

BACKGROUND

Mr. Kyle Skaggs, a local entrepreneur, seeks to improve a mower deck and integrated string trimmer design. The purpose of this project is to improve the design to allow people to easily mow and trim a yard at the same time and decrease the time needed to do this task. The mower deck trimmer project was a previous senior design project and is undergoing its third design iteration to improve the issues with previous versions. The sponsor had a list of issues with the previous iteration. These issues were related to the length of the trimmer cut, ease of access to the trimmer head, and a drive system failure. Figures 1 and 2 show previous iterations of the integrated trimmer design.



Figure 1: Old Design

Figure 2: Mower Deck

CUSTOMER NEEDS

After the design team, advisor, and sponsor met to determine the state of the previous design, a list of customer needs were created and are shown in Table 1. The primary issues with the previous design were the trimmer head and its lack of easy use. This system also had a major failure in its drive system causing the design to fail. Figures 3 and 4 illustrate these design issues.

Table 1: Customer Needs

Line auto feeder
Total Expense
Hardware Material
Trimmer Line
Drive system
Cut diameter
Cut Height
Mower deck width
Maintenance
Attachment height
Activation Switch



Figure 3: System Failure

Figure 4: Old Trimmer

DESIGN CONCEPTS

The team produced 3 concepts for the sponsor to review, Figures 5-10. The first concept used a metal scissor head rather than a traditional head, the second used an auto-feeding head which feeds based on rotation speed, and the last concept used a modified bump head which extruded line after a lever pull.



