Faculty of Engineering

Computer Department

Final Internship Report

Internet of Things in the field of smart city

Faculty of New Sciences and Technologies

Written by

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Abstract

The project is related to the Internet of Things in the field of smart city. First, we looked at our goals, needs, and wants of a smart city to know what elements, tools we need.

In the next step, we reviewed the available tools and hardware and by comparing them, we tried to select the best option, which during the reviews, using the Raspberry Pi and Arduino boards in combination gives us the best performance.

Before performing and finalizing the project, during a simulation with Packet Tracer software, we simulated a number of executable nodes, which you will see at the end.

The results are that we have a smart city that we can have full monitoring of it and have full access and remote control to all parts.

Table of Contents

First Chapter

The subject of the internship is related to the Internet of Things. The reason for choosing this topic is that it is related to the theme of my project, and the next main reason is the importance and up-to-dateness of this theme, as well as my personal interest.

For this purpose, I chose the topic of my internship in consultation with the supervisor and the person in charge of internship, the Internet of Things in the field of smart city, which is related to the topic of my project, which is the Internet of Things in the field of smart greenhouse. As a result, I chose my internship at Razi university in the faculty of New Sciences and Technologies, where my project professor is also present.

Chapter III

3-1. Internet of Things (IoT)

The Internet of Things is one of the most up-to-date topics in the computer world today, used to connect objects to the world of the Internet and remote access, as well as intelligence. An object in the Internet of Things can be a human, a farm full of An animal is a car with a built-in tire pressure sensor, or any natural or handmade object that has the ability to assign an IP address to it and the ability to transmit data over a network platform. As we know, any advancement in technology is in order to make a human task and activities easier. Life becomes easier, speed increases, energy is saved, time is saved, costs are reduced, etc. Therefore, we intend to Use this technology in order to make a city smarter, which can have many achievements. For each task, we must have a specific pattern of behavior, a certain process and path in order to move towards the goal that we have as coherently, systematically and purposefully as possible. First we ask ourselves what is a smart city, what are its features and what are our demands from a smart city? And what software?

2-3.History of the Internet of Things

We have been fascinated by the operation of gadgets on a larger scale in recent decades, but the core potential and high capabilities of the Internet of Things have become more apparent in recent years. Gradually, with the advent of wireless Internet, the concept of the Internet of Things evolved, powerful and sophisticated sensors developed, and humans realized that this technology, in addition to being a professional tool, could be a personal tool. Although the concept of the Internet of Things has been around since 1999, the technology has been in development for decades. In the early 1980s, for example, the first Internet device was a machine for storing and delivering soft drinks at Carnegie Mellon University. The programmers were able to connect to the machine via the Internet and check its status, and to be able to remotely manage and serve the customer.

Today, the Internet of Things is a concept in all objects from industrial machines to wearable gadgets that can use their internal sensors to collect data and use the data collected in the network at the right time. Thus, it is possible to name a building that uses its sensors to automatically adjust light and heat, or use equipment that warns the support staff of organizations about impending system errors. All of these are subsets of the Internet of Things and will help the future of technology to facilitate and increase the efficiency of human life.

3-3. The importance of the Internet of Things

You may be interested in how many objects can be connected to the Internet, or how cost-effective data flow analysis maybe. Here are some examples of the effects of the Internet of Things on various industries:

- Intelligent transportation solutions have accelerated traffic control, reduced fuel consumption, optimal timing of vehicle repairs and ultimately saved human lives.
- Smart grids are more efficiently connected to renewable sources, in which case the reliability of the system is improved and customers pay less.
- Data-driven systems are placed within the infrastructure of smart cities, the work of municipalities to manage waste and waste is very easy, and the implementation of laws and other programs is done in the best way. The effects of the Internet of Things on people's personal lives are also many IoT-based networked equipment and supplies have a large market share. for example:
- A message from the refrigerator stating that there is a lack of milk. This alert message will be sent to you when you are moving from work to home to buy milk.
- Home security system, allows you to remotely manage locks and heating system brings. In order to reduce the ambient temperature of the house or even based on the settings, order the windows to open

3-4. Who are the IoT applicants and customers?

The Internet of Things is more than just a tool for the well-being and of individuals. The Internet of Things offers new data sources and a range of business models that can strengthen those businesses in a variety of industries. for example:

3-4-1.Health and care

Many people today use wearable equipment to monitor and control their exercise, sleep and other daily behaviors. These are the effects of the Internet of Things on people's health. Patient status monitoring equipment, recording patient events by electronic equipment and other intelligent devices, can help save lives and lives.

3-4-2.Manufacture and production

This is one of the industries that has benefited a lot from the Internet of Things. Data collection sensors installed on factory machinery or smart storage shelves can instantly detect problems and errors and track the source. This facilitates work and increases efficiency and reduces costs.

3-4-3. Retail

The Internet of Things is good for both the seller and the consumer. For example, in stores, the Internet of Things can be used to check inventory or security purposes. For customers, the experience of buying, calculating prices and paying by data collection sensors and cameras is also very interesting

3-4-4. Telecommunication

The industry has been heavily influenced by the Internet of Things since telecommunications took over the storage of data used by the Internet of Things. Smartphones and other personal devices should be able to communicate securely to the Internet for better Internet of Things.

5-4-3. Transportation

Undoubtedly, with the advent of self-driving cars, more than ever, you see the impact of technology in this industry. The Internet of Things is also affecting transportation on a larger scale: Freight and freight forwarding companies use GPS solutions to track their fleets. In addition, roads are monitored by sensors for added security.

4-3.Welfare services

Intelligent tools are not only used for automatic data collection, but also the ability to analyze data to better track and manage energy use. In this way, sensors in equipment such as windmills can track data and provide predictive models for failure timing to use energy efficiently. Experts estimate that by 2020, the Internet of Things will include about 30 billion objects. The global IoT market will also reach $ 7.7 trillion by 2020.The study of IoT literature and projects that demonstrate the outstanding power of technology in IoT projects is often driven more by technological interventions than by business innovation models.

5-3.Smart city

A smart city is an urban area that uses a variety of electronic sensors to collect and analyze information, which is useful for managing urban assets and resources. This process includes information collected from citizens, devices and urban resources that is processed and analyzed to monitor and manage traffic and transportation, systems, power plants, water, network supply, waste, management, law enforcement information systems And help schools, libraries, hospitals and other social services. Smart City is the integration of Information and Communication Technology (ICT) and various devices connected to the Internet of Things (IoT), to optimize the efficiency of urban services and uses and connect it to citizens. Smart city technology allows city officials to interact directly with the community and urban infrastructure, monitoring what is happening and what is evolving.

5-3-1. The effect of technology on the speed of the urbanization process

People are increasingly migrating from rural to urban areas. By 2050, about 86 percent of people in developed countries and 64 percent in developing countries will live in cities. As cities attract large populations in the future, effective and efficient use of resources is very important.

5.3.3 The effect of smart city technologies on the speed of the urbanization process

We want to examine how technology in a smart city can accelerate the urbanization process, which are mentioned below:

1-) Intelligent energy

Intelligent energy systems monitor energy consumption and manage and maintain it more efficiently. Cisco estimates that energy-efficient cities will see a 30 percent increase in energy efficiency over the next 20 years. Using renewable energy sources, managing water resources and having a city waste management system can reduce pollution and consume less energy.

