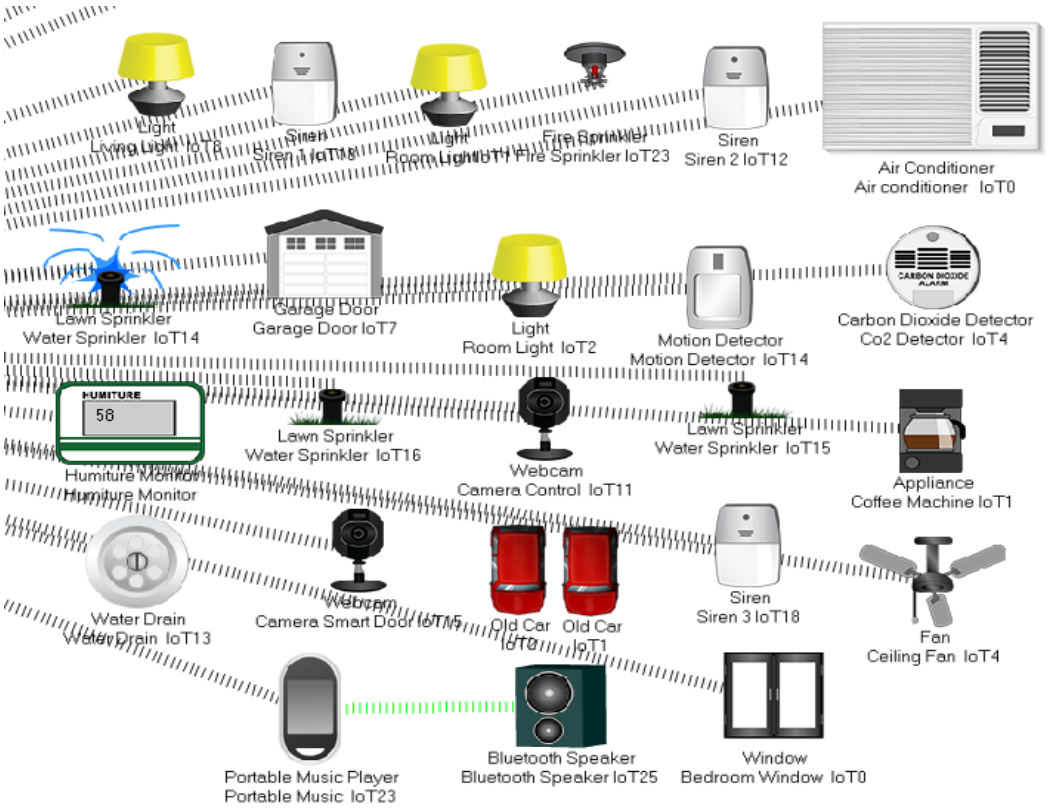


Figure 108_The figure above shows the whole system devices used in the smart home.

