Energy Re-leash

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Abstract

In the United States over 260,000 accidents occur yearly from animals on the road. The majority of these crashes occur at night. Many people walk their dogs at this time, which poses a danger as they can be difficult for drivers to spot. Dogs can be out of control and act on impulse, adding to the risk of car accidents. Lights are one way to mitigate this risk, allowing for drivers to identify an otherwise dark object as a dog by its light up harness. Current models rely on environmentally costly batteries and have low product-lives to power lights. This given product produces energy to power LEDs for a dog's collar for safety purposes while focusing on being environmentally friendly and as efficient as possible.

The project we created is a modified dog leash that still maintains the typical characteristics while being useful with the energy that the leash obtains from the dog's power. Consequently, this product is efficient, cheap, easy-to-use and provides extra safety for you and your dog. This dog leash addresses the given problem well because it forces the dog and its walker to be seen at night, which is typically when most crashes occur as they can be hard for a driver to spot in the dark. This easily attainable leash will prevent thousands of accidents all over the world, saving not just dogs but humans too.

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Introduction/Background

For hundreds of years, engineers have been solving problems for our people and our globe. This product focuses not only on the wellbeing of humans but their friendly counterparts too, dogs. This project focuses on an energy source that is the dog itself. With the dog producing the energy for the LEDs on the collar, as long as your pet is active and moving, these lights will continue to stay on, creating an illuminating presence at night to protect your pet and yourself. Much of where energy comes from today consists of non-renewable sources such as fossil fuels, while only 12% of energy consumption comes from renewable sources (U.S. Energy Information Administration). Concurrently, governments are trying to move away from non-renewable resources for energy as they are bad for the environment. This simple innovation on a dog leash promotes human and pet safety while using a renewable energy source. Over the last 40 years, pet ownership has increased by 20% with over 63 million dogs in U.S. households (Miller). With dogs being an essential part of so many families' lives in the United States, this project can become a safety staple for the pet industry.

Historically, there has been minimal innovation on dog leashes because of its importance compared to other real-world problems. Although animal-car accidents are dangerous and happen all over the U.S. and in other countries, these types of problems are not typically focused on because of the importance of human and environmental safety over everything else. This paper will explain the approach that was taken to burst into a different energy field using dog-generated power to save thousands of humans and animals, as well as how the idea came to be.

Methods and Approach

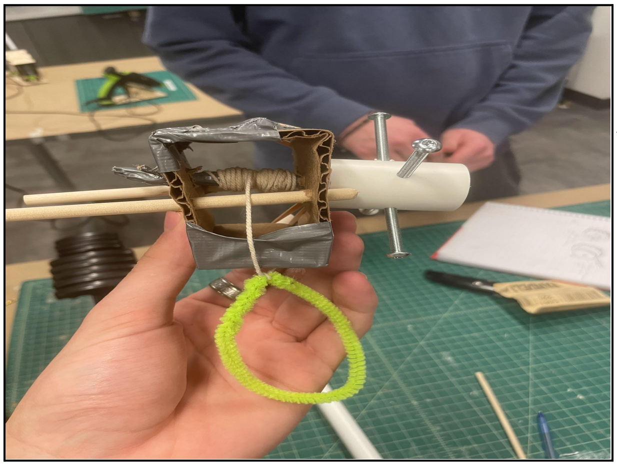
Firstly, the basic mechanics of a dog leash and other products were examined so that the team could have a solid idea of how to make a working dog leash while improving on past ideas that were researched on. A typical retractable dog leash uses a spool system to house a leash that retracts using the torsion spring inside of the spool system. Most leashes that were researched also had a locking mechanism, naturally, this project features a double-locking mechanism that can prevent the dog from pulling the leash out of the spool and has the ability for the owner to control the length (of the leash) at their will. The team took some of their inspiration from a previous project involving a similar leash that used a different generator for power [3]. The original leash case itself has an axle where said spool is placed and this project replicated that by drilling out the sturdy axle used in **Figure 1.1**, as shown on the right.

