Automata - Carousel

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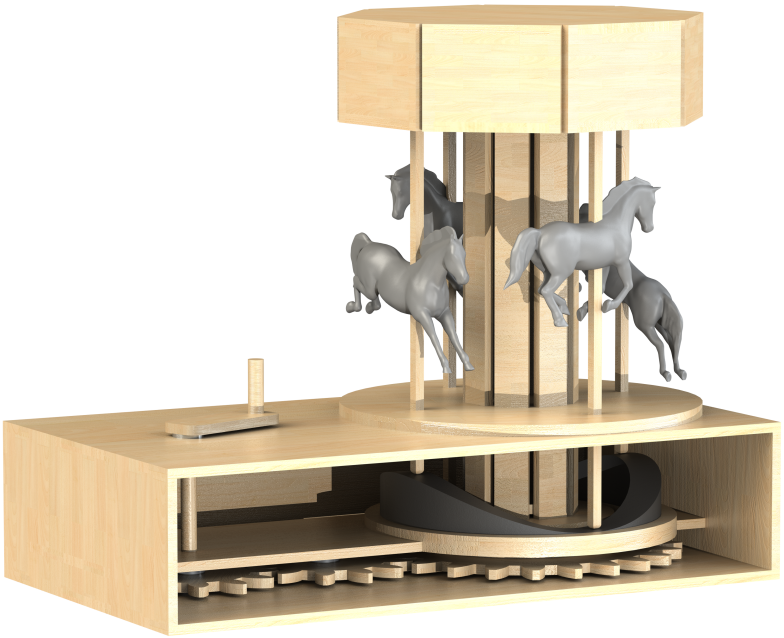


1 Summary

While not the most fun carnival ride, to me carousels have always had a special, old-timey, romanticism charm. Seemingly complex with their both rotational and vertical motion, there are several ways to achieve this motion, none of which are terribly complex but all interesting, which was my focus for this project.

The primary mechanisms of the carousel include a gear train connected to the drive shaft and a wedge cam to facilitate the movement of the carousel steeds vertically as it turns.

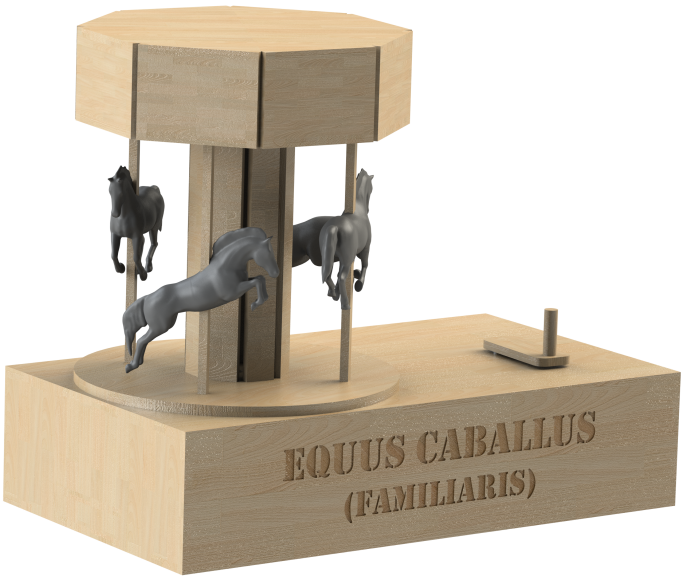
The gear train consists of three laser cut spur gears, the first two of which are connected to their axles and act as a way to stop the axles' transnational movement along their rotary and major axis. The last one, which also acts as the base of the carousel turn table, spins freely around is axle which is used only to center it. The gear train was chosen to allow for lowering the rotational ratio from the drive shaft to the carousel so it wouldn't feel or look unnaturally fast as well as decrease

