Full Size Eight-sided Polygon, Attempt One

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By Robert “The R.A.T.” Allen Turner

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# Introduction

When young Tod Loofbourrow designed the somewhat famous “MicroTron Robot”, he did so based on the availability of the Herbach & Rademan TM20K370 Motorized Caster Wheels. Those wonderful wheels were a “godsend” to any prospective robot builder in the 1970s through to the late 1980s. In any event, MicroTrons entire construction was designed specifically to fit those motorized caster wheels. To that end, Tod designed the basic framework as an equilateral triangle, 23” to a side intended to attach to three of those TM20K370 motorized wheels. Later, when Tod found it necessary to include some sort of contact sensing bumper scheme (the impact sensors), he designed an eight-sided figure to hold the impact sensors and intended to attach to the inner triangular framework. This outer hull, or impact sensor frame, was designed such that it would overlap, at some point, each of the three vertices of the triangle for mounting purposes.

MicroTrons inner triangular framework and outer hull (impact sensor frame) were all constructed from 1"x1"x.125" (25.4mm x 25.4mm x 3.175mm) Aluminum Angle Stock. The lower inner triangular frame was assembled by bolting it directly to the swivel discs of the motorized caster wheels. The upper inner triangular frame was necessitated in order to stabilize the “wobble” inherent in the shaft/swivel disc of the motorized wheels. The two triangles were separated by 5” thus making the total height (distance), from the bottom of the lower triangle to the top of the upper triangle, about 7”. Two of the eight-sided polygons were then constructed and attached to the lower and upper triangles, thus bringing the total height (distance), from the bottom of the lower polygon to the top of the upper polygon, to about 7.25”.

Given that the TM20K370 Motorized Caster Wheels are no longer available, it would behoove the prospective MicroTron Robot builder to search out a replacement motorized wheel and modify the original design to fit the replacement motorized wheels. All three of MicroTrons wheels were motorized in the original design, with the single front drive wheel also being used for steering. As we will be basically redesigning the drive system to fit currently available wheels and motors, there is no reason why we could not simply use a single drive motor in addition to the steering motor. In fact, there are many possibilities. A few configurations to consider might be:

1. A single front drive and steering motor with the two rear wheels “free spinning”.
2. Dual rear drive motors with a single “free spinning” front steering motor.
3. Dual rear-drive/differential steering motors with a single “free spinning” front “swivel caster”

There are many other possibilities such as using omni-wheels, mecanum wheels, three wheel steering and so on. In the end, it depends mostly on how close that you want to get to the original MicroTron design. I am currently considering the second option above based on the availability of several dual motorized wheel kits being on the market. These kits range from units specifically designed for robotics/smart car use including several made from electric car window motors through to those designed for use in childrens ride on toy cars (such as the Power Wheels brand). A few such kits that come immediately to mind are:

1. Parallax, Inc. Motor Mount & Wheel Kit - Aluminum (#28962) @ $299.00. The aluminum Motor Mount and Wheel Kit is a precision-machined mechanical drive system designed for mobile robotic platforms. The brushed motors are worm-gear driven, and the main drive axle (0.5” dia.) is cradled in a ball bearing assembly for smooth-rolling performance. The included 36-position disk Quadrature Encoders resolve to 144 discrete ticks per tire revolution for precision navigation. Key Features Include: machined 6061 aluminum components for smooth, worry-free performance, 60 lb. payload capacity, compatible with any microcontroller, 144 encoder positions per revolution provide 0.14” of linear travel accuracy, conveniently positioned pre-tapped screw holes for easy mounting, rugged 6” pneumatic tires are suitable for a variety of terrain, smooth-rolling and quiet performance. As of this writing, this is the only and current motorized wheel kit offered by Parallax, Inc. In the past, they have also offered ABS Plastic (rather than, but in addition to, aluminum) versions of their wheel kits, however no such product is currently available. There have also been previous versions of the aluminum version which, in general, is not compatible with the newest version.
2. Cytron Power Window Motors w/5" Wheels (Pair) @ ~$62.50. Description: Voltage Rating: 12VDC, Speed (No Load): ~ 85RPM, Torque: 30Kg.cm, Includes 5" wheels. Everyone loves to build mobile robots with Power Window motors, but the shaft is not standard and difficult to mount a wheel to it. The Power Window Motors w/5" Wheels (Pair) is now readily attached with 5 inches robot wheel together with the coupling/hub. Now, building combat robot should be easy and fun!
3. Generic Children Electric Car DIY accessories, includes wires and gearboxes. Intended for construction of a Self-made toy car. Full set of parts for electric kids ride on car. These “generic power wheels” type kits usually contain two to four 550 or 570 type drive gearboxes/motors, a steering motor, wiring harness, bluetooth remote control, etcetera. These types of sets are perfect for use in constructing a more modern MicroTron robot. The lower the RPM, the higher the torque and we need all of the torque that we can muster.

