MECH ENG 4Z03 Design Project

Group 40

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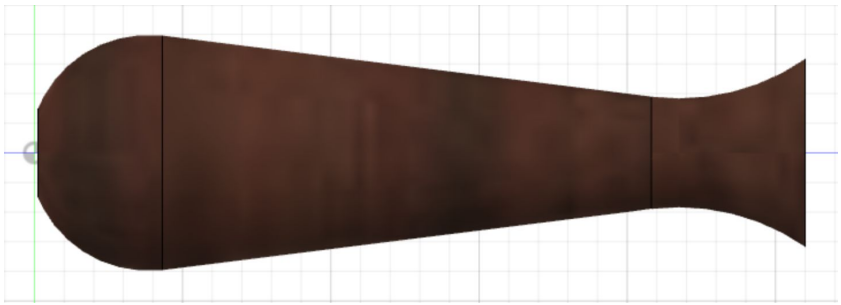
Introduction

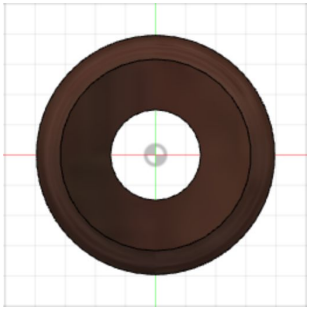
The assembly we decided to model was that of a meat grinder. We chose this specific tool as it is something simple and basic that many families have, but also is a great example of basic mechanical systems and how they work together. The intended function of the meat grinder is to take some sort of input (usually meat, but can also be vegetables and lentils), and to grind the input together so that it comes out in a soft and ground consistency. The way this works is the user would input the food into the funnel at the top, and rotate the handle which is connected to the auger inside. The auger will then proceed to grind the food together, gradually being pushed towards the end of the tunnel where it will be cut up by a cutting star (or in our case, ninja star). The food then proceeds to get pushed out of the shaping plate at the end, which further breaks down the food into a softer, more grounded consistency. We chose to make most of our design out of stainless steel, as it provides the strong reliable support one can expect from steel but also rusts a lot slower and is easier to clean. These are attributes we deemed important when choosing the material of our meat grinder.

Design Components Breakdown

Handle

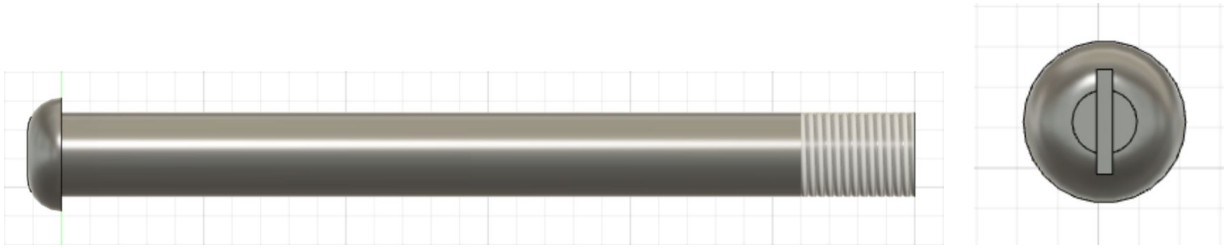
When designing the handle, our main concern was the users comfort. To ensure a comfortable handle, we decided to make it out of mahogany so it has a softer touch and will not get slippery if the user has sweaty hands. The handle was designed to give the user some free space to move their hand while also not wasting too much space, and to provide a solid grip as the user's main interaction will be with the handle. The modeling was fairly simple. We decided what the dimensions of the handle we wanted were and we drew circles and lines to make a 2D face, then revolved to get the desired shape of the handle.





