Grab-A-Goose: Toy Design Report

A Report Prepared For:
Spin Master Ltd.
121 Bloor Street E
Toronto, Ontario, M4W1A9

Prepared By:
Jonathan DiGiorgio, Salma Tartoussieh, Noor Bansal, and Samy Merhi
Department of Mechanical and Mechatronics Engineering
University of Waterloo
200 University Ave W.
Waterloo, Ontario, N2L 3G1

December 7, 2022

Department of Mechanical and Mechatronics Engineering
University of Waterloo
200 University Ave W.
Waterloo, Ontario, N2L 3G1

December 7th, 2022

Mollie Jameson
Spin Master Ltd.
121 Bloor Street E
Toronto, Ontario, M4W1A9

Salutations,

This report, entitled ME100: Toy Design Project Report, was prepared as our design project submission for ME100: Introduction to Mechanical Engineering Practice I at the University of Waterloo. This report is intended to provide all the information regarding our selected concept and the progress we have made in the concept's development.

Our group consists of four 1A Mechanical Engineering undergraduates. We were tasked with ideating, prototyping and designing a toy for this design project. The toy company Spin Master has worked with the entire class to give constructive criticism and advice on the toy creation process. This has been a challenging but valuable experience in the world of toy design.

Our toy is a fishing-style game with the added twist of a whirlpool. It contains all the classic components of a fishing game, including targets, spring-powered fishing rods, and reels. The game is meant to be played competitively against other players to capture the most targets.

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,

Jonathan DiGiorgio
1A Mechanical Engineering - ID: 21007800
jddigior@uwaterloo.ca

Salma Tartoussieh
1A Mechanical Engineering - ID: 20996883
smtartou@uwaterloo.ca

Noor Bansal
1A Mechanical Engineering - ID: 21020542
n2bansal@uwaterloo.ca

Samy Merhi
1A Mechanical Engineering - ID: 21020542
smerhi@uwaterloo.ca

Table of Contents

List of Figures

Summary

After extensive ideation, the chosen toy idea was a fishing-style game where targets float in a whirlpool to be ‘caught’ with a fishing rod launch mechanism. The game theory was inspired by ‘The Fishing Game’, however, it includes more complex and engaging mechanics. The required hand-eye coordination and the relatively complex idea make the toy rated for 8-year-olds and above. The design includes several important functions: creating and maintaining a whirlpool, launching a projectile, having the projectile attach to the targets, targets floating and moving within the whirlpool, and finally, a way to reel the target to the player. An issue that came with the creation of this game was making it unique and fun. The different coloured geese and point system allow for a challenging and mildly frustrating game that becomes highly satisfying and fun to win.

There are several constraints associated with these functions. Most importantly the toy had to be designed in a way that is safe for children. Other important constraints include a $15 spending limit per member, a 5-minute minimum run time for the whirlpool, space for a minimum of 10 targets, a minimum of 50 cm launching range, a 15–75-degree launch angle, and a reel that can crank and store at least 50 cm of string. Everything must also be waterproofed and function when wet. The criteria include maximizing user satisfaction, allowing for the projectile to effectively launch, and the targets being able to float without flipping over.

Each function had several solutions that could have been chosen. Influencing the whirlpool could have been done using a blender propeller, a pump that drives water in and out of the container, and lastly, the one that was used for the toy, a spinning magnet. The magnet rests on the bottom of the container, with another magnet under it separated by the container and creating the spinning magnet due to the opposite poles. Some solutions to the projectile included a hydraulic launcher and a pneumatic launcher, working in a similar fashion with fluid and pressure. The final considered solution that was chosen for the toy was a pull-back spring launcher. Rubber ducks as targets were the only solution thought of since they are cost-efficient and float on water. Hooks, velcro, and magnets were considered solutions for the projectile. For the toy, magnets were the most logical and easiest way to attract the targets to the projectile. Finally, the solutions to the retrieving mechanism were manually pulling the rope back, and a grooved ball bearing and crank with 50 cm of string.

Recommended further plans for the toy include re-aligning the driving magnets to reduce vibrations, reworking the launcher drawback to decrease the pinching hazard and trying fishing line instead of a string. A possible addition would be a feature to change the speed of the whirlpool. Making this toy more cost-efficient would be the goal in mass-producing it, which would mean considering alternate solutions for a whirlpool without a circuit.

1.0 Introduction

Grab-A-Goose is a classic fishing-style game where players compete to capture the most targets using spring launchers. However, this toy includes a whirlpool unlike comparable products on the market. This adds a level of difficulty and plays into the fishing role-play. Each player flicks a spinner with different colours on it and must catch the corresponding-coloured target. The player with most targets at the end of the game wins, which is when all the targets are captured. The age range is 8 and up because the complexity of play requires more advanced motor skills than younger children will have. The most comparable product on the market is "The Fishing Game", which provided inspiration for the design process of this toy [1]. Though there are certain differences between the two, Grab-A-Goose essentially brings "The Fishing Game" to life. The main objective of this report is to answer the question of whether the toy is viable to be mass-produced commercially as well as determine whether further work should be done on Grab-a-Goose.

