



Advanced Manufacturing Academy



ROBOTICS

College of Engineering and Technology

East Carolina University

Our Robot – Our Plan

- Keep it Simple!
- Building a simple robot
- Want to show you.....
 - Anybody can do it
 - Utilize powerful technology and concepts
 - Low cost
 - How robotics can connect all the facets of advanced manufacturing.

Imbedded Processing

- Utilize a modern “Microcontroller”
 - Small computer
 - Meant to be installed (imbedded)
- Imbedded processing allows us to:
 - Collect data
 - Monitor systems
 - Control the world around us
 - The “Internet of Things” (IoT)
- Robot is just a great example.

Building the Robot

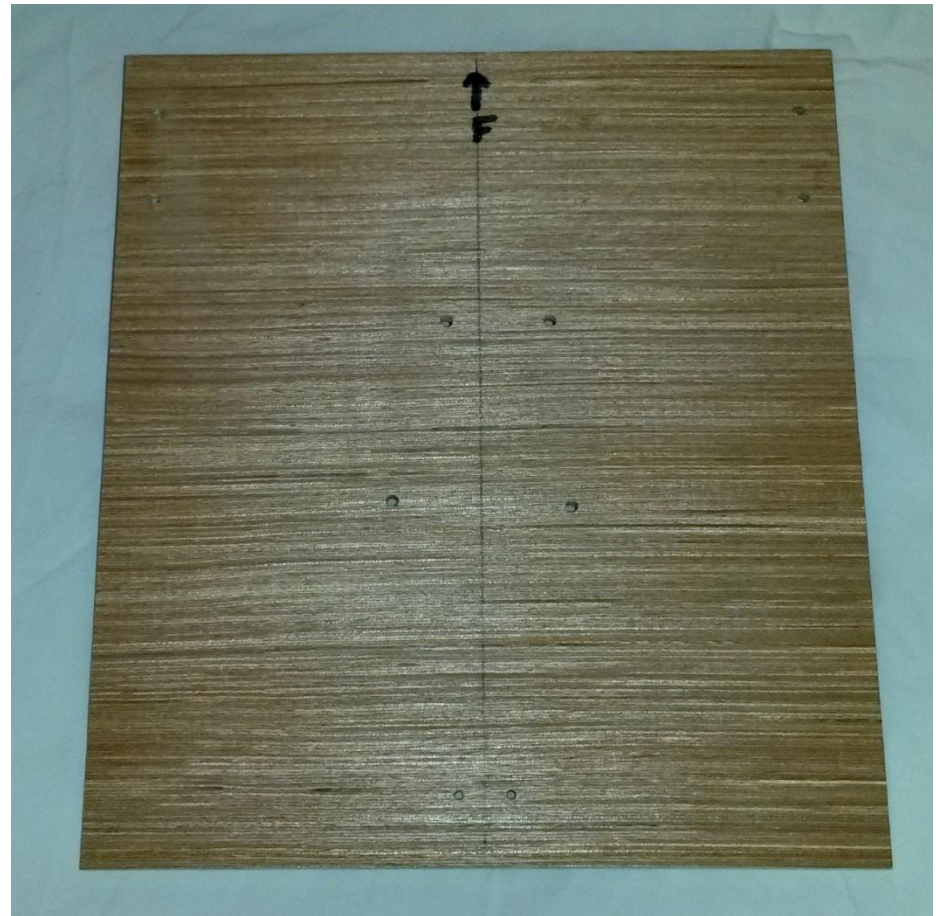
- Let's get started!
- The Plan
 - Parts Review
 - Show you each of the assembly steps
 - You assemble your robot
 - Load sample code
 - Test the robots

Assembly – The Parts

- Parts List
 - Base Plate
 - Arduino Controller
 - Servos – Continuous rotation
 - Wheels
 - Roller Assembly
 - Harness
 - Battery holder
 - Fasteners/spacers/zip ties/tape

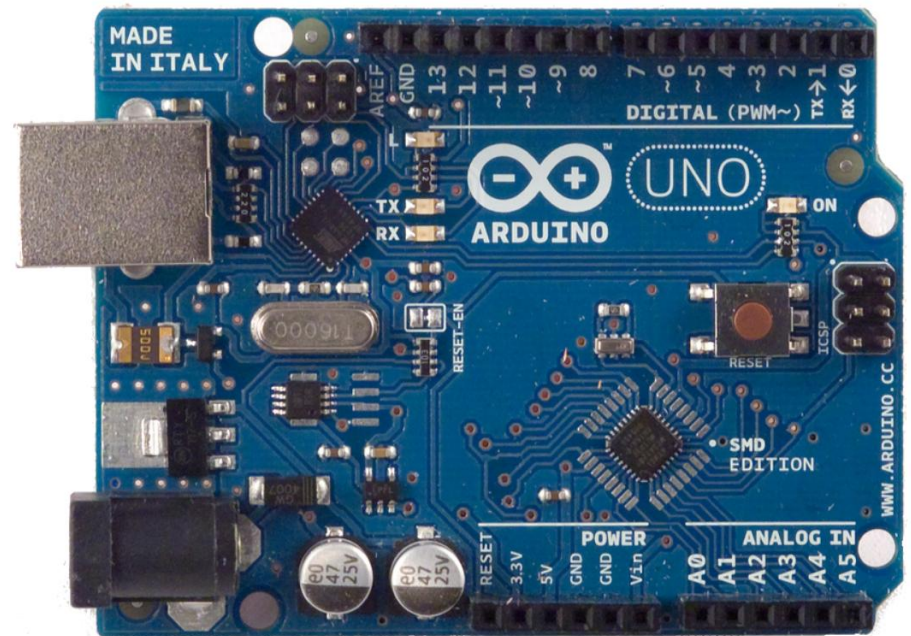
Robot Parts – Base Plate

- Base plate
 - Predrilled
 - Note Orientation
 - FRONT/TOP



Robot Parts – Arduino

- Arduino Uno
 - Surface Mt.
 - CAREFUL!!
 - ✓ Static sensitive
 - Main Parts
 - ✓ Power Connect
 - ✓ USB Connect
 - ✓ User Connection
 - ❖ Power
 - ❖ Analog
 - ❖ Digital



Robot Parts – Servo

- The SERVO
 - Feetech FS90R
 - Continuous Rotation
 - Combined functions
 - ✓ Motor
 - ✓ Feedback control
 - ✓ Gearbox



www.pololu.com

Robot Parts – Wheels

- Molded plastic wheels
 - Pololu #290
 - Intended for Futaba
 - Slight mod for us



Robot Parts – Roller Assembly

- 3/8" Ball Caster Assembly
 - Pololu #950
 - Provides third wheel



Pololu ball caster with 3/8" plastic ball.

Robot Parts – Wire Harness

- Custom Wire Harness
 - Provided for this program
 - Normally make your own
 - SO MANY variations



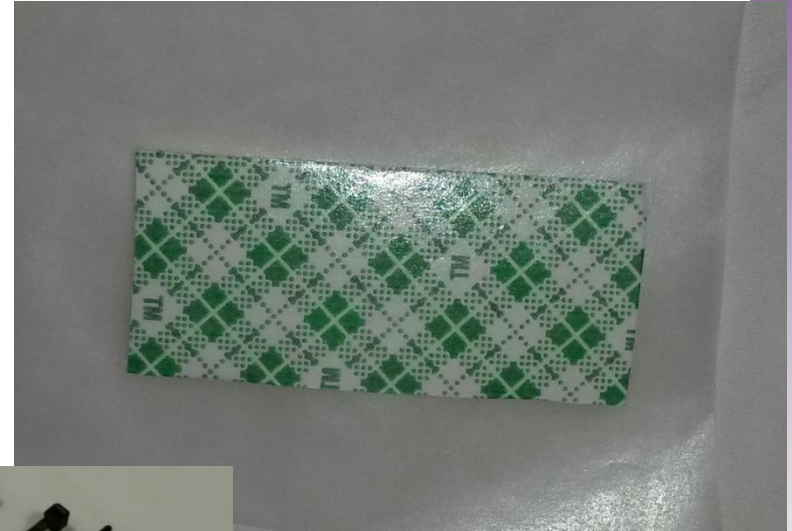
Robot Parts – Battery Holder

- Battery Holder
 - Jameco 2207030
 - No switch
 - On/Off – Pull the plug



Robot Parts – Miscellaneous

- Fasteners and small parts
 - 4-40 screws
 - Spacers/Brackets
 - Tape and zip ties



Introducing – My Thumb

- Star of many pictures



Assembly – Tools

- Most assembly steps can be done with pliers and screwdriver shown
- Any additional tools will be noted.



