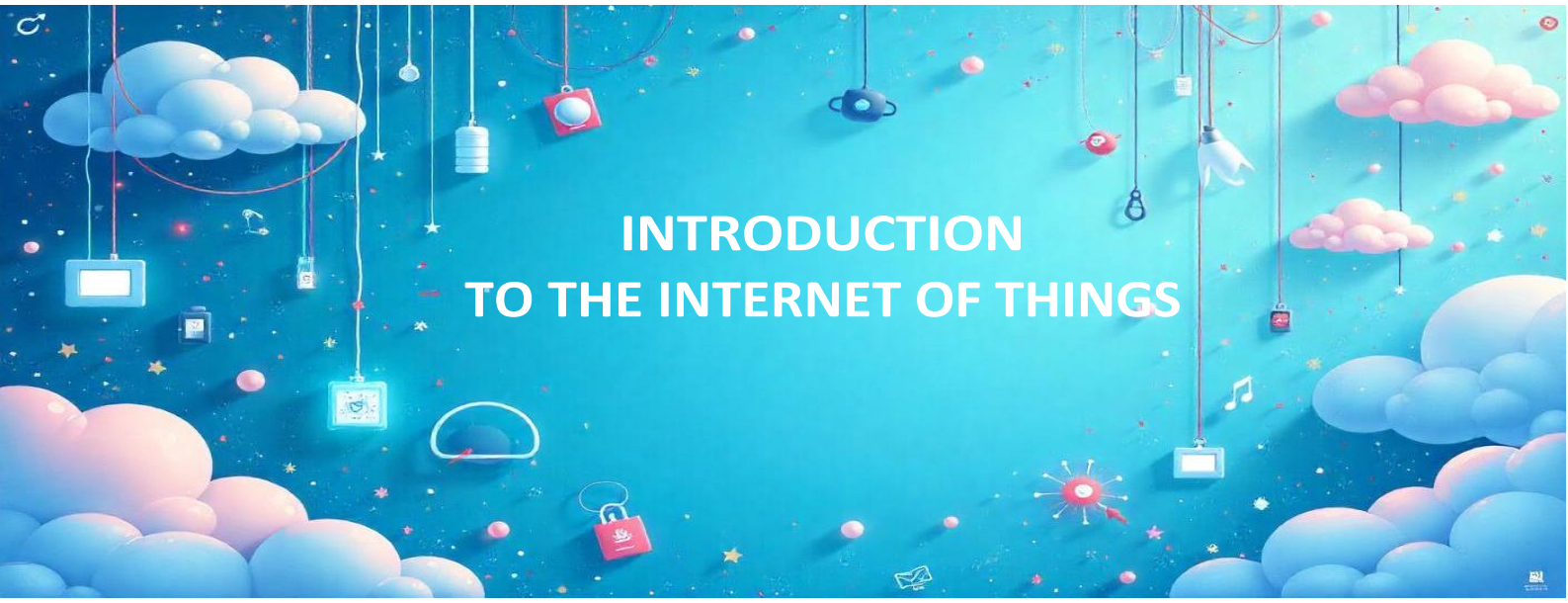

Powered by IEEE TRYEngineering | IEEE STEM Grant

Lesson plan

Lesson summary

In this lesson, we will learn about the basic ideas behind the Internet of Things. The first part will cover some history and theory, as well as a demonstration of how the equipment works. In the second part, we will configure the equipment ourselves to control a device in a "smart" home.

Lesson plan

Lesson stage	Title	Duration (minutes)	Content
0	Organization of activities	3	Introduction, duration, breaks
1	Goal setting, planning	4	Lesson objective, questions and answers on the topic of the Internet of Things
2	Learning new material and developing subject-specific vocabulary	15	Discussing various terms, what things are called, how they work, demonstration of equipment operation of equipment
3	Application setup and working with equipment	23	Installing and configuring the application, connecting a smart light bulb, configuring a script to control the light bulb under the guidance instructor
	Break	5	
4	Independent work to reinforce the material studied	30	Working with sensors, coming up with your own scenario for smart home, assemble and configure everything, or draw and present it to the group
5	Discussion of results, reflection, and assignment	10	Summing up the results, what was done, what worked out. Task description: create your own smart home project

Educational outcomes

Subject-specific:

- familiarization with the concepts of: the Internet of Things, sensor, data transfer protocol, device address, application, script;
- logical operators;
- practical skills in working with software and equipment.

