

# Mechanical Shredder

## UGRADS Presentation

Sultan Al Shahrani, Ryon Baloo, Kendall Meyer, and Mohammed Molani

April 24, 2015

NORTHERN  
ARIZONA  
UNIVERSITY



*College of  
Engineering, Forestry  
& Natural Sciences*



# Overview

- Introduction
- Research
- Concept Generation
- Mechanism and Part Details
- Final Product
- Bill of Materials
- Conclusion

# Introduction

- The team was tasked with designing a mechanically operated paper shredder for an office environment
- A majority of paper shredders today are electric driven, which limits them to nearby available power sources
- A mechanical paper shredder does all the work an electric paper shredder can do while remaining portable and reducing noise levels

# Objectives

Objective	Measurement Basis	Units
Features	Portable Manually Operated Enviromantely Operated Compete with electric shredder	
Inexpensive	The unit must cost less than a \$100	\$
The shredder should have a small carbon footprint	The amount of carbon footprint does the shredder have	kg
The shredder has trash container	Size of the container	gallons
Shreds up to 10 pages together	The amount of paper the shredder can shred	# of papers
The shredder should have a noise level less than 65db	Noise level	db

# Constraints

- Environmentally friendly with minimum carbon footprint
- The design costs less than \$100.00 for fabrication
- Materials to shred: Papers, CDs, Credit cards
- Minimum of 10 sheets per feed
- Paper size: 8.5 x 11 in
- Speed: at least 36 pg/min
- Volume: max 5 ft<sup>3</sup>

# Current Mechanical Paper Shredders



The Premium Connection Paper Shredder [1]

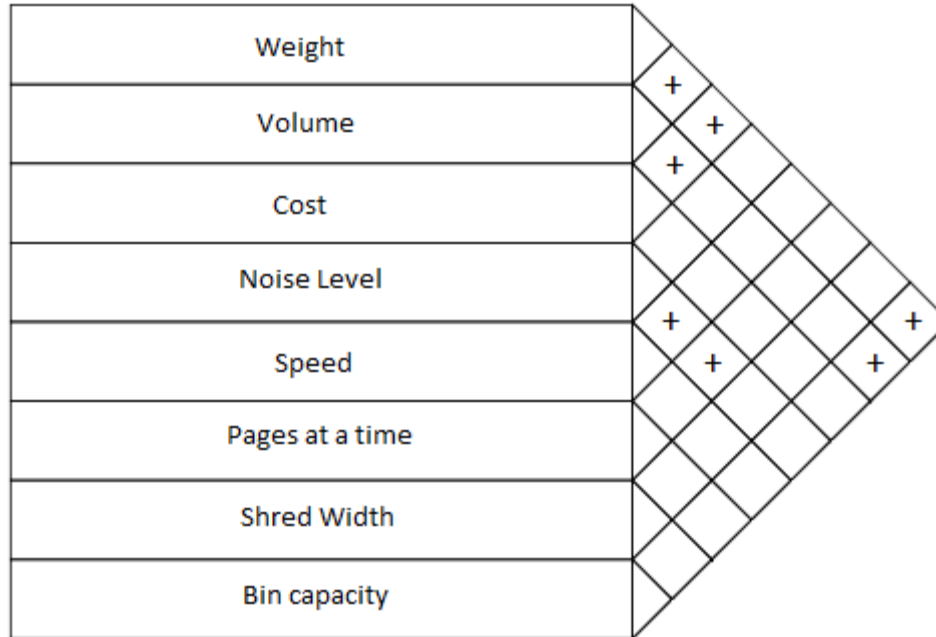


Manual Paper Shredder [2]

# Quality Function Deployment (QFD)

		Engineering Requirements								Competitors	
		Weight	Volume	Cost	Noise Level	Speed	Pages at a Time	Shred Width	Bin Capacity	Product 1	Product 2
Customer Requirements	Minimum Carbon Footprint		X								
	Reliable					X	X	X			
	Inexpensive	X	X	X					X	O	O
	All Mechanical System				X	X				O	O
	Cost Effective			X		X	X			O	
	Units	lbs	ft <sup>3</sup>	\$	db	Pages/Min	x Pages/Iteration	inches	gallons		
		20-25	5	100	65	36	10	0.25	5.25		

