

# Prototype Design and Research Collection

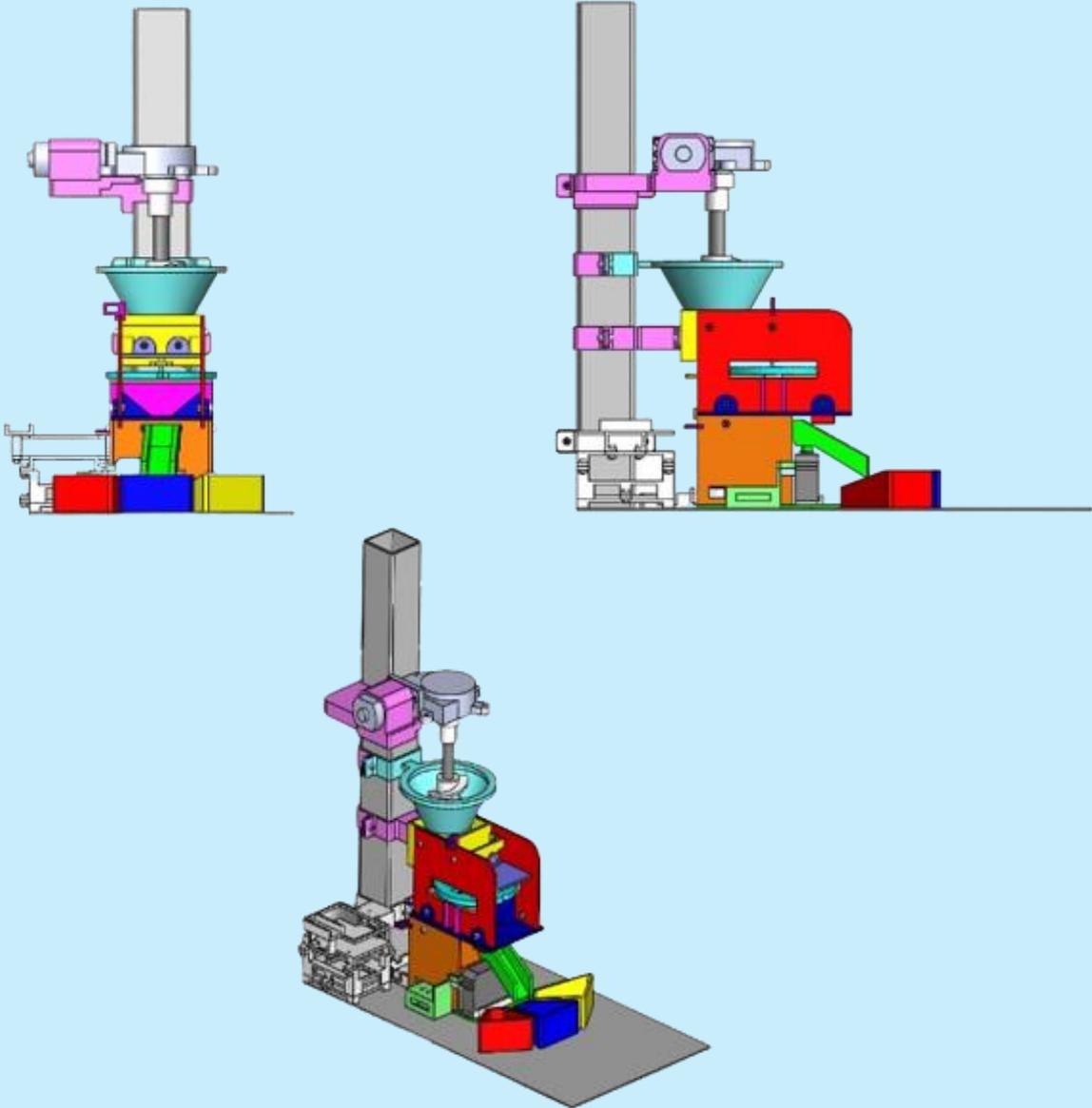
Series 1



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 18

### Design and Fabrication of Nutmeg Grater

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#### ABSTRACT

A nutmeg grater is essential for grinding nutmeg into a fine powder, but conventional designs pose risks of accidental cuts. To address this issue, a safer and more user-friendly nutmeg grater should be developed, ensuring ease of use for both adults and children. This innovation aims to reduce kitchen injuries while simplifying the cooking process. To gather relevant data, surveys will be distributed, and online research will be conducted to analyse existing designs and user concerns. The project focuses on designing and fabricating a scaled-down, manually operated nutmeg grater with a simple hand crank mechanism, making it both practical and efficient for home kitchens. The methodologies for this project outlining as the design, material selection, and fabrication process. The expected outcome is a fully functional and safe nutmeg grater capable of efficiently grating nutmeg, fruits, and soft vegetables, ultimately enhancing kitchen safety and usability.

Keywords: Design, Fabricate, Nutmeg grater

## 1 INTRODUCTION

Nutmeg is the seed of an evergreen plant native to Asia, Australasia, and the Caribbean. When kept in its shell, whole nutmeg can last up to nine years, whereas grated nutmeg has a significantly shorter shelf life of about a year or less. Freshly grated nutmeg enhances recipes with a stronger aroma and richer flavour [1].

Grater come in various designs with different slot sizes, making them versatile tools for food preparation. They are commonly used to grate nutmeg, cheese, and citrus peels to create zest. Additionally, they are essential for dishes like toasted cheese, Welsh rarebit, egg salad, macaroni and cheese, and cauliflower cheese, where finely grated ingredients improve texture and taste [2].

Unlike food processors, which produce uniform shreds, hand grater create pieces that taper at the ends, allowing for better melting and even cooking. This is particularly beneficial in recipes that require smooth blending, such as sauces or baked dishes. Hand-scraped nutmeg, for instance, integrates more effectively into cooking, enhancing both consistency and flavour.

