

PROTOTYPE DESIGN COLLECTION

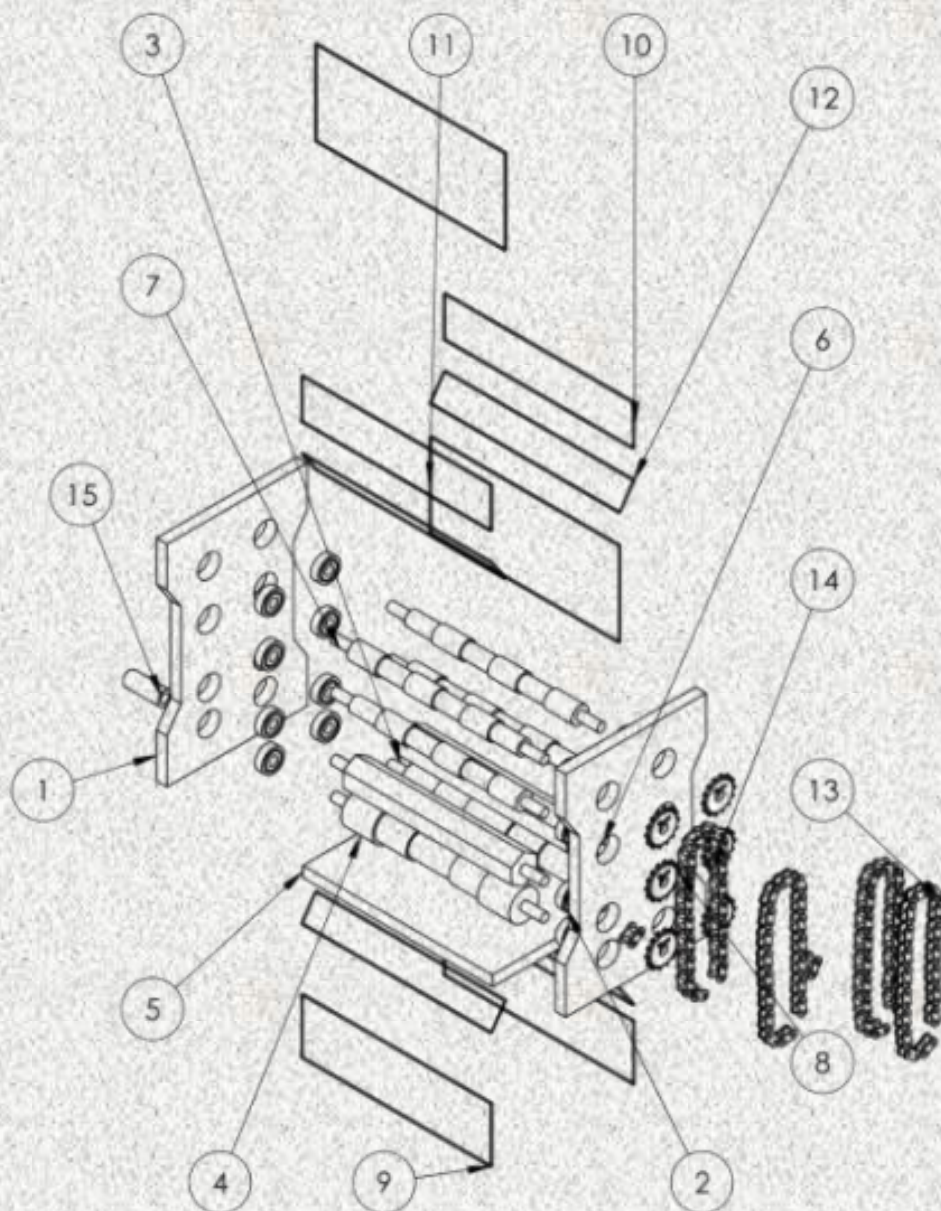
SERIES 4



Universiti Teknologi MARA
Pasir Gudang Campus

Prototype Design Collection

Series 4



Ahmad Najmie Rusli

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FOREWORD

This digital book on Prototype Design Collection Series 4 (PDC Series 4) is published as a reference design for mechanical engineering students. The designs presented experience a few phases of analysis before fabrication of prototype. Each project summarises the project description, prototype, figures, and design parameter. The design products vary in tools or equipment for household, workshop, entrepreneur, etc. Suggested material and detail of prototype dimension are also mentioned in this book.

