



ECE 497: Introduction to Mobile Robotics
Lab # 3
(Behaviors & Object Detection)

Purpose:

The purpose of Lab #3 is to implement object detection and follow center algorithms or behaviors on the mobile robot. These behaviors will be created by using the serial port on the SBC44B daughterboard, an infrared receiver and transmitter as well as the infrared sensors on the Traxster robot.

Equipment:

Traxster Robot
MPLAB ICD2 package
9VDC Power Adapter
DB9 female to female null modem connector
USB-Serial cable
various lengths of wire
Laptop Computer with MPLAB IDE
Ruler, yard stick or measuring tape
ES203 lab kit
Masking tape

Procedure:

1. *Hardware Setup (Serial Communication)*
 - i. Retrieve the Traxster robot, jumper wires, MPLAB ICD2 and power adapter from the parts cabinet. (Use the **SAME** robot for all of your assignments)
 - ii. Connect the battery connector, microcontroller power cable, and MPLAB ICD 2 debugger the same as in Lab #1a. Also, connect the motors to the microcontroller the same as in Lab#1a. Connect the **VCC** and **GROUND** pins on the microcontroller to create the **VCC** and **GROUND** busses. Connect the encoders to the microcontroller the same as in Lab #1b. Connect the 3 infrared sensors and servo mount the same as in Lab #2.
 - iii. Connect the null modem converter and USB-serial cable to the serial port on the PIC daughter board. Make sure you use the CD in the package to install the driver for the USB-serial cable. Use the device manager to confirm the COM port that the USB-serial cable is connected to (see Figure 1).
 - iv. Connect the Pushbutton to *RC0*
Connect LEDS 1, 2, and 3 to *RE0*, *RE1* and *RE2*
2. *Hyperterminal Setup*
 - i. Open the HyperTerminal by clicking Start→All Programs → Accessories→Communications→HyperTerminal
 - ii. Name the New Connection “Data”
 - iii. On the “Connect To”, select Connect Using the COM port where the USB-serial cable was connected
 - iv. On the properties dialog, select 9600 Bits per second and leave the default for the other options



4. *Follow Center and Follow Object Behaviors*
Implement the follow-center and Follow-object behaviors as described in the Pre-lab 3 by using feedback control with the infrared and encoder sensors

5. *Object Detection (Follow Robot and Go To Goal Behaviors)*
 - i. *Calibrate the Transmitter*
 - a. Connect the (“+”) and (“IN”) terminals on the transmitter to 5V on the power supply. Connect the ground (◆) terminal to the ground on the power supply. Connect an oscilloscope or Digital Multimeter across the infrared LED on the transmitter (see Figure 3).
 - b. Measure the frequency across the infrared LED and adjust the potentiometer until $f_o = 36.7$ kHz.
 - c. Leave the transmitter connected to the power supply but remove the oscilloscope leads.
 - d. Test the sensing range of the receiver by connecting the PNA4601M IR receiver output signal to the oscilloscope. Use the power supply to provide 5V and ground to the receiver (see Figure 4).
 - e. Move the receiver to various positions near the transmitter and observe the output signal on the scope. When the receiver is within range of the transmitter it will read 0V. Repeat this step until you are satisfied that you understand the capabilities and limitations of the receiver. This data should be reported in your final project report.

