Robot Line Following



1 Objectives.

- 1. Become familiar with the QTR-8RC Line Sensor Array.
- 2. Utilize the Arduino to detect lines.
- 3. Integrate the Line Sensors with the DFECBot and program the DFECBot to follow a line.

2 Materials.

- 1. 1x QTR-8RC Reflectance Sensor Array
- 2. DFECBot
- 3. USB Programming Cable
- 4. Black Tape

3 Introduction.

3.1 QTR-8RC Reflectance Sensor Array

The QTR-8RC Line Sensor Array uses 8 infrared radiation (IR) reflectance sensor with an IR light-emitting diode (LED) and an IR sensitive phototransistor.¹ The sensors are powered using the 3.3 V and ground pins on the Arduino. Powering the sensors illuminates the IR LED. A 100 Ω resistor is on-board and placed in series with the LED to limit current. The output of the phototransistor is tied to a 10 nF capacitor. The

¹Information found at Pololu, https://www.pololu.com/product/961

faster the capacitor discharges, the more reflective the surface is. The QTR sensors have an optimal sensing distance of $3 \ mm$.

Wire your QTR-8RC Reflectance Sensor Array to the Arduino according to the schematic shown in Figure 1.

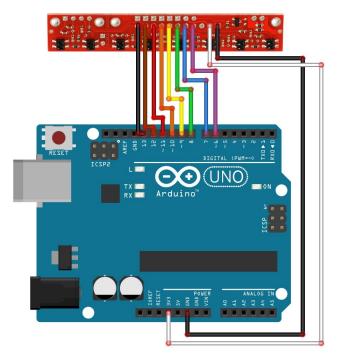


Figure 1: QTR-8RC Reflectance Sensor Array Wiring Schematic

3.2 Example Code

Copy the Arduino sketch folder robot_linefollowing from **Teams** (Labs/robot_linefollowing). Copy the QTR-8RC library from **Teams** (Labs/Custom Libraries/QTR-8RC) to your documents folder: Documents/Arduino/libraries/. Open the robot_wallfollowing.ino sketch.

3.3 QTR-8RC.h

The Arduino Sketch utilizes a library called QTR-8RC. This is a custom library adapted from the QTRSensors library to utilize the QTR-8RC Reflectance Sensor Array. This library provides functions to read values from the sensor array and return the distance off the line.

3.3.1 robot_linefollowing.ino

This example Arduino Sketch provides code to calibrate the DFECBot's QTR-8RC Reflectance Sensor Array and determine the distance off a black line.

```
// read calibrated sensor values and obtain a measure of the line position
// with a position of 0.1 mm relative to the center of the line
// -33.2 mm to 33.2 mm
int16_t position = qtr.readLineBlack(sensorValues);
```

4 Procedure

Use the example code provided, robot_linefollowing, Motor.h, and QTR-8RC.h to code the DFECBot to do the following:

- 1. Use a ruler to confirm the accuracy of the line sensor read function
- 2. Program the DFECBot to follow a line

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<u>CALIBRATION</u>: The first 10 seconds after powering on your robot (or uploading the code) is used to calibrate your line sensor. During calibration, without lifting your robot off the surface, slowly move your robot so each line sensor is over a black line for approximately one second. This allows the script to collect minimum (white surface) and maximum (black surface) readings used to calibrate the sensors.

HINT: You should remove all print statements and delays when testing your line following.

5 Notes on Proportional Controller: