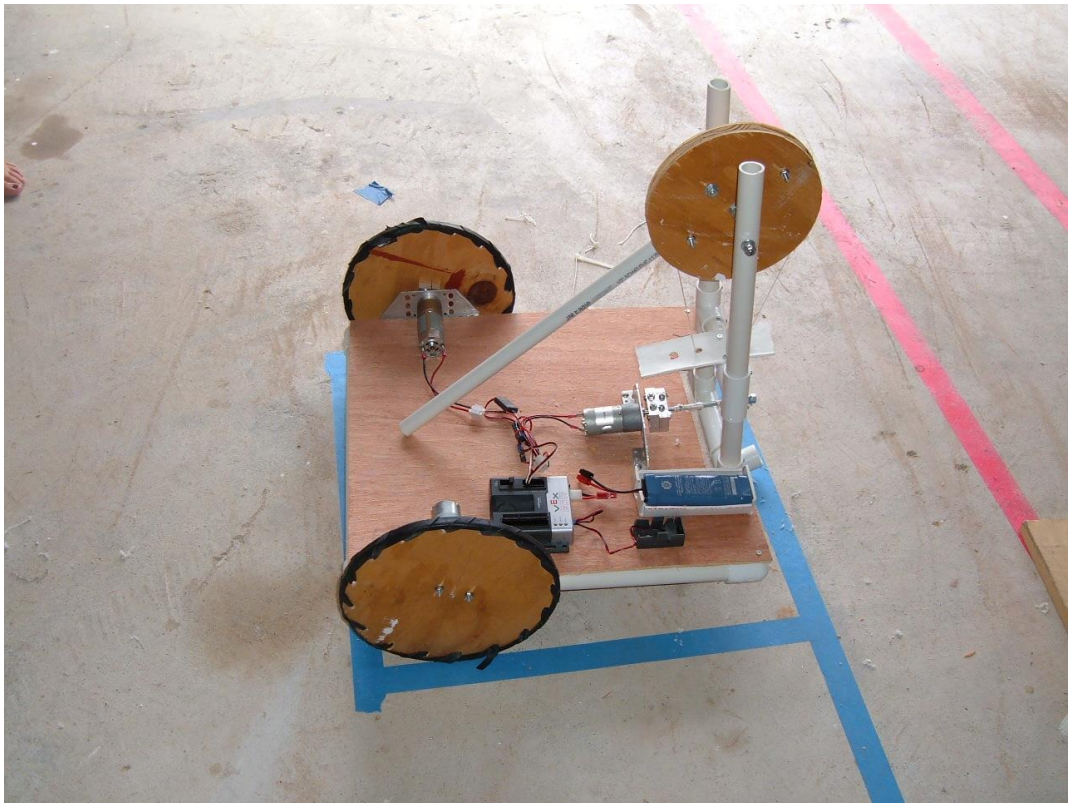
The WIRED Standard Bot

Revision A (September 2013)



Introduction:

Welcome to BEST and the Westbrook Intermediate Robotics Engineering Division (WIRED) instructions for the WIRED Standard Bot!

WIRED developed this robot for 2 reasons. First, we realize that experienced teams know how to take the odd collection of materials from the BEST robotics consumable and returnable kit and turn it in to a robot that can move. They can jump right in with how to solve the challenges of this year's game. Rookie teams, on the other hand, do not. It can be a daunting task to figure this out, so we'd like to help!

Second, having a basic robot platform at the beginning of the season helps the students to focus on how to modify what they already know to meet this year's challenge. It can also be used to start driver training and selection before the competition robot is ready.

With these two goals in mind, WIRED designed the robot to be easy and quick to build, easy to modify, and have a design that applies directly to the 70% of the games that involve rolling around the field.

We're glad you decided to participate in BEST and hope you find these instructions helpful.

Please let us know what you think by sending an email to ccisd.wired@gmail.com or by leaving a comment on our website at ccisd-wired.com. We'd love to hear from you!

