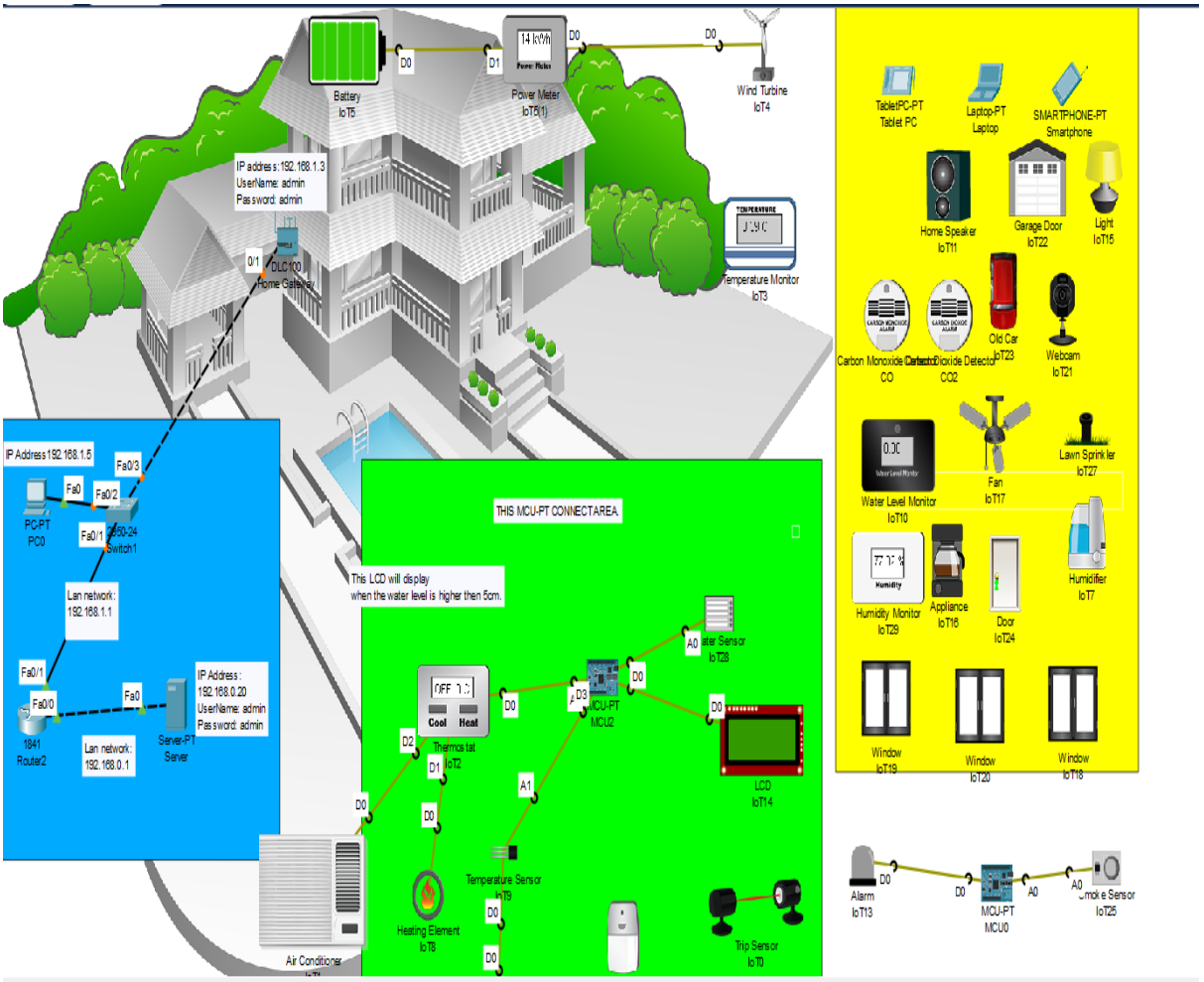
IoT and Cloud Computer



Course Submission Cover Sheet Module:
CS5053 Cloud Computing and the Internet of Things
Assignment no: 001
Weighting: 50% of module mark
Deadline: 4th (Monday) of December 2023, 3pm
Module Leader: Dr Viktor Sowinski-Mydlarz Student ID: 22038179

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(Signature:) **MARCOS TAVARES** Date: 05/11/23

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Cheating, Plagiarism and Collusion
Section 2.3: "The following broad types of offence can be identified and are provided as indicative examples …..

(i) **Cheating: including taking unauthorised material into an examination; consulting unauthorised material outside the examination hall during the examination; obtaining an unseen examination paper in advance of the examination; copying from another examinee; using an unauthorised calculator during the examination or storing unauthorised material in the memory of a programmable calculator which is taken into the examination; copying coursework.**

(ii) **Falsifying data in experimental results.**

(iii) Personation, where a substitute takes an examination or test on behalf of the candidate. Both candidate and substitute may be guilty of an offence under these Regulations.

(iv) **Bribery or attempted bribery of a person thought to have some influence on the candidate's assessment.**

(v) Collusion to present joint work as the work solely of one individual.

(vi) Plagiarism, where the work or ideas of another are presented as the candidate's own.

(vii) Other conduct calculated to secure an advantage on assessment.

(viii) Assisting in any of the above.

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2. Taking extracts from published sources *without attribution* is an offence. To quote ideas, sometimes using extracts, is generally to be encouraged. Quoting ideas is achieved by stating an author's argument and attributing it, perhaps by quoting, immediately in the text, his or her name and year of publication, e.g. " $e = mc^2$ (Einstein 1905)". A *references* section at the end of your work should then list all such references in alphabetical order of authors' surnames. (There are variations on this referencing system which your tutors may prefer you

TABLE OF CONTENT

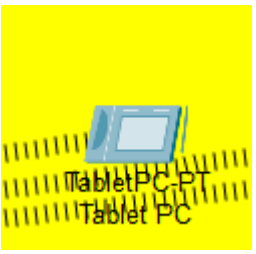
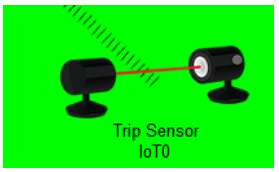
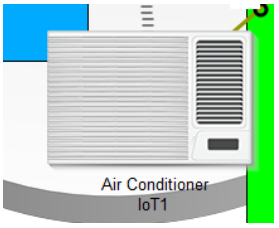
INTRODUCTION

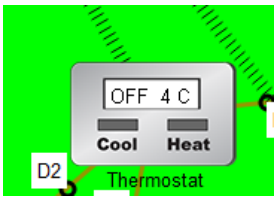
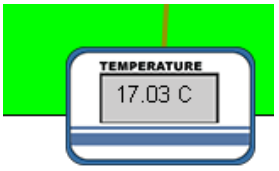
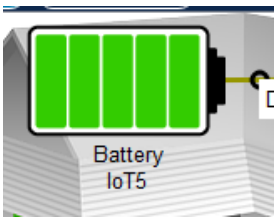
The introduction of this report aims to provide a brief overview of the project's objectives and set the context for the reader. The project's general aim is to explore and implement IoT technology for creating a smart home environment. To achieve this, the report will detail the process of connecting various IoT devices and services to a home gateway, highlighting the practical applications of this technology in our daily lives. This development is situated within the ever-evolving field of IoT, showcasing the relevance and importance of IoT devices in modern home automation and connectivity.

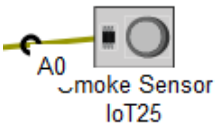
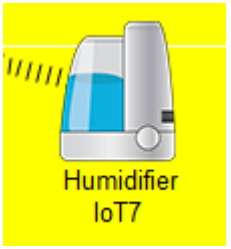
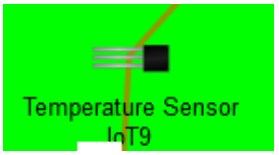
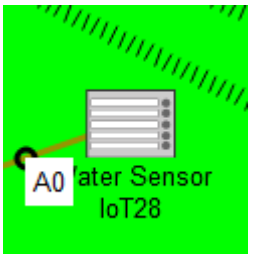
1) Components and description

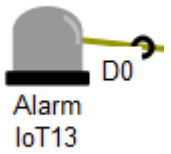
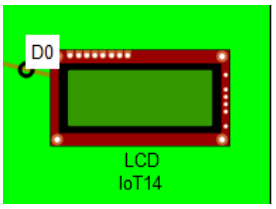
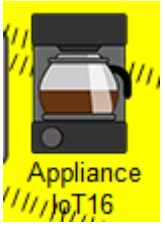
These are the components used to develop the project:

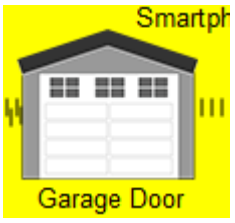
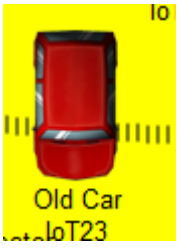
Number	Name	Description	Image
1	Router	device that helps direct internet traffic to different devices in your home or office, allowing them to access the internet.	
2	Switch	device that connects multiple devices within a network, like computers or printers, enabling them to communicate with each other.	
3	Home Gateway	is a central device that connects your home to the internet and allows various smart devices to communicate with each other.	
4	Registration Server	is a server that manages and keeps track of devices on a network, ensuring they're correctly	

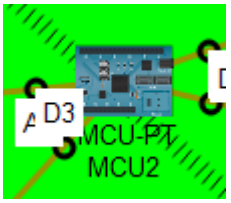
		connected and authorized.	
5	laptop	is a device that allows you to browse the Internet.	
6	desktop PC	is a device that allows you to browse the Internet.	
7	smartphone	is a mobile phone that can perform various functions like browsing the internet, sending messages, and running apps.	
8	tablet	is a portable, touch-screen computer larger than a smartphone but smaller than a laptop.	
9	Trip Sensor	is a device that can detect when someone trips or falls, often used for safety.	
10	Air Conditioning	is a system that cools the air in your home or office to make it more comfortable.	

11	The Heating Element	is a component of a heating system that generates heat to warm up spaces.	
12	thermostat	is a device that lets you control the temperature in your home by adjusting your heating or cooling systems.	
13	Temperature Meter	is a device that measures the current temperature of a room or environment.	
14	Wind Turbine	is a machine that converts wind energy into electricity.	
15	battery	is a portable power source that stores electrical energy for later use.	

16	Smoke Detector	is a device that can sense the presence of smoke, often used for fire safety.	
17	CO and CO2 Detector Devices	that detect the presence of carbon monoxide and carbon dioxide gases, which can be harmful in certain concentrations.	
18	A humidifier	is a device that adds moisture to the air, useful in dry environments.	
19	Temperature Sensor	is a device that measures temperature and can be used for various applications.	
20	Water Level Monitor	is a device that measures temperature and can be used for various applications.	

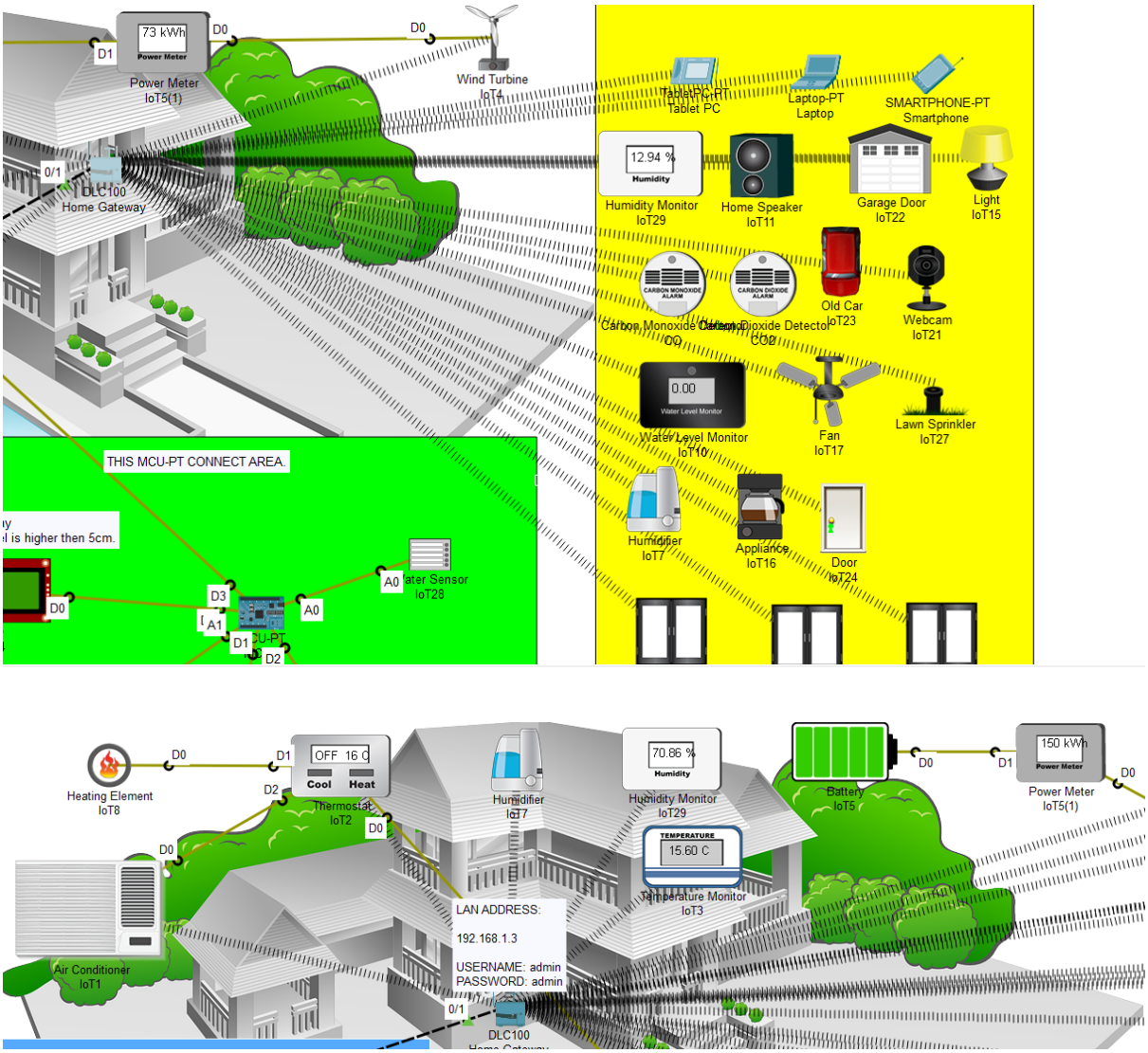
21	An alarm	is a warning signal that can be triggered by various events or conditions.	
22	A siren	is a loud, attention-grabbing sound device often used in alarms and emergency situations.	
23	Home Speaker	is a speaker system for playing music or audio in your home.	
24	LCD Display	is a screen that uses liquid crystals to display information, like those found on digital devices.	
25	Light	is a source of illumination used for visibility and creating ambiance.	
26	A Coffee	Maker is a machine that brews coffee.	

27	A Ceiling Fan	is a fan mounted on the ceiling to circulate air and regulate room temperature.	
28	3 Windows Openings	in walls that allow light and air to enter buildings, often equipped with glass for visibility.	
29	A Lawn Sprinkler	is a device for watering lawns and gardens	
30	A Garage Door	is a large door that opens and closes to allow vehicles to enter or exit a garage.	
31	Classic Car	this device serves only to produce CO2.	
32	Front Door	The main entrance to a building, typically the first point of access.	

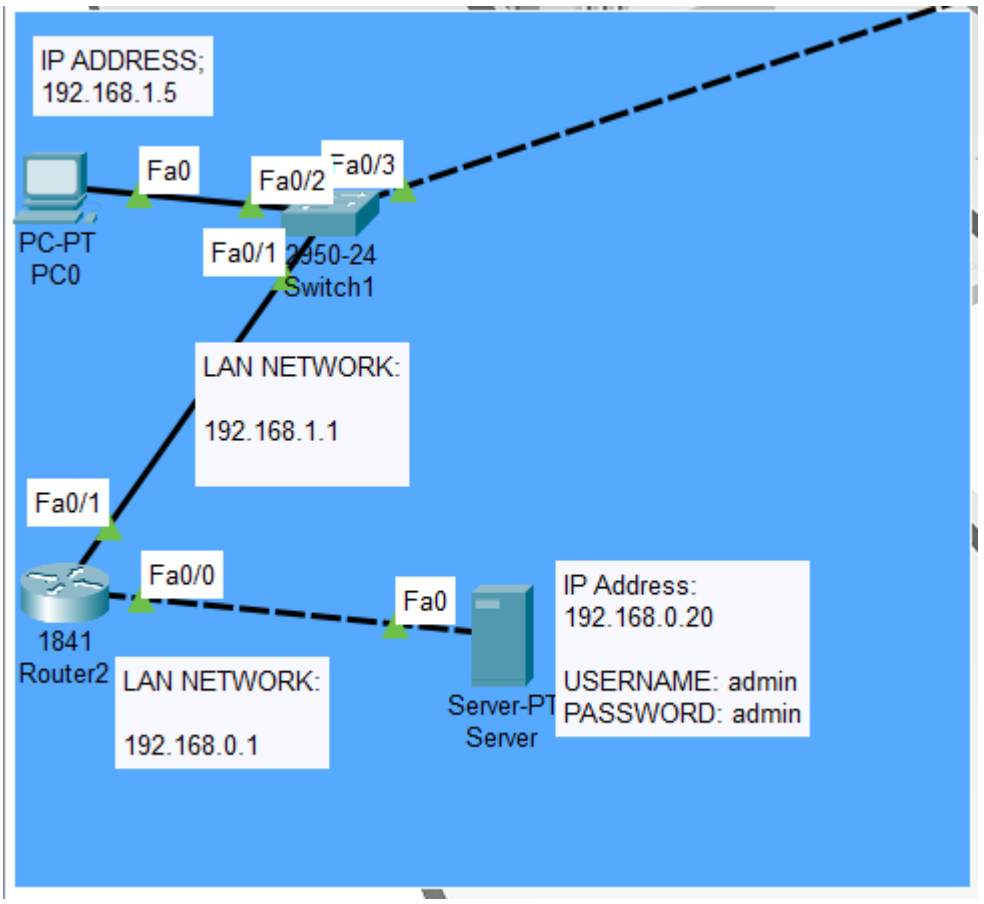
33	MCU-PT	also known as the Microcontroller Unit. is responsible for processing and managing	

2)Devices connection

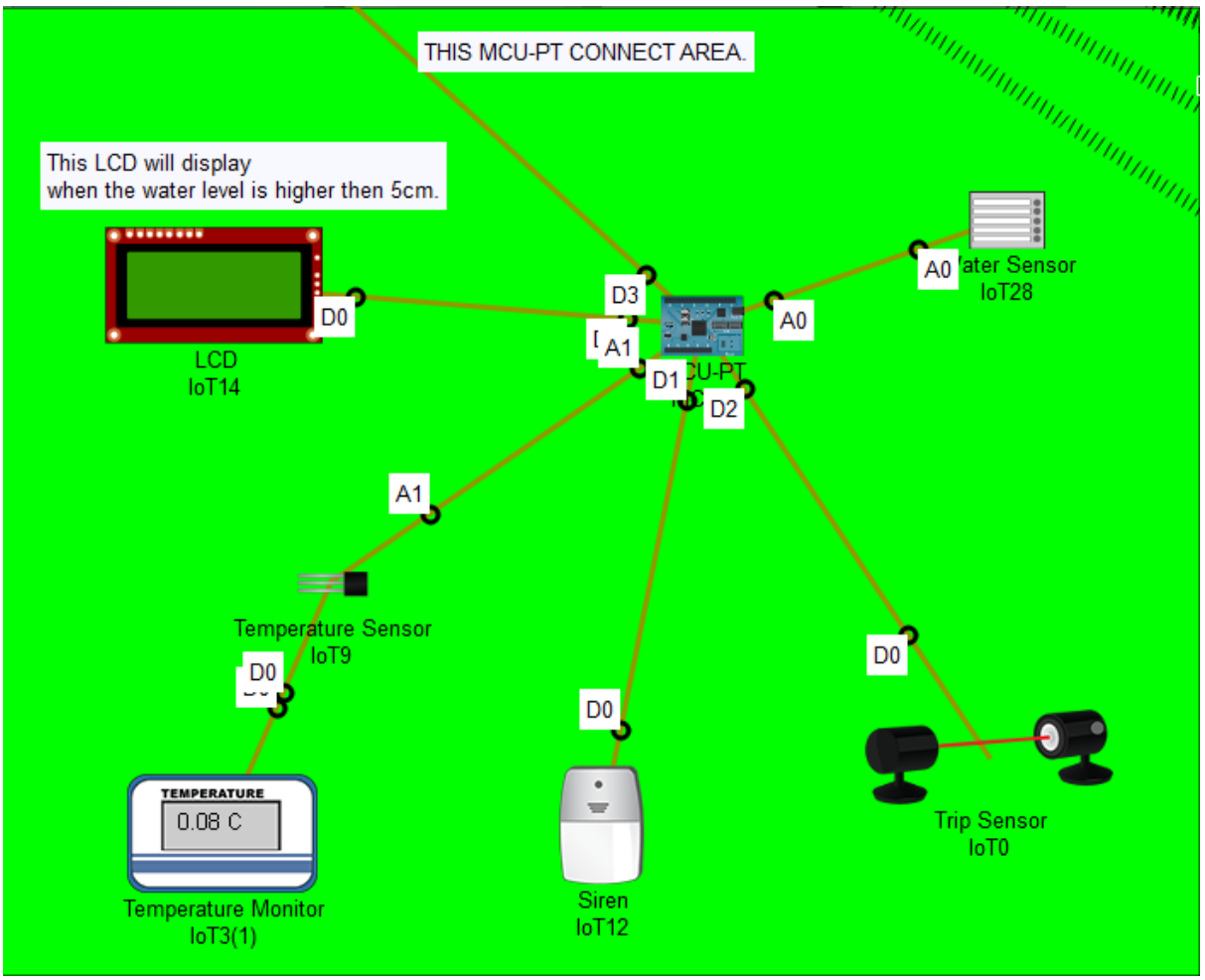
The yellow devices are wirelessly connected to the home gateway. Furthermore, the image below illustrates additional devices that have established connections with the home gateway



Additionally, the blue lines on the diagram depict the LAN network connections. Within this network, there are connections established between the PC, router, and home gateway to the switch. The switch facilitates the interconnection of the PC, router, and home gateway. The router serves as the bridge connecting the local network with external servers. This intricate connection structure can only be achieved through the utilization of the router.



Furthermore, within the green area, we find the MCU-PT, which stands for Microservices Communication Unit for IoT devices. This component plays a pivotal role in enabling communication among IoT devices. The MCU-PT is programmed to perform various essential tasks, fostering effective communication within the IoT ecosystem.



2.1) Smart Home Modelling

Network configuration:

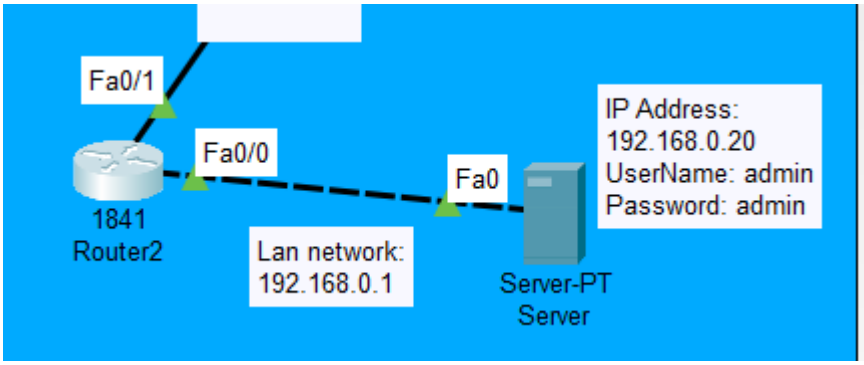
In the designated blue area, you will find the network section. I will now explain the process I followed to set up the network.

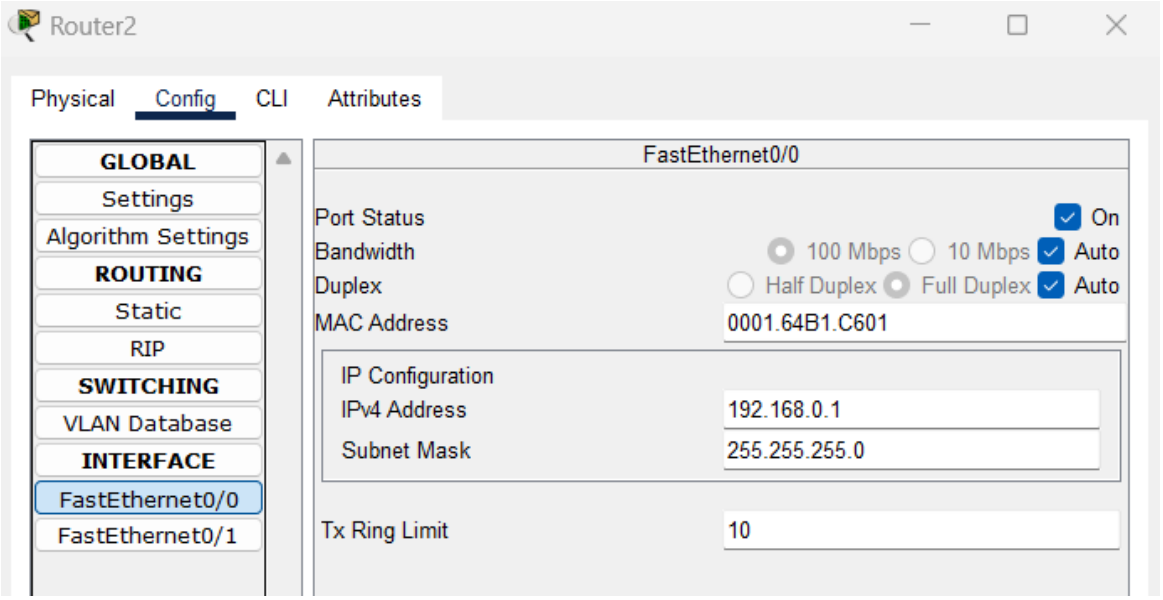
To begin, I connected all the devices using Ethernet cables. The servers were connected using copper cross-over cables, and the switch and home gateway were also connected using copper cross-over cables. For the router, switch, and PC, I used copper straight cables. All devices were connected to fast Ethernet ports.

