

# Prototype Design and Research Collection

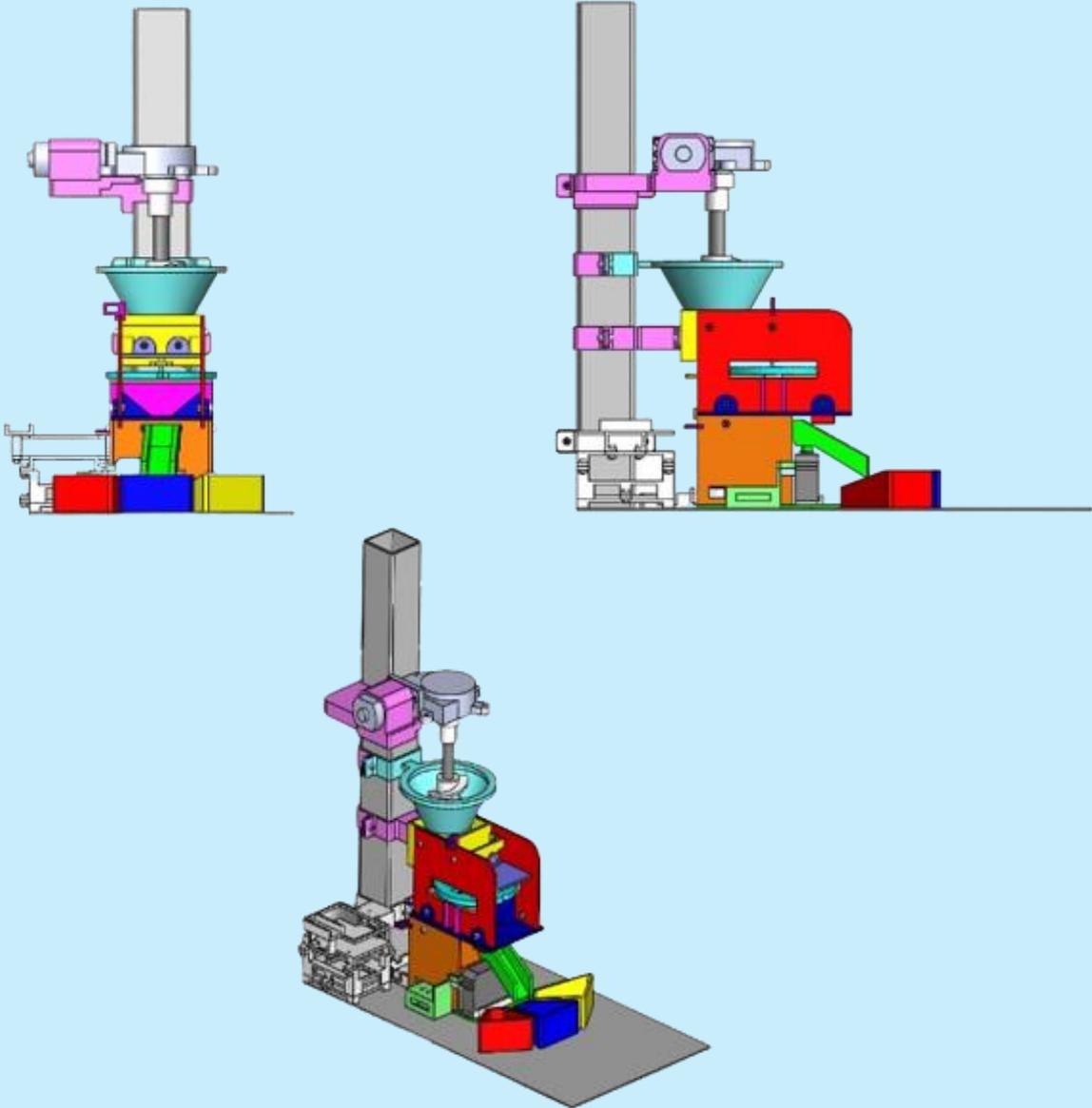
Series 1



Universiti Teknologi MARA  
Pasar Gudang Campus

# Prototype Design and Research Collection

## Series 1



AHMAD NAJMIE RUSLI

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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 6

### Mini Electric Sander Belt Machine: Design, Development, and Testing

Muhammad Bariq bin Mohd Bakhit <sup>1</sup> and Ab Aziz bin Mohd Yusof <sup>2\*</sup>

<sup>1,2</sup>*Faculty of Mechanical Engineering, Universiti Teknologi MARA Johor Branch, Pasir Gudang Campus, Bandar Seri Alam, 81750 Masai, Johor Darul Ta'zim.*

*\*Corresponding author (e-mail): abaziz86@uitm.edu.my*

#### ABSTRACT

Machines are designed to make tasks easier. They come in various sizes and price ranges, but smaller ones are often expensive and difficult to find. This project aims to address this issue by creating an affordable and compact electric sander belt. The process begins with designing the machine using software called SOLIDWORKS. Following the design phase, fabrication involved using tools like drills, cutters, and grinders, with aluminium as the primary material. The objective is to develop a small electric sander belt that activates with a switch. It was suitable for grinding small items such as shaping knives or reshaping drill bits. This mini machine particularly useful for small-scale projects and accessible to a wide range of users due to its affordability.

