

Build Your Own AC Wind Turbine

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ELG 2331: Electric Circuits and Machines for Mechanical Engineers

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Equipment Used



From Left to Right and Top to Bottom:

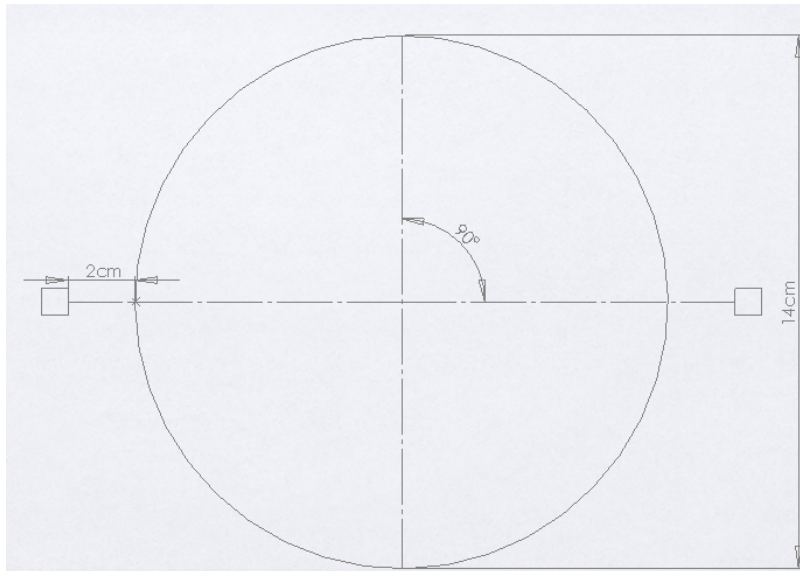
- Fine grit sand paper
- Compass
- Ruler
- Pencil
- Scissors
- Hot glue gun
- Electric Drill
- Toilet paper roll x2
- Philips bit
- $\frac{1}{4}$ " drill bit
- Voltmeter
- Hand saw (not in photo)

Materials Used

Quantity	Item	Source
1	1.5L Plastic water bottle	Grocery store
2	3/8" x 36" square dowel	Hardware store
1	5/16" x 36" round dowel	Hardware store
1	Brass thumb tack	Hardware store
1	1-1/8" Zinc plated screw eye	Hardware store
1	Base approximately 38cm x 29cm (particle board, old cupboard door)	Scrap wood, hardware store
1	Plastic Sign Board (at least 30cmx30cm)	Old campaign signs, hardware store
120m (approx)	28 Gauge enamelled magnetic copper wire	Electronics store
4	1" Rare earth magnetic disks	Lee Valley Tools
2	Toilet paper roll tubes	Finished toilet paper
1	LED light	Electronics store
1	Philips screw, no longer than the thickness of your base plate	Hardware store/around the house
3	Hot glues sticks	Hardware store/craft store
-	Electrical tape	Hardware store
-	Double sided tape	Hardware store/craft store

Building Steps

A. Base



1. Draw this template onto your base platform. It outlines where the stator will be set up and where the main supports of the frame will go.
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2. Screw the Philips screw into the very centre of the circle on the base.
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B. Frame



1. Cut the square dowel into two 30cm long pieces and one 20cm piece
 2. Cut six 5cm support brackets out of dowel and cut the ends of them off at 45° angles.
 3. Cut a 33cm piece off of the round dowel. This piece will be used as the shaft of the turbine.
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4. Using the hot glue, glue the main support in on the spot indicated on the platform.
 5. Support the main support by gluing three supports brackets to each main support as shown in the figure above.
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6. The frame should now look like this
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7. Screw the eye screw into the midpoint of the 20cm top beam.
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8. Glue the flat side of the thumb tack on the very bottom of the shaft.
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C. Turbine Blades



1. Take the empty water bottle and remove the paper label.
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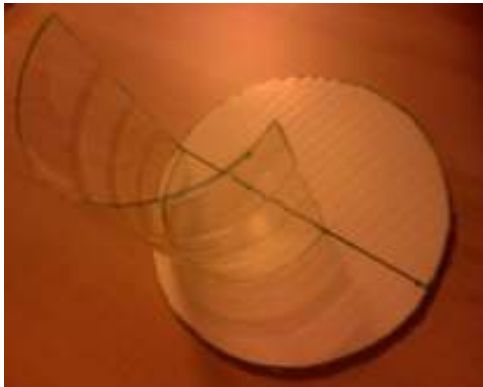
2. Using the shape on the bottom of the bottle to help, mark the water bottle as indicated in the diagram above. The line should intersect the centre of the bottom.
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3. Cut along the lines to get the four blades of the turbine. This can be done by poking a hole in the upper part of the bottle near the neck in order to not damage the blades.
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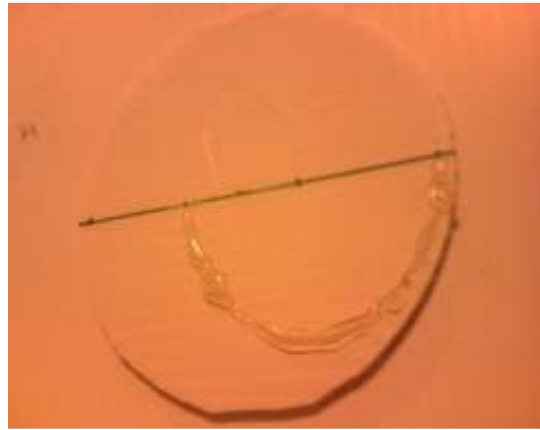
4. Trace three circles using a compass on the poster board approximately 13 cm across and draw lines that cut the circles in half. Mark two dots on the line 2 cm from the centre of the circles on either side. Make two more dots 6 cm from the centre of the circles. These are to help position the blades later.
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5. Cut the discs out and see if the blade fits by putting the tips on the dots on the lines. Tracing along the circular portion of the blade makes it easier to put the hot glue as shown in the next step.
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6. Drill holes in the centre of the circles using a $\frac{1}{4}$ " drill bit, or a bit that is a little bit smaller than the round wooden dowel. The plastic poster board will create a force fit when it is inserted.
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7. *****IMPORTANT***** Lay the hot glue down onto the circle and wait 20 seconds before putting the plastic blade. Not waiting for the glue to cool down will make the blade melt.
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8. Put the blade in the glue, making sure a good bond is made and that there are no giant holes. Repeat this for the other blade to finish one stage.
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Bottom of Blade Circle



Top of Blade Circle

9. Copy the line pattern at 90° to the upper face onto the bottom of the sign board disk. The lines on the bottom if the blades will face opposite directions if compared to each other. To clarify this, refer to the above comparison. Once again, wait 20 seconds before putting the blades into the hot glue.
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10. Repeat steps 6 to 8 and add the third sign board disk to the top of blades in the second stage to complete the wind turbine blades.
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11. The complete turbine blades should look like this!
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D. Stator Coils



1. Cut eight 4cm (approx) wire pieces.
 2. Measure approximately 30cm of wire off and tape it to the end of one of the toilet paper rolls.
 3. Start your windings around the cardboard tube. To make the windings tight, hold the wire in place against your thumb nail.
 4. Indicate on the cardboard tube the direction in which the coil is wound.
 5. Make 200 windings per coil.
 6. After each coil is made tie a piece of wire cut in step 1 around each side of the coil. This will keep the coils tight together.
 7. Direct the top end of the tie in step 5 in the direction that the coil is wound.
 8. Leave about 10cm of wire between the first & second coil and the third & fourth coil.
 9. After the second coil has been made start your next coil on the next toilet paper tube.
 10. After the fourth coil has been made leave about 30cm of wire.
 11. Keep your coils on the cardboard tubes until they are ready to be made into the stator.
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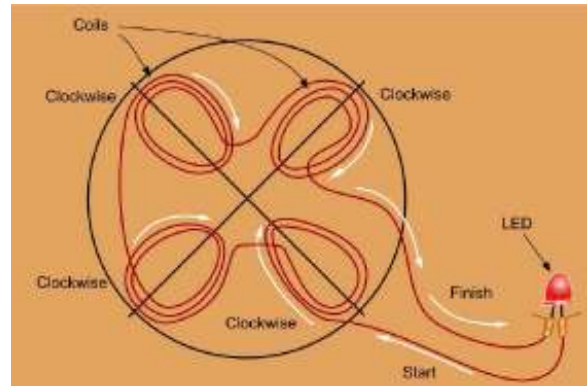
E. Stator



1. Cut four pieces of double sided tape large enough so that the coils can fit onto them.
 2. Place the pieces of tape 90° apart from each other on the template on the base, (template shown in section A).
 3. When the tape is positioned correctly remove the top side of the tape.
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4. Take the coils off of the cardboard tube. This can be done by deforming the tube.
 5. As the coils come off the tube place electrical tape around the edges of the coils to keep the coils nice and tight.
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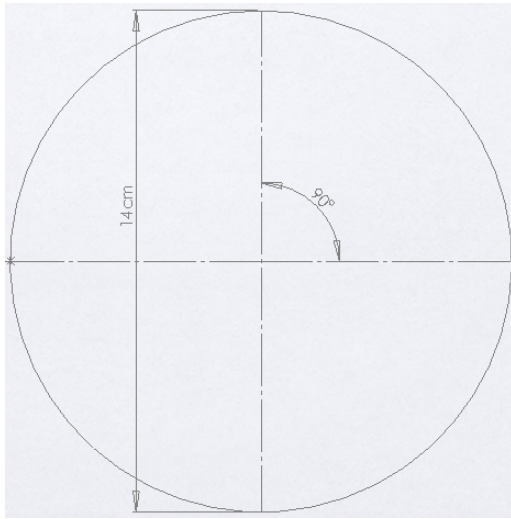


6. Lay the coils out as shown in the diagram above. All the coils should be laid out so that the direction of turn is the same way. This will ensure that when the current flows one coil does not oppose the other ones.
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7. The coils should be laid out to look like this.
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F. Rotor



1. Cut a 14cm diameter circle and mark it with two intersecting lines 90° as shown above.
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3. Glue a magnet at every point where the lines drawn touch the top of the rotor disk.
 4. Make sure the same pole of magnet is facing outwards. The north side is indicated by the red dot.
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2. Drill a hole through the direct centre of the rotor plate with the $\frac{1}{4}$ " drill. The hole will be slightly smaller than the diameter of the shaft to allow for a force fit.
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G. Final Assembly



1. Twist the rotor disk onto the shaft and down near the bottom. This twisting is necessary as the shaft will be bigger than the hole in the sign board.



2. Twist the turbine blade onto the shaft to look like the above image.



3. Set the shaft in place by having the point of the thumb tack sit into the Philips screw on the base.
4. Slip the eye screw on the top support bar over the shaft.
5. Make sure that the shaft is perfectly straight then glue the top bar in place.



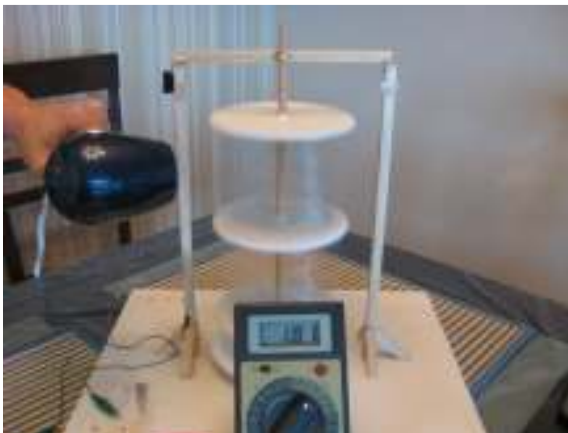
6. The turbine should now look like this.



7. Adjust the rotor disk so that the magnets are between (1-3)mm above the coil. The closer the magnets are the more voltage that can be generated.
 8. Make sure the rotor spins freely with the above clearance at the points where each magnet passes over each coil.
 9. When the rotor is placed correctly, glue it in place.
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13. Once the turbine has been confirmed to produce voltage sand the enamel off the ends of the copper wire.
 14. Wind the copper wire ends around the two ends of the LED.
 15. Tape the LED anywhere on your turbine or base with electrical tape.
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10. The wind turbine is now ready to be tested with the voltmeter.
 11. Set the voltmeter to AC and attach the positive and negative terminals each to a copper wire end.
 12. Spin the turbine with your hand, use a fan or take it outside. Your turbine should be able to create voltage anywhere from 0-4 volts.
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16. Congratulations! You now have a complete homemade AC wind turbine!
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