Oregon State University
Robotics Club
groups.engr.oregonstate.edu/osurc

ORK 2.0 Instruction Manual

OSURC Robotics Kit v 2.0

Manual Revision 4

Acknowledgements

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Contact Information:

Website: http://www.groups.engr.oregonstate.edu/osurc

Email: OSURCofficers@engr.orst.edu

Please send an email to the above email if you have any questions or suggestions, a club officer will be happy to get back to you.

Designed by:

Nick McComb

Corwin Perren

Ryan Skeele

Club Leadership:

President – Billy Edwards

Vice-President – Nick McComb

Treasurer – Corwin Perren

Secretary – John Zeller

Hardware Developer – Nathan Brahmstadt

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Chapter 1: Kit Overview

Kit Overview

This kit is a basic Robotics platform developed using Off-The-Shelf components. It is designed as a guided learning platform to introduce the skills that are required for the Robotics discipline. The kit is designed such that people from any major can pick up and start learning. The kit mixes the disciplines together just like any robotics project.

There are three major portions to this Kit:

Mechanical

- Assembling a basic robotics platform
- Sensor integration
- Physical control of actuators and limitations of motors

Electrical

- Soldering and Wiring
- Assembly of an Motor Driver
  - Reading schematics / datasheets
- Sensor integration
- Protoboarding
- Breadboarding

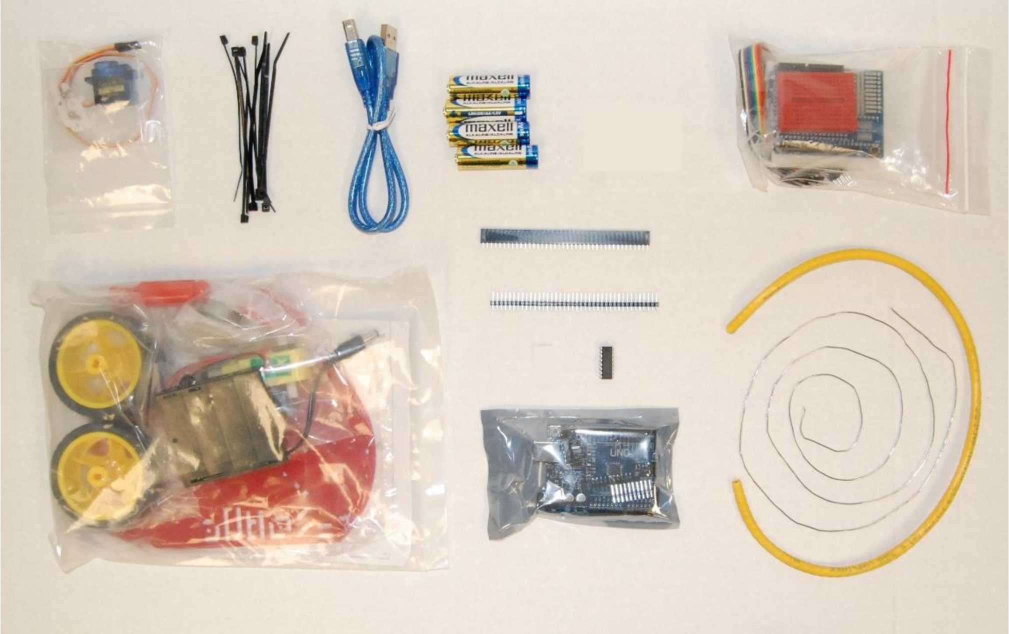
Software

- Arduino-based programming
- Introduction to Robotics decision making
- Sensor integration

Extended Learning

- 3D-Printed custom parts
- Embedded programming using an Atmel 328p microcontroller
  - This will also be covered in further workshops
- Integration of advanced sensors (Wi-Fi, Bluetooth, Infrared, etc.)

