



E11: Autonomous Vehicles

Fall 2014

PS 6: Gold Code Detection

For PS6, write a single Mudduino file named `ps6_lastname_firstname.ino`.

Important: place the following comment on the first line of your code (where `xx` is the number of hours that it took you):

```
// Time to complete program = xx hours
```

Your goal for this assignment is to use your phototransistor code from Problem Set 5 and your Gold code correlation program from PS4 to read Gold codes being transmitted by LED beacons and to determine which code is being sent. Specifically:

- 1) Uses your phototransistor to detect the Gold Code being transmitted by a beacon on the competition or being transmitted by the LED on another robot. Note that each bit of the gold code will be transmitted for 250 microseconds.
- 2) After detecting the Gold Code, three values should be printed to the Serial Monitor:
 - a) The ID number of the gold code detected
 - b) The corresponding correlation
 - c) The team color

Note, this lab is virtually impossible to get right on the first try. So, as usual, test each small step (printing intermediate results) as you go along. Debug that step until you get it right, and only then move on to the next step. You'll need to do most, if not all, of your programming and testing in the lab.

Suggested Steps

You may complete your program in any way you desire, but here are a set of suggested steps to get you started:

1. First, you'll want to read and store 31 raw samples of the beacon's LED using your phototransistor. We suggest sampling every 250 microseconds using a timer, (not a delay).
2. Next, we'll want to turn these 31 raw samples into a binary format. We're trying to figure out which of these values correspond to the LED being ON and OFF. To do this, take an average of all 31 values. Then compare each raw value to the average. If it's above the average, the LED was OFF. If it's below the average,

- the LED was ON.¹ Use this principle to turn your 31 raw inputs into a sequence of 31 bits (i.e. each input becomes either a 0 or a 1).
- Now, you have a sequence that you can correlate against the known Gold Code for each of the 8 beacons. The beacon whose Gold Code most strongly (in absolute value) correlates with your sequence will determine the ID number of the broadcasting beacon.
NOTE: Since the gold codes are being continuously broadcasted from the beacon, you may have sampled a shifted version of the beacon gold code! Thus, you'll want to compare each of the 8 gold codes with all possible shifts of your sequence.
 - The beacon will transmit the normal code for White and the inverted code (0's and 1's swapped for Green). Thus, you can identify the color of the beacon by the sign of the correlation.
 - Have your Mudduino board print which gold code it's detecting, the color of the beacon, and the strength of the correlation. Experiment with the distance and alignment of your Mudduino to the beacon and see how that impacts the strength of the correlation and accuracy of your detection.

Deliverables

You are responsible for turning in 1 Arduino file to the “Resources/Problem Set 6/” folder in the E11 page on Sakai:

- `ps6_Lastname_Firstname.ino`

Be sure to include this line at the top of your file, (xx = hours it took you to complete):
`// Time to complete program = xx hours`

The files are due before class.

Grading

Your score is based on the following:

- Up to 2.0 points for the program:
 - 0.5 points if your program compiles
 - 0.5 additional points if your program has basic functionality
 - 1 additional points if your program works according to the requirements described above
- Up to 1.0 points for your commenting:
 - 0.5 additional points for code that is mostly clear and well commented
 - 1.0 additional points for code that is clear and well commented
- This results in 3.0 points maximum

Note that you will need to have this code working for the final project!

¹ If you're using another bot to double as a gold code for you with the GoldCodeBroadcaster code, you may need to be as close as 2.5 [cm] to actually read the LED flashes.