1.1 Scoped Idea

The idea is a competitive 2+ player game. Two or more players face head-to-head to see who can catch a specifically coloured goose that is spinning around a whirlpool. The colour will be chosen by a spinner wheel with a multitude of colours and the players will need to successfully remove the goose from the whirlpool to acquire the point. The player must launch some sort of 'fishing rod' and reel out the goose to gain a point. The group's playtesting found this to be a challenging game but will make a more interesting and fun time for the user since it adds an aspect of mildly frustrating competition.

1.2 Play Pattern / Age Range

Grab-A-Goose is a multi-component toy involving the use of a whirlpool and a launching mechanism. Two or more players at once attempt to fish out targets from an active whirlpool using the provided launchers. The launchers are equipped with a reeling system, allowing them to retrieve the targets out of the pool and pull the targets toward them. The toy also comes with a coloured spinner that corresponds to the targets in the whirlpool. Figure 1 accurately represents the scoped-out set-up of the game.

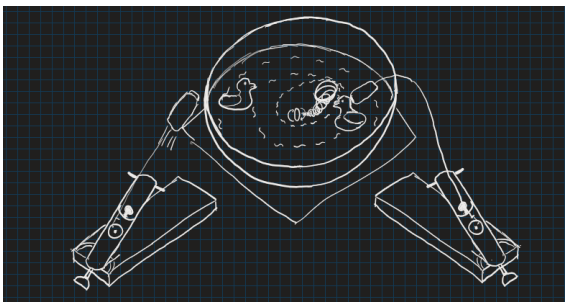

Figure 1: Grab-A-Goose Big Picture Sketch

The whirlpool is situated in the middle, equally distanced from both launchers. Before each player takes their turn, they spin the spinner, having it land on a colour, telling them which target they must aim for. This continues until all targets are collected from the whirlpool, ending the game between the players.

Grab-A-Goose toy is recommended for children ages 8 and up. There are certain elements of the toy (using the launcher, aiming for the targets in the whirlpool, reloading the launcher, etc.) that require more hand-eye coordination and strategic thinking that children under the age of 8 have yet to develop. The Consumer Product Safety Commission of America (CPSC) states that children aged 6-8 "focus more on playing their games and activities by spontaneous or set rules, either of which can be complex… They often want to focus on and develop specific skills, and are adept at a variety of activities requiring great dexterity, such as complex hand games" [2]. Due to the current difficulty of the toy, the group has decided to take the higher end of this range provided by the CSPC. Having this minimum age prevents any unnecessary injuries from the lack of critical thinking which young children may have (putting a hand in the whirlpool, putting a hand in front of the launcher, etc).

1.3 Comparable Products

The most comparable product to Grab-A-Goose would be "The Fishing Game" [1]. This toy has a fishing mechanism and targets; however, the play pattern of the game is slightly different. The product uses a hook mechanism to catch the targets on the game board as seen in Figure 2. The targets spin around in wave-like motions in plastic craters while opening and closing their mouths so the player can use the hook to effectively catch the targets. Grab-A-Goose essentially brings "The Fishing Game" to life, where the targets are situated in water that is moving more realistically due to the whirlpool. The launching and receiving mechanisms are also different due to the use of a launched projectile rather than a fishing rod. This toy provided a lot of inspiration considering how popular and highly rated it was during its release.

Figure 2: The Fishing Game by Sonew [3]

1.4 Objective

The objective of this report is to examine the viability of Grab-A-Goose as a legitimate toy idea. This report aims to provide an answer to whether the toy should or should not be produced commercially. It will furthermore explain flaws in the design, and potential solutions to increase the viability. This report is also being made to collect the process and thoughts of the group in order to create a foundation for which further potential models may be created. It will also provide insight into whether it is worth it to continue working on and remodelling the toy.

2.0 Problem Definition

Every toy design process involves several underlying engineering problems that must be solved. Grab-A-Goose has multiple mechanical functions; however, it also has smaller elements to it which contribute to the overall performance of the toy. One of the main components of the toy must allow the targets to move instead of remaining still. Incorporating a whirlpool as a mechanical function allows the targets to move in a rotational manner. Grab-A-Goose must also include a component which allows the user to interact with the targets, thus, developing a launching mechanism is another mechanical function for the user to control. To successfully complete the "catch", the projectile must touch and connect with the target. As the user "fishes" the target, it is critical for the projectile to stay attached to the target. In order to successfully "catch" a target, they must float above the whirlpool. After a launch, there must be a function to allow the user to retrieve the target. Aside from the main functions, a few general problems contribute to the success of the toy. To create a successful toy, the toy must be considered unique and fun to play with by play testers of the intended age range. Researching comparable toys and their functions can provide inspiration for the toy. They can be further refined based on Grab-A-Goose's required functions and problems allowing it to be unique. The toy must also be enjoyable for the target users while remaining within its constraints and criteria.

2.1 Required Functions

Grab-A-Goose requires five functions to work successfully.

1. **Influence a Whirlpool:** The toy must be able to create and maintain a whirlpool with floating targets in it. This adds a level of fun and gets the targets to move around rather than remain in a stationary state.

2. **Launch a Projectile:** The design must be able to effectively launch a projectile with user control. 'Launching' the fishing apparatus is an integral part of the game.