Chapter 2: Included Parts



Part Name	Quantity	Related Links
Magician Chassis	1	https://www.sparkfun.com/products/12866
Arduino UNO R3 (clone)	1	http://arduino.cc/en/Main/arduinoBoardUno http://www.wch.cn/downloads.php?name=pro&proid=5
USB A to B Cable	1	
Arduino Prototype Shield	1	
SG90 Micro 9g Servo	1	http://www.hobbypartz.com/topromisesg9.html
SN754410NE Motor Driver	1	http://www.ti.com/lit/ds/symlink/sn754410.pdf
Female and Male Header	1	
ZipTies	~5	
Batteries (AA)	4	
63 / 37 Solder	1 length	
Assorted lengths of wire		Ethernet Cable

Chapter 3: Required Tools / Skills

Required Tools

- Soldering Iron (solder included in Kit)
- Wire Cutters
- Wire Strippers
- Computer with Arduino IDE installed

Recommended Tools

- Multi-meter for continuity testing
- Solder wick or a “Solder Sucker”
- X-ACTO Knife, or any sharp knife

Applicable Skills

While there is a list of “required” skills below, the whole point of this kit is to introduce these skills. OSURC holds workshops where qualified people lead instructional sessions to teach these skills. OSURC leads everyone attending our workshops through the kit one step at a time, helping people as they get stuck.

You have to start somewhere, and this is a great place to start!

“Only those who dare to fail greatly can ever achieve greatly.”

-Robert F. Kennedy

Skills

- Soldering
- Wire Cutting / Stripping
- Assembly of a mechanical chassis
- Arduino Based Programming
- Sensor integration

Chapter 4: Assembling your Kit

After verifying you have all items included in the kit and the tools required to complete construction, use the following steps to assemble your new kit!

Open the provided schematic (see Appendix), we will be building this circuit.

Open the motor driver datasheet using the provided link. This is good practice as reading datasheets is a crucial skill for all roboticists! Find the pinouts on the datasheet.

Also, if you are working in a workshop, and have any questions, feel free to ask the people facilitating the workshop. That's what they're for! Also, the demo robot that they built can be an excellent reference for building your own bot.

Electrical Instructions

Place motor driver on center of empty shield, making sure it is on the top and the **notch faces the button side.**

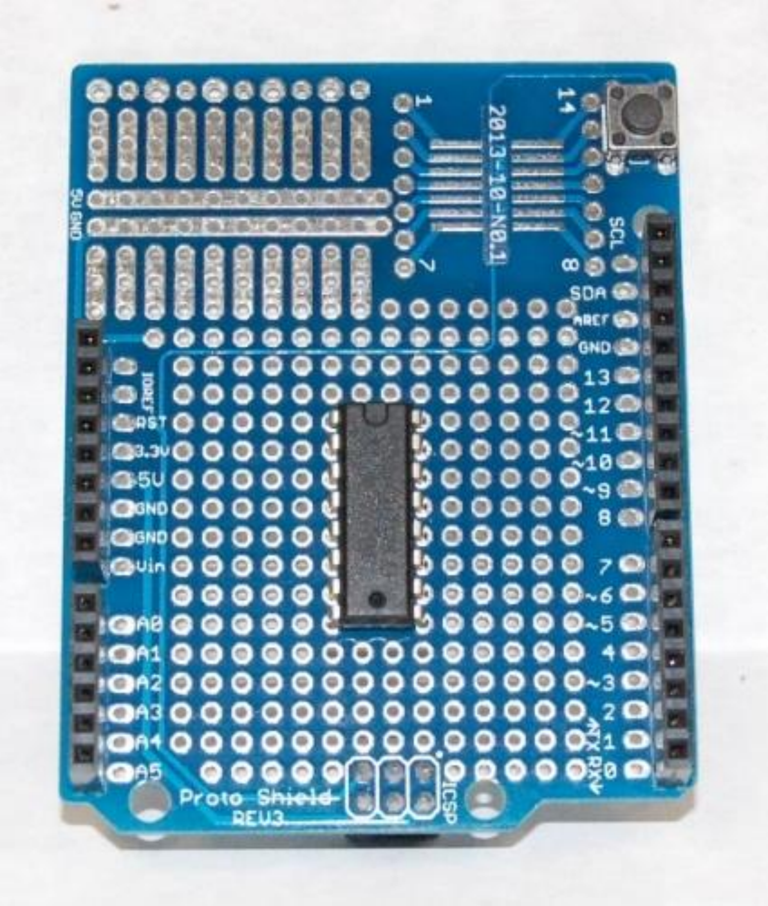


Figure 1: Placement of Motor Driver on Protoboard.

Solder the motor driver leads to the board.

Tip: Remember that both surfaces need to be heated for the solder to flow correctly. Put a little solder on your iron tip before, to help increase the heat transfer. This is more necessary on large heatsinked parts.

Tip: While not necessary in this case, it is always best to first solder down one lead and then verify your part is oriented correctly and only after that should you solder the rest of the leads.