Keywords: Sander belt machine, Mini machine, Fabrication process

#### 1 INTRODUCTION

Sanders are machines used in various industries such as carpentry, metal fabrication, and automotive repair to achieve smooth surfaces. One popular sander is the belt sander. It has a motor that moves a sanding belt continuously over a flat table. The workpiece is moved against the belt to sand it. The size and roughness of the belt can be changed to match needs [1].

The main goal of a belt sander is to remove material quickly while making the surface smooth. They are used for tasks like smoothing surfaces, removing paint, and shaping wood or metal.

Belt sanders have improved over time. Now they have features like speed control, dust collection, and user-friendly designs. Different types of sandpaper are also available for them [2]. However, belt sanders have some problems. Sometimes they don't make surfaces smooth even. This could happen because the belt isn't tight enough, the pressure isn't right, or the material being sanded is different. They also create a lot of dust, which can be bad for air quality and health if not managed properly. This dust can also make the sander less effective and need more maintenance

The durability and performance of abrasive belts in belt sanders significantly impact efficiency and cost-effectiveness. Issues like premature wear, clogging, and reduced cutting ability affect material removal rates and productivity. Optimizing belt performance is crucial for enhancing reliability. Prolonged use may cause operator fatigue due to vibration and weight.

Improving ergonomic design, including handle grip and vibration reduction, is essential to enhance operator comfort and reduce musculoskeletal issues. Addressing these challenges is vital for developing more efficient belt sander machines, ultimately improving productivity, surface quality, and operator well-being.

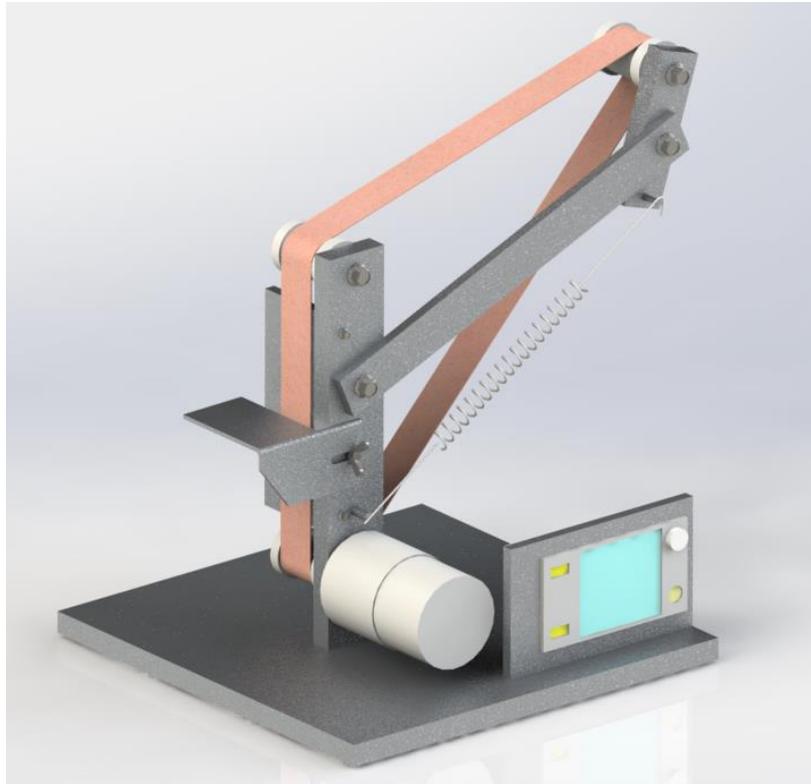


Fig. 1: Render model of the belt sander machine

## **2 LITERATURE REVIEW**

When comparing belt sander machines, essential factors include power, speed, belt size, construction quality, and price. In a recent benchmarking and comparison analysis, three notable models—Model 1, Model 2, and Model 3—were assessed based on these criteria.

