Integrated Mower/Trimmer Deck

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ABSTRACT

Lawn mowers have been around for 190 years, and string trimmers have been around for over 50 years. Normally these two products must be used independently from one another. This is an inconvenience to average landscaper and a problem that the Trine design team was tasked with fixing. This project is a continuation from the 2019-2020 Senior Design team. The best products on the market are simple trimmer attachments to a zero-turn deck.

Figure 1: ExMark Lazer Z Mower

This product needs to have an electrical concept that runs off the mower battery, and a belt driven concept that runs through the belt system used to power the mower blades. Safety of the user is top priority and having the capabilities of an industrial trimmer was the goal of the project. This product will be placed on the deck so the user can easily reach areas where a normal mower would not be able to. The largest factors of this project were finding applicable products with which to build and fitting the assembly onto the Lazer Z mower deck.

CUSTOMER NEEDS/SPECS

Based on sponsor requirements, the team created a list of needs and specifications for the project as seen in Table 1.

Table 1: Customer Needs and Specs List

Customer Needs	Specifications
Safe for the User	Cut within ¼" - ½" of mower blades
Usable	Cut diameter of 5"-6"
Reliable	Trimmer head speed of 8,000-10,000 rpm
Energy Efficient	Designed for zero-turn mowers

DESIGN CONCEPTS

The team created a decision matrix to evaluate the different ideas developed. Table 2 shows this matrix.

Table 2: Decision Matrix for Final Concepts

Sub-components	Ideas			
Trimmer style	Mounted on Trimmer Shaft	Motor Mounted on Deck, Connected by Pulley	Swinging Tensioner	Two Separate Tensioner
Power	Electric	Electric with Pulley	Belt/Pulley	Belt/Pulley

Concept One is a belt driven system shown in Figure 2. The existing deck drive belt combined with added pulleys and an electric PTO clutch. The PTO clutch allows the mower blades to spin while the trimmer is not in use.

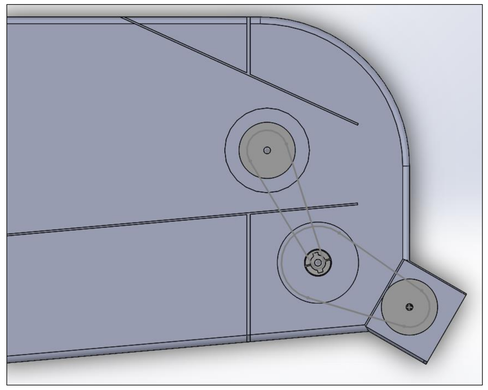

Figure 2: Belt Driven Concept

The second concept is powered by an electric motor. The motor is wired into the control panel that is located below the user's seat. This allows for easy access as well as for the trimmer to be toggled off and on when wanted. Figure 3 shows the protective housing for the electric motor.

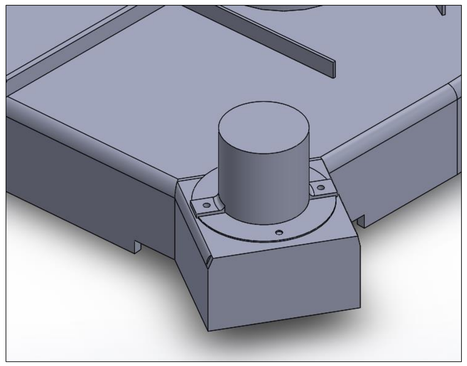

Figure 3: Electric Driven Concept

TEST RESULTS

The final design was tested by using different types of safety tests. The tests will consist of the Durability, Reliability, and Safety tests. The Durability test will consist of determining if both concepts can withstand an impactful force on the trimmer head. The concept will pass with no deflection after force. The Reliability test will set to a time limit for the motor and belt driven system to run without failure. The passing time limit for both systems will be 25 minutes. The safety test will consist of mounting cardboard around all edges of the front left of the mower deck. To pass the test the prototype will need to not send any debris to puncture the cardboard to ensure the bystanders are safe from projectiles.

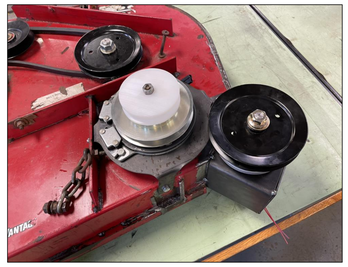

Figure 4: Fit and Function of Clutching System

FINAL DESIGN

The final concept is an interchangeable system that will work for the Electric Concept and the Belt system. The Electric system is shown in Figure 5. The team decided that the best way to design and create the mount of the electric motor was to 3D print the two components. This was to allow rapid testing and turn around if there was ever a problem. The Motor will be wired to a switch on the control panel on the sponsor's deck. The motor will be powered by the 12-volt battery that is already existing to run the mower.

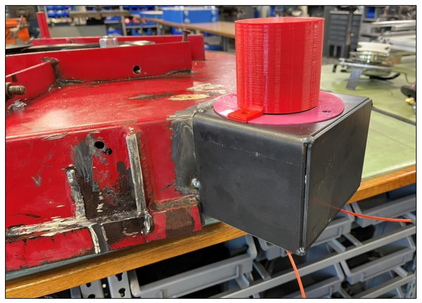

Figure 5: Final Design Electric

In Figure 6, a clutch holder was designed to hold the clutch off the deck because when activated, the PTO clutch pops up. The clutch is wired to a switch on the control panel between the user's legs. The PTO clutch will be powered off the existing 12- volt battery.

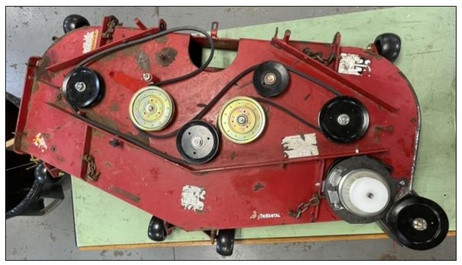

Figure 6: Final Design Belt

CONCLUSION

The team has created an integrated trimmer system for an Exmark Lazer Z Ultracut 60 zero-turn lawn mower deck. Throughout the different engineering design phases, the team effectively created a one-off prototype for proof of concept and patentability. The team created two versions of the integrated trimmer. One version is powered with an electric motor and the other is powered with a belt driven system. Figures 5 & 6 show the mower deck trimmer designs that the team believes will meet all the sponsors needs for trimming grass while simultaneously cutting grass.

LESSONS LEARNED

Throughout this project, the team learned:

- The importance of time management.
- The first design is never perfect.
- Successful teamwork is based on good communication.
- Attention to detail throughout the whole project is necessary.
- Documentation is critical

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