Assembly – Step 1

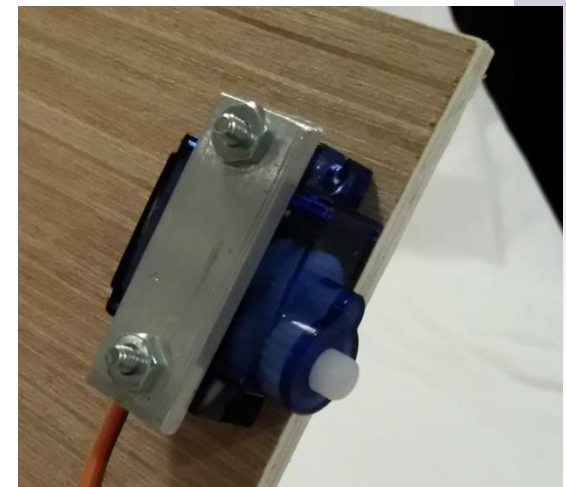
- Install continuous rotation servos
- You will need:
 - Base Plate
 - Continuous Rotation servo (2 pieces)
 - Servo Mount brackets
 - 4 – 40 x 1 screws (4 pieces)
 - ✓ Watch out for screw with flat spot
 - ✓ Need that one for later operation
 - 4 – 40 nuts (4 – pieces)



2 X Per Robot

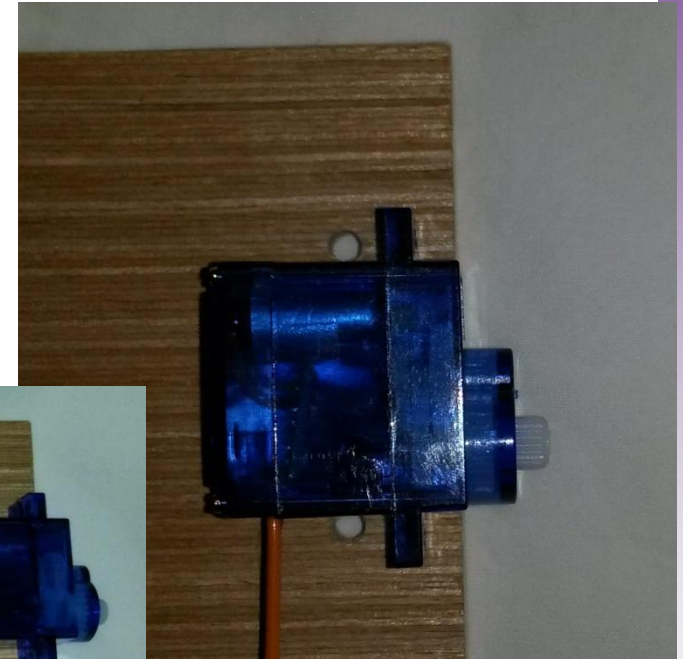
Assembly – Step 1 (cont)

- Install continuous rotation servos
 - Note top/front orientation of base plate
 - Align servo as shown
 - Place bracket over the servo
 - Install screws from underneath
 - Install nuts on top of plate
 - SNUG the screws
 - ✓ Do not over tighten
 - Same assembly for both sides



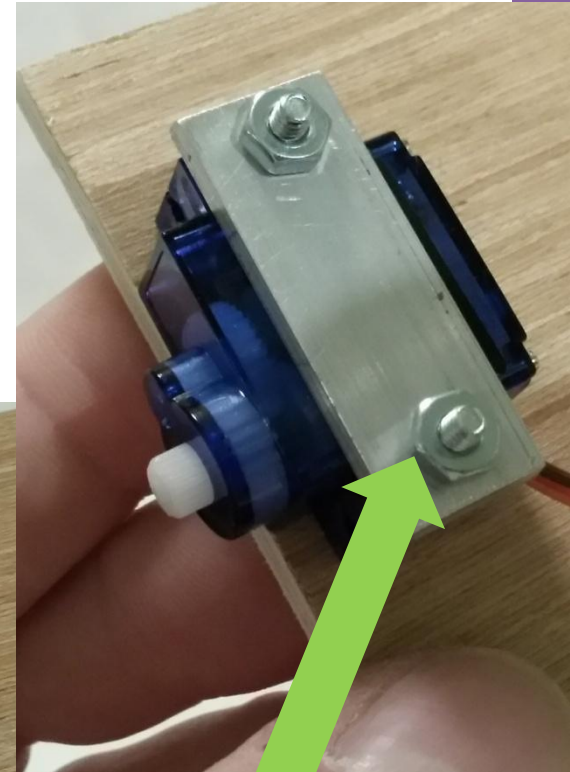
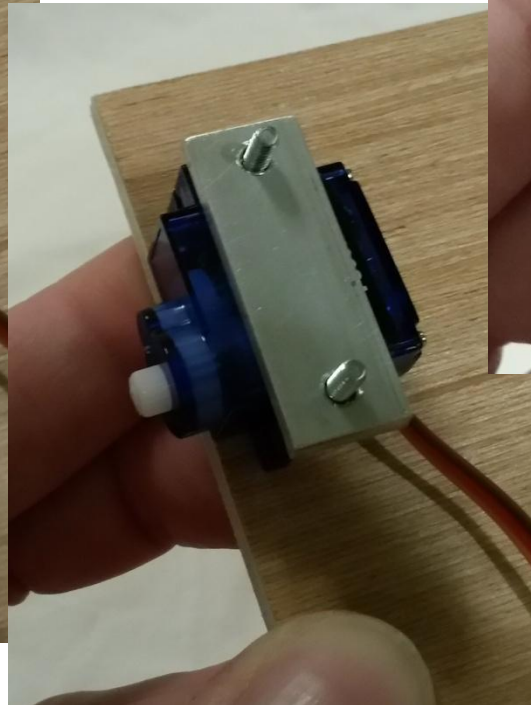
Assembly – Step 1 (cont)

- Align servo with edge between holes
- NOTE:
 - Servo orientation (L&R)
 - Location



Assembly – Step 1 (cont)

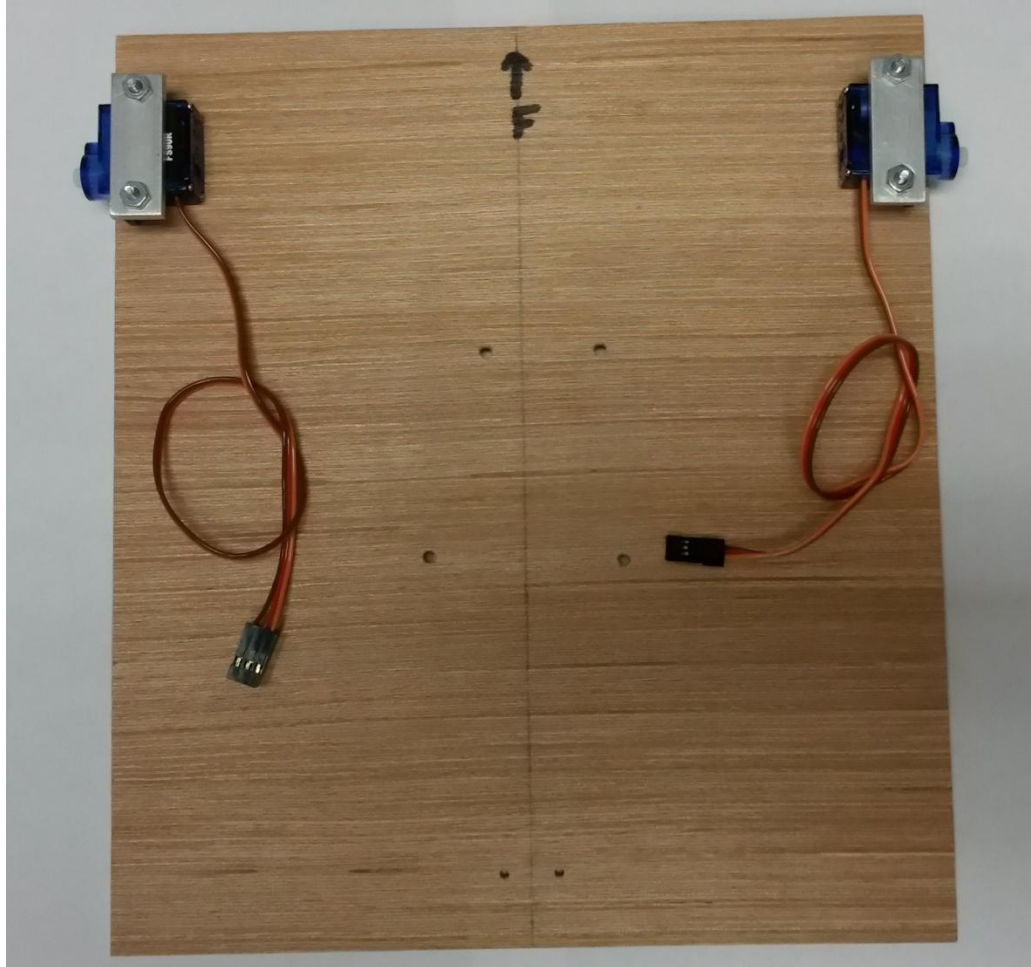
- Assemble like this....



SNUG – NOT TOO TIGHT

Assembly – Step 1 - Done

- Should look like this.

