Toy Design Project Report: Launcho, The Adjustable Rocket Launcher

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Greetings,

This report was prepared as our design project submission for ME100: Introduction to Mechanical Engineering Practice I, the intro class to the mechanical engineering practice at the University of Waterloo. The intent of this report is to provide you with the concept that we have selected, and to outline the progress we have made towards developing this product.

The purpose of this design project was to practice engineering design and the engineering design process, all through the lens of creating an original toy. We displayed this through the creation of our toy, Launcho, and the many iterations and design considerations we went through, all of which are shown in this report. Launcho is a projectile launcher that can rotate at a range of angles and spin 360 degrees, it also features a target for the user to try and hit.

The toy we designed is both fun to use and presents an engineering challenge. To overcome this challenge, we ideated through numerous potential solutions and built those that we felt were best suited for the toy. We have worked hard on the design and are proud of how far we have come in the time given. We wanted this toy to be just as fun to play with as it was to create. We hope you enjoy Launcho as much as we do.

This work was completed entirely by the undersigned and has not been submitted for credit at this or any other institution. Thank you for taking the time to review this work. If you have any questions or concerns, please do not hesitate to contact any of us.

Best Regards,

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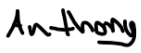

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Summary

The objective of this report is to prove the feasibility of the toy design, named Launcho. Launcho is a spring-based projectile launcher toy which can fire a rocket-shaped projectile, in any direction. This is done using a tube which acts as a shaft to hold the rocket, the spring, and its locking mechanism. The spring is then released using a trigger. The launching mechanism is mounted on a ball joint which rotates three-dimensionally and can lock into place when ready to be fired. Launcho is feasible but requires more time and better materials to improve the overall toy design and functionality.

The play pattern for Launcho is categorized as an activity for kids ages 8-12. There are various safety concerns when playing with a projectile toy, and an age range modelling that of a Nerf® gun was chosen due to Nerf® being a leading brand in projectile toys for kids. Playing with Launcho involves launching the rocket with the proper trajectory to hit a target. This target will be a mat, laid on the floor, which displays various scores. Launcho can be played with one or multiple sets, in a group taking turns, head-to-head with a friend, or solo. Each player tries to get a high score by launching the rocket a certain distance from the target.

Launcho has various aspects that are like different toys currently on the market. One of these are air-powered rocket launchers that cannot fire at different angles. Then there are other spring-powered projectile launchers seen in products like Nerf® guns. These products fire smaller foam dart ammunition.

The design must meet a few constraints otherwise it is a failed design. Primarily, the design must be safe to use. Launcho's launch mechanism cannot be repurposed to launch a more dangerous projectile, it cannot be accidentally fired, and cannot cause physical harm if someone is hit by the rocket. The design must be capable of repeating the firing of the rocket without destroying itself or the projectile. The rocket must fit inside the launch mechanism and be launched at a minimum height of 1.5 meters vertically. Finally, Launcho must be capable of aiming and firing in three dimensions. Criteria the toy should meet are having a max launch height exceeding 1.5 m, launching the rocket should be consistent, and the toy should have simple and intuitive controls.

The process of creating Launcho involved many different ideas and iterations. Launcho's initial concept was based on a Jack-In-The-Box; however, the final concept was based on the internal spring components of a Nerf® Gun. These components required heavy reconfiguration and re-design to fit into the final design. Initially, there was a first working prototype produced; however, it featured low-quality components and failed to meet some constraints. The initial prototypes of the 3D launch function involved a hockey ball in plastic cups, but this did not incorporate a way of locking the ball in place, and the launch mechanism was not strong enough to launch the rocket 1.5 m.

This prototype was improved upon with a final completed design, but it requires better materials to be a finished product. The final design features a rotating ball to provide an adjustable launch angle, a large spring to actuate the launch, and a spring-loaded pin to release and hold the launch spring. Several solutions were considered for the method of locking the ball in place, but a bolt was chosen because it is easy to use and can apply pressure to the ball when tightened, thus holding the ball in place. The current design iteration produced solutions for all the shortcomings of previous Launcho prototypes and will serve as a basis for the final product. The design for the rocket itself went through many iterations, however one that performed better, and was safer than a Nerf® dart was not found.

