Team 58:
Snip Happens

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Executive summary

The apple industry faces a major bottleneck in post-harvest processing: manual stem clipping, a labor-intensive step required to prevent bruising during transport. "Snip Happens" is an automated apple stem clipping system that leverages advanced mechanical engineering and computer vision to precisely detect and trim stems, reducing labor costs by up to 70% and enhancing fruit quality and market value.

By automating this process, our solution can potentially save $200M annually for apple growers by minimizing labor dependency and reducing post-harvest losses. Our system is adaptable for apple varieties of various sizes (2.25–4 inches), making it scalable for all growers. We are collaborating with Tom Zhang's startup, Daxo Industries, to integrate our technology into existing fruit processing workflows.

In addition to labor savings, our system enhances produce quality, increasing growers' access to premium markets. The system's potential in real-time data logging on apple weight, size, and condition also aligns with precision agriculture trends, allowing farmers to optimize production based on collected insights.

Since our initial concept, we have fully completed the software pipeline, including:

1. Segmenting apples for recognition,
2. Identifying apple center and stem with trained YOLO-v8 algorithm,
3. Applying circle fitting for precise geometry analysis,
4. Calculating angular error for alignment correction,
5. Transforming error into angular velocity and motor timing for accurate clipping.

We have also gone through multiple iterations of the mechanical structure, such as:

1. Recutting and calibrating the support structure for the 3D printed wheel and omni wheels to support the ball bearings,
2. Finalizing the angle between the 3D printed wheel and omni wheels for the most efficient apple rotation, and
3. Adding support for motors and integrated fixing structure for cameras.

We are currently working on final details such as ordering additional necessary parts, fine-tuning and recutting parts of the structure, and integrating the stem clipper with the structure that rotates the apple. We are also performing

hardware-software integration and are on track to finish within the next 3 weeks. The next steps include full-system testing and validation in collaboration with Daxo Industries and the demo video is here.

Value Proposition Summary

Please see full detail in the previous report.

"Snip Happens" provides a transformative solution for the apple industry by replacing a high-cost, labor-intensive process with a scalable, automated system. Manual clipping represents one of the most expensive components of post-harvest handling, and with labor shortages becoming a growing issue, automation presents an economically viable alternative. Our solution significantly reduces labor dependency while ensuring consistent, high-precision clipping, leading to improved produce quality and greater profitability for growers. By reducing bruising and damage, apples maintain their premium-grade status, allowing growers to command higher prices and access more lucrative markets.

Beyond labor efficiency, "Snip Happens" aims to integrate data-driven insights by tracking apple size, weight, and condition, allowing growers to optimize sorting and pricing decisions. Additionally, the system's adaptability ensures compatibility with different apple varieties and various operational scales, making it suitable for both small farms and large-scale commercial orchards.

Stakeholders Summary

Please see full detail in the previous report

The primary stakeholders for "Snip Happens" are apple growers and producers, who stand to benefit the most from cost reductions and efficiency improvements through precision agriculture. By automating stem clipping, growers can significantly lower labor expenses and reduce waste from damaged apples, directly impacting their bottom line. Retailers and wholesalers also benefit as they receive higher-quality apples that are less likely to be bruised, leading to greater market consistency and reduced losses from unsellable fruit.

On the manufacturing side, agricultural equipment producers represent an important secondary stakeholder. Partnering with them can help scale production and distribution, integrating our system into broader automation solutions for the farming sector. Additionally, regulatory bodies and industry groups play a role in ensuring compliance with agricultural automation standards and promoting innovation within the industry.

Market Research Summary

Please see full detail in the previous report

The global apple market is valued at $101 billion, with the U.S. contributing approximately $23 billion to this industry. Labor remains one of the largest cost drivers for apple growers, accounting for up to 25% of total production costs, with wages for apple pickers ranging between $10–$12 per hour. However, after accounting for overhead costs such as housing, transportation, and regulatory compliance, the effective labor cost rises to approximately $17–$18 per worker hour. With increasing minimum wage policies and labor shortages, automation in post-harvest processing is becoming an urgent need to ensure profitability and sustainability for apple growers (USDA ERS).

In the U.S., over 27,000 apple farms operate across all 50 states, collectively managing approximately 382,000 acres of apple orchards (US Apple). These growers typically rely on migrant workers from Mexico and Central America, who work 11–13 hours per day during peak harvest seasons. Once harvested, apples are sent to regional packers, where they are graded based on dimensions, appearance, and damage levels. Apple growers receive revenue based on the USDA Apple Grades, with higher-grade apples commanding significantly better prices. However, bruising caused by improper handling and untrimmed stems results in lower grading, pushing apples into the low-margin juice or processing category, which often yields negative net returns after processing fees.