Figures 5-7: Trimmer Head Concepts

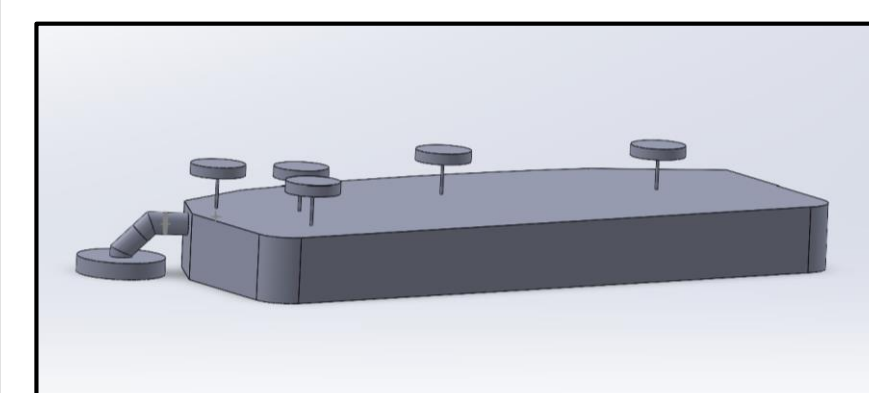


Figure 8: Concept 1

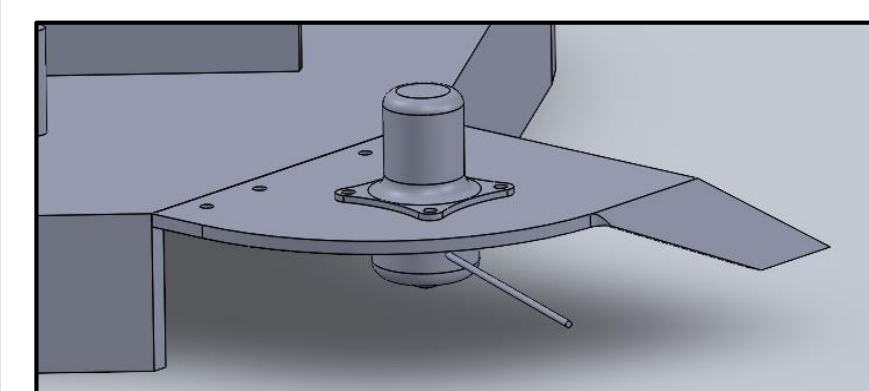


Figure 10: Concept 3

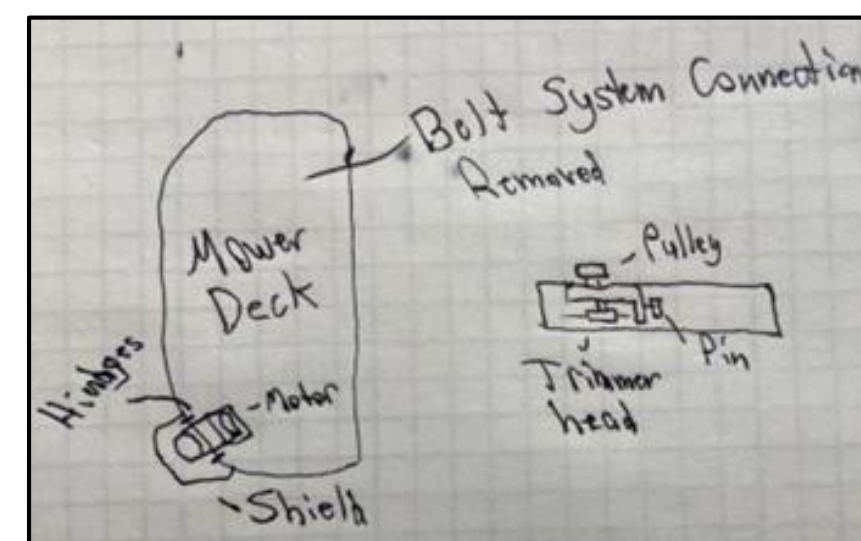
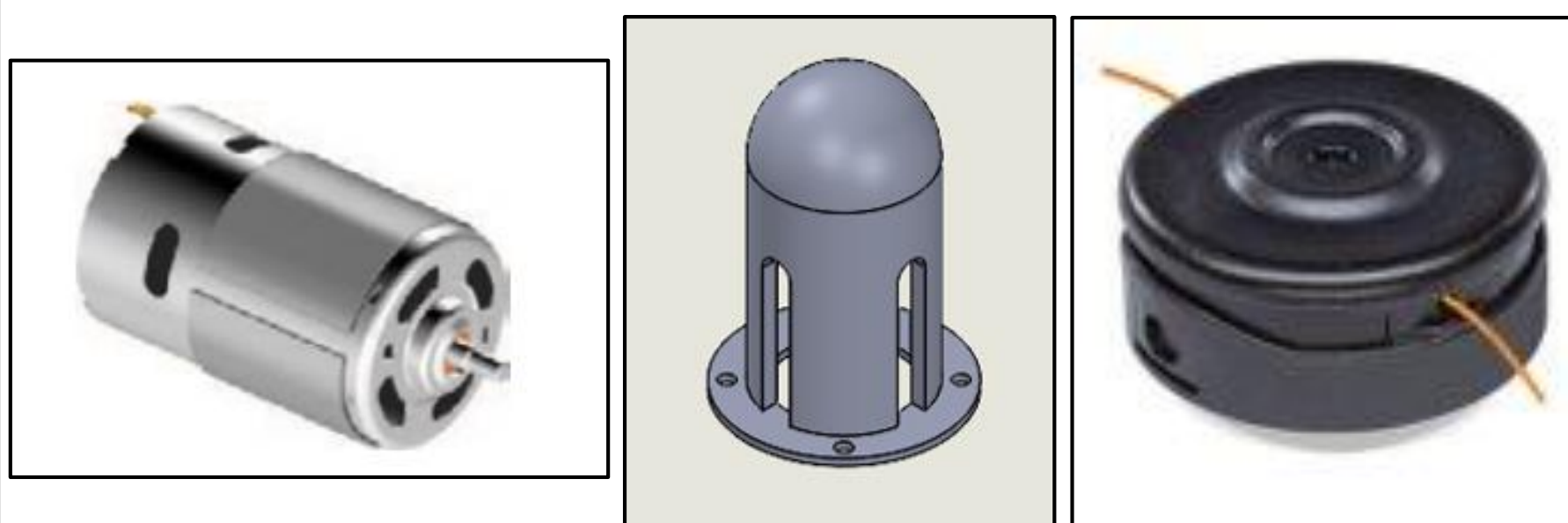