There are some remaining challenges with the design that have yet to be solved. The 3D printing process is slow and produces fragile parts. The ball bearing experienced too much force from the bolt, causing it to break. Super glue was also not the most ideal adhesive as some parts would come loose, and the current design does not meet the criteria of launching 1.5 meters high.

Although the current design is functioning, it does not consider all the required constraints. Primarily, better materials need to be sourced to meet the design's goal of 10,000 launches. A stronger spring must be used to meet a minimum launch height of 1.5 meters, and a proprietary rocket needs to be designed specifically for Launcho. The toy's priming method should also be made smoother for ease of use. Launcho is a feasible design and product, but it requires more time and better materials to make it a reality.

1.0 Introduction

Launcho is a spring-powered rocket launcher toy (Figure 1) designed after the launch mechanism of a Nerf® gun. Launcho features a spherical rotating platform to allow a customizable launch angle, which the rocket launch mechanism will be mounted on. The launch mechanism itself features a manual slide to pull down and prime a spring inside the main launch tube, which can then be launched at will. Once the rocket is loaded into the launch tube, it rests on top of a platform attached to the spring, thus allowing the rocket to be primed with, and propelled by, the spring. The toy is made for kids ages 8 and up, and it is comparable to other projectile toys currently on the market.

Figure 1 Big Picture Visual Representation of Launcho Toy Rocket

1.1 Objective

The objective of this report is to prove the feasibility of the toy design, Launcho. Launcho is a feasible toy, however it currently does not have a completed design, and this shall be demonstrated throughout the content of this report. This report also includes details as to how and why each design solution was decided upon and built. While this design is feasible and has been built, it currently requires proprietary rockets, more durable materials as well as more testing to ensure a sufficient range for the rocket. These will be outlined throughout the report.

1.2 Play Pattern/ Age Range

Launcho has a recommended age range of 8-12 years old. Since this toy is a projectile, there is a possibility of children getting hurt, so the age range of a Nerf® gun was followed [1].

Due to this, and the fact that the launch mechanism uses springs that require some force to prime, this older age range was chosen to reflect the play pattern of the toy. The upper range of 12 was chosen as Launcho would most likely not appeal to children older than 12, due to teens spending most of their time on electronic devices [2]. However, it can still be used and enjoyed by anyone 8 and up. Launcho is categorized under the activity play pattern and specifically involves two players dueling with each other, each with their own toy rocket launcher. Due to the nature of the game being structured with pre-existing rules, this toy is classified as an activity. The Launcho playset comes with a mat of a target, with each point on the target corresponding to various points players can earn (Figure 2). Each player launches their rocket from the same location and adjusts their launch angle to try and land the rocket on the target. Wherever the rocket lands on the target corresponds to the number of points the player receives with the objective being to score more points than the opposing player. Launcho can also be played solo or as a group with one playset, where the activity is to instead aim for a high score when launching the rocket, a certain distance from the target.

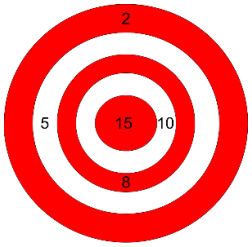

Figure 2 Target with Points for Launcho Playset

1.3 Comparable Products

Launcho is comparable to other toy rocket launchers, the most common type being air-powered ones such as the “MGFED toy rocket launcher for kids” [3]. Both Launcho and these kinds of rocket launchers are mechanisms to launch a toy rocket, but a difference between the two is the launch mechanism itself. Launcho utilizes a spring-powered launch system whereas the MGFED toy rocket launcher utilizes air to propel its rocket. Launcho also has the unique feature of a multi angle, 360-degree rotation about its launch point, giving further customizability to the user’s experience.

