# runlinc Beginners Project 2: Smart Lights (STEMSEL Version)

## Contents

## Introduction

### Problem

We use lots of streetlights to light the roads at night. However, all of those lights use a lot of electricity which is entirely wasted if they turn on when it is still bright. In this case, we want to use our STEMSEL boards to make a smart streetlight that Is only turned on when it is dark, as well as program it by using runlinc technology.

### Background

Streetlights should only come on when the ambient light level is low, either at night or during very cloudy days. In order to save energy, the streetlights should be turned on only when it is necessary. This is clearly a good thing since fossil fuels, such as gas and coal that we burn to generate electricity, create greenhouse gasses which contribute to global warming. This project allows you to create a smart streetlight.

### Ideas

So how can we turn on the streetlight only when it is needed? One solution is we could use a timer to turn the light on at say 6:00 in the evening and off again at 6:00 in the morning, but the problem alongside this solution is that the days have different lengths over a year. Because of this, sometimes the streetlight might be on when it is still bright, or remain off when it is dark. The best solution would be if the streetlight could see if it was dark or light and turn itself on or off automatically. Can we do this by using our kits?

## Plan

We have light-dependent resistors (LDR) in our kits which we can use to check if it is bright or dark. We can simulate the lightbulb in a streetlight by using the smaller lightbulb in our kits. Firstly, we will use the LDR to check the ambient light level, then the microchip can turn on the lightbulb when the light level is low and turn it off when the light level is high.

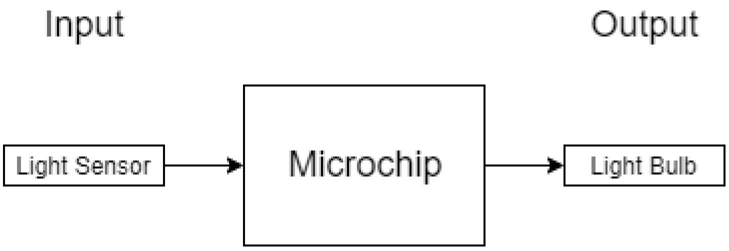
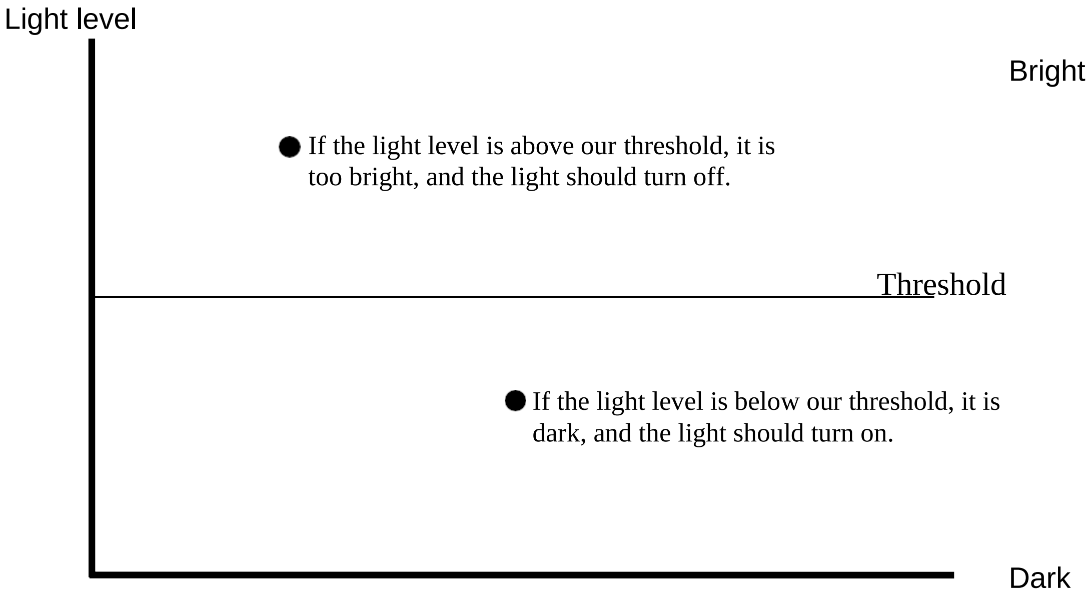


**Figure 1:** Block diagram of Microchip outputs



- If the light level is above our threshold, it is too bright, and the light should turn off.
- If the light level is below our threshold, it is dark, and the light should turn on.

