Chiller Trailer Team

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ABSTRACT

The Allen School of Engineering and Technology at Trine University, and Innovation One, bring in entrepreneurs to develop ideas and construct physical artifacts each year as well as sponsor senior design projects. Tour De Café is a small coffee business based locally out of Fort Wayne that is owned and operated by entrepreneur Mike Roselle. The chiller trailer is an addition to the original staple of the business, that being the coffee bike itself. Mr. Roselle's trailer can be seen in Figure 1.

Figure 1: Current Trailer

The new chiller trailer will need to meet many safety and functionality requirements. The design team is tasked with completing a new trailer design that includes a frame and chassis, a cooling system, and a rechargeable power supply based on a battery-operated system. The main goal of the project is to provide a quality design that meets the sponsor's needs.

CUSTOMER NEEDS/SPECS

Tour De Café needs an efficient and durable trailer that has the capabilities to store cold liquids and provide power and additional workspace to the operators of the business. So, the design team took the needs of the customer and turned each need into specifications to work with to start the design process. Tables 1 and 2 show the target needs and specifications.

Table 1: Customer Needs

Supply area for large quantity of ice
Area for cold storage
Water drain for ice melt
Power supply capabilities
Plug in charging with direct power hookup
Additional workspace
Must fit through doorway
Weight must suitable for bike pulling

Table 2: Specifications

Room for 8-12 gallons of liquid
Temperatures at or below 32°-36°F
At least 4000-Watt Hours of power
Weight capacity of 800 lbs. maximum
1-2 Additional workspace areas
Frame size of 19" x 36"
2 compartments for storage
1 point of contact for hitch to bike
At least 1 wheel required for the trailer
Power supply of 110V

DESIGN CONCEPTS

The design problem was broken down into six sub-problems by the team; cold storage space, trailer size, temperature control, additional workspace, weight, and power supply. The team developed three initial concept designs that solved the six sub-problems defined above. Figures 2-4 illustrate the initial designs created by the team.

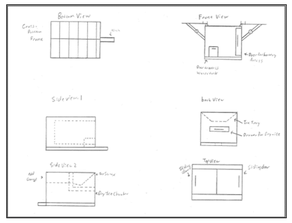

Figure 2: Initial Concept 1

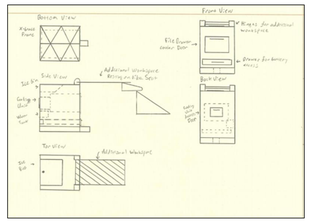

Figure 3: Initial Concept 2

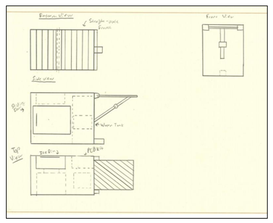

Figure 4: Initial Concept 3

The team developed two design concepts for the frame that houses the box chassis of the trailer. The frame in Figure 5 utilizes bumper stops to prevent metal-on-metal squeaking and provides weight distribution in the middle of the trailer. The frame in Figure 6 will hold the box chassis with bolts separated by rubber stops and will let the trailer be pulled chariot style. Both frames would be made of Hot Rolled 1020 Mild Steel.

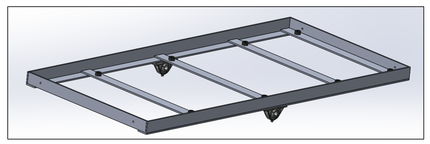

Figure 5: Frame Concept 3

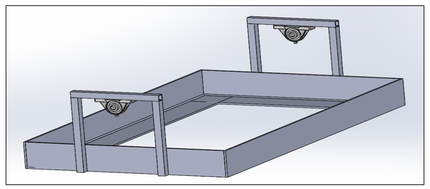

Figure 6: Frame Concept 3

SYSTEM-LEVEL DESIGN

To assist in the design process, the team chose to breakdown the cooling and electrical systems. The team broke down the systems involved with the Tesla battery module and the cooling unit. Figure 7 illustrates the Tesla system breakdowns and Figure 8 represents the cooling system breakdown.

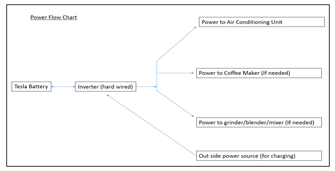

Figure 7: Power System Breakdown

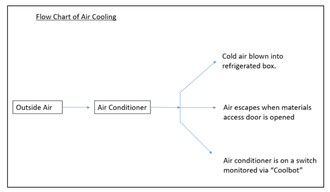

Figure 8: Cooling System Breakdown

FINAL DESIGN

After researching electrical systems and speaking with cooling industry specialists regarding the power and cooling portion of the project, many changes were made to the initial design concepts that the team created. The team was also handed a valuable piece of material for the project, a food-grade box chassis, which also changed the initial designs that the team proposed. The design illustrated in Figure 9-10 represents the final design that the team created for the project that met all the customer needs. Figure 11 represents the final design for the electrical system that utilizes a 5200 Watt Tesla battery module with inverter, and is cooled by a torn apart slushie maker.

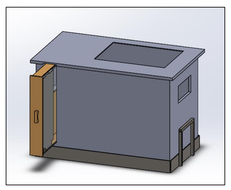

Figure 9: External View

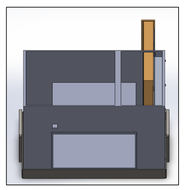

Figure 10: Internal View

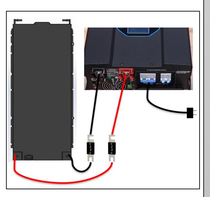

Figure 11: Power System

FUTURE WORK

The team created a plan of action to follow if future work was to be done. The team would have focused on troubleshooting any problems that would have came from the electrical system, cooling system, and weight reduction. The team also planned on addressing the safety issues involved with the charging of the battery system and relaying the information to Mr. Roselle to ensure usability. Also, creating a user manual for Mr. Roselle was in works.

CONCLUSION

Although the team was not able to complete the physical project due to the spring outbreak of the Covid-19 virus, the chiller trailer team was able to produce a safe and strong design that was cost effective and convenient to work from. The team used a system of phases to complete aspects of the project which proved effective in creating the design for a quality chiller trailer. Although many items cannot be proven as quality until built and tested, the team is confident in the design presented and strongly believes in it from an engineering perspective based on previous experience and research.

LESSONS LEARNED

The chiller trailer project taught the team the following:

- The importance of communication between team members.
- The importance of time management and scheduling for the completion of assignments and milestones.
- The design process is iterative and always evolving.
- The team must adapt to unexpected events in projects and solving the design problems.

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