2-) Smart movement

The purpose of smart transportation is to provide options for sustainable transportation. According to reports An American stays in traffic for an average of 34 hours a year. With the rapid growth of cities, there must be methodsIntroduce new transportation to keep the movement dynamic. Thus, for the US government 124 billion The dollar is saved every year. Walking, cycling and other transportation methods are some of the solutions that can solve the traffic and transportation problem to some extent. Finding new and better solutions can reduce costs and have a positive impact on the environment.

3-) Intelligent infrastructure

Intelligent infrastructure provides the necessary foundation for all intelligent solutions. Using new technologies to convert raw data into information, urban and regional planning can be done. To be suitable for future needs. Also current systems can be used with Improved data analysis, traffic patterns and tracking systems.

4-) Smart public services

By connecting citizens and city officials, they can become safer, cleaner places, and raise the overall standards of the city. If citizens have the opportunity to report problems with garbage collection or other infrastructure problems, the authorities can act more quickly and solve the problems.

5-)Smart health and wellness

order to adapt to changes in the urban population, smarter health services must be provided. Smarter methods of providing treatment services can reduce costs, establish effective communication between healthcare professionals, and provide essential patient information. When nurses and physicians have access to patient information, they can work together in new ways to best care for patients.

A smart city can respond better to the challenges of population growth than a traditional city. By using resources more efficiently, governments can reduce costs, improve the quality of life, and meet the needs of future generations.

3-6. Examining and recognizing existing hardware

In the field of IoT, many hardware companies have been active. These tools include microcontrollers, Raspberry Pi boards, Arduino boards, etc. During the reviews, we intend to review some of the most popular hardware available.

3-6-1. Arduino Board

The Arduino is actually a hardware and software platform for implementing a variety of electronic boards Its main purpose is to facilitate the construction of boards and their coding and has been made available to the public in a completely open-source manner. By preparing many application modules as well as building a simple and streamlined coding platform, the Arduino eliminates the hassle of additional complexities such as initial setups and extensive wiring, or writing all the basic functions required by hardware programming. he does .Working with Arduino modules, there are simple microcontrollers to set up the motor drive and even a pre-designed Wi-Fi network connection that can be used for your projects. Also, the coding for Arduino is in Arduino, which is very similar to C ++, and can be compiled and programmed on the board in the Arduino compiler environment, and the very interesting thing about it is that many basic functions are required In coding, including mathematical functions such as sine, etc., or functions with time, as well as functions with micro-ancillary features such as analog to digital converter or serial port, etc. Drastically reduces

3-6-1-1. Hardware advantages

Arduino is open source hardware - being open source also means that the user has the ability to change its software and hardware, and can redefine it as they wish with changes – and It includes a central core of ATMEL microcontrollers, and some models use more advanced microcontrollers, such as the ARM series.

I If you are familiar with microcontroller programming, for example, you know that you have to use an external crystal to create the frequency you want, or you have to use a programmer to run your program from the computer to the micro, or you have to use VCC pins to power it. Connect to a power supply with a wire and many other hassles. In simple Arduino language, design all these requests from the microcontroller on one board and without enough trouble, connect it to the computer with an ono cable to run the program on it. Pour. If you want, you can not connect it to the power supply because it has the ability to work with USB port and port voltage, or a crystal is embedded in its design that provides the need for external clock and create your desired frequency easily and without hassle. And many other benefits!

3-6-1-2. Software advantages

Hardware advantages are not the whole story and advantages of the Arduino. In the programming section, this board makes programming very simple due to having many libraries and does not require the user to go into the details of in-app programming. As a result, the speed of the project will increase again, both novice and professional users will really enjoy programming with this board! Let me add one more thing about this board and that is that because of the open source nature of Arduino, there are so many examples and projects all over the internet.

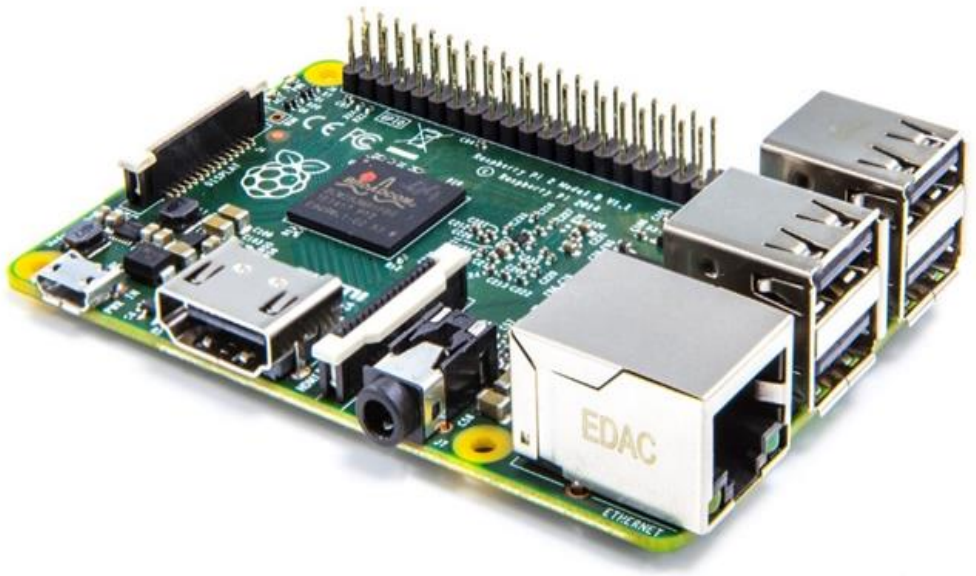
Although Arduino is a changeable hardware, but Arduino is still satisfied with the design of not just one model, and in the picture above you can see that it has different models, take the most famous and most used model. There is Uno to other models such as, nano or mega series, which are the biggest Arduino boards. If I want to name a few other models, I can refer to other famous models such as Leonardo and Due, etc.

3-6-1-3.Shield Arduino

Arduino not only simplifies microcontroller programming, but also connects the board to other components such as LCDs, motors ... through the shields make it easy for us again! In fact, these are shielded boards that, for example, minimize communication wires, programming, and PCB design for the components required.

2-6-3.Raspberry Pi board

Raspberry Pi has made a name for itself over the past 5 years and has maintained its stability in the market during this time. The board company started with small (credit card-sized) and low-cost products aimed at teaching programming to children. The biggest claim of the stock breaker is the failure to crack the hardware. On the Internet you can find strange projects and Find strangers to Raspberry Pi, such as electric skateboards, remote controls, and magic mirrors. Many people use Raspberry Pi as a home computer system, game console (old and nostalgic games), or network file server.



3-6-2-1. Profile of Raspberry Pi

The boards of these products have undergone major changes over the past 5 years. The original boards used a USB port, a 700 MHz processor, 512 MB of RAM, and did not have a wireless module on board (it could be installed externally).The new board is much more advanced than the old models.
Model B Raspberry Pi 3 has a 1.2 GHz quad-core processor, VideoCore5 graphics card, 1 GB of RAM, 4 USB ports, micro-Asad port and wireless communication facilities (Bluetooth and WiFi).Raspberry Pi 3 is so efficient that it can be used as a desktop computer instead of being used in weird projects.
There's an HDMI port, an Ethernet port, and a 40-pin GPIO header on board to control adventurous projects. Both models are weaker than Raspberry Pi 3, but 40% stronger than Raspberry Pi. The $ 10 Raspberry Pi Zero has a Broadcom 1GHz processor, 512MB of RAM, Micro USB 2, USB, Mini HDMI, microSD port, and Bluetooth and Wi-Fi support. Raspberry Pi Zero W for $ 5 uses the same processor and RAM; But it does not support camera connection and wireless capabilities are not included on the board.