There really are quite a few options available for gearmotors and wheels. Try to make an informed decision and design your version of MicroTron around that decision. An important point to note is that since we are not using the motorized caster wheels as used in the original design, we could quite easily eliminate the two triangles and the two eight-sided polygons that were originally constructed from the 1"x1"x.125" (25.4mm x 25.4mm x 3.175mm) Aluminum Angle Stock. Indeed, that is the whole point of this document in which we will lay out the eight-sided polygon and cut it from a sheet of plywood or aluminum sheeting. The motorized wheels will then be attached directly to the lower eight-sided polygon. In this manner, we have eliminated the need to cut all of those pieces of angle aluminum to size and to cut all of those angles in the resulting pieces which would then have had to be bolted together to form the triangles and the polygons. This not only saves a lot of work but also results in a much more sturdy mainframe.

The contents of this document and the accompanying DIRectory (folder), including all files, represents a full-scale implementation of the MicroTron Robot Eight-Sided Polygon (referred to by Tod Loofbourrow as a non-equilateral octagon). Unfortunately, the dimensions of this particular design are incorrect mostly due to my improper mathematical calculations and C.A.D. layout. This eight-sided figure (polygon) is certainly close enough for use in building a full-sized MicroTron robot. There is, however, plenty of room for improvement, such as correcting the improper dimensions. I, personally, would not use this version of the eight-sided polygon. In fact, the only reason for including this information in the archive is so that all of the time and effort that I expended in creating this component is not wasted.

.Allow me to elucidate: Tod designed the MicroTron ("Mike") Robot around the Herbach & Rademan TM20K370 Motorized Wheels. As such, Tod constructed the majority of the robot from 1"x1"x.125" (25.4mm x 25.4mm x 3.175mm) Aluminum Angle Stock. This Aluminum Angle was used, initially, to create an equilateral triangle 23" (584.2mm) on a side with the angle aluminum pieces bolted directly to the swivel disc of each of the motorized caster wheels. When it came time to add a set of contact sensing bumpers, which Tod referred to as "impact sensors", Tod devised an eight-sided polygon that would overlap, at some point, each vertice of the triangle. Those eight pieces of angle aluminum were of the following lengths:

# Conclusion

Text

The contents of this DIRectory (folder) are a full-scale representation of the MicroTron Robot Eight-Sided Polygon (referred to by Tod Loofbourrow as a non-equilateral octagon). Unfortunately, the dimensions of this particular design are incorrect. Certainly, this eight-sided figure (polygon) is close enough to build a full-sized MicroTron, there is much room for improvement. Allow me to elucidate: Tod designed the MicroTron ("Mike") Robot around the Herbach & Rademan TM20K370 Motorized Wheels. As such, Tod constructed the majority of the robot from 1"x1"x.125" (25.4mm x 25.4mm x 3.175mm) Aluminum Angle Stock. This Aluminum Angle was used, initially, to create an equilateral triangle 23" (584.2mm) on a side with the angle aluminum pieces bolted directly to the swivel disc of each of the motorized caster wheels. When it came time to add a set of contact sensing bumpers, which Tod referred to as "impact sensors", Tod devised an eight-sided polygon that would overlap, at some point, each vertice of the triangle. Those eight pieces of angle aluminum were of the following lengths:

1: 18.250" (463.550mm)

2: 11.000" (279.400mm)

