

WIRELESS NETWORKS CSCI 6682-02



University of
New Haven

PROJECT REPORT

IntelliHome: Advancing Smart Living through IoT-Based Home Automation

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Abstract:

This project aims to design a home automation system. The emphasis is on using smart technology to save energy in the home, which also contributes to a comfortable and secure lifestyle. We are all dependent on networks and the Internet in the engineering and technological world of today. IoT is a contemporary technology that is used to automate tasks around the office and in daily living at home.

This is a result of people's growing reliance on technology to lead fulfilling lives. A home where the demand for technology keeps up with the most recent advancements is a basic human requirement. This implies that a person requires a house furnished with all the conveniences.

For the intent of Design, its operation, and connectivity, we connected home appliances with the Cisco packet tracer simulation environment. In this project, a wireless system for controlling lights, air conditioning, TVs, fans, electronic doors, computers, security cameras, and other devices is presented. The system can be combined into a single portable unit.

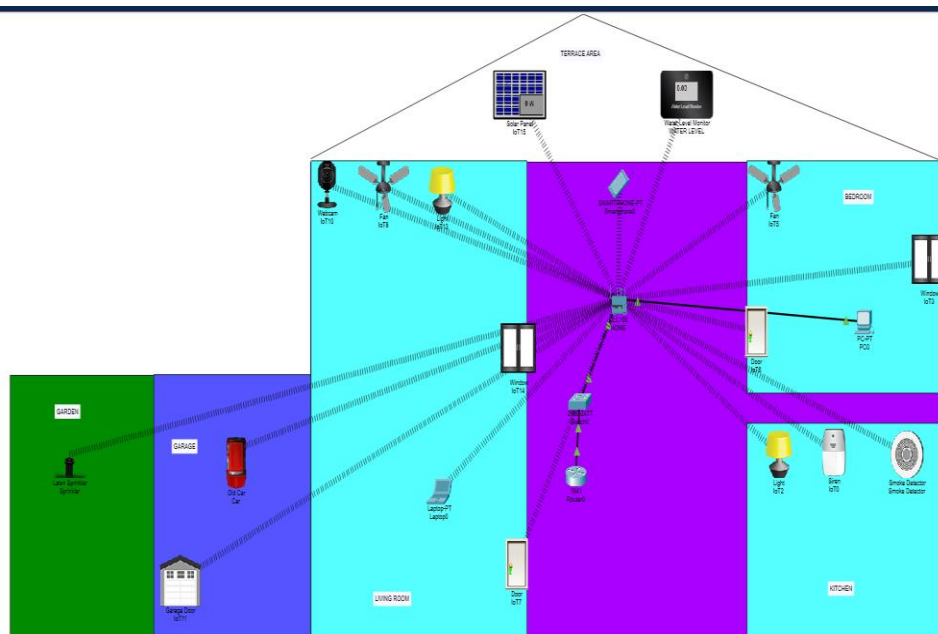
Moreover, an internet-connected Android application manages the turning on and off devices. One of the main components of a smart home system is the Home Gateway, which acts as an access point and network connector for all smart devices.

Introduction:

The goal of IntelliHome is to create a home where intelligent things perform activities automatically, freeing up time for humans to participate.

Sensors track several environmental factors like temperature, humidity, smoke, wind, and sound, enabling the system to modify ventilation as needed.

The project showcases the advantages of automated security systems, such as alarm systems, which improve safety and comfort in living areas.



Problem Statement:

Smart home automation offers a way to cut down on labor requirements, save electricity use, and increase productivity. The project targets industrial hubs like Texas and focuses on tackling the issues related to energy consumption, especially the 3.9 terawatt-hours that were recorded in the USA in 2021.

Moreover, by using voice commands and Internet of Things devices for seamless home appliance operation, the suggested solution is designed to help people who are physically handicapped.

Objective:

These days, energy conservation for every organization is one of the trendiest areas of study. Automation systems, for instance, can save energy use by shutting down electronics when not in use. Remote access, such as viewing the house from a laptop or even a smartphone, is what home automation refers to.

The capability of smart home automation systems to adjust power levels in real time is another crucial feature. Thus, there may be opportunities for growth and energy savings.

The project's benefits include:

- Here, convenience is a key factor to consider. The ability to connect everything to the IoT through a single interface is a significant leap in both technology and house management. We will learn how to utilize the smartphone application here, and we will become acquainted with a range of features and applications found across the smart home.
- We may significantly improve our house's security through implementing the monitoring and security functions of smart home networks. Here, you

have a plethora of options, including systems that operate security devices that are physically attached to your home or business, such as cameras, motion detectors, automated door locks, and others, all of which you can activate from a single mobile device before shutting off. It is still our choice to receive alerts on various devices, regardless of our location in the world.

- When it comes to incorporating contemporary appliances and other technologies, smart houses are remarkably flexible. You can find new technologies to complete your indoor and outdoor settings by upgrading your previous gadgets. We will be able to perform a lot less work at home if we can swiftly adapt to new technologies.

Challenges with Smart Home Wireless Systems:

- Starting with the choice of accessories: Most smart systems are linked to a corresponding smartphone app, but the ideal way to control thermostats, security cameras, fans, air conditioning, lights, and alarm systems is with a single app or service.
- Nothing is more annoying than a smart device that is requesting your attention without a valid reason. This is particularly valid for alarm systems and security cameras as it isn't ideal to get phony security alerts on your phone.
- When smart cameras lose connectivity or your living room's smart lighting won't switch off, for example, connectivity problems can be inconvenient and occasionally even dangerous. The good news is that there is a very quick cure for this issue.
- The reason for the maintenance needed for wireless systems is that their cameras and sensors use up batteries more quickly than other low-power devices like door sensors, which only need to be changed out every year or two.

Internet of Things:

In recent years, one of the most significant technologies has emerged: the Internet of Things. It is now feasible to establish a constant connection between people, processes, and objects. For example, embedded electronics can be used to link automobiles, thermostats, and household appliances to the Internet. People can live smarter, work smarter, and take back total control of their lives because of this. In addition to offering smart home automation gadgets, the Internet of Things is essential for safe travel and living arrangements.



It is anticipated that these connections will expand and develop into a complex dynamic Internet of Things network now that anyone can connect to anything at any time, from anywhere. The Internet of Things will revolutionize several industries, including automation, energy, transportation, healthcare, financial services, and nanotechnology.

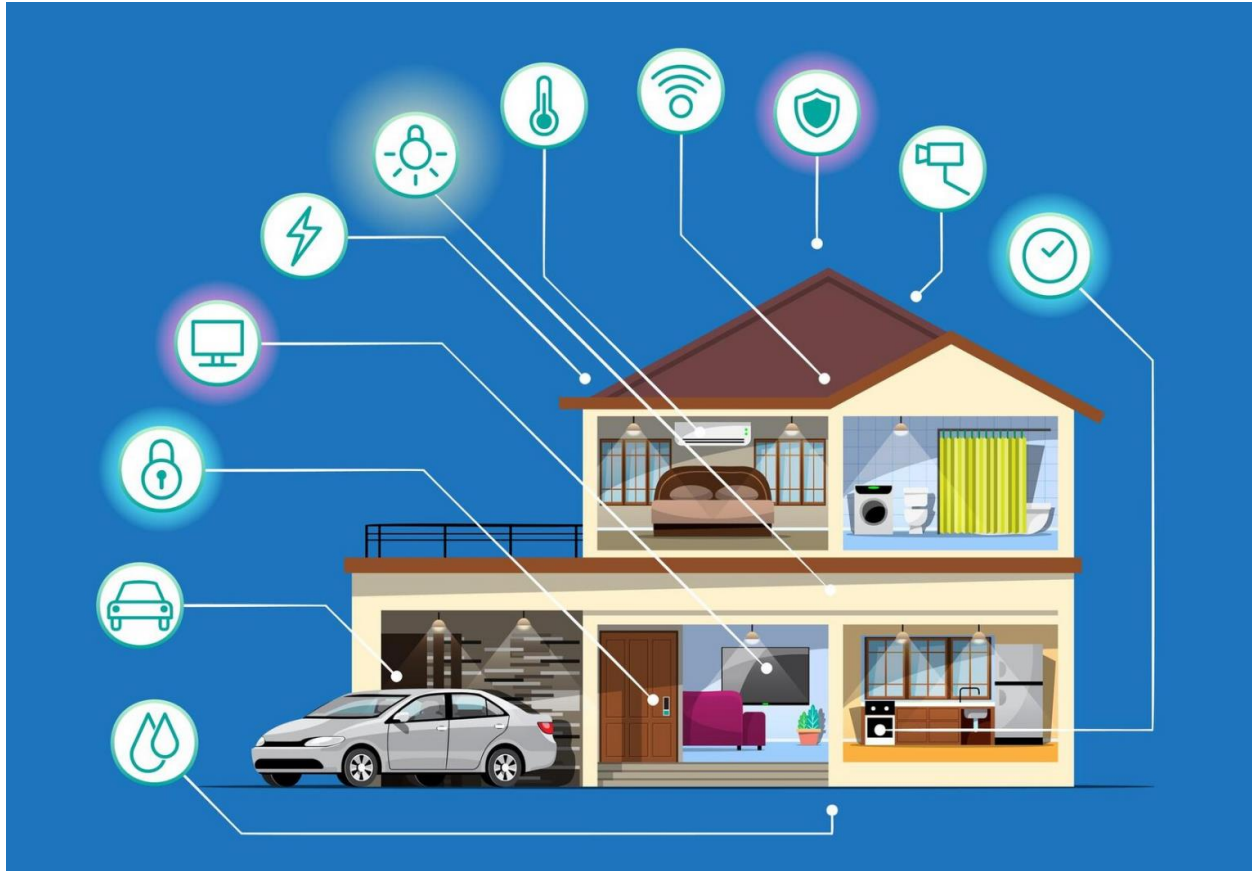
Home Automation Systems:

Home automation is the use of technology in the home that offers users comfort, convenience, safety, and energy efficiency.

The extra security of the home setting, for instance, might enhance the quality of life for the elderly and disabled who would typically depend on carers or institutional care. Home automation is expected to get increasingly more popular and available to more people as technology advances and gets more reasonably priced.

Certain smart home features, such as automated door locking systems, watering the garden, and controlling lights, fans, and alarms with laptops or smartphones, are all controlled by these devices. Broadly speaking, "domotics" refers to any smart home gadget that combines several services and technology to enhance security and quality of life. These systems usually use several sensors to gather information, which is then utilized to automatically modify the home environment in several ways.

On the other hand, users may also operate their homes manually, giving them more control. Homeowners can benefit from increased comfort, energy efficiency, convenience, and security with the aid of smart home technology.



Not only can these sensors open windows without a person being there, but they can also close, lock, or unlock the garage door, control the temperature within the house, provide the right amount of light in each room, activate the sprinkler system when the floor gets too dry, and many other functions. This technology leads to new technologies that allow for home automation.

Many devices and appliances in homes nowadays, including air conditioners, lights, security systems, and entertainment systems, are linked to the Internet. The home environment can be remotely controlled from laptops or PCs, and it can be continuously monitored to control energy use or maintain a precise desired temperature. Home appliances and devices that have Internet connectivity help homeowners accomplish their goals more conveniently and effectively as energy savings and cost reductions become more and more essential to them.

Achievements:

To ensure that a project is moving forward as intended, milestones act as checkpoints. To ensure the project's successful completion, several milestones will be followed in the research and development of the smart home automation project. These benchmarks will be part of the project.

- Project aims and goals.
- The requirements for designing home automation.
- Creating intelligent home automation with Cisco Packet Tracer design.
- Using Cisco Packet Tracer to test the automation of smart homes.
- Finding problems with the layout.
- Correction of errors.
- Examining outcomes.
- Making a report for a presentation.
- Launching the project.
- Compiling the project's final report.

These are a few of the significant benchmarks that must be met to guarantee success. Every significant milestone, however, is also made up of more manageable actions or sub-milestones that the project team will decide on later.