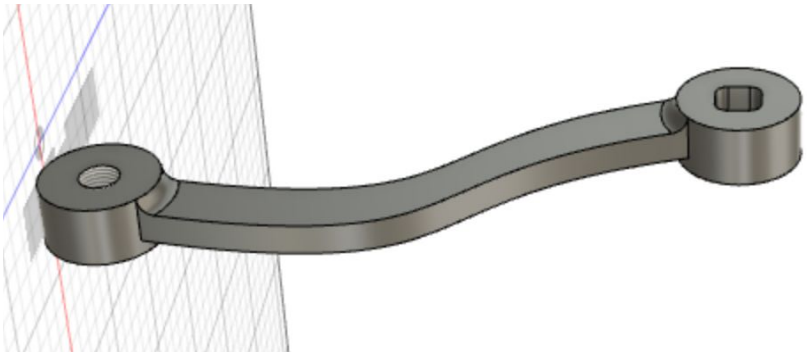
Handle Pin

The handle pin was a simple part that was needed to connect our handle with our handlebar. It is a simple screw with a thread only at the end of it, this way it can be slid through the wooden handle and screws onto the handlebar. We used a flat head on the screw as it simplifies the design while also getting the desired results. Modelling was simple with just two circle extrusions, a thread, a fillet, and a rectangular extrusion to make the flat head.



Handle Bar

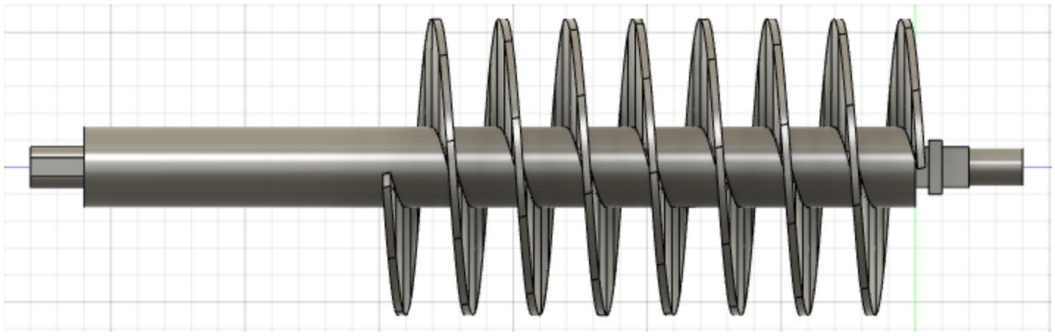
Next is the handle bar, which is used to connect the handle (through the handle pin) to the auger. This way we are able to translate the rotational motion of the handle to the auger. On the bottom end of the handle bar, the handle pin is screwed into it to connect the handle, while at the top end, the auger's rounded square end is inserted into it which is connected to the pin. After deciding the length, all that was left was to connect the circular parts at the top of the bottom. A thread was added in the bottom section so that the handle pin can connect the handle with the handlebar. We added fillets on the handlebar to reduce stress concentration, while also adding a sense of style. We decided to use a curved shape to provide some style, which was done by using the fit-point-spline tool.

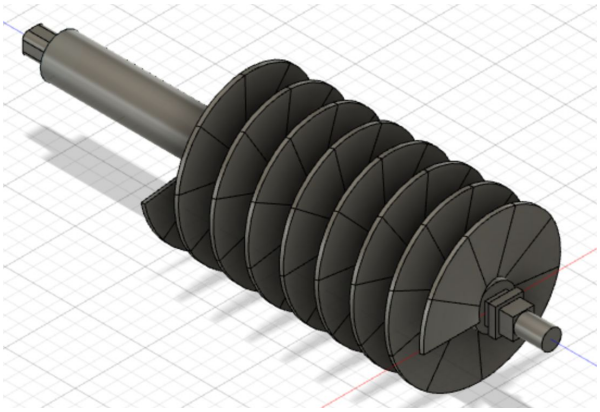


Auger

Next is the auger, which is the part that the user has the least interaction with but is also the most crucial for the operation of the meat grinder. On one end of the auger, we have the rounded square end that is connected with the handle bar, which is then screwed together using the pin, and the other end lies in the shaper so it has support. Designing the auger was a complicated process as Fusion 360 does not have a helix tool so a more roundabout method was needed. The steps to model the auger were as follows:

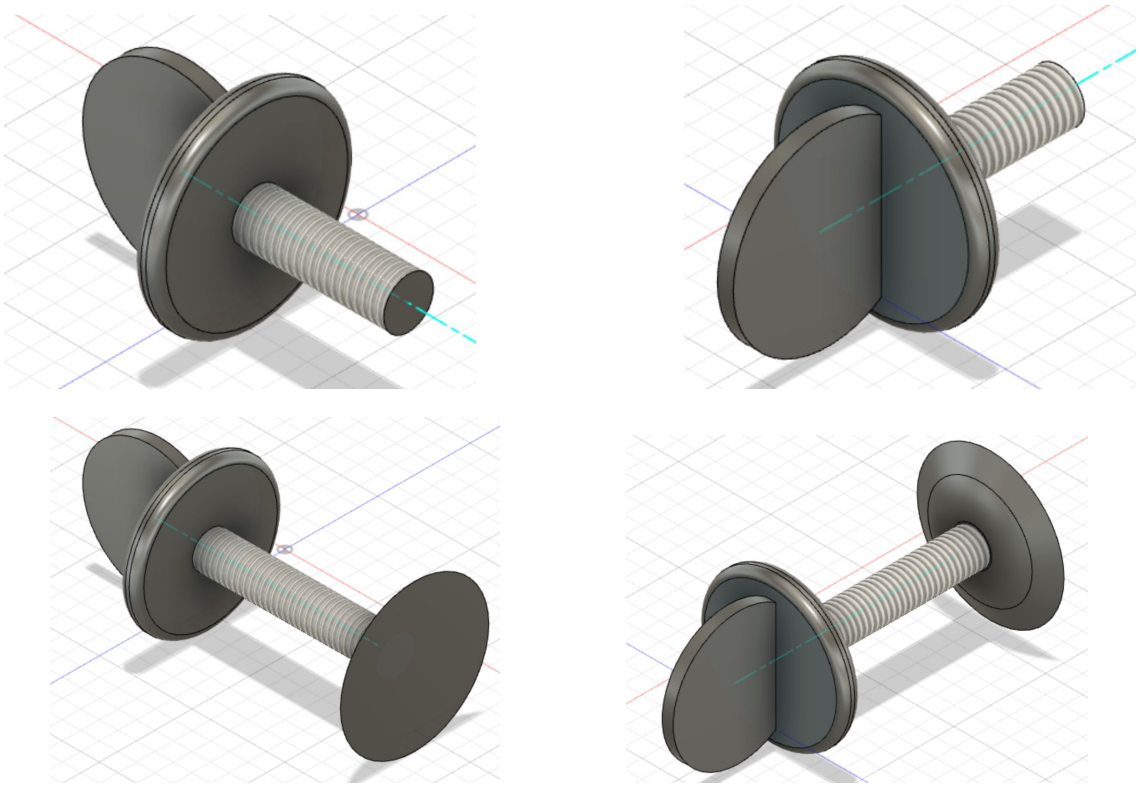
1) Extrude Circle to make a cylinder
2) Create a coil (square cross section) with the length of the desired auger with the same diameter as the cylinder, also chose how many revolutions we wanted
3) Create a plane on an angle which was based off of the end of the coil, so that we can draw a rectangle on it which soon become the tooth of the auger
4) Use the "Path + Guide Surface" type Sweep tool along the path of the edge of the coil, which then gives shape to the rectangle we drew earlier
5) Designing the auger itself is done now, just design the endings so that the auger may connect with its counterparts as required





