Business Case

64-fidget Lynx-Connect

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Executive Summary

This report outlines the results of 64-fidget's exploratory design project to design a new product prototype for the Hasbro company with sufficient market viability.

Across Canada and the US, there has been a recent emphasis on STEM related courses and specifically hands-on methods of teaching. This has created an influx of demand towards smaller modelling and 3D puzzle projects for children. While this has primarily been saturated by the Lego company, there is a hole in the market that looks to bridge the simpler concept of Legos with a harder modelling project such as wooden animal models, or even simple machine constructions. This project acts as the next step for children looking to up their modelling skills while still in a relatively approachable difficulty level.

Our team noticed Hasbro's puzzle line does not include many 3D modelling puzzles, and with a growing demand for such puzzles on the market, we felt this was a necessary market to tap into. Lynx-Connect by 64-fidget is a 3D modelling puzzle that provides purpose and learning to its users. It is a 3D-printed puzzle with 5+ parts for children to work with and put together. Not only does the puzzle expose children to simple machines such as hinges, but also to dovetails that are used later in more complex modelling projects. This product is the next step for students looking to explore more about 3D modeling projects.

The goal of this exploratory design was to create a minimum viable product (MVP) to test how different complexities of joints could be combined into a single puzzle. After designing a CAD model, and printing out the initial design on a Z300 3D printer we painted the different pieces and reassembled them into the final product. The final puzzle features various complex connecting parts including a hinge and a dovetail, as well as simpler connecting parts such as pin joints. Additionally, it features a variety of moving parts for stimulation including moving legs, and the key element, a body that opens up along the hinge when the head is removed to reveal a secret compartment. The project was finished off with the creation of an instruction video and an instruction manual for users on how to assemble the puzzle.

Our team encountered many successes and lessons throughout the course of this project. Some challenges we faced related to the smaller size of some of the joints, as well as the accuracy of the model design to our original reference. Overall, this model shows strong promise for future development and a place in Hasbro's toy line.

Project Report

Project Goals

When starting the assignment Hasbro gave us several limitations and goals;

- Target age group is ages 7 - 12

Hasbro has performed research that there is availability in the toy market for this age group.

- Toy must be smaller than 15x15x15cm

This limitation is in place so that the toy is easily transportable

- Toy must be relevant to Canadian culture

Hasbro is launching a new series of toys for main distribution in Canada

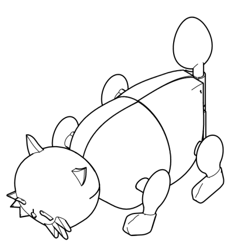
Our Design Goals

- A puzzle that can be assembled and disassembled
- Improves children's spatial awareness with moving parts
- Toy should be 3D printed

Opportunity / Problem

Parents of younger children and people who like "mind puzzles" have tendencies to invest more in spatial development toys, i.e. puzzles with shape matching. The gap in the market is caused by not having enough 3D toys of medium difficulty. The number of small, simple and texturized puzzles for this group of people is not a market that has been expanded on in its fullest capacity. We anticipate that the next iteration within this field will come in the form of small 3D puzzles. 3D puzzles enable deeper spatial awareness than 2D counterparts while still being simpler than Lego and easier to manufacture.

Project Description



Our design team, 64-Fidget, has developed a plastic 3D-printed Canadian Lynx puzzle. This 10x10x15cm plastic puzzle is split into 10 pieces that can be assembled and disassembled with very little physical effort, perfect for children above the age of 7. It features various complex joints as well as simpler more recognizable joints to create a medium-level difficulty for younger users, while still introducing them to more complicated connecting mechanisms.

Technical Implementation

Since this design must be easily assembled by young children, the moving parts must be designed with non-permanent joints. This was kept in mind when creating the parts on SolidWorks. We decided to connect the legs to the body with a simple rotating pin joint, the bodies connected with 6 pins, and the head was removable from the neck in only one direction, with a dovetail joint. The main feature of this toy is that when the head is removed the tail acts as a hinge to open up the hollow body. This hinge will teach kids about a simple machine and the hidden compartment will allow for an extra dimension of play. Each part was also designed to follow choking standards, greater than 3 cm in diameter and 6 cm in length [1].

