

ABSTRACT

Nick Santino, a graduate of Trine University and entrepreneur had an idea to design and create a solar-powered prototype device that could be mounted near gardens or other plants that functions to fend off wildlife from damaging the plants and trees on the property. The sponsor



Figure 1: Deer Enjoying a Snack

wants the device to include a means to sense deer, sound production, light, and some type of chemical that deters deer. The sponsor would like to use alternating sounds, so deer do not become accustomed to the device repeated sounds and still get deterred. The team had to analyze the given problem, research existing and past products/patents, evaluate the customer's needs, and provide and relate target specifications. The team's device will be a 3D printed prototype and potentially injection molded later on. Part of the device will be made with the help of the sponsors grandson, Nick Femano and Douglas Outdoors.

CUSTOMER NEEDS/SPECS

Nick Santino needs a device that will deter deer using an environmentally friendly means of power. A list of customer needs and target specifications are in Table 1.

Table 1: Needs and Specs

Customer Needs	Target Specifications
Alternating sounds only heard by animals	At least four alternating sounds will be used for the device
Solar powered device	An environmentally means of power is needed for the device
Dusk to dawn feature	The device should only work at night
Ease of use	A less than five-minute setup
Deer deterrent	≈80% of deer will be deterred if within device range.

DESIGN CONCEPTS

As a team, three concepts were created using the team's understanding of all of Mr. Santino's needs. All three of the team's ideas used sound, smell, and light deterrence. Concept one used a passive smell deterrence. A mixture of dried blood and Irish Spring soap would be used for the scent. Concept two used a trail cam-based design.. A telescopic stand is used to hold up the device, which will help maintain an easy setup.

