

Mechanical Shredder

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Team 10

Project Proposal

Document

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Introduction

Group 10 has been given the task of retrofitting an electronic paper shredder to be fully manual and be able to act as efficiently as the average market paper shredder. Multiple designs were considered, but the group agreed upon attaching a hand crank directly to the main shaft of the internal shredder system. This saves the group from using money on custom parts and multiple manufacturing expenses and still lets the paper shredder meet all customer requirements.

Previous Design Concept and Problems

The group previously proposed attaching additional gears to the mechanical system in the electronic shredder and attaching a hand crank as seen in Figure 1. This system allowed the team to work with the initial gears that come with the system and add an additional gear to reduce the turning ratio to shred a single sheet of paper.

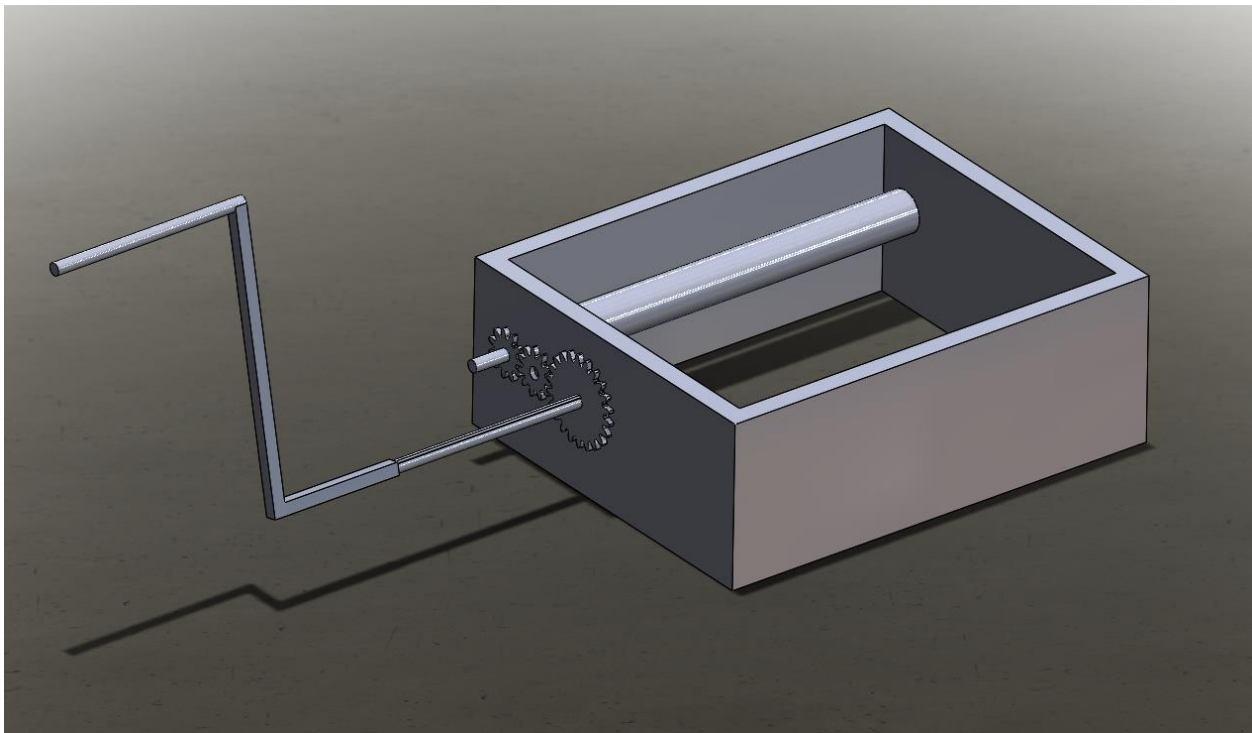


Figure 1: Previous Hand Crank System

Figure 2 shows a more in-depth look at how the gears would be designed. The first 2 gears on the left are attached to the shafts that hold the shred teeth in the system, and the third gear would be added in sequence to be able to power both of the initial gears. The main issue with the extra gears came with the size and shape of the gears that come with the system. Those gears are not a standard measurement of gears, which meant that to design a third gear that would be compatible would mean to design and manufacture custom gears which would bring about an issue of time and money needed to manufacture the pieces. The custom gear would also need to be three times the size of the other gears and would push the limit of the wall space given to us in the system.