Apple varieties such as Honeycrisp, Gala, and Fuji, which are among the most valuable in the market, require careful handling to maximize shelf appeal and market pricing. Removing stems from apples significantly reduces bruising and improves the overall condition, directly impacting growers' profitability and supply chain efficiency. With machine learning driven automation, our product enhances the percentage of apples that qualify for premium pricing while reducing the reliance on seasonal labor, making it a highly valuable addition to the apple processing workflow in precision agriculture.

Targeted Customer Segment

Our automated apple stem clipping system is designed to serve a broad spectrum of commercial apple growers, spanning both vertically integrated operations and non-verticalized independent farms.

For vertically integrated growers—such as large-scale operations that control the entire supply chain from cultivation to packaging and distribution—our system offers immediate ROI by reducing manual labor requirements during post-harvest processing, which is often a major cost center. These operations typically

manage extensive volumes, and integrating our system can significantly streamline throughput, improve consistency, and enhance the quality of apples entering premium retail channels or export markets.

For non-verticalized growers, especially mid-sized and small farms that rely on third-party packers or cooperatives for post-harvest handling, the system presents a path to cost savings and quality improvements that directly influence market competitiveness. These growers often face greater labor constraints and seasonal bottlenecks—our compact, adaptable system reduces dependency on scarce manual labor and enables consistent stem clipping that minimizes bruising and rejections during grading.

We are particularly targeting growers in Washington State, New York, and Michigan, which together account for over 70% of U.S. apple production, as well as emerging high-tech orchards across Canada, Europe, and South America where labor shortages and quality requirements are increasingly driving demand for automation.

Our modular, variety-agnostic design (compatible with apple diameters ranging from 2.25" to 4") also makes it ideal for operations growing multiple cultivars, such as Honeycrisp, Gala, Fuji, and Red Delicious, where stem length and fragility vary. Additionally, we anticipate strong interest from cooperative packing houses, ag-tech equipment distributors, and government-supported agricultural innovation programs focused on boosting efficiency in specialty crop production.

Competition

Please see full detail in the previous report

Competitor	Approach	Weaknesses	Snip Happens Advantage
Manual Labor	Traditional human stem clipping	• Expensive • labor shortages • Inconsistent quality	• Full automation • Cost reduction • Consistency
ClipTech	Conveyor-based automated clipping	• Lacks precision, • No computer vision • High Capex	• Uses AI-powered vision for precise clipping
Mechanical Harvesters (Oxbo)	Large-scale automation for picking	• Does not address post-harvest clipping	• Complements existing harvest automation

Our product is made to revolutionize the apple industry by introducing the first fully automated stem-clipping system, eliminating the need for manual labor in this critical post-harvest process. While existing technologies, such as the advanced.farm robotic harvesters, have made strides in automating apple picking, they still require human intervention for tasks like stem clipping. For instance, these robots utilize mechanical arms to harvest apples but depend on human operators to clip stems, as this function has not yet been automated. Our technology offers a comprehensive solution that automates the entire process, setting a new industry standard. Its advanced integration of computer vision and machine learning ensures precise adaptation to varying apple sizes and conditions, making it an essential tool for both large-scale orchards and smaller farms.

Cost and Revenue Model

Pricing

We propose our pricing based on cost savings for the apple growers. The savings come from two parts: (1) direct labor cost savings from automating the apple stem slipping process, and (2) reduced damage by using our machine to clip apples that would otherwise not be clipped due to labor constraints. We calculate the total savings per machine based on the expected throughput, then price each machine at 50% of the cost savings. The pricing model is attached below:

Pricing Model		
Cost of manual labor		
Days migrant worker is hired during harvest season	60	-> agricultural dept data
Accomodation cost per night	50	
Flights from Mexico / Hondurus	300	
Hourly wage of picker	14	-> agricultural dept data
Hours worked per day	11	-> agricultural dept data
Total cost per worker per day	209	
Cost savings from automating apple clipping		
Time spent picking apple stems as % of total time	20%	
Total cost of stem picking per worker per day	41.8	
Apples picked per day per worker	30000	-> 10 boxes at 1000 pounds each, assuming average apple weight of 0.33 lbs
Throughput of apple picking machine per day	8640	-> 5 seconds per apple, working 12 hours / day
Cost savings per day	**12.0**	
Cost savings per season	**722.3**	
Cost savings by clipping currently unclipped apples		
Lbs damaged per worker per season	6615.0	-> Daxo internal estimate
Crop value of apples per lbs	0.3	
Value of damage	423.4	-> assuming 20% packing house marginal damage charge
Loss prevented by each clipping machine	**121.9**	
Total cost savings per machine	844.2	
Proposed price as % of cost savings	50%	-> industry norm
Proposed ASP	**422.1**	

We expect the useful life of our product to be around one year due to the heavy workload required during harvesting season. Therefore we are assuming we will sell new units to each grower every new season.