Meta-subject:

- development of speech in the field of subject vocabulary in different languages;
- development of skills in connecting existing knowledge with new knowledge, comparison, and analysis;
- developing skills for synthesizing new ideas.

Educational models and forms of work in class

- working with the teacher: explaining the material, questioning, generating new ideas;
- individual practical work;
- group work.

Class schedule

Stage 0. Organization of activities

The recommended group size is 5-6 people. The lesson is adapted to the age of the participants: for younger schoolchildren, demonstration of the equipment and independent work under adult supervision; for older children, independent configuration of equipment and scripts.

At the beginning of the lesson, participants are introduced, and the duration of the lesson and breaks are announced .

Theoretical part

Stage 1. Goal setting, planning

The topic of the lesson, "Introduction to the Internet of Things," is announced, and participants learn what the Internet of Things is and what we can already use it for.

Teacher's questions:

- Are students familiar with what the Internet is?
- Do they know what the Internet of Things is? How does it differ from the Internet?
- What is a "smart" home? Describe what elements of a "smart" home are present in your home. Provide examples of how they work.

Stage 2. Studying new material and building subject-specific vocabulary

Basic concepts of the Internet of Things

How can you access a specific device? Addressing on the Internet. What is a sensor? Give examples.
How is data transferred between devices on the network? Physical phenomena. What are the rules for data transfer called? Protocols.

First, discussion, then possibly a demonstration using slides.

Demonstration of equipment operation

Using a mobile phone app and/or website, show how to turn a light bulb and/or any other equipment on and off using the the Shelly Plug S Gen3 smart plug, see Fig. 1. Then demonstrate the same thing using a smart speaker and voice commands.

Show what all the sensors look like and name them, discuss how they work, and demonstrate how the sensors work:

— water leak sensor, see Fig. 2;

— motion sensor, see Fig. 3;

— temperature and humidity sensor, see Fig. 4.

Shelly Plug S Gen3 is a compact smart plug that can be used to control household appliances and monitor energy consumption via a mobile app. It connects directly to Wi-Fi and does not require an additional hub, allowing you to set schedules, timers, and automatic scenarios — for example, turning on a lamp in the morning or turning off a heater (air conditioner) when the desired temperature is reached. The socket shows energy consumption in real time, helping you monitor usage and save electricity. Despite its small size, it can handle loads of up to 12 amps, and an LED ring shows the status of the device. The color of the LED ring can be changed, or it can be turned off so that it does not interfere at night.

Figure 1 — Shelly Plug S Gen3 smart plug (description)

Shelly Flood is a sensor that helps detect water leaks in time and prevent flooding, or, conversely, signal the absence of moisture. It works via Wi-Fi and does not require an additional hub, sending notifications directly to the mobile app when it comes into contact with water. In addition, the device measures temperature, which allows it to be used for comprehensive monitoring of conditions in a room — for example, in a basement, bathroom, or under a sink. The sensor is powered by a long-life battery and can be part of a "smart home" system, automatically turning on a pump or shutting off the water in the event of a leak, for example.

Figure 2 — Shelly Flood water leak sensor (description)

Shelly BLU Motion is a compact and energy-efficient motion sensor that works via Bluetooth. It detects movement and transmits a signal to a smart home system or mobile app. This allows you to automatically turn on lights, run security scenarios, or notify the user of movement in the room. The device has a wide viewing angle and a short response time, and a single battery provides up to several years of operation. Shelly BLU Motion can be conveniently installed anywhere — at home, in the office, or at the cottage — and helps make the surrounding space safer and more comfortable.

Figure 3 — Shelly motion sensor (description)

Shelly Wave H&T is a smart sensor that measures air temperature and humidity, helping to maintain a comfortable indoor climate. It operates on the Z-Wave protocol, which ensures stable communication and low energy consumption. The device transmits data to the smart home system, allowing you to automatically control heating, air conditioning, or humidifiers. Shelly Wave H&T can run on a battery for several years and is easy to install

anywhere in your home — in your bedroom, nursery, or office. Its compact and stylish design makes it inconspicuous, and its accurate measurements help create a healthy and energy-efficient environment.