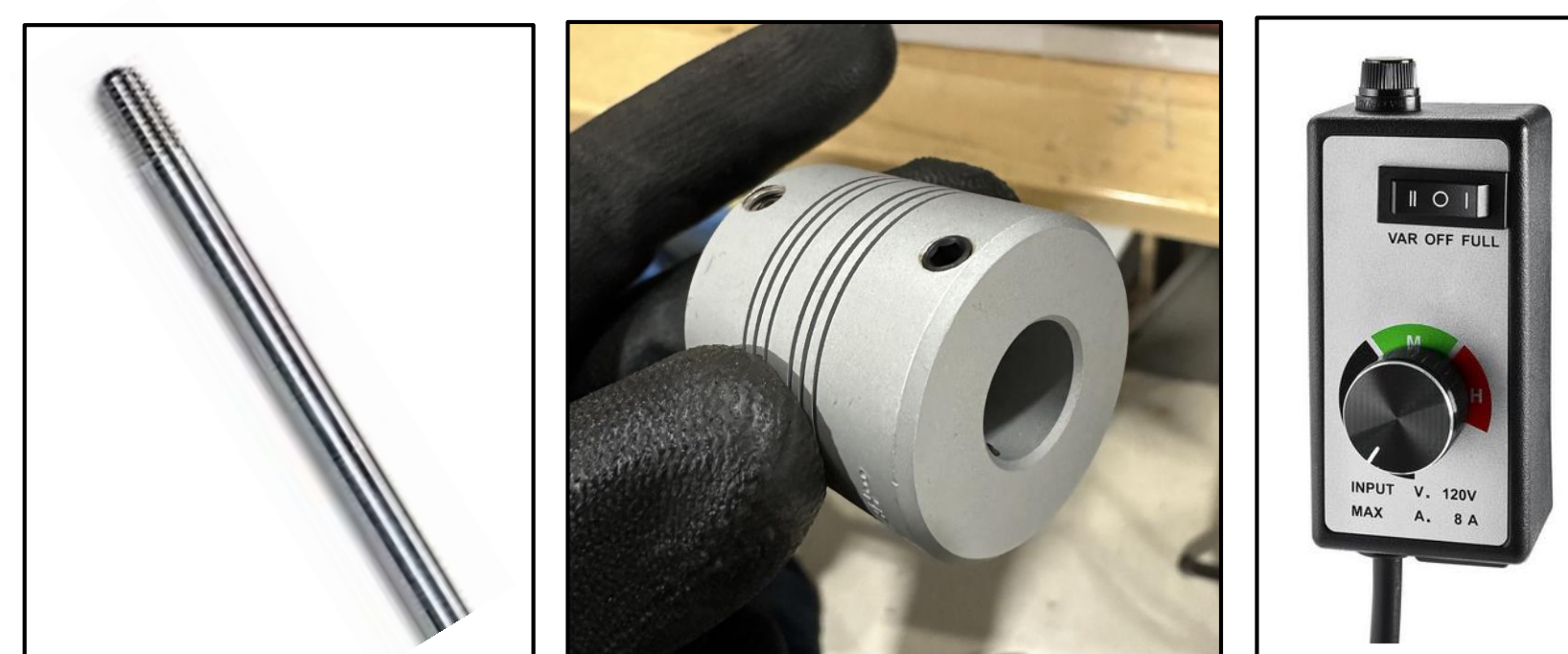
Figure 9: Concept 2

FINAL CONCEPT

A combination of concepts 2 and 3 was chosen as the final concept design. The trimmer head and ease of use from concept 2 and the electric drive system of concept 3 would be used. This would solve the customer needs and make the design much more robust...Figures 11-16.



Figures 11-13: Final Concept Components



Figures 14-16: Additional Components

TEST RESULTS

After the team completed the first artifact, testing began with the electrical components. Testing was done using a wall outlet, car battery, and the mower battery, Figures 17-19. After testing, the team found that the trimmer head works correctly, however the design would not run on the mower battery. The motor was damaged during testing likely due to excess amperage.



Figures 17-19: Testing

FINAL DESIGN

The final design is a completely updated version of the original project achieving the customer needs given to the team. The trimmer head utilizes a Stihl 40-2 Auto-Feed head which auto-feeds the trimmer line when hovering around 7,000 rpm. The shield is a steel folding shield that can lock in the down position and allows for easy trimmer line refill. The electrical components consist of a second 12V battery which increases the voltage to 24V when in series. This is then connected to a 24V DC motor.