It is hoped that this book will assist the students to have more ideas on innovation design products in the future.

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CHAPTER 1

Design and Fabrication of a Multipurpose Baby Cot

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PROJECT DESCRIPTION

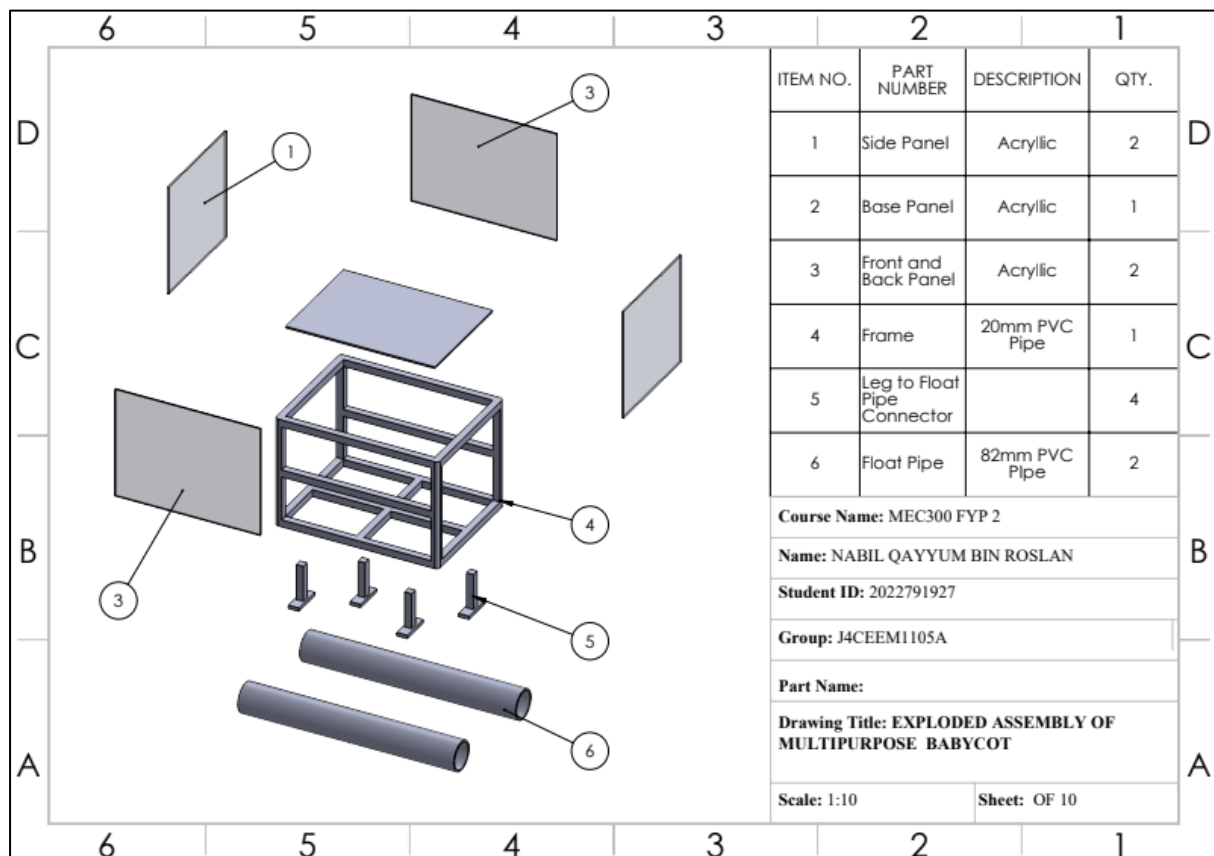
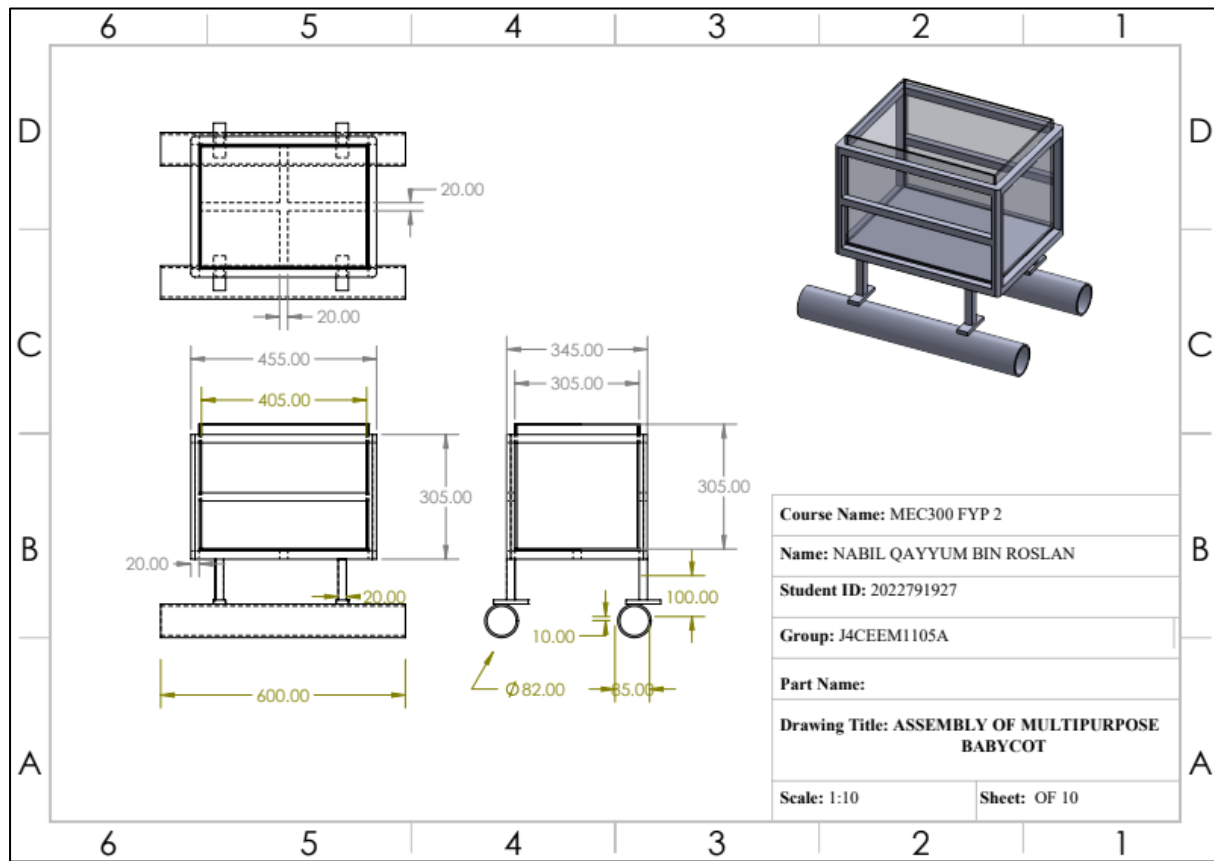
The increasing demand for space-saving and multifunctional baby furniture has led to the development of a multipurpose baby cot, designed for household use and emergency situations such as floods. This project focuses on the design and fabrication of a modular baby cot that integrates convertibility, buoyancy for flood safety, and structural stability. The design process involved CAD modeling, material selection, and fabrication using lightweight yet durable materials to ensure strength and water resistance. Engineering analysis was conducted to assess load-bearing capacity, stability, and structural integrity under different conditions. Testing results showed that the cot remained stable while floating and maintained its balance under load. However, further improvements in waterproofing, weight distribution, and attachment mechanisms are recommended to enhance durability and long-term usability. This project demonstrates the feasibility of integrating modular and buoyant features into baby furniture, providing a practical and adaptable alternative for modern households and emergency relief applications.