Figure 4 — Shelly temperature and humidity sensor (description)

Other Shelly equipment can also be used, see Fig. 5: window or door opening sensor, various buttons, programmable modules.

Figure 5 — Shelly equipment for a smart home

Practical part

If necessary, you can divide the students into teams. Each team should be provided with a tablet or phone with the mobile application installed. **The equipment should only be configured on it**, as the equipment is linked to the application. This link can be removed, but this will require additional requests to the equipment manufacturer.

If a participant has their own equipment, they can use their own app, which they have previously installed and registered using their email address.

It is recommended that only one application be able to run on the tablet for "smart" home so that participants are not distracted, for example, using TinyMDM.

Step 3. Setting up the app and working with the equipment

Go straight to step 3 if the tablets with the application are already configured.

Step 1. Installing the application

Shelly Smart Control (select and install the application)

Step 2. Authorization in the application

You need to register in the application using your email address. In addition to the application, all control panels will be available via the web interface: https://control.shelly.cloud/.

Step 3. Configuring the smart socket

Plug the Shelly Plug S Gen3 into a power outlet without a device connected. Next, there are several possible scenarios, depending on your app settings. If Wi-Fi scanning is not disabled in your app, the device will be found automatically, see Fig. 6 (left).

If the device was not found automatically, tap "Add Device," and a screen like the one in Fig. 6 (right) will pop up. Select "Scan network" and "Next."

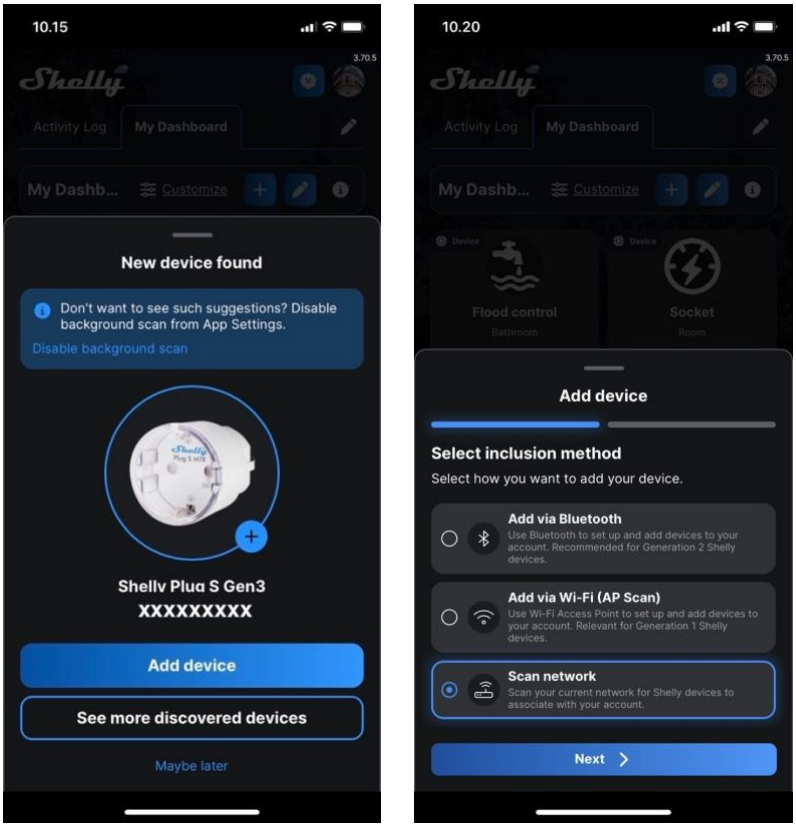

Figure 6 — scenario 1 (left): device found, click "Add device"; scenario 2 (right): click the button to add a new device, now select "Scan network" and "Next."

Once the Shelly Plug S Gen3 device is found, select it from the list of devices, see Fig. 7. If you are connecting the socket for the first time and it does not yet know your Wi-Fi network information, you will need to enter the information to connect to the Wi-Fi network.