A word about Safety:

Building a robot involves many hazards. Staying safe is everyone's responsibility. Make sure of the following for every task:

1. The person performing the task, and everyone around, must know how to use the tools, know what could go wrong, and have taken precautions to keep everyone safe.
2. Adult supervision is essential.
3. All tools, equipment, and materials must be in good condition.
4. Always where proper PPE (Personal Protective Equipment) such as safety glasses, hearing protection, etc.

With this in mind, the robot has been built using only tools that the WIRED mentors and faculty sponsor believe can be operated safely by 6th, 7th and/or 8th graders -. Even so, these intermediate school aged students are under intense adult supervision whenever tools are in use.

Instructions

Wheel Hubs (3 large motor hubs & 1 small motor hub required)

Wheel hubs are the slowest (1 hour each), most boring part of the whole robot. However, they are also critical. Here's how WIRED makes them:

Tools Required:

1. Measuring square
2. Awl
3. Scroll saw with a 5" hacksaw blade installed(a hacksaw can be substituted but not recommended)
4. Drill press & bits (a hand held drill can be substituted)
5. Momentary contact foot switch (available from Harbo-r Freight;highly recommended with a drill press)
6. Drill press vise

Materials Required:

- 2"x12"x0.5" aluminum block

- 2 #10x1.5 screws
- 2 #10 nuts

Steps:

Note: Before starting wheel hubs, refer to the WIRED_Hub_Drawing file (in PDF format) for dimensions.

1. Take the ½" aluminum stock and measure off 1.25 inches using a measuring square and awl.
2. Use the scroll saw to cut the block so you end up with a piece 1.25"x2"x0.5".

3. Place the block flat on a table. Use the measuring square to place a line 0.5" from the side down the long axis of the block. We will eventually cut along this line and then reattach the two pieces using 1.5" number 10 machine screws and nuts, but that comes later.
4. Mark a line 1" in bisecting the mark in Step 3.

5. The motor shaft is going to go where the two lines intersect. You'll need to drill a hole slightly off center for this shaft. The large motors require a ¼" hole. The small ones are 3/16".

Now another important note about safety.

Many tools, especially drill presses, have switches that turn on and stay on.

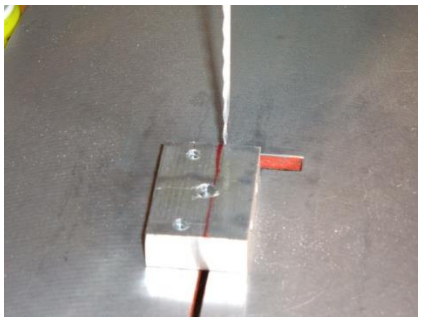
These require special care. If something goes wrong, they will continue to run until someone goes in to harm's way and turns them off or somehow removes power.

WIRED uses a momentary contact foots switch for such equipment.

With this device, the tool will only operate when someone stands on the switch. If something goes wrong, step back, and the machine shuts down.

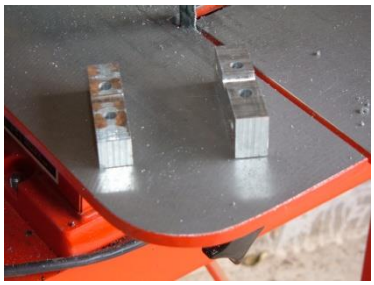
And now back to our regular programming!

6. Drill 2 3/16” holes through the face near the edge and 2 larger holes vertically through the block as seen in this picture:



Note: Make sure none of the holes interfere with each other.

