

# Guide for Smart Street Lamp Workshop

## Overview

In this workshop, students need to work in teams to design and make a smart street lamp for the government. The smart street lamp is required to be turned on only when sound is detected during the night time(no daylight).

Difficulty Level: 4



## Setup

Age: k3-k6

Number of Participants: 24

- 2~3 students for one team
- Prepare a name label for each student in case they don't know each other
- Arrange tables and chairs in U-shape for each team
- Put tools and other materials in two specified places of the room

## Learning Goals

- Design and make a smart street lamp
- Develop teamwork skills
- Learn to build up a circuit with BOSON
- Use digital media tools to shoot video clips

## **Materials**

- BOSON Inventor Kit V1.0 (Refer to introduction for more details)
- Paper Model (See appendix)
- Colored Paper

## **Tool**

- Scissors
- Colored Pen
- Cutter Knife
- Camera or Smart Phone

## **Time**

2~3 hours.

## **Award and Evaluation Criteria**

Students should be informed of the award and evaluation criteria. Special awards will be given to individuals or teams who perform well in the competition.

## **Process**

- Warm-up

5min      Improvement on normal street lamps

- Introduction

8~12min    a. What is BOSON?    b. Project interaction display    c. Get to know modules and learn how to connect

- Start Making

20~40min    a. Analyze and check    b. Cut paper    c. Assemble

- Test

5min      a. Test structure and function

- Optimization

5~10min    a. Project appearance optimization

- Share

5~20min     a. Video shooting     b. Project presentation

- Evaluation

5min     Project evaluation

- Clean up

5min     Dismantle projects and clean up

- Rethink

5min     Projects review

**Warm-up (5min):** teachers ask some questions about normal street lighting to lead students to think about how to design a smart street lamp.

**Question 1:** common street lamps usually keep on throughout the night, and they need to be turned on/off manually. Is there a way to control the street lamps automatically?

**Answer:** we have noticed that street lamps only work in the night, so we can make them "sense" the day and night, then turn off automatically in the day and turn on in the night.

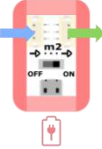





**Question 2:** ordinary street lamps in working hours always keep on regardless of the presence of people, which could waste a lot of energy, how do we solve this problem?

**Answer:** let the street lamp "sense" the presence of people around, turn on the lamp when there are people, otherwise, turn off.

### Introduction(8~12min)

- What is BOSON?
- Project interaction display
- Get to know modules and learn how to connect

What is BOSON?	Teachers play the video below to show students what BOSON is?  <a href="https://www.youtube.com/watch?v=5OnNy8uKOzw">https://www.youtube.com/watch?v=5OnNy8uKOzw</a>
Project interaction present	● Teachers demonstrate the project interaction effect using material objects.

	<ul style="list-style-type: none"> <li>● Present the project effect by playing video</li> </ul>
<p>BOSON module function and connection</p>	<p>Teachers tell students the module name and similar applications in daily life.</p> <p>The smart street lamp needs power from main-board and power source.</p> <p><b>m2 Mainboard-110</b></p> <p>Mainboard-110 can be used to supply power for other modules. Connect the input module to the left, output module to the right, a basic project is ready. Don't forget to connect an external power source to the module.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: center;"> <p><b>Real Case Simulation</b></p>  <p>Phone Charger      Power Adapter</p> </div> </div> <p>Use a light sensor and sound sensor to make smart street lamp sense light and the presence of people.</p> <p><b>i9 Light Sensor</b></p> <p>Light sensor can be used to detect the intensity of the ambient light. It features analog voltage output that is directly proportional to the ambient light.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: center;"> <p><b>Real Case Simulation</b></p>  <p>Night Light Sensor      Photography Light Meter</p> </div> </div> <p><b>i4 Sound Sensor</b></p> <p>A sound sensor is typically used to detect loudness in ambient. It can feel the sound and convert it into related analog signal. We can use the sound sensor to make lots of funny interactive applications and the sensor is also widely adopted in various conditions, such as smartphone, recorder, sound-controlled light, medical machine, and industrial noise detection.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: center;"> <p><b>Real Case Simulation</b></p>  <p>Microphone      Phone</p> </div> </div> <p>Realize lighting function with a bright light LED, it is an actuator.</p>

### o1 Bright Light LED

The bright light LED is a simple white LED module.



