VANIER COLLEGE - Computer Engineering Technology
247-609 Networked Embedded Systems

Lab 1 : Introduction to IoT on PT

Leonardo Fusser (1946995)

Purpose:

a) To understand the functionality of various components in an IoT system.
b) To familiarize with IoT simulation on Packet Tracer platform.

To be submitted :

Apart from demo, an informal report is required by deadline stated in MS Teams.

- Attach final design file.
- Necessary screen shots (with explanation and descriptions) to show the results of your work.
- Analysis and discussion of your results, so conclusion is required in the report.

Lab Work:

Part A : Auto lighting in smart home

1. Using PT, design a basic smart home system where a light is turn on when the main door is opened. Your system should at least consist of :
    a. A home gateway.
    b. A door.
    c. A light.
    d. A smart phone for the purpose of monitoring and setting up conditions.

2. Perform a screen shot of your PT workspace that show your working system.

    ➢ Refer to screenshots (Figures 1 and 2) on the next page.

Note: for all the following parts (A, B and C), the same core components are used in Cisco PT. Those being the IoT smartphone and the home gateway. The IoT smartphone is used for accessing the home gateway's IoT management webpage and the home gateway is in charge of connecting up and managing all the IoT end devices in Cisco PT. The only changes that will occur are newly added IoT end devices and home gateway IoT actions/rules. A basic private class C network has been configured beforehand for the Cisco PT IoT system.