The Launcho can also be compared to a Nerf® gun as the internal launch mechanism was modelled after that of the Nerf® Elite 2.0 Volt. SD-1 blaster [4]. Specifically, the platform that

includes the spring and the latch which helps hold the spring in place was modelled after that of the Nerf blaster; this will be further elaborated on in section 3 of this report. However, these fire smaller foam darts whereas Launcho is designed to fire larger rockets.

2.0 Problem Definition

Launcho was being designed as a mechanical engineering toy for the ME 100 course as discussed in the letter of submission. The overarching concept of Launcho is a projectile launcher that can fire a toy rocket in any direction. It was decided early on that Launcho will be spring powered and have an adjustable launch angle to differentiate it from other toy rocket products. This also presented the main problem in designing the toy, as no prior toy has been created that shares these traits. These two main ideas served as the core functions of Launcho, and other required functions stemmed from this core concept. The various constraints (conditions that Launcho must meet) and criteria (features that Launcho should have) were also built from the core concept and are outlined below.

2.1 Required Functions

There are numerous required functions for a design to accomplish the idea of Launcho. The design should be able to launch a projectile. Additionally, it should also be able to adjust its launch direction to a wide range of angles and rotate 360 degrees to fire in any direction. Aside from the two most basic functions of the toy, a successful design must be able to hold the rocket in place, to ensure the rocket does not fall out of the launch tube before it is launched. Additionally, it must have a reusable launcher and projectile after each launch. If the launcher or rocket were to break after every single use, the design would not be successful as a final product. The launch angle must be able to lock in place to keep the chosen angle constant while the rocket is being primed and launched. Finally, there must be a way to launch the projectile on command as a random launch would make aiming the rocket difficult.

2.2 Constraints

For the design to be considered successful there are several attributes the toy must be capable of. If it does not meet these characteristics, it is not functional and thus unusable as a toy and the design is unsuccessful.

The toy must be safe. The overall safety of the toy has several aspects. There are many dangers associated with building a projectile launcher. The rocket cannot harm someone if they

are hit by the projectile. It should be impossible for the rocket to launch prematurely. It must be guaranteed that the rocket will not accidentally fire without the user's input to do so. The last major safety concern is that the launching system cannot be repurposed into a more dangerous weapon by using a different projectile or increasing the power of the spring system.

For the toy to be a successful design the launching mechanism must be reusable for at least 10,000 launches. If the projectile can only be fired once before the launch mechanism is replaced, the design is no longer usable. This would make the toy concept impractical and unviable. 10,000 launches provide a long lifespan for the toy and does not require expensive and over-durable materials.

The launch mechanism and size of the rocket must be compatible. For the rocket to fire, it must be capable of fitting in the launch mechanism with at least 1 cm of clearance. This allows room to avoid the rocket from scraping the inside of the launch tube, while also securing it in the tube without much room for movement.

For the toy to be enjoyable and functional, the rocket must be capable of firing at least 1.5 meters vertically. 1.5 meters allows the toy to be launched indoors, as the average room is about 3 meters tall [5],while still giving the toy enough height to be fun and a challenge to aim at the target.

One of the major functions of the toy is that it has an adjustable launch direction in a range from 90° straight in the air to 45° in front of the launch mechanism and rotate 360 degrees to fire in any direction. Once the platform is rotated it must then be able to lock and hold the launcher steady through the loading and firing process.

2.3 Criteria

Launcho has several criteria that would ideally be optimized. These are several characteristics of the toy that would inherently make it a better design without being crucial to the success or failure of the final product

While having a minimum launch height of 1.5 meters was a constraint, the design would ideally launch as high as possible without compromising how easy it is to fire or its safety for use indoors. This means optimizing the efficiency of the system to utilize as much energy from the spring in the firing of the rocket as possible. Having a rocket that launches higher would also make the toy more exciting for the user.

The next criteria is to make Launcho as consistent as possible. The process of loading the rocket, pulling the spring down into place and pulling the trigger to release should be similar every time. This process, while part of the toy, is not the focus of the play pattern but having an inconsistent loading process would take away from the game. The predictability of where the rocket will go after launch should also be consistent. The certainty of the flight path is important to the play pattern as the rocket is being fired at a target. The likelihood of hitting the intended target relying on luck reduces the playability of the game. For these reasons, the design would benefit from making the input and output of the launcher as consistent as possible.