3. **Projectile Attaches to Targets:** The projectile and targets must be designed such that they can attach and be pulled out of the water together. This is an immensely important function so that targets can be 'fished' as per the game objective.

4. **Targets float and travel around the whirlpool:** The designed targets must be able to float in the water and travel in a uniform motion around the whirlpool.

5. **Retrieving mechanism:** The retrieving mechanism, projectile and 'fishing line' must be designed such that the targets can be lifted out of the water. This is essential to give the true fishing experience in a game, as well as a convenient way to return the projectile to the launcher.

2.2 Constraints and Criteria

Along with functions, engineering problems always come with constraints and criteria which must be worked around. When dealing with children's toys, safety is obviously of the number one concern and the most important constraint on the design. Safety constraints include non-harmful projectiles, a stable build to reduce tipping/spilling, maintaining a barrier between circuitry and water, a non-harmful magnetic stirrer and ensuring there are no safety hazards with the launcher. Another large constraint on the group is cost. The cost of the prototypes must be below $15 per person as determined by a unanimous group vote. The manufacturing cost must also be considered to create a viable toy.

Each component of the toy has its own set of constraints which ensure the toy is playable. For the whirlpool, the group determined that it must function continuously for 5 minutes to give ample time for gameplay. The whirlpool must also be able to handle at least 10 targets and run off a standard Canadian outlet. The launcher must have a range of at least 50 cm since the recommended distance of play is 25-40cm. If mounted, it must have a launch angle of at least 15-75 degrees for accurate launching. Since the range must be at least 50 cm, the reel mechanism must be able to hold and pull all 50 cm of string. Waterproofing is a constraint which applies to the targets and the projectile. The final design must be able to prevent all leaks which may lead to sinking in the water. The design's materials must also be constrained to those which do not lose structural integrity from wetting. The toy and all its components should continue to function after touching water.

It is also important to consider the criteria involved with each function. Ultimately the goal is to maximize fun by balancing competition, difficulty and novelty. The projectile must be able to easily and effectively launch into the whirlpool container. The projectile and targets must float in the water to avoid interference with the spinning magnet. The targets must also not flip over and put the magnetized area away from the surface.

3.0 Technical Progress

During ideation the group considered several solutions for each of the required functions. For the whirlpool, a propeller, pump system and magnetic spinner were all considered. The latter was chosen due to its ease in waterproofing, safety and ease of design compared to a pump system. For the launcher, the possible solutions were pneumatic, hydraulic and spring-powered launch mechanisms. The spring launcher was chosen due to its simplicity of design and use by players, as well as being cost-effective and consistent. This choice is also marginally safer due to the immense force that can be produced from pneumatic and hydraulic systems. For floating targets, the only viable solution was rubber ducks since they float effectively and are not costly. For a projectile that attaches to the targets, the considered solutions were a physical hooking mechanism, velcro, and magnets. Magnets were chosen to make the game easier to play, more aesthetically pleasing (magnets are hidden), and avoid safety concerns of hooking mechanisms. To retrieve the target pulling the string and a reel mechanism were considered. The group chose to sacrifice simplicity to make the reel in order to play into the fishing role-play and make the game more interesting.

Thus far the group has tested the constraints and found that the proposed launcher prototype meets the range and angle requirements. The targets and whirlpool times passed the constraints with minor leaking in targets noted. The reel functions within the length requirements and the projectile effectively connects to targets. The projectile also experiences no leaking and floats on the water. The max target capacity was untested as the group only had the time and money to create 4 targets. Of the targets, it was observed that wide flat targets with a low center of mass are optimal to prevent flipping.

There are many remaining challenges to the production of Grab-a-Goose. The magnets must be realigned in order to reduce vibrations. The magnet strength used, and the size of the reel must be tested and altered to give the most optimal play. Whirlpool speed is an interface that the group would like the players to have as an additional means of challenge. Different target sizes and shapes must be tested in order to prevent the flipping of targets from the weight of the magnet. The toy is also expensive to be mass produced due to the electronics. The development of a foot pedal instead of electricity could be a viable option to spin the bowl of water for a cheaper manufacturing cost.

3.1 Solutions Considered

Influence a Whirlpool:

The first proposed solution was a ‘blender’ system composed of a propeller placed at the base of a container. The container is filled with water submerging the propeller. As the propeller spins, the water

rotates and creates a whirlpool, similar to a blender. The next proposed solution used a pump to drive the water in and out of a container. The pump is placed in a base container filled with water (separate from another container where the whirlpool will occur). A tube attaches to a pump that leads into the whirlpool container. The pump sends water to the top of the whirlpool at an angle to create rotational motion. As seen in Figure 3, there would be a small hole at the bottom of the container to drain the water back into the pump, having it repeat the process continuously.

Figure 3: Pump whirlpool system. Intake bottom, outputs top right [4].

The last solution considered involves a spinning magnet solution with two magnets placed in the centre of a powered fan or motor; this fan is powered through a simple series circuit. As seen in figure 4, the two magnets are positioned in the center of the fan: one having its north pole facing upwards, and the other with its south pole facing upwards. This system is then put in a separate container and placed underneath a large bowl. This bowl holds a magnetic stirrer that attracts to the magnets below in the container. Once the fan/motor spins, it causes the stirrer to spin, creating a vortex when the water is added.