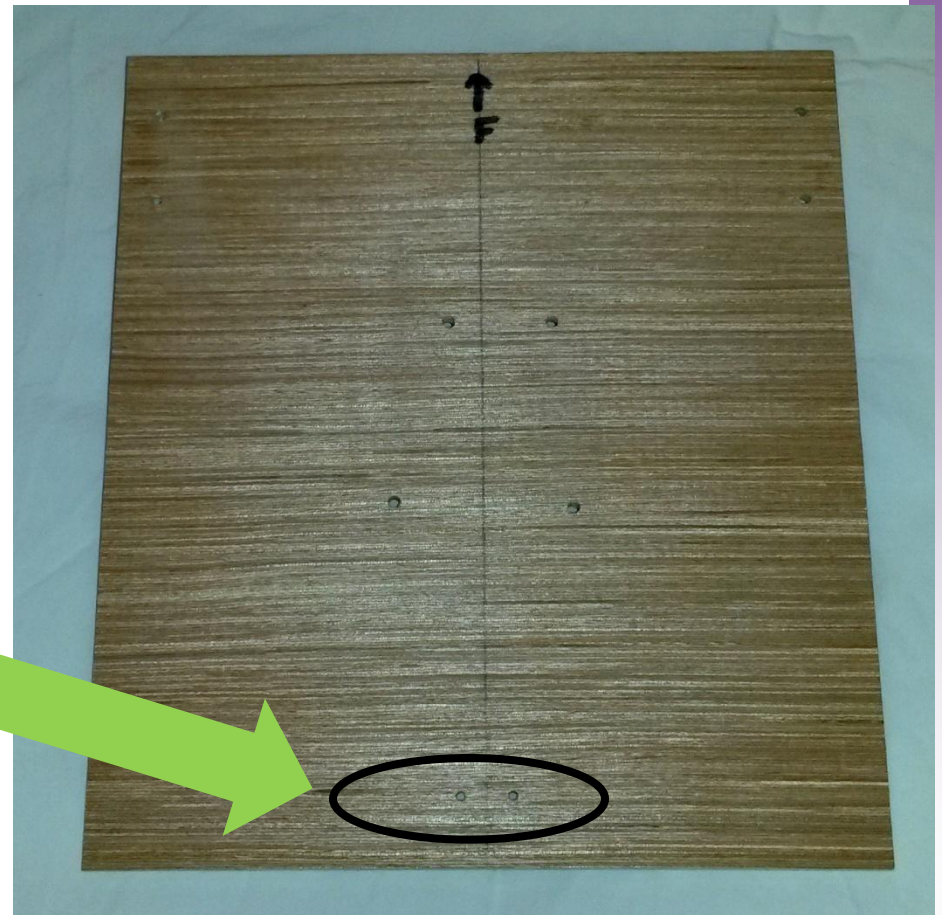


Assembly – Step 2

- Install Ball Caster!
 - Goes under robot



Pololu ball caster with 3/8" plastic ball.



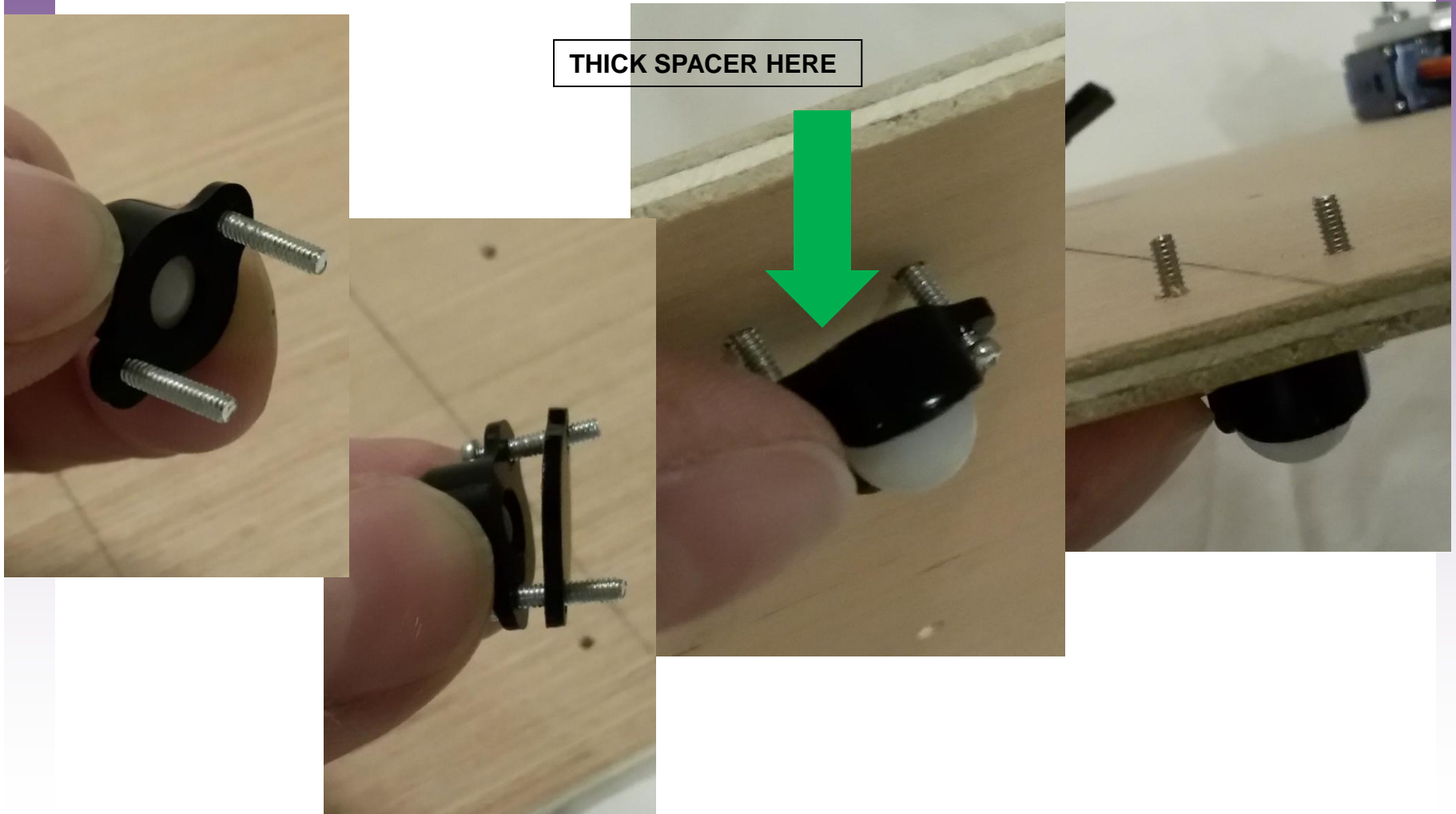
Assembly – Step 2 (cont)

- Assemble caster like this...
 - Install screws through ball caster
 - Install spacer (THICK)
 - Push screws through holes in plate
 - ✓ Goes under the robot (Bottom side)
 - Install nuts on top side
 - Snug up nuts with pliers and screwdriver



Assembly – Step 2 (cont)

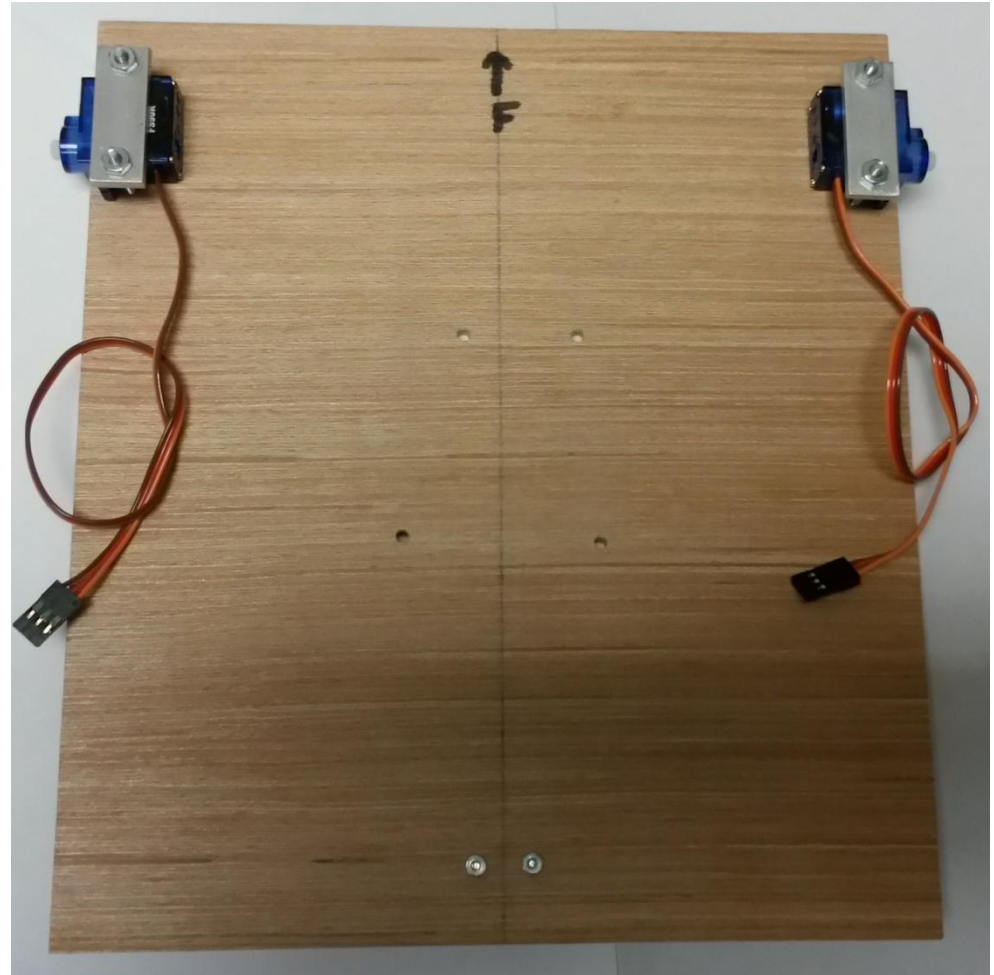
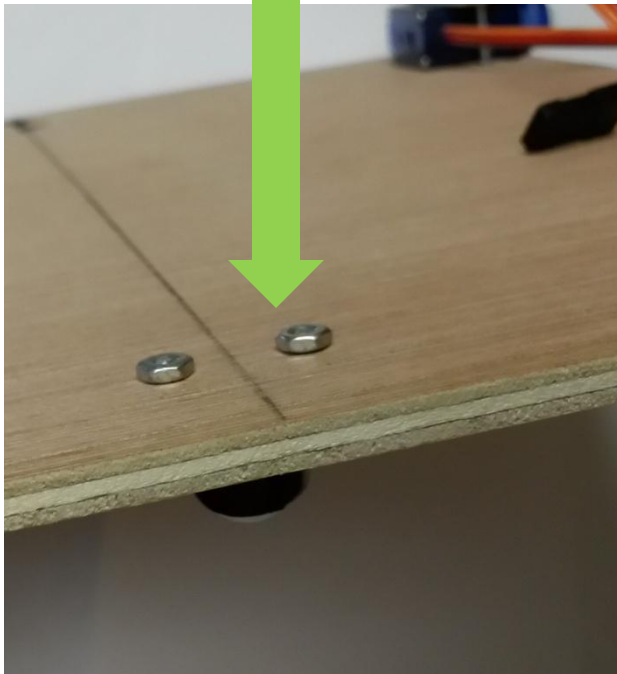
- Assemble caster like this...