Strip one end of a short wire.

Insert the wire in a hole next to the motor driver leads so that the insulation is flush with board and only wire sticks through.

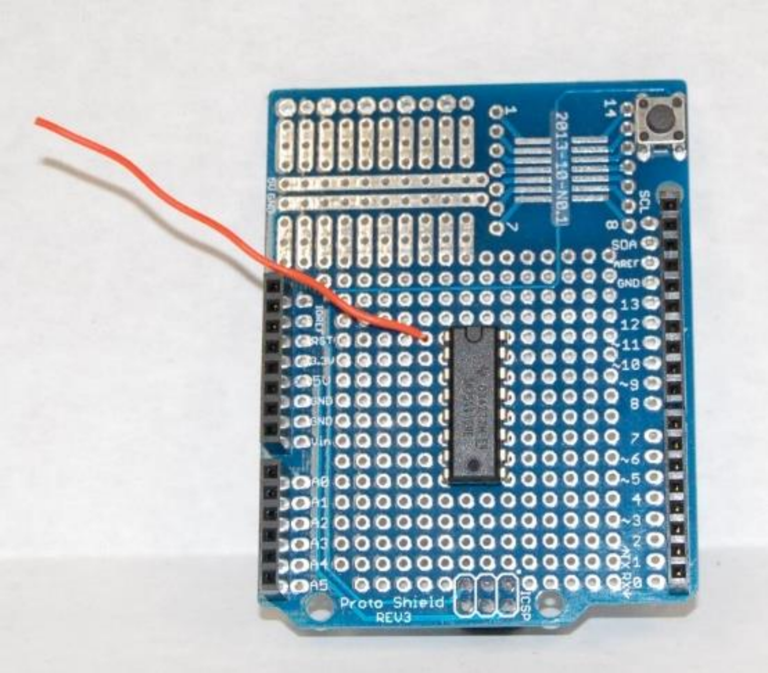


Figure 2: Inserting a wire next to the motor driver.

Solder the wire to the backside of the board. [Figure 3]

Tip: Carefully add enough solder and angle your tip so that you bridge the gap between the wire and the motor driver lead. If you have trouble, try slowly dragging your tip from the wire to motor lead.

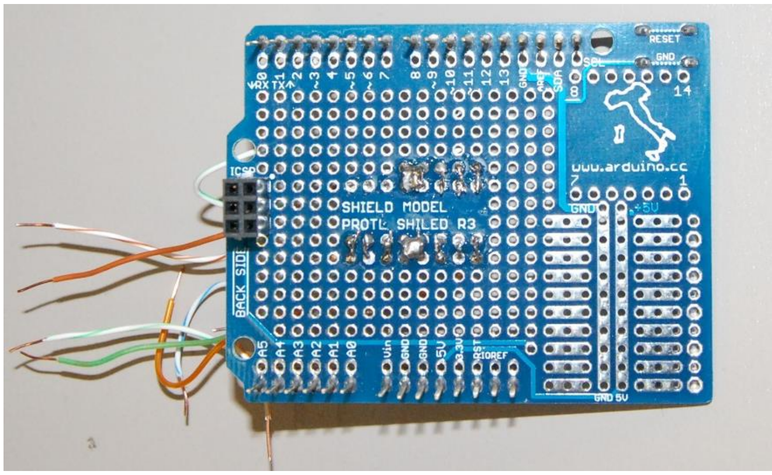


Figure 3: Soldering the back of the Protoboard.

Repeat this process for every lead **except** one of the middle leads from each side can be skipped. The two middle leads are ground and will need to be bridged.

Using the schematic find the matching Arduino pin that a wire connects to.

Carefully route the wire to the hole then trim the wire with **enough extra length** to strip the end of its shielding. Look three steps ahead for when you are doing the wires that go to the motors.

Insert the stripped end and on the backside solder the wire to the board.

Tip: If you made your wire too short you will need to heat the solder and pull out the wire. Strip the end of a new wire and replace the short wire. Try again.

Repeat the last three steps for all connections to the motor driver from the Arduino.

