*Suggested Progression of Lesson*

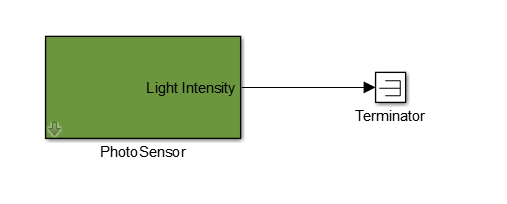
|  |  |
| --- | --- |
| **Step** | **Content** |
| 1 | [Introduction](#_Introduction) |
| 2 | [Taking It Further: Darkness Follow Bot](#_Taking_It_Further:) |
| 3 | [Study 7](#_Study_7) |
| 4 | [Light Follower Bot](#_Light_Follower_Bot) |

**Introduction**

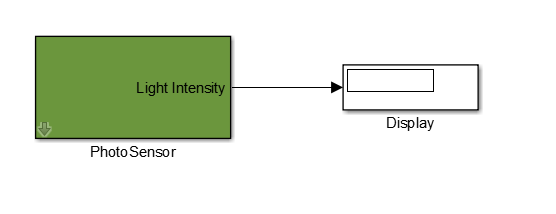
*For more information, reference the “Instructor Reference Lesson 1 Unit 5” document in the Unit 5 Instructor Reference folder*

Video Reference: [Unit5a\_LightTurnerAndDarknessFollowBot.mov](https://www.youtube.com/watch?v=Js8bdidWZ40)

*Testing PhotoSensor Values:*



Running the following code allows you to check the values in the serial monitor. Notice the difference in values depending upon if your hand is the right or left from of the robot. Record these for use later on.

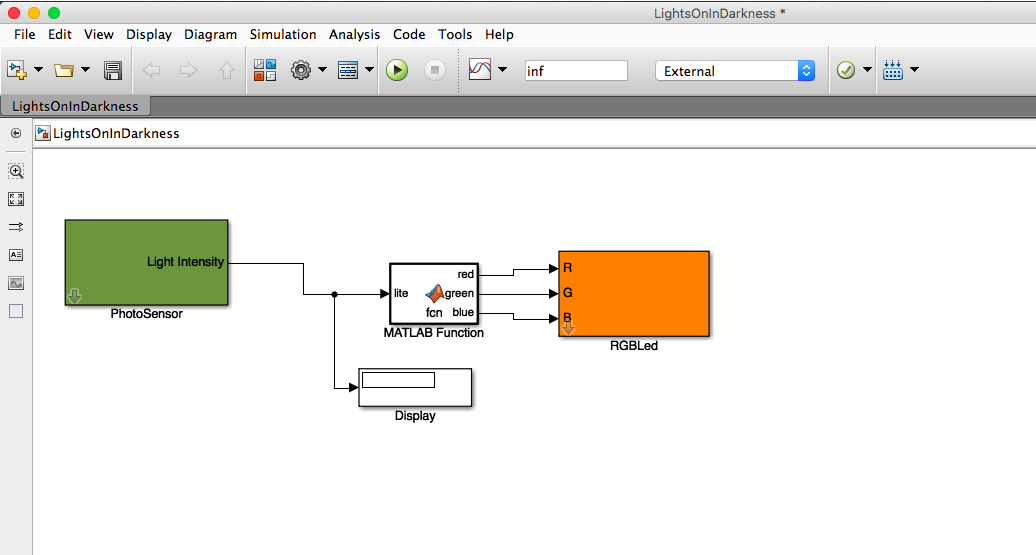


If you run the above Simulink model in external mode you can take readings from the light sensor in the above way. You’ll find the “Display” blocks in the “Sinks” tab of the Simulink block builder.

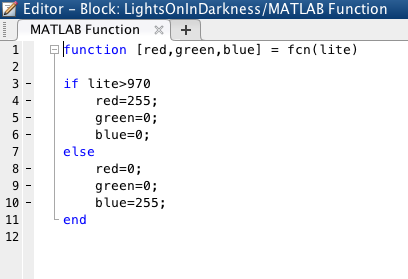
*Intermediate: “Lights On In Darkness”*

Index: LightsOnInDarkness.slx

In the Simulink model below, whenever the lights dim the RGB LED on the miniQ robot will change color.