Assembly – Step 2 - Done

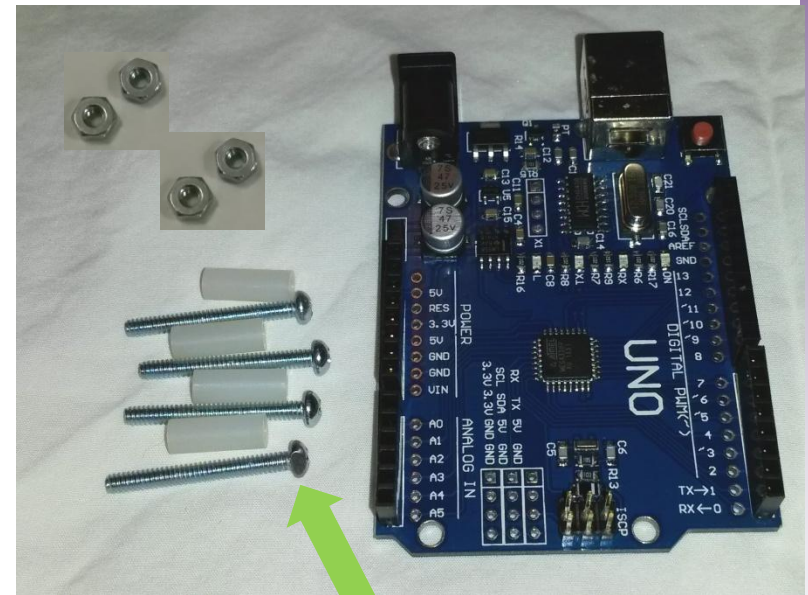
- Add the nuts and it looks like this...

Gently tighten these nuts using pliers and screwdriver.



Assembly – Step 3

- Install the Arduino controller
- You will need:
 - Arduino
 - 4-40x1 screws (4)*
 - ✓ One with flat spot
 - 4-40x1 nuts (4)
 - 1/2" plastic spacers (4)



NOTE: Flat side
this screw only.

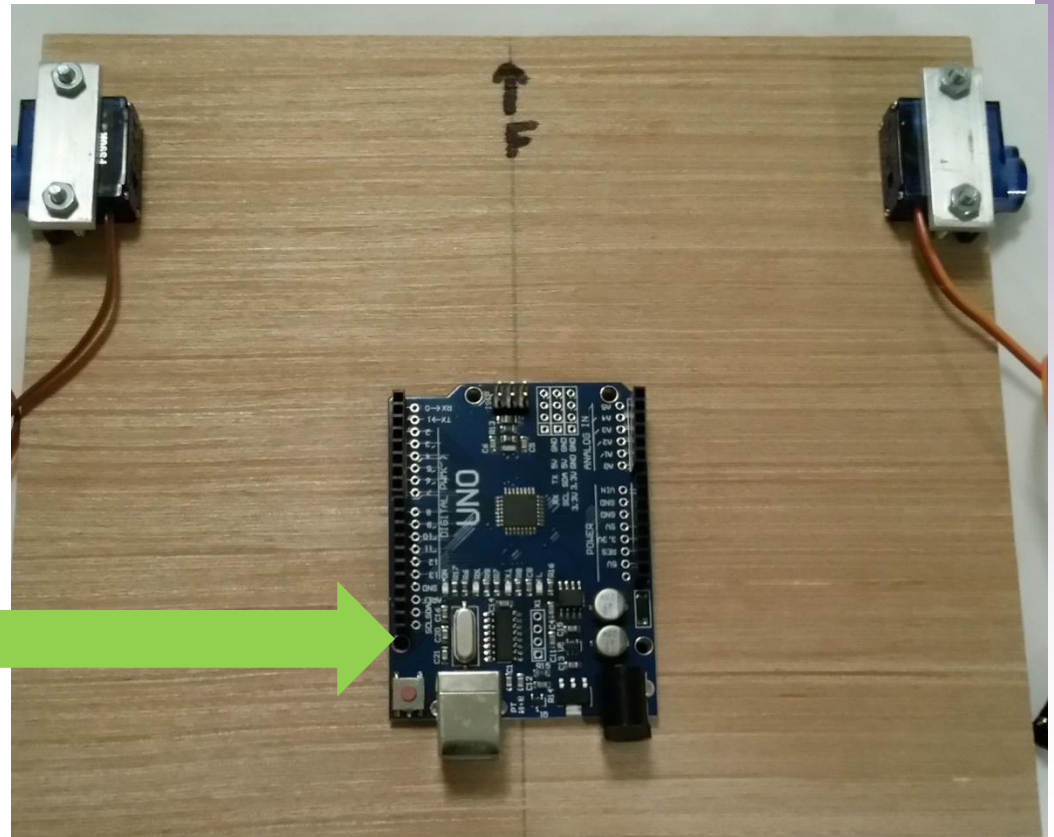
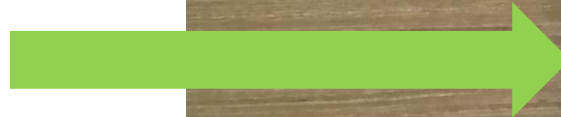
* Note – One of these 4-40x1 screws must have a flat on one side of head to fit

Assembly – Step 3 (cont)

- Unwrap Arduino
- Check hole alignment



Make sure the mounting holes line up – easier to modify before installation.
4 PLACES.