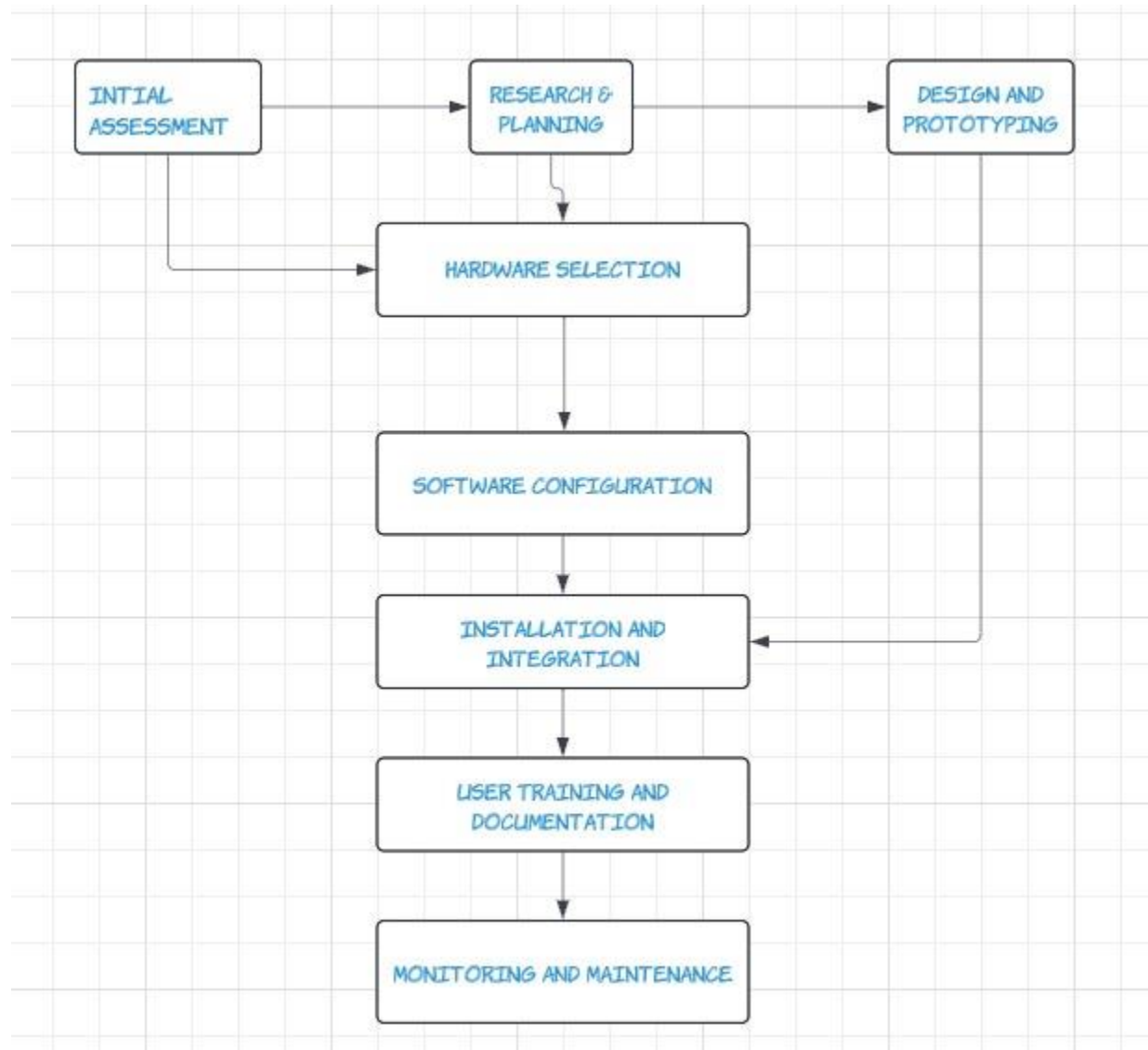
Design and Technical Goals:

To construct this project with a wireless connection, we are employing Cisco Packet Tracer since it allows the user to control his home gadgets from anywhere at any time. In addition, selecting technical instruments that are appropriate and compatible for the user to use correctly is crucial when it comes to achieving technological goals. such that the consumer is happy with his home's intelligent functionality.

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Diagram for the planning:



The Goal of the Project:

Creating a networked system that can automate different household appliances and gadgets and give homeowners more convenience and control is the aim of IoT-based smart home automation. This system can give inhabitants real-time data and insights

so they can make informed decisions regarding energy usage, security, and other aspects of the home by utilizing IoT-enabled devices like smart lighting, fans, and security cameras. This project can create a secure and controlled environment for testing and development by simulating the behavior of Internet of Things devices and network connections using Cisco Packet Tracer.

Describing all the Technologies:

We have employed a variety of gadgets in this smart home automation, with the following designs and procedures for all the processes:

Hardware Requirement:

- Internet of Things (IoT) devices: doors, windows, sirens, smart lights, fans, lawn sprinklers, water level monitors, smoke detectors, and security cameras, solar panels.
- Wireless router
- Home gateway
- 2960 Switch

Software Components:

Since it can send packets and monitor hardware through a PC or mobile app, the simulation environment also contains software components.

Methodology:

We utilized Cisco Packet Tracer for network configuration and simulation. The fact that the simulation has a variety of smart home automation items, like sensors, lights, fans, water sprinklers, windows, and lights, is also intriguing. Multiple devices can be connected wirelessly to an Internet of Things home gateway, which also gives the connected devices automatic addressing. Users may effortlessly operate and keep an eye on their electronic equipment with the use of a PC interface or smartphone.



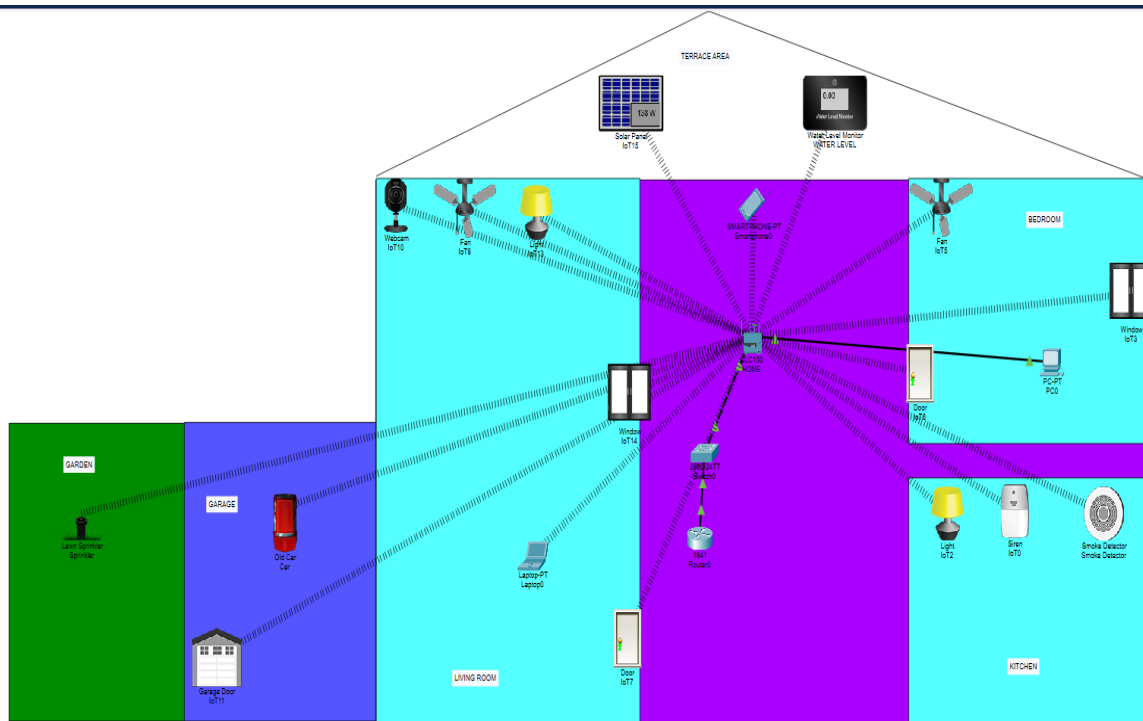
The Home Gateway Wi-Fi Network serves as the connection point for the numerous IoT devices that make up the suggested system. A laptop, PC, or smartphone are examples of electronic devices that users can use to access and manage the system. A home network can facilitate communication between any IoT device. A device's information may also trigger a network message to another device, instructing it to take the proper action in response to a user's selection.