7. Now cut down the line ½” from the edge. It is very important that the cut intersects the motor hole slightly off center



8. File (or belt sand) as necessary.

Wheels and Pulley

Tools required

1. Router with circle jig and ½" bit and a ¼" cove bit

2. Momentary foot switch
3. Drill press, 9/32 bit and circle drilling jig (hand held drill can be substituted)

4. Clamps
5. Hand held drill with 3/16" bit
6. Screwdriver
7. Wrench to fit #8 nuts

Materials Required

- 3/8" plywood
- Wood glue
- Inner tube
- 2 large wheel hubs
- 4 #8 x 1.25" machine screws with nuts and washers

Steps:

1. Use the router with the circle jig to cut two (2) 10” diameter disks and two (2) 8” diameter disks from the plywood. Note: some routers have on off switches. Some have triggers. Use the foot switch as appropriate.

2. Remove the bit and circle cutting jig. Insert ¼” cove bit.

3. Cut the cove in the 8” diameter disks.

4. Glue the two (2) 8” disks together so that the 2 coves meet and form a nice pocket for the string to ride in. Be sure to clamp the pieces together while drying.


5. Use a protractor to lay out 16 equally spaced lines from the center to the edge of the 10” disks. Each one should be 22.5 degrees from its neighbors (you can verify that calculation at home!)

6. Use the drill press and jig to drill 16 equally spaced holes ½” from the edge.


7. Cut the inner tube in to ½” strips.

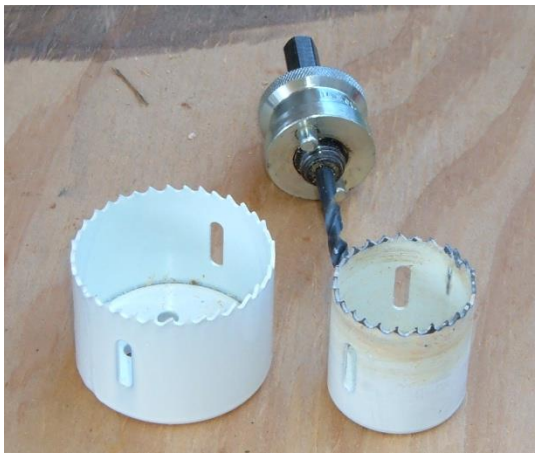
8. Weave the inner tube strips around the wheel as shown.


9. Attach large motor wheel hubs with #8 screws and nuts as shown.


Tensioner

Tools Required:

1. Drill press with foot switch
2. Two hole saws -2.5” and 2”



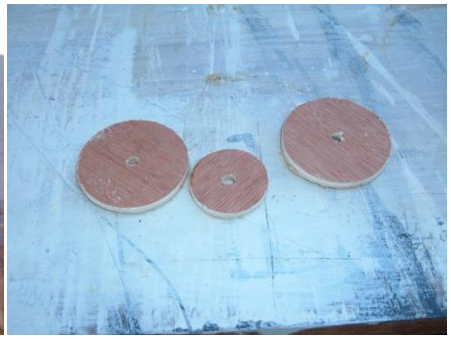
3. ¼” bolt and nut

Materials Required:

- ¼” plywood
- Glue

Steps

1. Use the drill press to cut two (2) 2.5” and one (1) 2” disks. Note: hole saw sizes are to the outside of the cut. These disks will be about ¼” smaller. That’s okay.

2. Glue them together and secure with a ¼” bolt while drying.

Assemble the Base

Tools Required:

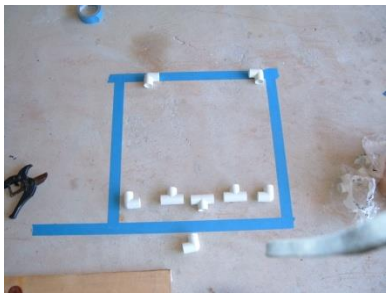
1. Flat section of floor or desk with 2’ square laid out
2. Hand held drill and bits
3. Screwdriver
4. PVC cutter
5. Jigsaw and blade

Materials Required:

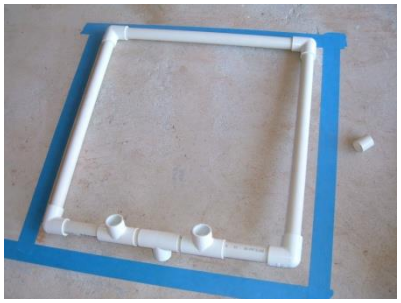
- 5 ¾ elbows
- 3 ¾ T’s
- ¾ PVC pipe
- #6 wood screws
- 2 large motor mounts
- ¼” plywood

Steps:

1. Lay out the fittings as desired in your square.



2. Cut PVC pipe and dry fit in to place.



3. After drilling pilot holes, fasten the fittings using wood screws. Note: Avoid using PVC glue whenever possible; screws hold well enough and can be removed as necessary.
4. Attach large motor mounts.
5. Cut and attach ¼" plywood to make a deck.

Assemble the arm

Tools Required:

1. Hand held drill and bits
2. PVC cutter
3. Hacksaw
4. Metal file

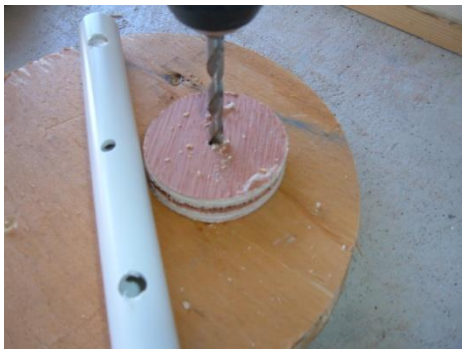
Materials Required:

- ½" PVC pipe
- 2 #10 screws with nuts and washers
- Pulley
- Tensioner
- ¼ threaded rod
- ¼" nuts and washers

Steps

1. Cut a piece of ½" PVC pipe at the desired length for the arm. We used 24" for this one.
2. Attach to the pulley with #10 screws and nuts so it looks like this:

3. Locate the tensioner on the side of the arm pulley. The location is not critical. Drill ¼" hole through pulley to support it.



4. Cut the ¼" threaded rod 2" long. Be sure to file any burrs so it can take a nut easily.
5. Use the ¼" rod along with 2 nuts to secure the tensioner.

Attach the arm to the base

Tools required:

1. PVC cutter
2. Hand held drill with bits

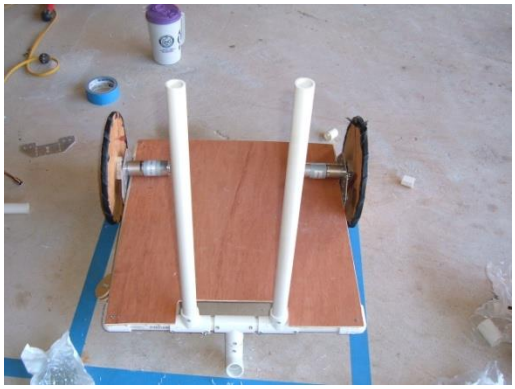
3. Screwdriver
4. 2 7/16 open end wrenches

Materials Required

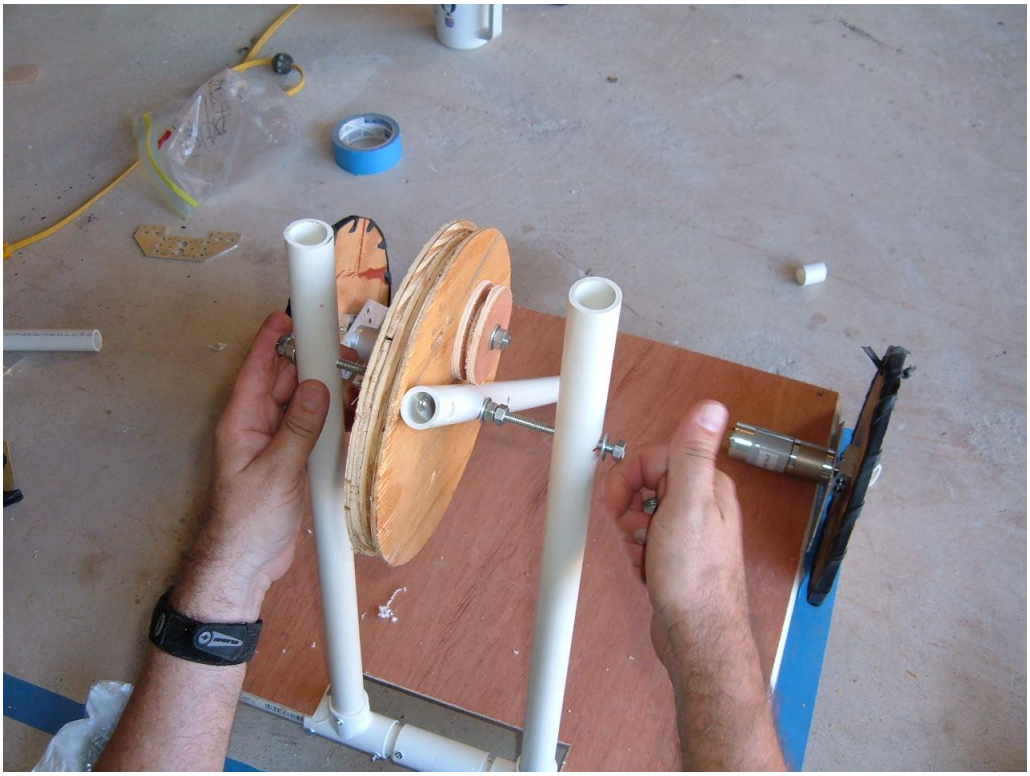
- ¾” PVC pipe
- Robot base
- #6 wood screws
- Threaded rod
- 8 ¼” nuts
- 4 ¼” washers

Steps

1. Cut 2 pieces of PVC pipe such that they can go in the base and still be within the required 24” height requirement.
2. Insert the pipes in the base.



3. We will use threaded rod between these two towers to hold the arm. Figure out exactly where you want the center of the arm and mark the location on the two towers.
4. Drill ¼” holes in the towers in the location identified.
5. Cut the threaded rod to the appropriate length to stretch between the towers.
6. Put two nuts and a washer on one end of the threaded rod and insert in to the first tower.
7. Put 2 more nuts on the threaded rod along with another washer.
8. Put the arm on the threaded rod.
9. Put another washer and 2 more nuts on the rod.
10. Work the rod into the second tower.
11. Secure the rod with a washer and 2 more nuts.



12. Adjust the center nuts so the arm (not the pulley but the arm) is centered.
13. Secure all nuts by tightening them against each other as lock nuts. This requires 2 open end wrenches.

Mount Arm Motor

Tools Required:

1. Hacksaw
2. Drill press vise
3. Hand held drill with 3/32” drill bit
4. Metal file
5. Screwdriver
6. Wrenches
7. Hand held drill with bits

Materials Required:

- ¼” threaded rod
- 1 large, 1 small wheel hub
- Robot base
- 1 VEX small motor mount

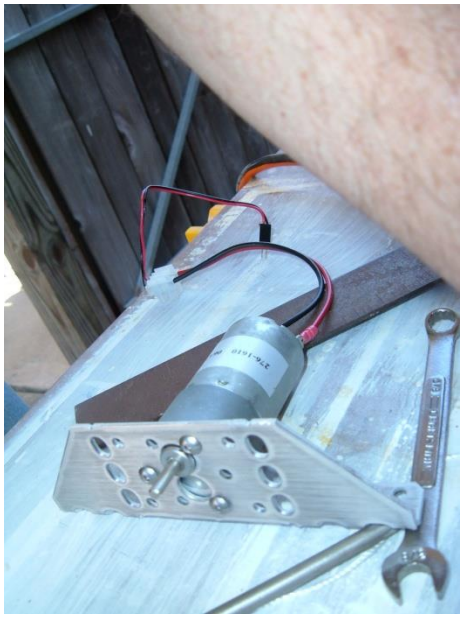
- Two (2) 8-32 screws and nuts
- Flat PVC sheet

Steps

1. Use a hacksaw to cut an 8” piece of ¼” threaded rod.
2. Drill two (2) 3/32” hole approximately 2.5” from each end as shown.

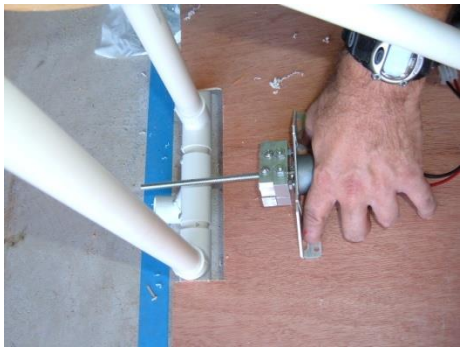
3. File a flat tab on one end of the rod.
4. Insert into large motor hub and tighten.
5. Attach large motor hub to small motor hub as shown(you can test fit with the small motor as seen in this picture).

6. Bend the bottom tabs of the small motor mount so the mount can bolt to the deck of the robot and hold the motor parallel to the deck.
7. Put the small motor into the small motor mount.



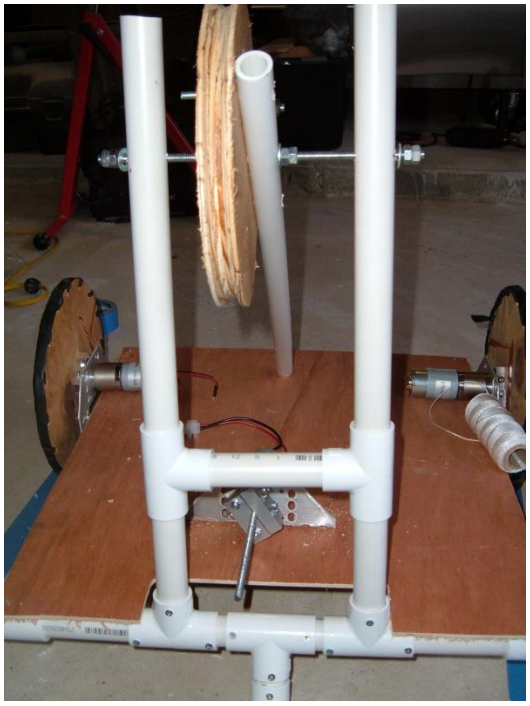
8. Put the spindle on the small motor as shown.

9. Place and fasten the motor assembly on the robot beneath the arm towers. Note: it is possible to mount this motor almost anywhere and run the strings through the PVC, but that's more advanced than we want to demonstrate here.



10. To prevent the strings that will articulate the arm from twisting, travelling, or fouling, we need a string guide. Step one is to cut the tower about 3" above the level of the motor. Then use some

PVC and two T's to make a crossbeam and replace the tower. You'll probably have to trim the tower to prevent it from being over height.



11. Place a flat piece of PVC on the crossbeam and secure with wood screws. Drill two (2) 3/8" holes in the PVC directly above the 2 holes in the spindle.

Connect string to arm

Tools Required:

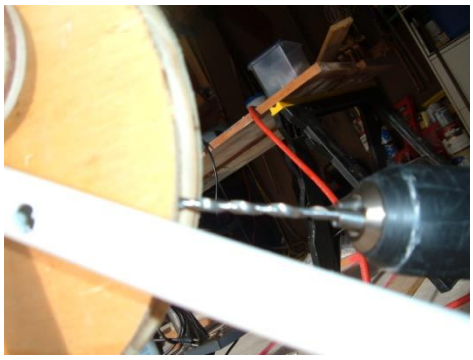
1. Hand held drill and bits

Materials Required:

- Robot
- String

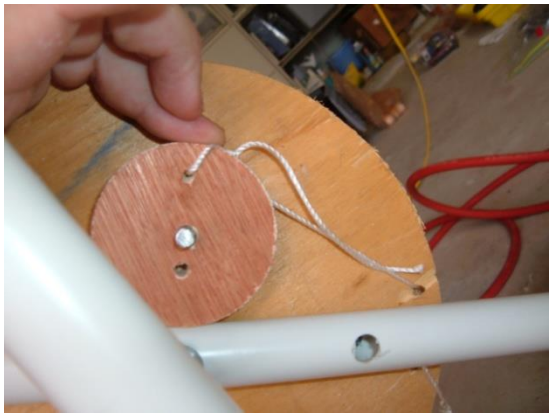
Steps

1. Drill small holes on the pulley and tensioner for the string to go through.

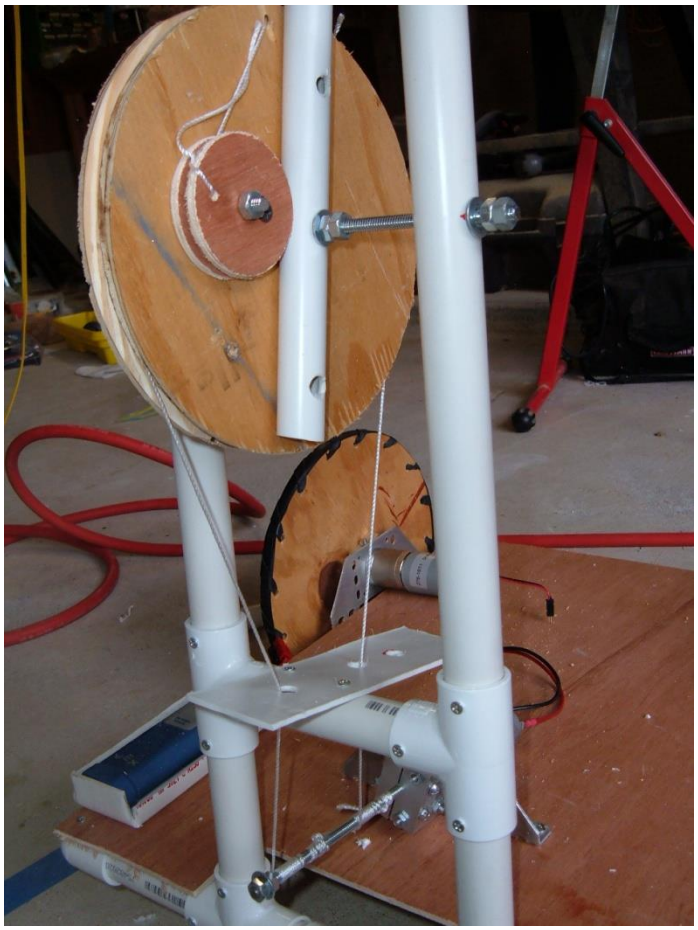


2. Move the arm so that the tensioner is down. In our case, that means the arm is outside the robot and resting on the ground.
3. Work the string through the hole in the pulley and tie it off using a bowline knot (see http://www.animatedknots.com/bowline/).
4. Run the string outside the pulley, through the guide and through a hole in the spindle. Secure with another bowline. Note: It is best that there are a few inches of slack in this string.

5. Manually rotate the arm motor until the arm is fully rotated to the opposite position.
6. Run the string through the unused hole in the pulley and tie off to the tensioner as shown.



7. Run the string over the pulley and through the guide, wrap around the spindle 5-6 times, and attach to the spindle using a bowline. 2-3 inches of slack is helpful. Very important: the string should be wrapped around the spindle such that one string is on the left and one is on the right. That way, one always feeds out while the other pulls.
8. Turn the tensioner until the slack is completely gone and then anchor with a screw. Note: as your robot gets used, the string will stretch. You can "re-tension" by loosening the screw, rotating the tensioner, and then anchoring with a screw once again.



Congratulations!

Your robot structure is now mechanically complete!

You can mount the electronics, wire it up as per BEST instructions, install the default program, sync your VEX keys, and your team should be rolling!