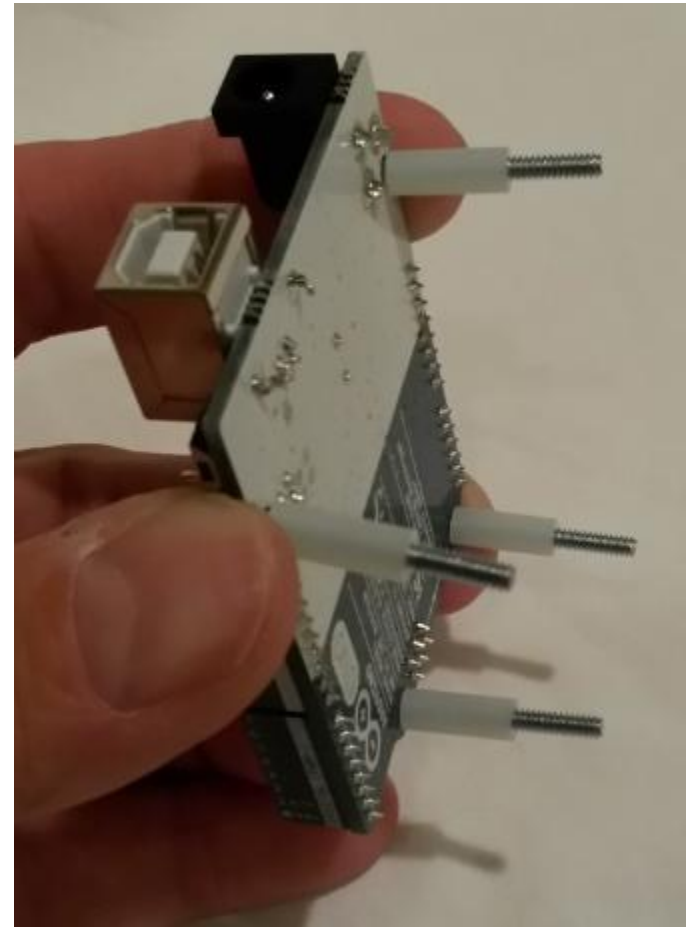
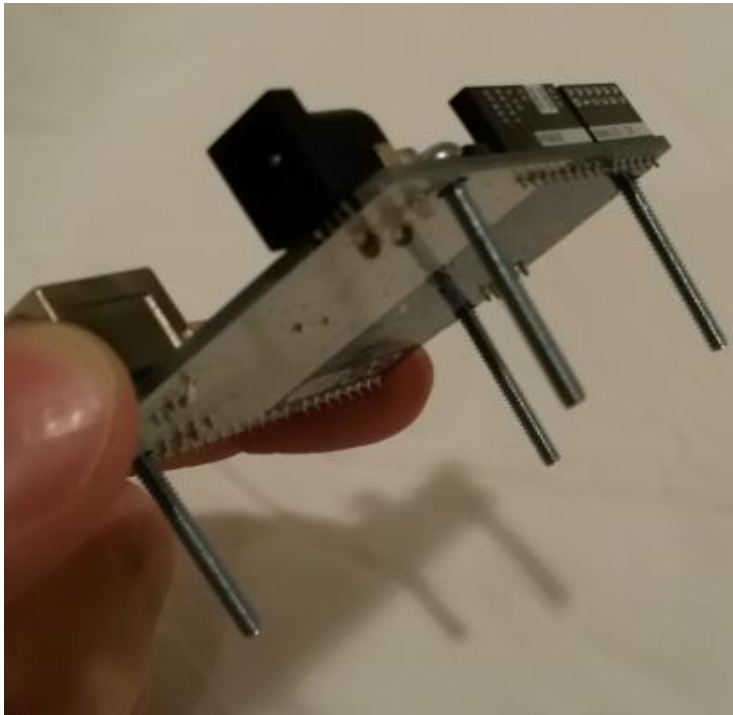
Assembly – Step 3 (cont)

- One Screw is not like the others
 - Bottom left needs flat spot to fit
 - Make sure to locate flattened screw to this location.



Assembly – Step 3 (cont)

- Install all 4 screws
- Install 4 spacers
- Careful – parts may fall



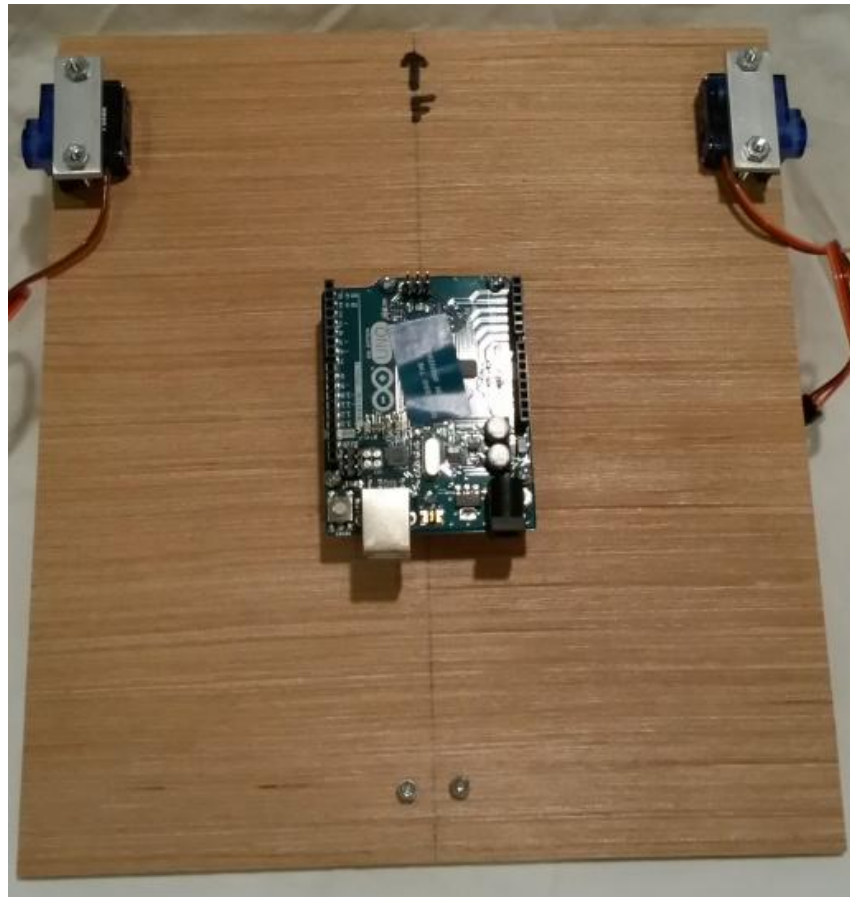
Assembly – Step 3 (cont)

- Push screw through
- Install 4 nuts
 - Tighten gently - snugly



Assembly – Step 3 - Done

- Assembly Looks like this....



Assembly – Step 4

- Install The Wheels!
- You will need
 - Wheel assemblies (2)
 - Servo adapter (2)
 - Mounting screws
 - Hot glue



Assembly – Step 4 (cont)

- Install the tires first
 - Only need one tire per wheel
 - 2 “tires” with each wheel – ONLY USE 1
 - Stretch over wheel



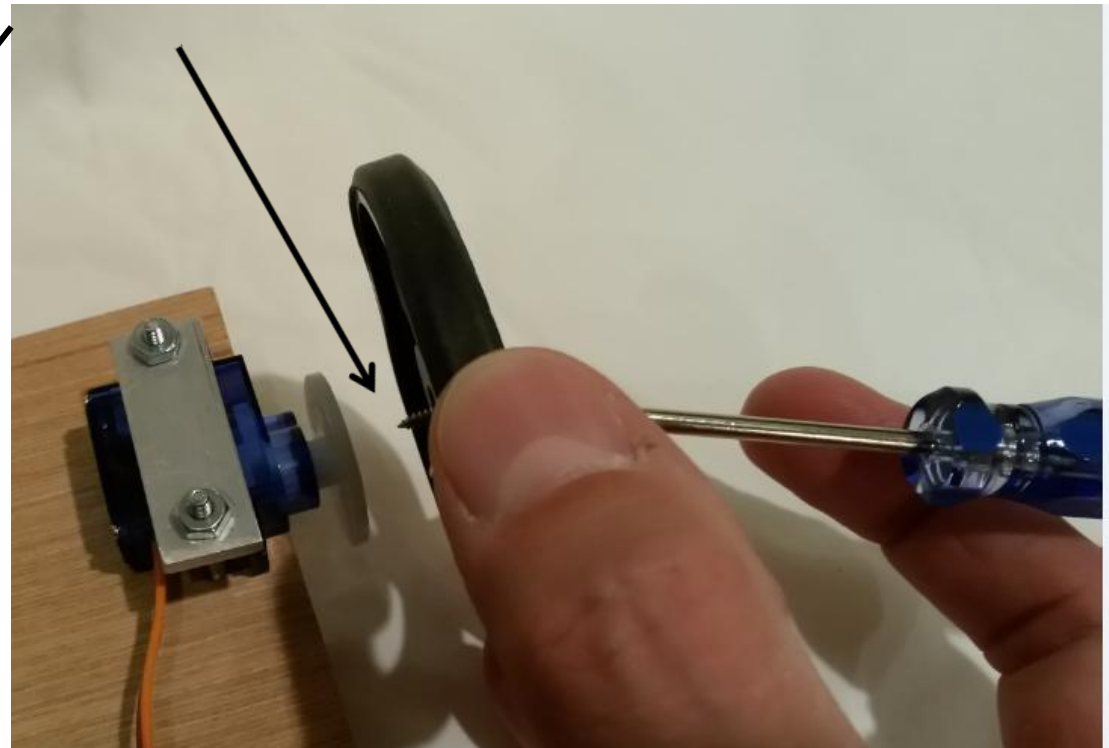
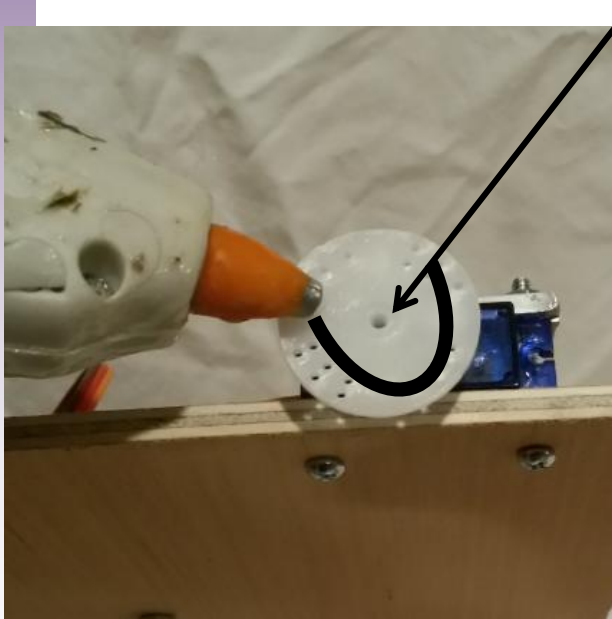
Assembly – Step 4 (cont)