Figure 1.1: Case, Axle and Locking Mechanism from an Original Leash

This axle was then screwed on tightly to the case that was 3D printed, mimicking the same axle idea while addressing the problem of a 3D printed axle being too flimsy for a torsion spring.

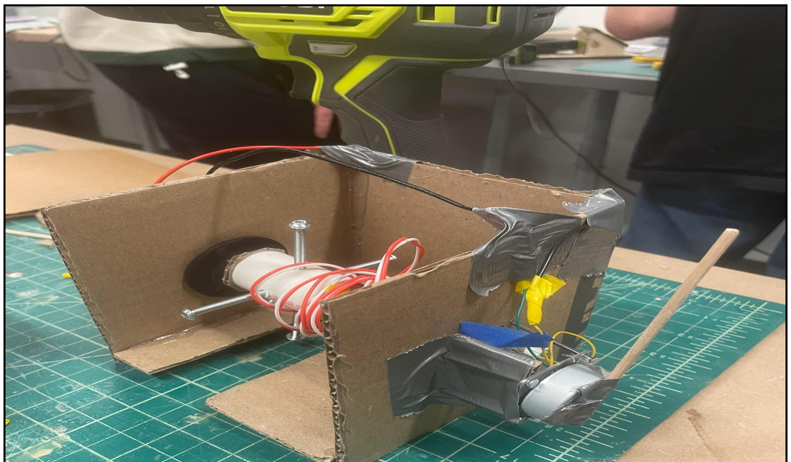
The prototypes that were created for this project show the progression in design innovation, research and knowledge that is gained as the project went on. Initially, the first design was simple yet proved the concept. As seen in **Figure 1.2**, the first prototype is basic with materials such as wood, lots of duct tape and string to act as the retractable leash.

Figure 1.2: First Prototype Design



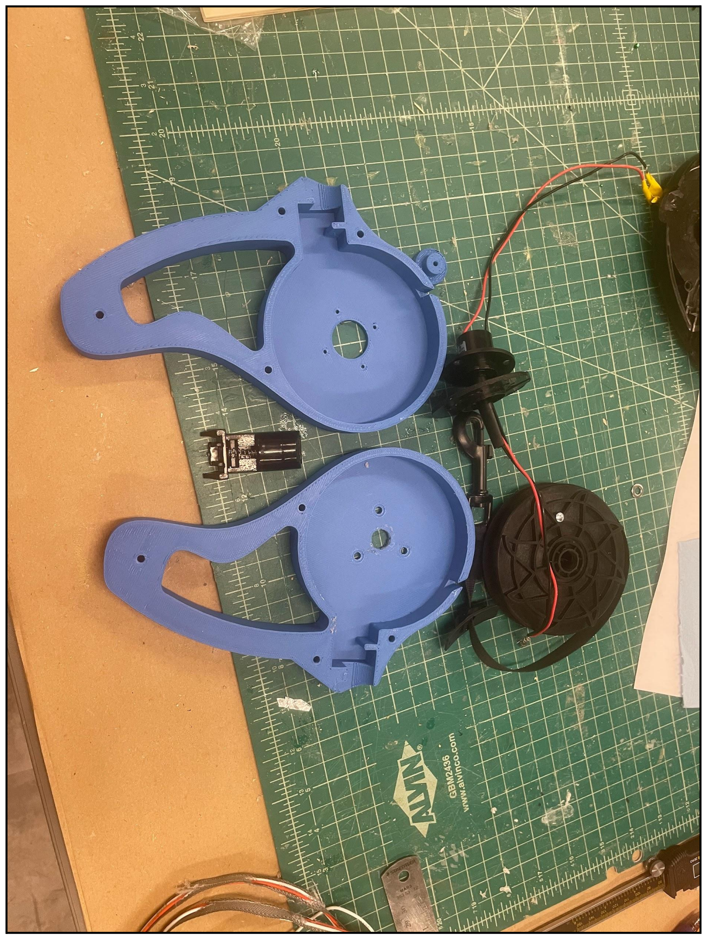
This design, completed about 2 or 3 weeks into the project, helps to justify the concept that is being examined and shows that the retractable dog leash concept is solidified enough to where a more complex leash can include extra criteria such as the LEDs that promote safety in this product. Next, this design was built on, creating a second and third design that although was made of similar parts, proved the LED safety concept and showed different innovations that were added to the prototype along the way.

