Proposal for an Alternate Parallax MadeUSA® Base Design

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The Current Design

The MadeUSA® Robot Base made by Parallax Inc. is a brilliant starting point for hobbyists and educators who want a sound platform for their robotic application. The individual components are made with high precision and are durable and dependable.

The platform consists of a round disc upon which the other components are mounted. The configuration consists of two drive wheels that are mounted at the leftmost and rightmost positions and two castors that are mounted in the front and back.

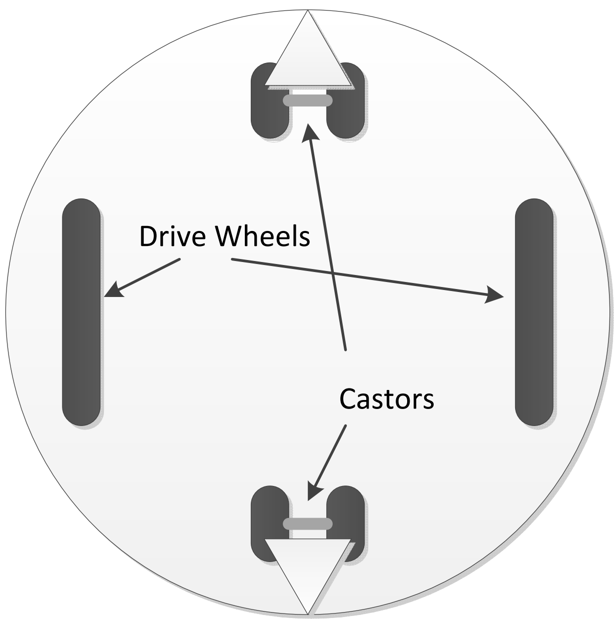

Figure 1

This arrangement means that the robot will be driven with differential drive. Steering the robot is simply a matter of turning the two wheels at different rates. If the wheels are driven in opposite directions at the same rate, the robot will pivot about a point in the center between the two drive wheels. This means that the robot will be capable of a zero turning radius.

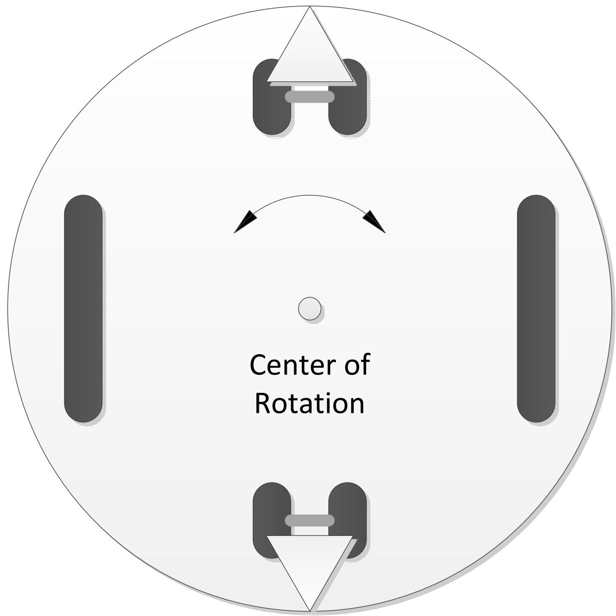

Figure 2

The Problem

This design works beautifully in an environment with a perfectly flat surface. As a hobbyist, I would like to create a robot that would navigate around my house. My house has many uneven surfaces such as thresholds and carpets. I suspect that the vast majority of environments will have the same issue. Even a house that is wheelchair friendly may have ramps that will provide access between different levels.

The problem is that the current design is intolerant to any deviation from a perfectly flat surface. Take the case that the robot is going to traverse across a threshold that rises ½ inch. The first wheel that makes contact with the elevated surface will be the leading castor. When the castor is elevated the weight will be on three wheels. These three wheels will be the front castor, the back caster and one of the two drive wheels.

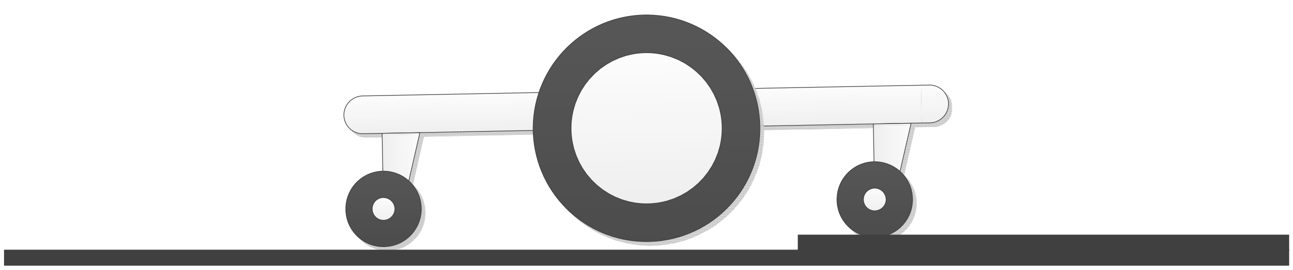

Figure 3

Actually this condition will exist whenever the robot will transition over uneven terrain. When the robot will go in the opposite direction and all of the wheels have moved from the higher level to the lower level except the last castor, the robot will be in exactly the same state.