Routing in a network:

The basic concept of routing involves choosing a path for traffic to take to reach its destination network. Using a routing system, the IP protocol in TCP/IP enables connections to be made between various physical networks. To identify computers that are part of a subnet, IP addresses utilize a bit group similar to the most important bit.

The network number, also known as the routing prefix, and the host identification, which makes up the remaining field, are the two logical fields that make up an IP address. An identifier for a specific host or network interface makes up the remaining field.

Implementation of a Secure Smart Home Automation System:



Smart Home Gateway:

Technology advancement has led to the introduction of numerous smart home technologies, and these technologies are becoming more and more prevalent. A smart house is a place of residence outfitted with technology capable of operating appliances and systems on their own. Numerous variable aspects, including cost, occupant preferences, and building types specific to the technology in question, are involved in managing these ecosystems. Smart homes have a network structure that can communicate with one other both inside and outdoors, automatically adjusting

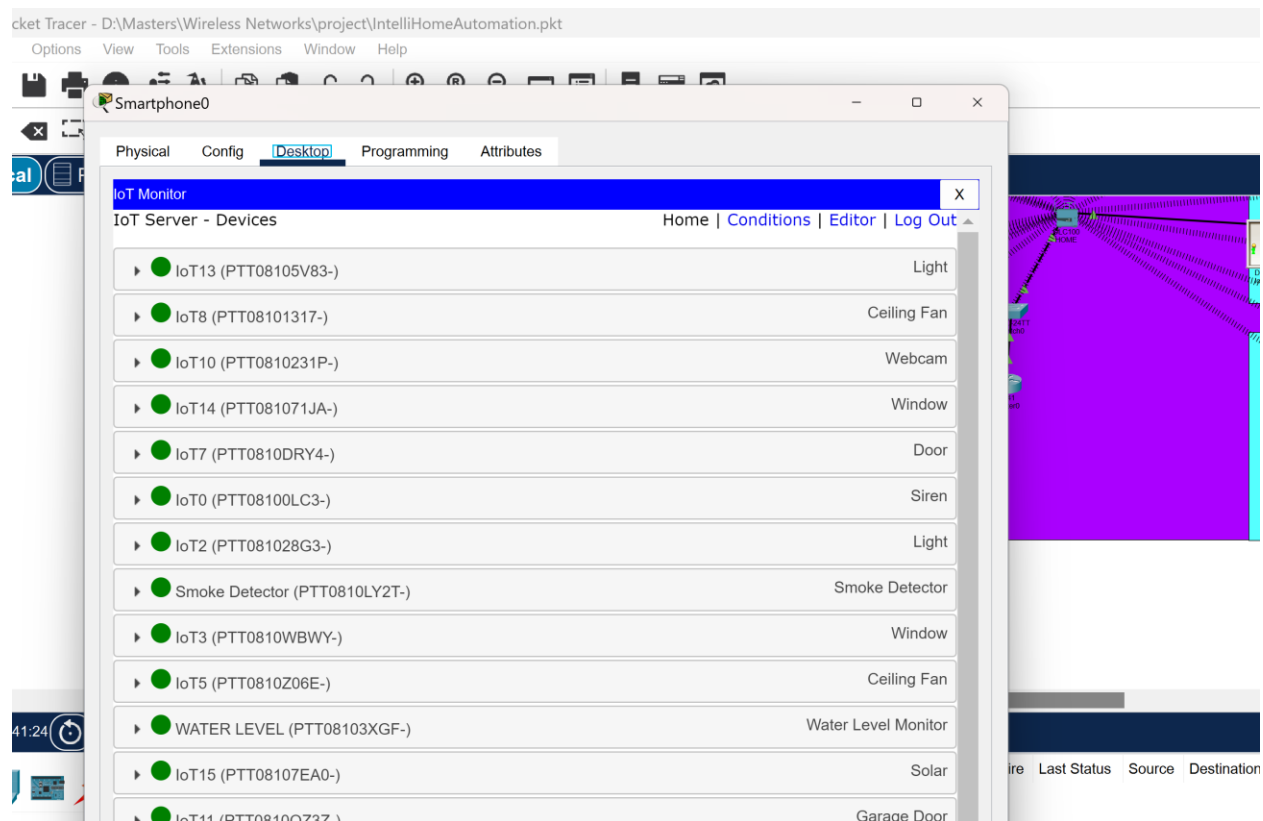
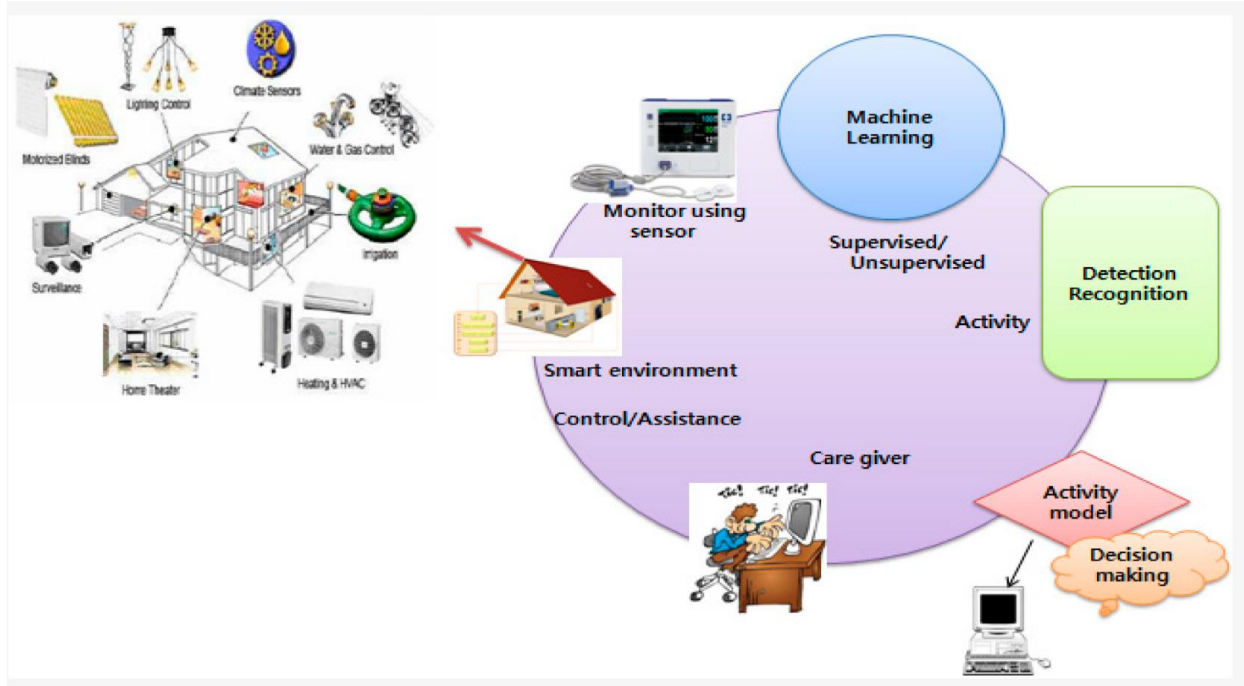
the temperature and security level and offering occupants a range of living options. These networks are constructed using a gateway that provides multiple choices.

- **Several types of home network connections:** Wi-Fi, Ethernet, Bluetooth, Zigbee, and cellular are just a few of the various kinds of network connections. It's crucial to select the connection that works best for your home automation needs and applications because each of these connections has pros and cons. For instance, Ethernet is renowned for its speed and dependability, but Wi-Fi is a common option for wireless device connections and Internet access. IoT and home automation systems frequently use Z-Wave and Zigbee.
- **Home Network and Internet Connections:** It's critical to have dependable and secure Internet connections to guarantee the smooth operation of the smart home and the protection of private information from illegal access. To safeguard the home network, network security techniques like WPA2 encryption are employed.
- **Home appliance diagnostics and remote control:** Two of the most crucial aspects of smart homes are these capabilities. Users can remotely monitor and operate their household appliances with the help of the remote control. To facilitate communication between smart home devices and the home network, which enables remote control and diagnostics, this function is made possible by combining IoT and a variety of sensors.
- **Adaptable methods for software update and expansion:** The system should be able to incorporate new services and devices that are compatible with it, hence increasing its capability through third-party integration. As a result, we could adapt their smart home to suit their unique requirements and tastes.
- **Reliable and secure remote operation method:** Using encryption techniques to safeguard transferred data and secure communication protocols critical to ensuring secure remote operation. Authentication and authorization are also essential steps to take before granting consumers remote access to household gadgets. The following outlines the security criteria for gates in smart homes. Security for gateways is crucial.

- **Privacy:** Encrypting sensitive data with a unique key and blockchain technology can guarantee secrecy by limiting access to authorized personnel only.
- **Integrity:** To guarantee integrity, a hash function can be employed to track and validate recorded data while lowering the possibility of data corruption during transmission.
- **Authentication:** By using the blockchain, you can confirm that a network member is legitimate and set up scheduled checks to make sure the configuration is correct.

Modeling the Simulation Environment:

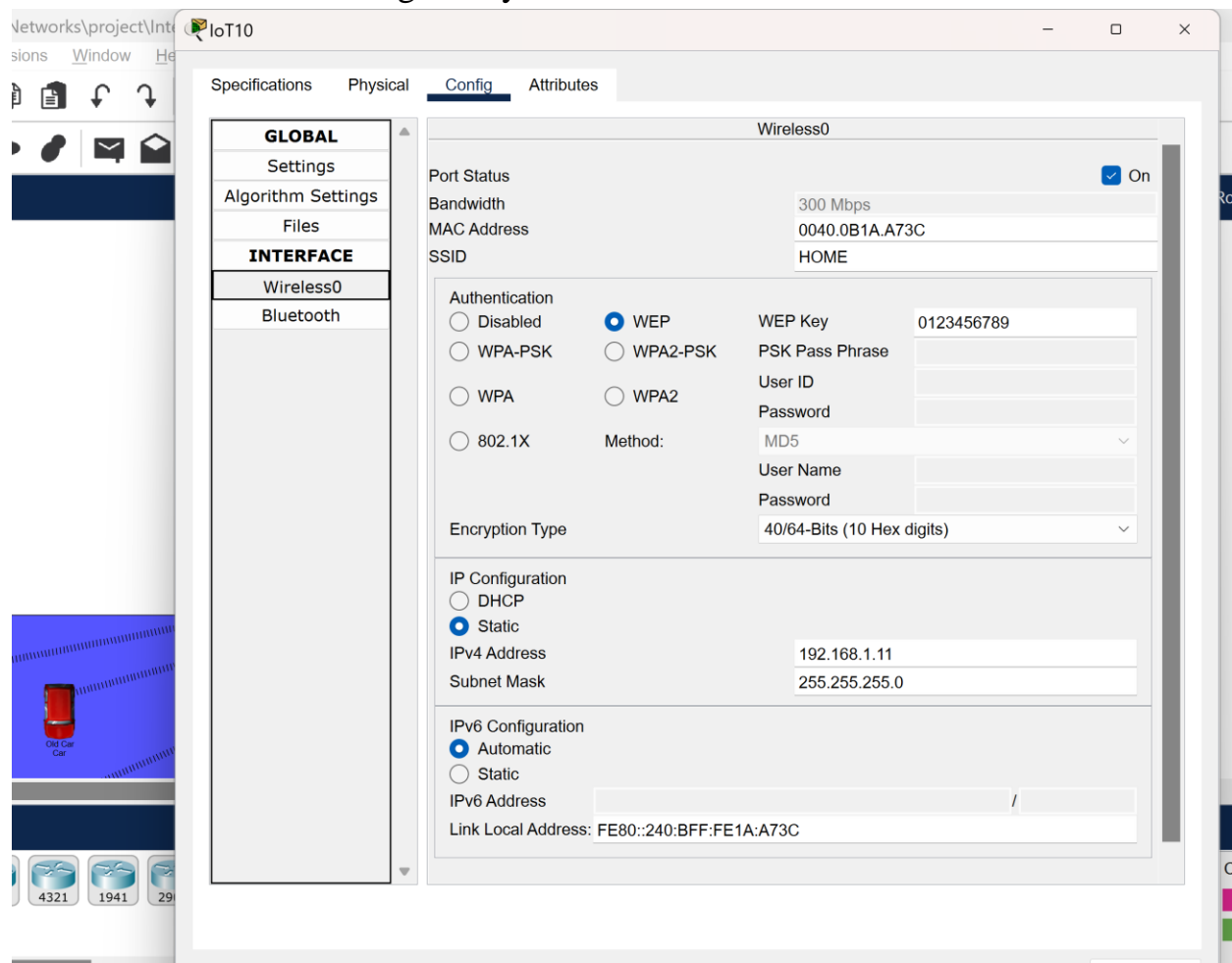
Now let's move on to the simulation process. Automation is involved, and there are many devices in the smart home automation network. To ensure that every smart device functions as intended, we must first assign its static IP address to the same default gateway address.



