Spin n’ Trim

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Introduction

Recreational marijuana dispensaries officially opened in Massachusetts on November 20, 2018 with 42 dispensaries approved for sales[1] as of December 5, 2018. The process of growing and selling cannabis to these dispensaries can be broken down into the following steps, the details of which vary from farmer to farmer:

1. Growing the plant
2. Trimming and curing of stalks
3. Removal of flowers from stalks
4. Trimming sugar leaves off of flowers

Addressing step 4, there exist several different methods for trimming sugar leaves. Typical industry quality standards require that each of these methods meet two main requirements.

First, cannabis buds should be "hedge-trimmed." Like trimming a hedge, only the parts of sugar leaves that protrude out of the bud should be trimmed, not whole leaves. The goal is to leave behind a lumpy but smooth shape. Automated trimming machines are useful and several options exist, but these tend to produce buds of uniform shapes. This regularity is seen as unappealing because buds look mass-produced.

Second, buds must experience a minimal amount of damage. As much of the original plant as possible should remain intact. It is undesirable to trim off any of the flower or shake off any trichomes. Trichomes are small, sticky crystals that form on bud leaves and are considered to increase the plant potency.

Another challenge inherent to trimming is that the trimming device will inevitably gather a sticky coating from contact with trichomes. This causes machines to slow down and necessitates frequent cleaning, which slows down production.

[1] https://www.mass.gov/service-details/massachusetts-medical-use-of-marijuana-program-snapshot

Scissors are the current standard for trimming tools. They are cheap and simple to use. Most importantly, they afford trimmers dexterity and tactile sensation; they feel like an extension of the hand. This enables trimmers to pinpoint protruding sugar leaves and accurately and gently snip them, creating high-quality buds without damaging the plant. However, scissors are not without their drawbacks. They quickly become clogged with sticky trichomes, strain the hands of the trimmers using them, and require large numbers of workers. From our user interviews we obtained a benchmark for hand trimming of 3 pounds in a 16 hour workday. With an increased demand for large production volumes, hand-trimming operations become inefficient. The only reason they remain the preferred production method for large-scale, high-quality operations is that they are the only method capable of producing the quality necessary to sell to dispensaries. This leaves an opening in the cannabis market for a trimming tool capable of trimming faster than scissors while maintaining comparable dexterity and minimal cleaning time.

Process

Problem Statement

Our team's objective was to build a tool to improve the efficiency of the trimming process for industrial cannabis farmers, without sacrificing quality.

Motivation

This problem poses an interesting challenge as the cannabis industry is in the midst of expanding across the US. Recreational dispensaries are now open in Alaska, California, Colorado, Washington D.C., Maine, Massachusetts, Michigan, Nevada, Oregon, Vermont and Washington[2]. This fast-growing market prompts farmers to produce high quality cannabis at a faster rate than ever before. Given the varied legality of cannabis around the world, innovation in the industry has been somewhat restricted. There are a number of tools on the market, but the quality of many of these devices is questionable and there is still a uniform response from farmers that these existing products do not meet their needs.

Performing market research for this project proved challenging. Cannabis farmers tend to be private about farm locations and processes, and are not receptive to outsiders without an introduction. The industry is so lucrative that they risk being robbed of their product if their location is publicized. This secrecy means that most farms do not have comprehensive websites or information online. All of these factors create an untapped market for a better mechanical engineering solution to the cannabis trimming challenge.