Pin & Clamp Pin

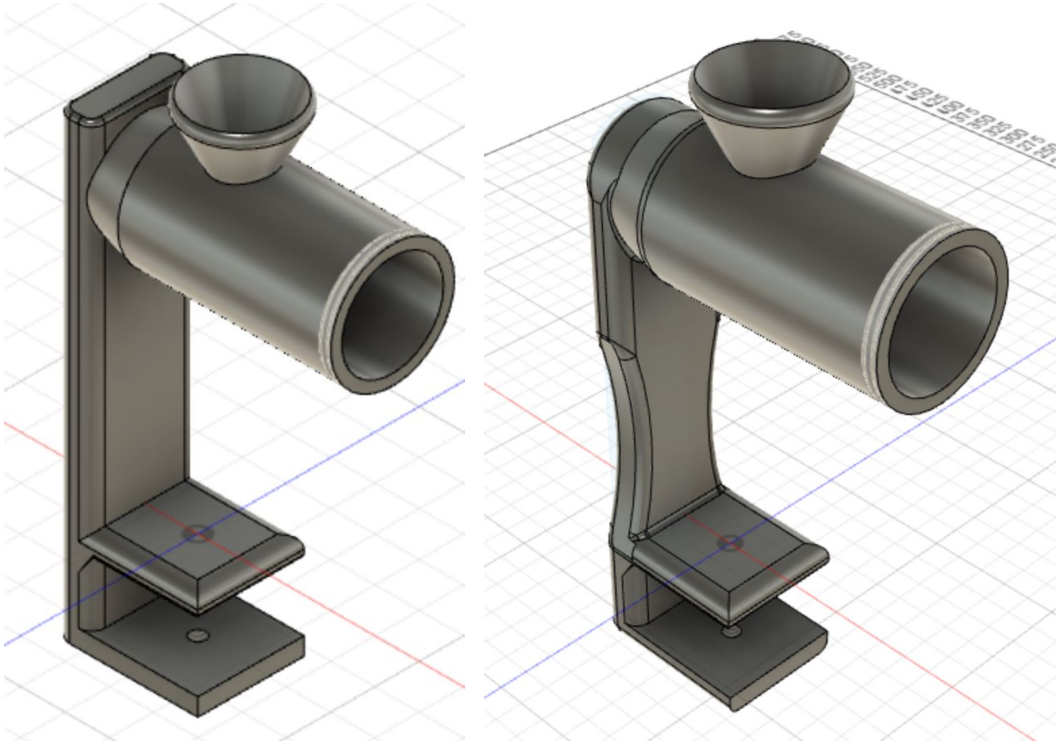
The pin and the clamp pin are both very similar parts. The key difference is sizing and that the clamp pin has a flat circular surface at the end of the screw, which is meant to get pressed upward onto the surface to provide support for the meat grinder. The pin is used to hold the auger and the handlebar together. Modeling these was very straight forward, we used a few circular extrusions and a fillet, with a thread at the end.



Body

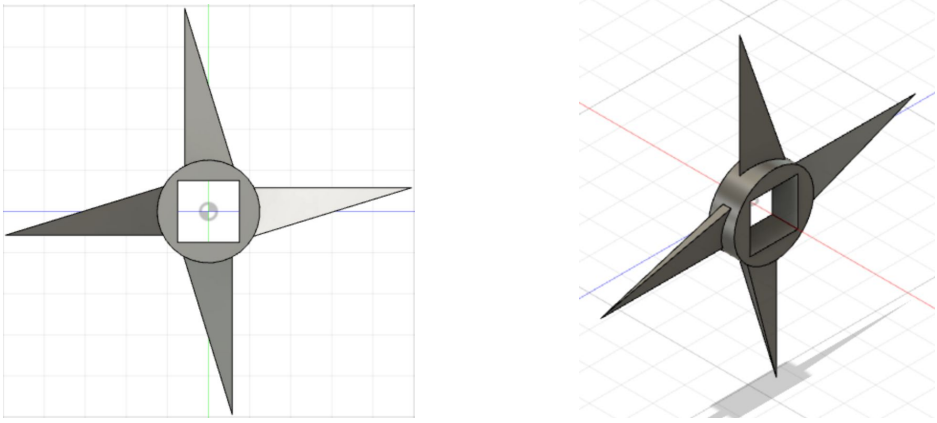
Next we have the body, which is the largest component in the design. The body connects all the pieces together and houses the auger in the grinding chamber. The body clamps onto the table with the teeth on the top surface and the clamp pin at the bottom. At the top of the grinding chamber there is a cone that the meat is fed into, which then falls into the auger for grinding. At the end of the grinding chamber we have a thread which is used to screw the shaping face onto the body. The body was designed using simple extrusions of basic shapes like circles, rectangles, and triangles (for the teeth), and some lofts to make the grinding chamber and the cone. We chose to add fillets around the body to reduce any edges that may cause cuts since the user will be holding onto the body a lot, and this will also reduce stress concentration.

The following are pictures of our first design and final design, after CAE improvements were taken into consideration.