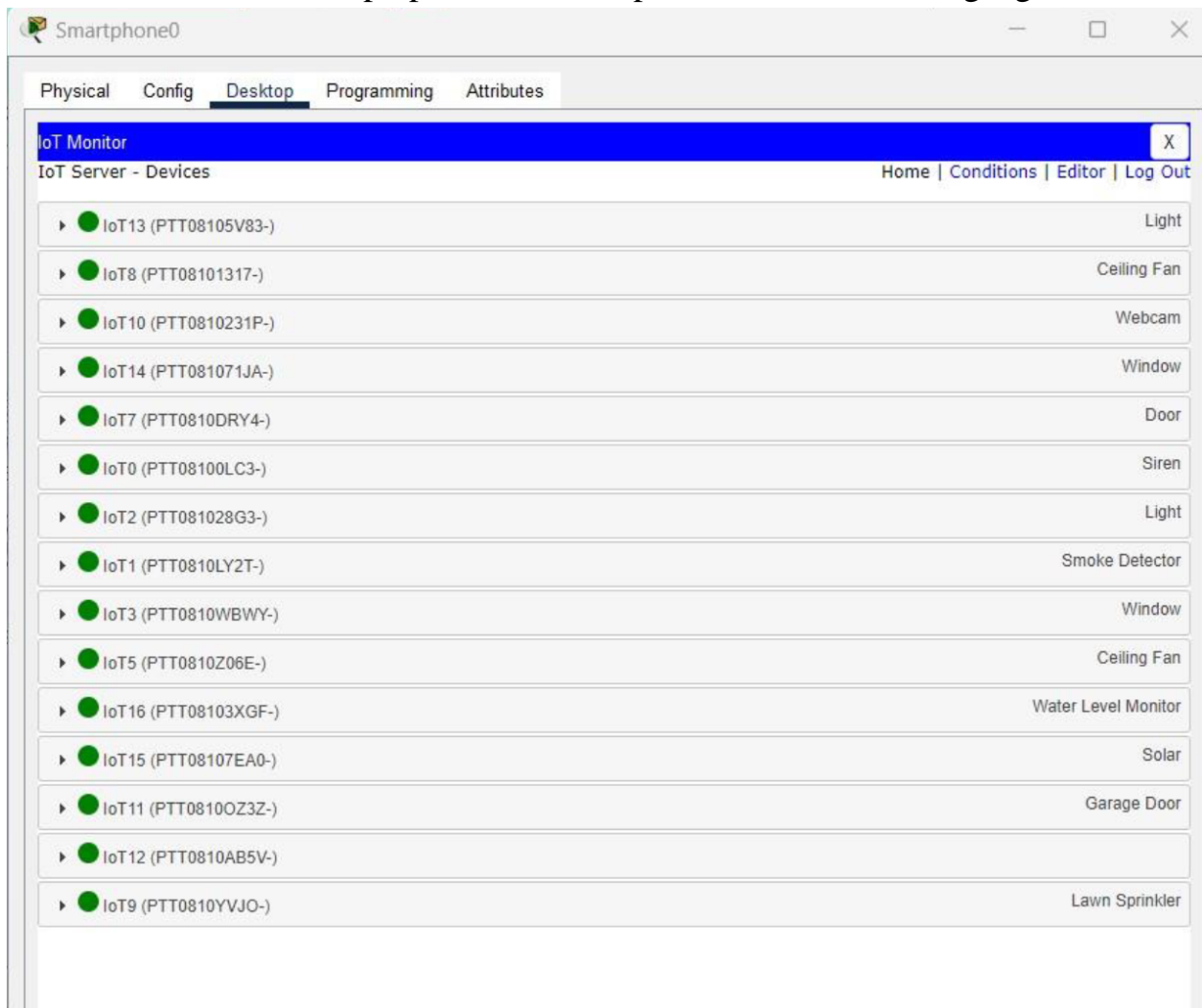
The fan and light are examples of the devices that are operational in the network topology diagram above, as shown by the toolbar. The "ON" position is occupied by these two gadgets. The above simulation diagram displays the control parameters.

Device Configuration and Setup:

- All of our smart devices use the home gateway as their primary port, therefore we have to set up WEP authentication on each device using a 10-digit lock code.
- Thus, we set up the SSID name "HOME" and the WEP authentication code "0123456789" following the project.
- Class C IP addresses are used to configure Internet of Things devices. The IP address and default gateway I used was 192.168.1.1.



- Next, we configured the following settings for the smart device: Select the network adapter as PT-IOT-NM -1W by clicking on the smart device, then selecting the "Specifications" tab, then on "Advanced", going to "I/O Configuration", and finally selecting "Configuration".
- Followed the same process for these parameters for every device.
Consumers can use laptops, PCs, or cell phones to access these gadgets.



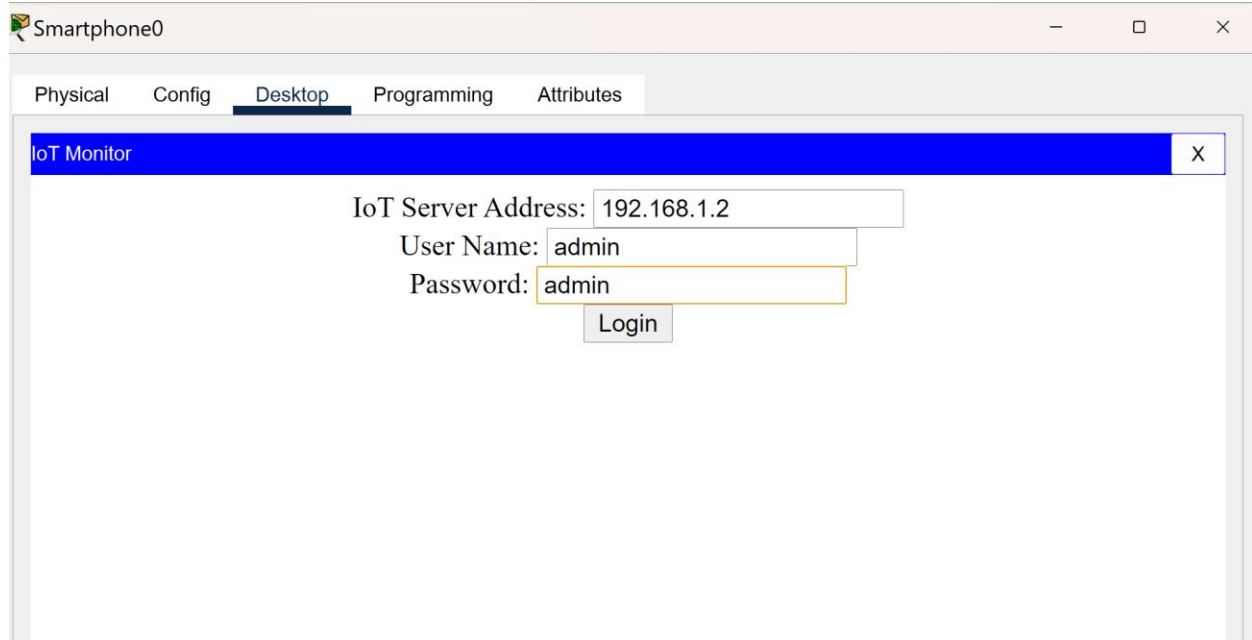
- After that, we configured each element of equipment required for intelligent operation without the need for manual labor. For instance, by adding some water level constraints to the devices, we can build up an automatic watering system in case the landscape is too dry.