## **2 LITERATURE REVIEW**

Benchmarking and comparison with available nutmeg graters highlight key differences in design, functionality, and cost. The William Bounds Nut Twister Mill features an easy-turning crank, serrated stainless steel blades, and includes whole nutmeg seeds, but it is relatively expensive. The Cole & Mason Classic also has a serrated blade but is noted for its somewhat inconsistent output and less durable construction. On the other hand, the Plastic Nutmill is the most affordable option while still incorporating a serrated stainless steel blade. These comparisons help determine the most effective design features to incorporate into the proposed nutmeg grater [3].

The manufacturing process for the new design includes the use of PVC pipe for the body, a steel rod for the handle, and sheet metal for the grating component. Sustainability aspects include cost reduction, eco-friendliness by allowing the grater to be repurposed into other household items, and improved safety features to minimize kitchen injuries. The ergonomic design ensures user comfort and efficiency, making the grating process smoother and more accessible for various users. Additionally, patent research references US patent US6315224B1, which details a grating plate with staggered rows of sharp-edged openings designed to enhance food processing.

Historically, nutmeg graters have evolved from simple flat designs with collection compartments in the 18th century to more sophisticated, egg-shaped models in the 19th century. These earlier designs inspired modern improvements aimed at efficiency and user convenience. The proposed project seeks to further enhance usability by developing an ergonomic, efficient nutmeg grater using sheet metal instead of stainless steel and a PVC body for durability and affordability. Ultimately, the goal is to create a practical, user-friendly grating tool that reduces effort while maintaining effectiveness in food preparation.

## **3 METHODOLOGY**

The development process begins with a discussion with the supervisor to finalize the project title and objectives. Once the direction is established, multiple design sketches are evaluated, and the best concept is selected for further development. Using SolidWorks software, the chosen design is then transformed into a detailed digital model for visualization and analysis as in Figure 1[4].