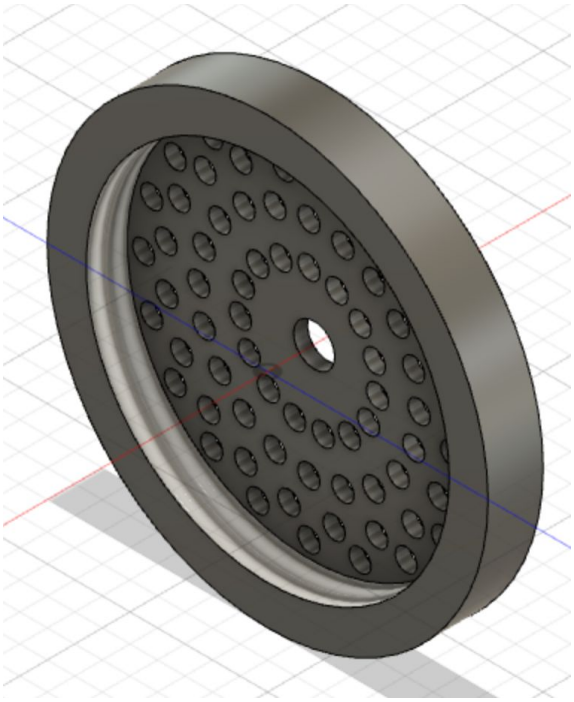
Ninja Star

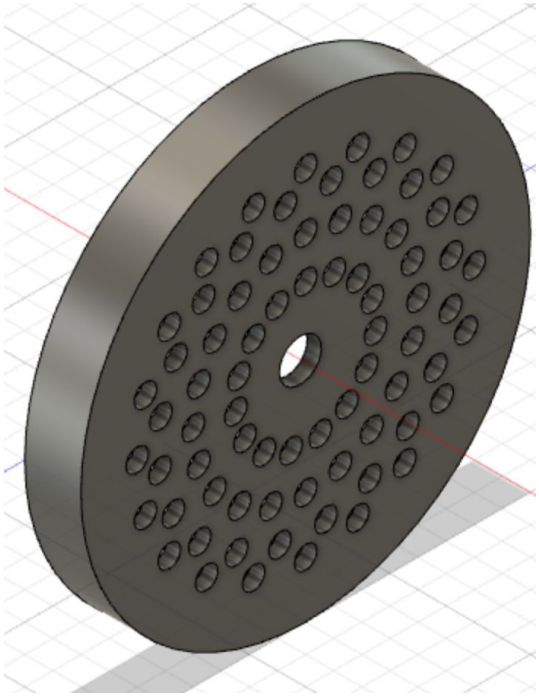
The cutter or the ninja start is used to cut the meat that gets pushed to the end of the grinding chamber before it gets processed through the shaper. It was designed with sharp edges to cut the meat with ease and is connected to the end of the auger cylinder so it rotates with it. It was designed with simple extrusions of shapes and 2D drawings and some cut-outs.



Shaper

Lastly, we have the shaper. The shaper is screwed onto the body at the end of the grinding chamber. The meat is pushed through the grinding chamber by the auger, cut by the ninja star, and then pushed out of the shaper. This is the last phase of processing of the meat and breaks it down into a more refined, ground material. It was designed with simple circle extrusions and a thread on the inner side



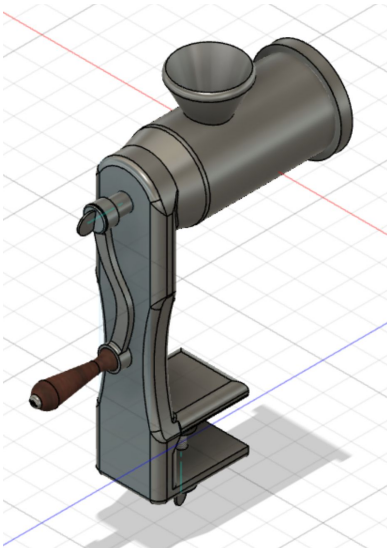


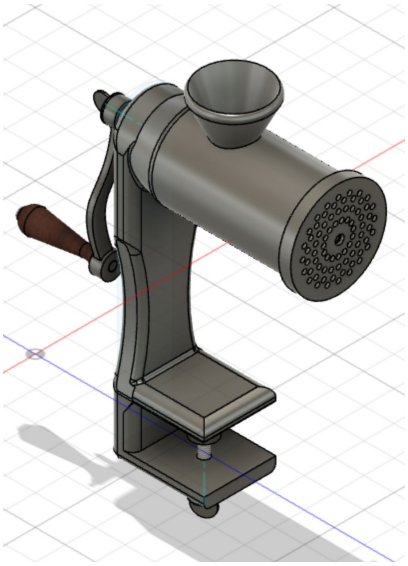
Future Improvements

For a future iteration of the design, we could choose to change several things about the design. One of the things we can look to improve is the size of the grinding chamber. It can be made to hold more/less meat based on feedback from possible users. Another thing we could change is the shapers; We can choose to add more shapers so that the user has the option to choose between different processing sizes for the shaper. Another thing we can look to improve is the handlebar. By choosing a different length and design, we can find an optimal design which would maximize torque and reduce the effort needed by the user.