### Real Case Simulation

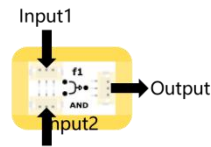


Lightbulb

How can we make the smart street lamp light only when the presence of people is detected during the night time? Since there are two conditions to meet, a logic "And" module is what we need here.

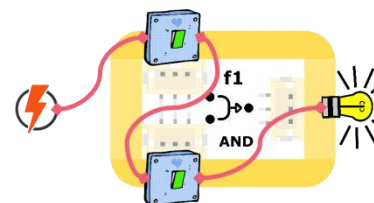
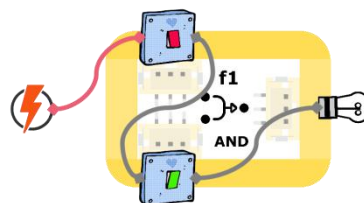
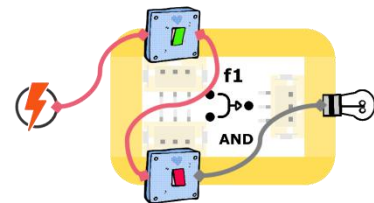
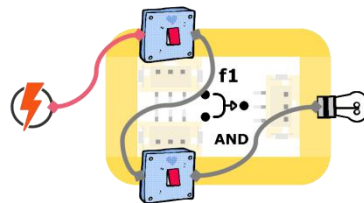
### f1 Logic Module - AND

The AND module can combine the two input signals and output them into one signal. The input and output mechanism is as follows: When the input signal at one or both ends is "OFF" or "0", the module outputs "OFF"; The module outputs "on" if and only if the input signal at both ends is "on" or "1".



### Truth Table

Input1	Input2	Output
0	0	0
0	1	0
1	0	0
1	1	1

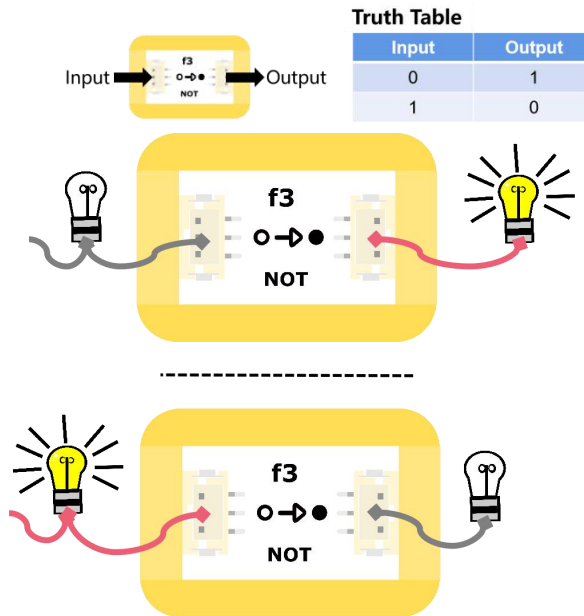


The smart street lamp turns on in the day, and turn off in the night, which is exactly opposite from our expectation.

What should we do? The logic "Not" module works here.

### f3 Logic Module - NOT

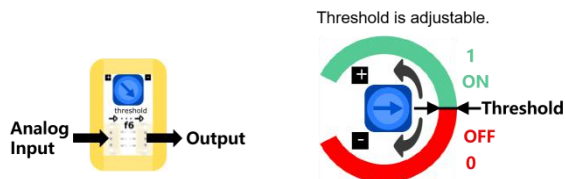
The logic module-NOT can process one input signal and output an opposite signal:  
When the input signal is "OFF" or "0", the module outputs "ON" or "1".  
When the input signal is "ON" or "1", the module outputs "OFF" or "0".