# House of Quality (HOQ)





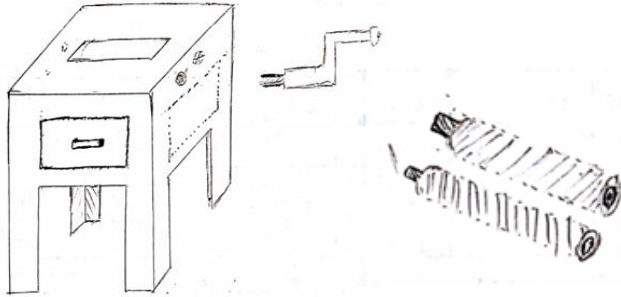
# Concept Generation

- Team developed a criteria to judge concepts
- Each member came up with two designs for the paper shredder
- Group meeting was held to discuss and share concepts
- Each member's decision matrix was compiled together to come up with final concepts

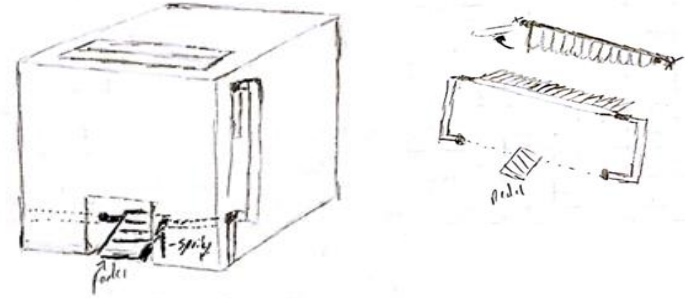
# Decision Matrix Criteria

- Reliability (15%)
- Cost Effective (13%)
- Materials (Shredded material+10 Pages) (13%)
- System Operation (11%)
- Volume (9%)
- Speed (8%)
- Ease of Use (7%)
- Stability (6%)
- Bin Size (5%)
- Shred Width (5%)
- Noise Level (4%)
- Portable (4%)