With either the front or rear castor elevated the weight MUST be removed from at least one of the two drive wheels. This is basic geometry.

The problem is further exacerbated because the drive wheels are propelling the robot with differential drive. When one wheel is lifted from the surface, the other wheel will be driving forward. This has the effect of unintentionally turning the robot in the direction of the raised drive wheel. Granted, the drive wheel that has traction should eventually get over the threshold and the robot should recover, but this makes for an ugly transition and if I were the robot, I would be very embarrassed.

Note that this effect would happen with any elevation including a thick carpet or even a gradual ramp.

The Proposed Solution

There is a simple solution that requires no changes to any of the components except the wooden platform upon which everything else is mounted. In this solution we simply rearrange the position of the wheels.

I propose that we move the two drive wheels to the front to corners and move the two castors to the back two corners.

Figure 4

Now let us examine what happens when a wheel is elevated by a threshold. If the leading wheel that is elevated is one of the two drive wheels, geometry dictates that the wheel that will be lifted off the surface will be either the other drive wheel or the castor that is on the same side as the elevated drive wheel. The castor that is directly opposite of the elevated drive wheel will be weight bearing and will not be lifted off the surface.

With a little weight planning we can give preferential treatment to the other drive wheel. In other words, we should mount the battery towards the front of the robot.

Now when the robot climbs over a threshold, thick rug, or ramp the wheel that will lose weight will almost certainly be one of the castors and the directional drive should not be affected.

You may say “what about the zero turning radius” and you would be correct to ask this. Indeed when the robot turns it will not rotate about a perfect center. It will, however, rotate about a point directly between the two drive wheels which is still within the body of the robot. The back end of the robot will swing wider when turning and this is the trade-off.

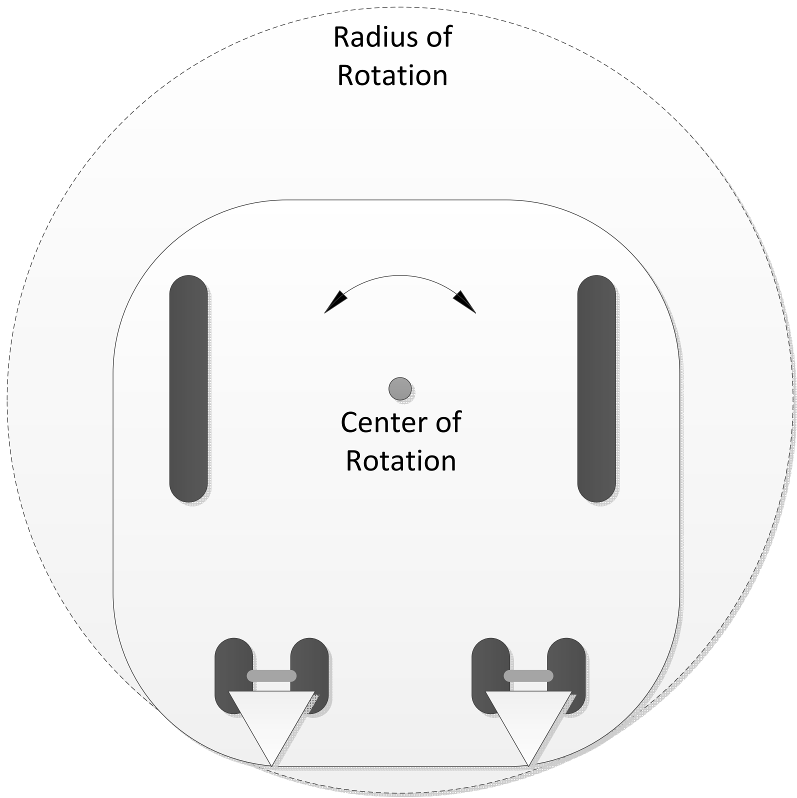

Figure 5

I wonder how important this really is. Sure, the spinning in one location is aesthetically appealing, but what does it bring to the table for practical solutions? I can see if the robot goes into a tight spot, it would be nice to be able to spin 180° and simply drive out. If the robot of the new design gets into a similar position, it would first have to evaluate if there is enough room to spin because its turning radius will be a little wider. If it doesn’t have enough room to spin it could always back out in the reverse of the path it took to get into the sticky wicket.

Sure, this requires a little more programming, but let’s face it, programming is cheap. I personally think it is worth it because no amount of programming will solve the lifted drive wheel problem.

Benefits

This change would have the following benefits:

- Solves the problem of uneven surfaces
- Does not change any of the components except the shape of the platform
- Not an expensive change

Drawbacks

The only drawback that I can see is the loss of a perfect zero turning radius.