Micromouse 2014-15
Andrew Chan & Ivan Petkov

Mini Project #2: Sensors

DUE: 11/26/2014

Expectations

The purpose of this mini project is to learn how to use IR emitters and sensors. These key components of a Micromouse allow you to determine if walls are to the front and sides of your mouse. As you might have seen from the first mini project, the mouse might not run perfectly straight. Thus, IR sensors are essential to help correct these problems. They help determine if your mouse is coming at an angle to a front wall or if it is too close to a side wall.

We have milled out a PCB board for you and soldered on all of the component so all you need to do is hook up the MCU to the female headers and plug in the batteries. Please make sure to plug in the MCU correctly. Look at the circuit diagram at the end of this document.

Here are the pinouts going from LEFT to RIGHT when the IR sensors are facing AWAY from you:

1. LEFT EMITTER--connect to digital pin digitalWrite(*pinnumber*,*HIGH*)
2. LEFT RECEIVER--connect to analog pin and analogRead(*pinnumber*)
3. FRONT LEFT EMITTER--connect to digital pin digitalWrite(*pinnumber*,*HIGH*)
4. FRONT LEFT RECEIVER--connect to analog pin and analogRead(*pinnumber*)
5. FRONT RIGHT EMITTER--connect to digital pin digitalWrite(*pinnumber*,*HIGH*)
6. FRONT RIGHT RECEIVER--connect to analog pin and analogRead(*pinnumber*)
7. RIGHT EMITTER--connect to digital pin digitalWrite(*pinnumber*,*HIGH*)
8. RIGHT RECEIVER--connect to analog pin and analogRead(*pinnumber*)
9. GND--connect to MCU GND

Remember that all emitters should be OUTPUT pins, while all receivers should be INPUT pins.

Remember to put delays before/after emitting to account for charge/discharge time. Charge time ~100us and discharge ~140us.

Remember to turn each emitter on one at a time to prevent interference.

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Note: the circuit boards we are giving you are prototype boards, thus they lack silk screens, solder masks, and other features of professionally fabricated boards. Be VERY careful not to drop any solder or conductive metals on the board as it WILL SHORT IT OUT AND PROBABLY BURN SOMETHING.

Task 1:

Use the Arduino Nano PWM pins to turn the LEDs on and off and to read values. After ensuring that your Arduino Nano is hooked up correctly, experimentally calibrate the LEDs with a plastic wall maze piece. We suggest plotting distance as a function of output voltage. After calibration, show us the following:

1. When a wall to the front is present, **print "Wall Front".**
2. When a wall to the left is present, **print "Wall Left".**
3. When a wall to the right is present, **print "Wall Right".**
4. Write nothing if walls are "significantly" far away (we'll let you determine how far away that is).

Task 2:

Sometimes your mouse will be at an angle with respect to the center of the maze. Place your mouse at an angle with respect to a wall. Show us the following:

1. When you angle the mouse right with respect to a front facing wall, print **"Needs to turn left".**
2. When you angle the mouse left with respect to a front facing wall, print **"Needs to turn right".**
3. Write nothing if your mouse is even with a front facing wall.

Task 3:

Sometimes your mouse will be aligned the center, but closer to one side wall versus the other. Show us the following:

1. When the mouse is closer to the right wall, print **"Closer to RIGHT wall".**
2. When the mouse is closer to the left wall, print **"Closer to LEFT wall".**
3. Write nothing if your mouse is in the center of a cell.

Task 4:
Next we take Task 3 one step further. Besides knowing if your mouse is closer to either left or right wall, it is also important to know to what degree it is off-center (which will determine how much you need to correct your position by). Show us the following:

1. When your mouse is closer to the right wall and slightly off center, print **"Slightly closer to RIGHT wall"**
2. When your mouse is closer to the left wall and slightly off center, print **"Slightly closer to LEFT wall"**
3. When your mouse is closer to the right wall and much further off center, print **"Much closer to RIGHT wall"**
4. When your mouse is closer to the left wall and much further off center, print **"Much closer to LEFT wall"**

We will let you figure out what "slightly off center" is, within reasonable bounds.

Parts

Arduino Nano
IR Emitter
IR Sensor
5V regulator
NPN 2N 3904 Transistor
Resistors
Capacitors
Wires (Strip your own)

Circuit Diagram/Theory/Tips for building your own circuit

As explained in lecture, all diodes have an anode (positive) and cathode (negative) end. Usually, the positive end has a longer lead than the negative end. However, for the IR emitters that we have given you, the negative end has a longer lead, so the flat side is the negative end. In addition, the negative end of the IR LED emitter housing has a flat side. In addition, the max rating for these LEDs are 100mA. This means that you ***need*** to place a resistor in series with the emitter as well as a resistor in series with the receiver. We have a limited amount of LED emitters and receivers.

Assuming we want our IR emitters to have around a 70mA output and around a 1.5V drop. Thus, given a 5V output from voltage regulator, and using V=IR, the correct

resistor value is (5V-1.5V)/(70mA) is 50 Ohms. Be sure to use a resistor, since the max forward current is 100mA. Since the Arduino Nano is only rated for 40mA, we have to have the MCU control a transistor that is connected to the IR emitters. DO NOT POWER YOUR EMITTERS INTO YOUR MCU. The MCU only controls the transistor and not the emitter. Thus, you will input a PWM signal into the base of the transistor to control the output of the transistor.

