



Lab 01

Getting to Know Your Robot: Teleoperation/Remote Control

Read this entire lab procedure before starting the lab.

Objectives: At the conclusion of this lab, the student should be able to:

- Calibrate the robot servo motors
- Install the necessary software to control the Arduino robot, including adding the IRremote library
- Mount the infrared receiver onto the robot
- Program the Arduino by creating a sketch to download to the robot
- Use the infrared receiver with a universal remote with an infrared transmitter to design a movement routine for the robot.

Equipment: Arduino Robot Base

Infrared Receiver

Remote Control

Screwdriver

Software: Arduino IDE:

<https://www.arduino.cc/en/Main/Software>

IRremote Library:

<https://github.com/z3t0/Arduino-IRremote/releases>

References: Arduino Robot Getting Started: <http://arduino.cc/en/Guide/Robot>

Arduino Robot Boards: <https://www.arduino.cc/en/Main/Robot>

Arduino Language Reference: <http://arduino.cc/en/Reference/HomePage>

Arduino Robot Library: <http://arduino.cc/en/Reference/RobotLibrary>

Arduino Robot Tutorial 1: Hello User! Introduction to Arduino
<http://www.youtube.com/watch?v=vlxH0DAv5ds>

Arduino Robot Tutorial 2: LOGO and remote control your robot
<http://www.youtube.com/watch?v=3LLlXGvLxU>



LAB PROCEDURE

Inventory

Your first task is to take an inventory of everything in your robot kit. You are responsible for returning the robot and all peripherals in the exact same condition that you received them in so if anything is missing, please notify your instructor or the ECE technician immediately. **Remember you are responsible to pay to replace any parts of the kit that are lost or damaged!**

- Robot
- Robot Quick Start Guide
- Wall Adapter Power Supply
- USB Cable
- Energizer Battery Charger
- 12 AA Rechargeable Batteries
- Arduino LCD Screen with Micro-SD Reader
- Micro-SD 2GB Memory Card
- Micro-SD Adapter
- Pocket Screwdriver
- Remote Control
- Expansion Kit
 - Ultrasonic sensor
 - Infrared Sensor
 - Infrared Receiver
 - 3 TinkerKit LEDs
 - 4 TinkerKit cables
 - 2 photoresistors

Getting Started Guide

1. Navigate to the Arduino Robot Getting Started website (<http://arduino.cc/en/Guide/Robot>)
2. Under *Setting up the Robot*, confirm that the LCD and Memory Card and protective cover are already installed on the robot
3. Follow the directions to connect your robot to the computer.
4. Follow the directions to Install the Driver, if necessary. Please review the Troubleshooting tips on the website or on page 4 of the Robot Quick Start Guide in your kit if you run into any problems.
5. Since many of these robots have been tested or used in other courses, they may have a different program than *Hello User* when turned on. **WATCH THE ROBOT! DON'T LET IT DRIVE OFF THE TABLE!**
6. Complete the tutorials on *Moving the Robot* and *Changing the motor speed with the potentiometer*. Watch the Arduino Robot Video Tutorial 1 on Introduction to Arduino, see the link under resources.



Mounting the Infrared Receiver

1. Watch the Arduino Robot Video Tutorial 2 on LOGO and the remote control, see the link under resources.
2. If there is no header pin in the TKD1 (D1) robot silkscreen on the Robot Control Board (top once), take it to the ECE technicians to have one put on.
3. Mount the infrared receiver to TKD1. The pin out for the infrared receiver is shown in the following figure. **CONFIRM WHICH RECEIVER YOU HAVE SO THAT YOU DON'T MIX UP THE PINS!!** Note that the pins are not in the same order as they are on the Arduino robot. On the robot the order is +5V, Signal (OUT), GND.