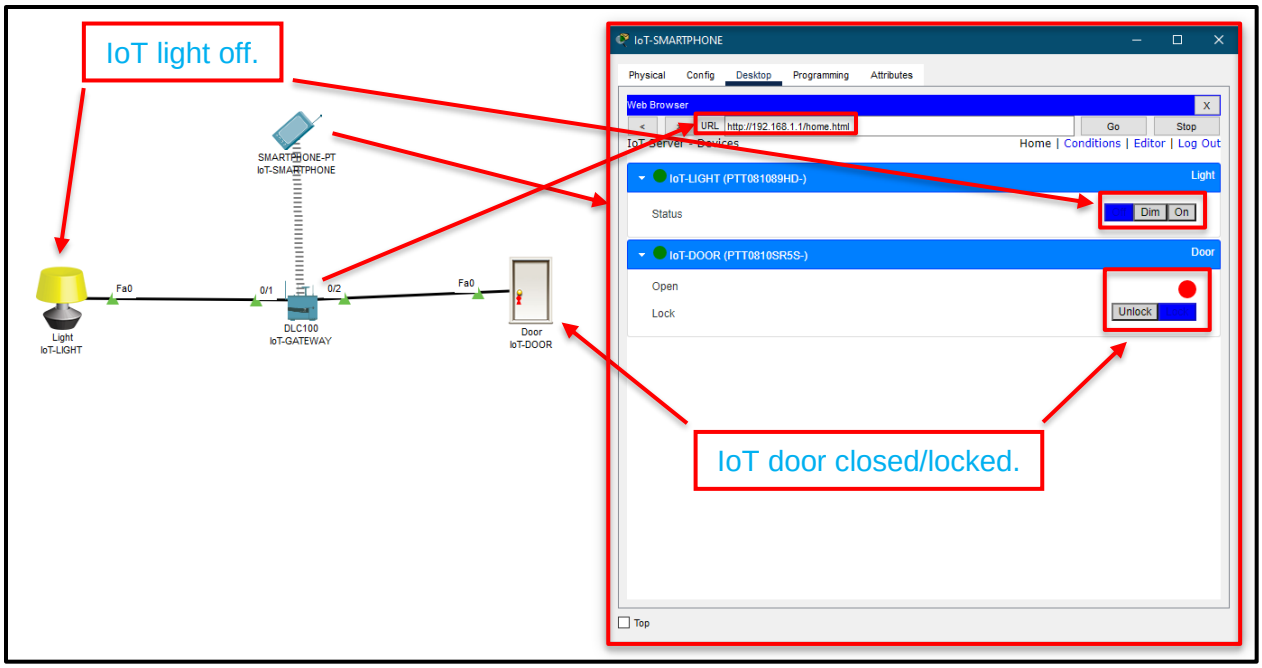

Figure 1. Part A Cisco PT IoT network. Four components are used in this IoT network. Those being the IoT light, IoT smartphone (for monitoring), IoT door and home gateway (for management). All of the IoT end devices and the home gateway are configured with basic network settings (IP address, wireless SSID, etc.). On the home gateway, two conditions are set: 1) when the home gateway sees that the IoT door is closed/locked, the IoT light does not turn on. 2) when the home gateway sees that the IoT door is open/unlocked, the IoT light turns on. The above screenshot shows what happens when the home gateway sees condition 1.

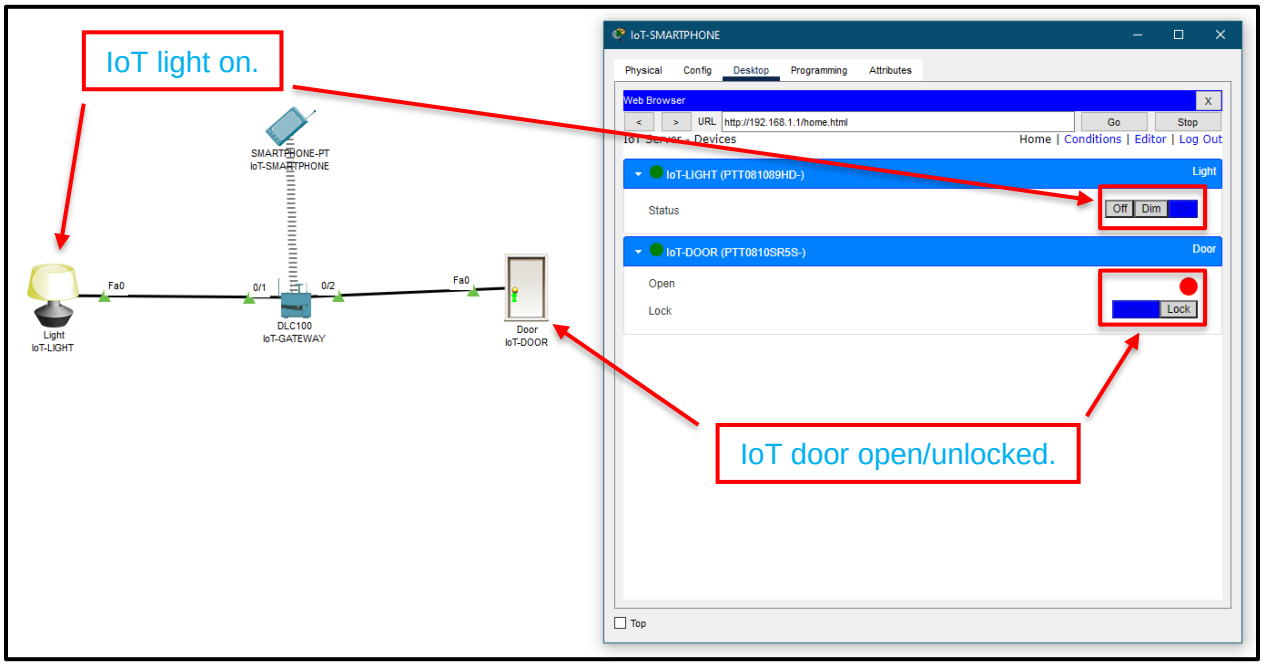

Figure 2. Same Cisco PT IoT network shown in figure 1 above. The above screenshot shows what happens when the home gateway sees condition 2.

Part B : Auto garage door in smart home

3. Expand your smart home by adding an auto garage door. When carbon dioxide detector detects high level of CO2, the garage door should open to vent CO2. Your system should at least consist of :
    a. A garage door.
    b. A CO2 detector.
    c. An old car, which when turn on, will increase CO2 around it.

4. Once the CO2 level reduced to a safe level, the garage door should be automatically closed again.

5. Perform a screen shot on the workspace to show your design.

    ➢ Refer to screenshot (Figure 3) below.