3-6-2-2. Raspberry Pi software

Raspberry Pi products typically use the Linux system. The most popular operating system used by these boards is the Raspbian operating system, which the manufacturer also recommends. Razbin is built on Debin Linux. The operating system uses standard Linux software such as a web browser, email service, various system tools including Java and Python programming tools, and a program called Scratch, which is a tool for teaching children coding. In the programming section, there is an additional program called Minecraft Pi, which is a game for teaching programming to children. Razbin has recently improved its desktop environment with "Pixel Desktop" and its visual effects are better and more eye-catching than previous versions.

If Razbin does not satisfy you, you can use Arch, Ubuntu Linux, the unofficial 64-bit version of Gentoo Linux and many other operating systems. If you want to turn your PC into a media center, OpenElec and OSMC are two operating systems designed to turn your hardware into a low-cost home PC. Even in 2015, Microsoft started making a version of Windows 10 for Raspberry Pi. Windows 10 with IoT kernel is a free version of Windows Desktop designed to advance hardware projects. The CEO of Raspberry Pi announced in 2016 that he would like his products to support Windows 10 desktop, but this is up to the decision of Microsoft executives. However, he expressed satisfaction with the prevailing conditions and support of the company's products for Windows 10 IoT.

3-6-2-3.. Raspberry Pi Accessories

There are bags to protect Raspberry Pi 3 and Raspberry Pi Zero boards. There's also a 5-volt power supply on the accessory list (although a 5-volt mobile charger will do the trick). Camera modules, infrared and 7-inch screen are other accessories available.

3-6-2-4. Programming for Raspberry Pi

There are two types of programming languages that Pi supports by default; Scratch and Python both have a shortcut icon on the Pi desktop graphic. The scratch was created by a team at MIT Media Lab. The language uses Tile-base commands that can be put together without worrying about syntax errors. Sounds, graphics and animations can be added. Projects can be saved or uploaded to the Scratch site for sharing with other users. The next language is Python v3.2.3, which starts with the Python shell. Python is an interpreter language in which commands are read and executed line by line. High-level commands and data structures make it suitable for programming.

3-6-2-5. Raspberry Pi connection

As mentioned, Pi is a standalone electronic board that you can buy all the accessories and add to the board to increase Pi performance. The first necessary tool is an SD card, which is used as a memory for the operating system or any software you want to install. Although a card with 2 GB of memory does this, it is recommended that the memory be at least 14 GB.

You must first format the card. Download and install Raspbian from the Raspberry Pi website. To do this, use a computer with Windows or Mac operating system, which of course is easier for Windows. After installing the operating system on the card, all that remains are the types of connections. You need a keyboard and a USB mouse, an HDMI or analog cable, and a USB power supply that generates 700 mA at 5 volts.

HDMI connections also include audio output; So, if you use it with a TV or monitor with speakers, the sound will come out. Otherwise, a 3.5mm audio output is provided for the audio. Another part of the B and + B models, of course, is the Ethernet connection to connect to the Internet modem. This is the fastest and easiest way to get Pi online. The last component is to get a fancy box to put Pi in it.

3-6-2-6. Specifications of various Raspberry Pi systems

Pi Zero	Pi 1 Model A+	Pi 1 Model B+	Pi 2 Model B	Pi 3 Model B
1 GHz 32-bit Single Core processor	700 MHz 32-bit Single Core processor	700 MHz 32-bit Single Core processor	900 MHz 32-bit Quad Core processor	1.2 GHz 64-bit Quad Core Processor
512 MB RAM	512 MB RAM	512 MB RAM	1 GB RAM	1 GB RAM
Broadcom VideoCore IV GPU	Broadcom VideoCore IV GPU	Broadcom VideoCore IV GPU	Broadcom VideoCore IV GPU	Broadcom VideoCore IV GPU
2 micro USB ports	1 micro USB port	1 micro USB port	1 micro USB port	1 micro USB port
No USB ports	1 USB port	4 USB ports	4 USB ports	4 USB ports
1 mini HDMI port, no HDMI	1 HDMI port, no mini HDMI	1 HDMI port, no mini HDMI	1 HDMI port, no mini HDMI	1 HDMI port, no mini HDM
1 microSD slot	1 SD/MMC slot	1 microSD slot	1 microSD slot	1 microSD slot
No dedicated audio port	3.5mm audio out port	3.5mm audio out port	3.5mm audio out port	3.5mm audio out port
No Wi-Fi, No Ethernet	No Wi-Fi, No Ethernet	No Wi-Fi, Ethernet via USB Adapter	No Wi-Fi, Ethernet via USB Adapter	Onboard Wi-Fi, Ethernet port
No Bluetooth	No Bluetooth	No Bluetooth	No Bluetooth	Bluetooth 4.1
65x30 mm (Half of Standard Pi Size)	85.60×56.5 mm (Standard Pi Size)	85.60×56.5 mm (Standard Pi Size)	85.60×56.5 mm (Standard Pi Size)	85.60×56.5 mm (Standard Pi Size)
$5	**$20**	**$25**	**$35**	**$35**

There are four models of pie crushers: Model A, Model B, Compute and Zero. In this article, we do not look at the computational model, as it is provided directly to equipment manufacturers and typically for smart home projects. There are subtle but important differences between models A, B and Zero.

- **Raspberry Pi model A +**

  The latest version of this $ 20 Raspberry Pi is equipped with the Broadcom BCM2835 chip, a 700 MHz single-core processor, 512 MB of RAM and a USB port.

- **Raspberry Pi Model B**

  This model is presented in two sub-models: Raspberry Pi 2 A $ 35 PC with the BCM2837 chip, a 900MHz 64-bit quad-core processor, 1GB of RAM with a graphics processor, and four USB ports. Raspberry Pi 3 A $ 35 computer equipped with the BCM2837 chip. The device uses a 64-bit quad-core processor with a speed of 1.2 GHz and 1 GB of shared RAM. In this case, too, there are four USB ports.

- **Raspberry Pi Zero**

  The PC is only available for $ 5 (there is also a $ 10 wireless version). This version of the 32-bit Raspberry Pi is equipped with a BCM2835 chip, a 1 GHz processor and 512 MB of RAM, which is shared with a graphics processor.

  Several aspects of pie hardware (except Raspberry Pi Zero) remain standard. This device is always equipped with a USB power connection and an HDMI port. An Ethernet port is connected to the USB port and there is a microSD port. For audio and video output, if there is no HDMI, a dual 3.5 mm mini-jack port is used. There are also parallel ports for the display module and Raspberry Pi camera.

3-6-2-7. How big is a raspberry pie?

Each of the models is slightly different from each other. The latest models A and Model B (Raspberry Pi 2 and 3) have boards measuring 85.60 by 56.5 mm (3.370 by 2.224 inches), while the Raspberry Pi Zero measures 65 by 30 mm (2.56 by 1018 inches). The depth of the boards is also different: the Zero model is only 5 mm deep, while the B model boards are 17 mm deep due to the additional hardware. One of the most important things about pie is that its makers never give up. Corrected versions are always available at both the hardware and software levels. Model A and Model B, for example, were initially equipped with 256 MB of RAM. This amount increased to 512 MB in 2014. However, Raspberry Pi 2 and 3 are equipped with 1 GB of RAM.

3-6-2-8. Universal Input and Output Pins (GPIO)

An array of GPIO pins is provided in Raspberry Pi. These pins can be used for a variety of tasks, from controlling the foot (possibly the game controller or other input devices) to controlling the input power from a secondary device.