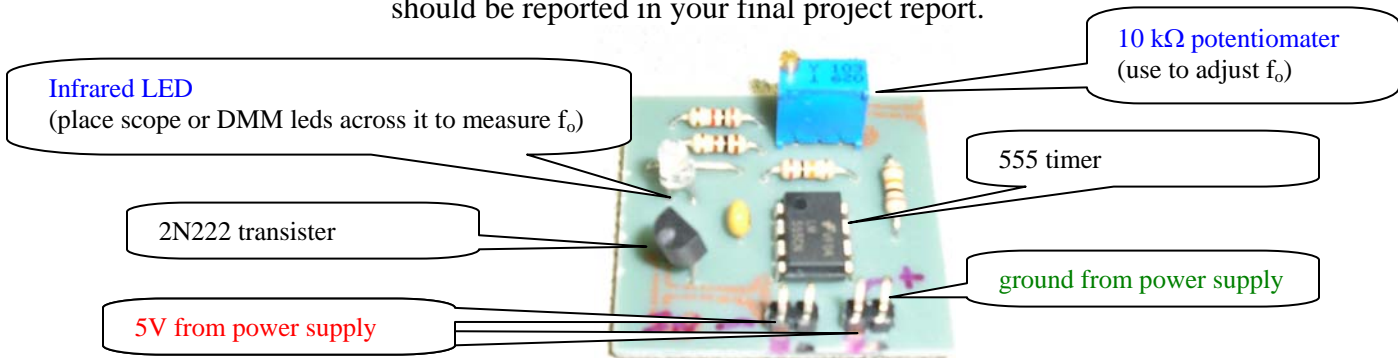


Figure 3: Infrared Transmitter Connection

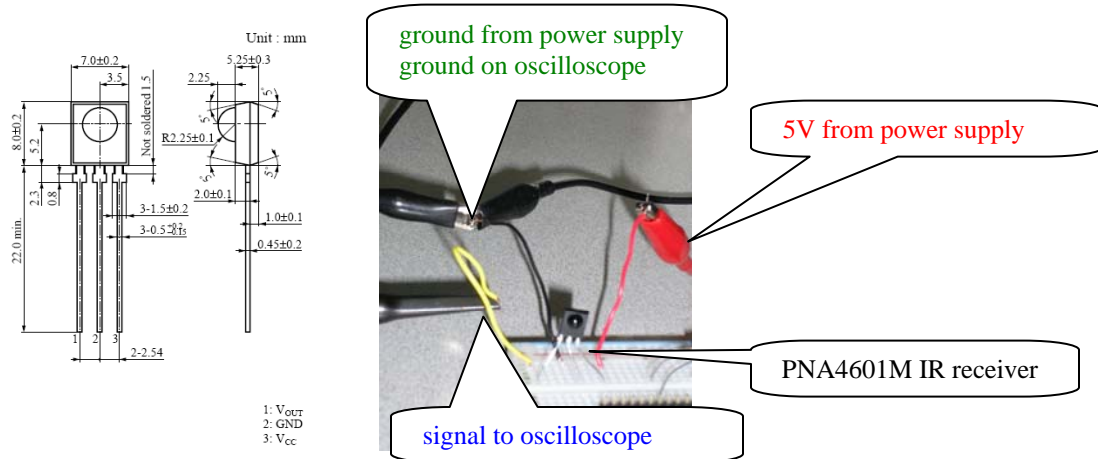


Figure 4: Infrared Receiver Connection



- ii. *Hardware Setup (Connect transmitter and receiver to robot)*
 - a. Connect the Infrared transmitter circuit board to channel RC2 by connecting the pin labeled “+” to the VCC buss on the daughterboard.
 - b. Connect either of the black pins “◆” to ground on the daughterboard (*note: they are tied together on the board*).
 - c. The pin labeled with the “IN” should be connected to RC2 on the SBC 44B daughter board.
 - d. Connect the Panasonic PNA4601M Infrared receiver to channel RC1. The left pin is the signal pin that should be connected to RC1. The center pin should be connected to the ground buss and the right pin should be connected to VCC.
 - d. For testing purposes, make sure the transmitter and receiver are facing each other. Once the code is working, the transmitter and receiver should both be mounted to the front of the robot facing forward in order to communicate with other robots or to find the object (see Figure 5).
 - e. **Do not use the AC power adapter when testing the object detection; it introduces noise from the lights and/or outlet.**

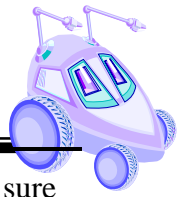
- ii. *Software Setup (IR transmitter/receiver communication)*
 - a. Download the “**ObjectDetection.c**” code from the Angel Labs folder and place it in a folder for all ECE497 lab files. (*Disclaimer: This code is not guaranteed to be “bug-free” and you are under no obligation to use it. If you prefer, you can develop your own decoding algorithm for the received signal but do not change the encoding scheme for the transmission of the signal (see Tables 1 and 2)*).

	value	length	value	length
Header	1	2T		
Data bit “0”	0	0.5T	1	0.5T
Data bit “1”	1	0.5T	0	0.5T
Stop Bit	1	0.5T	0	0.5T

Table 1: Transmission signal Manchester encoding scheme (9 bits)

Signal	Data (4 bits)	$\overline{\text{Data}}$ (4 bits)	Stop Bit
1	0001	1110	1
2	0010	1101	1
3	0011	1100	1
4	0100	1011	1
5	0101	1010	1
6	0110	1001	1
7	0111	1000	1

Table 2: Transmission signal data format (9 bits)



- b. If you choose to use the code, read it along with all comments and make sure you understand what it does