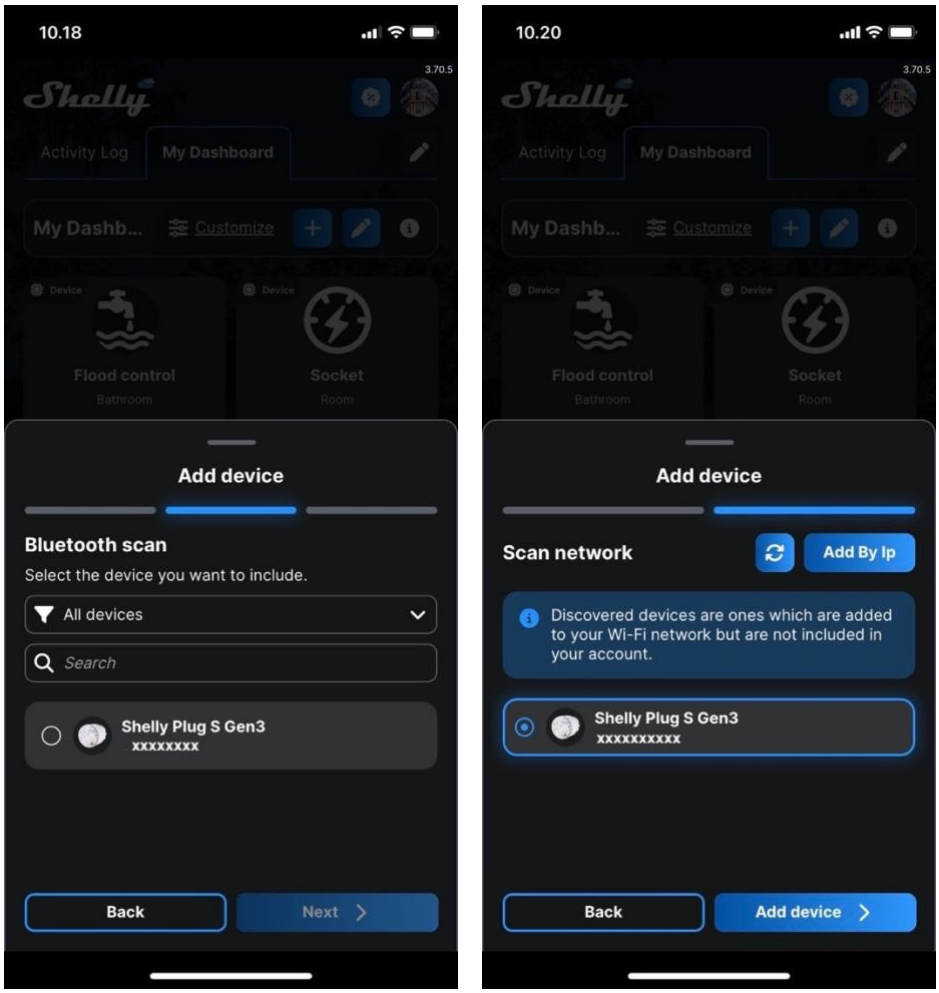

Figure 7 — left: device found during Bluetooth scanning, right: device found during Wi-Fi network scanning

Set the parameters to be used after connecting the device and wait until the application confirms the connection. The device will be connected to your smart home network, see Fig. 8. The LED on the socket will stop flashing. Set the device name and select the group to which you will assign the device, see Fig. 9. Groups are usually assigned based on the location of the device.