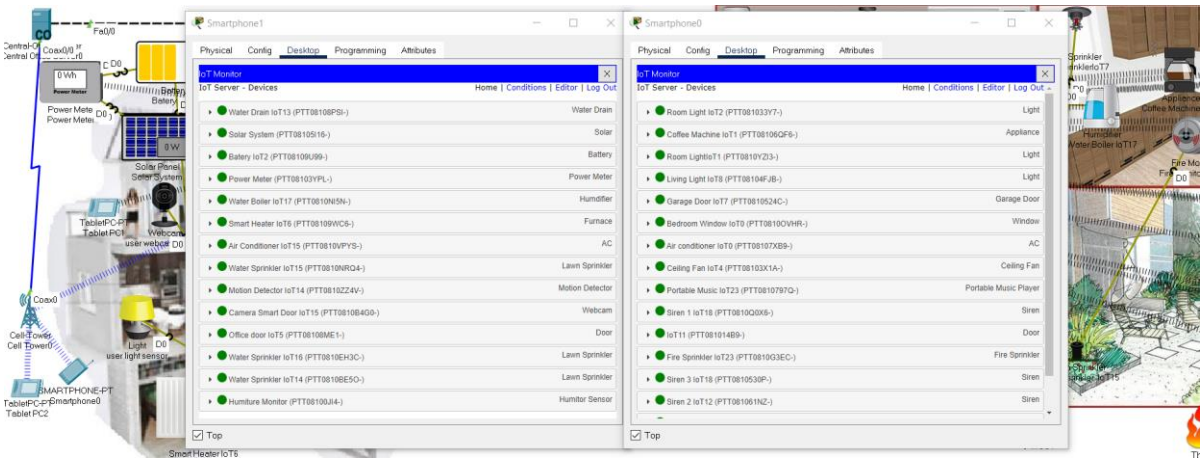


Figure 109_The figure above shows two smartphones used to control the smart home.

Chapter 5
Results and discussion

5.1 Findings:

- I had more experience while using packet tracer
- Learned many IoT and security courses
- I learned how to solve bugs and how to search for solutions
- learning more about security protocols like AAA protocol
- while working on packet tracer I learned more and more about network devices and the Cisco simulation tool
- while analyzing the cost of the whole project I found the importance of using network simulations tools like packet tracer and GNS3, etc.....
- finally, I found that one of the best resources in the networking field is CISCO corporate

5.2 Goals achieved:

- Finishing the project in scheduling time
- Also, made the home smarter to make the user's life easier
- One of the most important achieved goals; learning more about cisco packet tracer
- learning more about microcontrollers in different programming languages like (python, javascript, c++, etc.....)
- finally, simulate the whole smart home configurations for the network and the devices.
- all the goals proposed in the previous chapters had been achieved

5.3 Future work:

- Making a big team to design and develop the home in real-life (not on a simulation network tool)
- Developing SDN system or architecture to control the network devices from one single device
- Adding saving power features in the real-life smart home
- The time for smart home service will be measured, as well as the time for energy savings.

- I'll bring peace to the use of the devices in the future because they'll have sensors all over the house to provide the requisite protection.

- Over the next decade, health applications will drive at least some of the smart-home development. If people are reaching for sugary sodas too often, cameras and sensors installed in refrigerators will recommend healthier alternatives. Residents' prescriptions can be verified using similar technology in medication cabinets and sensors will even show up in toilets to check for signs of any potential health conditions by scanning human waste before it’s flushed.

- Homes will also have their health sensors, which will monitor for issues such as water damage, insect infestation, and so on, alerting owners of any possible problems until they become even lower cost to fix

- The smart home will know when to take those steps and will do so automatically. This is where home automation and IoT will go in the future.

5.4 Critical thinking Discussion

I think that after designing the network one of the major issues is the smarter devices the more the people are lazier.

The more smartness in our life makes us lazier and nonproductive, why you will work if there is something that does your work for you!

Chapter 6
Results Conclusions

6.1 Conclusion.

- Finally, the project proposes the concept of smart homes, which can accommodate a wide range of home automation technologies. Wireless networking, cameras, surveillance, and mapping are all part of a smart house. Smart homes are large structure that incorporates a variety of technology and software that can be used to include home protection and power.

- This project discussed the designed modules like sensors' circuits, monitoring and tracking of the home through IP camera, mobile notifications, and home navigator.

- Also, I want to talk about something that is a huge issue in the improvement of the technological era. That thing is that security in this era, in our today life's we use technology more than any time before our data, information, and location are out there on the internet. So, the security concept is an important thing in our today life's we must as possible as make more secure systems, homes, applications, and devices to make sure that users' data is not available to anyone out there on the internet.

- Working on this subject, I've concluded that "Smart Home" is the best option if you don't have time to deal with household issues and want to make your life simpler using cutting-edge technology.

- There aren't many "smart houses" in our country right now; the majority of them are non-smart homes. However, low-cost projects have also been built that allow for the installation of a "smart home" system with limited financial outlay.

- The possibilities of new technology fascinate me, and a house management system like this seems to be one of them.