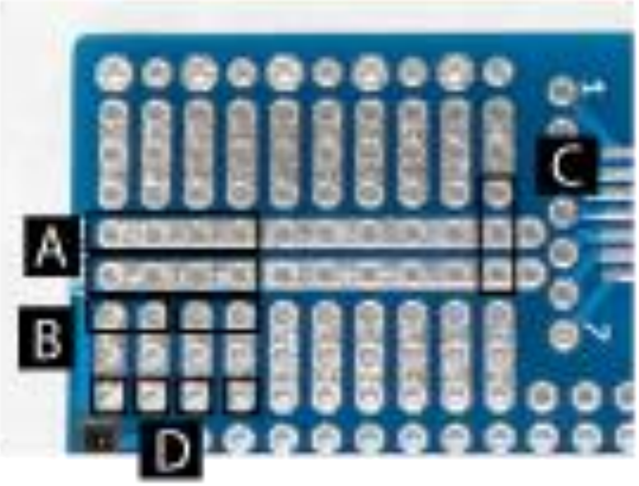


Figure 4: Placement of Headers on Protoboard.

Wires connecting to the motor leads will need to be routed to the connected three hole traces. Make sure you are using the correct traces and **NOT 5V AND GROUND.** All four wires need to be on their own (consecutive) connected traces starting from the board's edge. Solder the wire to the same row of holes. [Label D in Figure 4]

Tip: For the connections to the motor, we are going to use Female header to make our lives easier.

Cut the female header into three 4 hole lengths and the male header into one 3 pin section.

Insert and solder the female header so each pin is connected to the consecutive sections [Label B in Figure 4].

Tip: Solder one pin and make sure your header is straight before soldering the rest.

Insert and solder the two other lengths of female header along 5V and ground [Label A in Figure 4].

Insert and solder the 3 pin length of male header so that the pins connect **IN THIS ORDER:** ground, 5V, and signal. **MAKE SURE THE ORDER MATCHES THE SERVO WIRE.** [Label C in Figure 4]

Tip: The servo wire is as follows: brown – GND, red – 5v, yellow – Signal

Strip the end of another length of wire and solder it to the nearest hole connected to signal.

Route and solder this to the appropriate pin using the schematic.

Tip: if you want to be able to change the pin your servo is connected to then instead of soldering it to the shield, keep the length longer and lightly apply solder to the stripped end (tinning the tip). You will need to make it thin enough to insert it in the female header.

Follow the schematic to plug in the sonar sensor using the included group of male to female jumper wires.

Tip: As always, be wary of swapping 5v (Vcc) and Gnd

Chapter 5: Programming your Kit

Progress through the levels and you will be building custom robots in no time! The latest code for the kit can be found at www.github.com/OSURoboticsClub/ork, it is well commented and should walk you through the basics of getting your kit to move. However it is best to understand how programming works instead of depending on our available code. Use the resources below to advance your programming skills. Getting part way through level two is recommended for working with your Arduino. Getting part way through level three is highly recommended before getting involved in a competition team.

Level 1

This level is meant for beginners who have never seen a computer program before.

Watch this video series, or follow one of these tutorials.
https://www.youtube.com/user/OSHJunkies/featured
http://www.ladyada.net/learn/arduino/
https://www.youtube.com/playlist?list=PLA567CE235D39FA84

Level 2

This level is for people who know the basics of programming. You will learn specifically how to design a program and use your Arduino effectively.

Programming Steps/Design
http://en.wikibooks.org/wiki/The_Computer_Revolution/Programming/Five_Steps_of_Programming

Understand your hardware
http://arduino.cc/en/Main/arduinoBoardUno

Level 3

This level is for those of you who know how to program Arduino but are looking for the next step.

About microcontrollers
http://www.societyofrobots.com/microcontroller_tutorial.shtml

Learn some basics of c, or c++
http://www.codecademy.com/
http://101.lv/learn/C++/
http://cppreference.com
http://www.embeddedrelated.com/showarticle/453.php
www.codewars.com

Chapter 6: Extended Learning

Add a Bluetooth/wifi module to your robot and control it from your computer!

Use a webcam and OpenCV to track your robot and tell it where to go. This would be very advantageous in the competition.