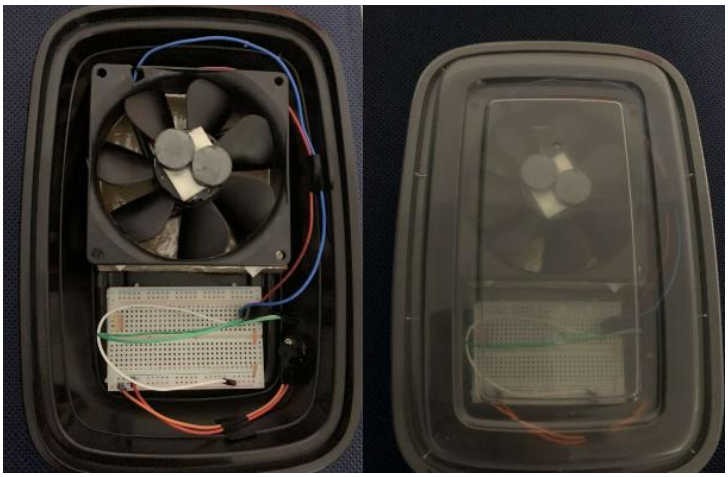

Figure 4: Prototype for magnetic spinner.

Launch a Projectile:

The solutions considered for this function of the toy include: a pneumatic launcher, a hydraulic launcher, and a spring launcher. The hydraulic launcher would be constructed by having a syringe, like figure 4 act as a hydraulic pump to push the fluid through the body of the launcher. This converts the hydraulic fluid power into mechanical energy, launching the projectile. The pneumatic launcher is composed in a similar sense. The launcher would contain a tank filled with pressurized air. Once the pressure is released through the valves, the pneumatic potential energy in the launching system is converted into mechanical energy, launching the projectile. Figure 5 is a diagram showcasing a potential pneumatic system.

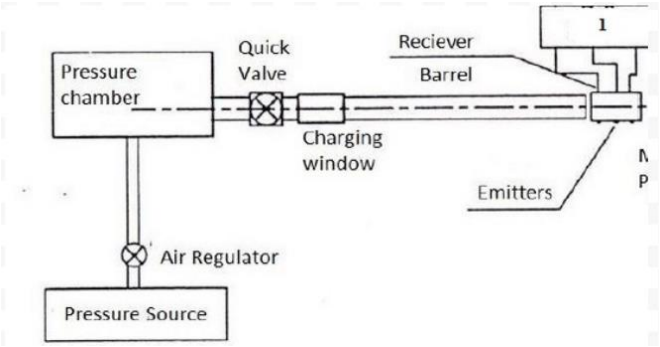

Figure 5: Diagram of pneumatic launch system [5].

The last considered solution was a spring launcher, which would be built in a similar way to a pinball launcher. As seen in figure 6, a spring is placed around a bolt which is then attached to the PVC body using a washer and resin. The projectile is placed in the barrel of the PVC. When the bolt is pulled back, the spring compresses, storing spring energy. When the bolt is released, the spring extends outwards, launching the projectile towards its aimed target. Figure 6 shows what a possible launcher would look like.

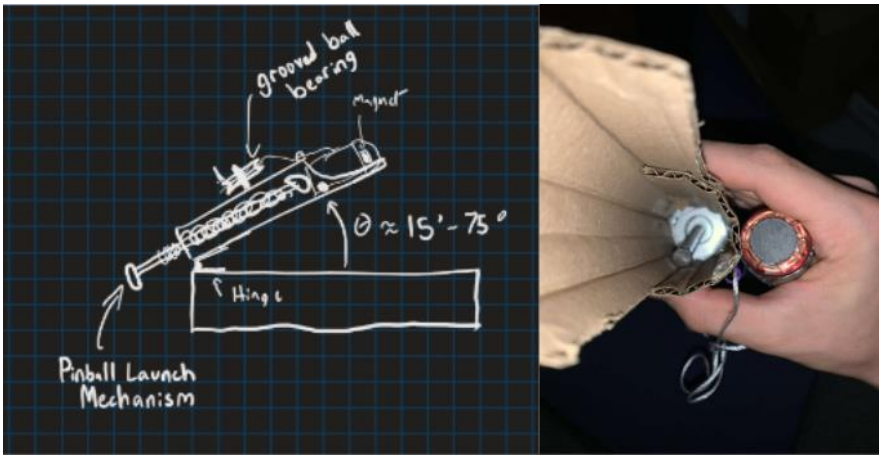

Figure 6: Sketch of launcher (left), prototyped launcher(right)

Targets Float and Travel Around the Whirlpool:

Using rubber ducks and Ping Pong balls were the solutions proposed when developing this function. Rubber ducks come in many different shapes and sizes, which allows the group to run many tests and find the optimal shape and/or size in which targets do not flip over. Additionally, the rubber ducks are cost efficient and water resistant. A ping pong ball exhibits many of the same benefits as the rubber ducks, however, they do not add to the toy's aesthetic, and they are harder to customize (e.g cut into).