6. Perform a screen shot on the condition(s) setup to achieve this automation. Also explain any other steps/modification made to carry out this simulation.

    ➢ Refer to screenshots (Figure 3 and 4) below and on the next page.

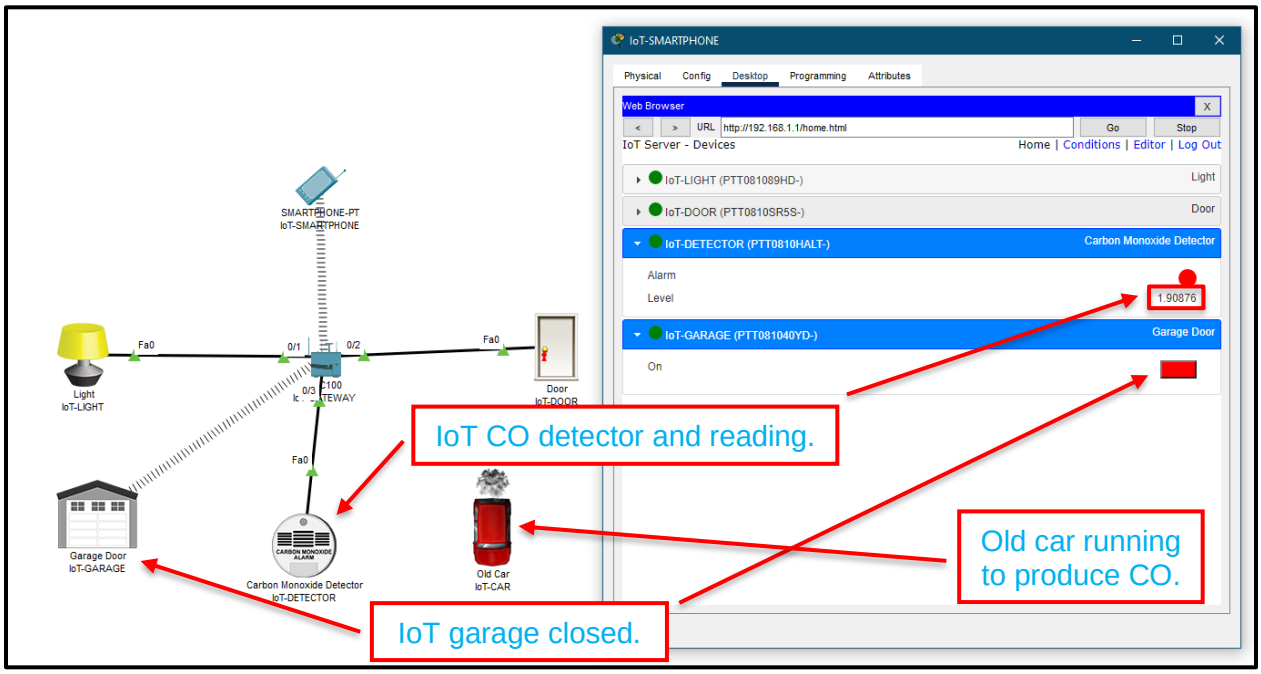

Figure 3. Part B Cisco PT IoT network. Three components are added in this IoT network. Those being the IoT garage, IoT CO detector and an old car. The new IoT end devices were configured appropriately to join the existing IoT network. On the home gateway, two new conditions are added: 3) when the home gateway sees that the IoT CO detector has a CO reading below 3, the IoT garage closes/stays closed. 4) when the home gateway sees that the IoT CO detector has a CO reading above 3, the IoT garage opens/stays opened. The above screenshot shows what happens when the home gateway sees condition 3.