If we click into the MATLAB function block what we’ll see is the code below. The outputs on the function are [red,green,blue] while the input into the function is named “lite”. This construction can be seen in line 1:

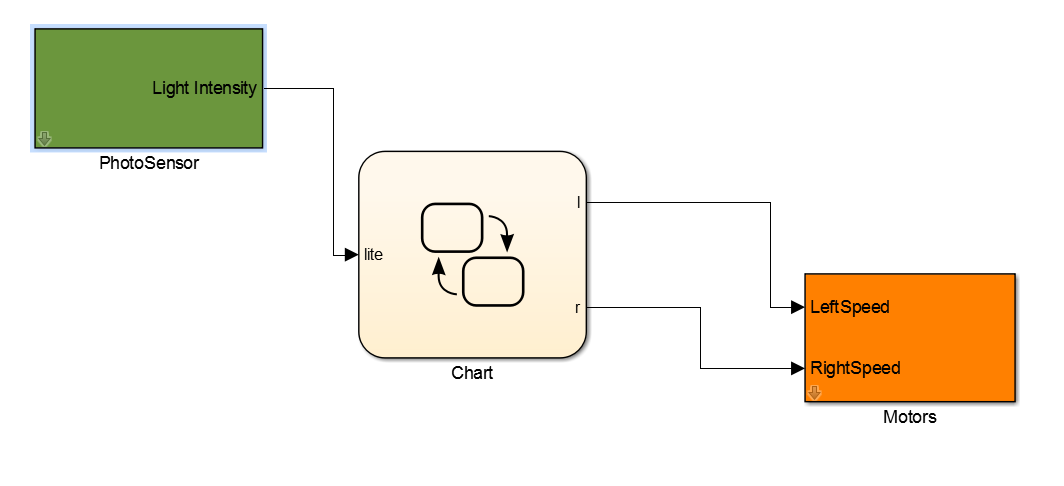


So when the lite reading is greater than 970 the red value will output 255 while the green and blue values provide 0 as their output. This will cause the RGB LED to turn red when the lights are dim “else” (in line 7) the LED color will be blue.

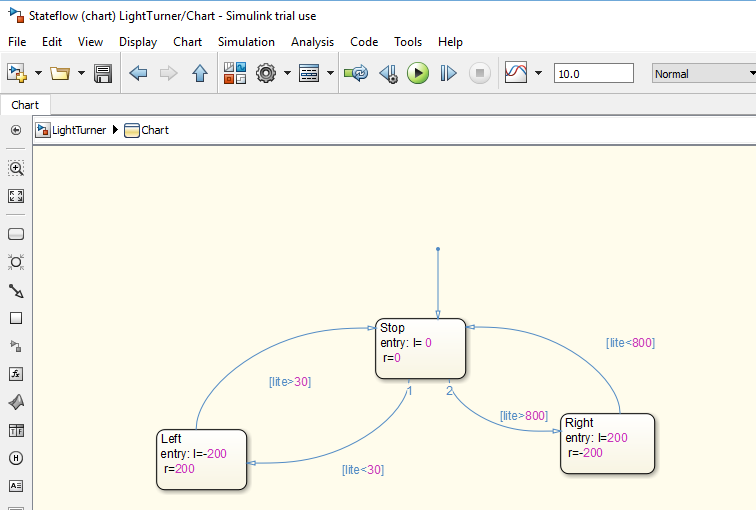
Activity: Experiment with different color values as well as “lite” intensity thresholds (in line 3) to see what occurs.

*Intermediate: “Light Turner”*

Index: LightTurner.slx



The objective is to create a robot which turns in the direction where there is most light. Create the following model above. Below is a picture of how the chart should be arranged:



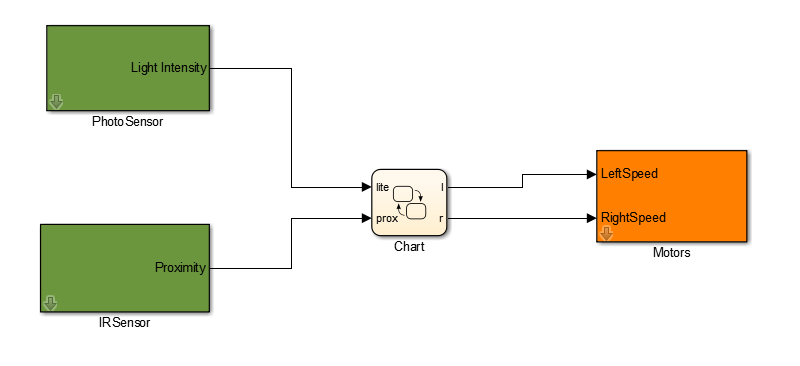
This flow state takes in an input “lite” and uses it as the variable used for deciding if the robot should turn right or left. Adjust the values as you see fit to achieve the behavior you’d like.

Activity: Have the robot turn in the direction where there is less light and also have the RGB light turn a different color between each direction it moves. This will involve having to create more outputs in your Simulink chart to control the RBG LED blocks.

**Taking It Further: Darkness Follow Bot**

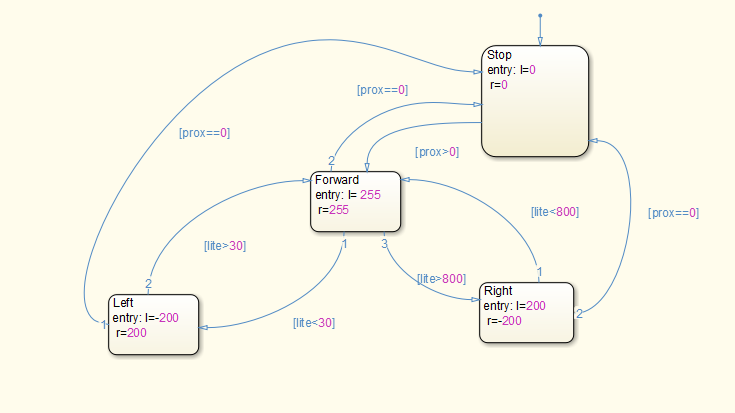
*For more information, reference the “Instructor Reference Lesson 2 Unit 5” document in the Unit 5 Instructor Reference folder*

Index: DarknessFollowBot.slx



The objective here is to create a robot which follows a hand put up close to it. The combination of close proximity to a hand casts a shadow. The light sensor can be used to figure out if a hand is left or right of the front of the robot depending on a lack of light. The proximity sensor is factored in so the robot following behavior is only present when a hand is close enough.

*The Darkness Follow Bot Chart:*



In the above chart, for the light readings to be factored in for right or left movement, the logic of the chart indicates that the first condition is that [prox>0]. Basically that there needs to be a hand close enough to the front of the robot indicating that it needs to move.

*Exercises to consider:*

1. Fine tune the movement of the Darkness Follow Bot. Have the Darkness follow but be changed to an autonomous light seeker rather than a robot dependent upon having a hand in front of it to move. How will you account for objects in the way of the light seeker robot? This activity focuses on combining what was learned earlier to create a robot which can follow a light source.

**Study 7**

*Note: Below is a copy of Study 7. For print-outs, the original document can be found in the Unit 5 folder*

Standards Covered: (a), (b), (c)**,** (d)**,** (e)

Sequence:

1. Bringing Telerobotics Into Space *(10 min)* <https://www.youtube.com/watch?v=diwDEAHm5ls>
2. Discuss the following questions as a group: *(30 min)*
3. What is telerobotics?
4. What was the mission of this Mars rover?
5. What is a difficulty faced by the robotics engineer as far as creating ‘haptic’ feedback with the Mars rover?

Taking It Further:

1. Split into pairs and read the following article. Summarize the main ideas and then share these with the larger group during a discussion. *(30 min)*

<http://www.wired.com/2014/10/robotic-followers/>

1. How does this robot relate to the Darkness follow bot? *(10 min)*
2. Can you think of any real world applications for the Index: DarknessFollowBot.slx code?