The connection between the router and the servers was established as follows:

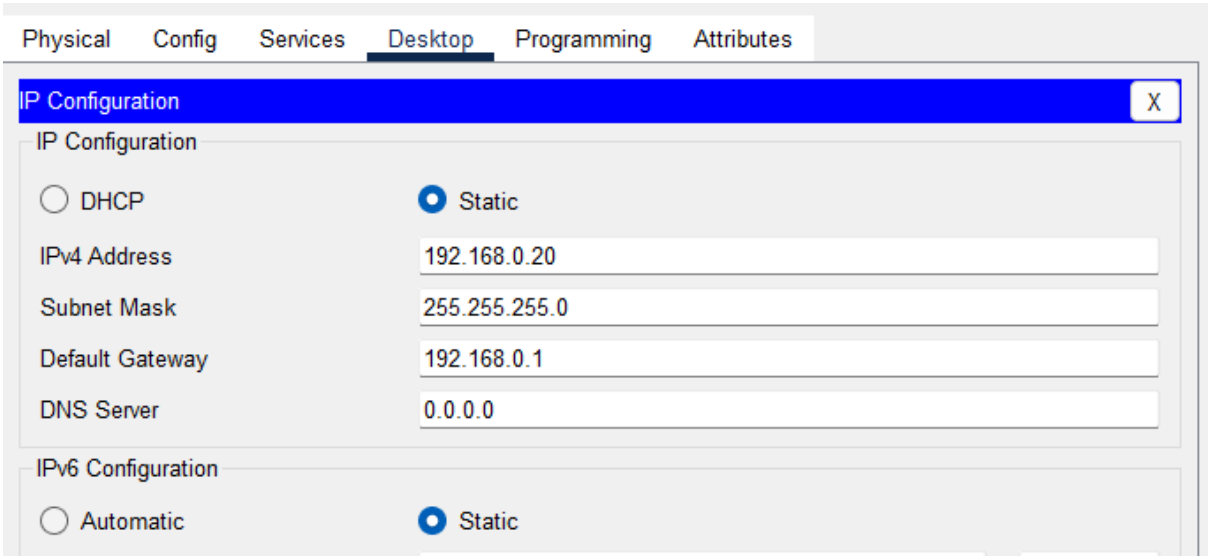
Router-to-Servers:

Furthermore, I assigned IP addresses to the network devices. In the case of the router, I accessed the interface settings, specifically the fast Ethernet0/0 port, which connects the router to the servers. The IP address assigned to this port is 192.168.0.1, as indicated below:

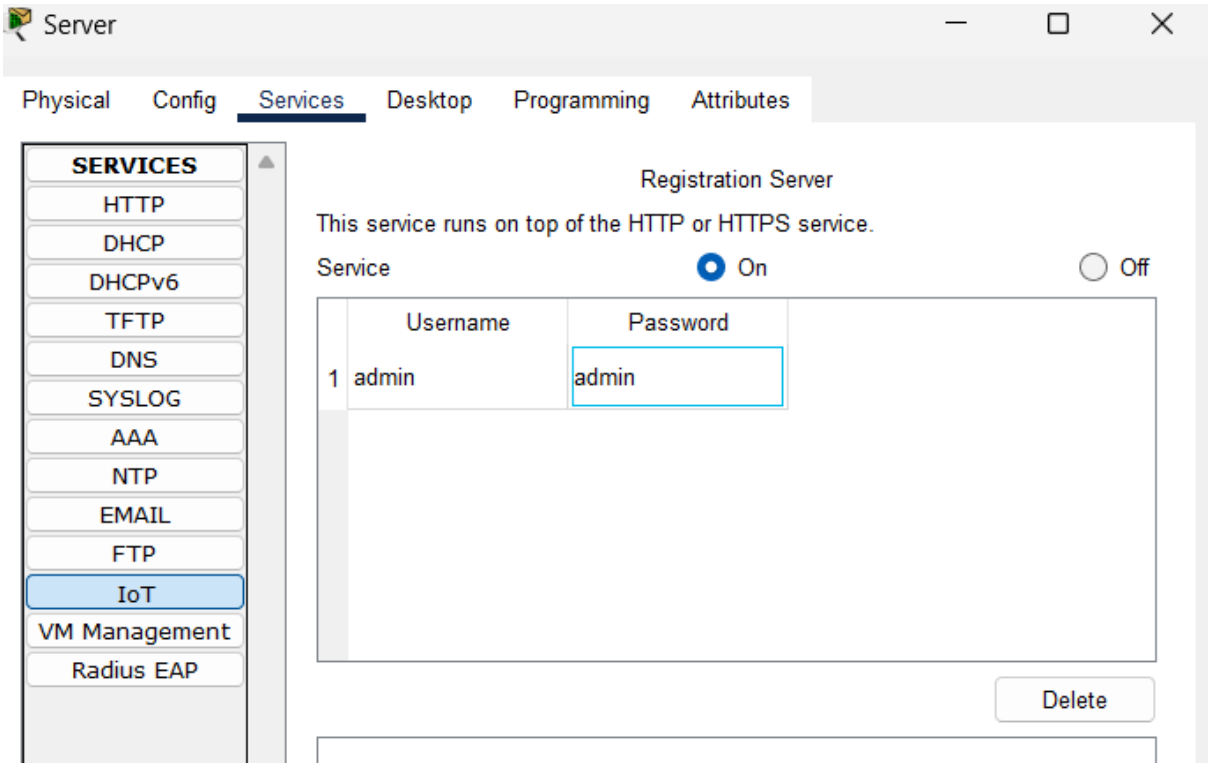




For the servers, you can configure their individual IP addresses by navigating to the IP configuration section. These addresses are specific to each server, providing them with unique identification and connectivity within the network.



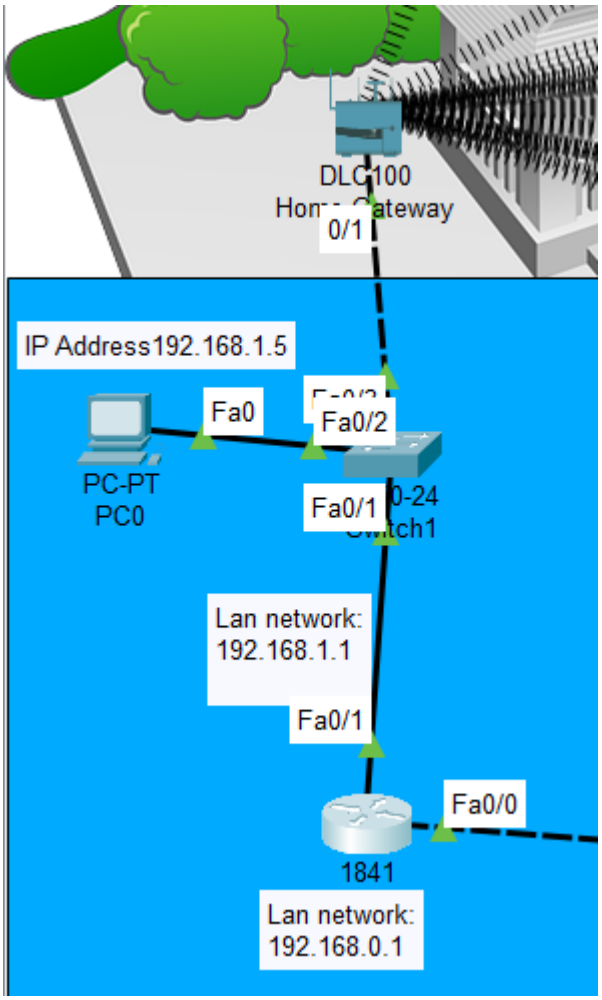
To proceed, the next step involves configuring the server to be capable of receiving data from IoT devices. This necessitates visiting the "Services" section and selecting the "IoT" option, followed by clicking to activate it. With this action, the server becomes ready to accept incoming data from the IoT devices.

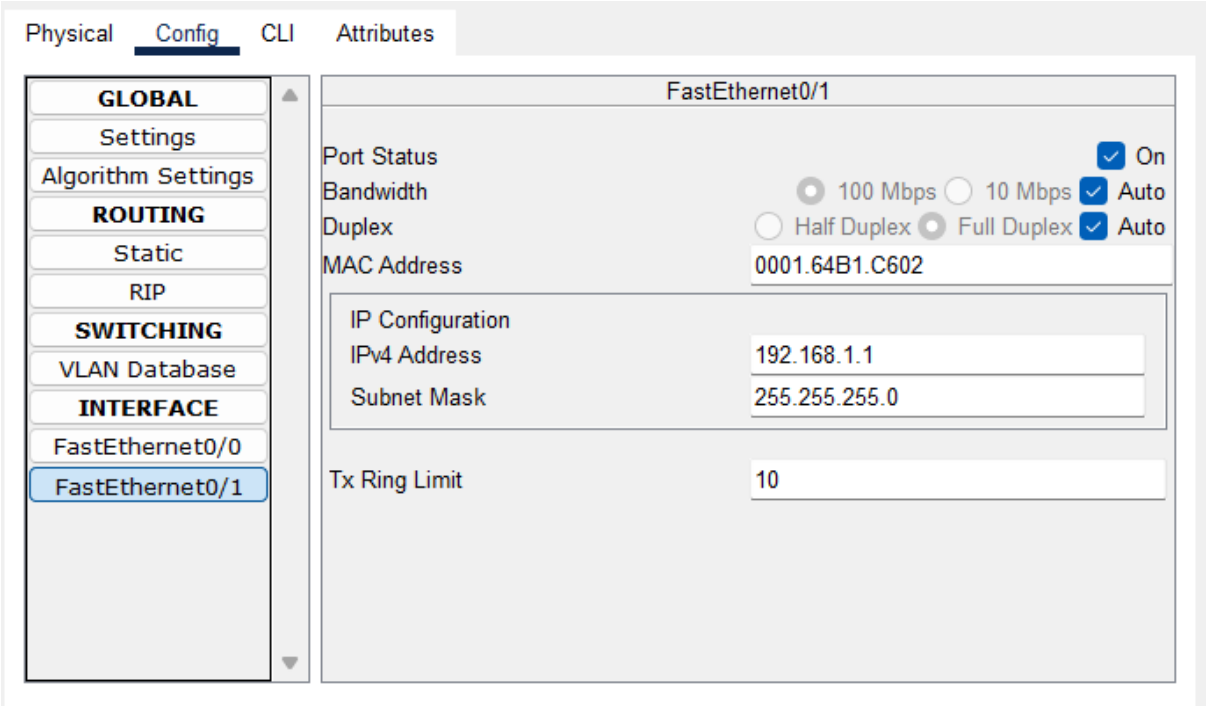


Additionally, in the next phase of the process, you are required to establish the username and password for server access. If this is your initial setup, you must navigate to the server's IP address, which is 192.168.0.20. There, you will be prompted to create the necessary login credentials. Following the creation of these credentials, you will have the ability to securely store data from IoT devices using this information.

Router-to-PC-Switch-Home Gateway:

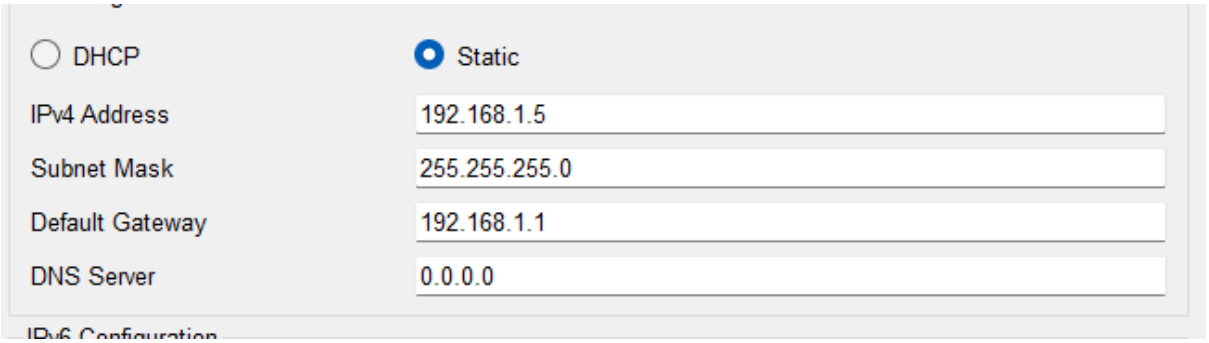
The procedure followed for the router-to-servers connection was replicated with the router-to-PC-Switch-Home Gateway connection. In this instance, the configuration involved the FastEthernet0/1 port on the router, with an assigned IP address of 192.168.1.1. This IP address serves as the gateway for the connected devices within this network segment.





With the assignment of an IP address to that port, we can now establish connectivity for devices that have designated this IP address as their default gateway with the router.

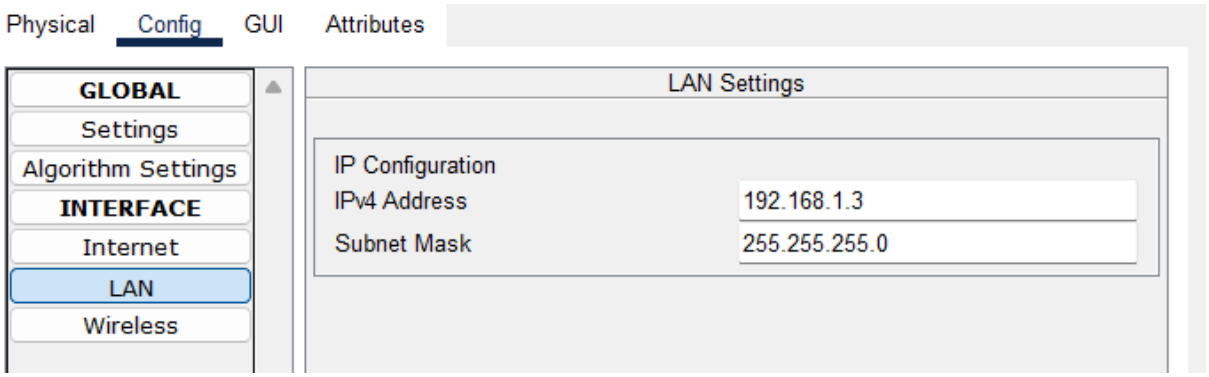
If we connect the PC to the switch and the home gateway to the router, with the switch also connected to the router, the switch will primarily serve as a data transporter, ensuring efficient data flow between devices. To configure the PC, access the PC configuration section and choose the IP configuration option. Below is the PC configuration settings:



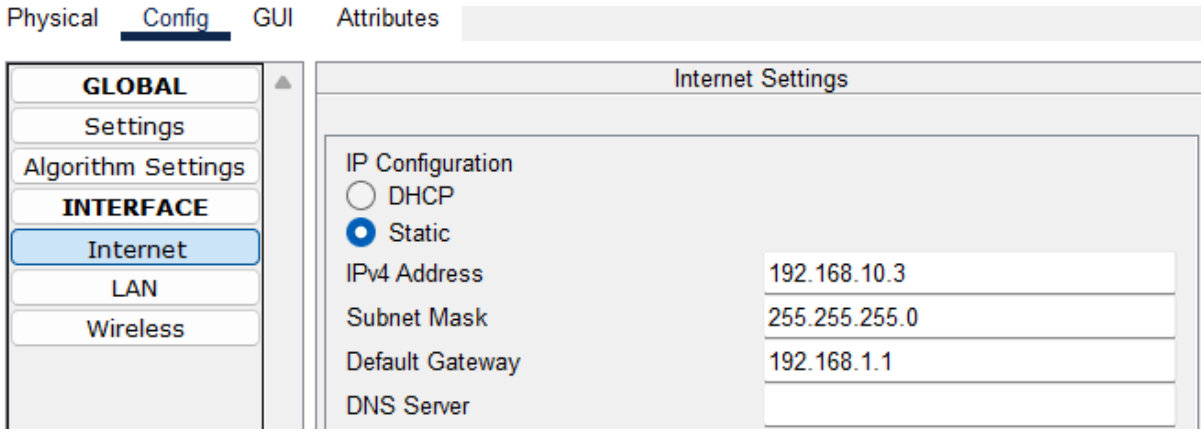
Additionally, there's a distinct configuration for the home gateway. The home gateway operates within its own network, specifically designed for IoT devices to connect to it. However, when other IoT devices wish to communicate with the server, they need to go through the home gateway.