Model 1, engineered by Herman S Newton (US2416493A), boasts a robust motor with high power output, making it suitable for demanding sanding tasks. Its variable speed control ensures precision, and its durable construction suits heavy-duty industrial use [3].

Model 2, designed by Georg Weber (US20050136813A1), offers a compact, lightweight design ideal for portability. Although slightly lower in power, its variable belt speeds accommodate diverse finishes, appealing to DIY enthusiasts [4].

Model 3, developed by John Schnell and Daniel Wall (US20060264161A1), strikes a balance between power and affordability. Its moderate power rating and adjustable belt speed make it versatile for various sanding applications [5].

This benchmarking and comparison studies drawn on product specifications, manufacturer details, and user feedback from reputable sources and industry publications. Its objective is to offer users a thorough analysis of each model's strengths and weaknesses, aiding them in making well-informed decisions.

### **3 METHODOLOGY**

The final design of the sander machine is shown in Figure 1. All the design process was based on this design, and it was used to make the final construction plans. The design of this project was made using a software called SOLIDWORKS, which helps to make 3D parts and drawings. Designing this project involved a few steps: making each part of the product with the right size and putting them together like pieces of a puzzle. After that, each part was drawn from different angles, like from the front, top, side, and an angle called isometric view, to show all the details.

Fabrication means making or creating something by putting together different parts using various methods. Cutting and drilling are common techniques used in fabrication to shape materials into a finished product. The machine was made using aluminium plates and sheet metal, as shown in Figure 2. First, ten-millimetre-thick aluminium plates were used based on certain considerations. These plates were measured and cut using tools like a band saw machine and angle grinder. Holes were drilled in them. The sheet metal was also measured, cut using a shearing machine, and holes were drilled in it too. Then, the sheet metal was bent at a 90-degree angle using a bending machine. After that, it was attached to the aluminium plates using bolts and nuts.

The bearing holder, which holds a ball bearing, was made from PLA plastic. It was created using a 3D printing machine, which took about 14 hours to make three bearing holders. After the bearing was put into the holder, it was attached to the main part of the mini sander belt machine using bolts and nuts.

### **4 RESULTS AND DISCUSSION**

One of the key features of the mini sander belt machine is its ability to remove material and smooth surfaces. Its main job is to take away material from a workpiece and make its surface smooth. This is done using a continuous loop of sandpaper or abrasive belts that rotate over the bearing holder to do the sanding.

Using the mini sander belt machine as in Figure 2 requires manual operation. It is crucial to follow the steps carefully to prevent accidents and ensure the machine lasts longer.

- Put the sander belt around the bearing holder and attach the spring to give it tension.
- Adjust the angle of the part by loosening the wing to the desired angle.
- Plug in the power supply.
- Turn the voltage clockwise according to the LED indicator until the sander belt starts rotating. Make sure the voltage regulator is off before plugging in the power supply.

The advantage of this mini sander belt machine is its low production cost. Making one costs around RM90, which is considered inexpensive. This makes the machine appealing for small businesses, hobbyists, or individuals on a budget who still need efficient sanding capabilities. It's a smart choice for the sanding process.

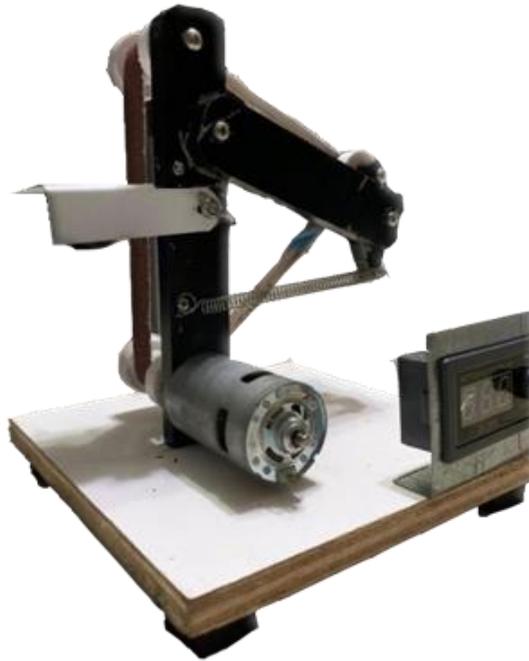


Fig. 2: Fabricated prototype of the sander belt machine

## 5 CONCLUSIONS

In conclusion, the mini sander belt machine, designed and manufactured for sanding tasks, demonstrates reliability and effectiveness. Recommendations to enhance its utility include adding a dust barrier, utilizing a higher-voltage motor and grit belt, and employing more durable materials. These measures aim to maximize its potential applications, catering to diverse sanding needs across different materials while ensuring longevity and efficiency.

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