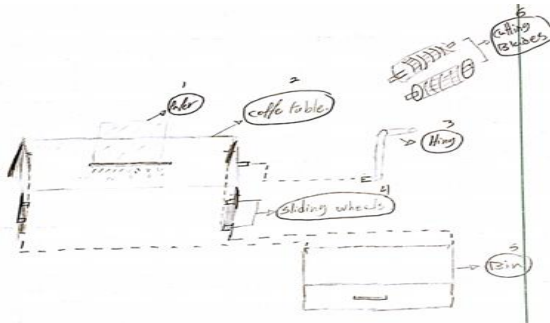
# Design 1



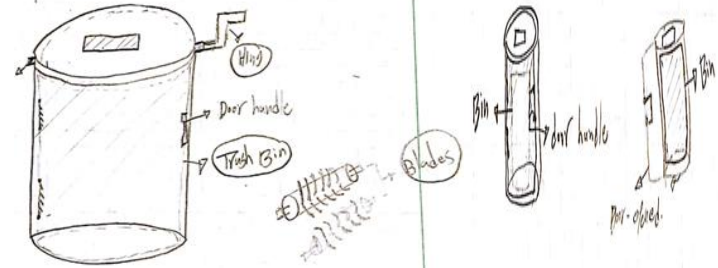
# Design 2



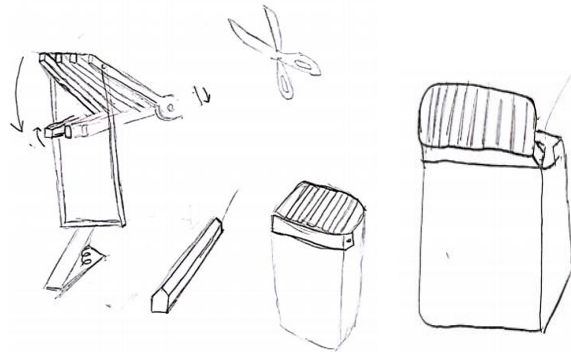
# Design 3



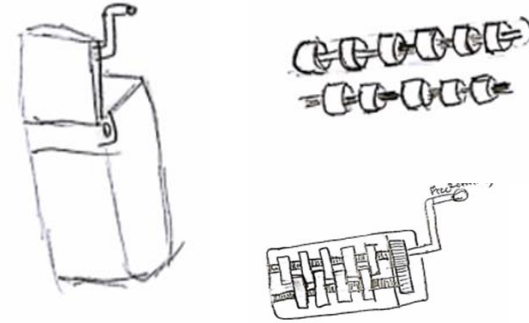
# Design 4



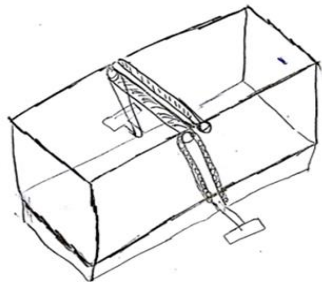
# Design 5



# Design 6



# Design 7



# Design 8

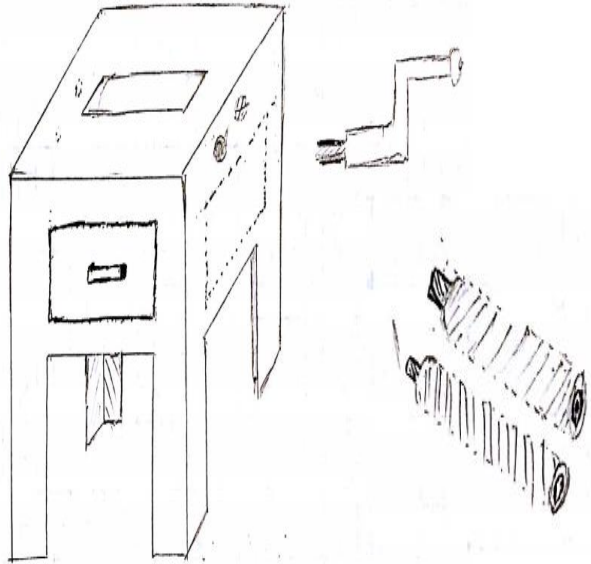


# Decision Matrix

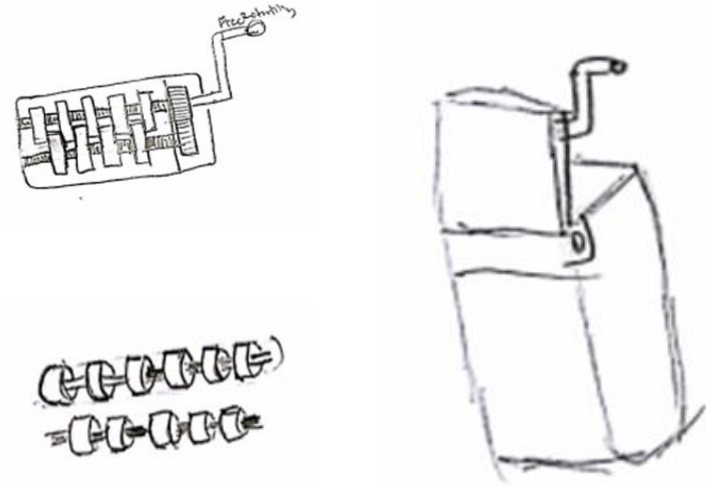
Group Decision Matrix Average								
	Design 1	Design 2	Design 3	Design 4	Design 5	Design 6	Design 7	Design 8
Reliability (15%)	1.2	0.975	1.0875	1.0875	1.0125	1.1625	1.0125	1.0125
Cost Effective (13%)	0.9425	0.8775	0.8775	0.9425	1.0075	1.04	0.8775	0.91
Materials (Shredded material+10 Pages) (13%)	1.0075	0.845	0.8775	0.8125	0.845	0.975	1.04	0.715
System Operation (11%)	0.88	0.825	0.825	0.825	0.825	0.88	0.825	0.6875
Volume (9%)	0.54	0.7425	0.5625	0.54	0.72	0.6975	0.5175	0.72
Speed (8%)	0.54	0.56	0.52	0.52	0.54	0.56	0.68	0.44
Ease of Use (7%)	0.6125	0.6125	0.5775	0.5775	0.6125	0.595	0.525	0.4725