The last main criterion is the ease with which it takes to operate the toy. The toy would be better suited to incorporate easy-to-understand and use controls. The toy is intended for children of at least 8 years old. This means that the intended user is not capable of operating complex machinery. The design should be as intuitive as possible so that everyone can easily jump right in and start playing with it. Specifically, this means the system of rotating and locking the launch platform in place as well as the loading, compressing of the spring and firing mechanisms.

3.0 Technical Progress

The design and creation of 5 parts for Launcho were required to have a functioning toy that matched the constraints and criteria outlined in section 2. These were the launch trigger to release and hold the spring, a method to prime the spring, the main launch tube to serve as the housing for every part, an adjustable base to meet the constraint of having an adjustable launch angle, and a rocket. Each of these parts had numerous solutions to be considered and were designed together into one first prototype, and then this prototype was refined into the final functioning prototype of Launcho.

3.1 Solutions Considered

Throughout the design process, many challenges presented themselves. The first of these being the body of the main launch tube. For this, IPEX® piping was chosen due to it being easily accessible, durable, and in a cylindrical shape. The durability of the piping specifically matches the durability constraint of the design. The IPEX® piping could also easily be cut, allowing

room for a handle to prime the spring, which was to be a metal bracket. This was chosen as it was easily accessible and thin enough to fit through the slits cut in the pipe.

The next part was the launch trigger. The initial solution was to create a launch mechanism using the components of a Jack-in-the-Box. Through online research looking into the mechanism of a Jack-in-the-Box [6], it was decided that this type of mechanism would not be appropriate because the release system is too weak to support the force of the spring that would be used. After concluding this, a Nerf® gun was chosen to be the new basis for the launch mechanism due to its ability to shoot a projectile a considerable distance, its ease of accessibility and its components that are safe for children. These characteristics also meant it would match the criteria of the toy to be safe and fire 1.5m. The Nerf gun was to be disassembled and its internal parts repurposed for the prototype (Figure 3).

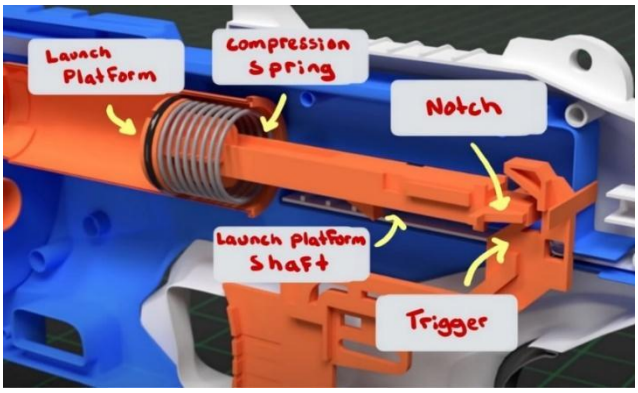

Figure 3 Nerf® Gun [7]. Photo of inner NERF® Gun components showcasing its function.

The final function of Launcho that needed a design was the adjustable launch angle. The solution was going to be a ball joint design, which will allow everything on top of it to spin and rotate, thus meeting the criteria to have a 360-degree, adjustable launch angle. A ball joint design was chosen as a tennis or hockey ball could easily be repurposed for a rotating platform and would also be approximately the correct size. The housing the ball would sit in would vary depending on the type and size of balls available. A cup was the initial solution due to their variety of sizes and being readily available, as well as the increasing diameter of some cups giving a good fit to allow a ball to sit and rotate in.

3.2 Progress to Date: First Prototype

As a Nerf® gun was the base for the main launch mechanism, one was acquired, and its components were disassembled, specifically the spring platform was used. (Figure 4).