Home Gateway to IoT devices:

Within the home gateway, there is a dedicated configuration section, appropriately labeled as "config," where you can manage and customize the settings for this network segment.

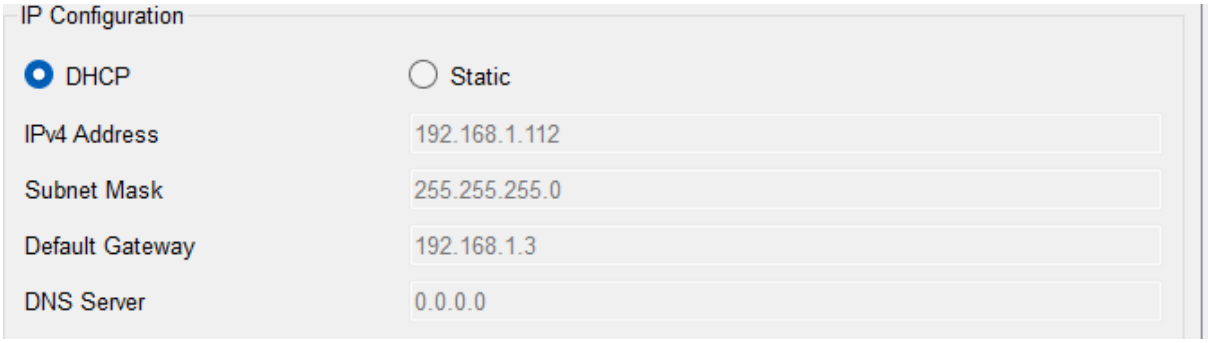


Furthermore, the "Interface LAN" section is where we configure the IP address for the home gateway. This particular IP address is crucial for facilitating communication between the home gateway and the router.



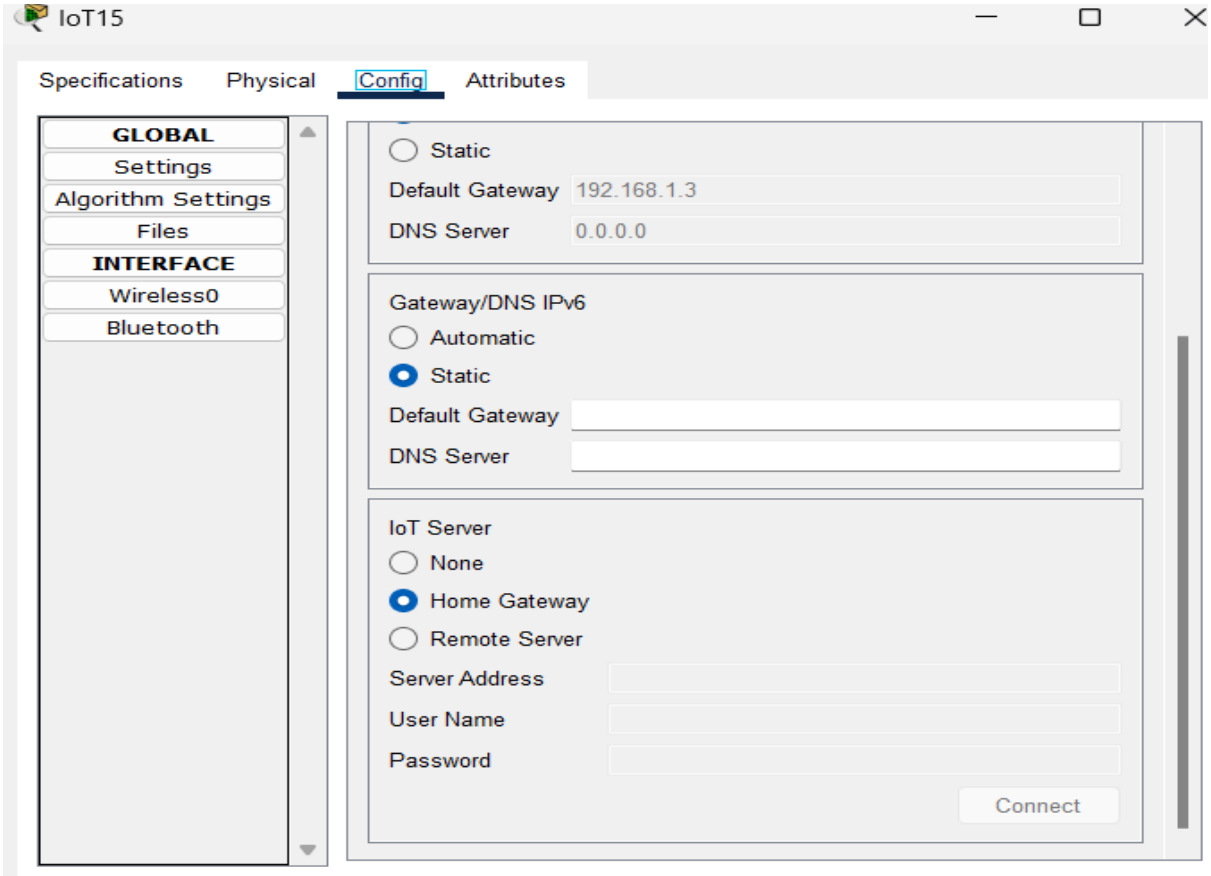
For all devices, including IoT devices and laptops, it's essential to designate the home gateway's IP address within the LAN, which is typically set as 192.168.1.3, as their default gateway. This is done because all of these devices operate within the same network alongside the home gateway. By using the home gateway as their default gateway, these devices can effectively communicate and function within this network.

This is the laptop IP configuration.

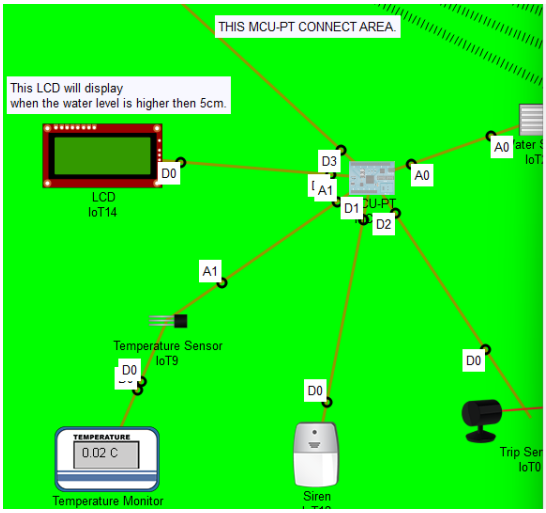


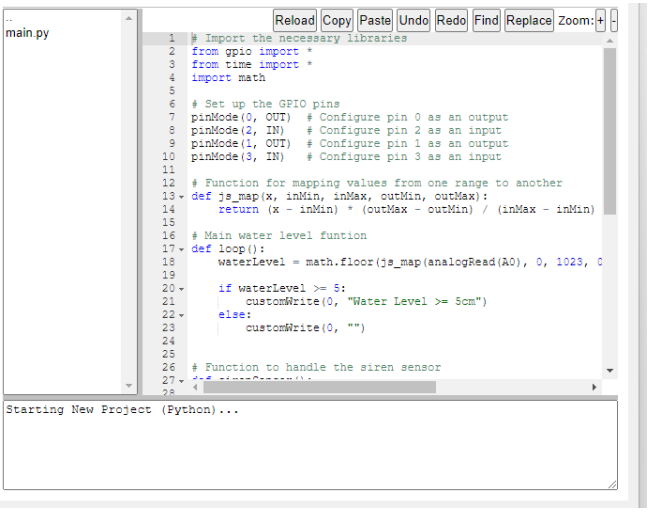
Furthermore, to save data from IoT devices to either the home gateway or the server, proceed as follows: Start by accessing the IoT devices, then select the specific device. Following this, proceed to the configuration settings and scroll down the options. Here, you will encounter the "IoT Server" configuration.

At this juncture, you will be presented with a choice between connecting to either the home gateway or the server. If you opt for the server, you will need to input the server's IP address, along with the associated username and password, to establish the connection.



MCU-PT Development:





Connection Setup:

The MCU-PT (Microservices Communication Unit for IoT devices) facilitates connections to various IoT devices: water sensor, LCD display, temperature sensor, siren, and trip sensor. IoT devices connect to the MCU-PT through custom IoT cables, which are then plugged into dedicated ports. The MCU-PT is versatile, accepting both analog and digital inputs, allowing for programming flexibility.

Water Sensor to LCD: The water sensor monitors lawn sprinkler activity and water level. If the water level surpasses 5cm, the LCD display reflects this.

Temperature Sensor: The temperature sensor obtains temperature readings from a thermostat.

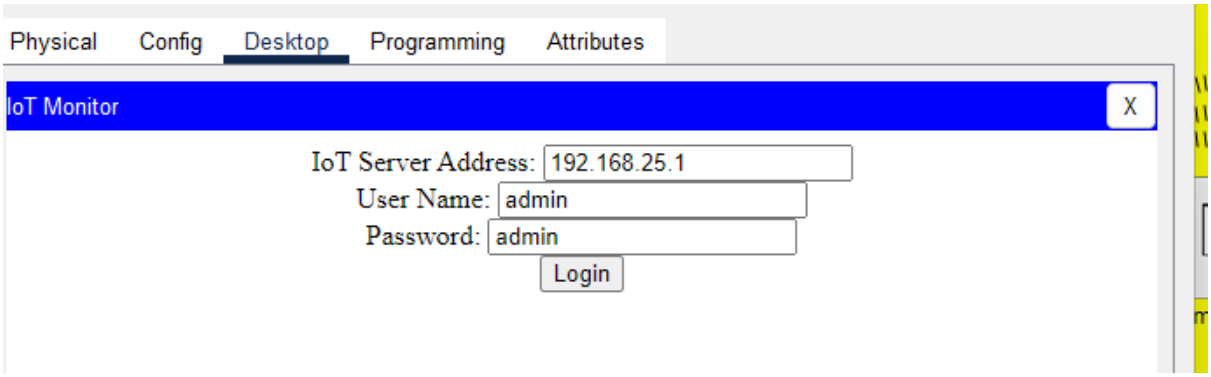
Trip Sensor to Siren: The trip sensor and siren are MCU-connected.Whenever the trip sensor detects an event, it activates the siren in response.

3)scenarios

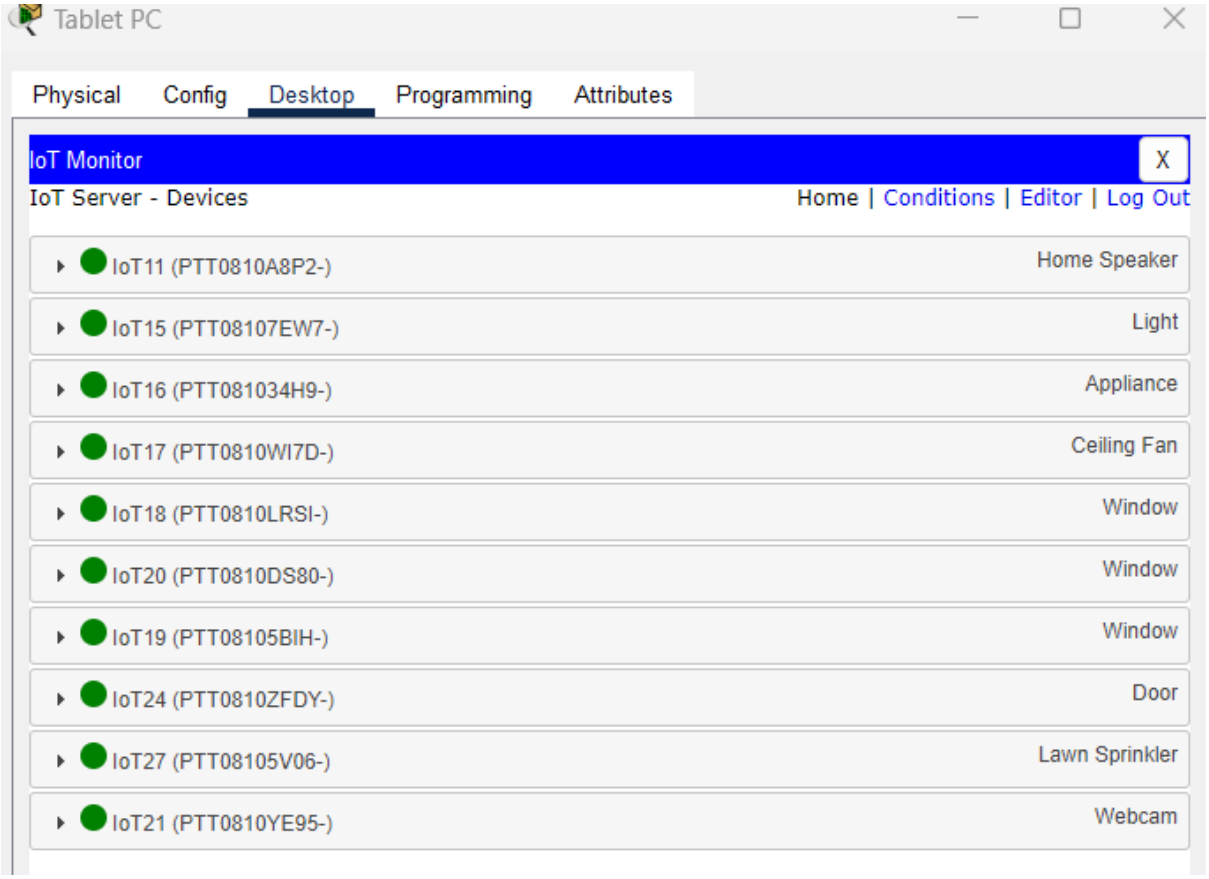
S1:

To proceed, the initial step entails accessing the end-user devices, which encompass personal computers, smartphones, laptops, and tablets. Once on these devices, navigate to the desktop section and scroll downwards. Within this section, locate and select the 'IoT Monitor' application.