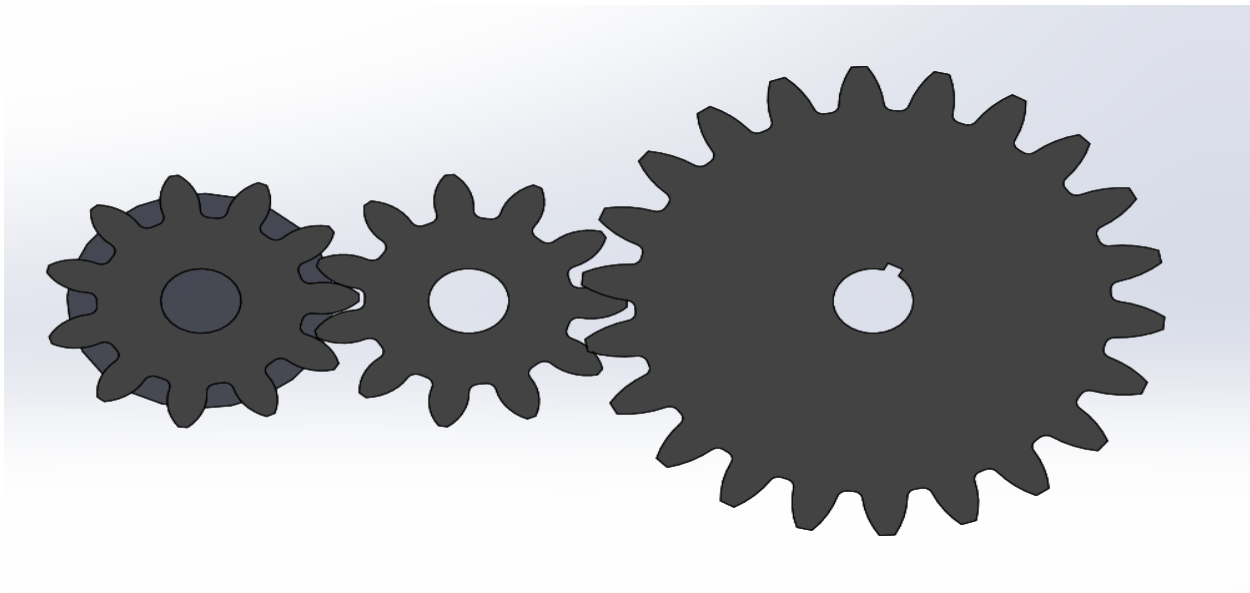


Figure 2: Custom Gear Assembly

New Design Concept

The system takes 3 rotations to shred a single length of paper which initially we wanted to reduce. This reason was why we wanted to come up with a new gear ratio, but further discussion led us to agree that the 3:1 ratio was not too inconvenient that it had to be adjusted and could remain the way it was. This compromise allows us to attach a crank shaft to the main shaft shown in Figure 3. The only issue that needed to be addressed was the need for the shaft to extend out of the housing, while the gear box was in and letting the hand crank to be able to rotate the shaft from the outside. The shaft is roughly an inch away from the housing wall and needs to extend outside of the wall.



Figure 3: Internal Shredder Mechanism and Main Shaft

Required Parts and Measurements

The first part that will need to be installed into the system will be a motor shaft arbor extension [1] (Figure 3). This piece has a small sleeve that will attach over the shaft of the shredder and screwed tight to fit the shaft tightly and will work as a set screw. The shaft extension is 3 ½ inches long, which will extend from the main shaft to outside of the housing where the hand crank can be directly attached. The bore diameter of the extension and the threaded side are ½ inch which is consistent to the size of the shaft and bore of the hand crank.



Figure 4: Motor Shaft Arbor Extension [1]

Finally the hand crank [2] will be attached directly to the threaded shaft and be able to rotate the cutter teeth directly. The hand crank (Figure 4) will have a rotating handle that allows the user to not have to adjust their grip constantly while operating the system. The hand crank also has an overall length of 7.29 inches and gives a significant amount of torque to the user to aid them in rotating the system. The hand crank is also made of a Glass-Fibre Reinforced Technopolymer that will prove durable for the quality of work needed of it.



Figure 4:Hand Crank with Revolving Handle [2]

New Assembly

The new assembly will only require the 3 parts previously mentioned: the cutter shaft, shaft extension, and hand crank. The shaft extension will be used to span the empty space between the main shaft to outside of the system. The threaded side of the extender will then be fit

into the threaded bore within the hand crank and allow the hand crank to rotate the whole system. A detailed visual of the assembly can be found in Figure 5. The sleeve of the extension will also be fit along the shaft and two small screws will be put in the two small holes located on the top to act as set screws and hold the shaft in place on the system.