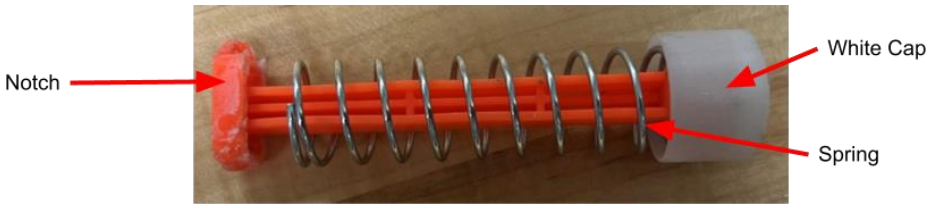

Figure 4 Nerf® Volt Spring Platform and Notch

The spring platform consists of a white cap to keep the spring on the orange rod, and a large notch unattached from the rest of the platform. The notch is stationary, and the rest of the system can move. When the spring and spring platform are pulled back, the notch gets caught in a divot inside the spring platform, locking it in place. It can then be fired by shifting the spring platform [4]. Based on the size of the spring platform, a 1-inch IPEX® pipe was chosen for the launch tube, and slits were cut in the side of it with a table saw. The metal brackets chosen were thin enough to fit in the slits and were flattened to create a straight handle. For the rotating angle, the original prototype was created using a hockey ball and plastic cups because these had a good fit with one another, and the plastic cups could easily be cut. For the rocket itself, a Nerf® dart was to be launched as the repurposed Nerf® launch mechanism was already designed to launch them. These parts were assembled into the first working prototype (Figure 5).

Figure 5 Prototype Adjustable Platform Rotating Via Ball Joint (left) and Prototype Rocket Launch Mechanism (right)

The spring inside the launch prototype gets primed by pulling down on the metal priming handle (Figure 5). The spring platform sticks out of the bottom of the launch prototype, and shifting it slightly allows the mechanism to fire. The platform can rotate about the red ball

located on top of the plastic cups (Figure 5). When the two prototypes are put together, the launcher can be rotated 360 degrees and aimed at a range of angles, meeting the constraint of the design that the rocket has a 360 adjustable launch angle.

When this prototype was tested, it was found that this trigger mechanism would release on its own without the action of the user. This is because the Nerf® gun latch always requires tension against the shaft to prevent it from being released. The prototype was then updated to use duct tape as a tensioning method which was not strong enough (Figure 6). As a result, this mechanism was still often released on its own and needed an improved design, as this fails to meet the safety constraint.

Figure 6 Duct Tape Covering the Bottom of Launch Mechanism to Provide Downward Force on Spring Platform

The launch mechanism itself also did not launch the dart 1.5m into the air, failing to meet that constraint. Other than a weak spring, this poor performance was because the metal slide moved independently of the spring platform, causing energy to be lost between the spring platform and the metal slide, as well as the metal slide and the dart. This also caused the dart to have an inconsistent launch path, therefore failing the criteria that it must have a predictable launch trajectory. The priming process was also difficult and not intuitive or consistent, also failing the criteria to have an easy and consistent operation.

The ball joint design did not account for locking the ball in place which is needed to ensure that the launcher stays at the correct angle when fired, and failed to meet that constraint.

While these prototypes are functional; however, they are too rudimentary and do not meet many of the constraints or criteria. Overall, this design was not complete and needed to be refined and improved into a final working prototype.

3.3 Progress to Date: Final Prototype

Many aspects of the initial prototype had to be refined, the first being the launch trigger. For the final design, a 3D model was created in Solidworks modifying the launch trigger of a Nerf® Gun. Instead of the trigger being parallel to that of the latch, the pin is perpendicular with a compression spring applying a constant force towards the shaft of the spring platform (Figure 7). This design was implemented by machining a steel rod to match the Solidworks design. The steel rod was able to be lathed down to size and filed for a smooth diagonal edge. As a result, this part locked the shaft in place and prevented the mechanism from releasing itself, thus meeting the safety constraint of not having accidental fires.