Assembly and Dynamic Simulation:

Assembly



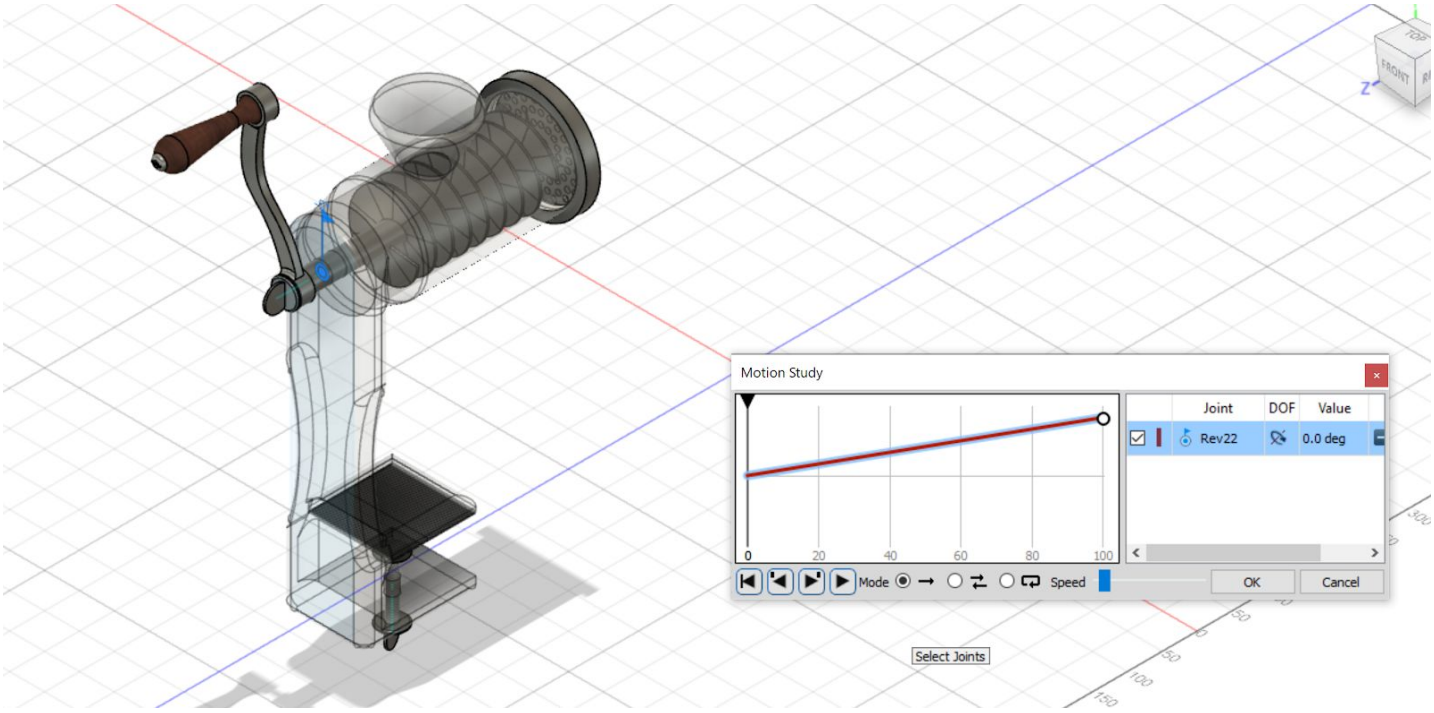


The views above are of the final assembly with all parts in appropriate positions using joints. A combination of rigid and revolve joints were used in order to ensure proper behaviour when the handle rotates. The handle is linked to the handle pin through a rigid joint to ensure that the pin rotates whenever the handle is moved. There is another rigid joint between the handle pin and the handle bar which is used for the same reason as the first rigid joint. Similarly another rigid joint links between the handle par and the pin. The auger is linked to the body using a revolve joint and to the pin using a rigid constraint, this ensures when the handle moves all the corresponding parts move accordingly including the handle pin, the handle bar, the pin, and the auger. The auger then is linked to the ninja star through another rigid constraint