Team 5993B from Toronto, ON, Canada Presents:

BUMPTHOLOMEW

"THE ONLY WAY YOU SHOULD PROTECT YOUR ROBOT"

- Meherzad Antia, Alexandru Darie, Alex Ding, Shaurya Garg, Roger Guo, Ali Iqbal, William Kellen, Arian Khavari, Andy Lee, Chris Li, Angela Lin, Mark Ma, Antonio Melendez, Leonardo Melendez, David Pasat, Jerry Qian, Sean Shin, Yunfan Su, Soshiyant Tasharofi, Kevin Yang, Sean Yang

Introduction

Crashing into walls and slamming into other bots is a common feature amongst all robots, and it's unfortunately the leading cause of RTSD (Robotic Traumatic Slamming Disorder). We wanted to offer a solution to this issue, and so we designed *Bumptholomew.* In previous VEX competitions that our team has participated in, our bot would collide with other competitors frequently. While admittedly quite funny, it can tend to be quite annoying and frustrating to deal with, especially if your bot is the one taking all the punches. *Bumptholomew* completely eradicates this issue, as its industrial grade springs and patented unbreakable plastic technology will leave your bot looking spotless, even after the most brutal of robo-wars.

Design

Bumptholomew's design is direct and effective. It consists of two main components, one of which is a structural base, and the other of which interacts with the environment. Once the two are connected by springs, the latter part is able to absorb impacts with ease. In order to safely append said springs, the two core pieces of the bumper each have attachment points that allow for springs to be physically locked in easily without the risk of loosening. Additionally, after preliminary testing, the interactive component gained auxiliary guards on the side to avoid derailing during glancing collisions.

As a secondary function, Bumptholomew also has a mechanical puzzle piece connection system that allows multiple instances of the bumper to be installed in parallel without requiring further screws. Altogether, Bumptholomew represents a flexible and efficient way to deal with collisions in the VEX Robotics environment.

Digital Modeling

TinkerCAD is a powerful CAD online modeling software from AutoCAD. Using TinkerCAD version 2021_12_17 on Google Chrome version 96.0.4664.110, we modeled the parts.

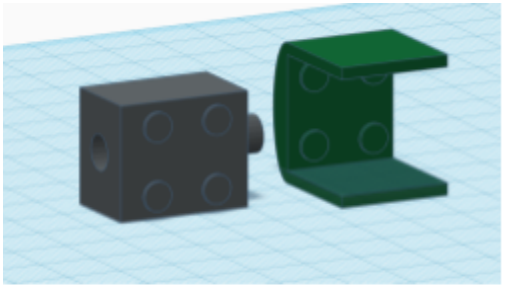

Figure 1 - Fully modelled components of Bumptholomew

Figure 2 - TinkerCAD Logo

Alongside existing VEX STL files, we were able to ensure consistency and appropriate sizing. The screw holes in particular were incorporated using TinkerCAD's hole function so that the bumpers could be attached to the structure, using the grouping function to shape the bumper.

The following are a few of the orthographic views of Bumptholomew.

Figure 3 - Front view of Bumptholomew

Figure 4 - Side view of Bumptholomew

Note how the spring connections were implemented through lego-like attachments to the two major components of the bumper, allowing for both convenient and secure attachment. The puzzle peripherals are also notable in these views, giving a better image of how they function to hold together multiple bumpers without auxiliary screws (also made similarly to how the screw holes were implemented into the design). Additionally, the long edge on the impact part of the bumper that overlaps the base part, was designed in order to keep a consistent and calculated movement when the impact is taking place.

Unfortunately, TinkerCAD does not support any form of animation. In order to create more interactive simulations of Bumptholomew, we used another program, Fusion 360. With the stl model files we had already created, we were now able to use this software in version 2.0.11894 to create clear and effective representations of the bumper in action!

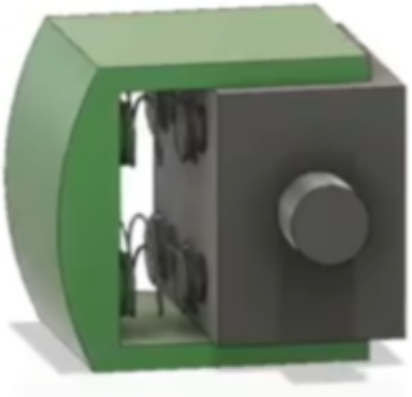

Figure 5 - Assembled model of Bumptholomew

Functionality

Our creation is custom built for maximum protection, and we have accomplished this with our professional grade quad spring design, which can absorb and deal with heavy

amounts of stress and impact. Our rubber screw head shape helps to firmly secure the spring in place, and ensures that the bumper can absorb any type of impact from all directions. Bumptholomew is as durable as parts can get in the heat of robo warfare, and our tough “walls” on the top and bottom of the piece make sure that the springs don’t twist and turn when the piece makes contact. This ensures that the part will remain intact for years to come, and will protect your robot through even the toughest of collisions.