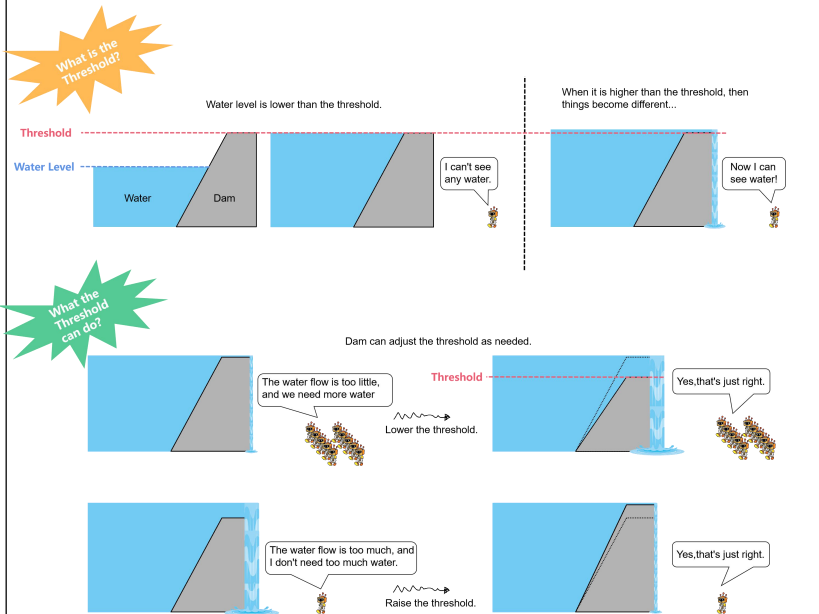


The noise from birds or insects could also be detected by the sound sensor, which may accidentally switch on the street lamp. So we need a "Threshold" module to filter out these small noises.

### f6 Threshold Module

Threshold module will compare the 1-way input signal with the preset threshold value, the output will be different according to comparison result:  
When the input signal is smaller than the threshold, the module outputs "OFF" or "0";  
when the input signal is more than the threshold, the module outputs "ON" or "1".

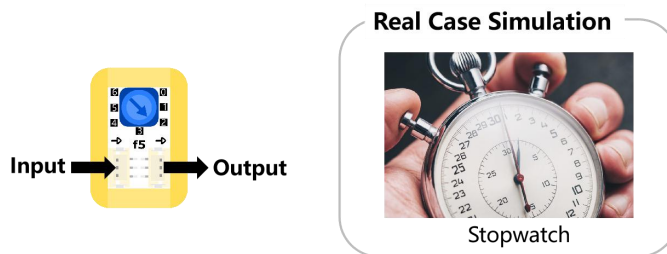




The “Duration” module can make the street lamp keep on for a fixed period.