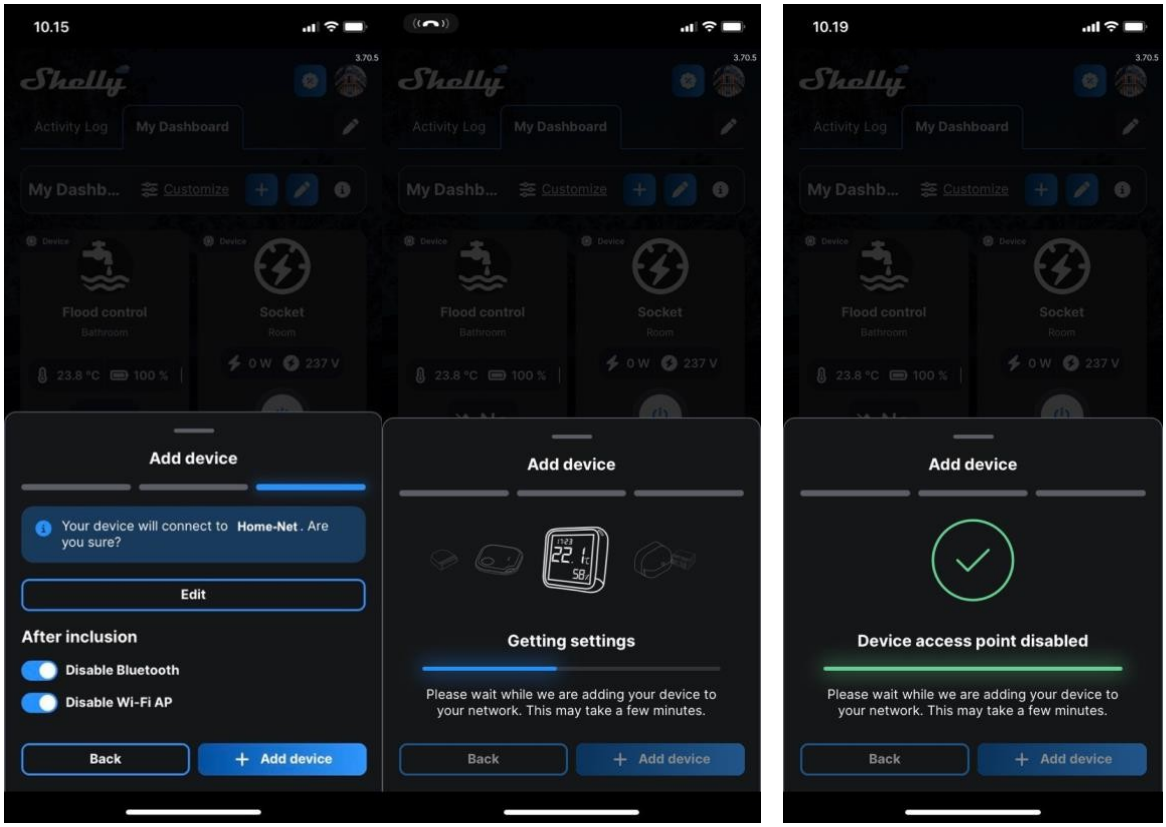

Figure 8 — left: setting the device connection parameters; center: waiting for the device to connect to your device network; right: the device's access points are disabled so that it cannot be detected when scanning the network

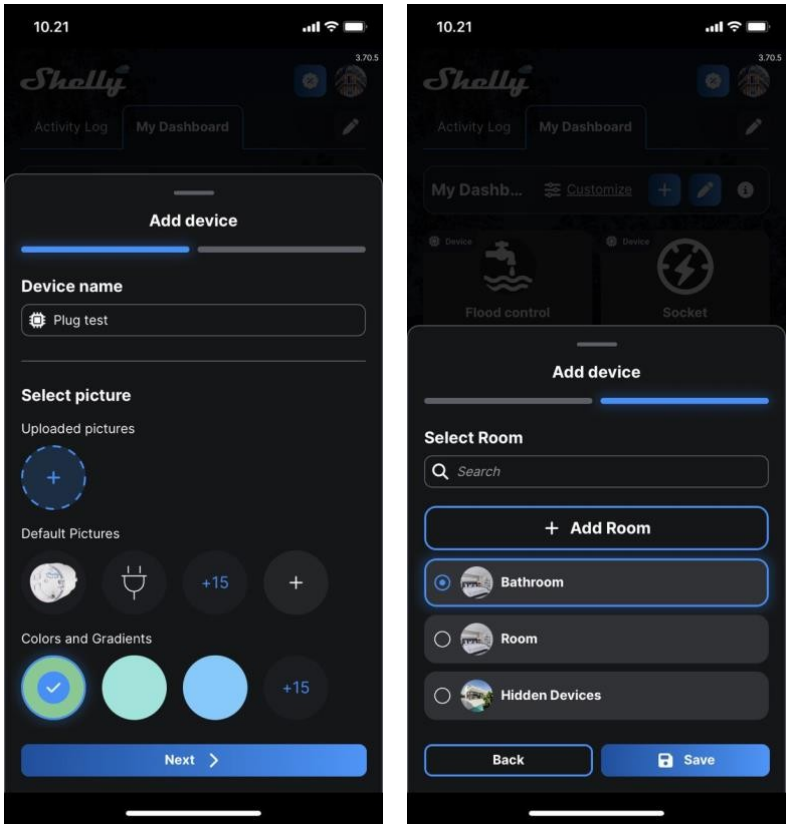

Figure 9 — left: set the device name and how it will be displayed in the app; right: select which device group to assign it to

Open the connected outlet in the app, Fig. 10. Now you can manually turn the outlet on and off to control the connected device. Set up schedules and timers: turn on and off by time, by day of the week, or cyclically.