For the IR sensors, place a 1k Ohm resistor in series with the negative lead of the phototransistor and input the voltage across the resistor to the MCU. Experiment with different resistor values to get a suitable range of values. (ie: if you get 1023 from analogRead(); you probably want a lower resistor value). We started with 10K then sequentially tried lower resistor values of 1K, 100, etc.

Future tips for building your own circuit:

1. Make sure to place a resistor in series with the IR emitter.
2. Make sure to place a resistor in series with the IR receiver.
3. Make sure not to power the IR emitter with the Arduino Nano. The Nano cannot support the current output that the emitter requires.
4. Make sure to power the Arduino Nano only with the USB. Do not input voltage to the Arduino Nano as people have burned their microcontrollers.

Any damages will be charged to your team's budget in the future. On that note if anything is not working or seems broken let us know right away!

Schematic for the board is below. Eagle files for both schematic and board are available upon request.

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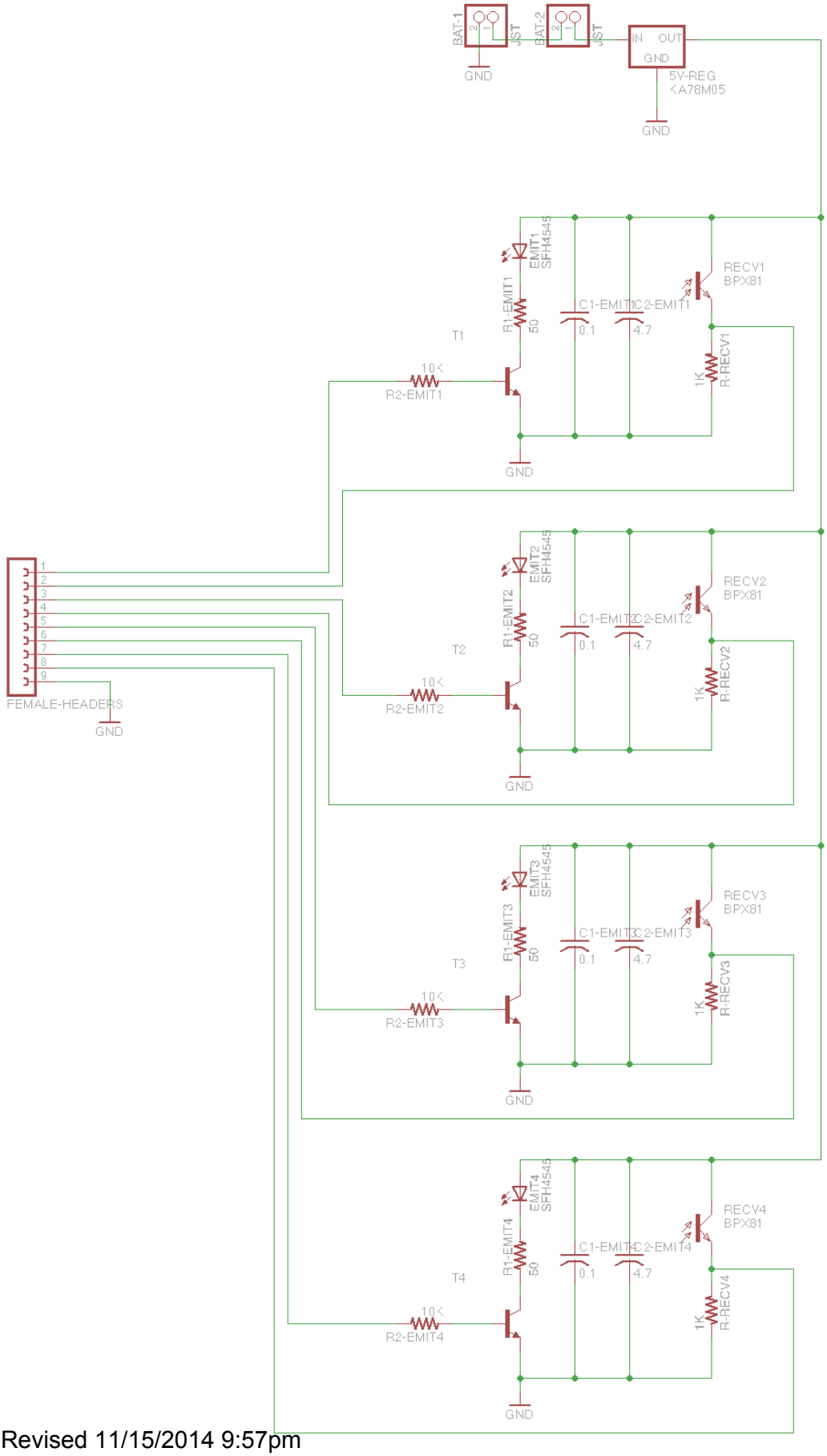

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