Cost

A complete cost analysis of one unit of MVP product is provided as follow:

Raw Material	Unit Price	Units Required	Total
Motor	50	3	150
Omni wheels	20	2	40
Shafts	10	3	30
Laser cutting materials	50	1	50
Rasperry Pi and battery	80	1	80
Camera	20	2	40
Custom ordered parts (incl. ball bearings, T slotted framing nuts, etc.)	100	1	100
Total			490
Cost after mass production as % of MVP cost			40%
Cost after mass production			**196.0**

Transitioning to mass production and establishing an assembly line are projected to significantly reduce per-unit costs. By sourcing components directly from manufacturers, rather than intermediaries like McMaster-Carr, we can capitalize on bulk purchasing discounts and economies of scale. For example, procuring Raspberry Pi units and shafts directly from factories is expected to lower expenses substantially. While precise figures necessitate further analysis, it's reasonable to anticipate a per-unit cost reduction of 60% when scaling from prototype to mass production. This projection is based on potential savings from direct sourcing and shared operational expenses. Applying this reduction to the initial $490 per-unit cost suggests a potential decrease to approximately $196 per unit.

Further cost assumptions are provided below:

Average selling price	**422.1**
Raw material cost	196.0
Manufacturing cost	2.4
Shipping from China to US end customer	40.0
COGS per unit	238.4
Gross profit per unit	**183.7**
Gross margin	**43.5%**

We forecast our revenue using a top down approach and by assuming a growing penetration rate of the existing customer base Tom has. See the complete revenue build below:

All numbers in USD except otherwise noted

	2025	2026	2027	2028	2029
US apple production (billion lbs)	9.5	9.5	9.5	9.5	9.5
US apple production (billion units)	28.8	28.8	28.8	28.8	28.8
% requiring stem slipping	20%	20%	20%	20%	20%
Stem slipping apples (billion units)	5.8	5.8	5.8	5.8	5.8
Throughput of machine per season	518400	518400	518400	518400	518400
Number of machines demanded	11106	11106	11106	11106	11106
DAXO penetration	20%	30%	40%	50%	60%
Automated stem clipping penetration	10%	50%	90%	90%	90%
Automated clipper units sold	222	1666	3998	4998	5997
ASP	422	435	448	461	475
Revenue	93,764	724,327	1,790,537	2,305,316	2,849,371
Growth rate		*673%*	*147%*	*29%*	*24%*

The other expense items are reflected in our income statement below:

	2025	2026	2027	2028	2029
Revenue	93,764	724,327	1,790,537	2,305,316	2,849,371
YoY growth		*673%*	*147%*	*29%*	*24%*
ASP	422	435	448	461	475
Units sold	222	1,666	3,998	4,998	5,997
Unit cost	238	246	253	261	268
COGS	52,955	409,081	1,011,248	1,301,982	1,609,250
Gross Profit	**$40,809**	**$315,246**	**$779,288**	**$1,003,334**	**$1,240,121**
Gross Margin	*43.5%*	*43.5%*	*43.5%*	*43.5%*	*43.5%*
Inventory Holdings	938	7,243	17,905	23,053	28,494
Sales Expense	4,688	36,216	89,527	115,266	142,469
D&A	2,648	20,454	50,562	65,099	80,463
Other Income from Data	1,111	8,330	19,992	24,989	29,987
EBIT	**$33,646**	**$259,662**	**$641,285**	**$824,905**	**$1,018,683**
Tax	7,066	25,966	64,129	82,491	101,868
Net Income	**$26,580**	**$233,696**	**$577,157**	**$742,415**	**$916,815**
EBITDA	**$36,293**	**$280,116**	**$691,848**	**$890,004**	**$1,099,146**
EBITDA Margin	*38.7%*	*38.7%*	*38.6%*	*38.6%*	*38.6%*