**Figure 2:** Light Level for a light sensor

## runlinc Background

Runlinc is a web page inside a Wi-Fi chip. The programming is done in the browser and sent to the chip over Wi-Fi. The runlinc web page inside the Wi-Fi chip will command the microchips to do sensing, control, data logging Internet of Things (IoT). It can predict and command.

## Part A: Design the Circuit on runlinc

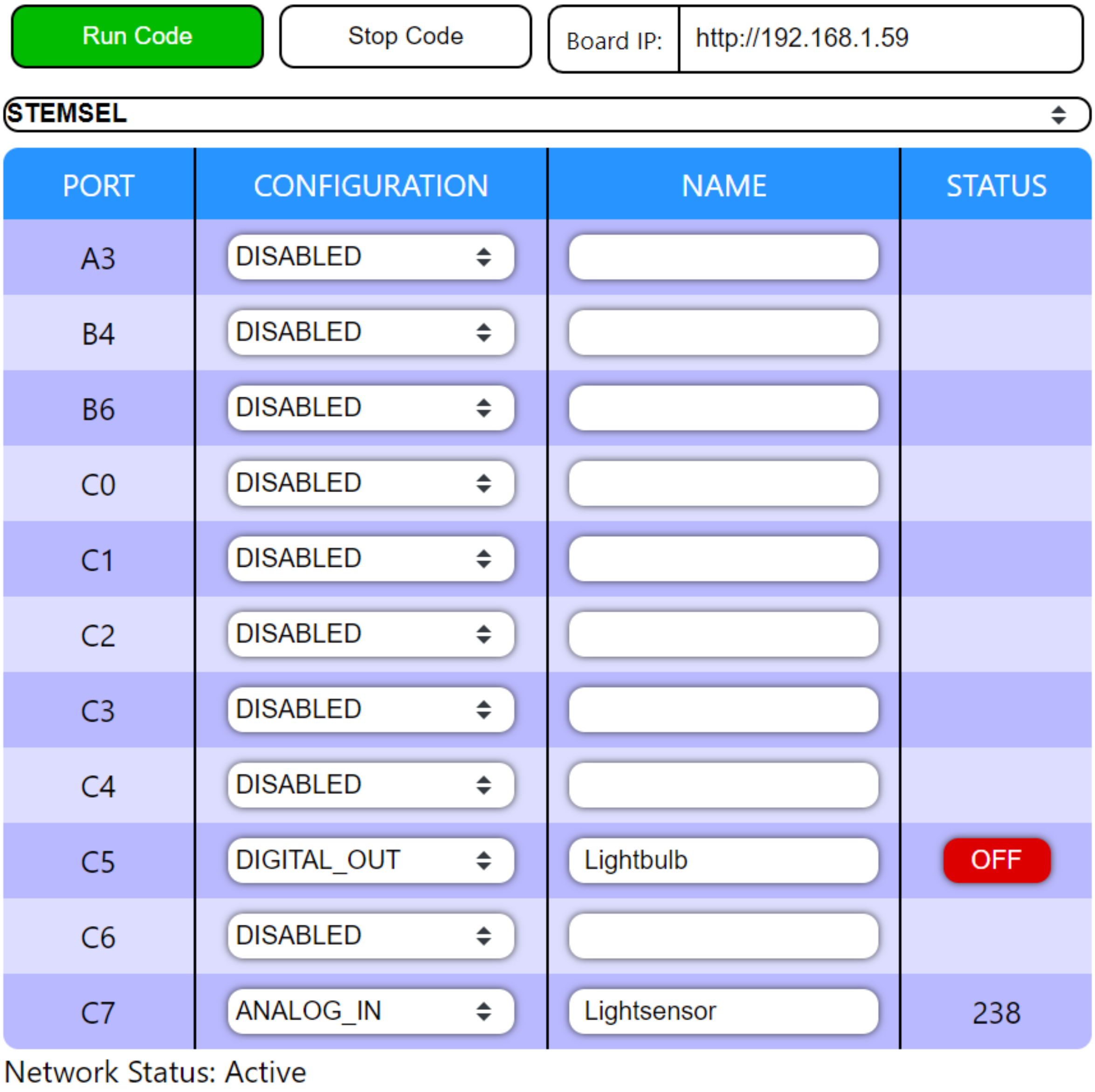
**Note: Refer to runlinc Wi-Fi Setup Guide document to connect to runlinc**