Stability (6%)	0.51	0.465	0.465	0.405	0.465	0.45	0.435	0.3
Bin Size (5%)	0.2625	0.375	0.3375	0.325	0.4	0.3875	0.325	0.4
Shred Width (5%)	0.375	0.3625	0.375	0.35	0.3375	0.3625	0.4	0.35
Noise Level (4%)	0.28	0.29	0.27	0.26	0.29	0.27	0.26	0.24
Portable (4%)	0.26	0.26	0.24	0.31	0.35	0.34	0.24	0.34
<b>Total:</b>	<b>7.41</b>	<b>7.19</b>	<b>7.015</b>	<b>6.955</b>	<b>7.405</b>	<b>7.72</b>	<b>7.1375</b>	<b>6.5875</b>

# Final Concept Designs

Design 1



Design 6



# Final Product Design

- Retrofit an existing paper shredder to save money on custom parts
- Depending on the system that was bought, retrofitting a crank handle would be attached to work with the system
- Most time and money would be need to go towards retrofitting the shredder and developing the hand crank system

# Purchased Product

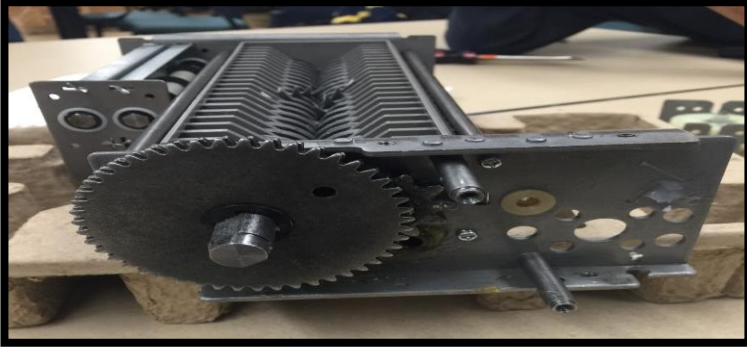
- AmazonBasics 12-Sheet Cross-Cut Paper, CD, and Credit Card Shredder
- Current Price on Amazon: \$54.99
- 8.9in x 12.5in x 15.7in system  
~1.01 ft<sup>3</sup>
- 4.8 Gallon Bin



AmazonBasics Paper Shredder [3]



