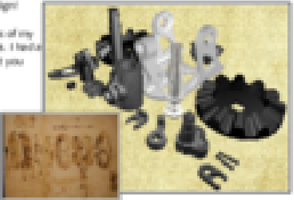
Thank you for your interest in my design!



This documentation covers all aspects of my design for the **da Vinci Gear Challenge**. I had a lot of fun designing it, and I hope that you find it just as entertaining as I did.

DESIGN ORIGINS

The concept for my design is based on the image displayed within the Challenge itself (https://grabcad.com/challenges/da-vinci-gear-challenge), along with a handful of images downloaded from sources with larger, more detailed images of da Vinci's drawing.

Part of the Challenge's requirements were to "Consider the ways in which 3d printing differs from Renaissance-era fabrication technologies and adjust the designs accordingly." I saw no reason to adhere to da Vinci's peg based design, since modern technology provides much better mechanical

[illegible] **Lulzbot TAZ** [illegible] (I say that I use the term "forced" quite facetiously.) However, this meant that I was forced to adjust my tolerances on many parts to accommodate TAZ's larger 0.5mm nozzle. (In that sentence, the word "forced" was much more literal.)

The entire design was modeled using **TurboCAD** v16, in native file format... then exported into STL, STEP, IGES, and OBJ formats. (I exported OBJ files for use in constructing an "Assembly and Operation" video, which can be viewed at [illegible].)

TECHNICAL SPECS

1) Part count: [illegible]
2) Print settings (**Lulzbot TAZ** 5 w/0.5mm nozzle):
   1. Layer height 0.2mm
   2. Shell thickness 1.5mm
   3. Top/bottom thickness 1.5mm
   4. Infill density 20%
   5. Print speed 50mm/sec
   6. Filament:
      1. 3mm "Husky Silver" PLA from **Orb Polymers** (silver parts)
      2. 3mm "Black Bat" PLA from **Orb Polymers** (black parts)

PARTS LIST

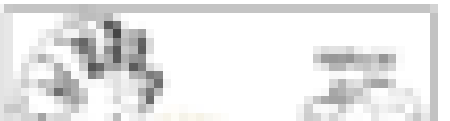
All parts files have been rotated to proper printing orientation, centered on the X/Y axes, and are sitting on the Z plane. All files have been run through the **Model Repair Service** on https://netfabb.azurewebsites.net/ (thus the "[Filename]_fixed.STL" name of all files), to ensure that they are watertight and all printable for most FDM printers.

All parts were designed to be printed without using support material, a raft, or a brim. However you may opt to add support structures to the Stand part, due to the vertical holes. (My stand printed just fine without using support.)

Only one of each part needs to be printed. Due to my time frame, I used rati rectilinear infill for most parts, a layer height of 0.3mm, and a 1.2mm wall thickness. My temperatures were 215°C for the extruder, and 60°C for the heated PEI build surface. I used two different colors of green PLA from **Orb Polymers**. My print speed was 50mm/sec for all prints, which were printed in 3 separate sessions.

ASSEMBLY INSTRUCTIONS:

1) Position the Left Gear and Right Gear on either side of the Carrier, and hold them up either while lowering them into position between the sockets of the Stand. The left gear



knob areas of the Axle shaft, directly behind the "square" portion, and the end section of the Axle shaft.

The Central Gear will need to be rotated until the tapered spline of the Axle slips into one of the six notches in the Central Gear.

6) Test the rotation of the gears. They should mesh snugly, yet rotate smoothly. If not, you may need to make adjustments with a reamer, sandpaper, or others.

7) Once you are satisfied with the fit, insert the Axle Retaining Clip into the slot at the top of the Carrier, and snap it onto the Axle. NOTE: The clip has a beveled side, and needs to be oriented with the beveled side of groove of the Axle. This will require a bit of pressure in order to push onto the end of the Axle.

8) Slide the shaft of the Ratchet into the hole on the front of the Stand, from the left side. The Ratchet has three spring loaded arms, but only one of those arms has detents that mesh with the radial notches in the Stand. These detents should face downward. For best operation, lubricate the small diameter of the shaft with graphite, as well as the shaft opening in the Stand.

9) Push the Ratchet literally up to the hub end of the Ratchet's shaft. It should click nicely

outlines the peg opening in the Handle Arm. (NOTE: The clip has a beveled side, and needs to be oriented with the beveled side of groove of the Handle. The clip will require quite a bit of force in order to snap onto the end of the Handle.

c) Tie a length of string around the "spool" of the axle, towards either the front of the threads, or the rear. Secure the string with a small dab of 5 minute epoxy, or adhesive of your choice. Allow the adhesive to cure.

d) Wrap the string around the "spool" several times, following the small threads... which I added could in nice, neat spooling of string.

e) Tie a weighted object to the loose end of the string. Enjoy lifting and lowering the object.

Assembly is complete!

You may also refer to my brief Assembly and Operation animation videos at [https://youtu.be/...](https://youtu.be/) for further reference.

NOTE: All parts of my printed parts fit together perfectly. Due to limited time, I had to use

The Design

As soon as I saw this design challenge, I knew that I had to enter it... and what I wanted to do. So I set up the parameters of the gear mechanism using these drawings:

grease that holds the retaining clip.

c) The Ratchet Handle Retaining Clip is a very redundant part, as the Ratchet Handle fits onto the shaft of the Ratchet in a very perfect way. If you choose to use this part, it will require an enormous amount of pressure, but will eventually snap into place, and sound like it broke. (Yours might break. Mine did not… but it scared me.)

POLITICALLY CORRECT ENDING

This design is not perfect, by any means. Generally speaking, I have a month or two to test and prove my designs (which I work on almost constantly). I love challenges like this, because they test my ability to work on yet another project – with yet another time frame to schedule around my work schedule. I work best under stress… however, I don't see time constraints as an issue, anymore.

As one of my coworkers always says, "Quality, or Production. Choose one. You can never have both at the same time."

> Given enough time, my design would work flawlessly. That's what I do for a living. I design things… machine things… and make adjustments.
>
> The flat side of the Carrier was intended to hold two entirely different "Ratchet" Angles, by