**f5 Duration Module (0-6s)**

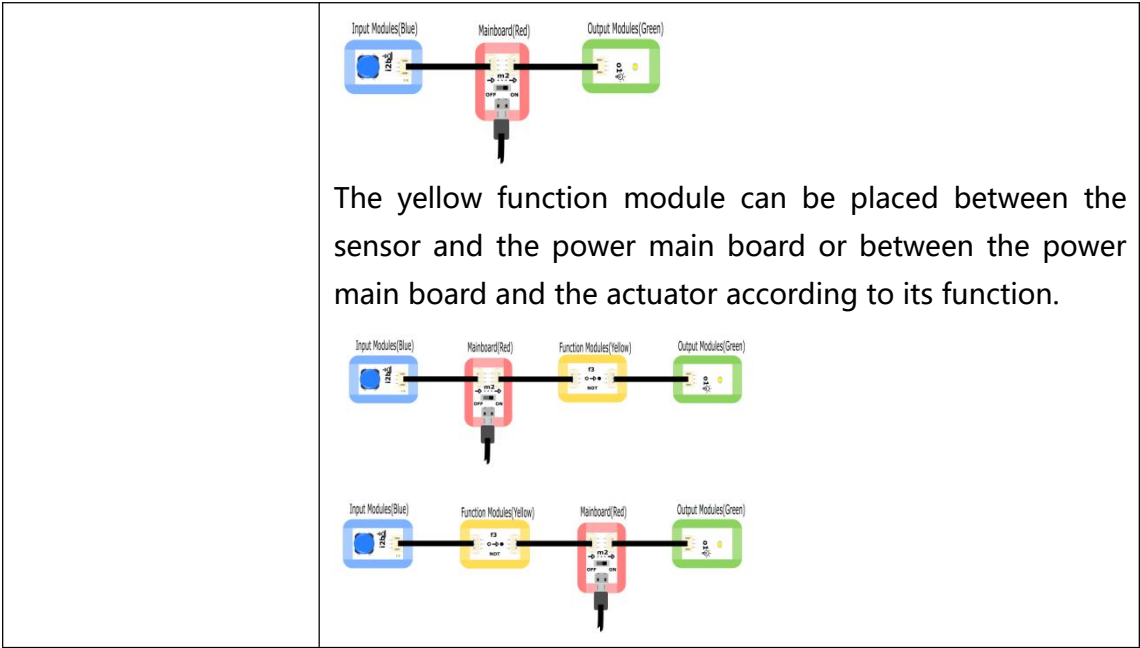
Duration Module can continuously output high pulses for a fixed set time. The input and output mechanism is as follows: When the high pulse is input, the module will output a high level for a fixed period.



Module “And” , “Not” , “Threshold” and “Duration” all belong to the function module.



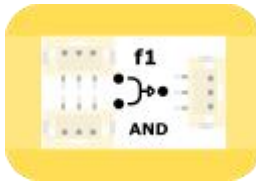
Have you noticed the color of these BOSON modules? Red is for power supply, blue for sensor, green for actuator, and yellow for function module. How to connect them correctly?

Place the blue sensor on the left side of the power board, and the green actuator on the right side.


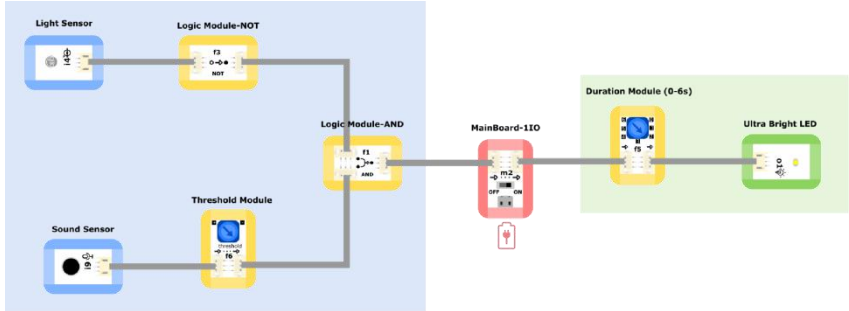



**Start Making (20min~40min):**

Analyze(how to realize functions and connect hardware) and check; cut paper; assemble.

<p>a. Analyze and check</p>	<p>1. Students first need to list all the functions of the smart street lamp, and then consider how to use BOSON modules to realize these functions.</p> <p>Sound sensing—detect the presence of people Light sensing—detect the light</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p>Both two conditions are met:</p> 
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	<p>street lamp:</p>  <p>2. Sort out all modules and draw the connection diagram.</p>  <p>3. Connect the BOSON module as the designed diagram, and then check whether all the functions are realized as expected. If it failed, analyze the reason and revise the connection, try it again.</p>
<p>b. Cut paper</p>	<p>Cut the paper model as the instruction. (See appendix)</p>
<p>c. Assemble</p>	<p>Assemble all parts as the figure shown below. Put every module at the specified place and connect their wires.</p> 

**Test (5min):**

Test whether the project structure is firm and all the modules are tightly clamped.