Background

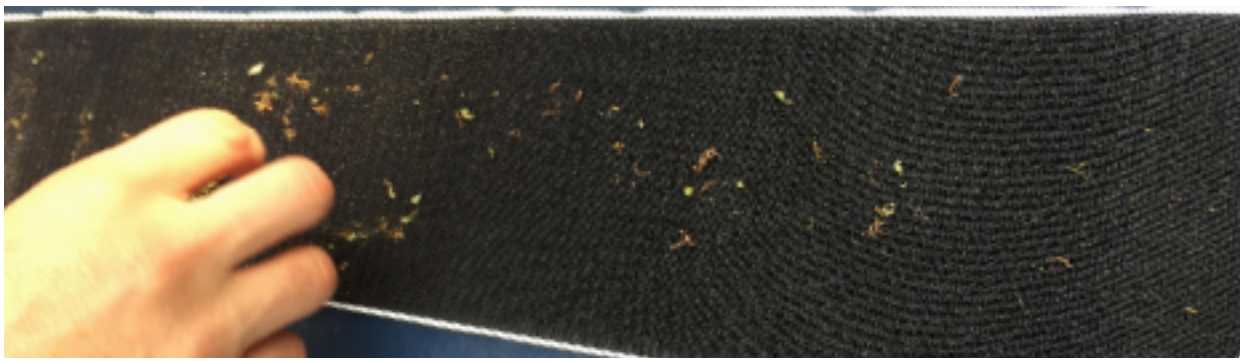
To begin our design process, we researched the existing approaches and technologies. Combined with information from a consultant, a farmer with a medium scale operation, we established a clear idea of the current market and the issues that these tools do not address. There is a wide range of existing solutions. Many large-scale automated trimmers utilize spinning blades or a tumbler to move around large quantities of flowers and only expose their leaves to a sharp trimming edge. Some smaller hand tools utilize a vacuum, or other forms of moving blades that can trim leaves faster than scissors. The large-scale tools tend to be too harsh on the bud, knocking off trichomes and around a third of the precious plant material

[2] https://www.businessinsider.com/where-can-you-can-legally-smoke-weed-2018-1#alaska-1

during the trimming process. This was the primary complaint of the consultant with whom we spoke. Additionally, many of the hand tools were fairly expensive and also did not provide as much control over trimming as standard scissors. Experienced trimmers prefer scissors in order to employ the greatest control over their trimming.

Brainstorming

Our consultant in the industry believed that existing trimmers utilizing sharp, fast-spinning blades could never produce "grade A" buds, so we initially decided to avoid blade designs. We did a lot of brainstorming thinking of creative ideas that did not include blades. Our top two contenders that we prototyped for were a freezing mechanism and a velcro mechanism.



The idea behind the freezing mechanism was that the flowers would be sprayed with water and then rolled on a very cold surface. We thought in the same way that your tongue sticks to a metal pole in the winter that the leaves of the flower would stick to the cold surface. Then, by rolling it on the cold surface, you the leaves would rip off the flower.

The main flaw with this design was that introducing water to the flower could lead issues with mold. Acetone could be a substitute, but it is more expensive. Another problem we encountered was the difficulty of scaling up this design. We made a mock version with six pounds of dry ice and 20 oz of acetone, but it was hard to keep the temperature stable and determine the "correct" amount of applied pressure in order to get the leaves to stick to the ice.

The second mechanism we considered was a slanted metallic velcro strip that the buds would roll down. While rolling down the strip, the leaves of the flower would get caught on the velcro hooks and be ripped off bud continued to roll down the incline. We eventually determined that this method would provide far too little control over the leaf removal. There is be a high likelihood that important flower material would

also be removed, or that leaves would remain on the plant even after descending down the ramp. Overall, this method provided too little control on the trimming outcome and we determined it was a dead end.

Final Design

Design Decisions

User interviews emphasized the requirement for the tool to allow for a hedge trimming technique. This drove us to settle on a design that incorporates a blade was this addressed both needs of effectiveness and trimming control. One existing design implements two "sheets" of blades that alternately rub against each other and allow for the cutting of product. Our team wanted to further improve on this design, specifically addressing 3 major shortcomings.

First, our design improves on the cleaning process. The nature of trimming cannabis always leads to the clogging or dirtying of the tool with plant residue, a major contributor to widespread use of tools other than scissors. A second contributor is the ease with which you can clean the tool. Our product is easily dismantled and allows for easy removal of the blades which can then the cleaned/replaced. With the future addition of a waste bucket, the cleanliness of the design further increases.