On the right, **Figure 1.3: Third Design**, shows a more complex yet efficient and working prototype. This design is the last



one completed before the 3D printing stage. It includes a cardboard box which holds as a case, implementing a similar design for the spool but using wire instead of string. The dynamo added to the end of the design is attached to a wooden dowel, which acts as a crank, which then powers a singular LED light, just to prove the concept that an LED safety dog leash is plausible for a final product. The third design was bulky, unsafe and uncomfortable for the user, leading the team to integrate about two more designs using 3D printed materials that would eventually be used for the final prototype.

Figure 1.4: Final Design Parts



Finally, the 5th and final prototype made can be seen in **Figure 1.4,** to the right. The final prototype builds on the research and knowledge that the team gained from working on the last three or four designs. Prior to this 3D printed model was a similarly, less ergonomic 3D print that simply helped test our theory to see if the idea was plausible and then it was set into action. As seen in the figure to the right, the leash consists of two sides that bolt together with screws to complete a case. There is a locking mechanism area in the design and the lock, taken from one of the leashes themselves, is also used. The spool's measurements were taken, and the case is based around the size of the spool that was taken from a previously made leash. The spool is wrapped up in a set of leash with wiring threaded to it to connect the LED strip on the collar to the power source when energy is harnessed. The idea is simple yet requires background research and with the right execution, it can be a cheap, efficient, and safe idea for the United States and anywhere around the world.

Results and Discussion discuss final product, success, failures, what can be improved on etc

The final product as shown above, although successful, was only so for such a long period of time. The proof of concept was there at every prototype and step along the way which is why there are various designs that each improve upon the last. The final product design was put together well with minimal problems. The problems arose when involving the spool and torsion spring from a previous leash. Specifically, the tension in the spring of the spool was constantly wound and with any movement of it, the spring could unwind, losing its tension and power that causes the leash to be retractable.

Figure 1.5: Torsion Spring and Spool

As shown in **Figure 1.5**, the torsion spring had uncoiled and been broken, exemplifying one of the three different springs that were used for construction of the team's modified dog leash. The steeper cost of each leash caused the total cost for production of this product to be significantly higher than it typically would be, sitting right at around $165. Otherwise, the product can be considered cheap and cost-efficient, as long as the outlying parts stay intact.