Shelly Plug S displays power consumption and energy costs in the app. You can view graphs by day, week, and month, which helps you control your electricity consumption.

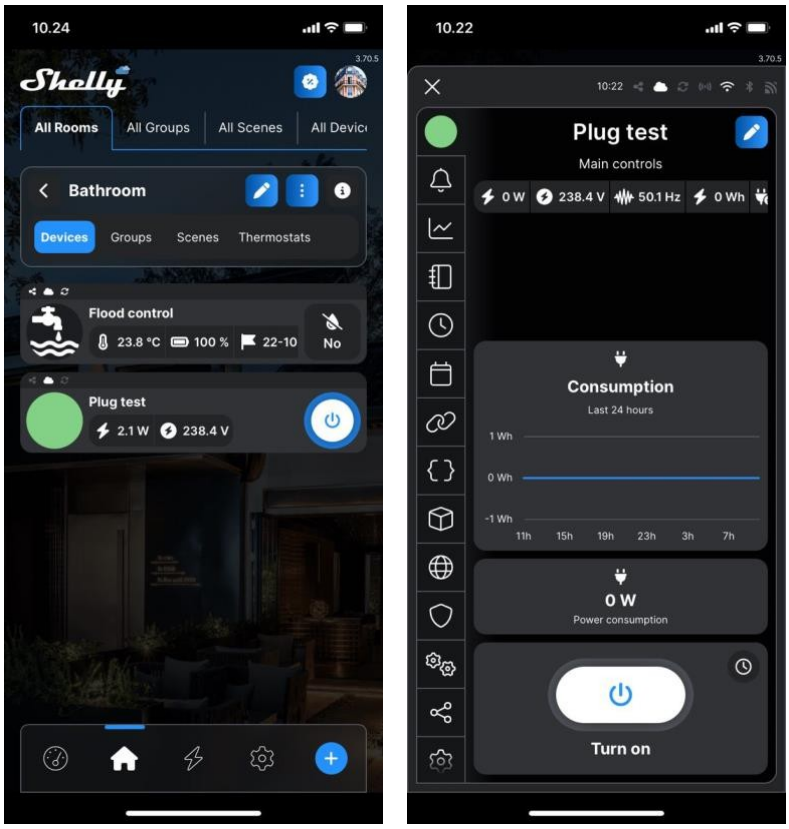

Figure 10 — Display of the "Plug test" device in the app

You can set up the outlet for use with Google Assistant using the Google Home app, enable device status notifications, and configure the LED indicators on the outlet's LED ring (color, brightness, on/off).

In the app, you can set up groups that will include devices, see fig.
11. Determine the total consumption of devices on your home network and monitor the device log, fig. 12.