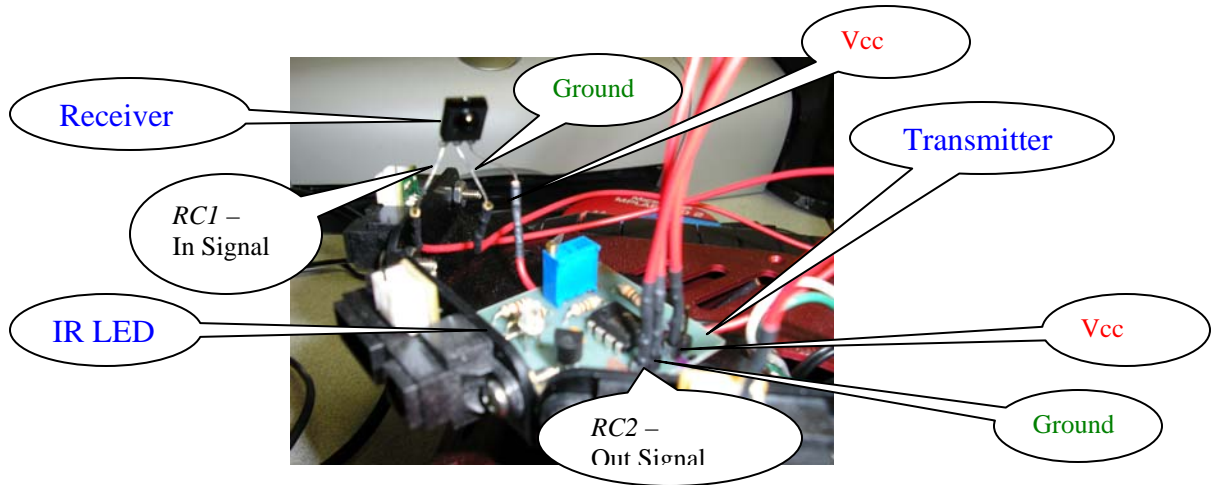


Figure 5: IR Transmitter and Receiver on Robot

- b. You will need to have a HyperTerminal window open and the pushbutton connected to *RC0* in order to test this code. The code will display the data received from the transmitter on the HyperTerminal. If you press the pushbutton, then the data signal should change (see Figure 6).

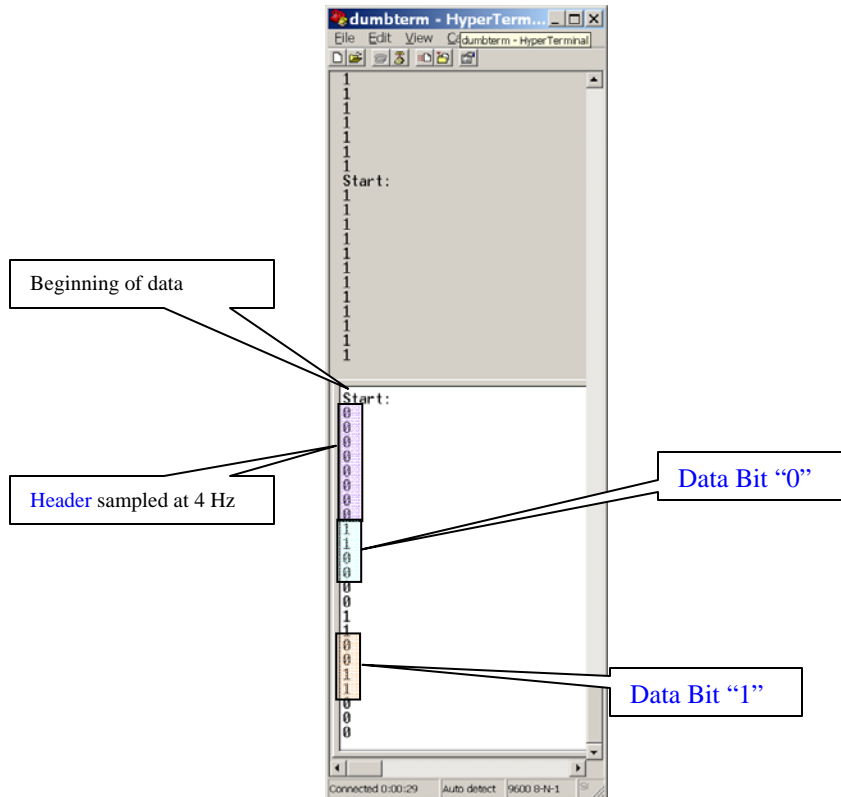


Figure 6: Object Detection Output Data