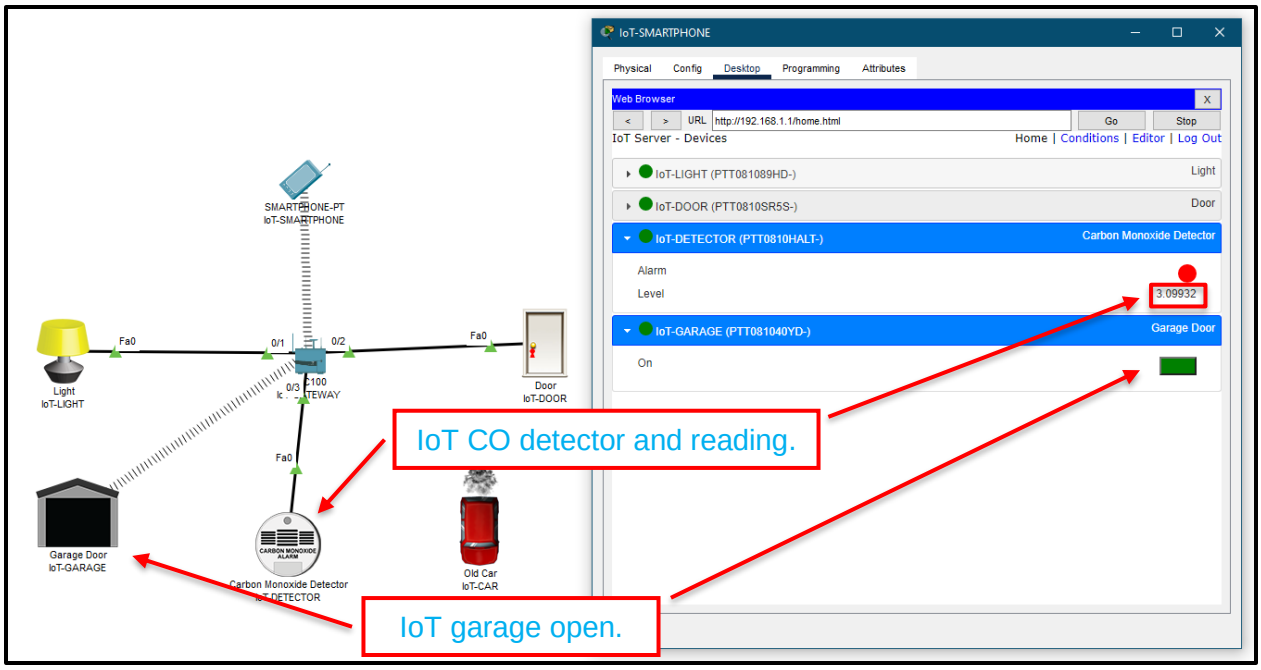

Figure 4. Same Cisco PT IoT network shown in figure 3 above. The above screenshot shows what happens when the home gateway sees condition 4.

Part C : Environment dependant lighting

7. Instead of simply turn on the main light whenever the main door is open, you are now required to enhance the system by turning on the light only when the environment is in low light condition (e.g., at night). Briefly explain the approach that you will be taking to achieve this.

   - An IoT solar panel is needed in order to differentiate between daytime and nighttime. For the above behaviour to occur correctly, the IoT light should only turn on when a IoT solar panel reads exactly 0 Wh, which means it is nighttime, and when the door is open. The IoT light will be off when a IoT solar panel also reads 0 Wh and when the door is closed. Anything else that does not meet these two conditions, the IoT light will remain off.

8. Perform all the necessary modifications on your packet tracer file. Clearly document (with screen shot and explanation) all your changes.

   - Refer to screenshots (Figure 5 and 6) on the next page.