- The smart home itself is a weapon with two faces. there is a lot of security issues in smart homes! You can imagine that if there is no security in the home it may cause that a hacker can access the home devices and control them to make the home owner's life miserable or have access to the devices under a zombie botnet to control them to attack someone else

6.2 Appendices

1) Micro controller door

```
//initialize the door and reader variables
var door =1;
var reader=A0;

//the setup function for the intilizalizing process
function setup() {
	pinMode(door, OUTPUT);
	pinMode(reader, INPUT);
	customWrite(door,0);
}

//the loop funtion is our main method
function loop() {
	if(analogRead(reader)===0){
		customWrite(door,1);
	}else{
			customWrite(door,0)
	}

	digitalWrite(1, HIGH);
	delay(1000);
	digitalWrite(1, LOW);
	delay(500);
}//end of the loop function
```

RFID code

```
Var DELAY_TIME = 1000;
var current_time = 0;

var X_READ_DISTANCE = 50;
var Y_READ_DISTANCE = 50;
var cardID = 0;
var lastCardID = 0;
var state = 2; // waiting

function setup(){
	/*
	Registration Server Setup
	*/
	IoEClient.setup({
		type: "RFID Reader",
		states: [
			{
			name: "Card ID",
			type: "number",
			unit: '',
			controllable: false
			},
			{
			name: "Status",
			type: "options",
			options: {
				"0": "Valid",
				"1": "Invalid",
				"2": "Waiting"
			},
			controllable: true
			}
		]
	 });

	IoEClient.onInputReceive = function(input) {
		processData(input, true);
	};
}

function loop(){
	var devices = devicesAt(getCenterX(), getCenterY(), X_READ_DISTANCE, Y_READ_DISTANCE);
	var found = false;
	for (var i = 0; i < devices.length; ++i){
		if (devices[i] === getName()){
			continue;
```

```
                }
                cardID = getDeviceProperty(devices[i], 'CardID');
                found = true;
                break;
        }

        if (!found) {
                cardID = lastCardID = 0;
                setState(2);
        }
        else {
                if (lastCardID != cardID){
                        lastCardID = cardID;
                        sendReport();
                }
        }
        if (cardID==1001){
                setState(0);
        }
        else{
                setState(1);

        }
        delay(DELAY_TIME);
}

function setState(newState){
        if (state != newState) {
                state = newState;
                analogWrite(A1, state);
                sendReport();
        }
}

function sendReport()
{
        var report = parseInt(cardID) + "," + state;
        IoEClient.reportStates(report);
}

function processData(data, bIsRemote)
{
        if ( data.length <= 0  )
                return;
        data = data.split(",");
        setState(Number(data[1]));
}
```

1) Microcontroller Welcoming home system

```
from gpio import *
from time import *
def main(): //
     pinMode(0, INPUT)
     pinMode(1, OUT)
     pinMode(2, OUT)
     pinMode(3, OUT)
     pinMode(4, OUT)
     print("SMART DOOR SYSTEM")

     while True:

             d = digitalRead(0);
             print(d);
             if(d==1023):
                     customWrite(1,HIGH);
                     customWrite(2,1,0);
                     customWrite(3,2);
                     customWrite(4,"WELCOME HOME");

             else:
                     customWrite(1,LOW);
                     customWrite(2,0,0);
                     customWrite(3,0);
                     customWrite(4,"DOOR-CLOSED");

             delay(500);




if __name__ == "__main__":
     main()
```

3 Microcontroller Fire Small System

```
from gpio import *
from time import *
def main():
	pinMode(0,INPUT)
	pinMode(1,OUT)
	print("Fire Alarm System");
	while True:
		fire = digitalRead(0);
		print(fire);
		if(fire==1023):
			customWrite(1,'1');
			customWrite(4,'fire owo');
			customWrite(3,HIGH);
			digitalWrite(2,HIGH);
		else:
			customWrite(1,'0');
			customWrite(4,'super good');
			customWrite(3,LOW);
			digitalWrite(2,LOW);
if __name__ == "__main__":
	main()
```