Use the left side of the runlinc web page to construct an input/output (I/O).

Set the C7 port as ANALOG_IN and name it Lightsensor.

Also, set the C5 port as DIGITAL_OUT and name it Lightbulb.

In our circuit design, we are going to use a light sensor and a lightbulb, which are coincidently inside of our kits. They can be used directly to our circuit as per the plan.



Board IP: http://192.168.1.59

STEMSEL

| PORT | CONFIGURATION | NAME | STATUS |
|---|---|---|---|
| A3 | DISABLED | | |
| B4 | DISABLED | | |
| B6 | DISABLED | | |
| C0 | DISABLED | | |
| C1 | DISABLED | | |
| C2 | DISABLED | | |
| C3 | DISABLED | | |
| C4 | DISABLED | | |
| C5 | DIGITAL_OUT | Lightbulb | OFF |
| C6 | DISABLED | | |
| C7 | ANALOG_IN | Lightsensor | 238 |

Network Status: Active

**Figure 3:** I/O configurations connections

## Part B: Build the Circuit

Use the runlinc I/O to connect the hardware. Remember that turning the screws clockwise will close the clamps and turning the screws anticlockwise will open them. All black wires should go in the negative (-) terminal, red wires go in the positive (+) terminal, and white wires go in the terminal we designated in the runlinc web page port.

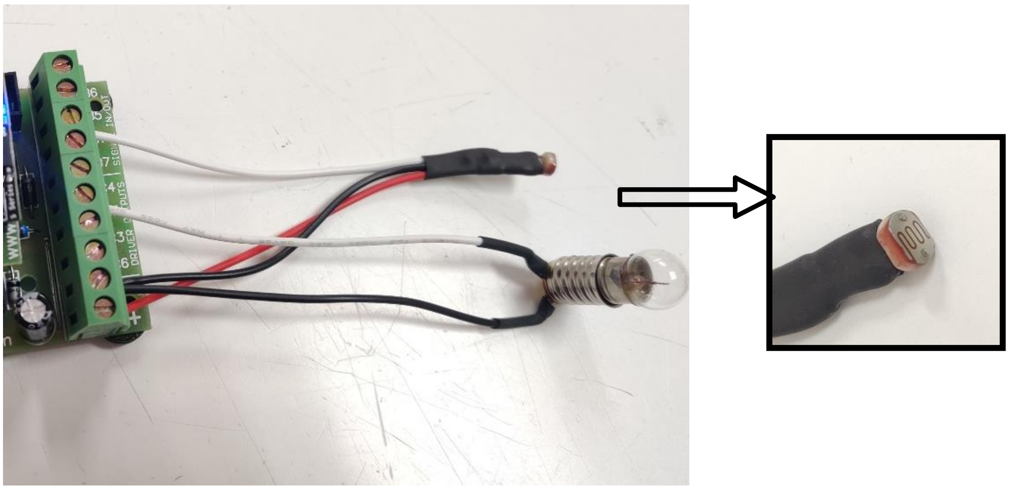


**Figure 4:** Circuit connection on microcontroller

### Wiring instructions

a.) For the light sensor, it should connect its white wire to the C7 port, the black wire goes to the negative port and the red wire goes to the positive port.

b.) While the light bulb needs to connect its white wire to the C5 port and the black one goes to the negative port.