Figure 1.6: Production Cost Analysis

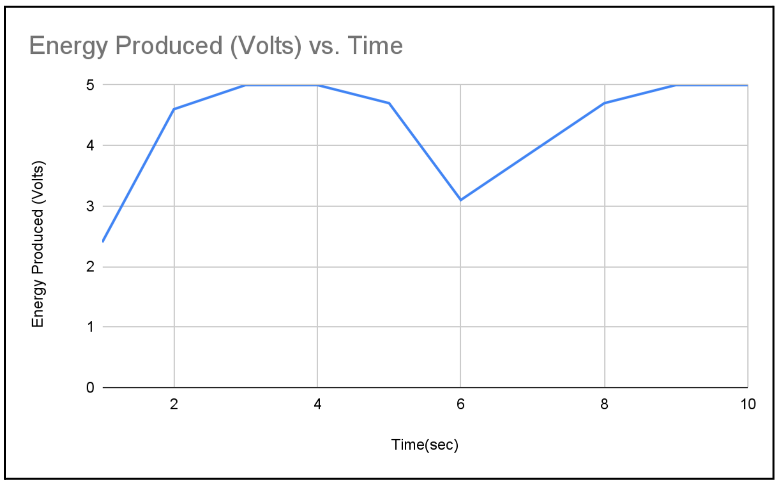
Parts List

Item	Cost
Dog Leash (3)	$30 each
Dynamo (2)	$15 each
Electrical Slip Ring Connector	$15
3D Prints (3)	N/A
LED Strip	$8
Dog Collar	$22
Total cost, excluding FYELIC-provided materials	$165

On the left is **Figure 1.6**, showing the different costs for each part of the product and how many (if more than one) of each item was purchased. The costs generally run low with no singular item costing more than $30. The unfortunate break in three different springs of each dog leash caused the product cost to skyrocket as multiple leashes had to be bought for the assembly of the modified dog leash. The dynamos purchased only generated so many volts (5V max) because of their size and efficiency so on a larger scale, a larger dynamo can be considered more efficient for leashes that will pull bigger dogs that can produce more energy. The electrical slip ring connector did not have such use as intended because of its rather large size in comparison to the product. In the team's case, 3D prints were free through FYELIC and a simple 10 foot LED strip was purchased for the safety aspect of the project. All other tools such as drills, tape, screws and so on were provided to us through FYELIC.

Data was collected for the product, through various trials over a ten-second span testing the voltage that the leash generates with the dynamo. In the data collection, the voltage is set for a maximum of five volts, which indicates that the LED has turned on at this value.

Figure 1.7: Data Collection



The data shown on the left is one of the ten-second trial runs that was taken into account for accurate results. A voltage meter was used to measure the voltage that the dog generates when pulling on the leash. When the voltage reaches the maximum at five volts, that gives indication that the LEDs on the collar have turned on. This data helps exemplify the idea of the product by showing how a tug and great production of energy helps alert the user and anyone else around them that a dog is nearby and aids to promote safety for not just the owner and pet but others on the road as well. This figure shows the only accurate results that were conclusive in the team's testing because of the unfortunate problems that occurred after a couple trials. The longevity of the product was short-lived and this is because of the torsion spring inside the leash that got worn down and messed with during testing. As mentioned earlier, three different spools with torsion springs were used and this still ended up being a serious problem, standing in the way between a failing and functioning prototype. Another problem that occurred in the setup of the final prototype involved wire twisting. The wiring that was attached to the dynamo that went through the spool would indefinitely twist, causing no rotation of the spool in the modified dog leash, preventing the leash from being retractable and causing problems in the leash. This twisting decreases the longevity of the product because it occurred pretty rapidly after the prototype was tested two or three different times. Although the product looks pleasing and is ergonomic, it can still be improved. When designing the 3D model, lots of research went behind creating an ergonomic prototype, as similar to a leash-like design as possible. The final prototype had a good shape and fit for the hand but because of the 3D print material, it was rather rough. To improve on this some filing could have been done to smoothen out rough edges and add to that completely ergonomic design that the team was aiming for. All these improvements mentioned could be made in the future to help increase the product's longevity, comfort and compatibility.

Conclusion

Conclusively, although this product only had short-lived success it was ambitious and helped the team to understand the main ideologies that an engineer follows, such as ethics, and problem-solving, and that these ideas are to be followed and re-evaluated at every step in the process. This product involved a lot of background research, physical design time and a majority of planning the steps out and repeating. An engineer is involved in so much more than just math and science, using their everyday knowledge to tackle problems that need to be solved. Consequently, engineering involves a lot of brainstorming, trial and error, and frustration. Those things alone help make this such a rewarding profession. Trying new things, brainstorming new ideas, reworking old designs into new ones and so on are all concepts that make engineering what it is, a multifaceted problem-solving based profession using knowledge from the world around you to improve the everyday lives of citizens all around the globe.

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