- Install Servo Adapter on servo
- Drop screw into wheel
 - NOTE Orientation of Wheel



Assembly – Step 4 (cont)

- One small line of glue on servo adapter
- Center and install wheel – QUICKLY



APPLY A “SMILE” OF GLUE ON
OUTSIDE OF ADAPTER AS SHOWN

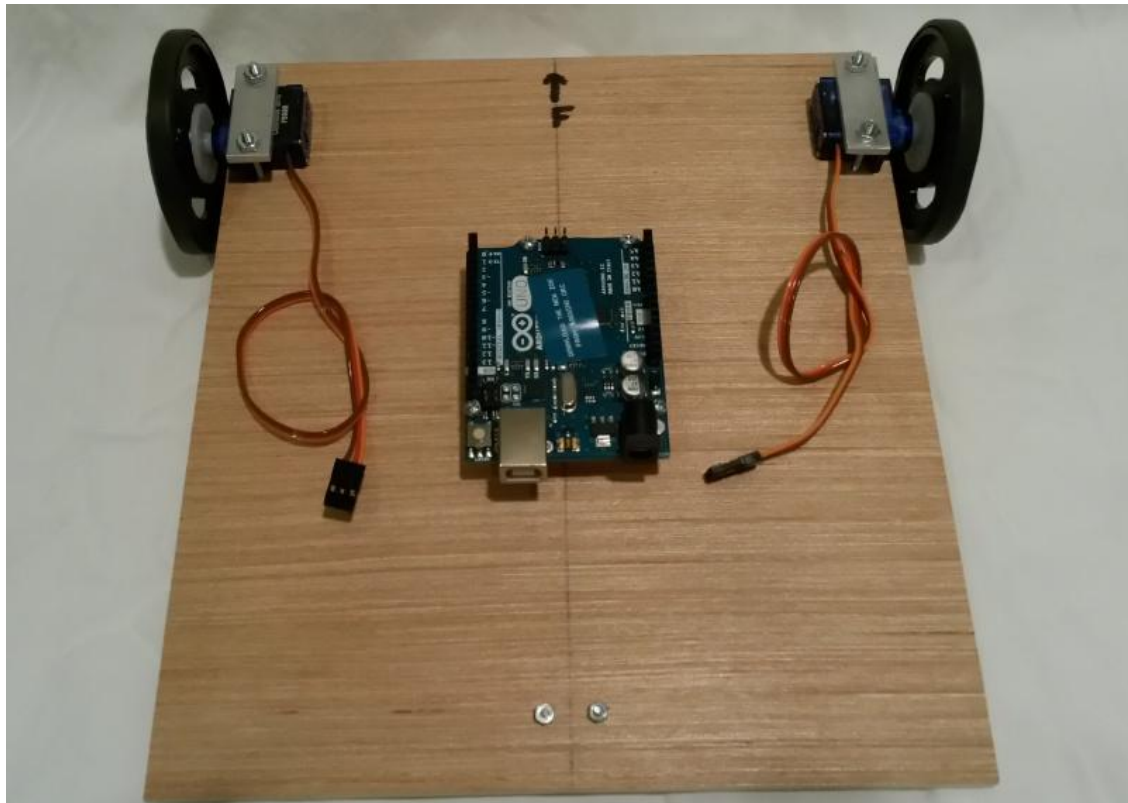
Assembly – Step 4 (cont)

- Work quickly before glue dries
- Make sure wheel is centered
- Carefully tighten center screw – Both sides
 - Give glue 1-2 minutes to cool



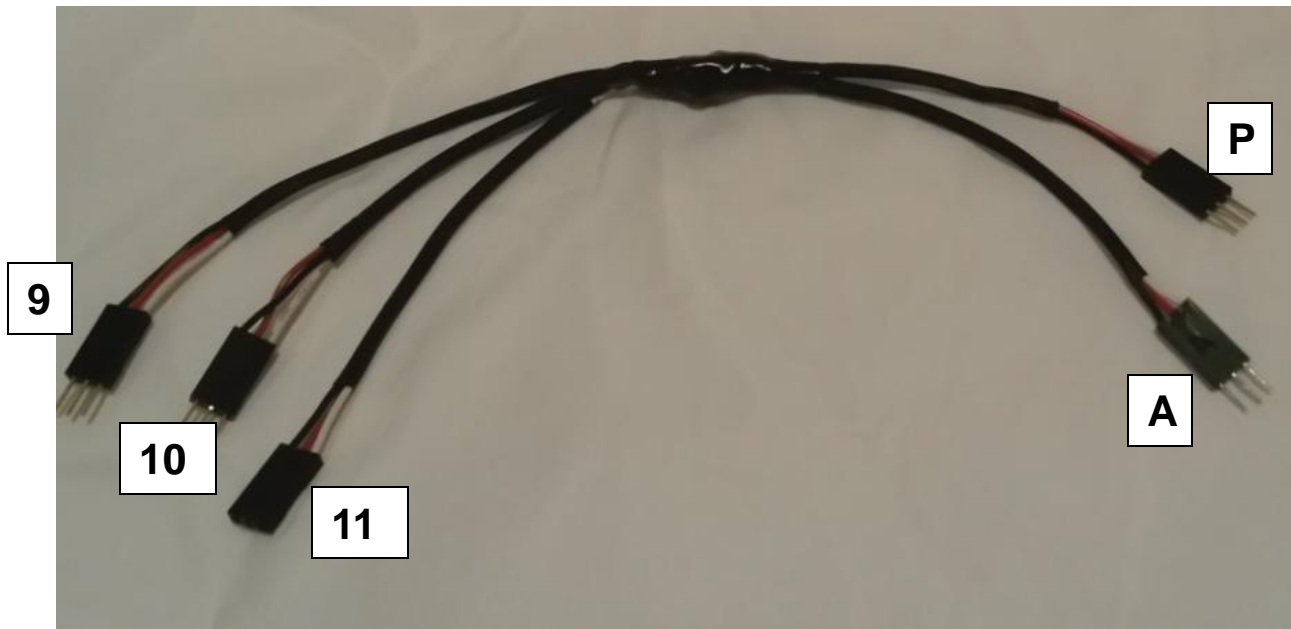
Assembly – Step 4 - Done

- Wheels Installed – It should look like this!
 - Test it: Wheel, servo adapter and servo should turn together if you turn wheel.



Assembly – Step 5

- Install Wiring Harness
- You will need:
 - Robot
 - Wiring Harness – Note markings

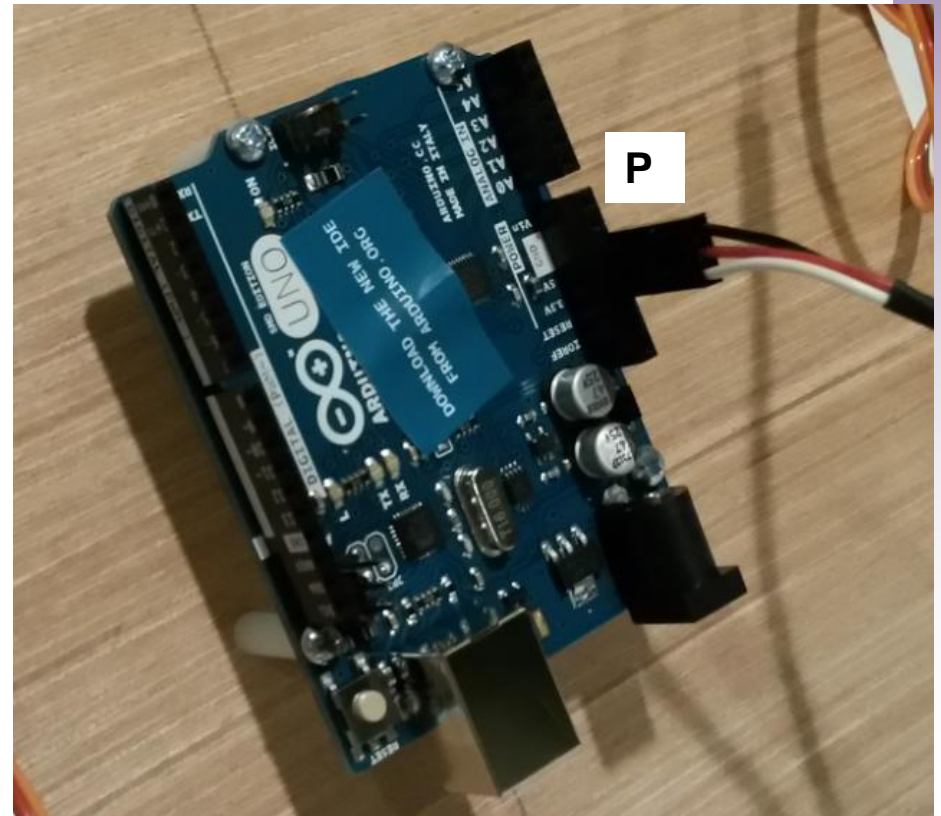


Assembly – Step 5 (cont)