The screenshot shows the 'IoT10' application window with the 'I/O Config' tab selected. The window contains a list of hardware configuration options on the left and their corresponding settings on the right. The settings are as follows:

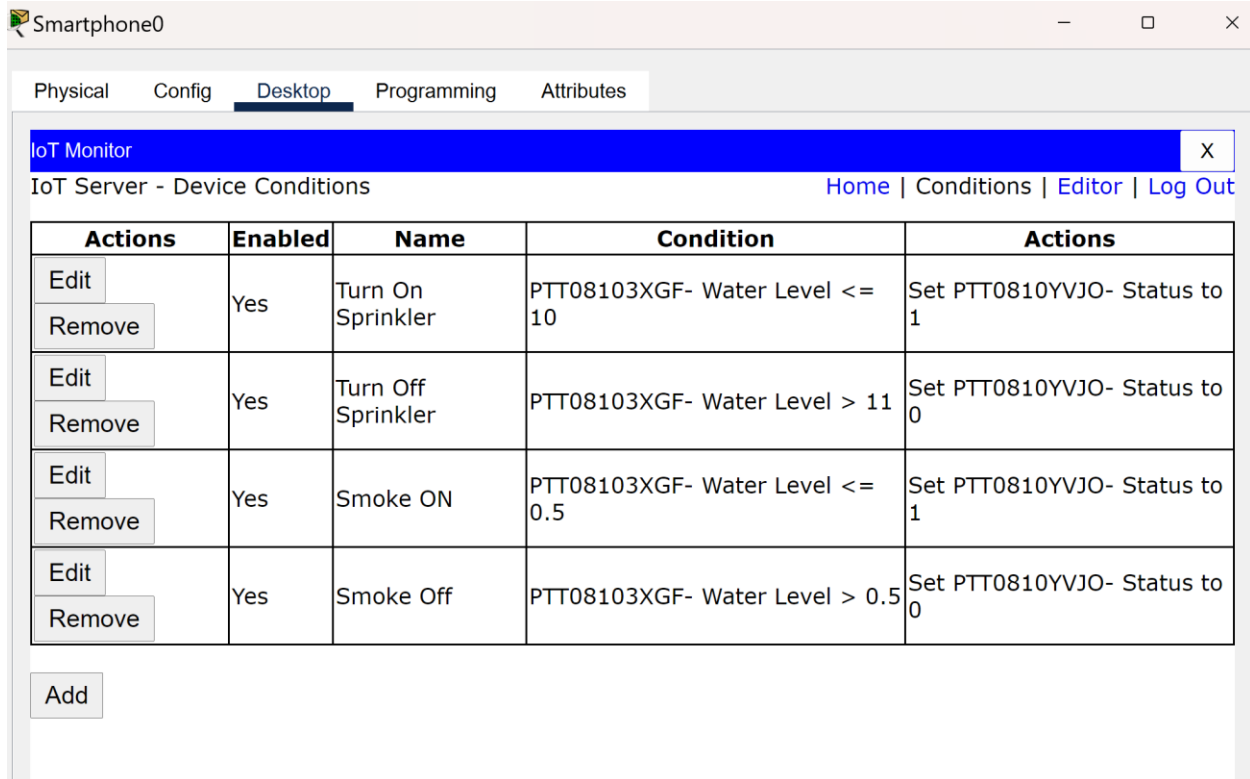
Configuration Option	Value / Setting
Network Adapter	PT-IOT-NM-1W
Network Adapter 2	None
Digital Slots	1
Analog Slots	0
USB Ports	0
Bluetooth	<input checked="" type="checkbox"/> Built-in
Desktop	<input type="checkbox"/> Show
Usage	<input checked="" type="radio"/> Smart Device <input type="radio"/> Component

At the bottom of the window, there is a 'Top' button with a checkbox and an 'Advanced' button.

- Navigate to the Desktop, select IoT Monitor, and enter the home gateway's IP address to generate login credentials (password and username).
- To view all the devices used for their home automation, the user needs to retrieve the address of the IoT server.
- The ensuing figure displays the web user interface.



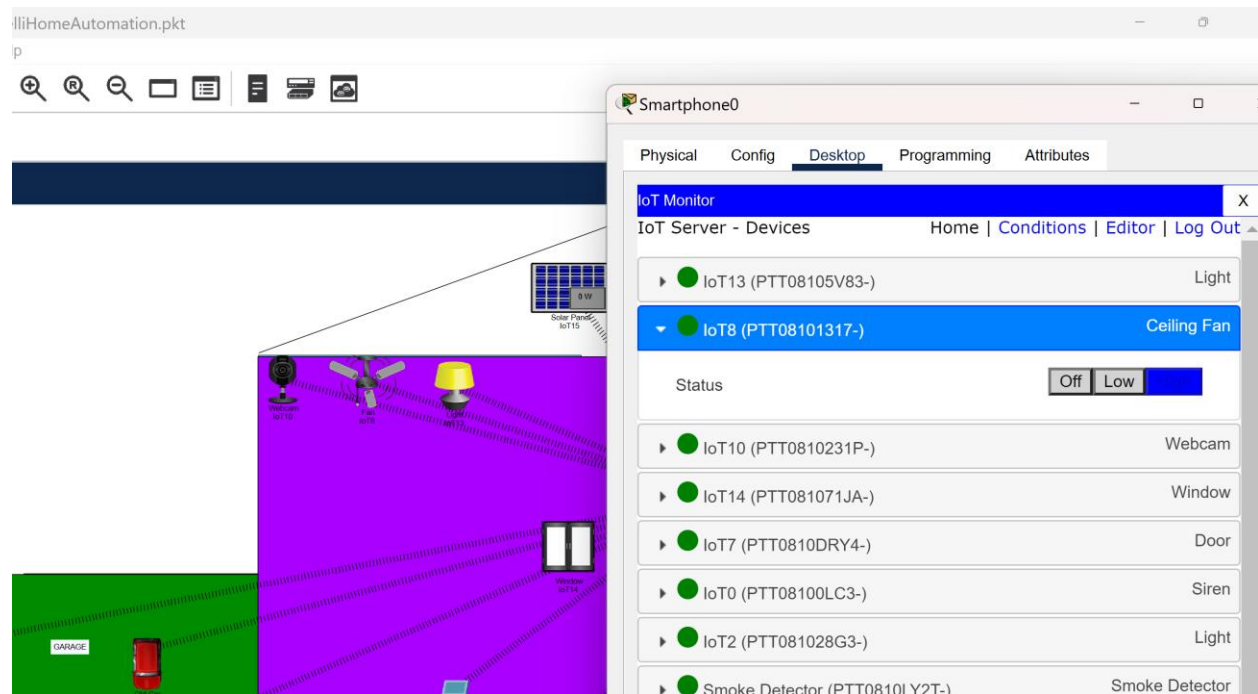
- The primary idea is to secure the house by using wireless communication to operate all equipment. Next, we can use a web browser to monitor these devices, so we'll also need to set up a web interface using the IoT server's address.
- Next, we must generate the login credentials and password to enable the user to keep an eye on the household equipment from anywhere in the house. The user can monitor all devices safely and securely by utilizing the IP address and the default gateway address.
- The taskbar of the smart devices is automatically prioritized for the operations shown in the following figure.