Second, our design is incredibly simple to use. We wanted to implement a "plug and play" approach to the design that could be used quickly and safely by anyone whether they have trimming experience or not, and added bonus for growers who do not have the time to teach seasonal trimmers how to use more complicated equipment.

Third, the cost of production is significantly lower than existing designs (the leading competitor is price between $4000 - $7500)[3] another bonus for growers who usually rely on seasonal trimmers that own their own pair of scissors.

Design Features

The current design features a large thrust bearing mounted to the rim of an aluminium cylinder (a large braising pot) to allow the top blade to remain stationary while the bottom blade spins. We wanted the top blade to be stationary so that the user can leave buds on the surface of the top blade, and they will sit still rather than spinning off of the surface. The bottom blade is driven by a rubber wheel powered by a geared DC motor. This wheel is pressed against the side of the top side of the thrust bearing by a simple spring device. The configuration with the motor on the outside of the container was chosen because there are trimmings and dust falling into the reservoir in the middle of the device (which in a future version may include a removable plastic bucket for trimmings).

To remove the blades, all the user has to do is turn the handle on the shaft in the middle of the top blade, and pull upward. When the shaft is correctly positioned relative to the housing, which is mounted to the bottom of the pot using angle brackets, the shaft can be removed completely, and the top blade will come

[3] http://ultratrimmer.com

along with it. The user can then take the top blade off of the shaft, and remove the bottom blade from its housing, both by hand. This process takes seconds, and then the user can switch the blades out to clean the other set. This keeps the device from losing almost any time to cleaning.

Final Testing



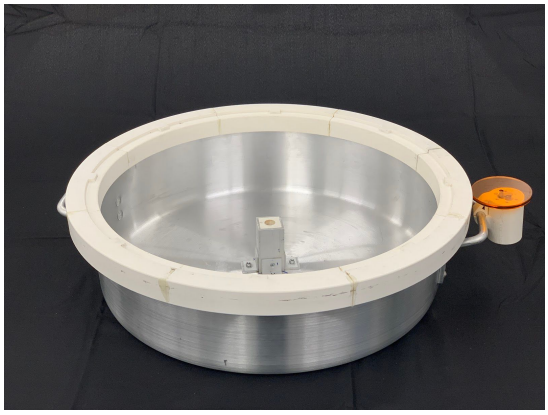

Next Steps

To improve the efficiency of our product, our team would seek out users that would be willing to test the machine. We would find farmers who sell their product to dispensaries, have them use our product and conduct feedback interviews. Some improvements could also be made to the action of the device. To increase the reliability of the rotation, we would pick a more powerful motor and reduce friction further in the setup to attain more consistent rotations.The addition of a waste bucket that would be placed under the blades. This is a simple plastic design that was unable to be implemented due to time constraints. Obtain higher quality blades. The tension mechanism that keeps our two blades flush with each other was also causing some asymmetric bending of the blades

