

# Final Project Report

## I PRO 321

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## 1.0. Introduction

IPRO 321 consists of four groups working on four different aspects of the overall project. The four teams are gears, sound, safety and design. Each team has a different task at hand however they all have the same goal, to improve the overall function of the paper shredder.

## 2.0. Background

The IPRO 321 team is very diverse, however we have found a niche for each member and work as a team to complete the project. The majors range from Electrical Engineering to Chemical Engineering and even Engineering management.

## 3.0. Purpose and Objectives

Each Team had different objectives:

The gear team's objective was to evaluate the gears and minimize the gear failure at initial shredding cycle.

The sound team's objective was to reduce the general noise output with a target of 10db reduction.

The safety team's objective was to evaluate the different models and advise improvements to enhance the safety features to exceed the 2007 UL Standards.

Lastly, the design team's objective was to evaluate the current marketing offerings and price points and create new designs for a line of paper shredders.

## 4.0. Research Methodology

### 4.0.1. Purchase of a Fellowes Brand Paper Shredder

The IPRO team purchased a new paper shredder, by the leading company, to compare the functions, design, and operations with the current Royal brand machines.

### 4.0.2. Observations

The team has conducted numerous observations of the functionality of the paper shredder. Comparisons were made in the gear train system, the safety features as well as the sound output of the machine. It was concluded that the quality of the materials used to construct the machine were far superior to the Royal in both material type, as well as size of components. The Fellowes brand machine also had safety features that were not included in the Royal brand machine. The team used these observations to aid in improving the Royal brand machine.

### **4.0.3. Sessions with the Sponsor**

The team has met with the sponsor on three occasions to discuss existing issues with the shredders. The meetings were held at the main IIT campus and were organized as a questions and answers session among the sponsor, students, and the faculty. The sponsor supplied the IPRO team with a list of points they would like addressed, the team in turn took the list and divided into groups based on student background and topic difficulty.

### **4.0.4. Research**

The IPRO 321 sub teams did research in each of their field to find what types of solutions would be possible, and which may have possibly been patented. The safety team reviewed the Underwriters Laboratories (UL) paper shredder requirements. Based on the UL guidelines, a paper shredder wedge was fabricated to verify whether these machines would pass UL guidelines. This was important because these machines were not yet for sale in the United States. The gear team studied the existing gears and had them analyzed to see what types of plastic or metal they were made from. Based on these findings, search for better alternative materials to improve gear strength. The sound teams measured the sound of the various machines and researched to find the best sound dampening materials while keeping cost to a minimum. They also took many readings from the existing machines, compare them to the Fellowes brand as well as common noises. The designed team visited local office supply stores to view the competition, based on their findings, they tried to create a machine that would be attractive and fairly unique.

## **5.0. Assignments**

The IPRO 321 team was divided as following:

Jianyu Chen / Sounds Team  
Richard King / Sounds Team  
Julianna Kovacs / Design Team  
Chil-Woong Kwon / Design Team  
Gregory Mennenga / Sounds Team  
Donald Myers / Sounds Team  
Raisa Pelae / Safety Team  
Garrett Strassler / Safety Team  
Michael Tomsa / Gear Team  
Dmitriy Zverev / Gear Team

In result of all of the efforts of the team the following results were achieved:

- Graphs for proposed solution of the issues identified
- Research analysis
- Recommendations for the sponsor

## 6.0. Obstacles

- Engineering is done offshore
- Lack of design specs
- Lack of part ratings
- Lack of readily available test equipment and the need to construct custom testing rigs
- Solution to a current problem affecting a product on the market
- IPRO team was only supplied one of each model, this made it difficult to do multiple tests at a time

## 7.0. Results

*The Paper Shredder team determined the following:*

- Sound mainly cause of use of universal motor/noisy gears
- Addition of a touch sensor
- Insulation to soften the noise
- Initial spike in current leading to high initial torque broke the gears
- Different materials used in plastic gears to improve performance
  - Glass filled Nylon
- Correlation between current and torque
- The brittle and high strain failures have the same low end value for torque

## 8.0. Recommendations

### **Gears**

-Plastic Gears

-Lengthen Motor Worm/widen helical gear

-Upgrade the material to glass-filled nylon

Metal Gears

-Change shape of center hole on metal gear

-Heat-treat the gear to increase hardness

### **Safety**

-Capacitive Touch Sensor:

-Detects Human Touch through change in Capacitance

Based on design ideas from edn.com

### **Sound**

-Active Noise Cancellation

-High cost

-Passive Noise Correction

- Noise is from the motor vibration
  - Addition of a flywheel
  - Noise Dampening
  - Noise transmitted through case and out from throat
- Recommend angled or shielded throat.

### ***Design***

Alternative designs based on modern trends

## **9.0. Future Plans**

The team will present the final conclusions reached by the various methodologies conducted, research, and failure results to the sponsor, The Manhattan Group. It has already been decided that the IPRO will continue to the following semester. That team will be responsible for expanding upon this team's findings.

## **10.0. Acknowledgements**

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