GPIO pins are different on each model (and of course some modifications). So you need to check if you are using them properly or not.

Although the detailed application of GPIO pins is beyond the scope of this paper; But in any case, for security reasons, we must mention them. You need to be as careful about connecting any external device to these pins as you are about any computer board. If the accuracy is not sufficient and the connection is incorrect, it is possible that the GPIO processor will fail. Before connecting each cable to the foot, make sure that you have measured its voltage

3-6-2-9. Communication cables

You need several cables to get the best results from Raspberry Pi:

Ethernet If you do not plan to use Wi-Fi (perhaps because your model does not have built-in Wi-Fi and you do not have a USB Wi-Fi dongle), you will need this cable to connect to a router.

HDMI cable

Raspberry Pi has an HDMI port that is used for HD audio and video. More importantly, the Zero model is equipped with a mini HDMI port. There is also a standard HDMI adapter in the device; But if you have a mini HDMI cable, it connects better.

Audio cable

Raspberry Pi has a special 3.5 mm dual-purpose jack. The first function of this jack is voice transmission, which is ideal for connecting your Pocket PC to the speaker. This will be especially useful if you do not intend to use HDMI or want to send audio to another device.

RCA video cable

The second use of the 3.5 mm jack is video output (low resolution), which is used for monitors without HDMI.

Micro USB cable

Although in most cases you will need a USB power adapter, if you want to power the foot from a computer, it is advisable to use a cable that has a power supp

3-6-2-10. Memory

One of the most important components of any computer is its memory, from which the operating system runs and data is stored. Raspberry Pi does not have an internal disk drive and instead has a microSD card slot. You need to get a high speed SDHC card to use on this small computer. The capacity of the card can be 8 GB or more, and of course, higher values provide better results in using this computer. Pai also supports memories such as SSDs, which is why the SHDC format is used to improve read / write speeds.

3-7. Comparison of Arduino board and Raspberry Pi board

The Arduino board is actually a microcontroller, which is a simple computer that can run only one program at a time and repeat it over and over again, and it is very easy to work with.

Raspberry Pi is a general-purpose computer that has an operating system, usually the Linux operating system, and is also capable of running and running multiple programs simultaneously, which is more complex than Arduino.

Below is a tabular comparison of the Arduino board and the Raspberry Pi board:

SL	Raspberry Pi	Arduino
1	It is a mini computer with Raspbian OS.It can run multiple programs at a time.	Arduino is a microcontroller, which is a part of the computer. It runs only one program again and again.
2	It is difficult to power using a battery pack.	Arduino can be powered using a battery pack.
3	It requires complex tasks like installing libraries and software for interfacing sensors and other components	It is very simple to interface sensors and other electronic components to Arduino.
4	It is expensive	It is available for low cost.
5	Raspberry Pi can be easily connected to the internet using Ethernet port and USB Wi-Fi dongles.	Arduino requires external hardware to connect to the internet and this hardware is addressed properly using code.
6	Raspberry Pi did not have storage on board. It provides an SD card port.	Arduino can provide onboard storage.
7	Raspberry Pi has 4 USB ports to connect different devices.	Arduino has only one USB port to connect to the computer.
8	The processor used is from ARM family.	Processor used in Arduino is from AVR family Atmega328P
9	This should be properly shutdown otherwise there is a risk of files corruption and software problems.	This is a just plug and play device. If power is connected it starts running the program and if disconnected it simply stops.
10	The Recommended programming language is python but C, C++, Python, ruby are pre-installed.	Arduino uses Arduino, C/C++.

Chapter Four

1. work reportIn

this chapter, we describe the activities performed. The activities performed can be divided into several sections:

Part 1: Understanding the subject of internship: In this section, we have defined the Internet of Things and the smart city to arrive at a correct definition and view of the subject. In this section, I read IoT articles and searched the Internet.

Part 2: Ideation and design of the needs of a smart city: We definitely need a lot of research and study in this section, for which I got a lot of help from the available articles and YouTube videos. And for this purpose, I designed a series of goals and needs for my smart city:

- Smart streets and highways: by announcing warning messages about weather conditions or unexpected events such as accidents or heavy traffic
- Smart trash: detect the level of garbage inside the trash in order to optimize and target the routes of garbage collection machines and prevent wasting time and increase traffic
- Traffic monitoring: display the level and amount of cars and pedestrians to optimize driving and walking routes
- Smart parking: showing empty parking spaces in the city
- Measure the level of UV rays of the sun to warn people not to be exposed to it
- Measurement of air quality and level of pollutants
- Measuring water pressure and its equal distribution, as well as controlling the level of water quality and water of rivers and seas- Smart lights for passages and streets: to increase security and reduce energy consumption
- Display the amount and density of population and traffic in all places, including organizations and offices, etc. for better and easier distribution of population and prevent traffic jams and congestion
- Gas leak detection
- Detection and monitoring of the exact location of the fire and informing the fire department and relevant centers as soon as possible and accurately

Part 3: Review of tools and hardware required to implement the project:

All the research has been done and the identification and review of the tools are all described in Chapter 3. According to studies, the combined use of Arduino board and Raspberry Pi board has the most and best performance.

Part 4: Simulation:

Before the components of any plan and project, the correct job is to simulate that project with the available tools and software. For this purpose, I simulated a smart city using Packet Tracer software, which I will explain below.

4-2. Packet Tracer

Packet Tracer software is a simulation software that is used in the field of network and is for CISCO company. From version 7 onwards, Packet Tracer also added IoT capability, but the installation and use of this version is slightly different from the previous ones, which I will explain below.

4-2-1. Install Packet Tracer software

To install, first go to the CISCO site, from there we will register the account, after which the installation file of the program will be downloadable. After installing the program, when it runs, first a page opens that asks us to login, we must use the same account details that we created, or in the second case, we can use the login as a guest, which is definitely a limitation. Has. All steps are possible with the filter breaker on.