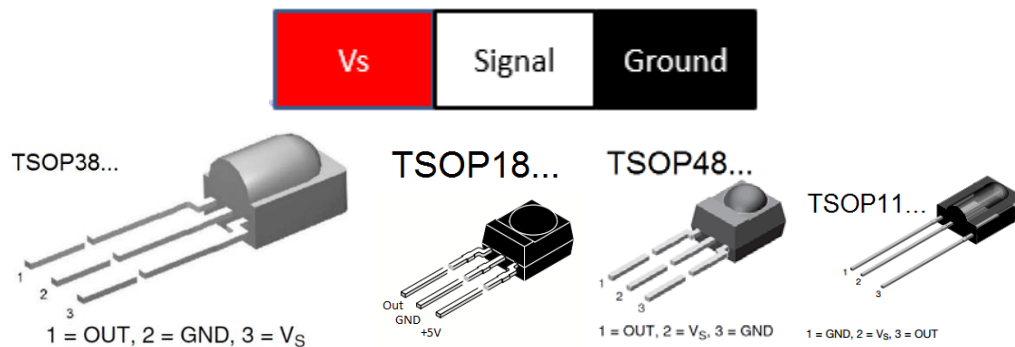


Figure 1: Infrared Receiver Pinout

Creating the program

1. Attach the robot to the computer's USB port and wait for the USB driver to install and note the COM port where it is attached.
2. Next, click Tools→Board→Arduino Robot Control
3. Next, click Tools→Port→then select the port where the robot is attached
4. To start writing your program, you are going to start with a sample program by selecting File→Examples→Robot_Control→explore→R08_Remote_Control
5. Save the file under a new name, "LastName-FirstName-Lab01".
6. If the program will not compile, it is most likely missing the library, you can install the library by clicking Sketch→Include Library→Manage Libraries, search for IRremote and Install.
7. You will have to close and open the Arduino software to register that the library has been added.
8. If the program still won't compile, you may need to try the older version of the Library available on Moodle or call the instructor for assistance.
9. Run the program and press various keys on the remote control. The code received by the infrared receiver should be shown under Remote Control Code on the LCD screen. If the value displayed is not negative and does not change after several presses then record the code for that key. Repeat this process to get at least 6 key codes. You need to be able to program at least 6 keys for the robot motion forward, reverse, turn left, turn right, spin left, spin right.
10. You should then modify the code to work with your keys and test it on the robot. Note that your code is required to be modular which means there must be separate functions for each of the



motions. This will help you in the future to re-use your code and as you build behaviors on reactive rules.

Demonstration

You will use the remote control to demonstrate the different robot behaviors you have programmed to the respective keys. Then, you will place your robot on the floor and use the remote control to drive it through an obstacle course.

If you have any questions, please do not hesitate to ask your instructor.

Part 1 – Software Installation

Getting Started Guide

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2. Under *Setting up the Robot*, confirm that the LCD and Memory Card and protective cover are already installed on the robot
3. Follow the directions to connect your robot to the computer.
4. Follow the directions to Install the Driver. Please review the Troubleshooting tips on the website or on page 4 of the Robot Quick Start Guide in your kit if you run into any problems.
5. Since all of these robots have been tested, it may have a different program than *Hello User* when turned on.
6. Complete the tutorials on *Moving the Robot* and *Changing the motor speed with the potentiometer*.
7. Review Arduino Robot Tutorial 2 on YouTube and calibrate your robot motors.

Demonstration

Bring your robot fully charged to class every day!

During the demonstration you will be graded on the following requirements:

- Ability to describe how the code works
- At least 6 keys programmed to move the robot
- Robot moves in a circle
- Robot moves in a square
- Robot can successfully navigate the obstacle course



Memo Guidelines:

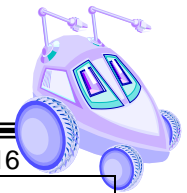
Please use the following checklist to insure that your memo meets the basic guidelines.

- ✓ **Format**
 - Begins with Date, To , From, Subject
 - Font no larger than 12 point font
 - Spacing no larger than double space
 - Written as a combination of sentences or paragraphs and only bulleted list, if necessary
 - No longer than three pages of text
- ✓ **Writing**
 - Memo is organized in a logical order
 - Writing is direct, concise and to the point
 - Written in first person from lab partners
 - Correct grammar, no spelling errors
- ✓ **Content**
 - Starts with a statement of purpose
 - Discusses the strategy or pseudocode for implementing the robot remote control (includes pseudocode, flow chart, state diagram, or control architecture in the appendix)
 - Discusses the tests and methods performed
 - States the results and or data tables including error analysis, if required
 - Shows any required plots or graphs, if required
 - Answers all questions posed in the lab procedure
 - Clear statement of conclusions

Grading Rubric:

The lab is worth a total of 30 points and is graded by the following rubric.

| Points | Demonstration | Code | Memo |
|--------|--|--|---|
| 10 | Excellent work, the robot performs exactly as required | Properly commented with a header and function comments, easy to follow with modular components | Follows all guidelines and answers all questions posed |
| 7.5 | Performs most of the functionality with minor failures | Partial comments and/or not modular with objects | Does not answer some questions and/or has spelling, grammatical, content errors |



| | | | |
|---|---|--|--|
| 5 | Performs some of the functionality but with major failures or parts missing | No comments, not modular, not easy to follow | Multiple grammatical, format, content, spelling errors, questions not answered |
| 0 | Meets none of the design specifications or not submitted | Not submitted | Not submitted |

Submission Requirements:

You must submit your properly commented Sketch code & memo to the Moodle DropBox by midnight on Sunday. Check the course calendar for the lab demonstration due date.