4. Microcontroller door

```
var door =1;
var reader=A0;
function setup() {
	pinMode(door, OUTPUT);
	pinMode(reader, INPUT);
	customWrite(door,0);
}

function loop() {
	if(analogRead(reader)===0){
		customWrite(door,1);

	// }if(analogRead(reader)!==0){
	//	customWrite(door,0);
			// customWrite(do2,0);

	}else{
			customWrite(door,0);


	}

	digitalWrite(1, HIGH);
	delay(1000);
	digitalWrite(1, LOW);
	delay(500);
}
```

RFID REDER

```
var DELAY_TIME = 1000;
var current_time = 0;

var X_READ_DISTANCE = 50;
var Y_READ_DISTANCE = 50;
var cardID = 0;
var lastCardID = 0;
var state = 2; // waiting

function setup(){
	/*
	Registration Server Setup
	*/
	IoEClient.setup({
		type: "RFID Reader",
		states: [
			{
			name: "Card ID",
			type: "number",
			unit: '',
			controllable: false
			},
			{
			name: "Status",
			type: "options",
			options: {
				"0": "Valid",
				"1": "Invalid",
				"2": "Waiting"
			},
			controllable: true
			}
		]
	 });

	IoEClient.onInputReceive = function(input) {
		processData(input, true);
	};
}

function loop(){
	var devices = devicesAt(getCenterX(), getCenterY(), X_READ_DISTANCE, Y_READ_DISTANCE);
	var found = false;
	for (var i = 0; i < devices.length; ++i){
		if (devices[i] === getName()){
			continue;
```

```
                }
                cardID = getDeviceProperty(devices[i], 'CardID');
                found = true;
                break;
        }

        if (!found) {
                cardID = lastCardID = 0;
                setState(2);
        }
        else {
                if (lastCardID != cardID){
                        lastCardID = cardID;
                        sendReport();
                }
        }
        if (cardID==1001){
                setState(0);
        }
        else{
                setState(1);

        }
        delay(DELAY_TIME);
}

function setState(newState){
        if (state != newState) {
                state = newState;
                analogWrite(A1, state);
                sendReport();
        }
}

function sendReport()
{
        var report = parseInt(cardID) + "," + state;
        IoEClient.reportStates(report);
}

function processData(data, bIsRemote)
{
        if ( data.length <= 0  )
                return;
        data = data.split(",");
        setState(Number(data[1]));
}
```

Music code

```
var state = 0;
var dstMac = "FFFF.FFFF.FFFF";
var dstService = "{58c41a2f-5111-45b0-863c-0429591c81fd}";
var btService = new BluetoothService();
function setup()
{
	IoEClient.setup({
		type: "Portable Music Player",
		states: [{
			name: "On",
			type: "bool",
			controllable: true
		}]
	});
	IoEClient.onInputReceive = function(input) {
		processData(input, true);
	};
	attachInterrupt(0, function() {
		processData(customRead(0), false);
	});
	state = restoreProperty("state", 0);
	setState(state);

	Bluetooth.init();
	Bluetooth.setAcceptingPairRequest(true);
	Bluetooth.setDiscoverable(true);

   Serial.println(btService.start(dstService));
}
function restoreProperty(propertyName, defaultValue)
{
	var value = getDeviceProperty(getName(), propertyName);
	if ( !(value === "" || value == "undefined") ){
		if ( typeof(defaultValue) == "number" )
			value = Number(value);

		setDeviceProperty(getName(), propertyName, value);
		return value;
	}

	return defaultValue;
}

function mouseEvent(pressed, x, y, firstPress)
{
	if (firstPress)
```

```
                setState(state ? 0 : 1);
}

function processData(data, bIsRemote)
{
        if ( data.length <= 0  )
                return;
        setState(parseInt(data));
}

function setState(newState)
{
        state = newState;

        if ( state === 0 )
  {
                digitalWrite(1, LOW);

                btService.send(dstMac, dstService, "");
  }
        else
  {
                digitalWrite(1, HIGH);

    if (dstMac)
        btService.send(dstMac, dstService, "/../Sounds/hamaki.wav");
  }

        IoEClient.reportStates(state);
        setDeviceProperty(getName(), "state", state);
}
Bluetooth.onPairRequest = function(mac, deviceName) {
        Serial.println("accepting pair request: " + mac);
        Bluetooth.acceptPairRequest(mac, deviceName);
};
Bluetooth.onDevicePair = function(mac) {
        Serial.println("paired: " + mac);
};
Bluetooth.onDeviceUnpair = function(mac) {
        Serial.println("unpaired: " + mac);
};
Bluetooth.onDeviceConnect = function(mac) {
        Serial.println("connected: " + mac);
};

Bluetooth.onDeviceDisconnect = function(mac) {
        Serial.println("disconnected: " + mac);
};
```