- Wiring Harness
- 5 Connectors
 - A – Plugs into pins 9,10,11 on Arduino
 - P – Power & Ground on Arduino
 - 9 – Output from pin 9
 - 10 – Output from pin 10
 - 11 – Output from pin 11

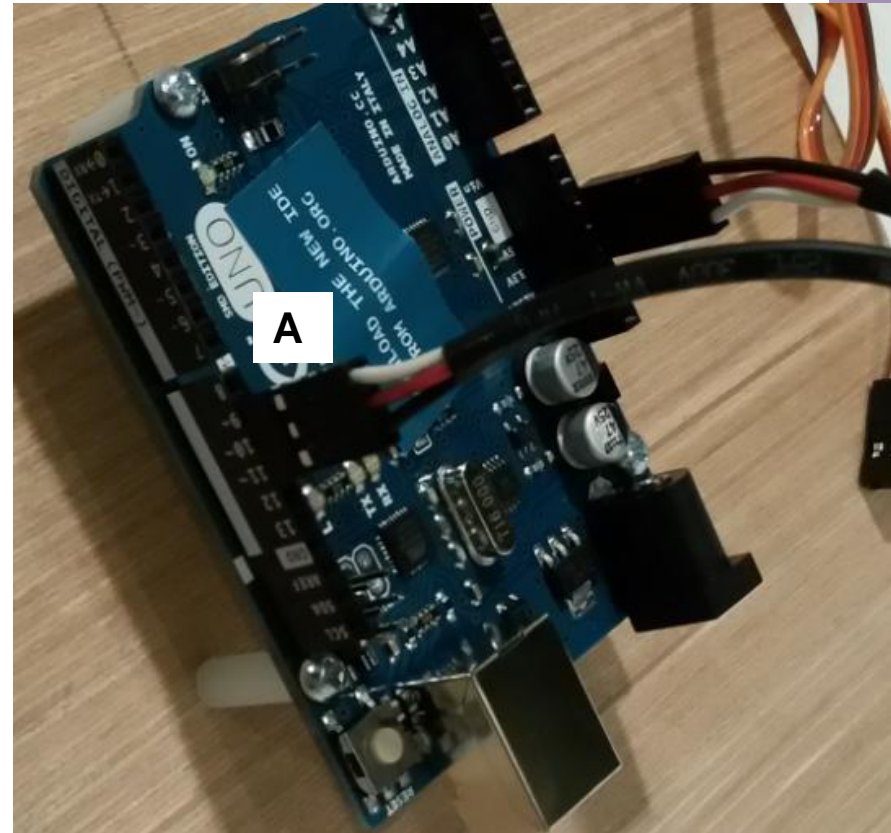
Assembly – Step 5 (cont)

- Plug into Arduino
- “P” Plug into Power/Ground
- Note orientation
 - Red wire is on 5v
 - Black wire on GND
 - White wire on 3.3v



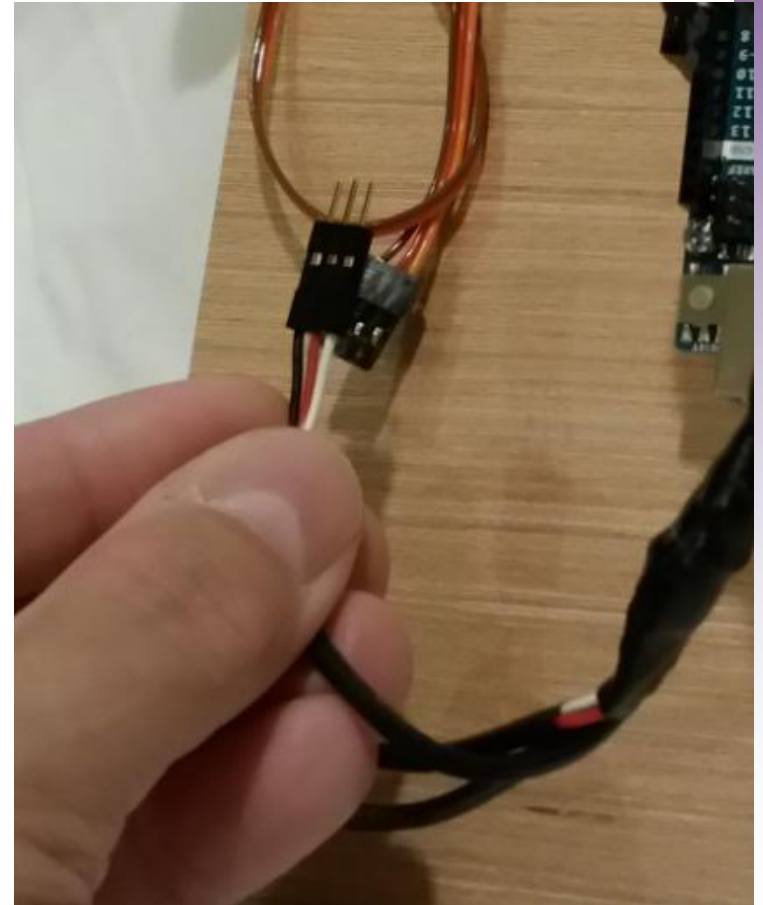
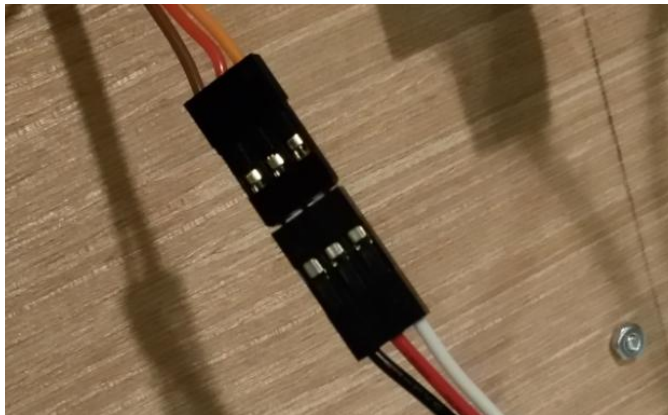
Assembly – Step 5 (cont)

- “A” Plug into PWM outputs
- “A” plug placed in pins 9,10,11
- Note orientation
 - White wire on pin 9
 - Red wire on pin 10
 - Black wire on pin 11



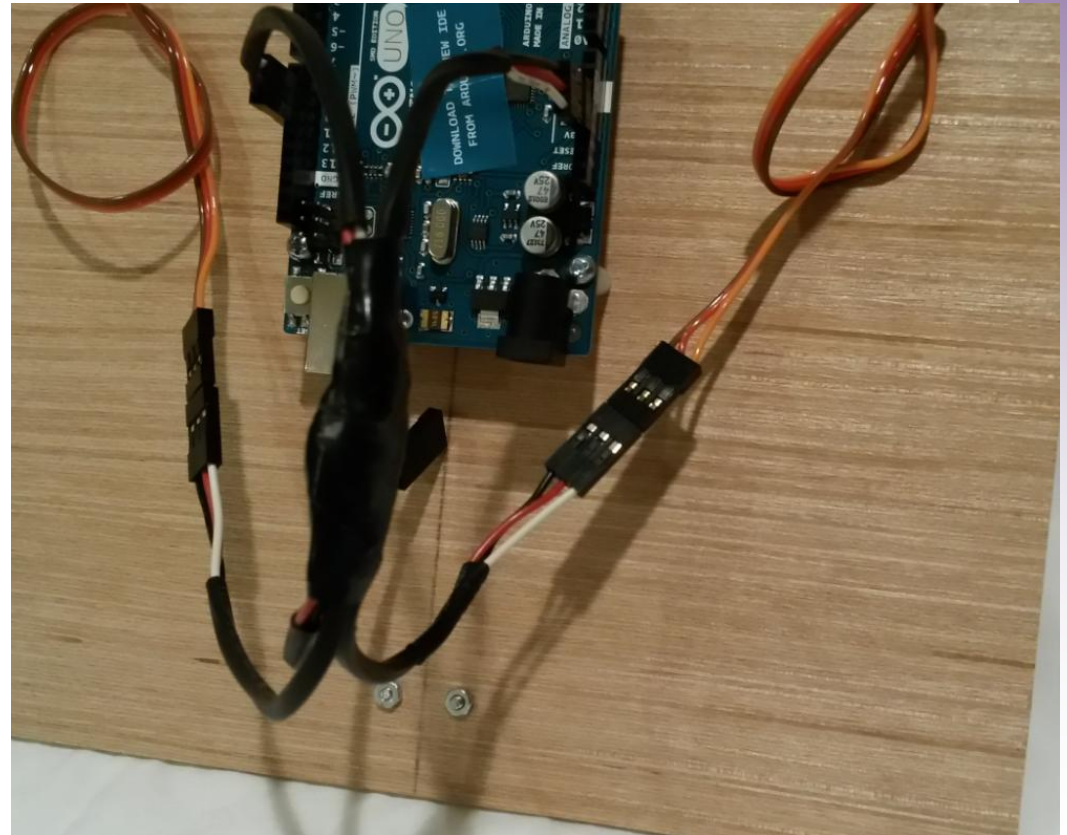
Assembly – Step 5 (cont)

- 9 & 10 to Right and Left Servos
- 9 plug – right servo
- 10 plug – left servo
- Note orientation
 - Align brown & black
 - Align orange and white



Assembly – Step 5 - Done

- Wiring Complete
 - Check orientation!
 - Check wiring!