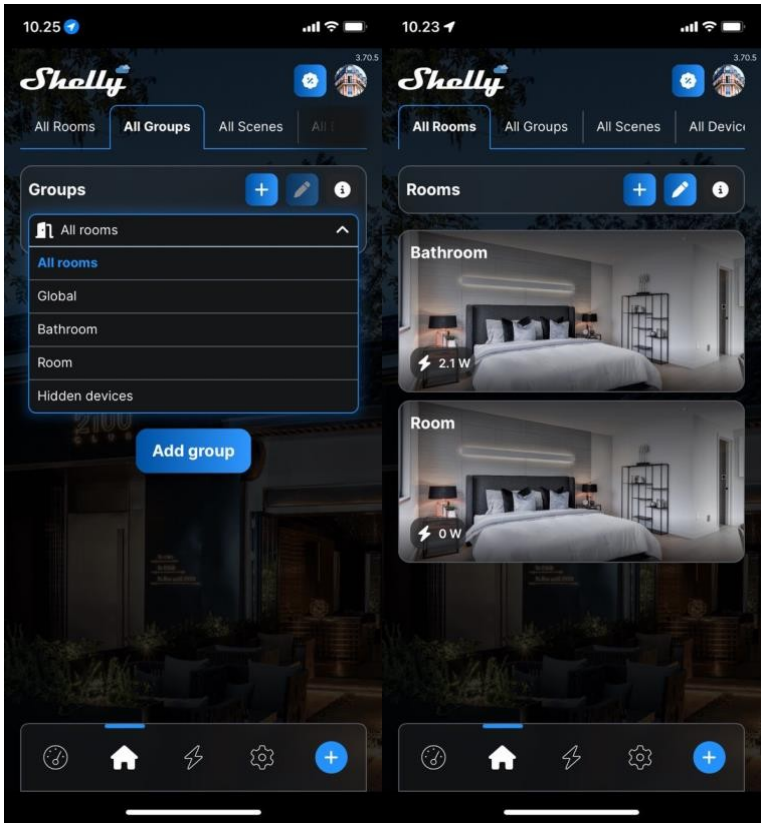

Figure 11 — Setting up device groups

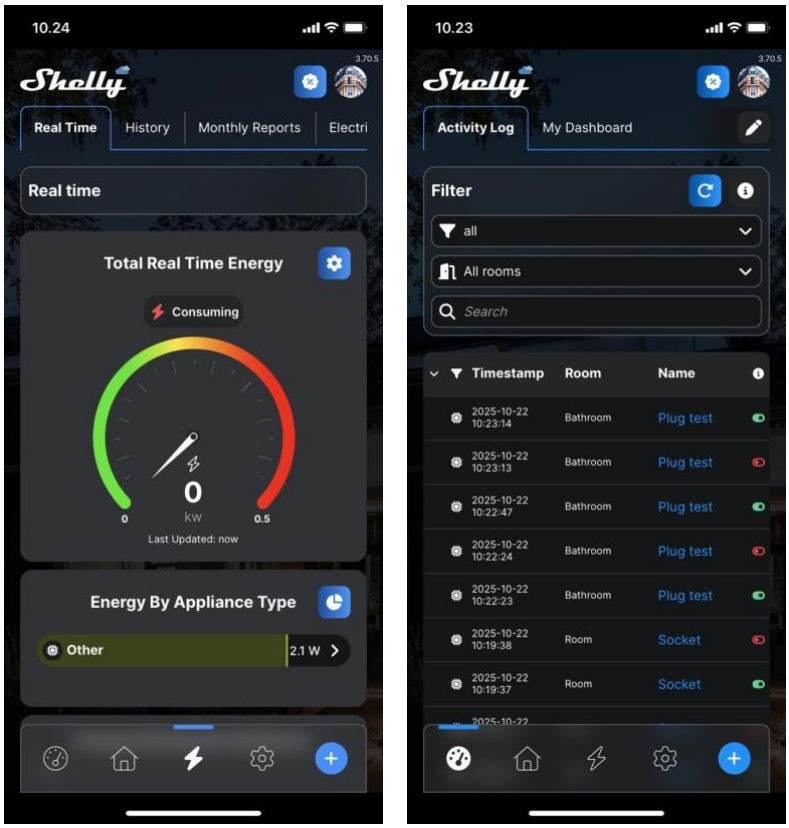

Figure 12 — left: total power consumption; right: network device log

Figure 13 — lamp connected to a smart outlet and Google Nest Mini smart speaker

Step 4. Controlling the outlet

To control the outlet, you can use a timer (see Fig. 14), set an action to be performed, configure a schedule (see Fig. 15), or write a script.