Figure 20: Final Motor Case



Figure 21: Final Coupler



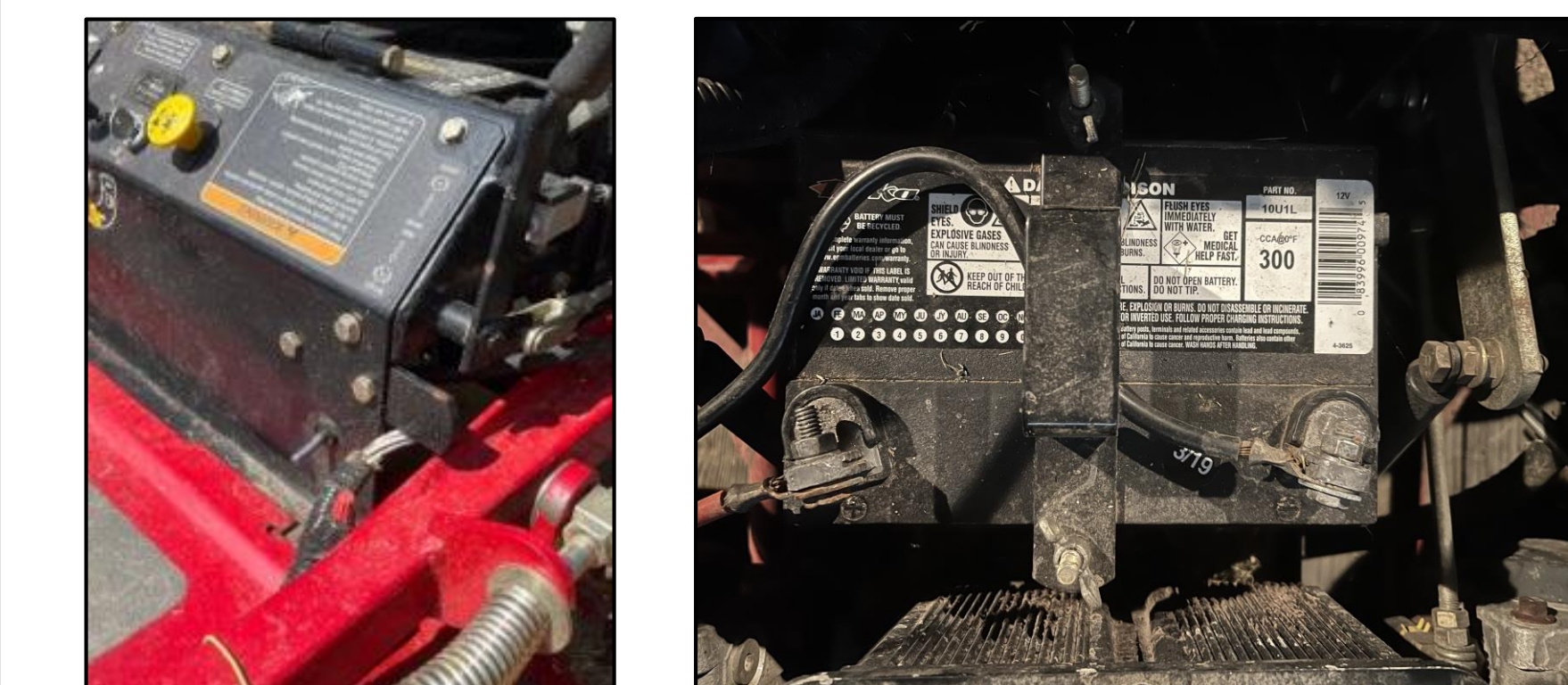
Figure 22: Shield Hinge



Figure 23: Charging Battery

CONCLUSION

The team has gone through the design process updating Mr. Kyle Skaggs' mower deck to solve any issues and enhance the design. The team followed a phase system throughout the project to stay organized and focused on the next steps of the project. The final mower design includes an auto-feed head which can change line lengths to any designed cut diameter and does not need to be refilled near as often. The shield was updated to fold up and down making line refills an easier process. The design also includes a method of powering on and off the mower deck trimmer when not needed to improve the lifespan of the device. The team believes this design is a step in the right direction for making the mower deck trimmer a robust design. Figures 24-28 show current progress.



Figures 24-28: Final Project Images

LESSONS LEARNED

With the conclusion of the project, the team learned:

- The importance of planning
- Management of documents
- Presentation skills
- Complex problem-solving skills
- The design process
- Importance of communication and collaboration

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