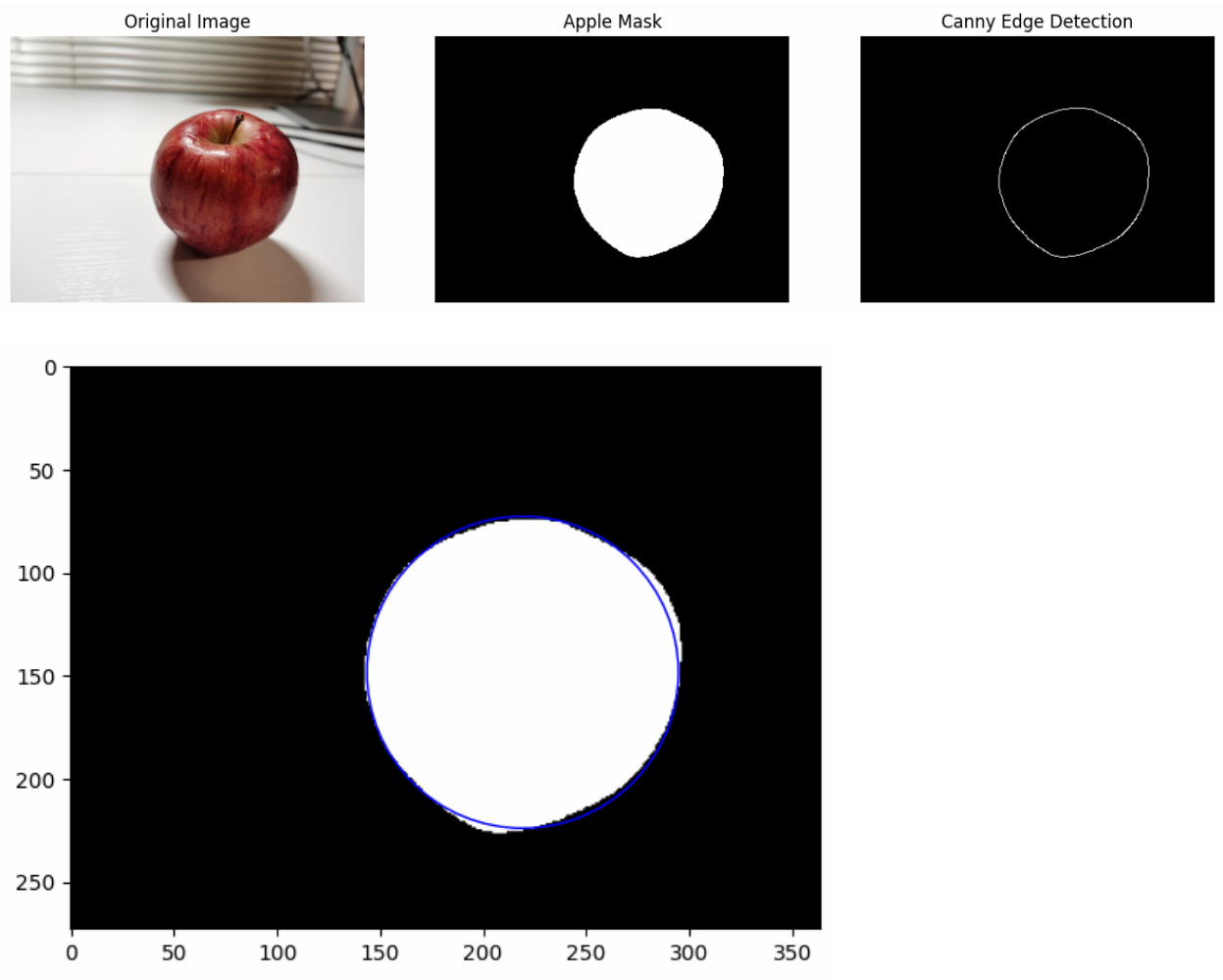
Integrating our product into Daxo Industries' existing lineup—alongside their clamps and Zapper machines—allows for shared inventory and sales expenditures, further decreasing overall costs. Collaborative resource utilization, such as combined marketing efforts and distribution channels, enhances cost efficiency for all parties involved. Therefore many of our cost assumptions reflect existing assumptions of Daxo Industrial's internal analysis.

Please find the full operating model here.

Appendix

See demo video here

See training results screenshot below



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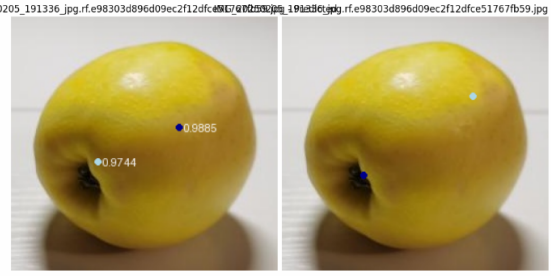

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