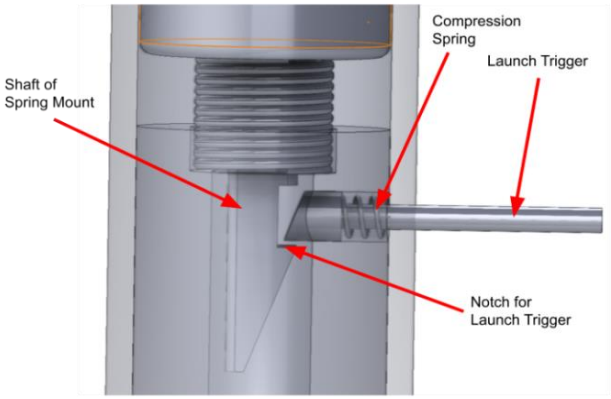

Figure 7 Launch Trigger. Image showcasing various inner components of the trigger mechanism

A second refinement required from the first prototype is priming the spring. The original spring platform did not have an efficient method to pull it down and lock in place. To resolve this issue, a scaled-up 3D model replica was modeled in Solidworks to be 3D printed (Figure 8).

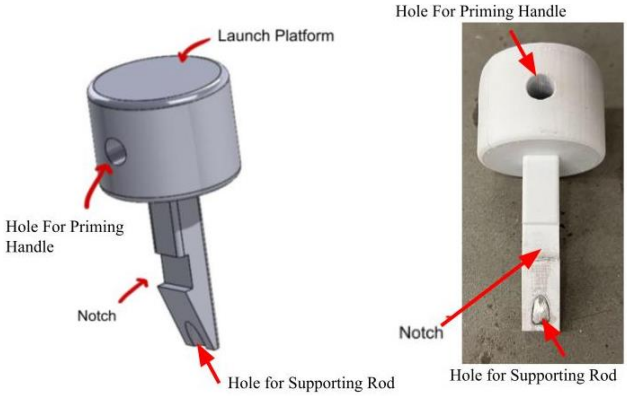

Figure 8 Launch Platform Solidworks Model (left) 3D Printed Part (right)

This part contained a hole where a steel rod can be inserted as a priming handle (Figure 8). The handle was made from steel as the rod size that was sourced perfectly matched the dimensions for the handle, as well as being a strong part to ensure the durability of the design, as per the durability constraint. This piece was also chamfered on both sides to remove the sharp metal edges which would be a safety hazard. This handle can be pulled down on either side and bring the lunch platform downwards to lock it in place. Also in this model is a hole in the bottom of the spring platform for a supporting rod (Figure 8). As this part housed the spring, it would experience the most force. To help prevent it from breaking and thus meeting the durability constraint, a supporting rod would go through the part from the hole in the bottom. The supporting rod was chosen to be made of steel since it was meant to support its weak 3D-printed counterpart, the launch platform. Another steel rod was purchased to match the diameter of the bottom hole, as machining the rod purchased for the priming handle was close to impossible due to its thinness. This and many parts of the final prototype were 3D printed, as 3D printing allowed for highly customizable parts, without the need to purchase a large variety of parts and have advanced machining skills.

To fix the lack of a locking mechanism for the adjustable angle, and to ensure a better build quality than the first prototype, A 3D Solidworks model (Figure 9) was designed with fixes to these problems and in turn, to meet the constraint of having a way to secure a launch angle. In this new model, the base had an opening for a bolt that can apply pressure to the ball, locking it in place. The ball itself is free to rotate inside the base and each component was scaled up from the initial prototype to match the other designed parts.

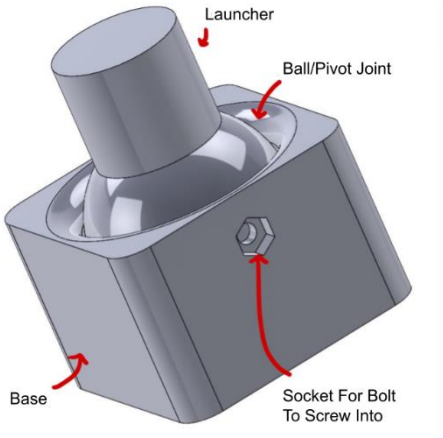

Figure 9 Ball Joint. Image of components for rotating launch base.