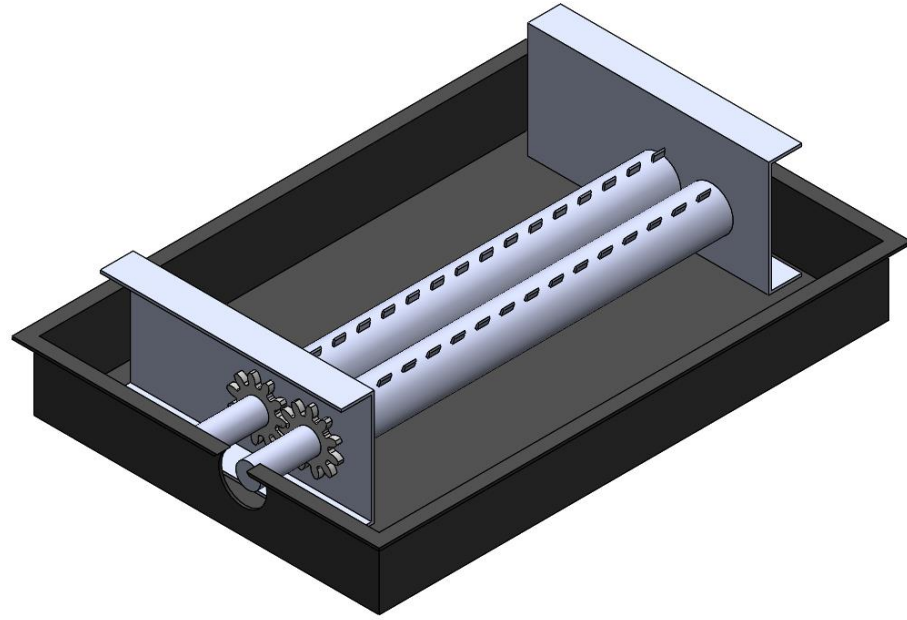
# Internal Shredder Design

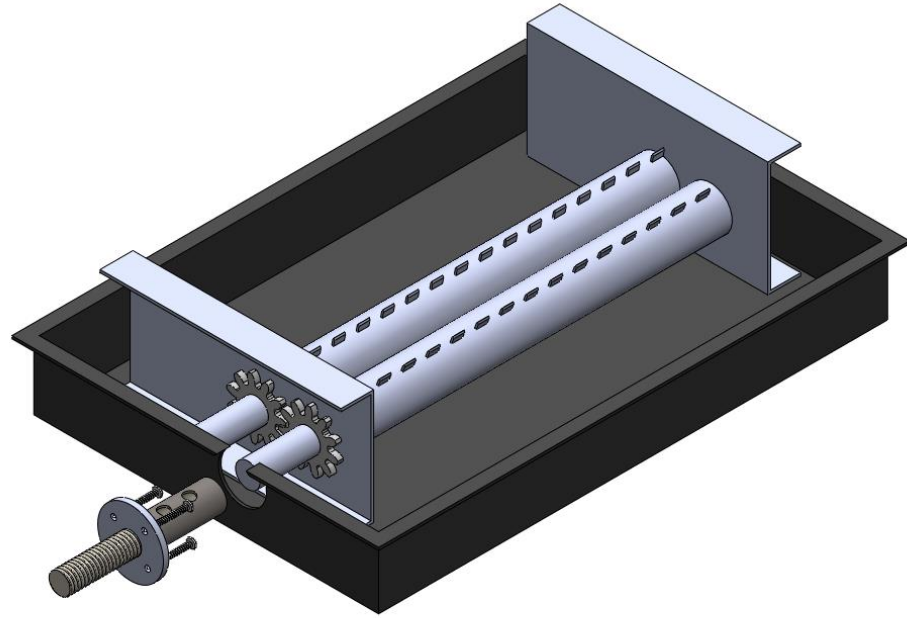


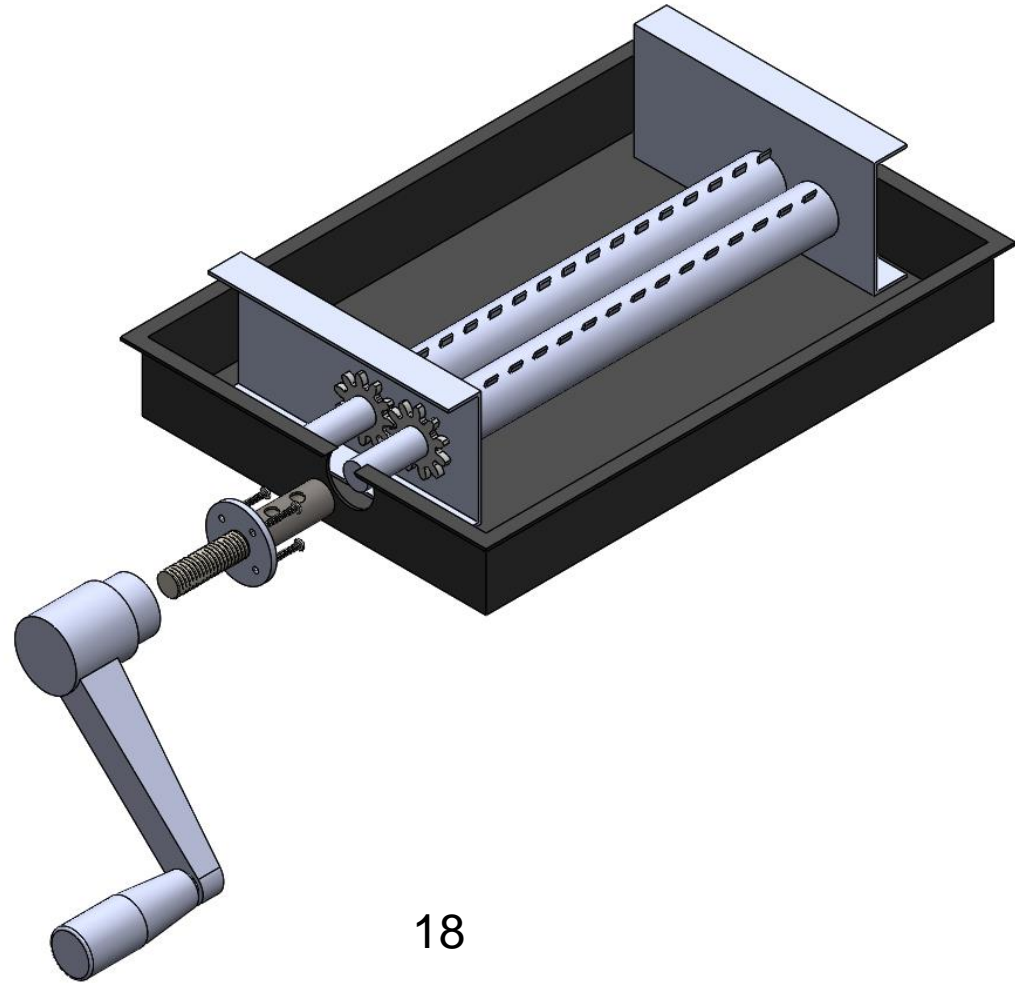
# New Design Concept

- Handle will be attached directly to main shaft.
- Motor shaft arbor extension will be used to extend shaft outside of system to the hand crank.









18

Meyer

# Hand Crank With Revolving Handle

- Thread Size:  $\frac{1}{2}$  in – 13 in<sup>-1</sup>
- Overall Length: 7.29 in
- Material: Glass-Fibre Reinforced Technopolymer



Crank Handle With Revolving Handle [4]

