Instaplow

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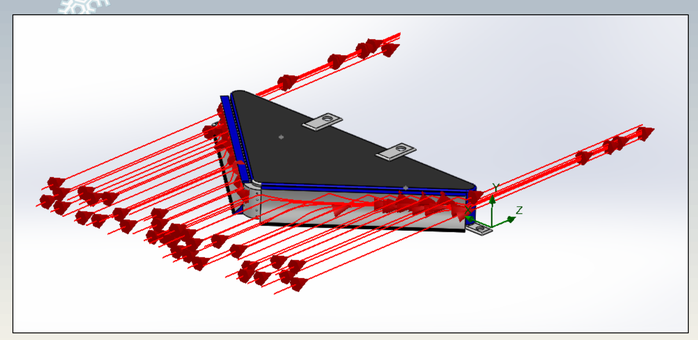
Problem Statement

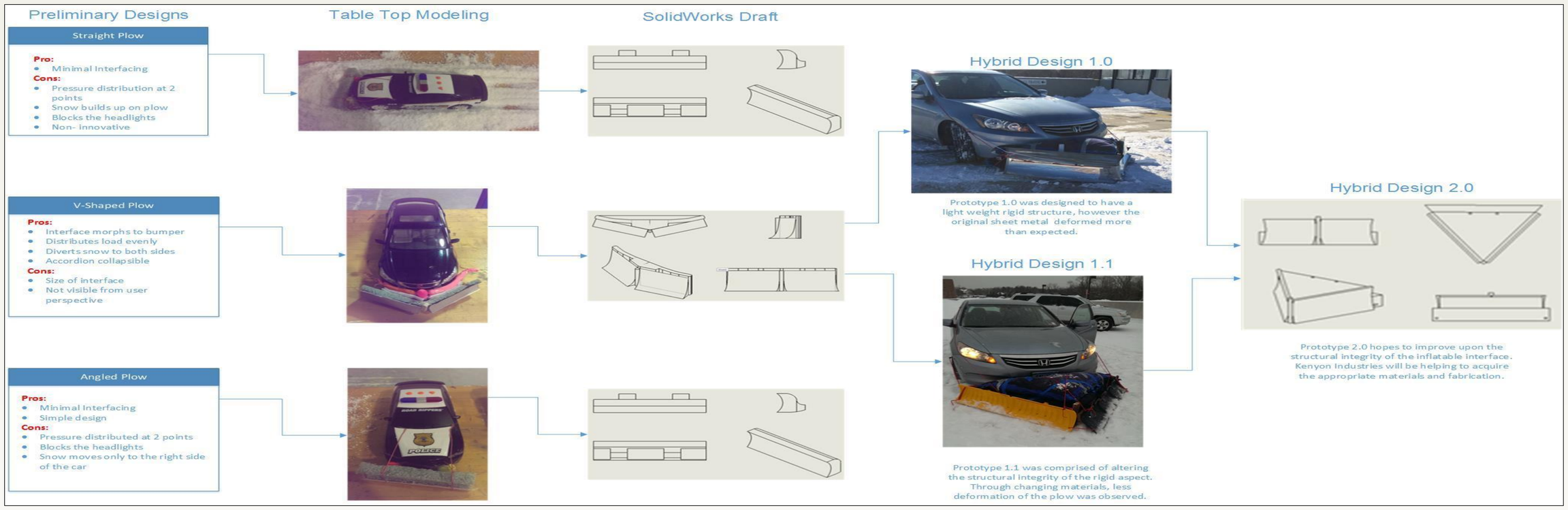
In a time restricted situation, the user must be able to assemble and install an easy to use snowplow device on the front of a midsized sedan to clear a 50 foot path safely and efficiently.

Requirements

- Light weight
- Attaches easily
- Safe and Simple
- Less than $200
- Easy set up
- Stress free



Flow trajectory study for the v-shape plow showing how snow moves to the side of the vehicle.



