LEGO Power Brick Sorter

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***Abstract*— Our team was assigned to a project that was sponsored by a faculty advisor to demonstrate engineering tools, specifically the skills being taught in both the Mechanical and Electrical Engineering departments at NIU. Our faculty advisor, Dr. Demir, presented a project in the outcome was to design a product to sort LEGO bricks. The LEGOs will have their pictures taken by a light sensor and will be sorted into bins based on their color with an Arduino board. Through implementing recommended strategies, the student team hopes that the machine will sort the LEGOs in an efficient manner.**

Keywords: Light sensor, Arduino board, automation

I. INTRODUCTION

The LEGO group was founded in 1932 by Ole Kirk Kristiansen and is a family business. The name LEGO is an abbreviation of two Danish words meaning "leg godt" which means play well. The LEGO business has come a long way in the production phase and is now one of the worlds largest manufactures of toys. LEGOs were created to simulate happiness and promote imagination, creativity, and development. The term "robot" comes from the Czech for "forced labor". Robots have been created to both look and act like humans [1].

Although various versions of this machine come before ours, there has been wonder if there was a more efficient way to sort LEGO bricks in a timely manner. Our team was responsible for designing a machine to sort LEGOs. In this paper, an Arduino board is used to read inputs-light on sensor and turn it into an output-activating a motor.

II. PRODUCT DESCRIPTION AND STATEMENT

The desire for LEGOs started to slowly decline nearly 10 years ago back in 2010. Kids no longer wanted to play with them, but now, LEGOs are seeing a massive resurgence in popularity. With nearly seven sets sold a minute, the demand for LEGOs have skyrocketed. With the increased desire for LEGOs, there will be a direct correlation to the need and want for a device to sort an accumulation of LEGOs. This article clearly describes an efficient model that will sort the LEGOs in a timely manner, allowing the LEGO creator to spend more time building and less time sorting. This project will use Arduino board to help with prototype development.

A. Requirements

The design constraint encountered was a financial budget of $1,000. Another requirement for this process was that it needed to be safe for all ages, in that it would not be a hazard for any age, adult or child. To ensure this product is safe, there are multiple switches to stop the machine if a part of the process failed. There was no requirement for the size or weight of the finished product.

B. Prototype Design

Figure 1. correctly shows the fully assembled prototype of the LEGO Power Brick Sorter. It consists of a combination of several custom-made 3D components as well as ordered parts. The overall design was constructed around the idea of a light system and the program to sort the bricks. With both of those ideas working together, we were able to design a system to sort LEGOs to produce our final design.

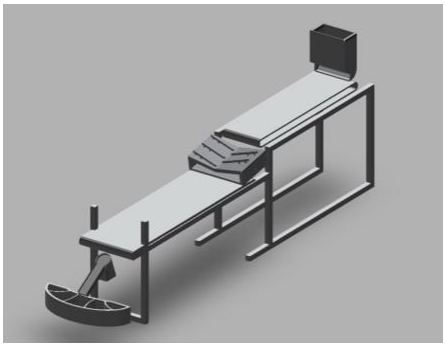

Figure 1. Fully assembled prototype

1. Drive

The drive consisted of DC motors that make two conveyor belts move and one for our light sensor. Motors were used to create movement in our vibration system so the LEGOs can be easily transitioned to each task throughout the process.

2. Hardware

The hardware used consists of conveyor belts, shaft, 3D components, and the quad track. All parts and components are mounted on the quad track and is interconnected.

3. 3D Components

Several parts were 3D printed: feeder, V-plate, shaft, chute system, and bins. These components were important in the overall design and each serve a big purpose. Figures 2a, 2b and 2c illustrates all components that were 3D printed by the NIU Machine Shop.

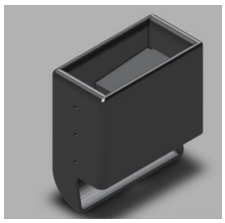

Figure 2a. Feeder

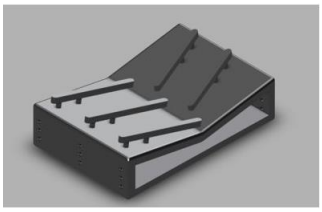

Figure 2b. V-plate

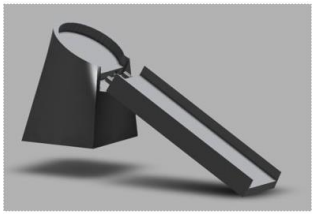

Figure 2c. Chute

4. Sensors

A light sensor will correctly identify the color of the LEGO brick so it can be sorted and placed into the proper bin.

III. Results

Using the light sensor and the Arduino, we successfully sorted our LEGOs by color. The LEGOs were able to make its way from the feeder to the conveyor belt, down the chute system, and placed under the color sensor. The sensor was able to read the code and distinguish what bin the LEGOs should be placed in. The machine was coded to sort 2 x 2 bricks that are red, yellow, green, blue and brown in color. When the bricks fell into the chute system, they piled up in the funnel, but had the ability to sort their way through the system. After the LEGOs were processed, it was placed on the chute, and slid down into the proper bin.

IV. Discussion

This project has given the researcher the ability to take our knowledge on coding and implementing it in an idea to help simplify a small task. Although there are other versions of a LEGO Brick Sorting machine, we invested many hours to create a new way to efficiently sort bricks. With the help of the Arduino board, we created code to read and sort LEGOs based on color. Due to awaiting parts and unplanned modifications, we were unable to fully execute the project by also sorting the bricks by weight. A more compact design for easy maneuvering is an improvement to be considered.

V. Conclusion

With an increase in popularity of LEGOs, sorting many bricks can be a tedious and time-consuming task for LEGO creators. This project created an efficient solution while automating the process. While the overall design of our machine is simple and not difficult to build, we were faced with trial-and-error situations that ultimately altered our initial design. With conveyor belts, chutes, and our program, we were able to sort the LEGOs and while it correctly understood which bin to separate the bricks. The project requirements provided by our faculty mentor were satisfied while staying under budget and passing safety guidelines. In summary, we provided a way to take the labor out of sorting LEGO bricks, which lends more time to building LEGO creations.

VI. Acknowledgements

This success of our project would not have been possible without the support of several people. Our teaching assistant, Amin Roostaee, who attended all our weekly meetings and helped us receive our parts. Our faculty sponsor, Dr. Veysel Demir, who not only provided us with the project but constantly challenged our thinking and provided feedback. And lastly, we would like to thank Michael Reynolds who helped us in the machine shop and gave us an understanding of how to manufacture parts.

VII. References

[1] "LEGO." *Companies History - The Biggest Companies in the World*, 20 Nov. 2020, www.companieshistory.com/lego/.