Skill Demo 8: Moth-bot

Build a moth-bot that seeks out light.
v1.2

Goals:

- Combine sensors, processing, and output to make a simple robot
- Learn to make simple mechanical assemblies
- Learn to use a laser cutter

Tools/supplies:

- Breadboard
- Wires
- Arduino-compatible microcontroller development board
- 1x PD333-3B/HO/L2 IR Photodiodes
- 2x Motors
  - 2x unipolar stepper motor, PF35T-48L4 or 28BYJ-48
    -or-
  - 2x DC brushed motor, ROB-10171
- Motor drivers
  - Up to 4x 600mA NPN BJT transistors, PN2222
  - Up to 4x N-channel enhancement-mode power MOSFETs, IRF650N
  - 1x SN754410NE quad half-H-bridge
- 2x D42L-R1XL micro switches
- 12"x24"x3mm Craft Plywood
- 7"x1/16" Rubber Bands
- 3 1/2" x 1/4" Rubber Bands
- Wood glue
- Any additional resources you decide to use
- Plastic wheels

Background:

Readings:

- Braitenberg Vehicles (Wikipedia)
- Tactile Sensing with Whiskers

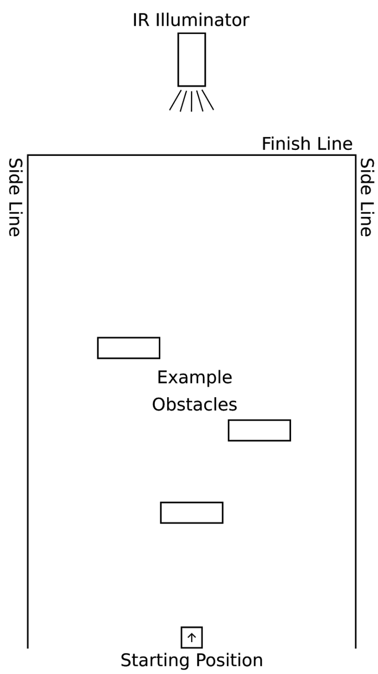
Requirements:

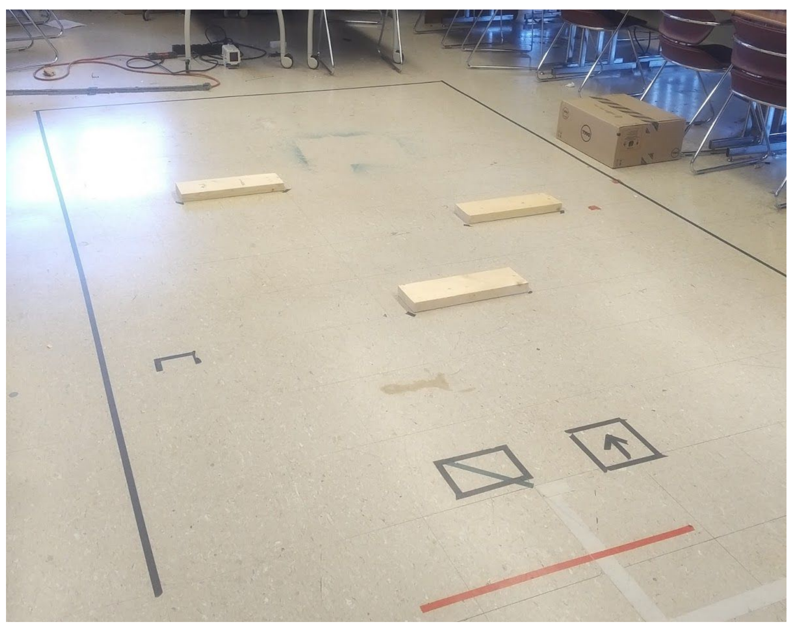
For this skill demo, you need to create a robot that can navigate across toward a bright light source. We will test this by having your robot traverse a the course from a starting position to a finish line without veering over either side line.

To avoid confusion with room and window light, we're using IR photodiodes as sensors, and an IR illuminator as a light source.

The course will also contain three obstacles, situated somewhere between the starting position and the light source. Your robot will need some way of detecting if it is stuck on one of them, so that it can reverse and find another route. The obstacles are 1.5" tall and 18" wide, and the IR light source is about 3" off of the floor, so you should be able to see over the obstacles. There will be at least 12" of space between the outside edge of the obstacles and the side lines. The course is set up in CCB337, and you can test on it any time you'd like. You should have card access to CCB337; let us know if not.

We require that your robot be able to fit within a 6x6 inch footprint, and that at least one part of your robot be laser cut. Aside from that, the design is largely up to you, but you'll likely want 'bump' sensors or proximity sensors for the obstacles, and some kind of differential steering using two motors, like in the motors skill demo.