Projectiles Attach to Targets:

The solutions thought of when creating this function were using velcro, hooks, or magnets. Velcro strips could be placed on the head of the projectile and floating targets. So, when the projectile is launched, the velcro attaches itself to the other velcro piece on the duck. Another solution is for hooks to be placed on the head of the geese and projectile. So, when the projectile is launched, the projectile grasps onto the duck's hook. The final proposed solution was magnets which are fastened to the head of the projectile, with the opposite side of the magnets placed on the heads of the geese as seem in Figure 7. When the projectile is launched, the projectile magnet latches onto the magnet on the floating goose.

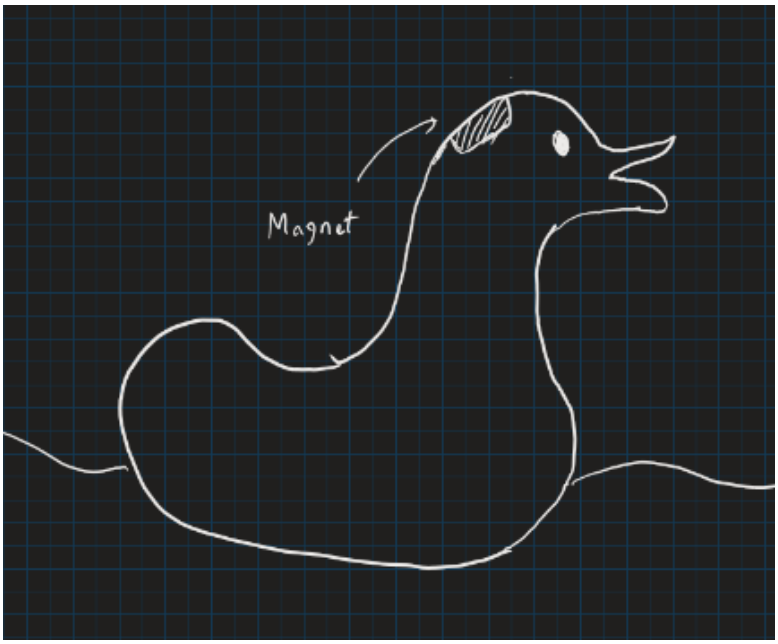

Figure 7: Magnetic target attachment system

Retrieving Mechanism:

The solutions considered for the retrieving mechanism were using a fishing reel system and pulling the rope back in manually. The fishing reel solution is made using a grooved ball bearing, and a crank attached to the string. The ball bearing is attached to the outside of the launcher with a crank rod placed near the edge of the bearing. Then, one end of the string is attached to the projectile, while the other is fastened to the groove of the ball bearing. As the crank is spun, the ball bearing collects the string, looping it around its body. Furthermore, when the projectile is launched the reel mechanism releases all the string and when the projectile needs to be retracted back to the player, the reel can do so by the use of the crank. Different sized grooves could be chosen by 3-D printing an outer groove which could be placed on a generic ball bearing. Figure 8 shows the reel prototype and a proposed 3D model for a reel.

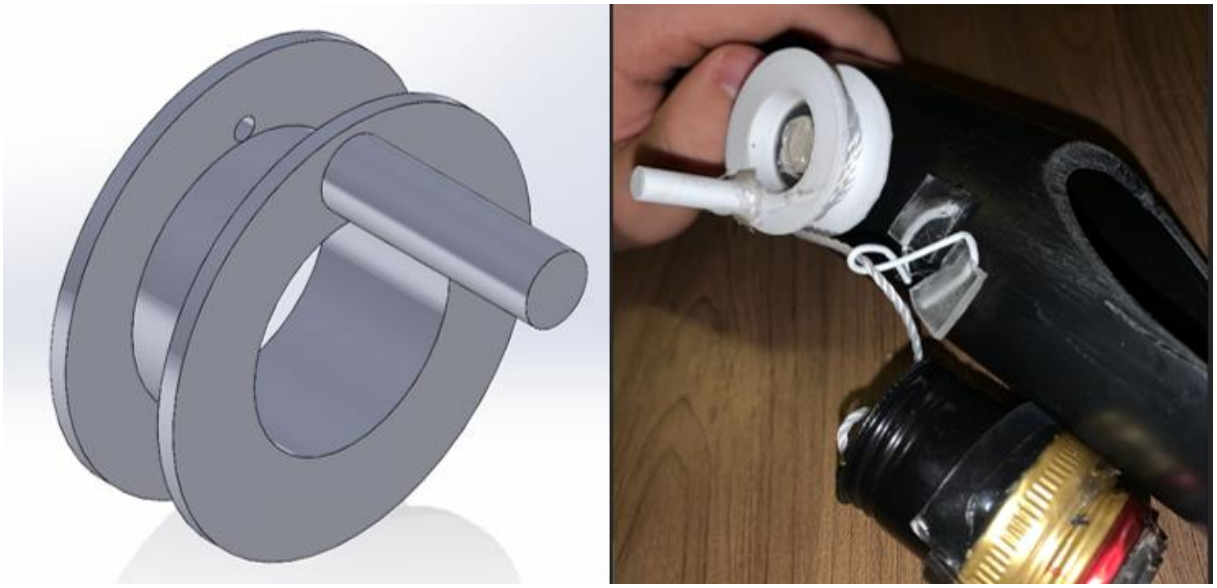

Figure 8: Solidworks model of bearing casing (left), 3-D printed bearing casing on prototype (right).