to maintain the same rotation motion. The shaper is linked to the body using a rigid constraint to ensure it does not rotate with the rest of the mechanism. The clamp pin is another part that is linked to the body through a revolve joint to enable the pin from settling in its position based on the width of the table.

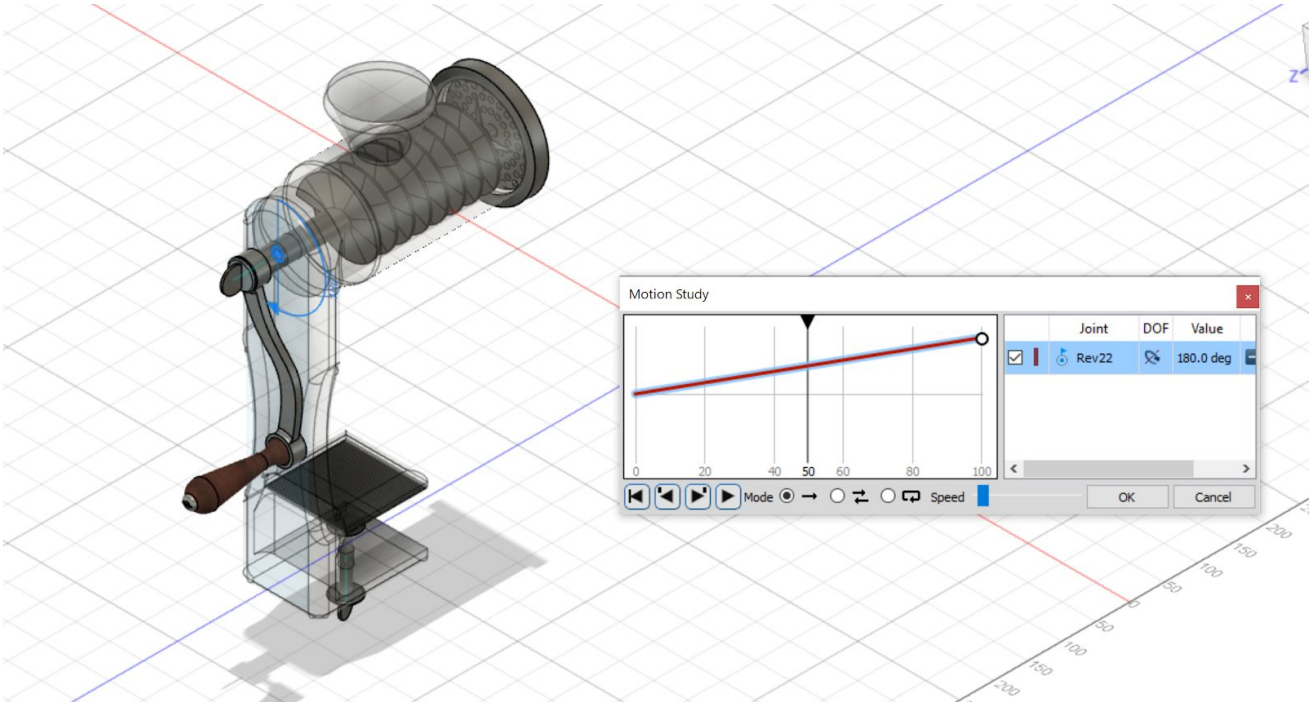
Dynamic Simulation

The simulation is available in the motion study section of the assembly and involves moving the main revolve joint that corresponds to the revolving mechanism and observing how parts move accordingly. The screenshots below illustrate the simulation performed. The body is made transparent to a certain degree in order to show the motion of auger and the ninja star inside the meat grinding chamber portion of the body.

Starting Position with handle angle 0 degrees



Middle Position, with handle angle 180 degrees



Position with handle at 270 degrees