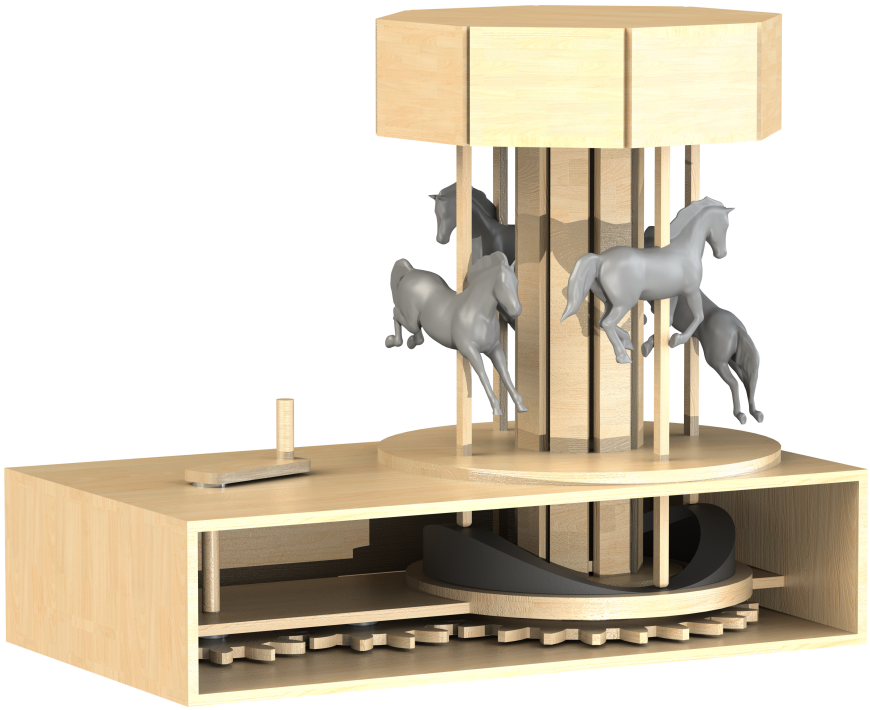
the likelihood of it binding by going too fast. It also allowed me to move the input shaft further away from the carousel and not have to deal with changing the axis of rotation had I put the hand crank on the side of the box.

The wedge cam has two rises of .75" twice during one rotation around it by the through-poles holding the steeds. The laser cut poles, being rectangular prisms (except for the ends which are rounded off to reduce friction along the wedge cam) and having two points of contact in the platforms they move through, are locked rationally and transitionally in the x and y axes, allowing it to only move transitionally in the z-axis, which is necessary to traverse the wedge cam. The wedge cam was 3D printed using an FDM printer. I chose to Mamie the wedge cam partly to learn more about how to make such a shape in SolidWorks and to test how nice of a curve a 3D printer could make. It also seemed like the natural choice for mimicing the motion of the carousel. I also probably could have gone with crank shafts like an actual carousel uses to produce the same motion instead but this typically requires many more, smaller, precise parts, namely gears which I did not fully trust the 3D printers to handle.

2 Renders

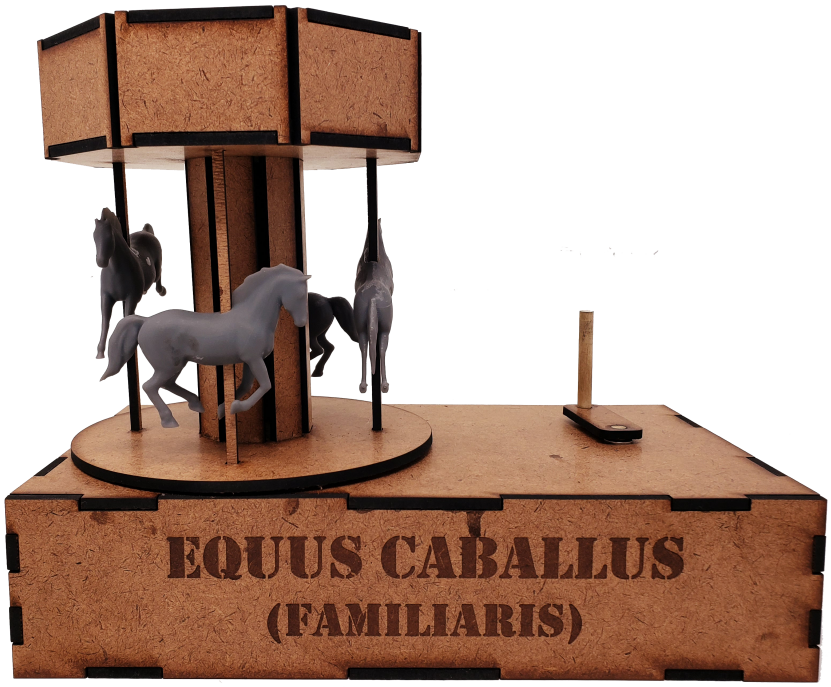
A movie of the CAD model in motion can be seen here: https://www.youtube.com/watch?v=tu1bMOa2pR4