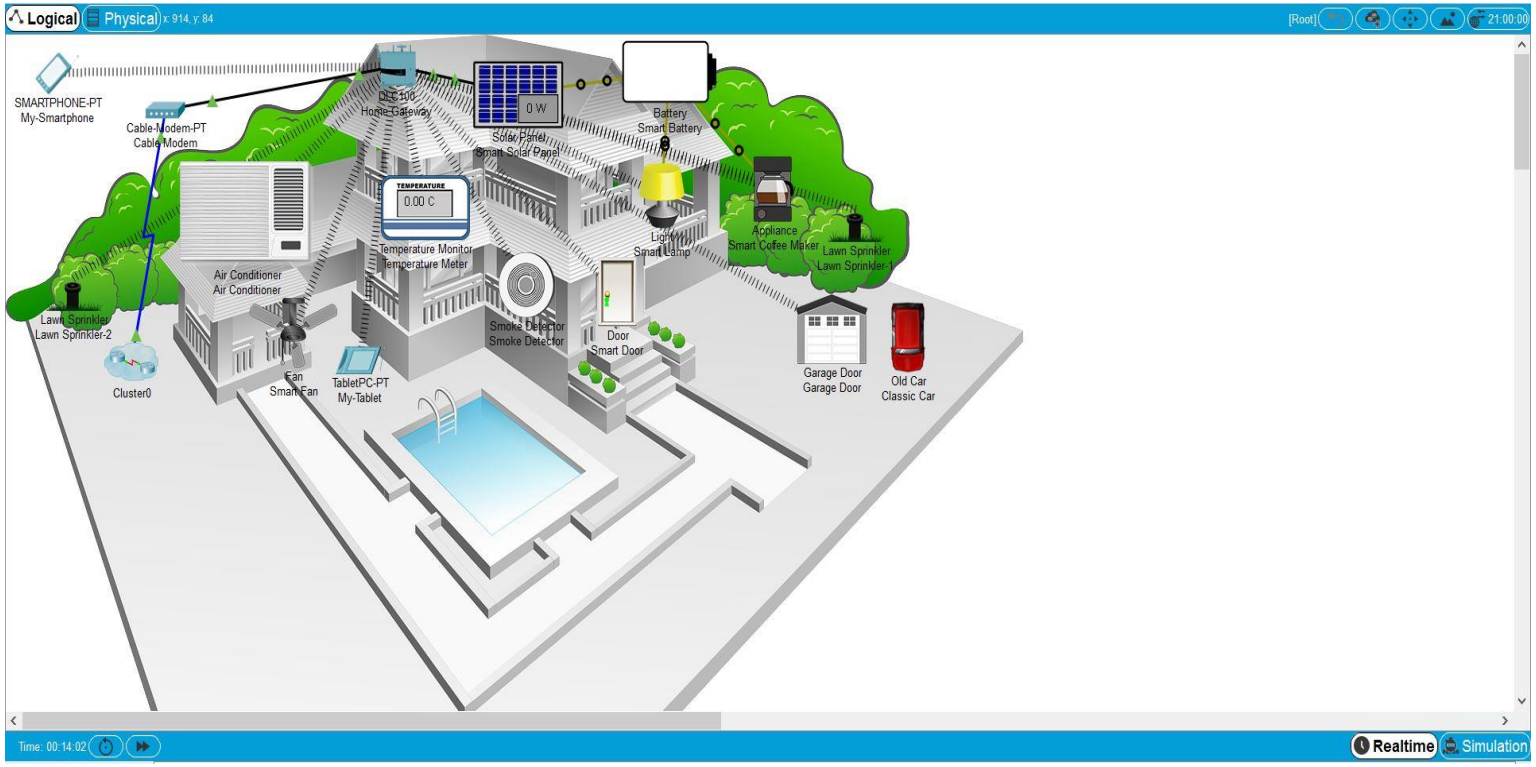
4-2-2. IoT in Packet Tracer software

The new version in the End Devices section of IoT tools can be seen:

As you can see in the picture, there are tools for IoT that are available in various fields such as home, city, industry and power plant. By selecting each element and placing it on the page, we can click on it and first find out the description of the features and capabilities of this element, then enter its settings and make the necessary settings to connect it to the network platform we give .

Here I am going to simulate a smart building with Packet Tracer software as part of a smart city, which I actually consider as a pilot.

Below you can see an image of smart building simulation:



- As you can see in the picture, there are a number of sensors as well as a number of monitoring tools and home appliances, all of which are wirelessly connected to our HomeGateway, with HomeGateway finally connected to a modem and finally to a server, and we are able to Have complete control and monitoring of everything online and from anywhere in the world.

  As you can see in the picture, we have smart door systems, smart garages, coffee makers, fans, ventilation systems, smoke detection sensors, green space irrigation, as well as green energy use and storage systems such as solar energy and other general systems such as displays. We have temperature, smart lights, and so on.

  It should be noted that in doing these designs, network knowledge and knowledge of Python or JavaScript programming language are required to be able to program Arduino and Raspberry Pi boards and be able to connect to existing sensors and systems, and finally connect. All these elements and elements to the world of internet for remote control and access.

  Of course, in Raspberry Pi, there is a tool called Node Red that eliminates the need for coding, which does not take much time to learn, but I did not use it in designing my project, and I just said it for information.

  Now I want to explain how to configure one of the executable nodes:

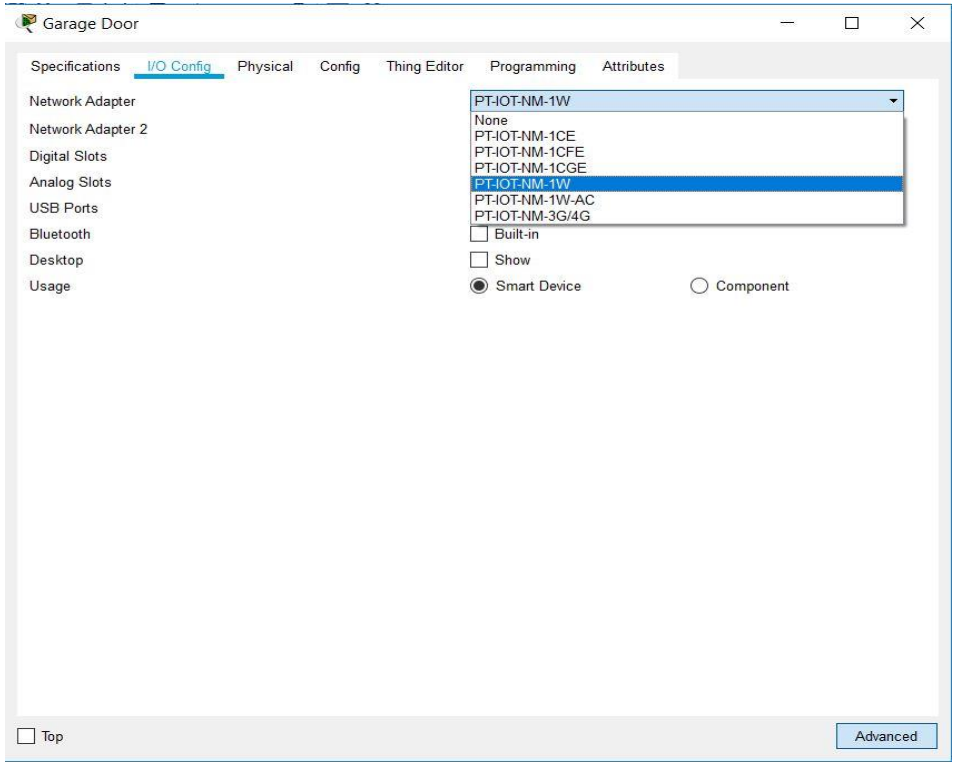
  As it turns out, I have a network platform for my smart building, which requires a Home Gateway and a main server to connect the components of this platform. Because in the end we want to be able to remotely monitor and have full control over our smart building.

  First, after selecting HomeGateway and the main server, we assign the IP and server settings, then we create an IOE account in our server and give it a user ID and password.