Prototype Construction and Testing

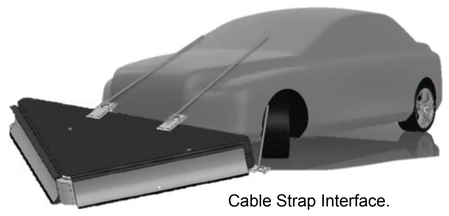
The first prototype for Instaplow was manufactured using an inflatable air mattresses and metal piping. The team began by cutting the vinyl air mattresses into the desired triangular shape. Re-attaching the sides and creating a proper seal proved to be the most difficult challenge. Four types of glue were tested including contact cement, hot glue, pool glue, and spray on adhesive. The team determined through a strength test that hot glue would hold the best. After several rounds of gluing the seal for the prototype, the inflatable compartment still did not hold air. The prototype was then sealed using a combination of a sewn stitch with glue. At this stage, the seal became much stronger but still did not hold air. In order to manufacture the rigid component which would come in contact with snow, metal piping was bent to the appropriate curve and cut down to size. The rigid portion was attached to the inflatable compartment with Velcro and duct tape.

Glue Type	Maximum Load (g)
Pool Glue	8072.46
Spray On Adhesive	1261.33
Hot Glue	2114.29
Control	9586.05
Contact Cement	504.53

Prototype testing was an important stage in the progress of Instaplow. To simulate air, the pockets were stuffed with pillow cotton. This added weight and rigidity to the compartment. During testing, Instaplow was attached to a Honda Civic with standard all weather tires and front wheel drive. Due to several recent snow storms, testing conditions were controllable. Testing for the first prototype was completed on the third floor of the parking garage at Roger Williams University. The team created a 50 foot test track by shoveling light snow at a depth of 2-3 inches. Testing was successful, but the metal piping became deformed beyond reuse. The rigid structure was reevaluated and replaced by plastic snow shovels attached to 2x4 scrap wood. When the test was repeated with freshly fallen 3-4 inches of snow, the plow cleared the lane successfully by leaving a snow height of ¼" behind the vehicle.

Interfacing

The inflatable bag consists of two compartments. The bottom bag is designed longer than the top bag to create a snug fit underneath the bumper of the vehicle. When inflated, the top bag will form around the shape of the bumper. Four brass gourmets will be manufactured into the inflatable bag. Two gourmets will be in the back corners of the bottom bag, and two will be located in the back-center of the top bag. Ratchet straps with s-hooks will connect the center gourmets to the hood. A custom y-piece bracket that clips to the inside of the wheel wells will allow the user to connect the ratchet straps to the corner gourmets. This will create a strong interface between the bag and the front car bumper that provides a tight fit to keep the bag stationary when turning.



Cable Strap Interface.

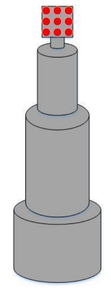
Interfacing between the rigid portion of the plow and the bag is the most difficult challenge. One idea is to have pockets on the side of the inflatable bag that allows the user to slide in two rigid pieces. The advantage of having pockets allows the user to inflate and position the bag without bearing the weight of the rigid portion. When the user has finished positioning the bag the rigid pieces can then be inserted into each pocket separately. The disadvantage of this design will increase the set up time. Another concept is to have the rigid portion manufactured and permanently attached to the bag. This will allow for a simpler and quicker set up operation, but will increase the weight the user will have to bear.

Pressure Feedback System

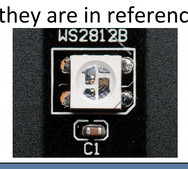
For the Instaplow Team safety is one of our top priorities. Thus the inflatable bags will be equipped with the Pressure Feedback System designed to indicate to the user should a malfunction occur. The Pressure Feedback Systems consists of several components to ensure the user has complete awareness of the plow's functions. A miniature arduino pressure sensor will be attached to the inflatable bags to read the psi, the regulator will then run through the Feedback system located in the front hinge of the plow. The front hinge feedback indicator is a miniature neopixel panel with 64 RGB LEDs. This panel will change from green to yellow to red indicating the user of a malfunction with the air pressure in the inflatable bag.

Air Pressure Regulator

NeoPixel LED Board



Designing the Pressure Feedback System prototype along with the interface is the next step for the Instaplow team. The team is working with Kenyon Industries to assist in sealing the bags and installing the valves. Another indicator for the pressure feedback system will be located on the strap interface. These straps will have neopixel LED sewn into the fabric and will coincide with the LED's located in the front hinge of the plow. The advantage to having this feedback system allows the user to be fully aware of any malfunctions with the inflatable component of the plow. Another advantage to this system is to show the user where the front of the plow is located, since the device itself is over 3 feet in length and lower to the ground. The collapsible front hinge feedback system will help the user gauge where they are in reference to whatever lays in front of them.



Sewable NeoPixel LED

Roger Williams University