The second solution for this function is pulling the rope back in manually. Once the players attach a goose to the projectile, they can retrieve it by pulling the string with their hands until it reaches them.

3.2 Progress to Date

Figure 9: Latest prototype including all chosen function solutions.

Figure 9 shows the progress to date: a functioning whirlpool, launcher, targets and retrieval system. The spinning magnets were chosen to influence the whirlpool. The materials needed to construct the blender and pump solutions were challenging to acquire with the time given and budget set. The magnets needed for this system were easy to retrieve and simple to assemble to create the whirlpool. Additionally, the magnets kept the whirlpool active for extended periods of time (e.g 30 minutes) and could continue being active while being disturbed; for example, if more water or targets are added to the container. Magnets also seemed to be the safer solution, as they did not expose audiences using this toy to sharp blades or any harmful suction. Furthermore, magnets do not need to be waterproofed as they can continue to function properly underwater for long periods of time.

The spring system was decided to be used when launching the projectile. While the pneumatic and hydraulic systems can be more powerful, they are harder to control and difficult to build for the toy's intended launching range. Additionally, these systems can be dangerous for the intended audience. Both can generate a large amount of force, which can be inflicted on the players and others when used improperly. Furthermore, the spring launchers are cost-efficient, user-friendly, and able to function properly

if exposed to water. It can also launch the projectile a certain range of distance each time, making it more consistent than others.

Rubber ducks were chosen to be the floating targets that travel around the whirlpool. As mentioned in section 3.1, they provide more benefits than the other solution proposed. Magnets were decided to be the best solution as the projectile that attaches to the targets. The attraction between magnets has a strong enough magnitude to attract targets but weak enough to avoid attracting the stirrer or multiple adjacent targets. This limits the chances of the ducks falling once they attach to the projectile magnet. Magnets are also safer around children rather than sharp, pointy hooks that could cut or puncture a child if used improperly. Additionally, as mentioned above, magnets can also function sufficiently when exposed to water, unlike other solutions.

The fishing reel system was chosen as the retrieving mechanism of the toy. It allows children to role-play as 'real-life fishers', expanding their creative mindsets. The reel also creates a safer environment for them. Additionally, pulling the string back in can result in burns on the players hands from attempting to pull the string back in fast; the fishing reel mechanism prevents this, while also adding more competitiveness to the game as it is more time-consuming to reel in the string. With all these solutions the group fabricated a prototype for the toy shown in Figure 9.

The bullet attached to the launcher effectively travels a distance which fits within the outlined constraints within the angular range. Since a prototype with a mounted launcher has not yet been developed, the angular range is 0-90 degrees, meeting the constraint. Ten trials were done to find the distance travelled by the projectile, as seen in Figure 10. An average range of 66cm was found which is greater than the constraint of 50cm.

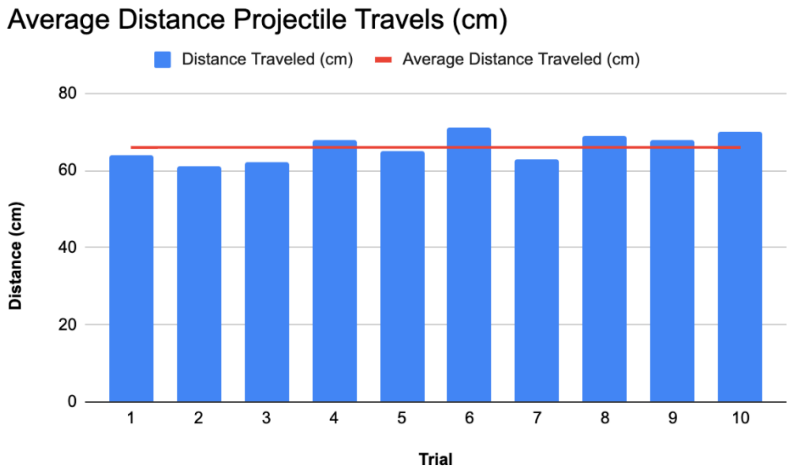

Figure 10: Data on launch range of prototype.

The launcher works well and can successfully attach to the objects without worrying about detaching due to the lack of strength between the magnets. During playtesting it was observed that the projectile rarely detached from a target unless there was a sudden movement. It was also observed that the projectile magnet never interfered with the spinning magnet. Additionally, the rubber ducks were waterproofed by having their bottom faces duct taped and sealed with hot glue. However, in all tests it was observed that water still seeps inside, causing the rubber ducks to begin capsizing. This made it harder for the projectile to attach to the ducks as the magnets within them now underwater.