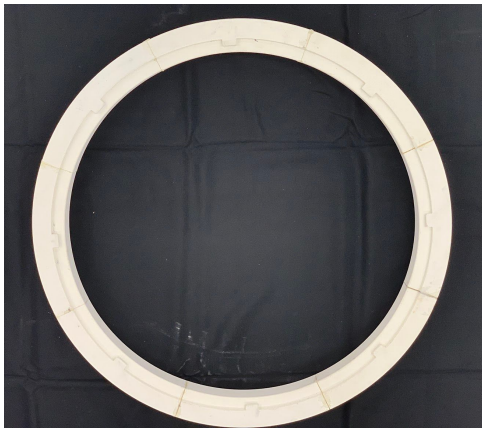
Appendix

Final Build Components

1. Metal pot

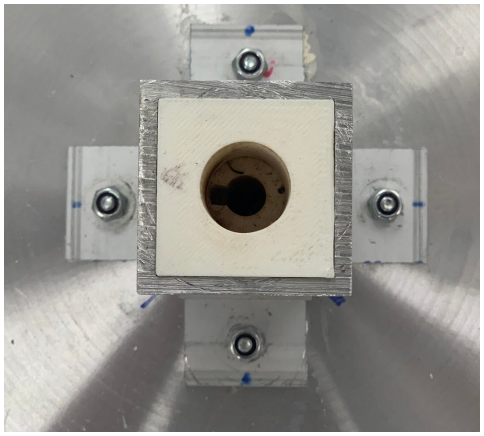


2. Blade carrier

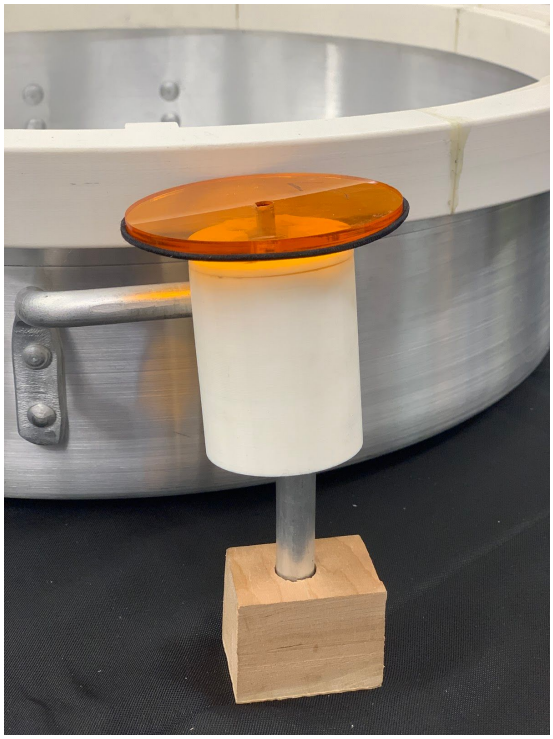


3. Bearings and bearing spacer

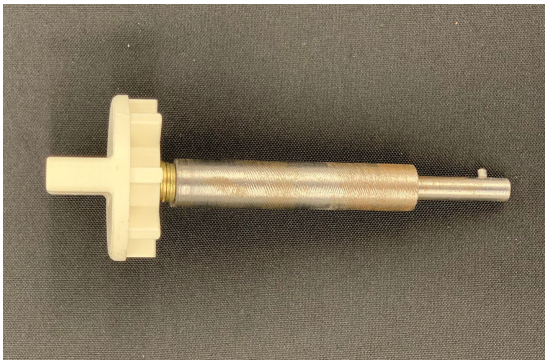
4. T slot at the bottom (square tube holder)



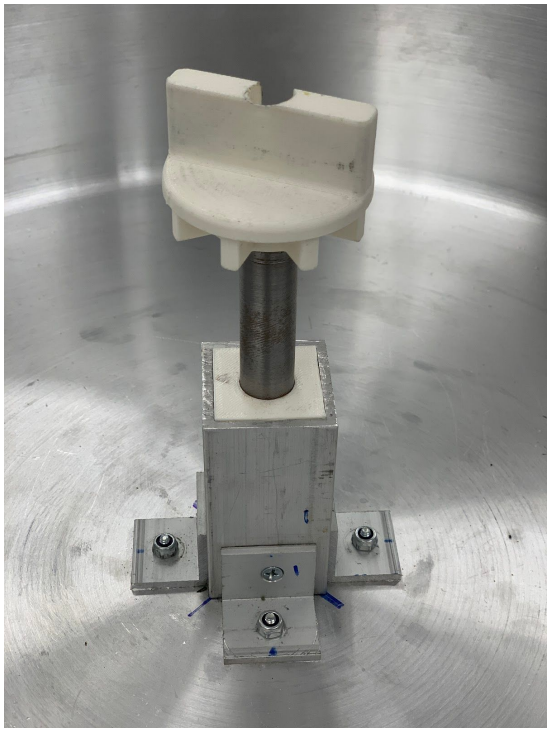
5. Motor, motor carriage, driving wheel



6. Shaft



7. Shaft cap



8. Blades one and two