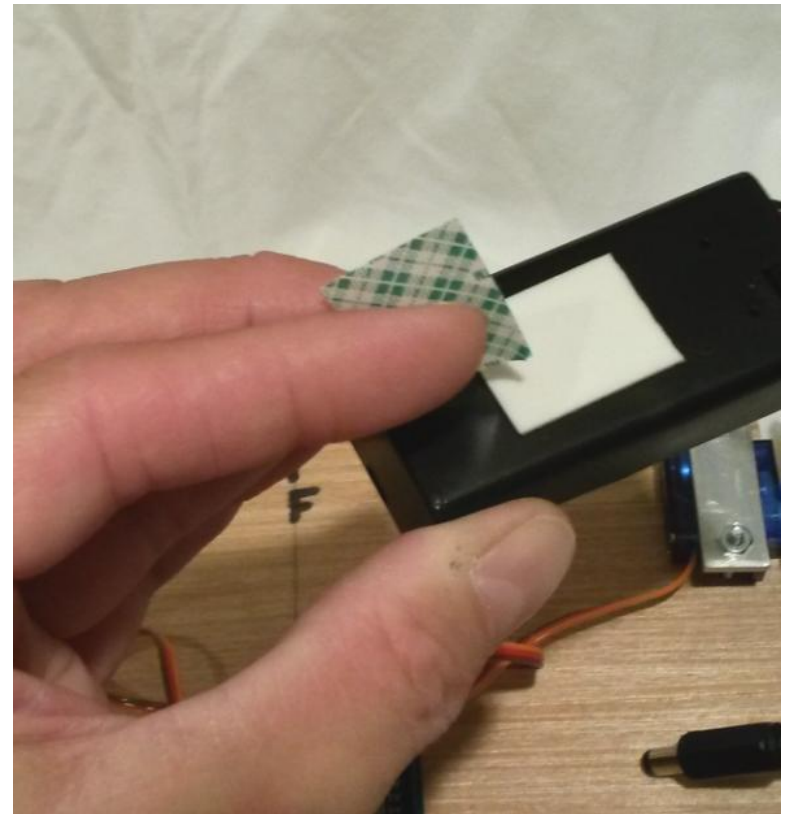
Assembly – Step 6

- Install Battery
- You will need:
 - Battery holder
 - Battery
 - Tape or glue



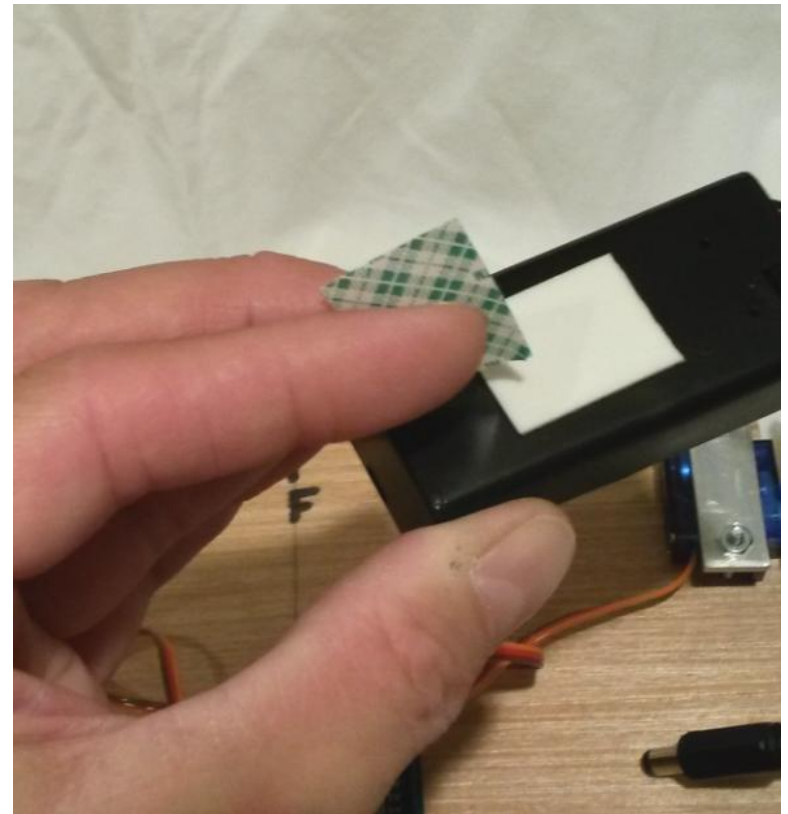
Assembly – Step 6 (cont)

- Install battery in holder
- Add tape on back of battery holder



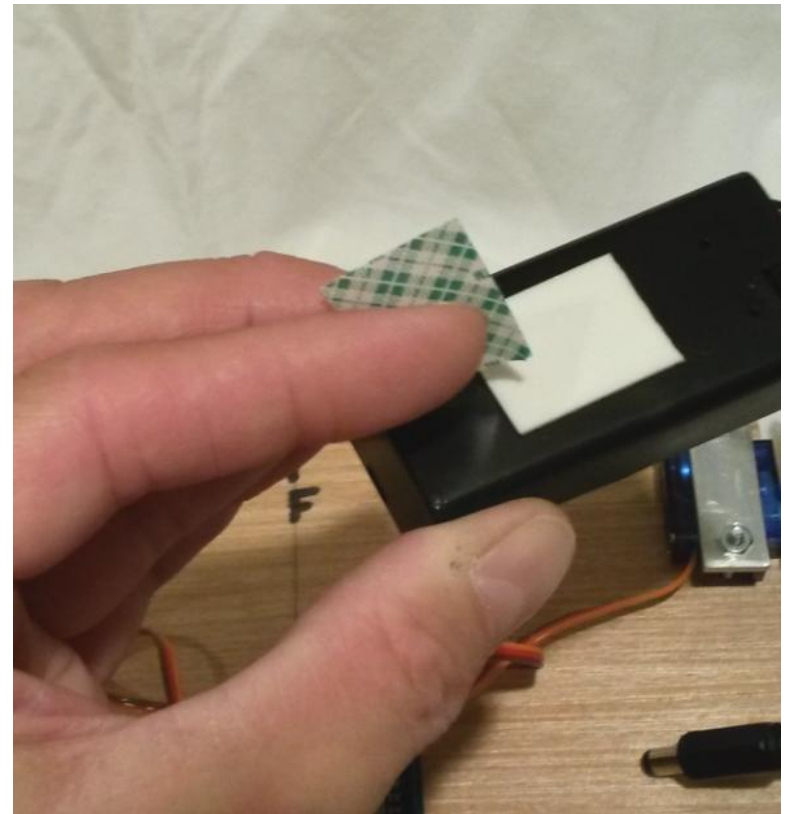
Assembly – Step 6 (cont)

- Install battery in holder
- Add tape on back of battery holder



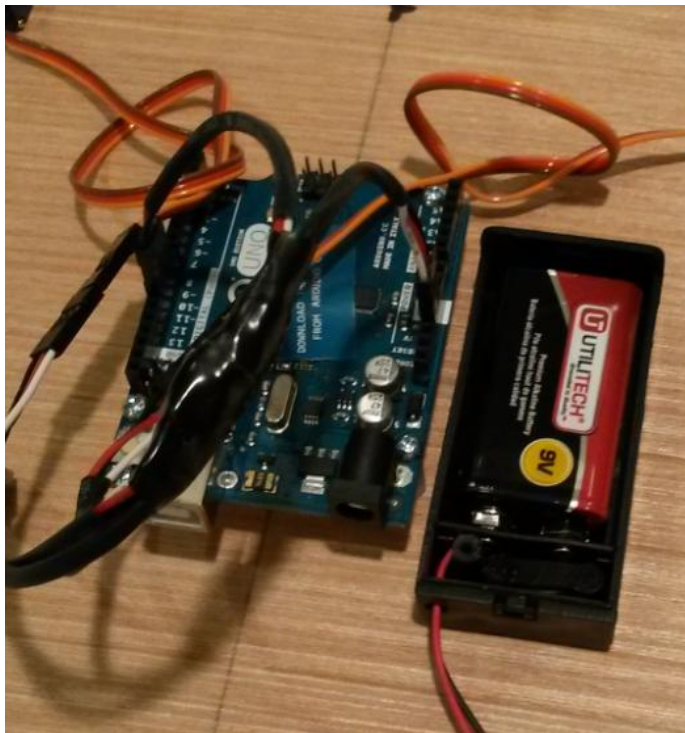
Assembly – Step 6 (cont)

- Install battery in holder
- Add tape on back of battery holder



Assembly – Step 6 (cont)

- Place battery holder
- Plug in to run robot – unplug to stop
- STOP! – Don't plug in yet!



Assembly – COMPLETE!

- Assembly is complete!
- The Robot should look like this.....