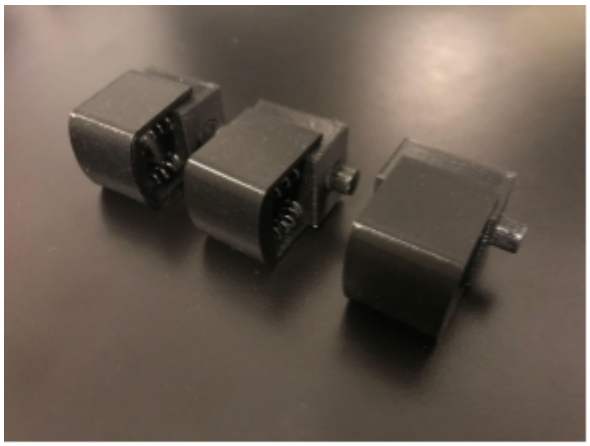

Figure 6 - 3D printed and assembled instances of Bumptholomew

3D Printing & Testing

Upon completion of our Tinkercad modeling process, the bumper was 3-D printed. Utilizing the Prusa i3 MK3S printer, PETG plastic, and externally sourced springs, we created 3 individual bumpers in a uniform manner.

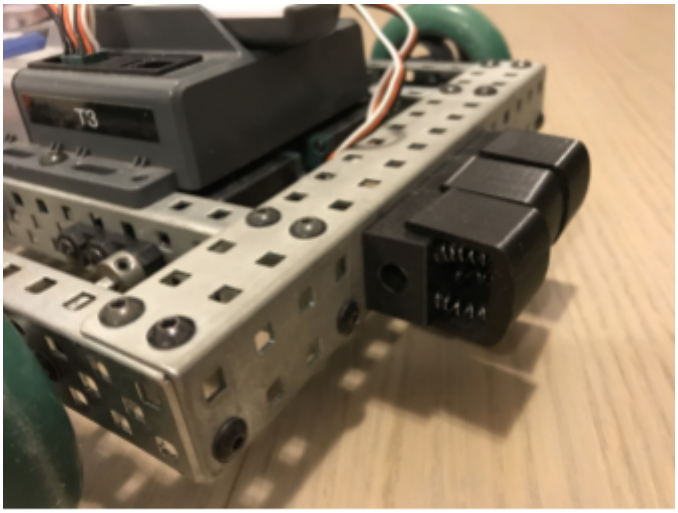

Figure 7 - Testing of Bumptholomew

Once printed, the bumpers were attached to an actual robot to observe their behavior in a real environment. Bumptholomew performed excellently, absorbing far more of the force of impacts than was expected! This first iteration of testing, however, did reveal some weaknesses in the design. In particular, the bumper had a tendency to function less effectively in glancing collisions. Through these revelations and further cycles of experimentation, we were able to adjust and re-envision Bumptholomew in its current form, better protected against such circumstances and able to take on a wide variety of situations effectively.

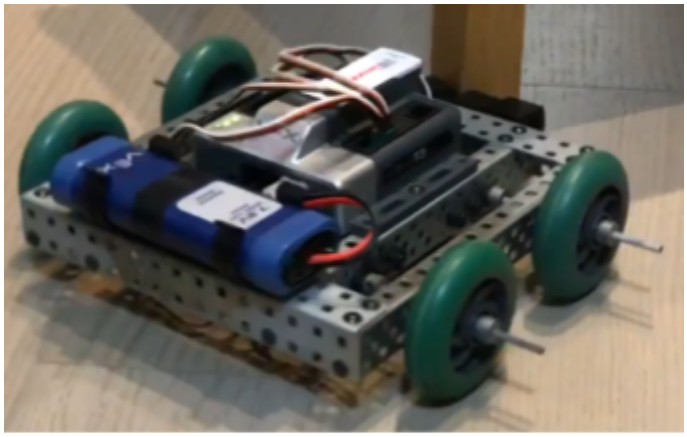

Figure 8 - Testing of Bumptholomew

Conclusion

Bumptholomew is an extremely useful part to put on a robot, protecting it from impact. Placing many bumpers together will allow your robot's sides to become invulnerable! Bumptholomew is of simple design, and able to be 3D printed and assembled with pieces that are easy to acquire. Better yet, the process of improving the bumper gave us important insight on the importance of iterative experimentation. The original design of Bumptholomew would not have been sufficient in a variety of scenarios, yet the changes we made to the part over time transformed it into something uniquely powerful. Overall, Bumptholomew's most recent version is extremely versatile, and can be adjusted to fit any robot's applications.

Figure 9 - Enhanced image of Bumptholomew

Acknowledgements

We thank the members of Team 5993A (Sultan Ali, William Gomes, Allen Guo, Jesse Li, Logan Li, Wing Li, Natalie Lim, Hubert Qin, Rohan Raina, Henry Ren, Jebrael Shaikh, Mikael Shaikh, Sunny Shen, Sunny Shi , Jimmy Tao, Owen Wang, Jay Wu, John Zhang) for sharing their knowledge throughout this project. This project would not be possible without the support of our teacher supervisor, Mr. Daniels Skuja, who provided 3D printing resources and assisted with registration.