**Light Follower Bot**

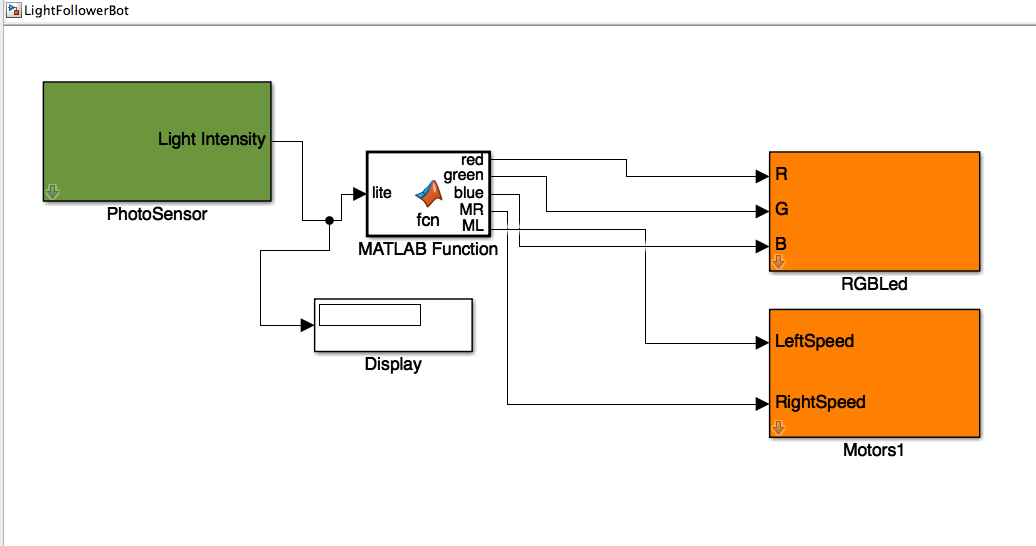
*For more information, reference the “Instructor Reference Lesson 3 Unit 5” document in the Unit 1 Instructor Reference folder*

Video Reference: [Unit5b\_LightFollowBot.mov](https://www.youtube.com/watch?v=6Beln84oOZ8)

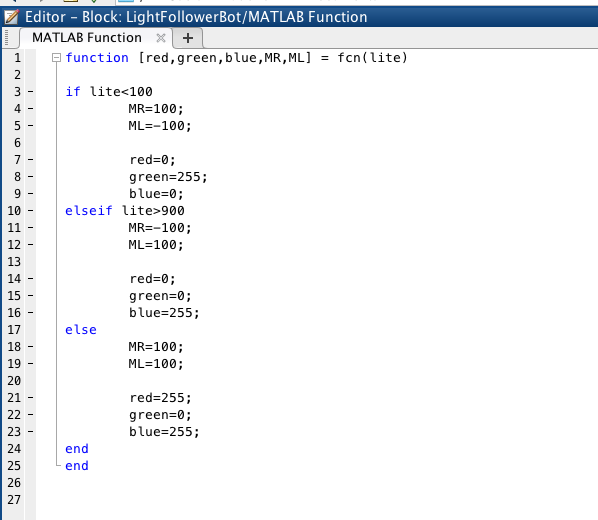
*“LightFollowerBot”*

Index: LightFollowerBot.slx

While the “DarknessFollowBot” takes time and effort to refine a much smoother Simulink model for the miniQ, which uses light sensors, is the Light Follower Bot. In this code the MiniQ robot will follow light; either a light source placed in a distance or a beam of light from something like a flashlight:



A MATLAB function is used in this example to interpret the input variables from the photosensor (light sensor) and then translate these into the RGB LED colors and Motor Speeds. A display is attached so if the model is run in external mode you can figure out what light thresholds you want to use within the function. Double click into the function block:



The first line describes the input and output variables [red,green, blue] as well as values for the motors [MR and ML]. And input variable “lite” is defined as well.

How the code works is every time lite<100, meaning that more light is being detected on the left side therefore causing the miniQ to take a left turn (MR= 100, ML=-100).

The inverse is true for if the lite value >900 which means there is more light on the right side therefore causing a right turn (MR=-100,ML=100). Otherwise, as begins in line 17, the miniQ robot will travel in a straight line.

*Activity:*

1. Changing the speed variables for the miniQ robot.
2. Adjust the light readings so they work best in your location.
3. With a set of flashlights turn out the lights and see if you can maneuver your miniQ into a particular location using only the beam of light?
4. Discuss if this principle follows the ideas of telerobotics (from [Study 7](#_Study_7))? Why or why not?

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