Function test: teachers create a silent environment in the workshop to allow students to test their projects under the following conditions one by one.

- No light, no sound, off
- No light, sound detected, on
- Light detected, no sound, off
- Light detected, sound detected, off

### **Optimization (5~10min):**

Use colored pen or paper to beautify the appearance of the project.

### **Share(5~20min)**

a. Shoot a video for the project, and post it to social account.

- Project display
- Effect demonstration
- Group photo

b. Present and introduce the project on stage

- Introduce the basic function of the project
- What improvements have you made? And why do you do that?
- What' s the highlight of your project?

### **Evaluation (5min)**

Assess students' works according to the Evaluation Criteria(see appendix) and select the best one.

### **Clean up (5min)**

- Dismantle the BOSON module on the project
- Put all modules back to the BOSON box.
- Put Inventor Kit and Tools to the specified place.
- Clean up the litters on the table and ground.

### **Rethink (5min)**

- What' s the role of logic "And" module in the project? Can it be removed?

- Try designing an energy-saving lighting system for your home. What factors do you need to consider?

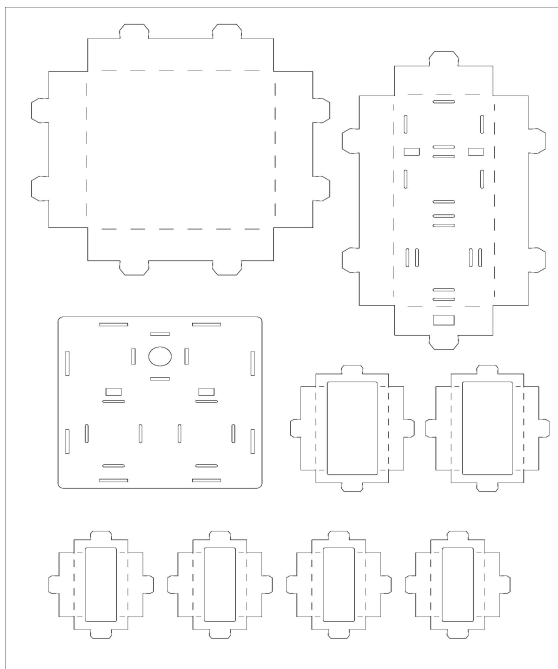
## Note

Here are some factors that should be taken into account when designing this workshop, and teachers can adjust, add or cancel some unimportant parts of the process as actual conditions.

- Age: adjust the requirement of skill and knowledge according to students' age and cognitive ability.
- Time: 50 minutes or more.
- Number of Students: control the number of students and choose to carry out a project in the form of individuals or groups as the actual scene.

## Appendix

**Paper Model:** the figure below can be printed as a paper model.



**Lego:** Lego blocks or other materials can also be used to build a street lamp.



**Evaluation Criteria:** teachers can observe students in the whole process to evaluate their performance.

Aspect	Marks	Content	Score
Problem analysis and solving ability	5	Be able to identify problems quickly, analyze problems correctly and put forward solutions with clear ideas.	
	3	Able to analyze and solve problems independently but struggle a little bit.	
	1	Only can analyze and deal with problems with the help of others.	
Creativity with BOSON modules	5	Able to understand the operation mechanism of BOSON circuit, achieve the expected effect, and use various materials to make improvements to the work.	
	3	Successfully finish the project and make some improvements	
	1	Can finish the work, but struggle a lot	
Expressing ability	5	Able to clearly express his/her ideas, or even make wonderful speeches to share the project.	
	3	Generally can express his/her idea to show the project.	
	1	Barely express his/her opinions and remain silent in the sharing process	

Teamwork skill	5	Get along well with team members and clear responsibility management	
	3	Work friendly with team members but the responsibility for each person is not clear.	
	1	Argue or cannot work with others in the process.	
Artistic expression ability	5	The work is aesthetic, can combine aesthetic with practicality.	
	3	Beautiful project with certain design	
	1	Rough project with a messy appearance	
Total			