Automatic Paper Ream Opener Experimental Results and Discussion

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Activity Report

1 Experimental Design

The experiment aimed to answer two questions:

Will a disabled employee be able to operate the apparatus after a 10 minute training brief and is the device safe and easy to use?

The previous experimental design aimed to gather data using the following metrics:

- **Quality laceration success rate**
- **Ease of use rating from employees on a ten integer scale**
- **Safety rating from employees on a ten integer scale**

Data was sought to be collected by having disabled employees perform the task of opening 50 reams of paper using the automated device after a 10 minute training session. The employees would be surveyed for feedback on the ease of use and safety of the apparatus. The number of paper reams put through the device would the independent variable, while the number of quality lacerations would the dependent variable.

The device aimed to control for safety by fully covering the razor blades utilized in the device, making them inaccessible to the user. The success of the experiment will be determined based on the number of paper reams that the disabled employee is able to open using the device. Any result greater than zero will be deemed as successful, since employees were previously not allowed to open reams due to physical dexterity and safety concerns.

Ultimately, a disabled worker was given the task of opening two boxes of reams which amounted to 20 reams of paper. Due to time restrictions imposed on the workers, implementing a formal examination survey at the conclusion of their testing was deemed inappropriate. As such, verbal feedback during their testing was extremely valuable and essentially quantified the latter two metrics without the use of a survey.

2 Results

The apparatus underwent rigorous testing with a mass amount of paper reams. The tests were conducted meticulously, pushing the machine to its limits,with the goal of showcasing exceptional reliability and efficiency. The table displayed in Figure 1 captures a snippet of the first thirteen tests performed and some brief comments concerning each individual test. Furthermore, the entirety of the testing log is visually depicted within Figure 2.

3 Discussion

From the experimental data gathered, it is evident that implemented design is largely successful. To quantify a percentage, out of the 130 paper reams opened, only 7 had issues that prevented the ream from being opened

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Test/Ream #	Left Lasceration Quality	Right Lasceration Quality	Center Lasceration Quality	Additional Notes	Blades Changed/Snapped	Ream Type
1	Excellent	Excellent	Missed	Center Blade needed to be adjusted.	YES	Soporset
2	Excellent	Excellent	Excellent	N/A	NO	Soporset
3	Excellent	Excellent	Excellent	Phenemonal Test	NO	Soporset
4	Poor	Excellent	Excellent	Left Cut Failed, got stuck within paper	NO	Soporset
5	Excellent	Excellent	Excellent	Phenemonal Test	NO	Soporset
6	Excellent	Excellent	Excellent	Phenemonal Test	NO	Soporset
7	Excellent	Excellent	Excellent	Initial Cut was barely visible on right side but after 5cm it began to cut normally. Gravity of the paper when removing the ream, made this not an issue.	NO	Soporset
8	Excellent	Excellent	Excellent	Simply Beautiful	NO	Soporset
9	Excellent	Excellent	Excellent	Phenemonal Test	NO	Domtar Copy
10	Excellent	Excellent	Excellent	Phenemonal Test	NO	Domtar Copy
11	Excellent	Excellent	Excellent	Phenemonal Test	NO	Domtar Copy
12	Excellent	Excellent	Excellent	Disclaimer: This test we set the current to the central motor to the lowest possible. In order to reduce the heat dissipated by the motor. SW123: ON ON ON	NO	Domtar Copy
13	Excellent	Excellent	Excellent	Disclaimer: This test we set the current to the central motor to the second lowest setting. In order to reduce the heat dissipated by the motor. SW123:	NO	Domtar Copy

Figure 1. Data portion of the testing log. The earlier trials were the most informative and utilizing this knowledge the necessary adjustments were performed. Subsequently the latter tests have an overwhelming theme of success.

completely. This translates to a success rate of roughly 95 percent which effectively satisfies the initial metric to achieve a quality laceration success rate. From verbal feedback gathered from employees at the facility, the latter metrics of safety and ease of use also received high marks.

3.1 Limitations & Future Work

Although the implemented design is largely successful, there are several aspects that can be improved if time constraints were not an issue. Observe:

- **Smaller Scale:** Although not a major concern considering the mailing facility has dedicated a cart for transportation of the device, having a smaller device could alleviate concerns about portability and overall system complexity.
- **User-Friendly Features:** Incorporating an LCD screen alongside LEDs could greatly improve ease of use and accessibility by making the design generally more pleasant to interact with.
- **Removal of Outside Layer:** The current implementation relies on three stepper motor controlled blades that cut adjacent sides of the ream but must be removed by the user. Future implementations could implement a more sophisticated model capable of removing this outside layer.