3 Photos

A movie of the physical automata in motion can be found here: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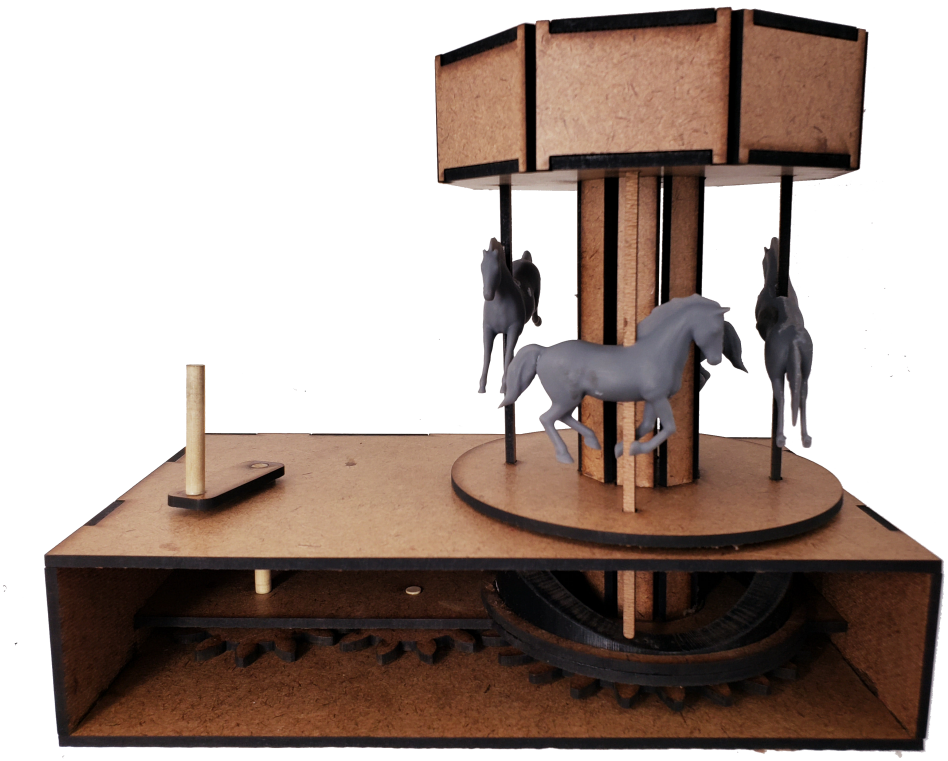

4 Reflection

Overall the project went well and came together fairly quickly. Coming into the project I had a vague idea of how carousels worked but nothing too specific so

The largest area for improvement for the project and going forward in general is working with gear trains over distances (although belts and chains may solve this more easily now that we're "allowed" to use them in the coming projects). Some binding occurs in the current gear train, mainly the center gear, because the washers I used as on a whim as spacers do not have enough contact area with the gears which combined with a little bit of free spacing, allow the gears to pivot and move up and down, causing binding with its neighboring gears. Besides increasing the contact area with the washers, double layering the gears would also have helped.

Coming from the laser cut box project, I was much more careful about application and use of glue in this project, using more press fits, interlocking, and freely moving rotating parts that were locked in translational motion. This was important not just because I wanted it to look nice and not have glue spots everywhere but also because if any glue got on rotational parts it either wouldn't work or be a pain to fix.

Between this project and the laser cut box I feel a lot more confident in my skills to quickly pull together a design in SolidWorks that allows for iteration through smart dimensioning and just the overall design. Additionally I feel better about identifying parts of the project that will require

testing or that should be done in small scale before committing a large amount of resources to it. In the case of the box it was the living hinge for waterfall while for this project it was the wedge cam and sizing for the poles.

5 Credit

Credit to GrabCAD user mcramblet for his horse models which were modified and resin printed for use as the carousel steeds. (https://grabcad.com/library/three-horses-1)