The ball joint, and Launch Platform were 3D printed as they were the hardest and most time-consuming to machine. Specifically, the ball joint because it required spherical features to allow for three-dimensional movement and the Launch Platform also had a very intricate and unique shape. ABS was chosen over PLA for the 3D printing material since it is generally sturdier, which was required for the durability of 10 000 launches.

The spring in charge of creating the launch force was initially sourced directly from a Nerf® Elite blaster. However, in the first prototype, it was proven to be insufficient for a launch height of 1.5 meters, so a new, stronger spring was purchased. Also like the prototype, the launch tube was made from IPEX® pipe but compared to the first prototype it was sized up to 1.5 inches. This is because a 1.5-inch pipe had already been acquired during the design of the first prototype, and each of the 3D-printed parts had been scaled up. However, unlike the prototype, it was milled with all the slots and holes (Figure 10).

Figure 10 Milled Slots of Final Prototype

These holes were machined to an appropriate size so that children would not be able to stick their fingers in the launch mechanism while still leaving room for the steel rods to fit inside. As an aesthetic addition, the launch funnel and platform were spray-painted red and Launcho was written on the side of the launch tube. This drastically increased the aesthetic appeal of Launcho.

Once each part was created, they were assembled into the final prototype (Figure 11). Nearly all parts were held together with super glue, as it was easily available.

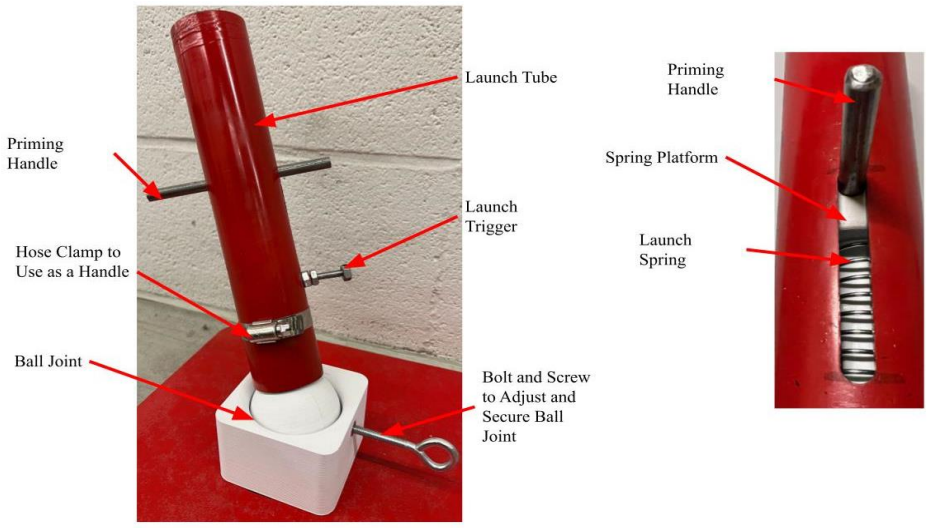

Figure 11 Final Assembled Prototype

To operate Launcho, the priming handles get pulled down to where the launch trigger locks into place, from there, the bolt on the bolt joint can be unscrewed to allow free movement of the whole system. Once the desired angle is chosen, the bolt can be tightened to lock the angle in place. Once the rocket is loaded, the launch trigger can be pulled, releasing the spring, and launching the projectile toward the target. Throughout testing, each individual component of the design worked, the supporting rod in the launch platform was successful in preventing damage to the part and the launch trigger worked flawlessly. However, over prolonged testing, many durability issues began to arise, specifically with the ball joint. Even with the material selection of ABS, the 3D-printed parts were still too weak for regular use of the bolt which locked the ball joint in place. Since the ball was slightly hollow, the bolt broke through the surface of the ball due to the constant pressure applied. Tape was used to create a temporary flat surface for the bolt to screw into (Figure 12).