9. Demonstrate your final results to teacher for approval.

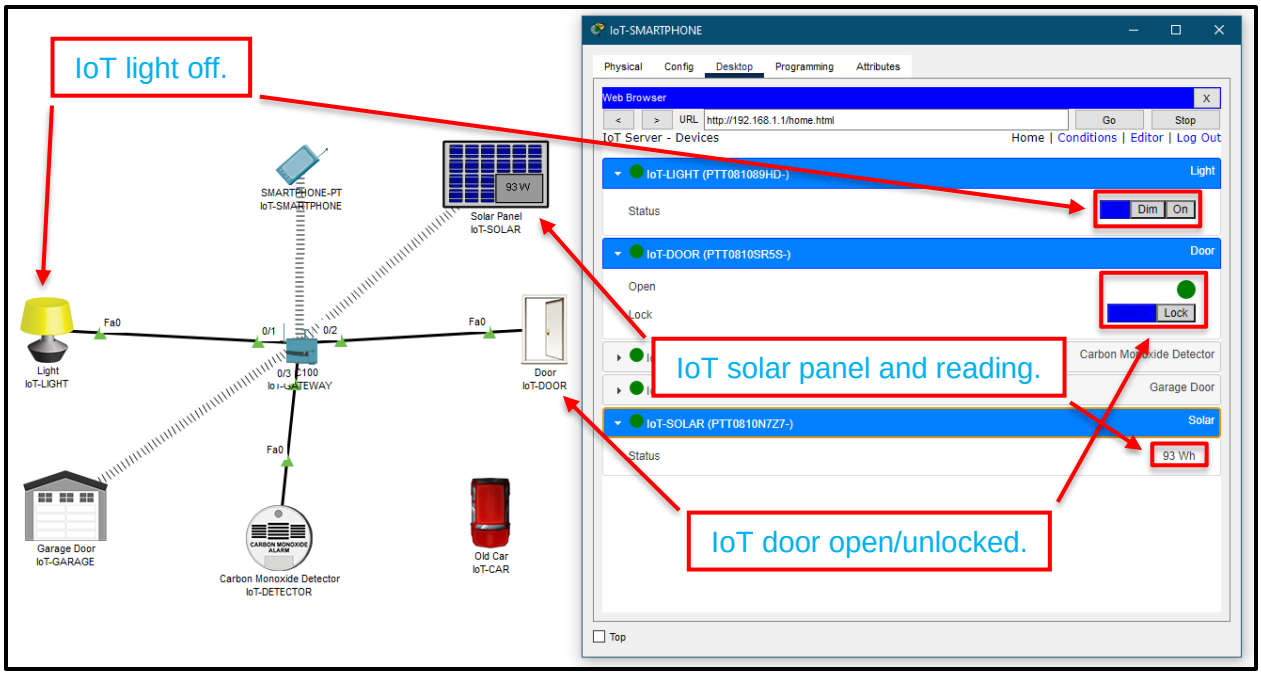

Figure 5. Part C Cisco PT IoT network. Only one component is added in this IoT network. That being the IoT solar panel. The new IoT end device was configured appropriately to join the existing IoT network. On the home gateway, the first two conditions are modified: 1) when the home gateway sees that the IoT door is closed/unlocked and that IoT solar panel has a reading of 0 Wh, the IoT light is off. 2) when the home gateway sees that the IoT door is open/unlocked and that the IoT solar panel has a reading of 0 Wh, the IoT light is on. The above screenshot shows what happens when the home gateway sees condition 2 (with a reading above 0 Wh).