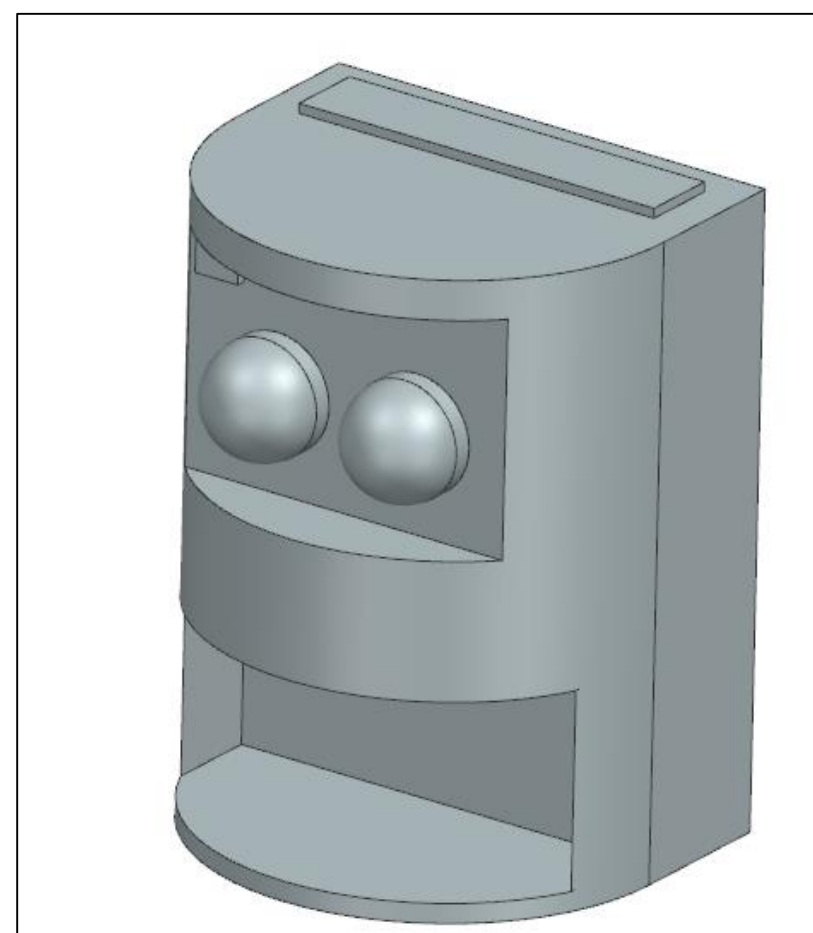


Figure 2: Original Passive Design Concept

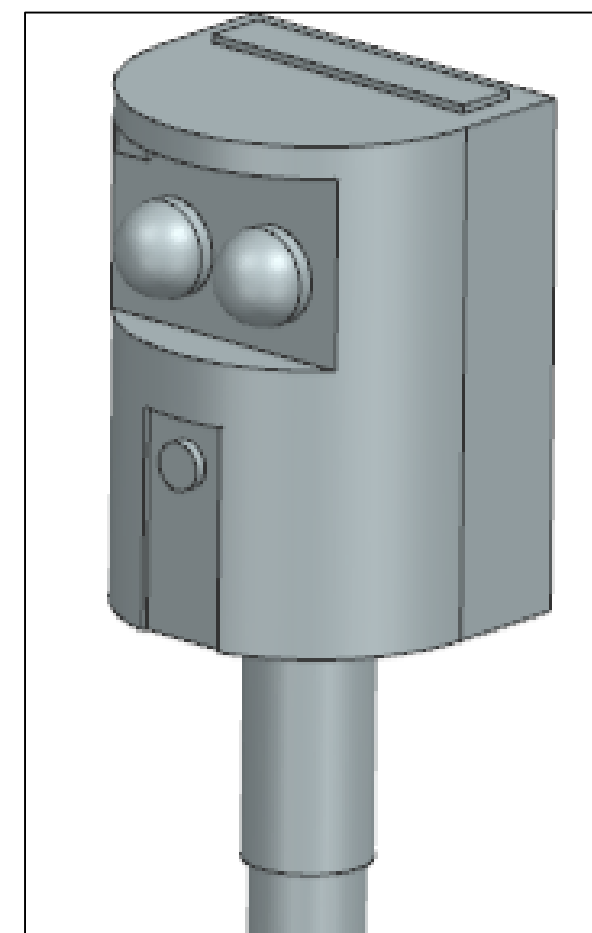


Figure 3: Original Non-Passive Design Concept

Concept three is remarkably similar to the second concept, it is just a slimmer case design. Concept three is half the size of concept two. Another difference in concept three is the acrylic sealed cap.

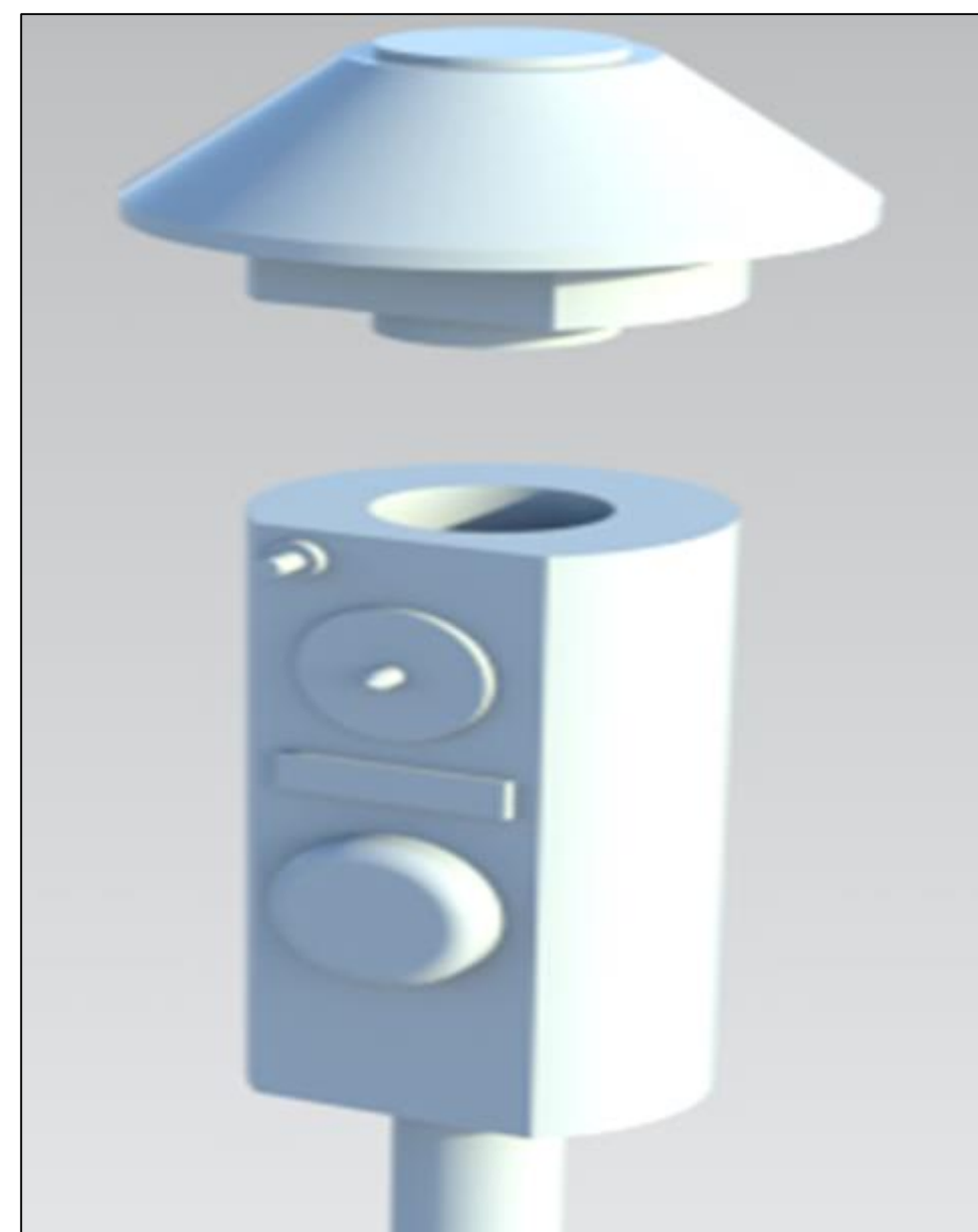


Figure 4: Sponsor Chosen Design Concept

TEST RESULTS

Passive testing was done by making up mesh bags of items said to deter deer. This test failed and the deer did not stay out of the sponsors plants



Figure 5: Passive Deterrent Subsystem Prototypes

Testing of the liquid deterrent was done by mixing it with an antifreeze and water to find the correct ratio needed so the device is affective during the winter months.