Figure 12 Damage to Ball Due to Repeated Use

Another issue with the ball joint was the nut securing the bolt used to lock the launch angle. While the nut was glued in place, repeated use caused the hold to weaken and eventually the nut would come out of its socket (Figure 13). This required constant re-gluing during use.

Figure 13 Bolt Mechanism Coming Out of Socket

Both issues with the ball joint prevented the design from meeting the constraint to last for 10,000 launches and proved to be a failure in the design.

Another oversight of the design is the lack of a proprietary rocket. The rocket itself was planned to be a short PVC pipe wrapped in foam. However, this design was too heavy to be launched and did not reach a reasonable height to make the toy enjoyable. Therefore, a Nerf® dart was used instead because it was light, aerodynamic, and safe. However, a Nerf® dart still did not meet the constraint to launch the rocket 1.5 meters high, and therefore also caused a failure in the design.

3.4 Remaining Challenges

A significant challenge is the 3D printing of components. The design relies on four printed parts which have a print time of about twenty hours. This process is extremely delicate, as a faulty printer can easily cause the whole print to fail. This also caused many durability issues as the ball joint structure collapsed through sustained use. New materials must be used for these components, and it would be faster to produce and create longer-lasting parts. Some possible solutions might be to use subtractive manufacturing techniques to create aluminum parts or plastic parts through injection molding.

The failure of these parts, specifically the ball joint connected to the tube structure, resulted in another major issue for Launcho. The toy was incapable of locking the structure into place when a force was exerted by the user in the loading phase. This is partially related to the structural failure of the base and ball joints. It was also partially due to the screw system

currently being implemented. The concept should be able to hold the position of the launcher, but more friction is required from the end of the screw.

Super glue as a means to assemble all of the components of Launcho proved to be a non-ideal solution. It was incapable of securing the bolt to the socket in the ball joint through repeated use. A stronger industrial-grade glue could be used or more parts could be manufactured together as one component to minimize these weak points.

There are also several smaller issues with Launcho's design. Pulling the priming handle down to prime Launcho must be done by pulling one side down first. This seems minor but through observing people playing with Launcho, it was clear that this was causing a significant amount of confusion. Launcho must also come with its own version of a projectile. It cannot rely on a Nerf® dart to be played with when being sold.

4.0 Conclusions

Launcho is a feasible toy design, but it requires more time to refine each function to the constraints and criteria, as well as fix material durability issues. While the toy meets the main functions, being able to adjust to a wide range of angles and launch a projectile, it is not refined enough to meet the durability constraint nor the height constraint on the projectile. Through the research of materials, parts, and constant testing, adjustments were implemented to counteract problems present in the first prototype. These designs were then evaluated to ensure they would be efficient and effective. Although each of the prototypes proved proof of concept, and in some cases, final designs of perfectly working parts, it was evaluated that they needed to be improved. This is because they had failed to meet some of the main criteria, meaning Launcho is not a viable product or completed design yet. The final prototype however was able to successfully meet its main functions, which proves the feasibility of the design.

4.1 Recommendations

The concept of Launcho is feasible as it successfully meets the main functions, but it needs time to have a fully completed design optimized enough to match each constraint and criteria, specifically the durability and projectile height constraint. If the assembly of the toy's components did not rely as heavily on 3-D printed parts, it would be more durable. This could be achieved through injection molding. Having more durable, injection-molded, parts would ensure

Launcho meets its criteria for surviving 10,000 launches. To also prevent the ball from taking sustained damage from the screw locking it in place, the tip could be made from foam, as this would cushion the two surfaces. Additionally, it would be best to create a more appropriate rocket for Launcho to use as a Nerf® dart was not the initial type of projectile envisioned, nor does it provide a good fit with the launch tube. This is because a Nerf® dart is much too small and prone to damage which then causes inconsistencies in its flight path. It would be better to create a slightly larger rocket that would correspond with the diameter of the launch tube, creating a more secure fit, while still ensuring a design that is still safe for children. For instance, molding a projectile with a shape and material like a Nerf® dart, but larger, would ensure safety and should produce better results.

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