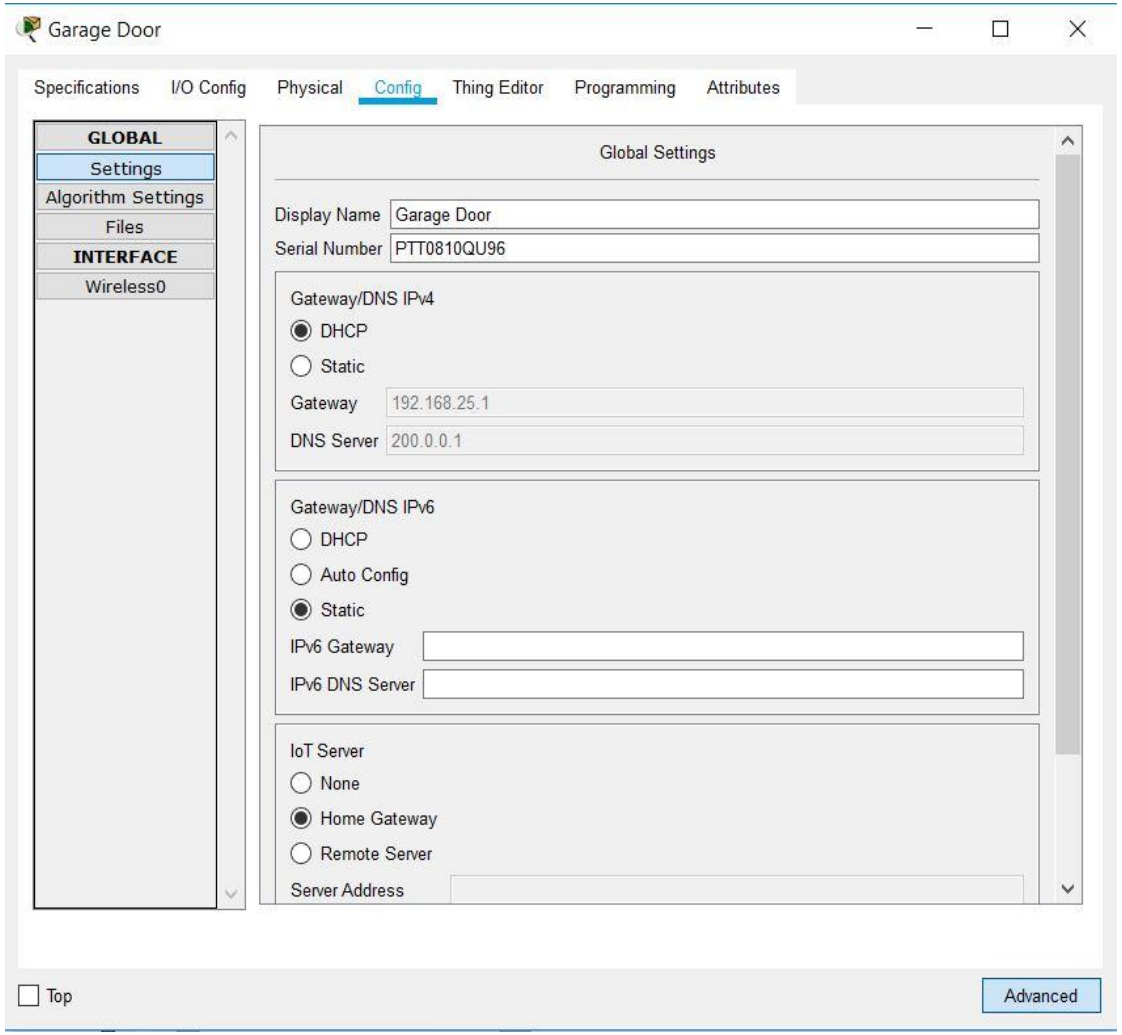
Now we add all the elements and elements that we want to have in our smart building one by one from the End Devices section to our page, and since we want our communication to be wireless, go to its Advanced menu for each element and in section I / O Config go to Network Adapter and set it to PT-IOT-NM-1W mode to support wireless, then connect to HomeGateway, and finally connect HomeGateway to the server. Now it's time to do the Config settings for each of the elements used, below is how to configure a simple example (due to the breadth and complexity of the settings of some elements, I apologize for explaining them, if necessary, personally explain I will.) You will see some of them:

You can see the settings of the Garage Door element below:

Click on it to go to the Advanced section and make the following settings:

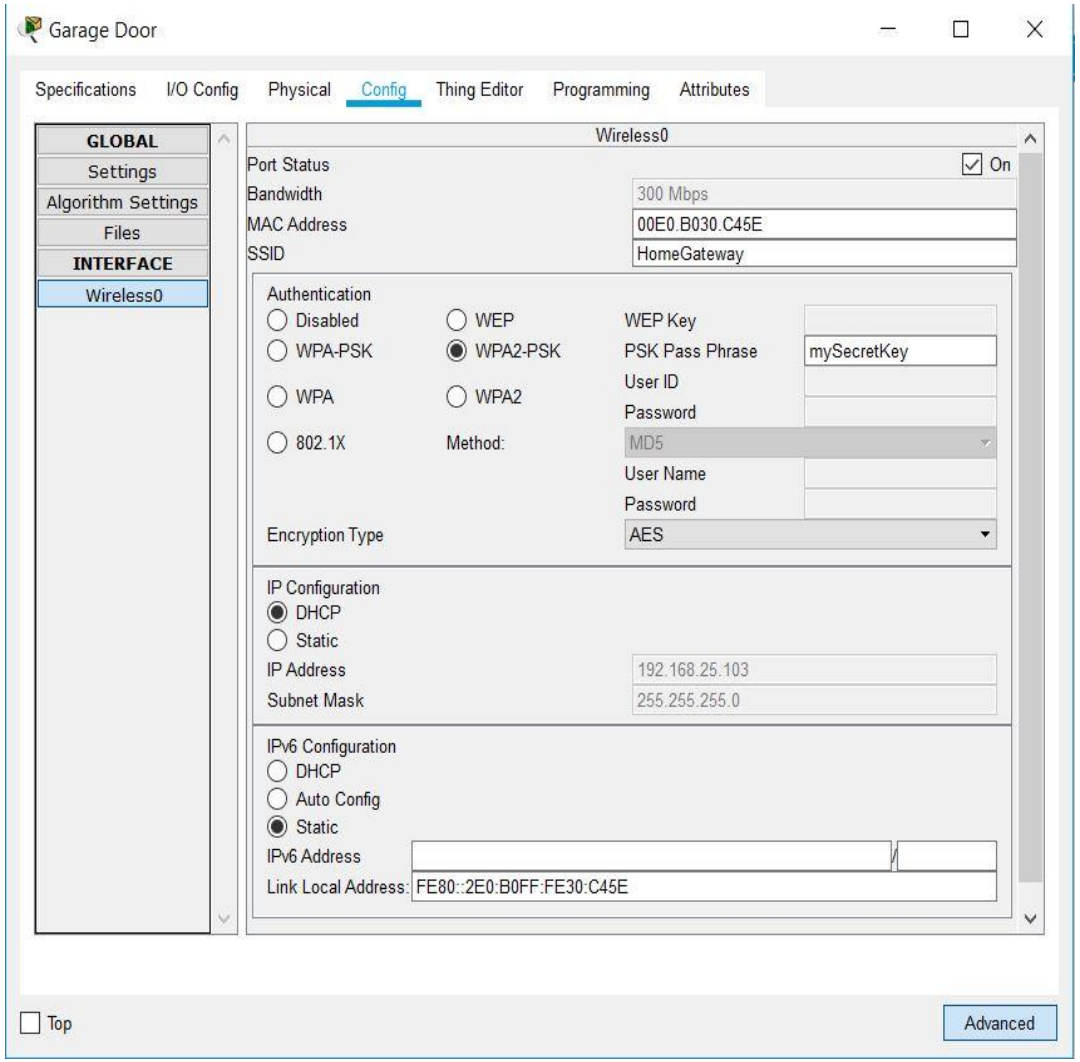


- Go to I / O Config and from there put the Network Adapter on PT-IOT-NM-1W.



- In this step, to the Config menu, here we name the Display Name according to the need.

- Then we put the IoT Server on the Home Gateway.