The whirlpool prototype successfully functions within the constraints, greatly exceeding the requirements. Each trial was cut at 15 minutes with the magnet still spinning because the whirlpool never stopped. The targets were also able to stay floating for 15 minutes per trial, however, some water penetration was observed which would most likely lead to eventual sinking. During this test, the group observed which targets tended to stay upright the most. Of all the targets with functioning magnets, it was found that the turtle (wide base and short) stayed upright the longest compared to the other targets. Empirically, it seems as though targets with a low center of masses and wide bases would be best suited as targets in Grab-a-Goose.

The group was unable to test the constraint of having 10 targets in the whirlpool. Due to a lack of time and money, the group was unable to acquire enough targets and the subsequent magnets to test the constraint. According to the online calculator planetcalc, 27 targets of 1in radius can fit in a bowl of 6in radius [6]. The prototype bowl is roughly 1ft in diameter which could therefore comfortably fit 10 targets roughly 2 inches in diameter.

3.3 Remaining Challenges

The current prototype for the Grab-A-Goose has many flaws which pose several future challenges for the development of the toy. Currently, the prototype of the whirlpool vibrates causing a disrupting sound and occasionally knocking electronics out of place. Vibrations in rotating objects are generally due to unbalanced rotation like in this case, uneven placement of magnets on the fan [7]. The spinning magnet in the water also occasionally flies out of place, stopping the whirlpool. The group's theory is that the fan magnets are too close together, creating a very narrow area for which the whirlpool magnet may function, slight deviations from this area cause dysfunction. In order to solve the issue, re-aligning the magnets and placing them further radially is necessary. Doing such might involve acquiring a wider-bodied fan or alteration of the fan body.

A foreseen issue is that the projectile may float in the water and pick up targets as it passes without any real skill involved. This can be controlled by testing and tuning different magnetic strengths such that

it is strong enough to lift targets but not to attract them from below the water. However, the launcher fires well but the pullback mechanism requires more force than most children could provide. A more optimal spring must be found which is less stiff but makes up for it in increased length.

The 3-D printed reel design works but many playtesters commented that the reel is ‘awkward’ to spin. A solution is to provide a more stable axle with an interference fit or stronger adhesive, as well as modifying and testing different reel diameters.

The group would like to see the implementation of whirlpool speed control as an extra layer of play customizability. This would involve the use of a potentiometer and transistor in addition to the original circuit (Figure 11). Having all the user interfaces (switch, potentiometer dial, power supply) on the outside of the circuit box would make for much more simple and more convenient use. This involves deciding on a final circuit box with grooves for each component and soldering the final circuit to it.

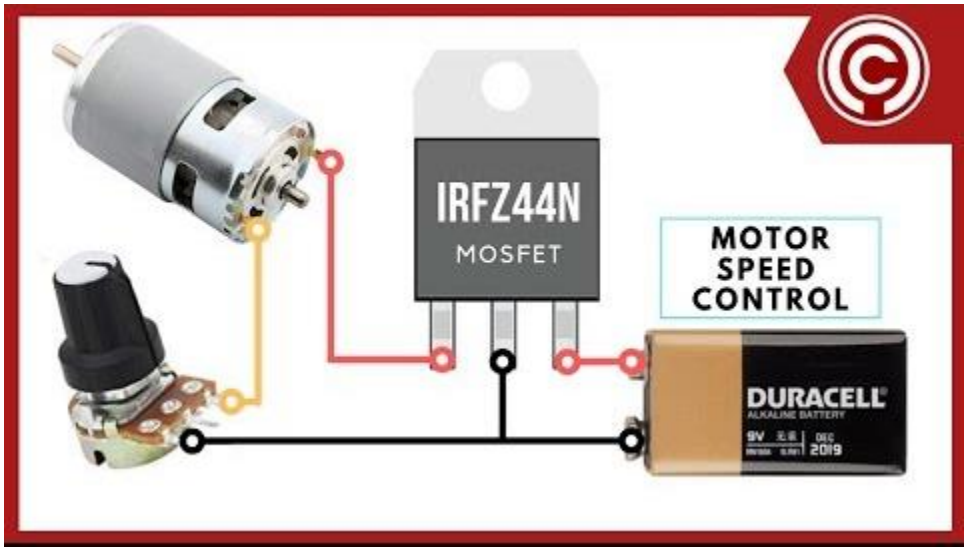

Figure 11: Proposed circuit for variable motor speed control [8].

Currently, the targets don't travel smoothly in the whirlpool and often flip over due to the internal magnet. The group would like to run tests of different shapes and sizes of spinning magnets to decide on a standard (most spin time, biggest/fastest whirlpool) as well as downscale the targets. In conjunction with a larger whirlpool bowl, this would allow more targets to rotate in longer arcs to make for a more fun game. Using wider-based targets or some other method to balance out the weight of the magnet may keep it upright.

According to a design review by Spin Master: the toy is projected to be quite expensive which may be an issue for the viability of the manufacturing. A possible solution would be to change the method of stirring from electrical to some sort of foot pedal which transfers mechanical energy into rotational energy

in the water. This could possibly reduce the overall cost of the toy for better manufacturing. However, due to the added complexity and lack of time, the group continued with the original electric stirrer.

4.0 Conclusions

This section concludes the report by going over the important details of Grab-a-Goose. It summarizes the functions and engineering decisions made to create Grab-a-Goose along with the problems encountered. As well as providing recommendations on the future development of Grab-a-Goose,a nd its viability as a commercialized product.