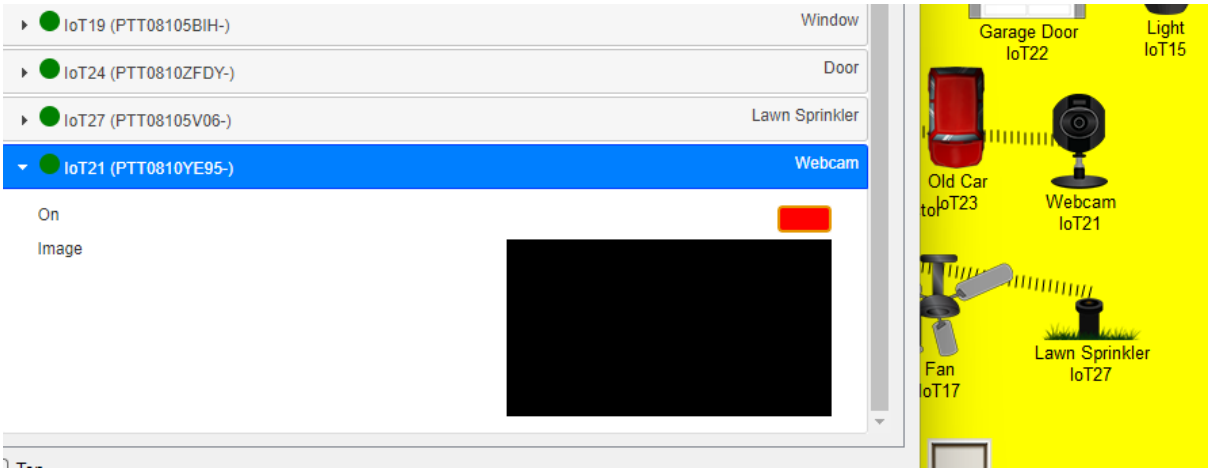
Upon clicking the 'IoT Monitor' application, you will be directed to the following interface. In this interface, it is imperative to input the IP address associated with the home gateway, alongside the requisite user credentials which consist of a username and a password.

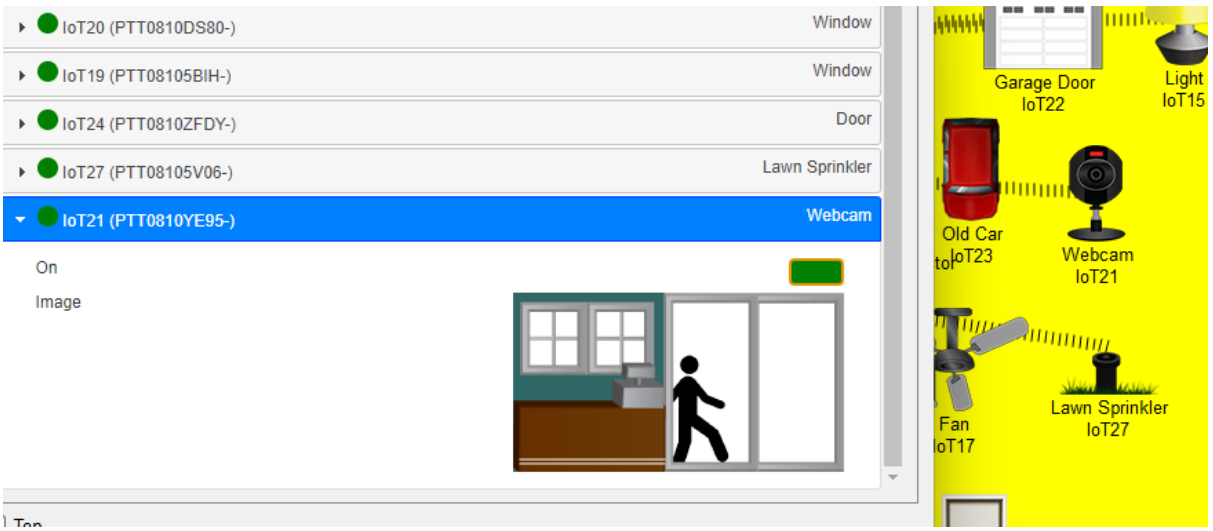


Upon correctly inputting the required information, the result will be displayed on the following screen. This screen provides a comprehensive overview of all the devices currently connected to the home gateway.



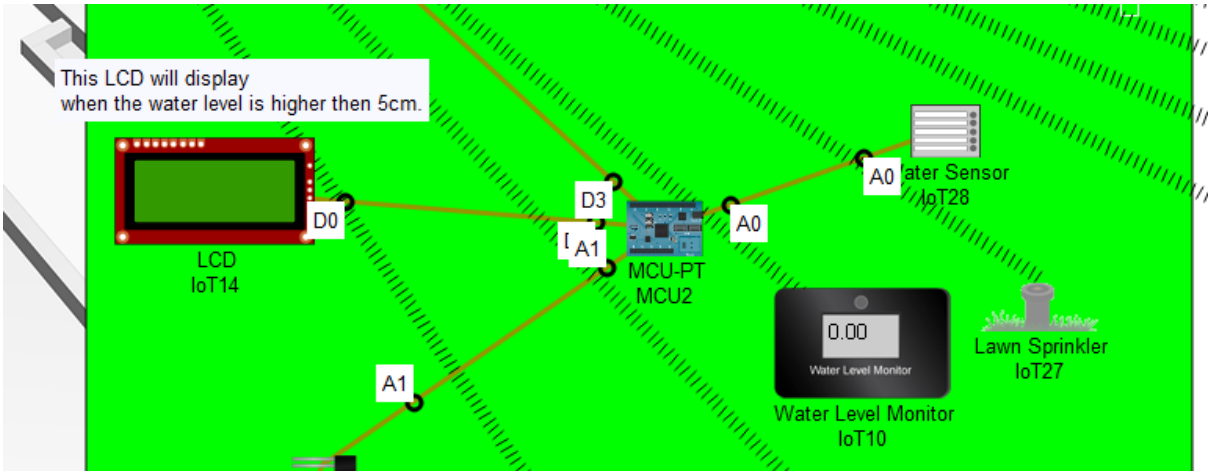
The monitoring interface offers the capability to control IoT devices directly through the connected computer. To illustrate, one can initiate the activation of a webcam, with the initial image depicting the devices in their powered-off state, followed by the subsequent image demonstrating the devices in their powered-on configuration.



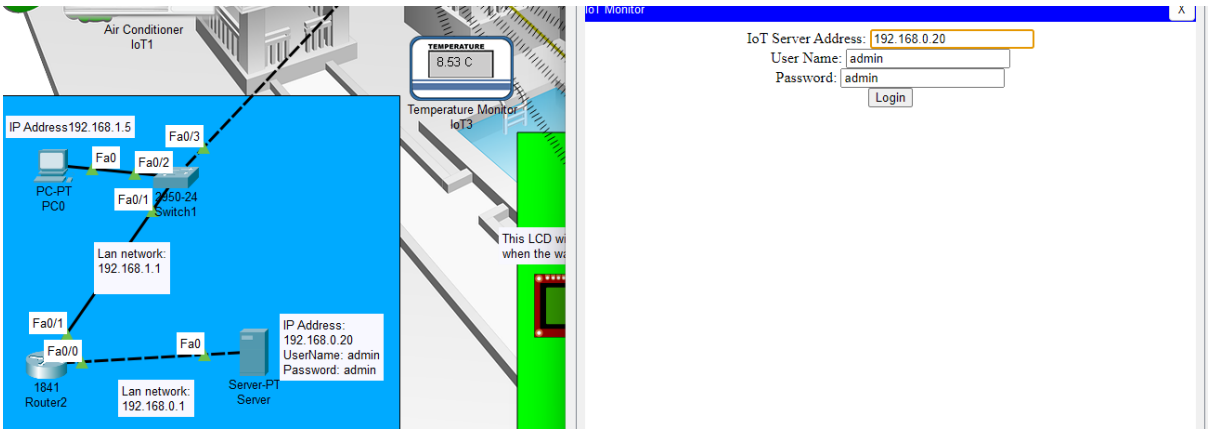


S2:

When the sprinkler turns on the sensor, the water sensor will catch the level of the water and turn on the LCD when the level is higher than 5 cm. The Water level will send the report to the service.

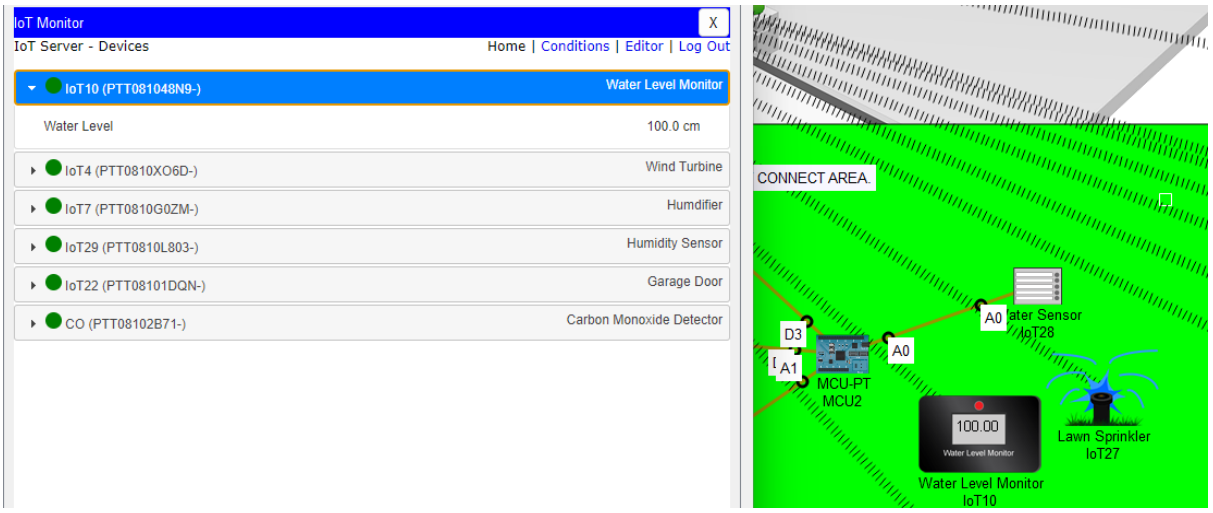


This is the service Ip address:

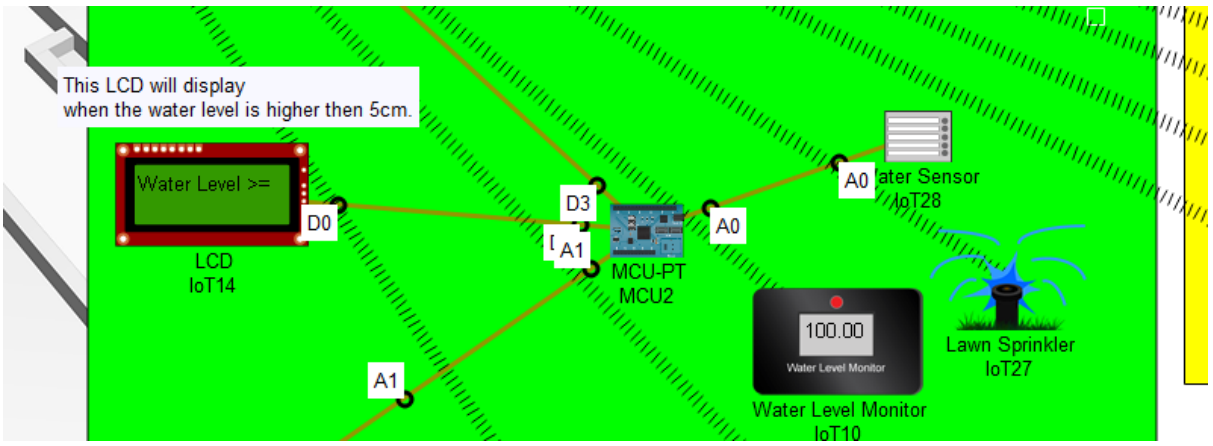


The Sprinkler is turned off:

Turned on:



The LCD will display when the level is higher then 5cm:

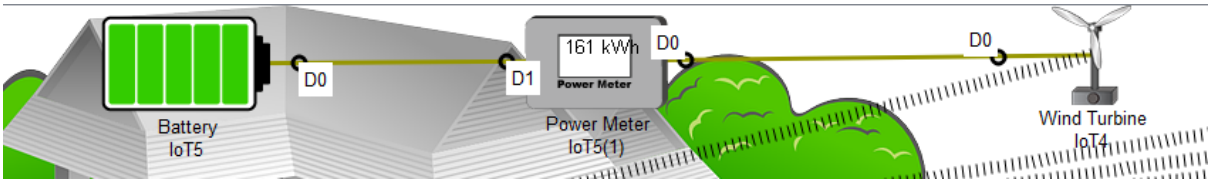


The code for water to be turned on is:

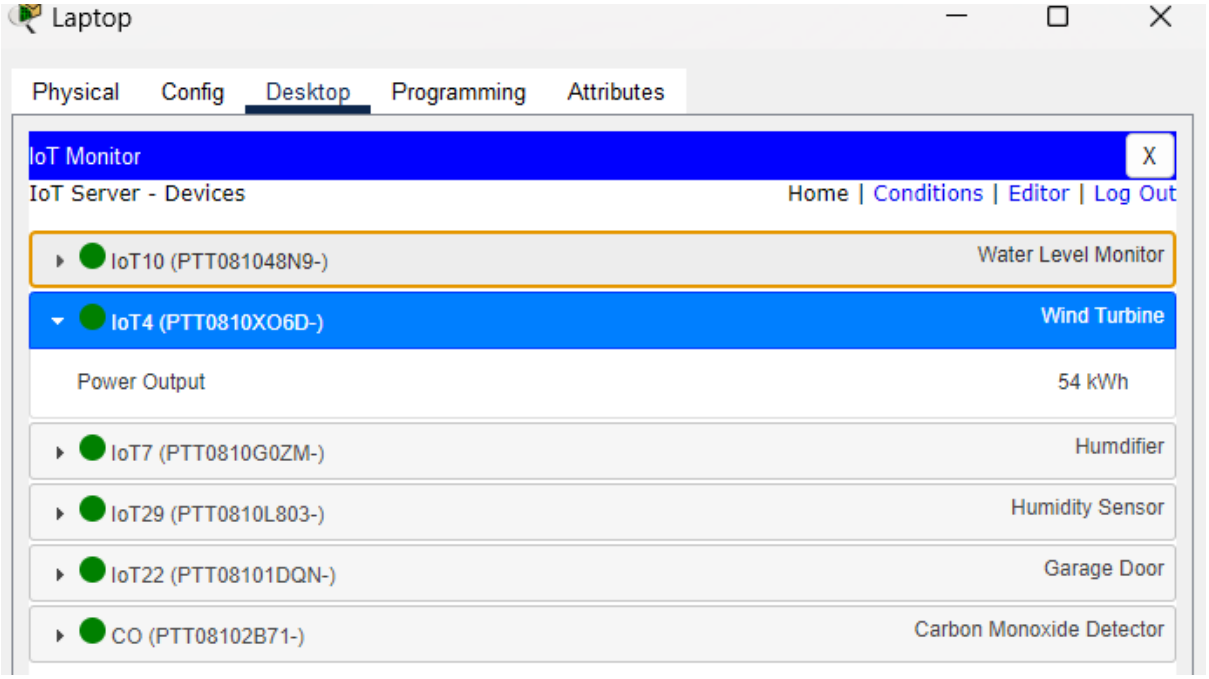
```
# Import the necessary libraries
from gpio import *
from time import *
import math

# Set up the GPIO pins
pinMode(0, OUT)  # Configure pin 0 as an output
pinMode(2, IN)   # Configure pin 2 as an input
pinMode(1, OUT)  # Configure pin 1 as an output
pinMode(3, IN)   # Configure pin 3 as an input

# Function for mapping values from one range to another
def js_map(x, inMin, inMax, outMin, outMax):
    return (x - inMin) * (outMax - outMin) / (inMax - inMin) + outMin

# Main water level funtion
def loop():
    waterLevel = math.floor(js_map(analogRead(A0), 0, 1023, 0, 20) + 0.5)  # Water level measurement

    if waterLevel >= 5:
        customWrite(0, "Water Level >= 5cm")
    else:
        customWrite(0, "")
```

S3:

On the turbine, I used as the power meter. I help the user to see the power being out put by a wind turbine to the battery.

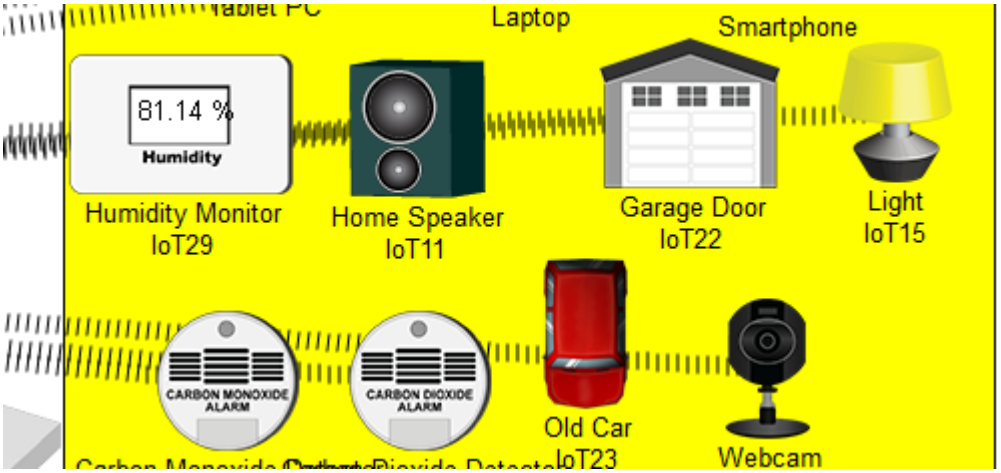


This is the service IoT devices accessed by the laptop. In the services, it is possible to see the wind turbine power output.

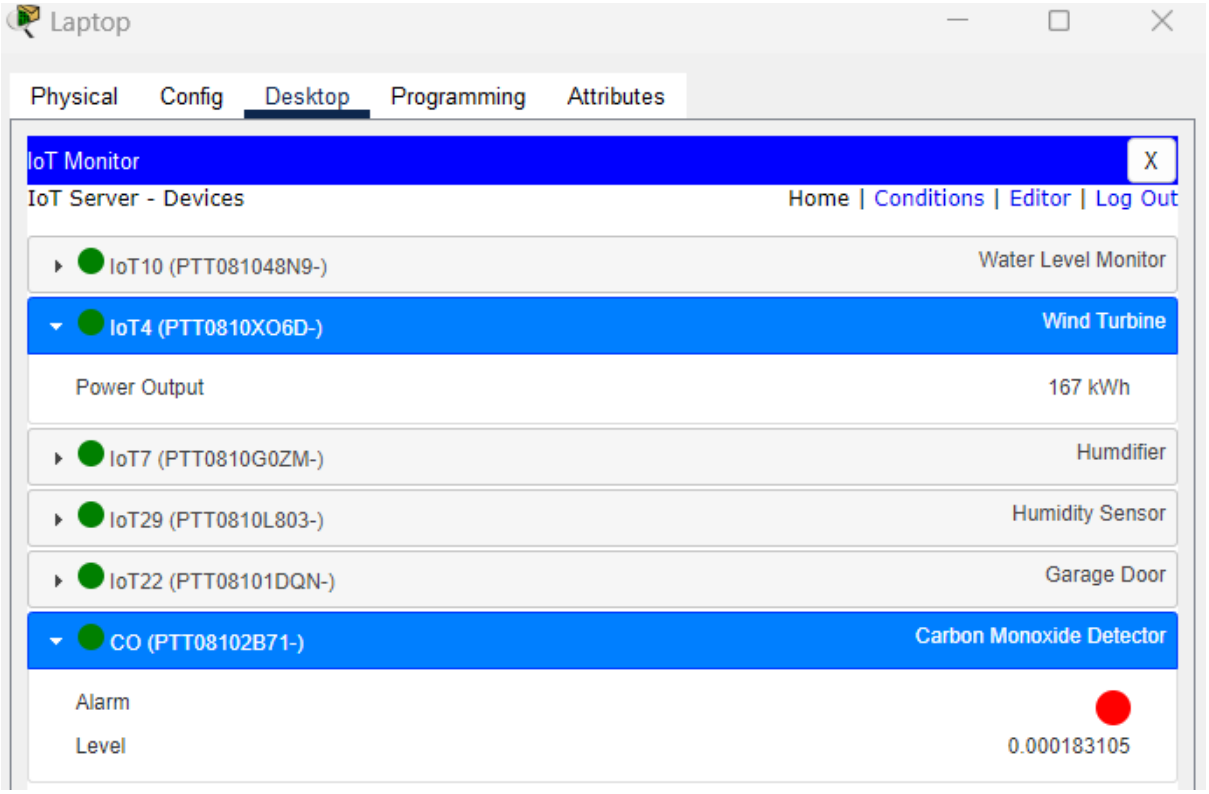


S4:

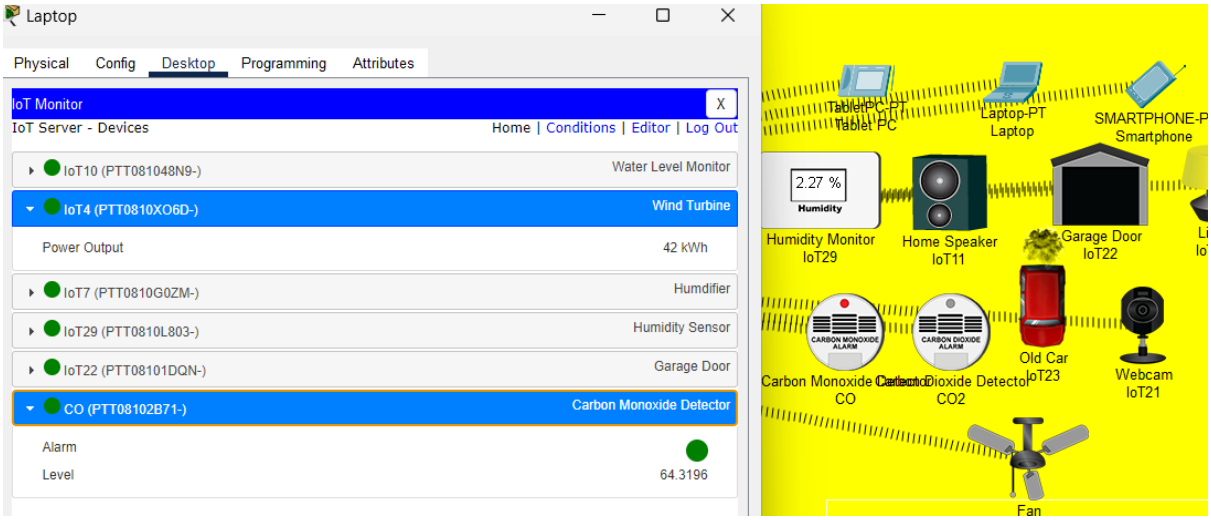
In this activity. The garage door has to open when the CO is higher than 60%. The system is controlled by the server.



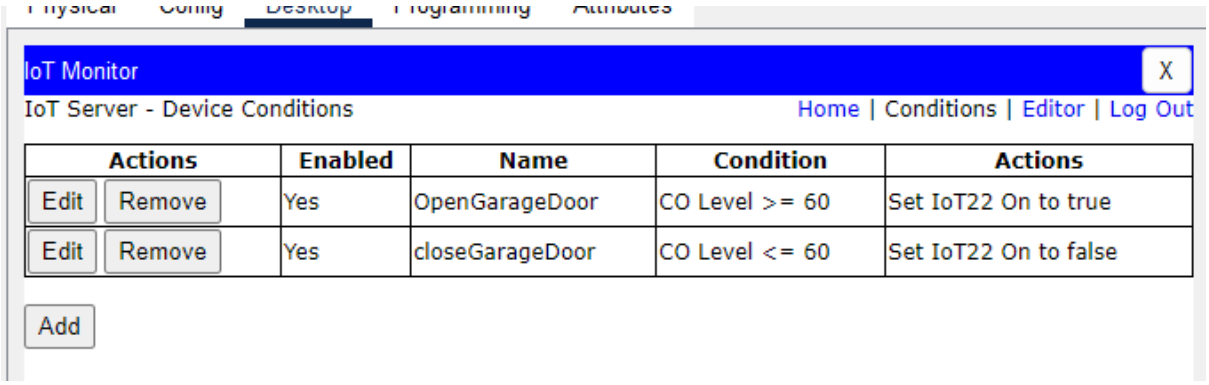
In serves the level of CO without starting the car:



After starting the car. The door will open when the level is higher than 60% and the CO is displayed a light red.

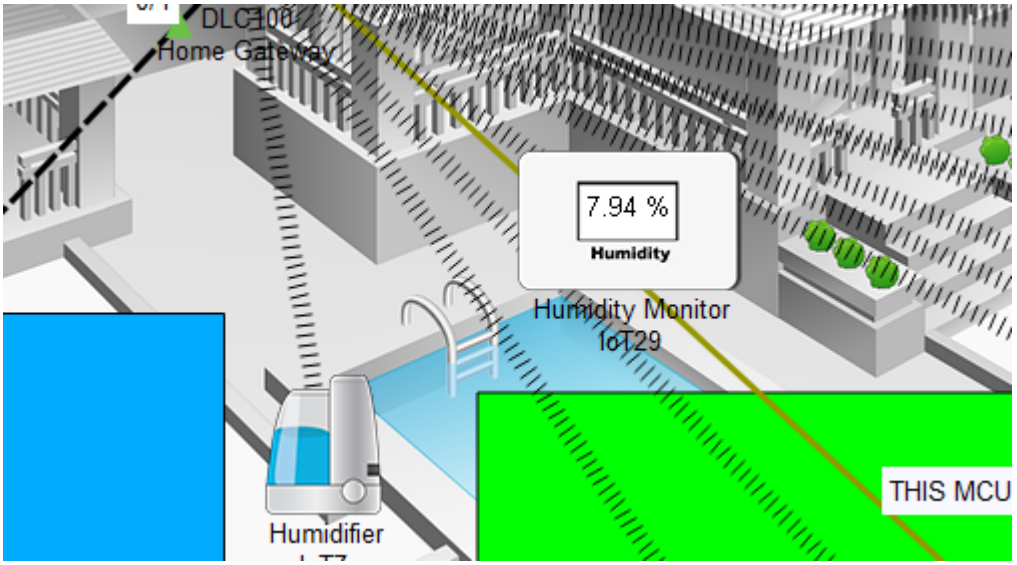


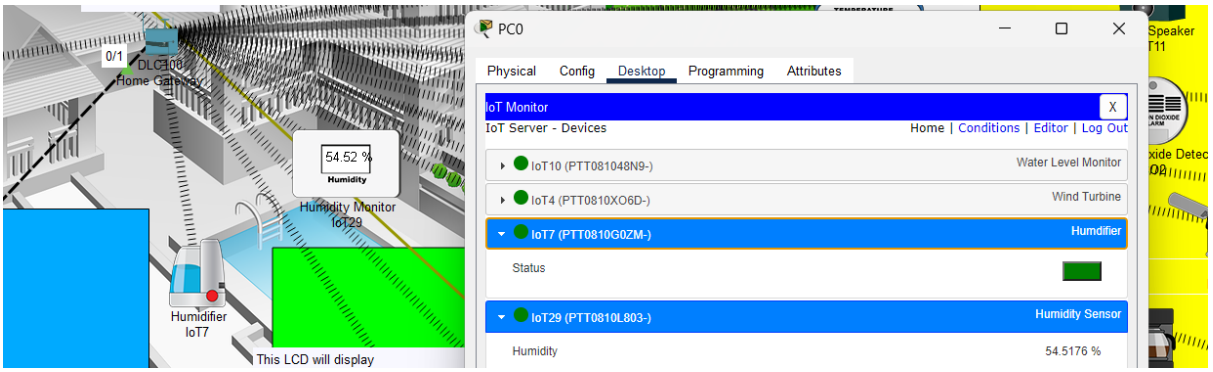
There is the conditions that are present in the server system that allowed us to make this system:



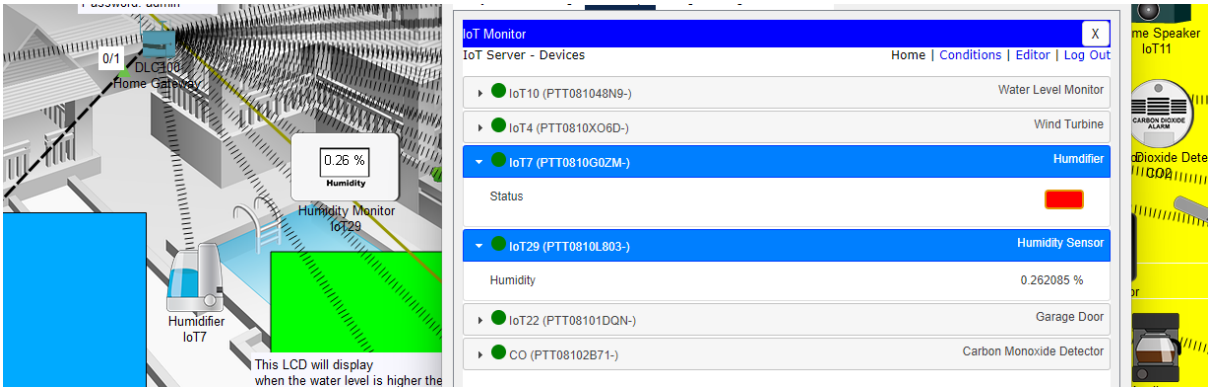
S5:

In this Activity when the humidifier is turned on the humidity monitor will increase. So the user will use the PC to log in to the servicer and see the humidity level.



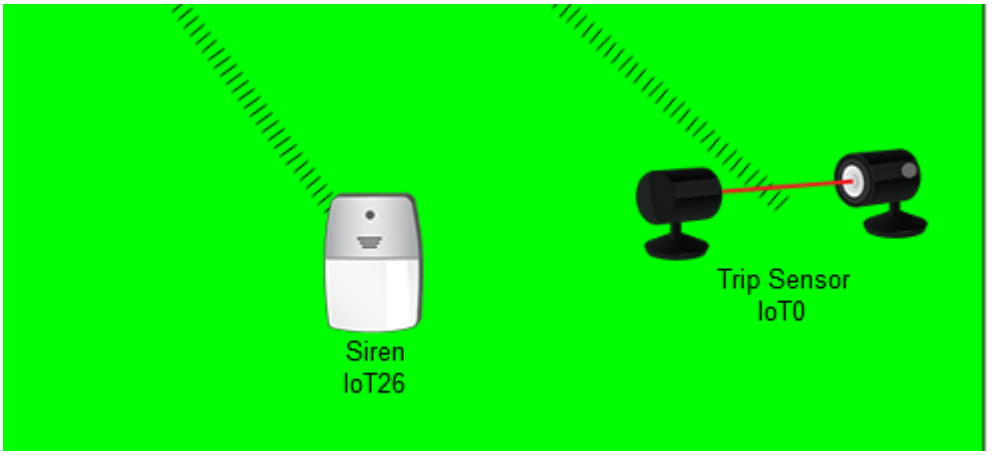


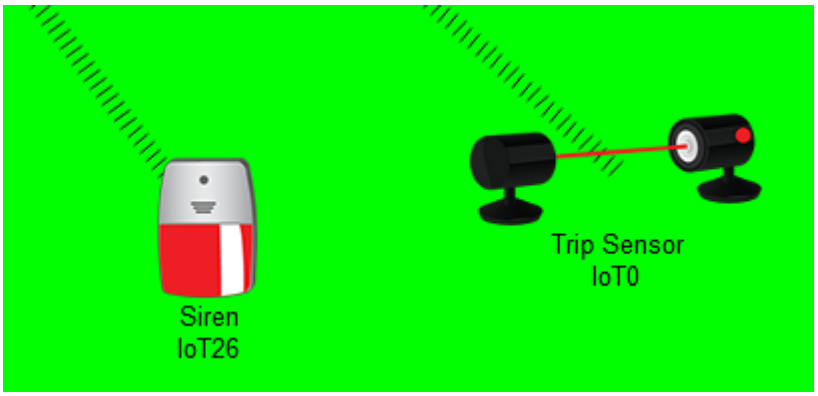
After turning off the humidifier:



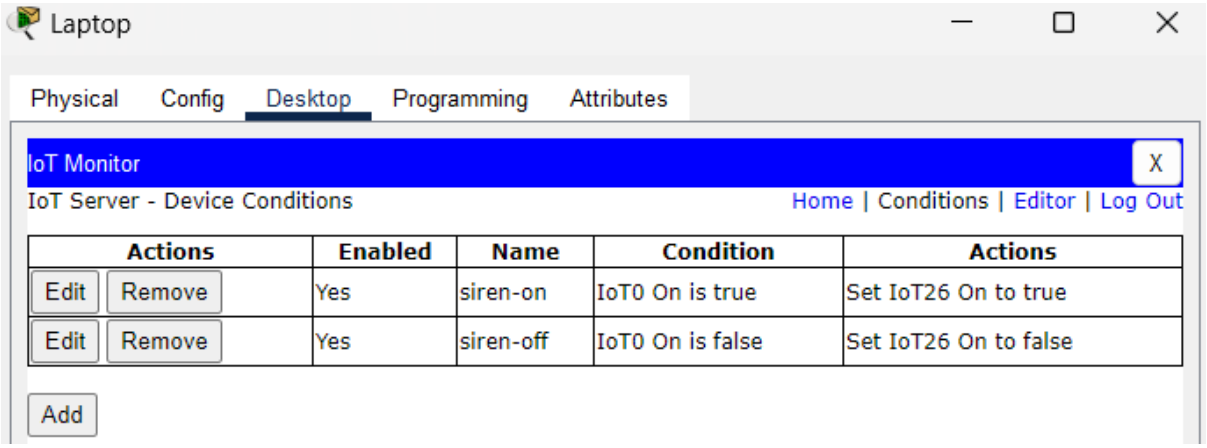
S6:

In this activity when the trip sensor is turned on the siren will activate automatically. However, to the system work, they are connected to the home gateway. With the conditions.



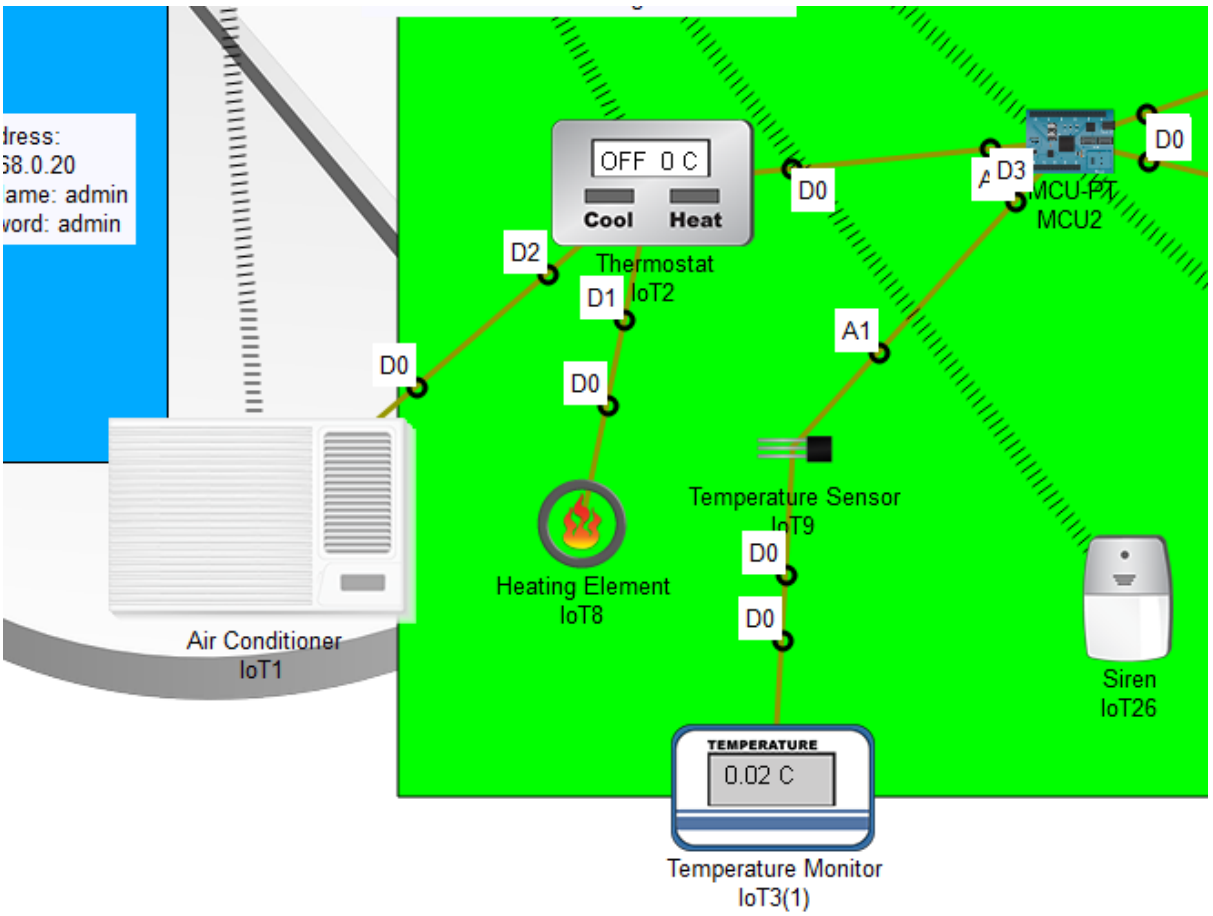


These are the conditions:

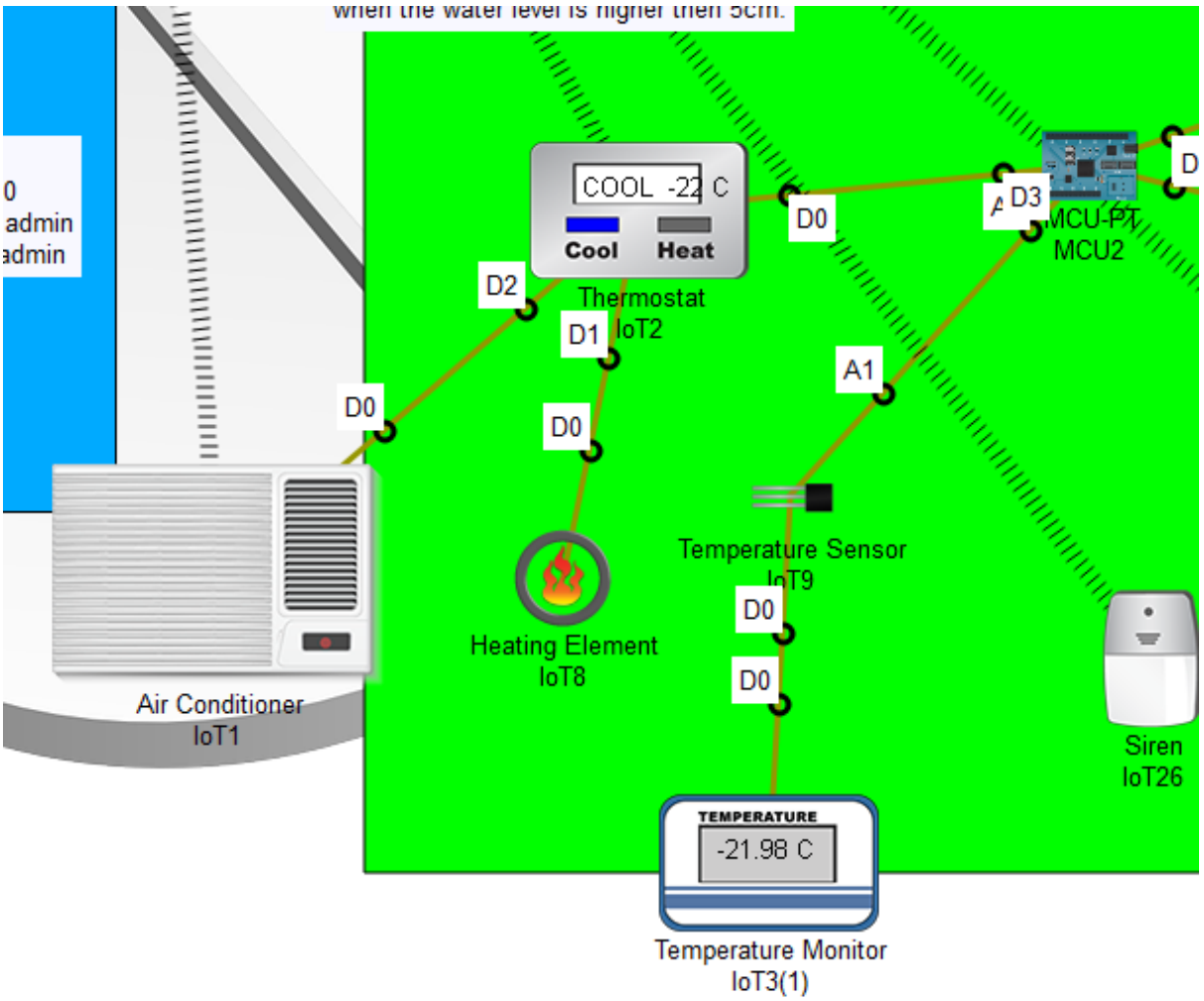


S7:

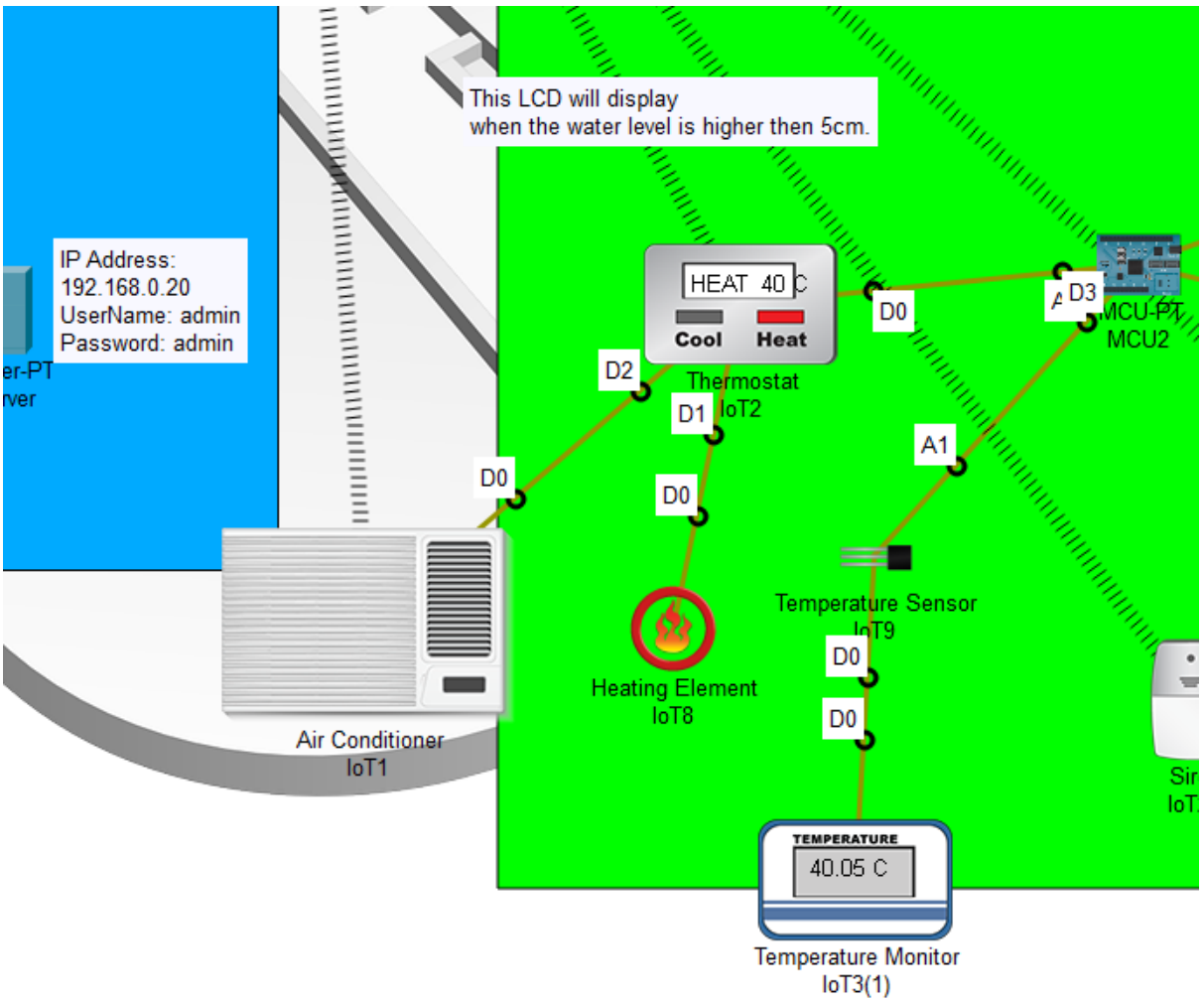
In this procedure, the thermostat will receive input signals from the air conditioner or heating element. Subsequently, it will transmit this data to the Microcontroller Unit (MCU), which will then forward it to a temperature sensor for monitoring. I have incorporated the temperature monitoring feature to enhance the user's visibility of the temperature conditions.



When the cold this turn on:



When the heating element is turned on:



This is the code that connects the thermostat to the temperature Sensor.

```
26
27  # Function to handle the temperature sensor
28  def temperatureSensor():
29      value = digitalRead(3)
30      analogWrite(1, value)
31
32  # Main program execution
```

Conclusion

In conclusion, this programming assignment has been a valuable learning experience. I have gained practical knowledge in connecting various IoT devices, which enabled me to create a functional IoT-enabled home. Through this project, I have come to appreciate the significance of IoT devices in enhancing our daily lives, making them more convenient and efficient. Additionally, I had the opportunity to utilize microcontrollers (MCUs) to code and control these devices. This hands-on experience not only deepened my understanding of IoT but also equipped me with valuable skills for future endeavors in this field. Reflecting on this assignment, I recognize the potential and relevance of IoT technology in our increasingly interconnected world.

Reference

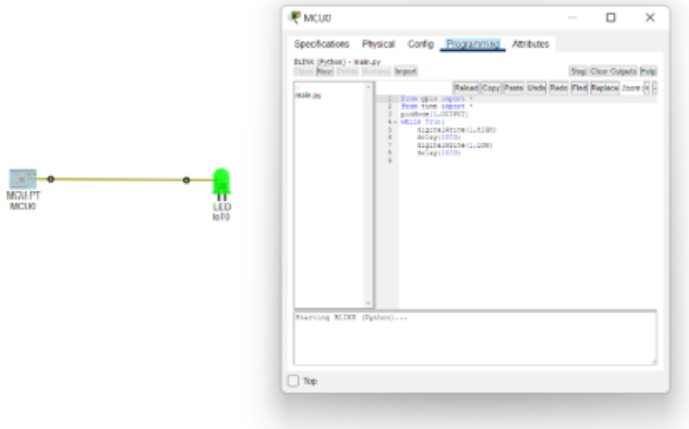
www.youtube.com. (n.d.). *[IoT] How to design a smart home on packet tracer - part 1*. [online] Available at: https://www.youtube.com/watch?v=DImMM-AgiQ4 [Accessed 5 Nov. 2023].

Appendix: Samples From my Logbook

During the **Week 3** workshop, the assignment was to create a blinking LED using a Python script. The components utilized included a single microcontroller and an LED. The LED was connected to the microcontroller via a cable.

The code entered into the microcontroller was as follows:

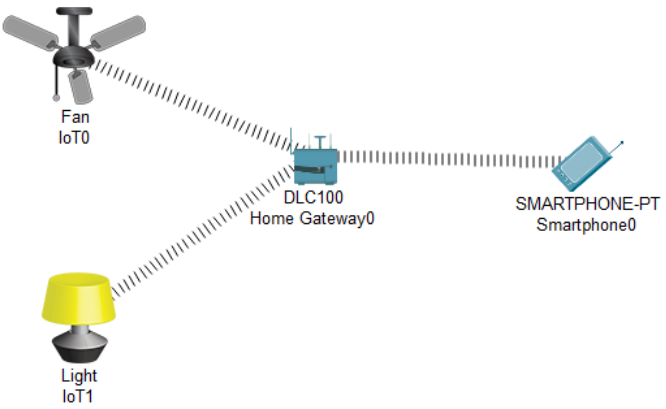
```
from gpio import *

from time import *

pinMode(1,OUTPUT)

while True:

    digitalWrite(1,HIGH)

    delay(1000)

    digitalWrite(1,LOW)

    delay(1000)
```

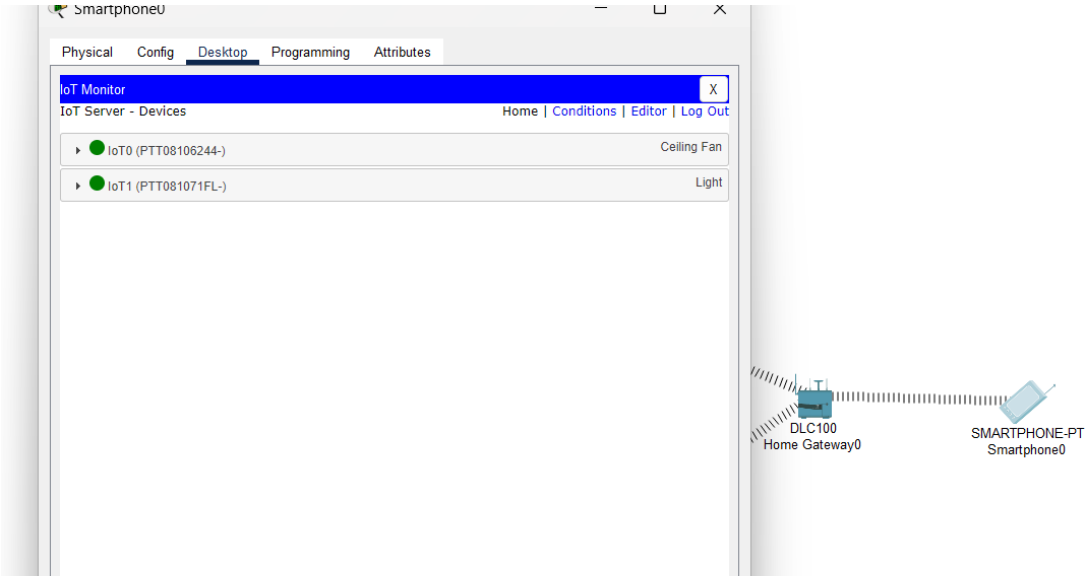


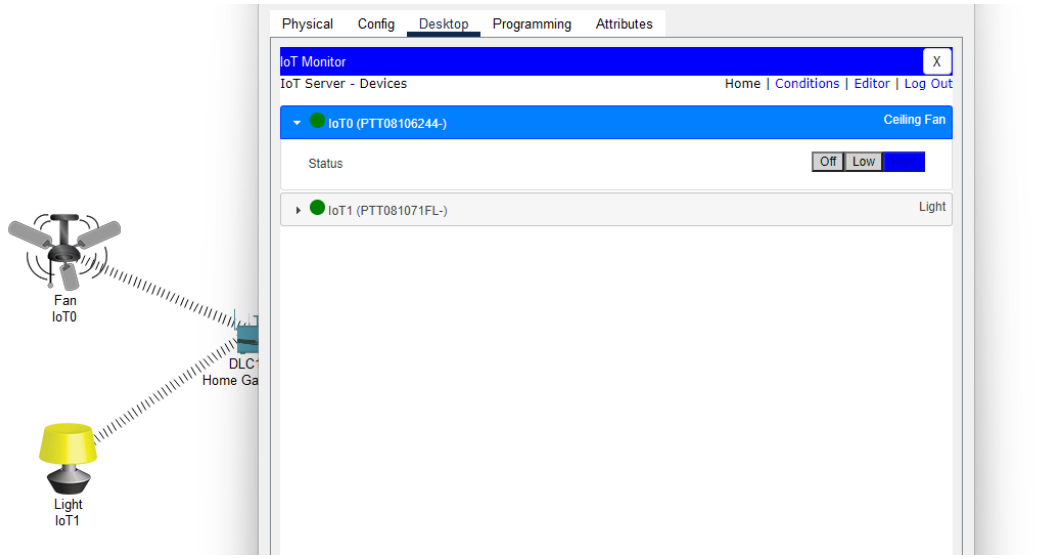
In the context of the **Week 5** workshop, the task at hand involved the capability to remotely control both the fan and the lighting system via a smartphone using a Home Gateway. The procedure encompassed the following steps:

Initially, the Home Gateway needed to acquire an IP address and default gateway settings after specifying an SSD (Service Set Identifier) name. Subsequently, the fan and the lighting system were linked to the Home Gateway using the designated SSD name.

Ultimately, the smartphone was integrated with the Home Gateway, establishing connectivity through the same SSD name. This facilitated access to the "Devices" section on the smartphone's interface, where the "IoT Monitor and Logging" feature could be found, allowing for the remote management of IoT devices.







During the activities of **Week 6**, the workshop entailed the creation of an intelligent room. This room incorporates a collection of Internet of Things (IoT) devices. The ensuing content elucidates the configuration and operational attributes of the smart room, encompassing a diverse array of intelligent devices. The salient details encompass:

1. The smart room is endowed with an assortment of intelligent devices, including:
   - Smart Light
   - Smart Fan
   - Smart Coffee Maker
   - Smart Air Cooler
   - Smart Heating Element
   - Thermostat

2. Upon the activation of the power button:
   - The lamp radiates light.
   - The coffee maker commences the coffee brewing process.
   - The temperature sensor initiates the monitoring of the room's ambient temperature:
     - If the room temperature falls within the standard range (between 15 and 18 degrees), the fan is triggered into operation.
     - In the event of a cooler room temperature (below 15 degrees), the fan is deactivated, the air cooler ceases its operation (if previously engaged), and the heater is activated.
     - Conversely, when the room temperature exceeds 25 degrees, the fan remains inoperative, the air cooler is engaged, and the heater is deactivated (if previously running).

3. Upon deactivation of the power button, both the light and coffee maker are promptly switched off. The temperature sensor persists in monitoring the room's temperature and provides this data on the Temperature Monitor device.