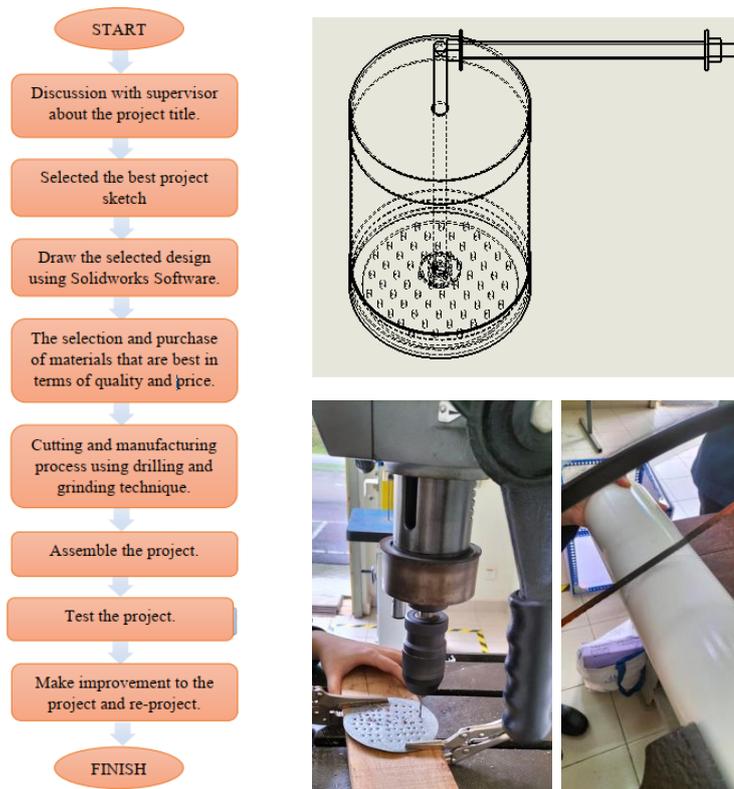


Fig. 1: Fabrication process

This section outlines the process of sketching, drawing, and selecting suitable materials for the chosen nutmeg grater design. The first step involves selecting the best sketch that meets standard product requirements. Once finalized, the design is measured and drawn using SolidWorks Software 2017 for accuracy and visualization. Following this, the appropriate materials are chosen to align with the design specifications. Before fabrication, all parts are measured precisely using a ruler to prevent errors during production.

The manufacturing process begins with cutting the PVC pipe using a hand saw, followed by cutting the steel threaded rod with a grinder machine and sheet metal with a cutting machine. The sheet metal is then marked and punched using a hole puncher and hammer to create holes. Milling is performed on the bottom PVC cap using a milling machine, and drilling is done on the sheet metal and top PVC cap using M3 and M10 drill bits, respectively. The steel threaded rod is bent as needed to fit the design requirements.

For the finishing process, the PVC pipe is sanded with sandpaper to achieve a rough surface before being painted along with the PVC cap using spray paint. Once all components are fabricated and assembled, a final inspection ensures the product is fully complete and ready for use.

## 4 RESULTS AND DISCUSSION

The completed prototype undergoes rigorous functionality and safety testing to ensure its effectiveness. Any identified areas for improvement are addressed, and necessary modifications are made to enhance the design. The final refined product is then ready for implementation, completing the project workflow.

Following the design phase, the appropriate materials are selected based on quality and cost-effectiveness, ensuring an optimal balance between durability and affordability. The manufacturing process involves cutting, drilling, and grinding techniques to fabricate the necessary components. Once fabrication is complete, the components are assembled into the final product as in Figure 2.



Fig. 2: Final product of nutmeg peel off

## 5 CONCLUSIONS

This study focused on developing a manual grater machine designed to press and compress for nutmeg peel off which making food preparation more convenient. The first objective was successfully achieved by creating a device that simplifies the process, reducing effort and time in the kitchen. The second objective was met by utilizing manual components, which, although less efficient than automated systems, offer ease of use and preserve the traditional cooking experience. Ultimately, this fabricated product provides a practical solution for nutmeg grater, enhancing both cooking and consumption.

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