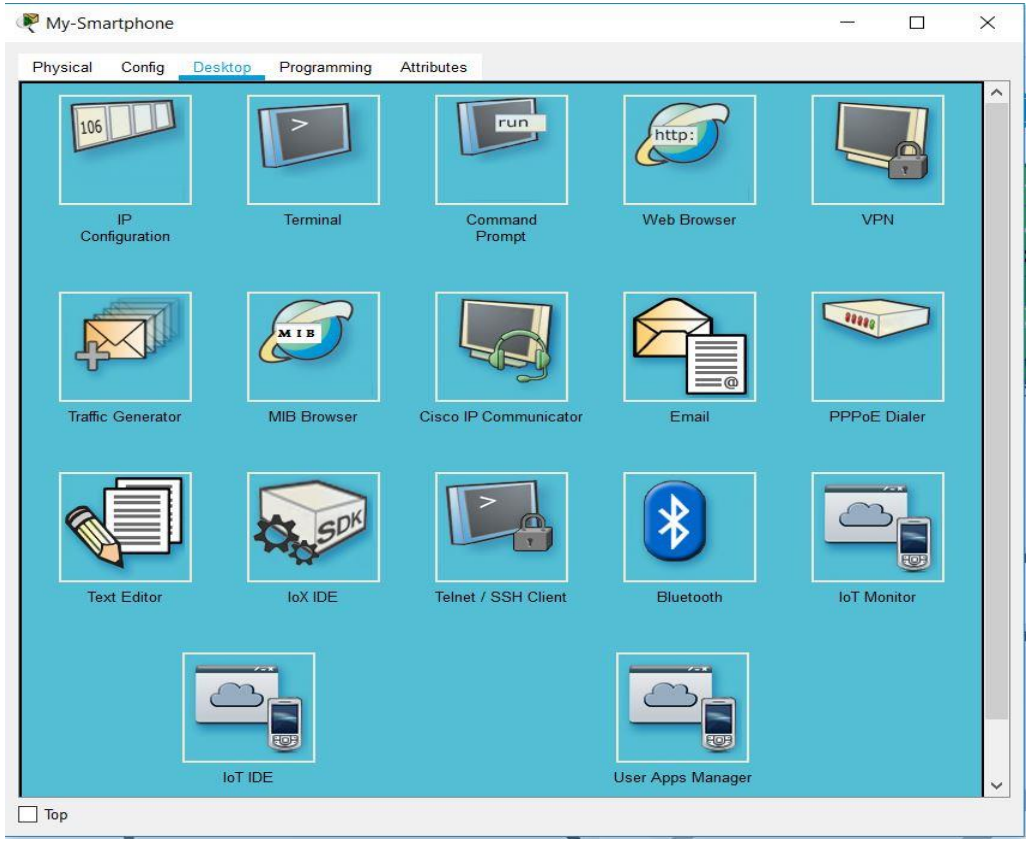


- In this step, go to the wireless menu to make the necessary settings to connect to HomeGateway.In the SSID field, we write exactly the SSID used in HomeGateway.

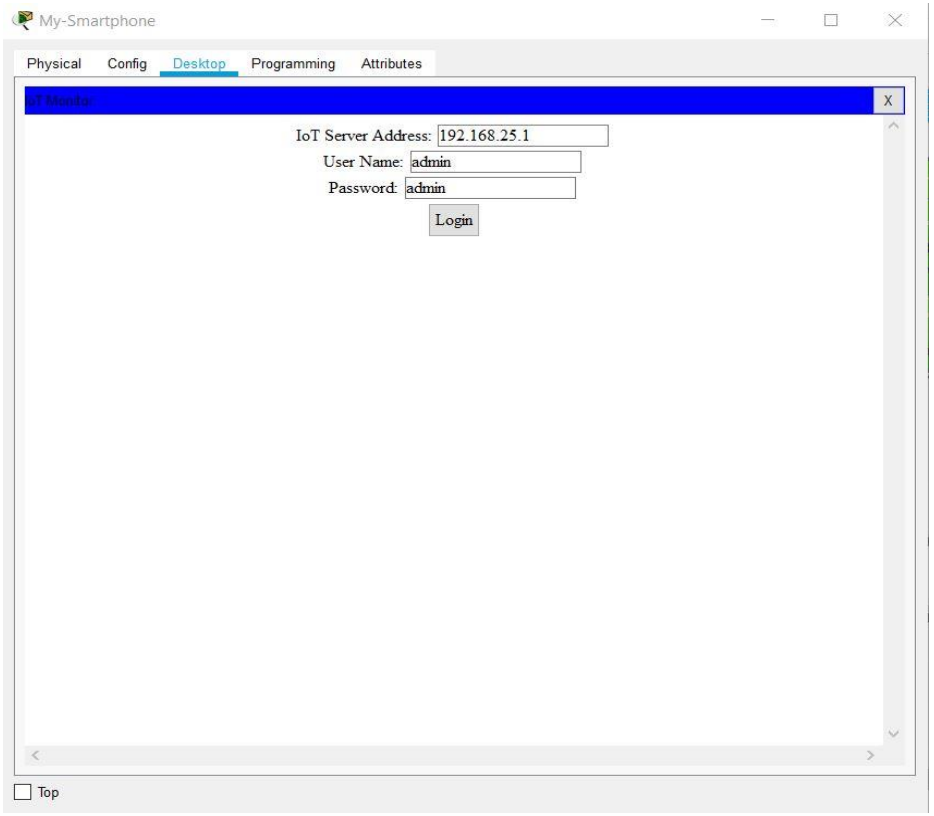
- Set the Authentication to WPA2-PSK mode and set a password for it.

- IP Configuration is also set to DHCP mode.Our device is now connected to HomeGateway wirelessly.In the same way, we make all the elements one by one, the same settings and other necessary settings for them.

Finally, all the elements are connected to the network platform and we do the same for the elements that need coding and a series of special settings, and we can have a complete control and monitoring of all components, here using a Smartphone from the Desktop menu. It went to IoT Monitor which you can see in the image below:

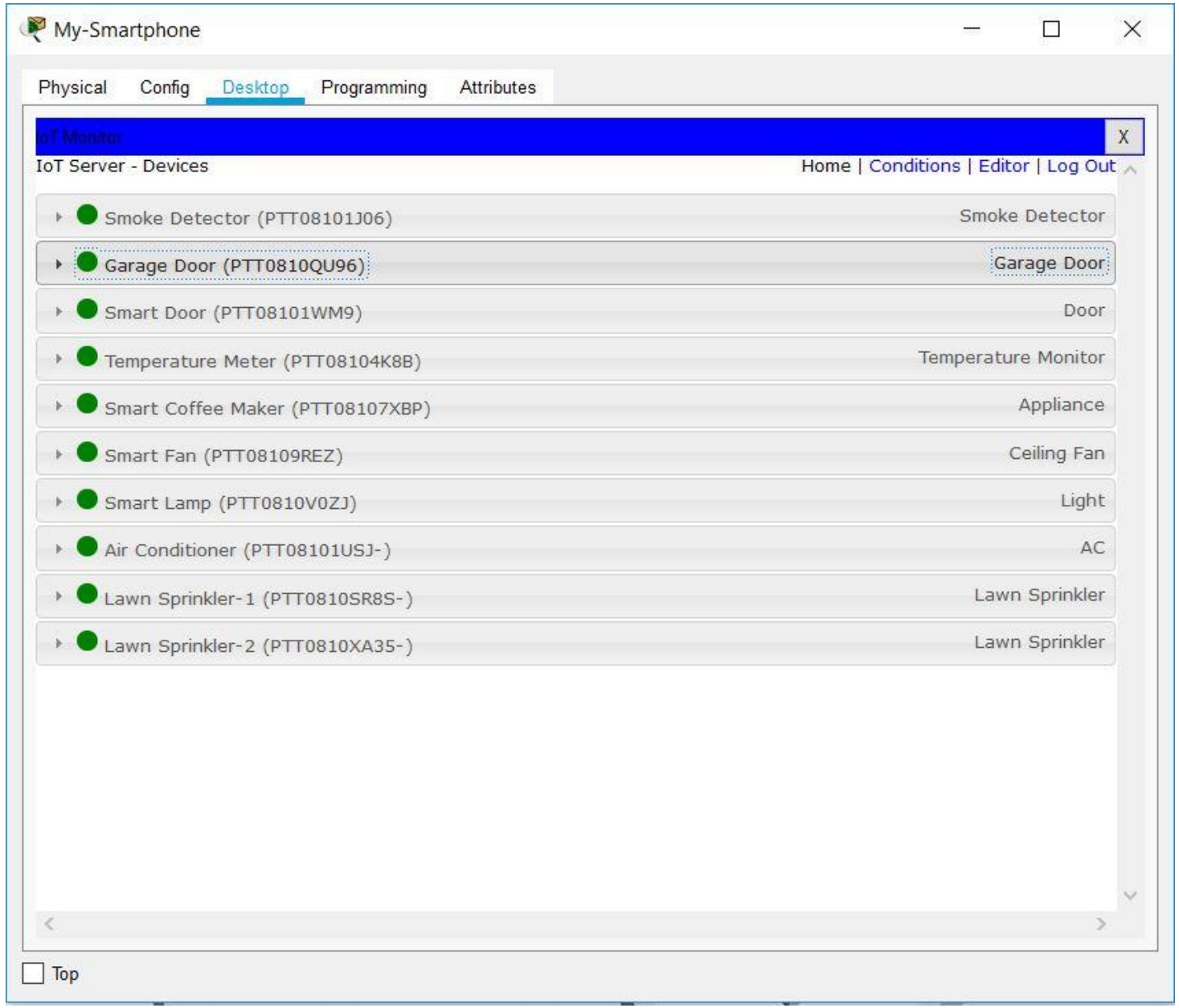


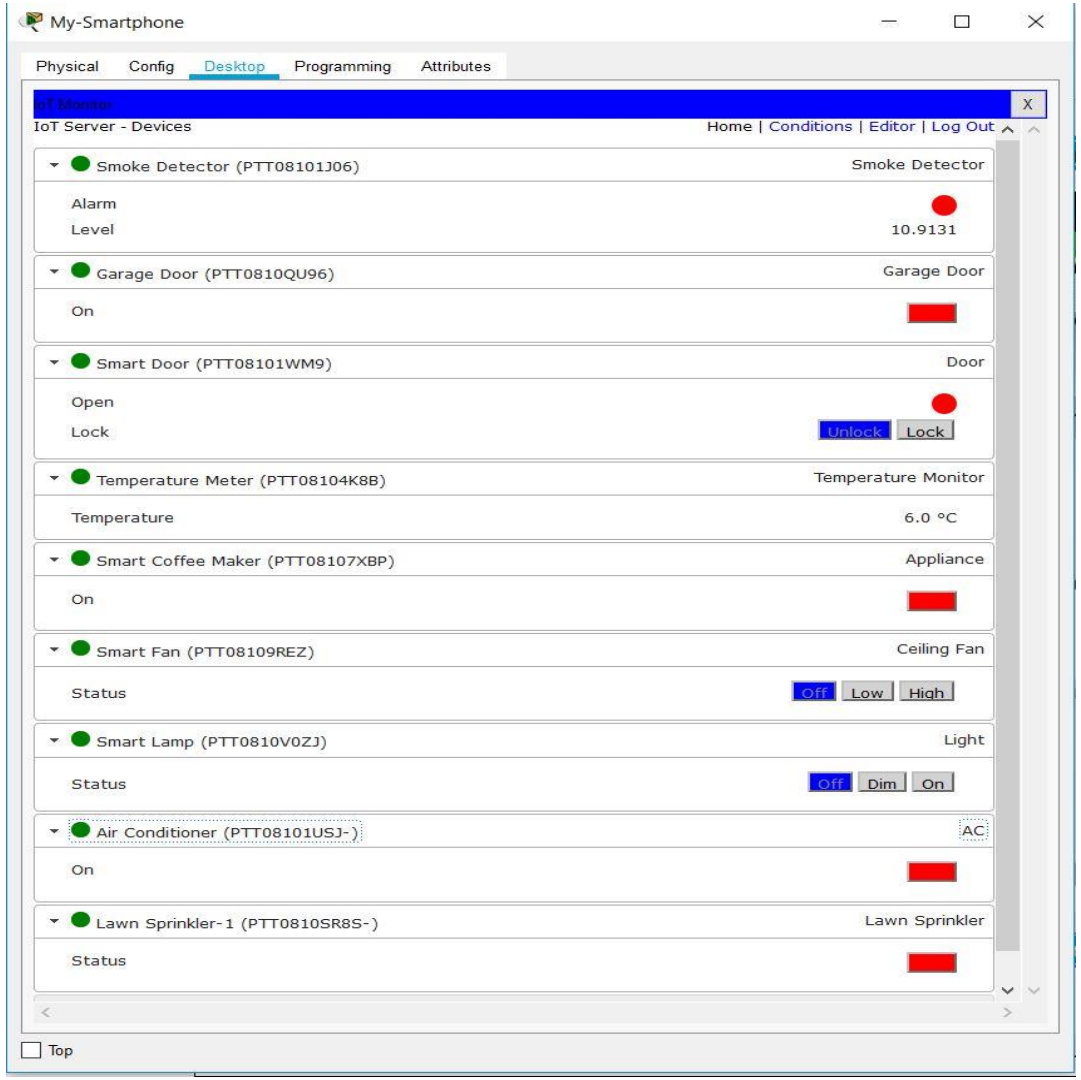
After clicking on IoT Monitor, this page will open for us:



As you can see, we enter the IoT Server address and Username, the default password so that we can login.

Now we are able to monitor all our tools and sensors and even from here we can set a series of conditional commands and Conditions that you can see below:


My-Smartphone
Physical
Config
Desktop
Programming
Attributes
IoT Monitor
X
IoT Server - Devices
Home | Conditions | Editor | Log Out
Smoke Detector (PTT08101J06)
Smoke Detector
Garage Door (PTT0810QU96)
Garage Door
Smart Door (PTT08101WM9)
Door
Temperature Meter (PTT08104K8B)
Temperature Monitor
Smart Coffee Maker (PTT08107XBP)
Appliance
Smart Fan (PTT08109REZ)
Ceiling Fan
Smart Lamp (PTT0810V0ZJ)
Light
Air Conditioner (PTT08101USJ-)
AC
Lawn Sprinkler-1 (PTT0810SR8S-)
Lawn Sprinkler
Lawn Sprinkler-2 (PTT0810XA35-)
Lawn Sprinkler
Top



Here we are able to see the overview of the data that the sensors are sensing for us as soon as we have control over our tools and devices and also define a series of Conditions from the top menu on the right. And finally, we can easily implement the same project in the real world, but of course there are many other sensors and elements in the real world that we can combine by designing an idea and specifying their use and function. To use.

Chapter Five

As mentioned at the beginning of this article, this is a very new topic and also very much discussed. Therefore, the issue of the Internet of Things has a lot of room for progress and development, and certainly entering this topic and trying and researching it is useful and fruitful. will be .