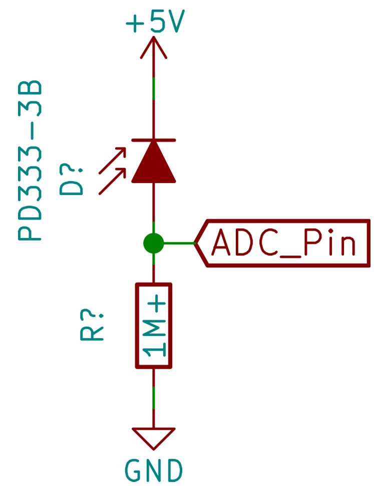




Procedure

1. Reading from a Photodiode

Connect a photodiode to your Arduino using a circuit like this one. Note that the photodiode is 'reverse biased' - it has voltage across it in reverse, so it won't normally conduct any current.



When photons of the right wavelength hit the photodiode, it will let a very small amount of current through. This will raise the voltage on the ADC pin. Get it working, and make sure your photodiode can see one of the IR illuminators in the lab.

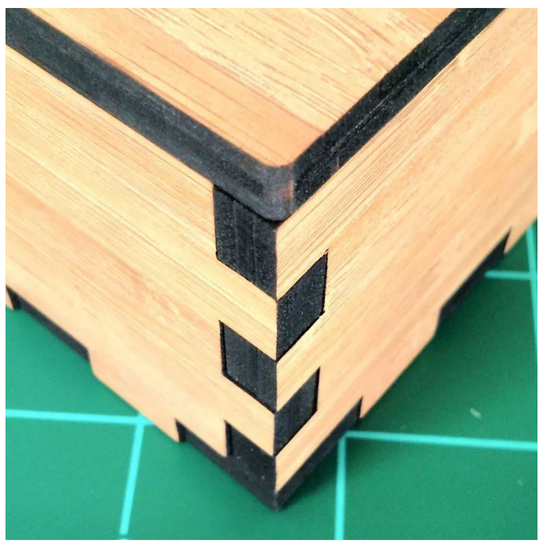
2. Reading from a 'bump sensor'

Connect one or more digital pins to the microswitches. Make sure they're working to detect when something pushes into it's long lever arm. If possible, connect to the microswitches using crimp-on quick-disconnects, like we used in Skill Demo 0.

3. Design and build a bot chassis

Pick out the motors of your choice, probably either the geared DC motors or the stepper motors from previous skill demos. Connect them to your Arduino using a drive circuit, likely the H-bridge IC we used previously.

Next, design a robot chassis. This can be fairly simple, perhaps a single sheet of material, or as complex as you'd like. 3D printing and manual fabrication is allowed, and you must have at least one laser-cut part.



One common approach is to use 'box-jointed' laser-cut wood or plastic, and you have 3mm plywood to use for just this purpose. By cutting these box joint tabs into parts, you can easily and quickly glue them together using wood glue or hot glue.

For manually cutting materials, you can use a hacksaw, bandsaw, or jigsaw, or even the miter saw in CCB337 (but ask before using the miter saw).

For laser cutting, we'll be available during normal class time and office hours to help operate the laser cutter. Additionally, you might use the open 'shop hours' in the GVU Prototyping Lab to use GVU's larger laser cutter, or to use a laser cutter in the Invention Studio.

You can design for laser cutting using any software that can produce a vector outline, such as in an SVG or DXF file. For very simple designs, you can use Inkscape or Adobe Illustrator. For more complex designs, you can design an entire assembly in solid modeling software, such as Solidworks or Inventor, and then export the flat panels or 3D parts.

If you are interested in learning 3D modeling, I recommend learning Solidworks. There are student licences available, and it should be usable though http://mycloud.gatech.edu.

There are also several online resources that can produce ready-to-cut designs for simple boxes and gears, such as makercase.com.

For inspiration on laser cut, interlocking flat part assembly design see:
http://makezine.com/2012/04/13/cnc-panel-joinery-notebook/
http://www.makercase.com/
http://www.re-innovation.co.uk/web12/index.php/en/information/random/designing-laser-cut-enclosures
http://www.123dapp.com/make

Note: Direct sharing of CAD files between students is not permitted (you can't just 3D print someone else's wheels or laser cut someone else's parts).

There's a fair chance that your first design won't work as expected. You may want to assemble your robot with masking tape at first to test the design before using more permanent wood glue or hot glue. Also consider being careful with your plywood usage in case you need to re-cut your entire car.

4. Program your bot to seek out and move toward lights

Adjust the phototransistor so that it is aimed toward the front of your bot. Write a program that rotates the bot in one place until it finds the brightest source of light.

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Due October 25, 2018

Build a moth-bot that seeks out light.

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NAME______________________________ GTID______________________________

1. Reading from a Photodiode

(signoff only needed for partial credit - ignore if you make a successful bot)

10/100 Initials________________ Date_______________

2. Reading from a 'bump sensor'

(signoff only needed for partial credit - ignore if you make a successful bot)

10/100 Initials________________ Date_______________

3. Design and build a bot chassis

(signoff only needed for partial credit - ignore if you make a successful bot)

10/100 Initials________________ Date_______________

4. Program your bot to seek out and move toward lights and avoid obstacles.

40/100 Initials________________ Date_______________

5. Reach the other side of the course.

30/100 Initials________________ Date_______________