

Prototype Design and Research Collection

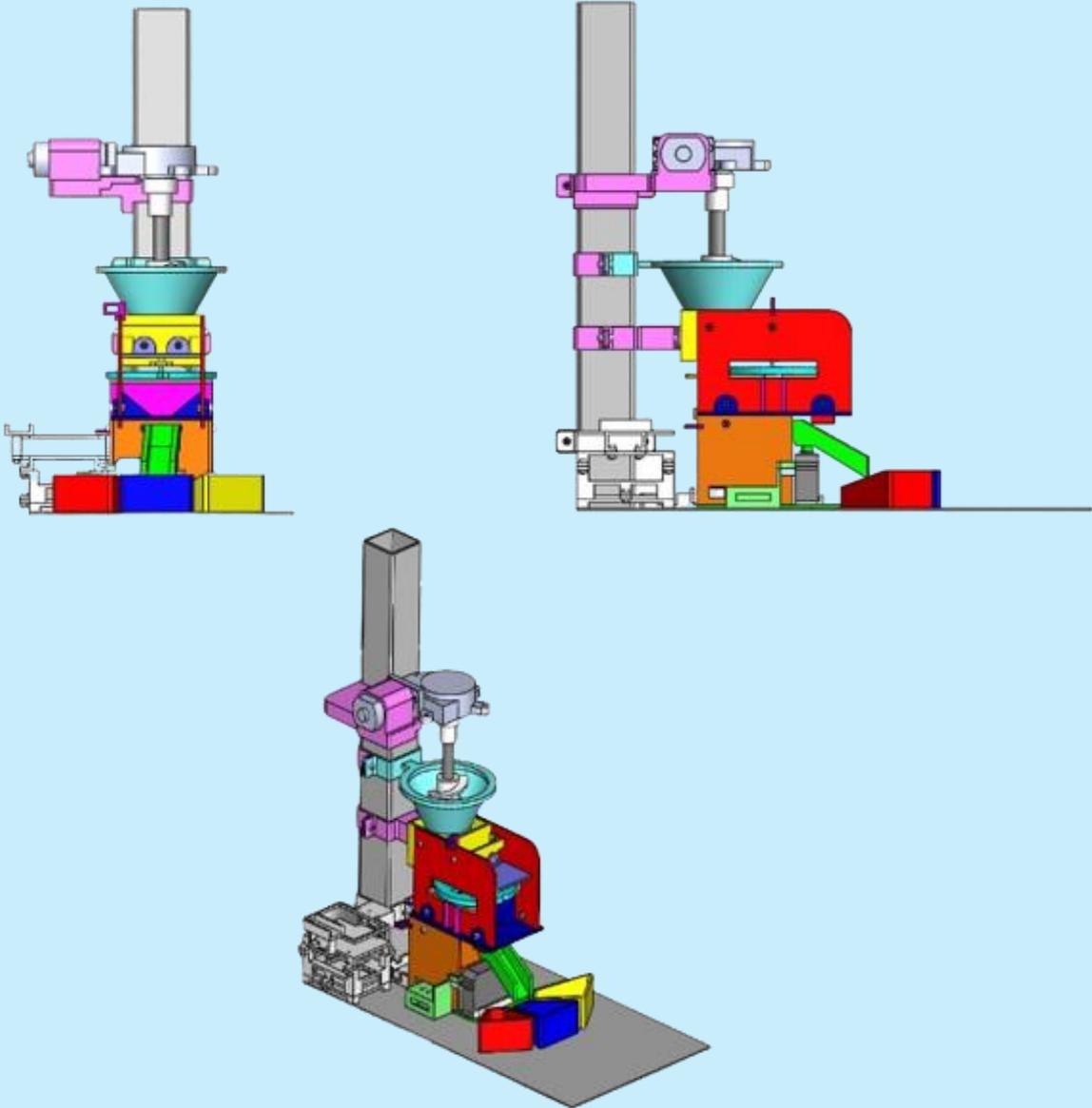
Series 1



Universiti Teknologi MARA
Pasar Gudang Campus

Prototype Design and Research Collection

Series 1



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FOREWORD

This digital book on Prototype Design and Research Collection Series 1 (PDRC Series 1), is designed as a comprehensive reference for mechanical engineering students. The designs featured in this collection undergo an extensive analysis process, incorporating both prototype development and research to ensure a thorough understanding of design principles. Each project is carefully analysed before the prototype fabrication with detailed summaries of the project description and design parameters. The design and research products presented in this series cover a wide range of tools and equipment for various applications including household, workshop and entrepreneurial purposes.

This collection aims to foster innovation by offering students valuable insights into both the technical and research aspects of product design. It is hoped that this book will inspire future engineers and designers to approach product development with a deeper understanding of the design and research processes.

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CHAPTER 20

Development of Candy Sorting Machine

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ABSTRACT

This project focuses on the development of a candy sorting machine designed to automate the process of sorting candies based on color detection. With the increasing demand for efficiency in production, manual sorting can be time-consuming and prone to errors. The proposed machine aims to overcome these challenges by automatically sorting candies according to their colors. The primary goal of the project is to achieve precise color detection, uniform distribution, and effective sorting through the use of Arduino-based control. The design of the system includes an Arduino microcontroller, color sensors for detection, motors for sorting, and a mechanism to handle the sorted candies. The project also involves developing custom Arduino code to manage the color detection process, sorting algorithm, and control mechanisms. The expected outcome is a fully operational candy sorting machine capable of accurately sorting candies by color, significantly enhancing productivity and reducing the reliance on manual sorting processes. By automating the sorting procedure, the machine aims to improve efficiency in the candy production process.

Keywords: Candy sorting, Sorting machine

1 INTRODUCTION

A critical aspect of many candy-related applications involves sorting candies by colour, particularly for creating visually attractive displays or ensuring consistency in packaging. However, this process is typically performed manually, which can be time-consuming and inefficient. For instance, sorting a batch of 1,000 candies by hand can take up to 2-3 hours, depending on the number of colours involved [1][2][4]. Scaling this effort to larger quantities or meeting tight deadlines becomes increasingly challenging. Despite the high demand for colour-sorted candies, there are currently not widely available or affordable machines designed to automate this process. A survey conducted among small and medium-sized confectionery businesses revealed that 85% of respondents relied on manual sorting methods, with 78% citing labour intensive sorting as a bottleneck in their operations [4][5]. Moreover, manual sorting introduces the potential for errors and inconsistencies, further affecting product quality.

Manually sorting candies into different color piles is a time consuming which extends preparation time for events. Additionally, inconsistencies arise due to variations in individuals' color perception and sorting methods, affecting the quality and presentation of the finished product. Achieving an even distribution and balanced assortment of colors requires meticulous attention to detail, further complicating the task and potentially increasing preparation time. To address these issues, the main objectives of this project are to design an automatic candy sorter

machine using SolidWorks software. Then, proceed to second objective to fabricate the machine as a proof of concept.

2 LITERATURE REVIEW

There are many different candy sorting and packaging products that are available nowadays, each with its own unique design, ergonomics, efficiency, and price point. While these products may share similar functionality, the specific features and performance characteristics can vary significantly between manufacturers and models.

Table 1: Summary the potential of benchmark product

Available Product	Advantages	Disadvantages
 <p>Veryx Digital Sorting Platform for Gummy Candy [3]</p>	<ul style="list-style-type: none"> • Unique sensor configurations. • Defect detection capabilities. • Fast sorting mechanism. 	<ul style="list-style-type: none"> • Expensive • High maintenance cost. • Not suitable for short production runs.
 <p>DhimanGroup's Automatic Candy Sorter Machine [2]</p>	<ul style="list-style-type: none"> • Use high precision sorting mechanism. • Less wastage and time consumption. 	<ul style="list-style-type: none"> • High operational cost. • High maintenance cost.

3 METHODOLOGY

Project flowchart was designed to ensure that the project will run smoothly. Figure 2 displays the project flowchart. This project begins by finding a problem statement and then proceed to objectives. While designing stages, three concept model was design, then has been evaluated by using Pugh Chart. Figure 2 shows the concept designs. This preliminary evaluation has been provided the most promising concept design before extended to the final featuring model. Then, the purchasing of material is being made based on bill of materials came from final featuring model (final design). The fabrication for the main frame has been conducted by workshop methods because of the require steel cutting and welding joints. After that, the other components is being produces by using 3D printing methods. The machine then is being install with the electronic controller executed by Arduino and sensors.

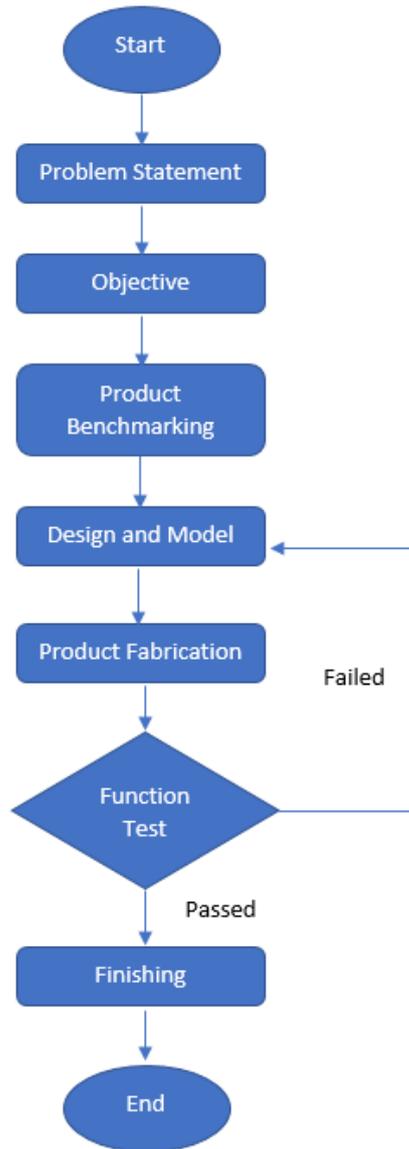
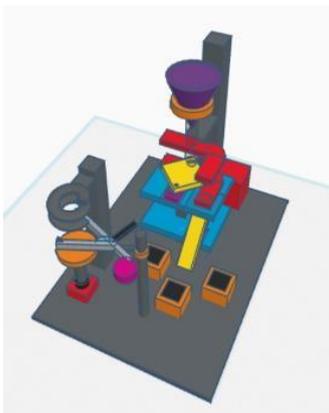
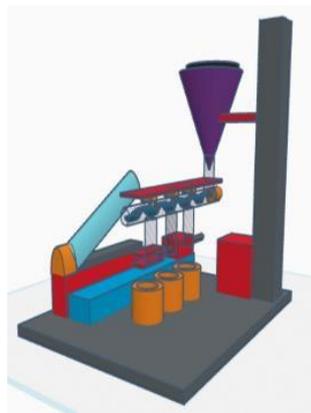


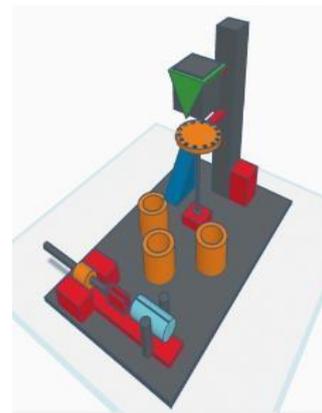
Fig. 1: Project flowchart



(a) Concept design 1



(b) Concept design 2

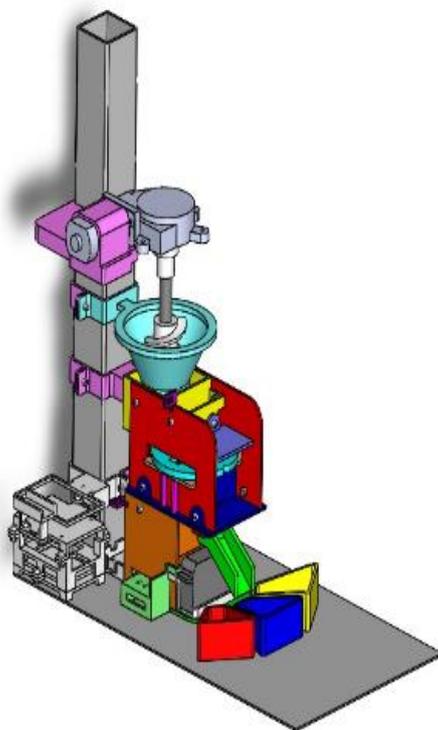


(c) Concept design 3

Fig. 2: Preliminary design (Concept design stages)

4 RESULT AND DISCUSSION

The Candy Sort and Pack Machine prototype is fully assembled and functioning as designed, with all mechanical and electrical components working together seamlessly. The 3D-printed parts, like the wheel, sorting chute, and hoppers, are securely assembled using fasteners and snap-fit mechanisms. The electrical system, controlled by an Arduino UNO, operates smoothly, ensuring accurate color detection and sorting. For example, the sorting chute moves precisely to sort Skittles candies into the correct storage compartments, while the LED and buzzer provide clear feedback during operation. This completed design demonstrates careful planning and ensures the machine runs efficiently and reliably. Figure 3 (a) shows the final designed model meanwhile Figure 3 (b) shows the final fabricated prototype.



(a) Final design



(b) Final prototype

Fig. 3: Final design model and fabricated prototype

5 CONCLUSIONS

The fabrication of the Candy Sort and Pack Machine successfully brought the conceptual design to life, serving as a proof of concept to validate its functionality. To enhance the efficiency and functionality of the Candy Sort and Pack Machine, it is recommended to integrate a conveyor belt system for automated candy feeding. This addition would eliminate the need for manual loading, ensuring a continuous flow of candies into the system and increasing the throughput. A conveyor belt system could also be paired with sensors to detect candy jams and pause operations temporarily to prevent mechanical damage.

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