Chapter 7: Competition Description and Rules

Competition Description

[To be released]

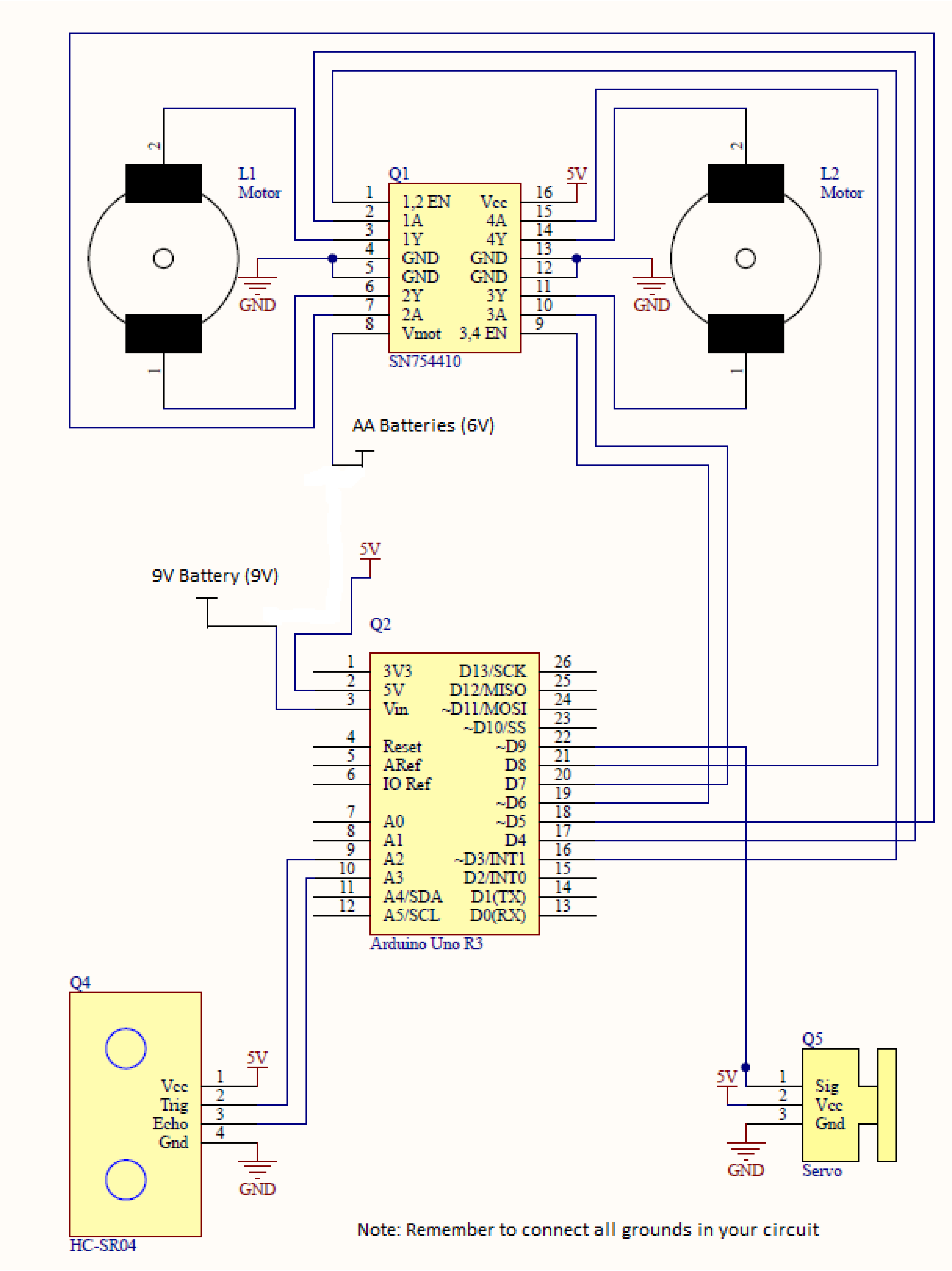
Short summary: The competition is going to be analogous to a Sharks and Minos game, with a group of Robots trying to get past a "shark" that tries to prevent them from getting to the other side.

Competition Rules

1. Robots must be smaller than [to be finalized]
2. Robots must not be bigger than [to be finalized]
3. Robots must not be teleoperated… Full autonomy! (Off board communication/processing is allowed)
4. Robots cannot damage another robot… Disqualification!
5. No projectiles
6. One flag (2"x2") black with custom logo. One flag (2"x2") white with custom logo.
   a. The flag will mount to chassis
   b. The flag has to follow the provided template [link]
7. The whole robot must cross the finish line to count
   a. This means everything that enters the field must leave
8. DBAG (Don't be a goon! This rule is up to the Judges' Discretion)

Appendix

ORK Electrical Schematic v2.1



Note: Remember to connect all grounds in your circuit