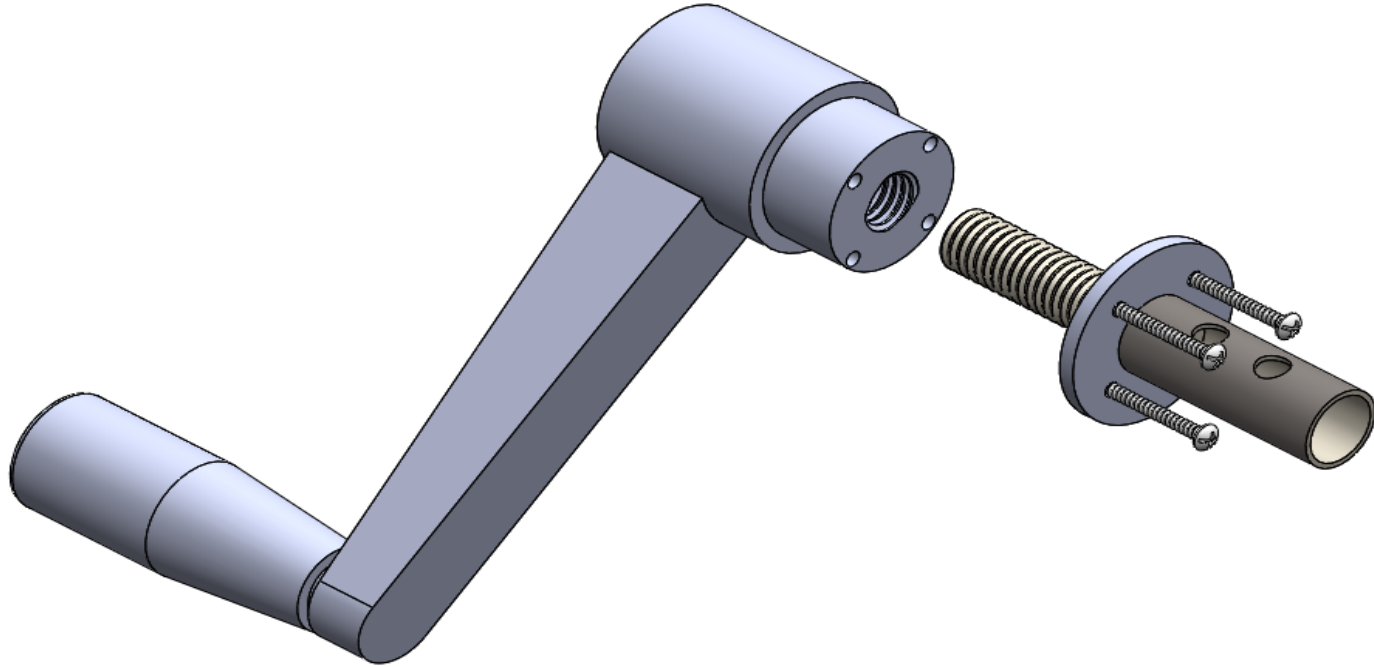
# Motor Shaft Arbor Extension

- Bore Diameter:  $\frac{1}{2}$  in
- Wheel Arbor Size:  $\frac{1}{2}$  in – 20 in<sup>-1</sup>
- Overall Length: 3  $\frac{1}{2}$  in



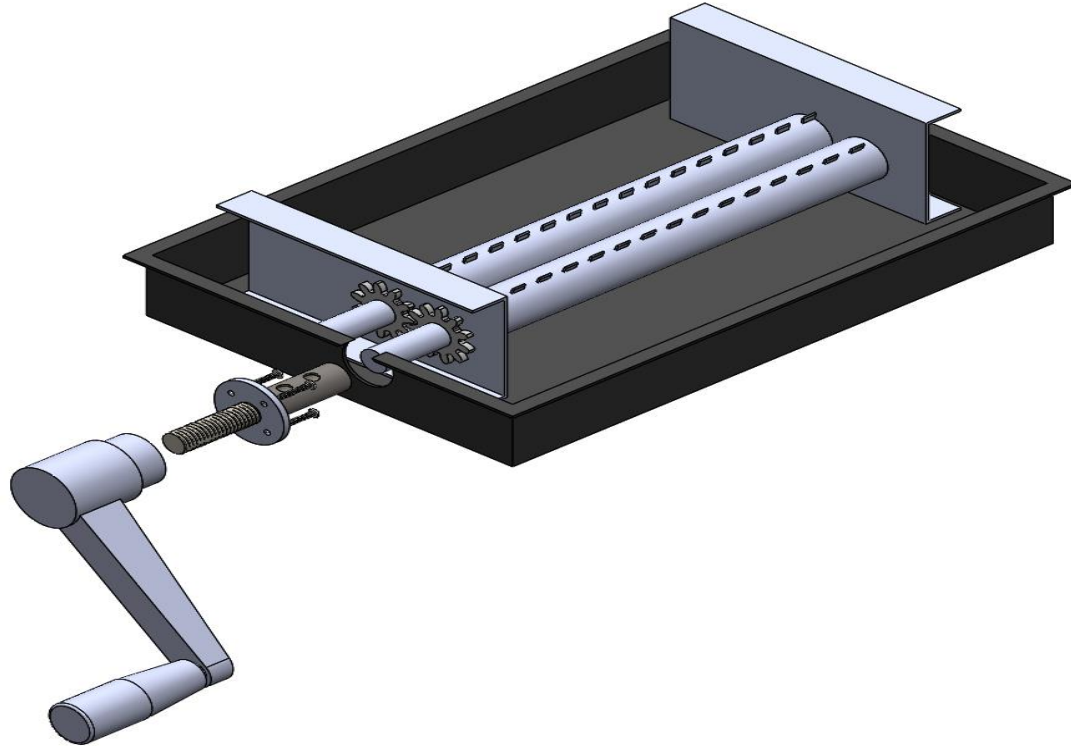
Arbor Shaft Extension from McMaster [5]