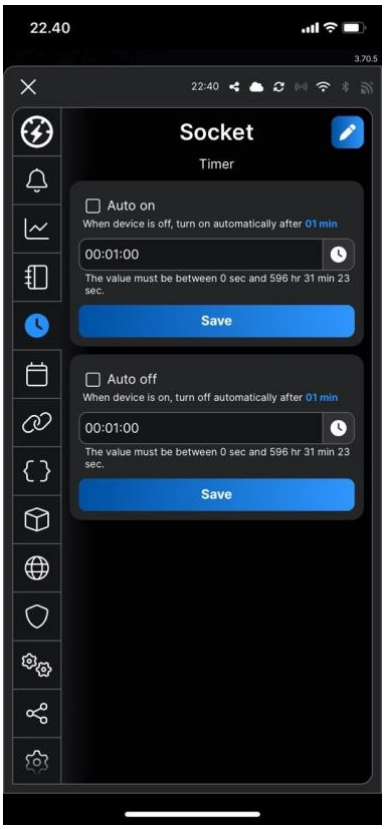

Figure 14 — Lamp connected to a smart outlet and Google Nest Mini smart speaker

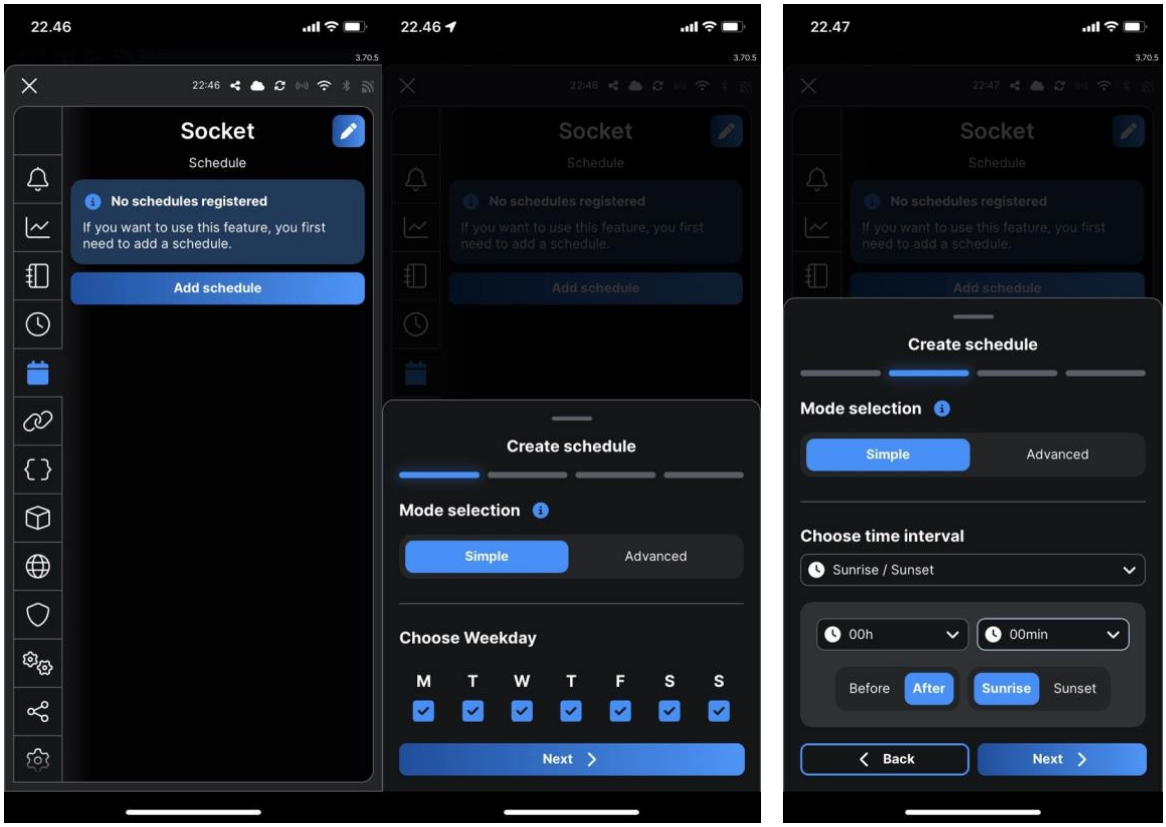

Figure 15 — Setting up a schedule for turning the lights on/off at sunrise/sunset

Stage 4. Independent work to reinforce the material studied

Brief discussion of what sensors are and how they work.
Each team should choose their own sensor to connect to the app.
You need to configure the sensor in the application and check that it is working.
Come up with and create your own script for the equipment to work.
What equipment will be needed for implementation? Discuss how much it will cost.

For younger schoolchildren

Discuss and suggest drawing what smart home elements they already have at home and come up with their own scenarios.
What sensors and other equipment will be needed for implementation? How do they work? What physical phenomena are used? Under what conditions will the script be executed, etc.

Bonus task

Set up voice commands to control equipment using a smart speaker

Stage 5. Discussion of results, reflection, and assignment

Summarize the work. Discuss the following questions: What was done? What worked and what didn't? Is there anything that still seems unclear? Can we say that any home can be made smart?
Tell them about the opportunity to describe their project and enter it in a competition for the best smart home project idea.