4 Conclusion

The automated paper ream was designed to address the issue of disabled employees who were unable to open paper reams by hand due to dexterity issues. To solve this problem, the machine was created such that the user only needed to place the packaged paper ream into

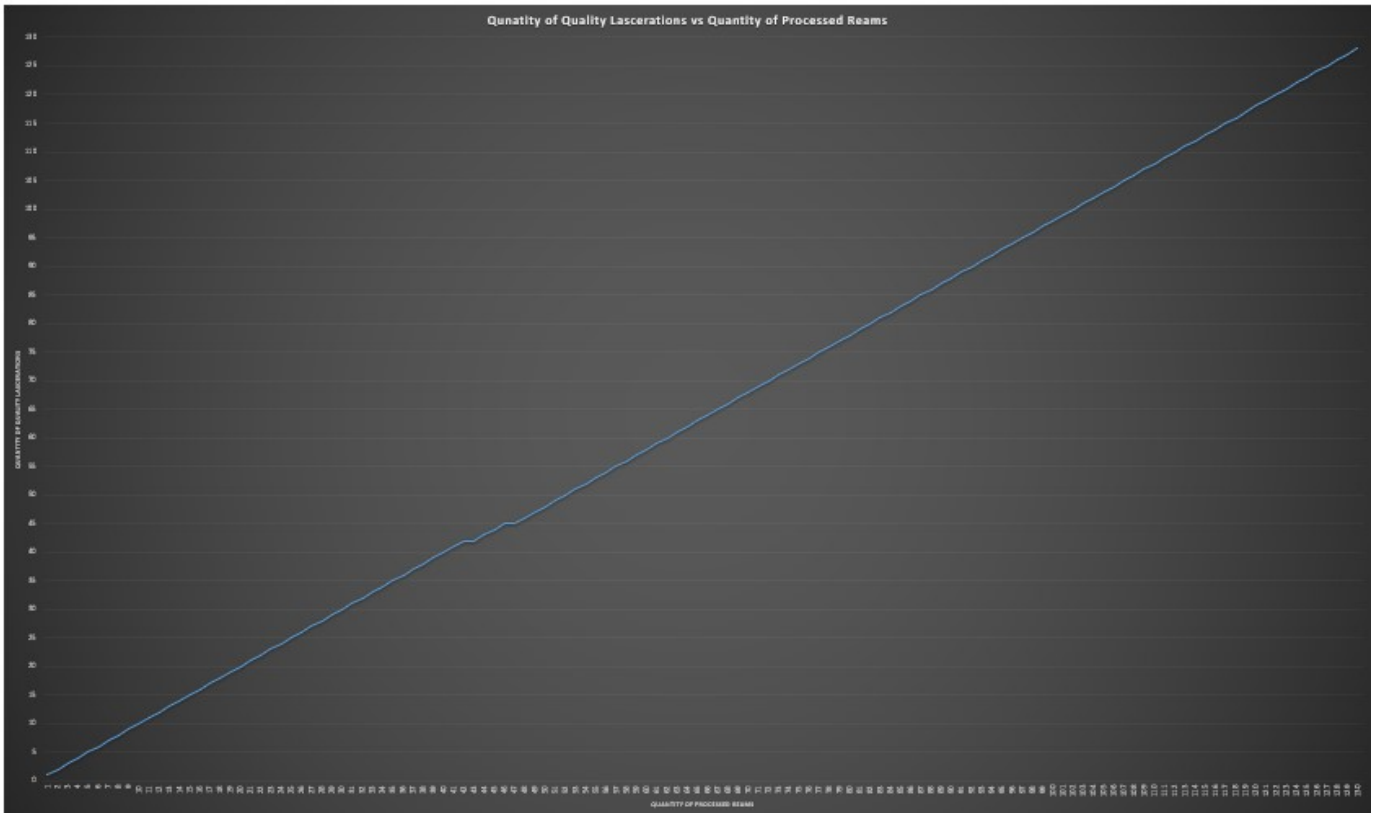

Figure 2. Visual depiction of the current data within the cumulative testing log.

the machine's drawer and press the go button. The machine contains three blades that apply cuts on three sides of the paper ream, making it easy for the user to remove the package by flicking the paper ream and pulling it apart.

Ensuring the safety of the machine's users was a primary concern during its development. The machine's blades and motors are completely enclosed, ensuring that there is no way for the user to put their hand inside the machine while it's operating. Additionally, an emergency stop button was included to disable the machine from running and stop every stepper motor inside the machine the moment it is pressed. Once pressed, the user can restart the machine by pressing the go button, and the machine will restart in the same state as it was when the emergency stop button was pressed.

Key accomplishments include providing opportunities for disabled employees being unable to open paper reams due to dexterity issues and ensuring the safety of the machine's users through the inclusion of safety features such as fully enclosed blades and an emergency stop button.