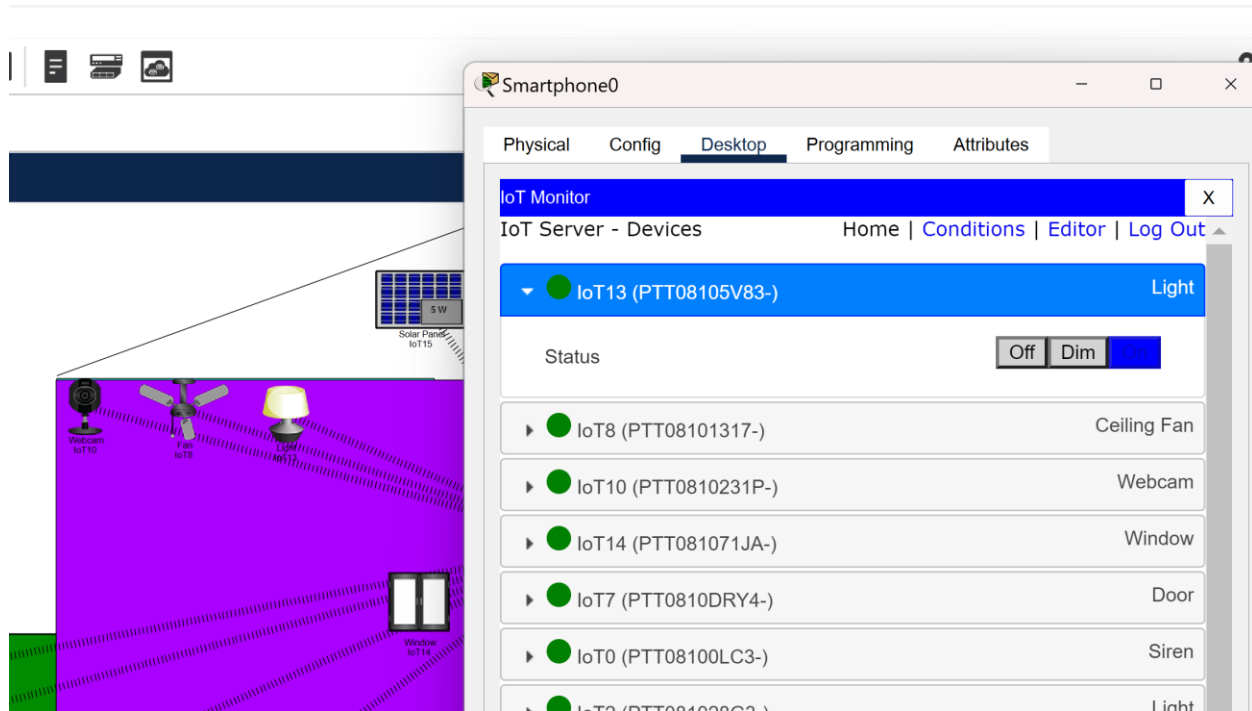


- The user can then add conditions based on their needs after that. As depicted in the preceding illustration. For instance, the sprinkler needs to water the garden if it is excessively dry.
- When the ground gets dry, the sprinkler will water itself automatically if certain requirements are met. In a similar vein, I've also included the smoke detector's requirements.
- Lastly, we can monitor every device from a laptop or PC as well as a smartphone by connecting to the network. To control these smart home gadgets, the user merely needs to know the address of the IoT device server.

Results:

This idea offers a workable way to install smart home technology to offer energy savings and security of some kind. Because the house is safe when we utilize these gadgets, this model also demonstrates how to prevent some of the causes when we are not at home. In addition to saving energy, this model is sustainable for usage by coming generations.





Discussion and Analysis:

In order to minimize human labor, it is believed that the project as a whole is built on intelligent home automation. Making the development at each person's home is preferable. Given that everyone is busy these days and that we should at least take some sensible action to minimize manual labor at home, intelligent home automation is quite helpful for our everyday lives. Not only can we preserve energy for future generations, but we can also save personnel.

Conclusion:

The concept of a smart home that can support several home automation systems has been put out by the project. Sensors, wireless connectivity, tracking, and monitoring are all connected in a smart home. The designed components for this project, including sensor circuits, smartphone notifications, home navigation, and IP camera monitoring and tracking of the house, were discussed. An effective smart house strategy was suggested and put into practice in this project.

References:

- [1]. Md. Ariful Islam, 2023. “HOME AUTOMATION USING CISCO PACKET TRACER”.
- [2]. G.L.P Ashok, P. Saleem Akram, M. Sai Neelima, J. Nagasaikumar, A.Vamshi, 2020. “Implementation Of Smart Home By Using Packet Tracer”. INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH VOLUME 9.
- [3]. Ghaliya Alfarsi, Jasiya Jabbar, Ragad M Tawafak, Sohail Iqbal Malik, Abir Alsidiri, Maryam Alsinani, 2019. “Using Cisco Packet Tracer to simulate Smart Home”. International Journal of Engineering Research & Technology (IJERT).
- [4]. Pitcheri Praveen Kumar, Murali Krishna, “M,R Ramprakash, 2019. Design and Implementation of Smart Home using Cisco Packet Tracer Simulator 7.2”. International Journal of Innovative Technology and Exploring Engineering (IJITEE).
- [5]. Krishna Teja Sanisetty, Tirumala Swaroop Chapidi, Sushil Lekhi, Greeshma Sri Bijjam, Siddhu Naik Battu, D S S Kalyani Kavya Madhavarapu, 2024. “Formulating and Implementing Smart Home Automated System Using Cisco Packet Tracer”. 7th International joint conference on computing sciences.