# Part C: Program the Circuit

Now we can start to program the functions of the smart streetlight. To do this, JavaScript and JavaScript Loop are needed.

For **JavaScript** box type the following:

```
sensor = analogIn(Lightsensor);
```

A variable is initialised with it containing the input light level from the light sensor.

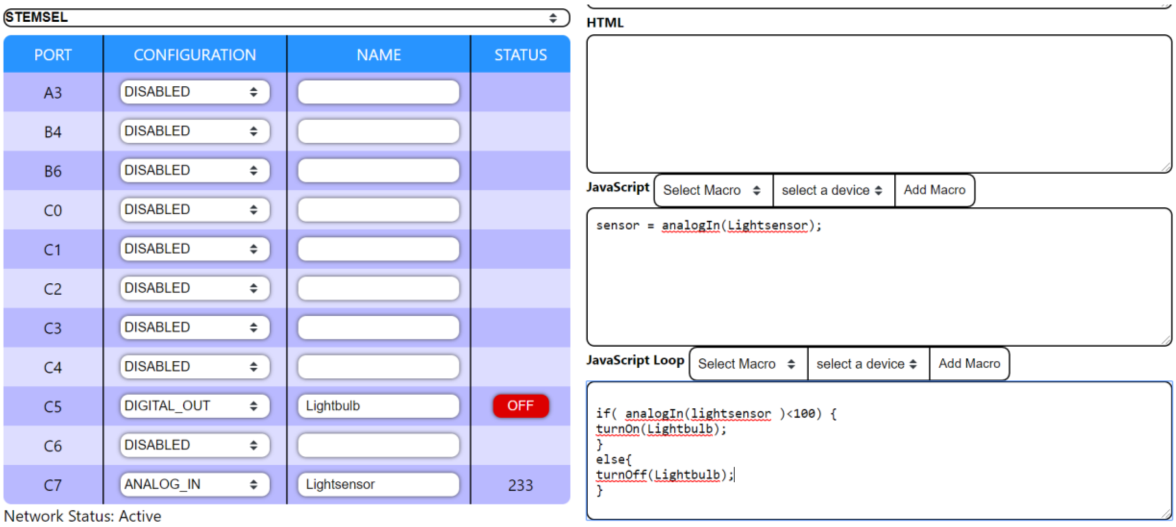
For **JavaScript Loop** type the following code:

```
sensor = analogIn(Lightsensor);
if( analogIn(Lightsensor) < 100) {
        turnOn(Lightbulb);
}else{
        turnOff(Lightbulb);
}
```

Here, a variable is initialised with it containing the input light level from the light sensor.

Then an if statement loop is added to the light sensor for it to decide in which time to turn on the light. For instance, if it's above 40, the light will turn on, whereas the light will be turned off when the value is below 40.

As the expected outcome of this project is for letting the light sensor to decide the right moment to turn on and off the light bulb, we can set the threshold value for the light sensor, which is 100.



STEMSEL

| PORT | CONFIGURATION | NAME | STATUS |
|---|---|---|---|
| A3 | DISABLED | | |
| B4 | DISABLED | | |
| B6 | DISABLED | | |
| C0 | DISABLED | | |
| C1 | DISABLED | | |
| C2 | DISABLED | | |
| C3 | DISABLED | | |
| C4 | DISABLED | | |
| C5 | DIGITAL_OUT | Lightbulb | OFF |
| C6 | DISABLED | | |
| C7 | ANALOG_IN | Lightsensor | 233 |

Network Status: Active

HTML

JavaScript

```
sensor = analogIn(Lightsensor);
```

JavaScript Loop

```
if( analogIn(lightsensor )<100) {
turnOn(Lightbulb);
}
else{
turnOff(Lightbulb);
}
```

**Figure 5:** runlinc webpage screenshot

## Summary

It is important to light the streets at night so that people can see where they are going, but it is also important to save electricity. By ensuring our streetlight only comes on when it is dark, both considerations are addressed. During this project, you should have learned how to use analogue inputs to use a light sensor, and an if statement to do different things depending on that input.