Figure 6: Liquid Deterrent Subsystem Prototypes Antifreeze Test

An initial case that did not include internal components was printed, Figure 7, to give the team an aesthetic idea. A case that housed all components in the actual case was printed but found too bulky, Figure 8.



Figure 7: First Case - No Electrical Components



Figure 8: Design with Electrical Components

FINAL DESIGN

The new design is more compact along each axis and maintains a uniform shape in the reservoir that is basic and simple to refill. The design moved the battery compartment into the provided stand that the sponsor gave the team, and in doing so allowed a lot of excess space to be removed to create an overall smaller design. This design is not completely finished, as finishing touches such as a Printed Circuit Board (PCB) can be used to simplify the wiring as well as wiring harnesses such as ribbon cables could simplify the mess on the inside and will most likely be added as a quality-of-life design.



Figure 9: Inside View of Prototype

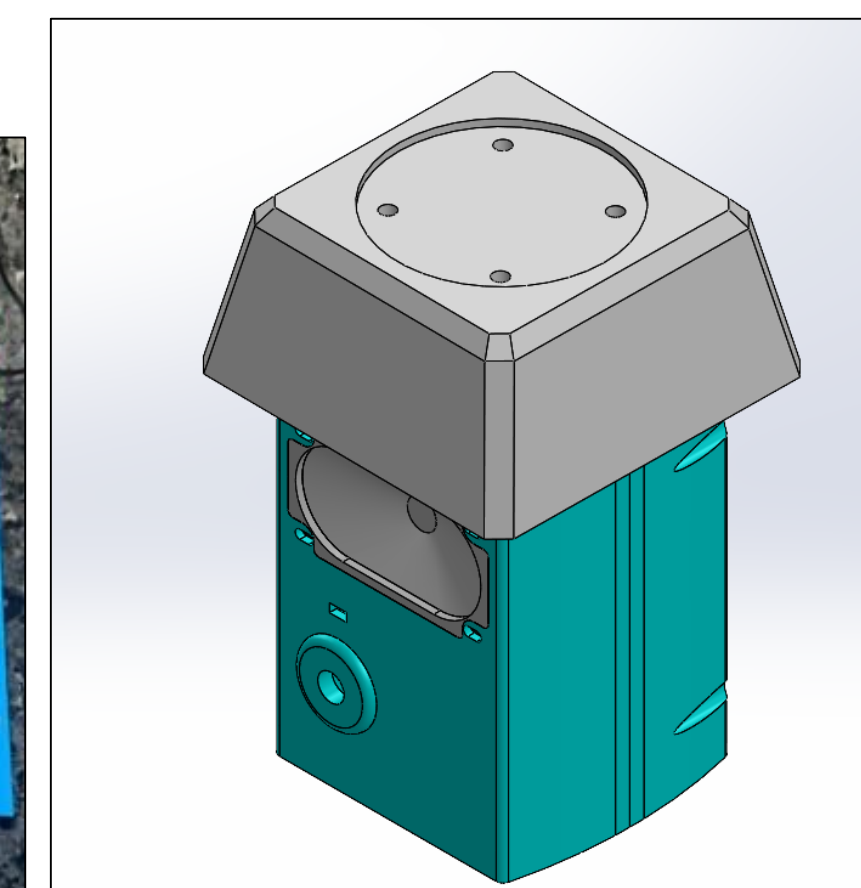


Figure 10: Most Up-To-Date CAD Design

CONCLUSION

The team has gone through the engineering design process to create a deterrent device that discourages unwanted deer for the sponsor, Mr. Nick Santino. The team followed a set phase schedule to better help the completion of the design. The deterrent device works by using multiple known deer deterrent methods including sound, light, and smell. By using multiple deterrent methods, the deer will get less accustomed to the deterrent methods and shouldn't return. The team believes that the device will meet all of Nick's needs for deer deterrence.



Figures 11-13: Finished Prototype With and Without Stand

LESSONS LEARNED

The team has learned a few things throughout the process of this project.

- Deer adapt to surroundings in the short time of 2 months.
- A product changes a lot throughout the designing phases.
- Developing a product required a lot of communication amongst the team as well as any needed outside resources.

ACKNOWLEDGMENTS

The team would like to acknowledge the following people for helping with the completion of this project:

- Nick Santino**, Owner of Reaction Light Systems of New York
- Dr. Timothy Jenkins**, Associate Professor, Design Engineering Technology
- Brayton Niccum**, Trine University Computer Engineer Student
- Michael Swango**, Trine University Software Engineer Student
- Jayden Pothoof**, Trine University, Biomedical Engineer Student