# Hand Crank Design





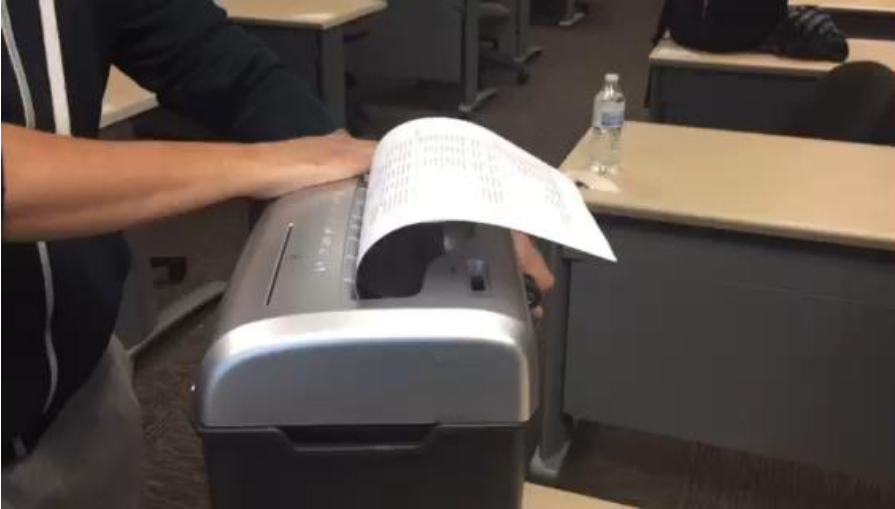
# Final Design



# List of Parts and Prices

Parts	Price
AmazonBasics 12-Sheet Cross-Cut Paper, CD, and Credit Card Shredder [3]	\$54.99
½ in Arbor Attachments for Electric Motors [5]	\$6.06
Crank Handle with Revolving Handle [4]	\$29.21
10 in Bolt	\$1.50
<b>Total</b>	<b>\$91.76</b>

# Results and Demonstration



Objectives	Results
Inexpensive	\$91.76
36 pages/min	20 pg/min
10 Pages/Iteration	4 pg/iteration
Credit Card	Yes
CD	Yes

# Conclusion

- The team retrofitted a mechanical paper shredder from an electric paper shredder that is hand operated and does not require any of its previous electrical components
- The shredder works almost as effectively as the electrical paper shredder and fell below the allotted budget of \$100
- While this design requires work to use, it is efficient and fits well in an office setting

# References

- [1] Amazon. *Paper Shredder* [Online]. Available: <http://www.amazon.com/The-Premium-connection-290-SHRED-Shredder/dp/b006J99PQQ>
- [2] Better Living Through Design. *Manual Paper Shredder* [Online]. Available: <http://www.betterlivingthroughdesign.com/accessories/manual-paper-shredder/>
- [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>
- [4] MSC Industrial Supply Co. [Online]. Available: <http://www.mscdirect.com>
- [5] McMaster. *Arbor Attachments for Electronic Motors* [Online]. Available: <http://www.mcmaster.com/#motor-shaft-arbors/=wgpwmo>