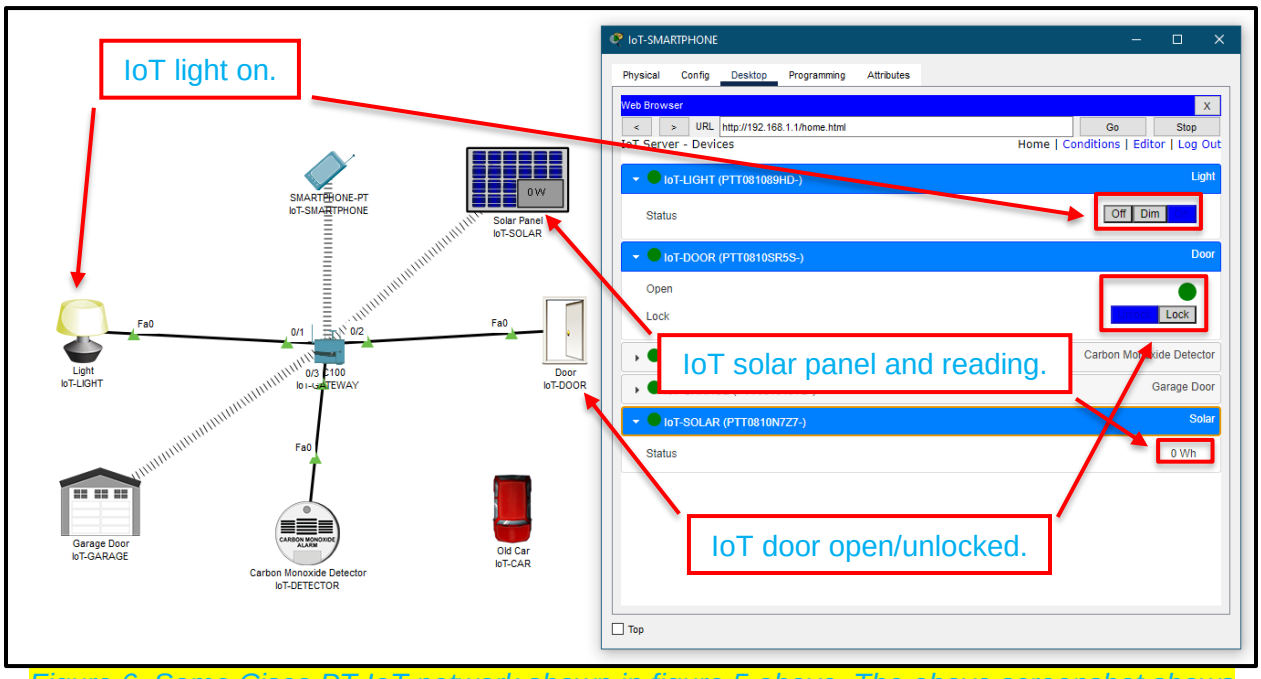

Figure 6. Same Cisco PT IoT network shown in figure 5 above. The above screenshot shows what happens when the home gateway sees condition 2 (with a reading of 0 Wh).

Discussion:

- For Part A, the beginning phase of the IoT system in Cisco PT was executed. Two main components were initially added in Cisco PT. Those being the IoT smartphone, which serves as a remote IoT management device (to see the statuses of the IoT end devices), and a home gateway, which will act as the IoT core for the subsequent parts of the lab. A basic private class C network was configured on the home gateway, DHCP services were enabled for ease of IoT end device deployment and some minor wireless settings were changed (SSID). To test the functionality of this newly created IoT system, an IoT light and a IoT door were added. Subsequently, two rules/actions were added onto the home gateway to change the status of the IoT light depending on if the IoT door was open/unlocked or closed/locked. If the home gateway saw that the IoT door was closed/locked, the IoT light would be off or remains off. The opposite behaviour would occur if the home gateway saw that the IoT door was open/unlocked.

  For Part B, the IoT system was expanded further to three new IoT end devices. Those being an IoT garage door, an IoT CO detector and an old car. These new IoT end devices were configured to join the existing IoT system (IP address and SSID) except for the old car. Once joined, the home gateway had two new rules/actions generated. Now, when the home gateway sees that the IoT CO detector has a reading above 3, the IoT garage door opens or remains open. Subsequently, when the home gateway sees that the IoT CO detector has a reading below 3, the IoT garage door closes or remains closed.

  For Part C, the IoT system was expanded a little further by adding one new IoT end device, that being an IoT solar panel. Similar to before, the newly added IoT end device was configured to join the existing the IoT system (IP address and SSID). Once joined, the first two rules were modified so that the IoT light would be on or off depending on the time of day. Now, when the home gateway sees that the IoT solar panel has reading of 0 Wh and that the IoT door is open/unlocked, the IoT light will be on or remains on (nighttime). On the other hand, when the home gateway sees that the IoT solar panel has the same reading as before and that the IoT door is closed/locked, the IoT will be off or remains off (nighttime). If none of these conditions are met, then the IoT light will remain off (daytime).

  The overall lab was a success.

Conclusion:

- Successfully understood the functionality of various components in an IoT system in Cisco PT.
- Successfully understood how to expand an existing IoT system in Cisco PT.
- Successfully understood how to manage an IoT system in Cisco PT.
- Successfully became familiar with IoT simulation in Cisco PT.