Heat & Lift, Wiper Design

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ABSTRACT

Throughout the winter months and/or in environments that constantly reach freezing temperatures, snow and ice can build-up and freeze a wiper blade to a windshield. This causes traditional wiper blades to wipe inadequately and decrease the life of the blade. An entrepreneur with ties to Trine University approached Innovation One with a design opportunity to develop a liftable wiper arm and incorporate current blade heating technology. The design team was tasked to design a complete windshield wiper blade system that lifts the blade above a car windshield while also having the ability to melt ice and snow. A few examples of the problem the team is trying to address regarding vehicle windshields can be seen in Figures 1 and 2.

Figure 1: The Problem - Snow

Figure 2: Unprepared Wiper

A mechanism to lift the wiper blade off the windshield is required to avoid the blade from freezing to the car. A heating mechanism is also required to efficiently melt snow and ice along with maintaining a safe temperature to handle if necessary. The team produced a design with a linear actuator encapsulated within the wiper arm to lift the blade along with heating wire embedded in the blade for snow/ice removal. This product now has a launch name of Heat & Lift, Wiper Technologies, LLC.

CUSTOMER NEEDS/SPECS

NEEDS:
- ☐ System should require minimal user interaction
- ☐ System should provide user with indication if on/off
- ☐ System should be low maintenance

SPECIFICATIONS:
- ☐ Automatic lift of at least 6 inches
- ☐ Wiper cannot lift while car is moving or in Drive/Reverse.
- ☐ Heats to 70° F in working conditions.
- ☐ Wiper should be able to activate remotely.
- ☐ Light indicators for cold/hot
- ☐ Wires in the wiper should be concealed.
- ☐ Wiper should work with GM vehicles.

DESIGN CONCEPTS

Three types of actuator: electric, pneumatic, and hydraulic, shown in Figures 3-5 were part of the lifting concepts.

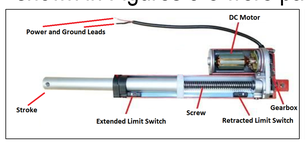

Figure 3: Electric

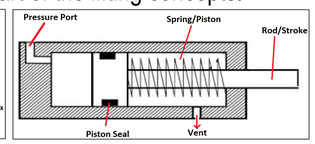

Figure 4: Pneumatic

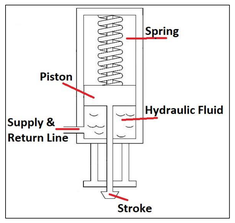

Figure 5: Hydraulic

Using the decision matrix in Table 1 and talking with the sponsor, the team chose to go with the electric version.

Table 1: Concept Decision Matrix

	Safety	Cost	Ease of Install	User Friendliness	Upkeep Cost/Time	Aesthetics	Total (more is better)
Weight	6	4	2	2	3	4	
Electric	1	3	2	3	3	2	14
Pneumatic	1	2	1	1	2	1	8
Hydraulic	1	1	1	2	1	1	7

The key reasons for this type of lifting device are: Cost and Safety, easy integration and less hassle (car battery), saves space (no fluid required), user friendly

TESTING

The team performed several tests. The lift function has over 5lbs of lifting capability. This will allow the actuator to push up off the windshield. The heat element has been tested thoroughly. 22-gauge heat wire has been implemented to the blade. The blade was tested in a frozen tube of water while having half the blade heated. Images of parts of the project being tested can be seen in Figures 6-9.

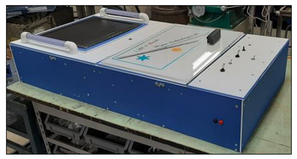

Figure 6: Housing for the Wiper

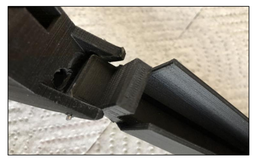

Figure 7: 3D Printed Arm and Base

Figure 8: Wiring the wiper

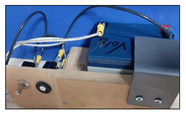

Figure 9: Battery Inside Housing

DESIGN CHANGES

Over the course of the project things progressively kept evolving and design ideas kept changing through the prototype phase. The team's final design combines simplicity with practicality. Final components can be seen in Figures 10-12. The prototype lifts the wiper by 7 inches and the wiper heats wire and melts ice in 55 seconds.

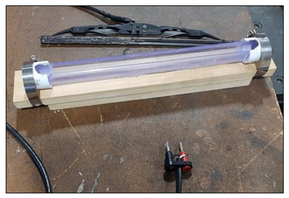

Figure 10: Final Heat Tester

Figure 11: Final Actuator

Figure 12: Final Lifted Components

Aluminum and polypropylene are the two main materials used to construct the wiper blade. These final materials are elegant and cost efficient. The polypropylene can handle the heat that the wiper needs to melt ice and snow. Currently, the prototype's arm and spindle base are 3D printed. Design is simple and takes current wiper manufacturing into mind. Design is adjustable (can be made to easily fit different vehicles) by using different arm lengths. Prototype and future models use 12 volts DC. This voltage can be found by stepping down power from a vehicle's battery. Any wiper with a common J-hook attachment can be used.

Innovation One

The team did not win an award during the Innovation One challenge. However, the team did pique the interest of representatives from Elevate Ventures (one of which was a judge for Innovation One). Elevate Ventures was interested in having the project try for pre-seed and seed awards. These awards can be as high as $80,000 for regional winners and $100,000 for statewide winners. Elevate Ventures was interested in the Wiper project because the wiper project addresses a conceivable market of over 500 million dollars, the team's idea seems related to high-growth production, the idea is novel, and the sponsor is willing to continue to support the project. The sponsor is continuing to correspond with Elevate Ventures regarding these options.

FINAL DESIGN

The liftable arm final design combines simplicity with practicality and can be seen in Figures 12 and 13.

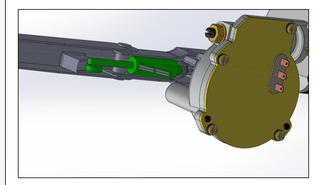

Figure 12: Bottom View of Actuator

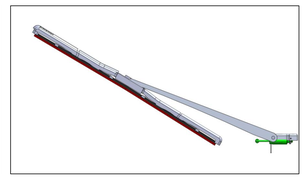

Figure 13: Side View of CAD for Final Wiper

CONCLUSION

The team has fabricated a working model using the five-phase design process in order to produce an effective model that is light weight, has a portable design, is cost effective, and for professional display for the product from Heat & Lift, Wiper Technologies LLC. The wiper arm is fully functional and lifts off the windshield. In order to show off the heat element, there is a side subcomponent with a wiper in a tube of frozen water. This will show the melting effectiveness of the heat element. The prototype is labeled accurately and is jazzed up with LEDS and a Monitor. The whole system has manual toggle switches and momentary switches. The system is equipped with a wireless key fob to run all the functions.

LESSONS LEARNED

Throughout the project, the team learned:
- Using Time Wisely
- Communication amongst the team, advisor, and sponsor
- Everything is always evolving
- Taking proper notes
- Organizational skills

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