4.1 Conclusions

The main objective in mind when creating this toy was for it to be unique and entertaining for children to play with. Through ideation and inspiration from other toys on the market, Grab-A-Goose was the group's finalized idea.

It was important to identify all the required functions needed to successfully create Grab-A-Goose. Each required function had multiple solutions conceptualized and tested to see which was the most efficient for the resulting toy. Each function was drawn out to develop a visual long-term prototype which helped sort out specific materials and tools needed to create the functioning prototype. It also helped outline components in the design that may need more adjustment to help allocate time efficiently to create the final prototype. Throughout the procedure of the build, the group encountered many obstacles that were not initially seen during the brainstorming process; some of which were crucial to fix to ensure a functioning toy. In assessing all the solutions for the toy functions, the most appropriate mechanical designs were selected to give the most successful toy.

After said evaluations, Grab-A-Goose is a fully functioning toy with multiple mechanical parts that allow the player to fully carry out the game. The toy remains with few minor issues that can be adjusted; however, they do not play much into the overall success of the toy.

The final step in this toy’s creation was to assess whether Grab-A-Goose could be considered as a legitimate toy that could be commercialized. It is observed that the toy has multiple mechanical features like the circuit-powered whirlpool that can be a financial burden to mass-produce. These experience features can pose a disadvantage for the company. With a complex toy like Grab-A-Goose it may not be feasible in its current form, however with further development and testing it is very much possible that Grab-A-Goose could become a success.

4.2 Recommendations

The final Grab-A-Goose toy is a fully functional mechanical design with multiple functions and game components that allow it to work. The toy itself was very well received at a toy symposium, having many play testers comment on their interest. However, because of these complex components, the toy comes along with a large manufacturing cost from the electronics. If the toy were to be manufactured for commercial use, it must be cost-efficient so the company which adopts Grab-a-Goose can benefit from its production. Therefore, it is recommended that the company which pursues this toy further modifies the toy to meet more specific criteria relevant to their goals. As mentioned, the most expensive part of the toy thus far is the whirlpool, more specifically the electrical circuit which allows the fan to spin. This component can be easily modified by replacing the circuit with cheaper alternatives that are more common in the toy industry. The best option for Grab-A-Goose would be to introduce a battery-powered fan. This way the toy could become fully functional with use of a battery while decreasing the cost production. The battery is also replaced by the user, thus cutting extra costs for the company overall.

With this small adjustment, the company would effectively be able to cut down on costs for its mass production and introduce Grab-A-Goose for commercial use. While its unknown if Grab-a-Goose would be successful as a mass-produced product, the feedback received from play testing in conjunction with further development could make for a successful toy.

References

[1] ToysRUSCanada, "The Fishing Game," ToysRUSCanada, 11 March 2020. [Online]. Available: https://www.youtube.com/watch?v=4fb7SalhnXU&t. [Accessed 18 November 2022].

[2] P. e. a. Melissa N. Richards, "AGE DETERMINATION GUIDELINES: Relating Consumer Product Characteristics to the Skills, Play Behaviors, and Interests of Children," Consumer Product Safety Commision, January 2020. [Online]. Available: https://www.cpsc.gov/s3fs-public/Age-Determination-Guidelines-Relating-Consumer-Product-to-Characteristics-Skills-Play-Behavior-Intersts-to-Children-January-2020.pdf?VersionId=4nM3QIubBtIsckhdaIY81wgmmrTYlV_i. [Accessed 2 December 2022].

[3] Sonew, "Sonew Fish Play Game,Electric Rotating Fishing Toy Fishing Game Parent-Children Interaction Educational Toy,Fishing Toy," Walmart, [Online]. Available: https://www.walmart.ca/en/ip/Sonew-Fish-Play-Game-Electric-Rotating-Fishing-Toy-Fishing-Game-Parent-Children-Interaction-Educational-Toy-Fishing-Toy/6MB8NCEQ8G1T. [Accessed 2 December 2022].

[4] ClearCaseMan, "Vortex Fountain," Instructables, 2019. [Online]. Available: https://www.instructables.com/Vortex-Fountain/. [Accessed 17 November 2022].

[5] H. A. K. A. A. R, "Experimental and Numerical Investigation of Perforation of Thin Polycarbonate Plate by Projectiles of Different Nose Shape," Research Gate, 2016. [Online]. Available: https://www.researchgate.net/figure/Schematic-diagram-of-the-Pneumatic-gun-setup_fig2_313881332. [Accessed 7 November 2022].

[6] P. Calc, "How many circles of radius r fit in a bigger circle of radius R," Planet calc, [Online]. Available: https://planetcalc.com/7473/?r=1&R=6. [Accessed 2 December 2022].

[7] J. Maurel, "Unbalanced Rotor Behaviour," Youtube, 2012. [Online]. Available: https://www.youtube.com/watch?v=R2hO--TIjjA. [Accessed 15 November 2022].

[8] C. creator, "Dc Motot Speed Control Circuit," Instructables, 2020. [Online]. Available: https://www.instructables.com/Dc-Motor-Speed-Control-Circuit/. [Accessed 15 November 2022].