3: 10.500" (266.700mm)

4: 14.625" (371.475mm)

5: 11.750" (298.450mm)

6: 14.625" (371.475mm)

7: 10.500" (266.700mm)

8: 11.000" (279.400mm)

There were also two additional "brace" pieces, however, they are irrelevant to the current discussion. These were of the following lengths:

9: 8.625" (219.075mm)

10: 8.625" (219.075mm)

Each of the above listed pieces (one through eight) had specific angles cut on each end such that they could be assembled into the proper eight-sided polygon. Once the polygon had been constructed and attached to the 23" (584.2mm) motorized triangular inner frame, the impact sensors were then assembled and added. The impact sensor lengths were shorter than the initial lengths of the sides of the eight-sided frame and were actually slightly shorter than the sides to which they were to be attached. The impact sensor lengths were given as:

1: 17.00" (431.80mm)

2: 9.25" (234.95mm)

3: 7.50" (190.50mm)

4: 13.00" (330.20mm)

5: 10.00" (254.00mm)

6: 13.00" (330.20mm)

7: 7.50" (190.50mm)

8: 9.25" (234.95mm)

You would, of course, be forgiven for assuming that the lengths listed above for the impact sensors would also be the lengths of the sides of the polygon. Indeed, they are close enough in practice. However, by application of some basic mathematics, I was able to determine the actual lengths of the sides of the polygon to be:

1: 17.188" (431.80mm)

2: 8.782" (234.95mm)

3: 7.576" (190.50mm)

4: 12.597" (330.20mm)

5: 10.072" (254.00mm)

6: 12.597" (330.20mm)

7: 7.576" (190.50mm)

8: 8.782" (234.95mm)

In order to verify my calculations, I modeled the angle aluminum pieces in C.A.D. software and assembled the pieces on-screen. All of my calculations lined up precisely to the model with the exception of polygon side one. Polygon side one was calculated as 17.188" (mm), however, the initial C.A.D. model indicated that the actual length should be 17.485 (mm). After minor tweaking, the C.A.D. model indicated that the precise length of polygon side one should be 17.484" (mm).

At this point, you may be wondering as to the purpose of creating this eeight sided polygon. The answer is that most of the framework that Tod designed was created specifically for use with the TM20K370 Motorized Caster Wheels. Since these wheels are no longer available and alternatives must be used, then there is no need to fool around with constructing the triangular portion of the mainframe. Two of the eight-sided polygon pieces could simply be joined together with about 5" (mm) of spacing between them. Then, it should be a simple matter to attach whatever motorized wheels that you have to hand to the bottom of the structure. Note that the cutout in the centermost part of the eight sided figure is intended to be used for the battery cage and should support all common 100Ah, 12V batteries. You would likely not need the cutout in the top piece of the mainframe since the battery sits through the hole in the center of the bottom piece, resting comfortably in the battery cage and riding approximately 2" above ground level.

Including this particular set of files in this archive negates the need of designing a TM20K370 motorized wheel, which is the actual focus of this project. My reasons for including it is that it just happens to be a very useful method of building a full-scale MicroTron Robot Mainframe utilizing moderm motors and wheels.

-to be completed later - need a nap before work (3rd Shift)

-The R.A.T.

Full Size Eight-sided Polygon, Attempt One

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Parallax, Inc. Motor Mount & Wheel Kit - Aluminum (#28962) @ $299.00

The aluminum Motor Mount and Wheel Kit is a precision-machined mechanical drive system designed for mobile robotic platforms. The brushed motors are worm-gear driven, and the main drive axle (0.5” dia.) is cradled in a ball bearing assembly for smooth-rolling performance. The included 36-position disk Quadrature Encoders resolve to 144 discrete ticks per tire revolution for precision navigation. Key Features include: Machined 6061 aluminum components for smooth, worry-free performance, 60 lb. payload capacity, Compatible with any microcontroller, 144 encoder positions per revolution provide 0.14” of linear travel accuracy, Conveniently positioned pre-tapped screw holes for easy mounting, Rugged 6” pneumatic tires are suitable for a variety of terrain, Smooth-rolling and quiet performance.