With the lynx fully designed the next step was implementation. We printed our models using the Z300 3D printer. As this was the first prototype there were some inconsistencies and improper tolerances. This was addressed by sanding the inconsistencies down so that the puzzle would require the perfect input force for children. In order to make the lynx more realistic and recognizable it was spray-painted brown.

Results and Challenges

The individual joints were successfully printed and created, and the initial prototype was able to connect together properly. However, upon further use and testing, different challenges came to light.

- **Pin Joints are too fragile**

  While the pin joints that were connecting the body structure were able to successfully hold the structure initially, after multiple rebuilds and tests, our team found that they began to break down much more rapidly than we had anticipated. We estimated this to be due to the thickness restrictions that were created with the hollow interior of the structure. The pin joints had to be much smaller than we anticipated due to the smaller thickness available to build them into. This process should be further explored in future design iterations.

- **Model accuracy to animal**

  Despite our best efforts to replicate the lynx reference, we felt future design iterations should improve the accuracy in order for the product to be viable. Elements such as the proportions of the body parts, facial details, and color of the puzzle pieces should be further designed. As this first iteration served to be the minimal viable product, this aspect was not as consequential as other elements, and should be straightforward to address by other specialized parties.

Next Steps

The next iterations of this project will be focused on working on the challenges faced in this first initial project as outlined below.

- Future iterations should ensure pin joints connecting the body have connecting holes with paddings of at least 3-5 millimeters from the edges, additionally, pin joints should have a diameter of at least 5 millimeters to ensure they are strong enough to hold the puzzle together under stress.
- Improve the overall design and details of the model as well as the artistic coloring of the parts and the facial features of the lynx. This should be implemented by a team with more

experience and skill in the area of artistic 3D modelling for the technical design team to have a better artistic understanding of the model.

Bibliography

[1] K. M. Cronan, Ed., “Choosing safe toys for toddlers and preschoolers (for parents) - Nemours kidshealth,” *KidsHealth*, Jun-2018. [Online]. Available: https://kidshealth.org/en/parents/safetoys-young.html. [Accessed: 07-Dec-2022].

Individual Contribution

To make the puzzle more entertaining and interactive, different types of joints are proposed as the key feature of the puzzle. In order to create a successful joint, my first task is to talk to other group members frequently. My goal is to make sure that everything will fit nicely together in the end, because based on our schedule, all the dimensions are not finalized until 2 weeks before the final submission. At the same time, rough drafts of the joint design process need to take place in parallel before receiving and verifying all the components. The design of the joints follows two considerations. First, under the physical constraints of the 3d printer, all the joints must be printable and have proper tolerance labelled on them. Second, joints should give users some clues about the assembly procedure. Referring to all the possible choices in the market, three of the joints are being selected: pin joints, hinges, and dovetails. All these joints are commonly used in everyday life, and by inspection, users can get a rough understanding of the assembly procedure regardless of the order. After receiving all the joints from other group members, small changes are made to unify the dimension of the lynx. Then tolerance is configured based on the desired tightness of each joint. In the end, the final lynx is rendered into an STL file ready to be printed. Unexpectedly, after the actual puzzle is being printed out by the M200 3D printer, our group discover that all the joints fit very tightly which make it extremely hard to interact with. First, a root cause analysis is held to discuss the reason. The problem observed is that the tolerance is set to be bidirectional. But the tolerance should be either upper or lower in the joint otherwise each dimension might cause an overlapping between each other. Under the limited time and reprint option, the only viable solution becomes to file down the current print and those fragile parts are being redesigned and reprinted. Throughout the design project, I learned the importance of printing out small samples and testing before starting large-scale manufacturing, and the proper ways to collaborate with other team members in a group.