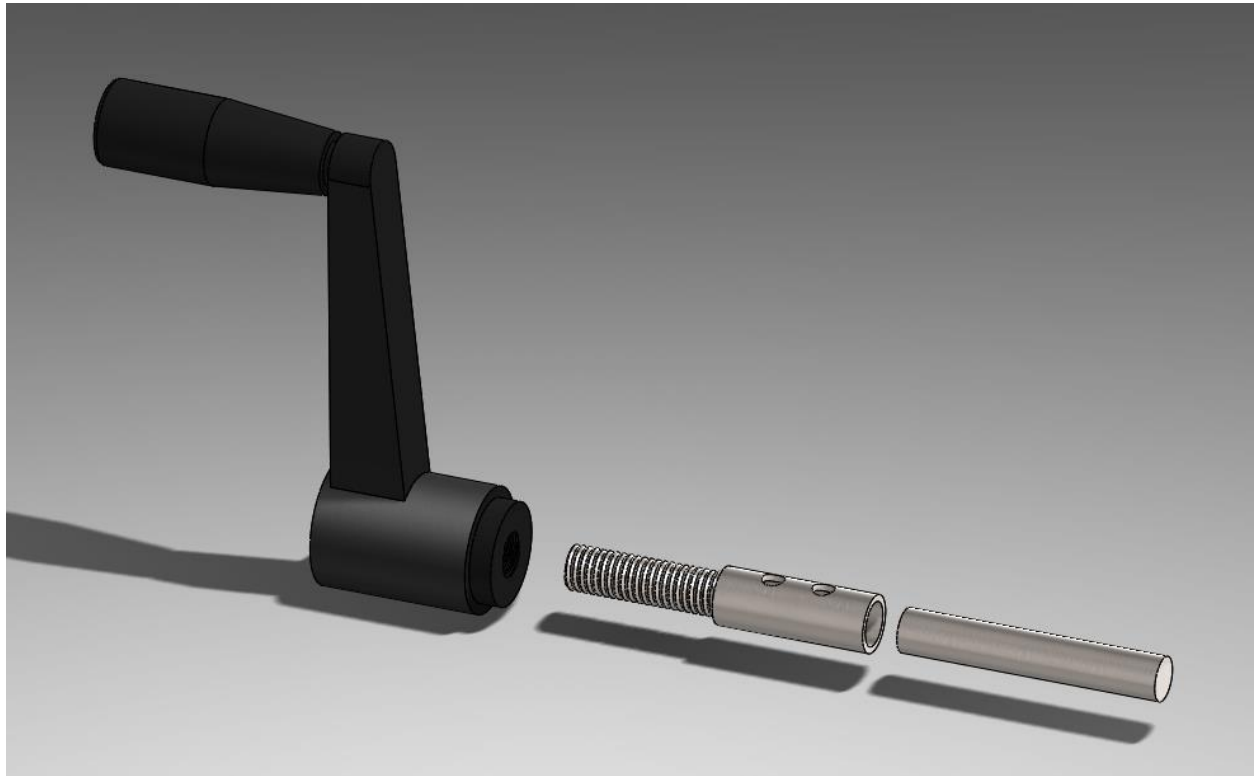


Figure 5: Assembly Drawing of Hand Crank System

Budget

Table 1 shows all purchases that will be necessary for this project, which the “AmazonBasics” paper shredder has already been purchased. The arbor attachment and crank handles that we found are reasonably priced and will allow us to remain under budget with the given price limit of \$100. The remaining money can be used for any minor purchases that need to be made before the final product, such as screws and clamps. At first, the team considered using the initial price of \$116.44. More research was executed by the team while planning for the design with an extra gear. The new design is beneficial to both the design group and client.

Table 1: Mechanical Paper Shredder Budget

Parts	Price
AmazonBasics 12-Sheet Cross-Cut Paper, CD, and Credit Card Shredder [3]	\$54.99
½" Arbor Attachments for Electric Motors [1]	\$6.06
Crank Handle with Revolving Handle [2]	\$29.21
	Total: \$90.26

Conclusion

The team was given the task to retrofit a mechanical paper shredder from the electronic system it previously entailed, which led to a constructed design that would allow the shredder to act efficiently. Originally the shredder had a multiple hand crank design, and the idea of adding another gear was discarded because of manufacturing costs and an inconvenience with wall spacing that was not yet available. The team decided upon attaching the hand crank directly to the main shaft of the system which still requires a 3:1 turning ratio for shredding a sheet of paper. The client decided that it would not be an inconvenience and the team agreed. The team will begin a new design by using an arbor shaft extension to be able to secure a hand crank outside of the system. This is accomplished by directly operating the cutting blades efficiently and reducing the budget while achieving a desirable outcome for the client.

References

- [1] McMaster. *McMaster-Carr* [Online]. Available: <http://www.mcmaster.com>
- [2] MSC Industrial Supply Co. [Online]. Available: <http://www.mscdirect.com>
- [3] Amazon. *Amazon Basics 12 Sheet Cross Cut Credit Shredder* [Online]. Available: <http://www.amazon.com/AmazonBasics-12-Sheet-Cross-Cut-Credit-Shredder/dp/B005QAQFFS>