Configuration router

```
Router>
Router>enable
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#hostname ISP_Router
ISP_Router(config)#interface FastEthernet 0/0
ISP_Router(config-if)#ip address 10.10.20.1 255.255.225.0
Bad mask 0xFFFFE100 for address 10.10.20.1
ISP_Router(config-if)#no shutdown

ISP_Router(config-if)#exit
ISP_Router(config)#interface FastEthernet 0/1
ISP_Router(config-if)#ip address 10.10.10.1 255.255.255.0
ISP_Router(config-if)#no shutdown

ISP_Router(config-if)#exit
ISP_Router(config)#interface FastEthernet 1/0
ISP_Router(config-if)#ip address 10.10.30.1 255.255.255.0
ISP_Router(config-if)#no shutdown

ISP_Router(config-if)#do wr
Building configuration...
[OK]
ISP_Router(config-if)#exit
ISP_Router(config)#ip dhcp excluded-address 10.10.10.1
ISP_Router(config)#ip dhcp excluded-address 10.10.20.1
ISP_Router(config)#ip dhcp excluded-address 10.10.30.1
ISP_Router(config)#ip dhcp pool IoT
ISP_Router(dhcp-config)#network 10.10.10.0 255.255.255.0
ISP_Router(dhcp-config)#default-router 10.10.10.1
ISP_Router(dhcp-config)#dns-server 10.10.10.100
ISP_Router(dhcp-config)#exit
ISP_Router(config)#ip dhcp pool Internet
ISP_Router(dhcp-config)#network 10.10.20.0 255.255.255.0
ISP_Router(dhcp-config)#default-router 10.10.20.1
ISP_Router(dhcp-config)#dns-server 10.10.10.100
ISP_Router(dhcp-config)#exit
ISP_Router(config)#ip dhcp pool CellTower
ISP_Router(dhcp-config)#network 10.10.30.0 255.255.255.0
ISP_Router(dhcp-config)#default-router 10.10.30.1
ISP_Router(dhcp-config)#dns-server 10.10.10.100
ISP_Router(dhcp-config)#exit
ISP_Router(config)#do wr
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
```

```
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up

%LINK-5-CHANGED: Interface FastEthernet1/0, changed state to up

Building configuration...
[OK]
```

Switch

```
Switch>enable
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#line console 0
Switch(config-line)#pass
Switch(config-line)#password 123
Switch(config-line)#login
Switch(config-line)#exit
Switch(config)#ser
Switch(config)#service pas
Switch(config)#service password-encryption
Switch(config)#do wr
Building configuration...
[OK]
Switch(config)#inter
Switch(config)#interface vl
Switch(config)#interface vlan
Switch(config)#interface vlan 1
Switch(config-if)#ip add
Switch(config-if)#ip address 192.168.1.10 255.255.255.0
Switch(config-if)#exit
Switch(config)#line vty 0 15
Switch(config-line)#pass
Switch(config-line)#password 123
Switch(config-line)#login
Switch(config-line)#exit
Switch(config)#ser
Switch(config)#service pas
Switch(config)#service password-encryption
Switch(config)#do wr
Building configuration...
[OK]
Switch(config)#hostname S1
S1(config)#do wr
Building configuration...
[OK]
S1(config)#
```

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