Keywords: *Baby Cot, Disaster Aid*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 2

Design and Fabrication of a Weather Sensing Cloth Drying Rack

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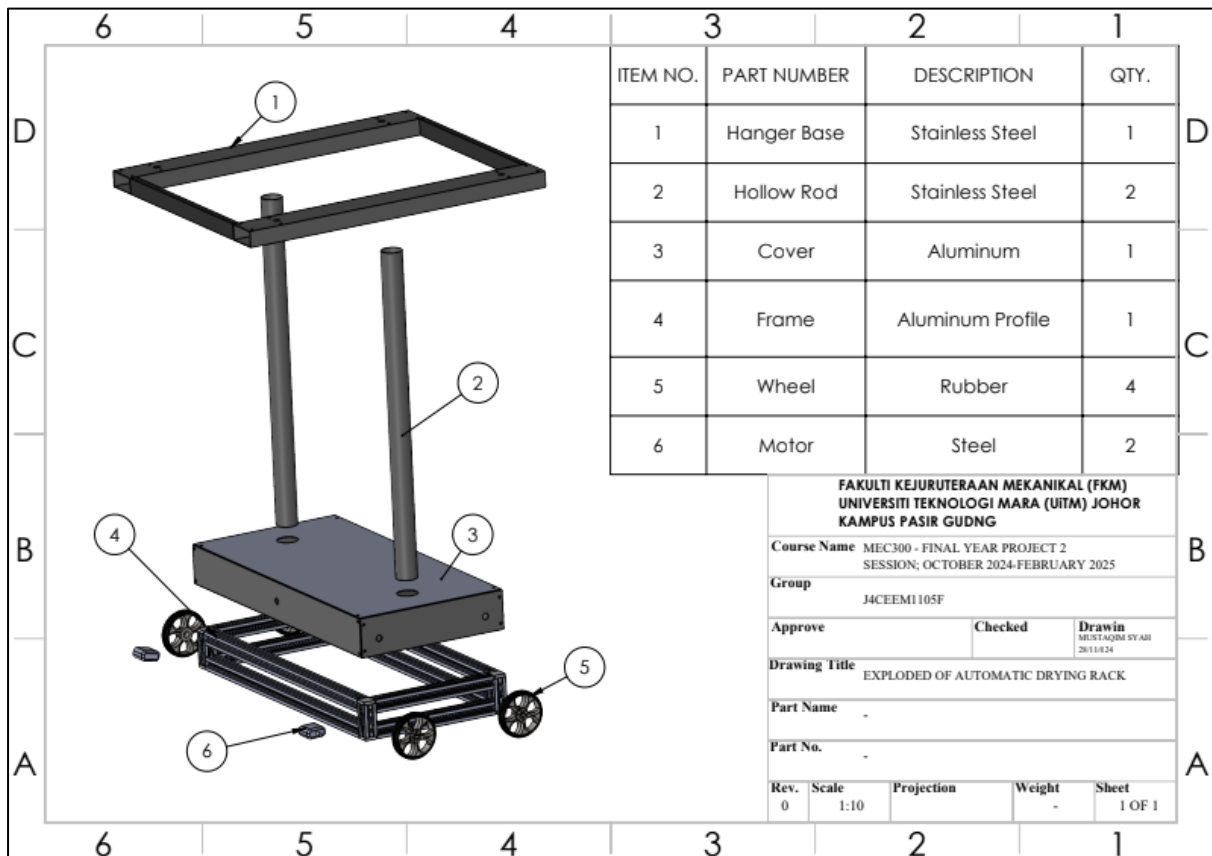
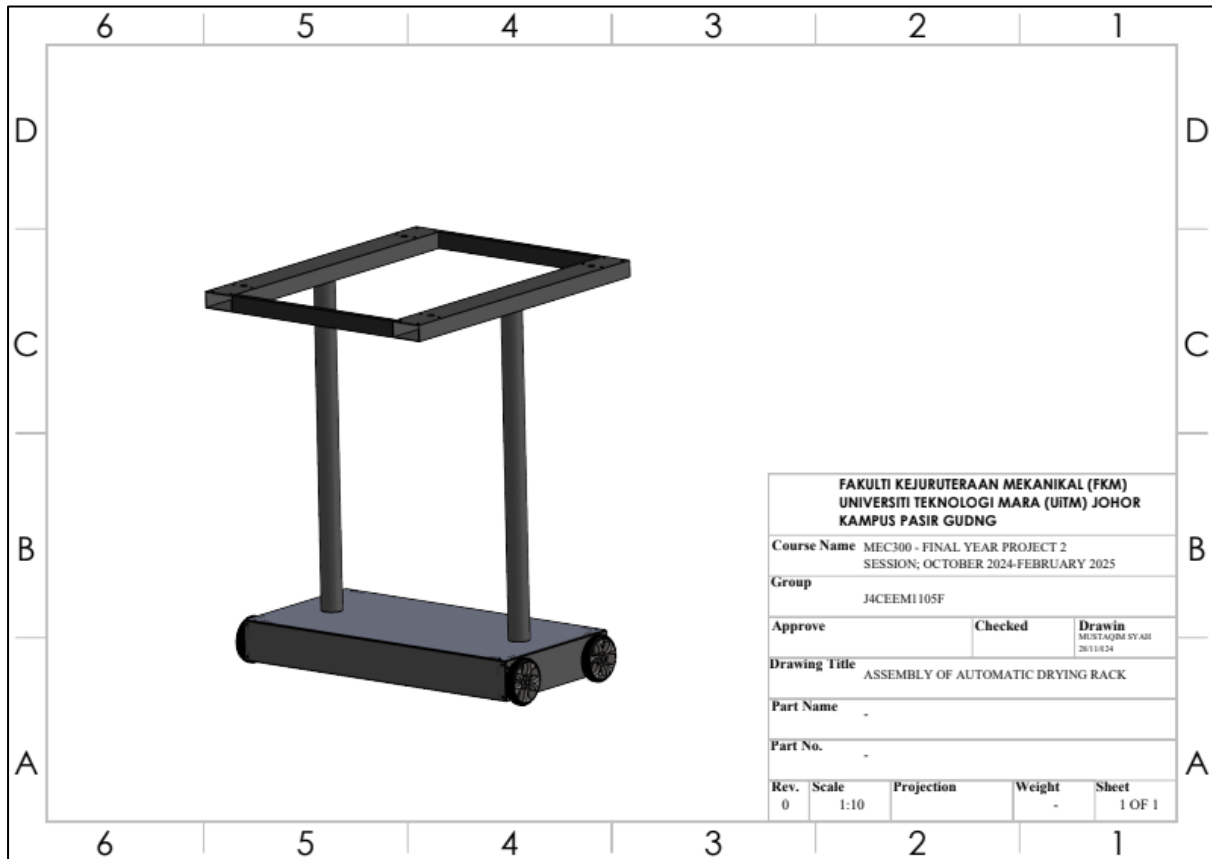
Traditional cloth drying racks pose challenges in unpredictable weather, requiring frequent user intervention. This project focuses on designing and fabricating an automated weather-sensing cloth drying rack equipped with a rain sensor and motorized retractable system to enhance drying efficiency and user convenience. The design process involved concept development, CAD modeling, material selection, and fabrication using mild steel for structural stability. Engineering analysis determined the maximum load capacity (3kg), motor torque requirements, and force distribution to ensure smooth operation. Testing validated that the rain sensor successfully detected precipitation within 3 seconds, triggering the rack's automatic retraction, effectively protecting clothes from rain. Performance evaluation indicated efficient mechanical operation with minimal response delay. However, improvements in sensor calibration, wind resistance, and structural reinforcement are recommended for future enhancements. This project demonstrates the feasibility of integrating automated drying solutions in residential applications, providing a reliable, user-friendly, and weather-adaptive alternative to manual drying methods.

Keywords: *Automated Drying Rack, Weather-Sensing System*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 3

Design and Fabrication of a Patient Transfer Aid for Seamless Bed to Wheelchair Mobility

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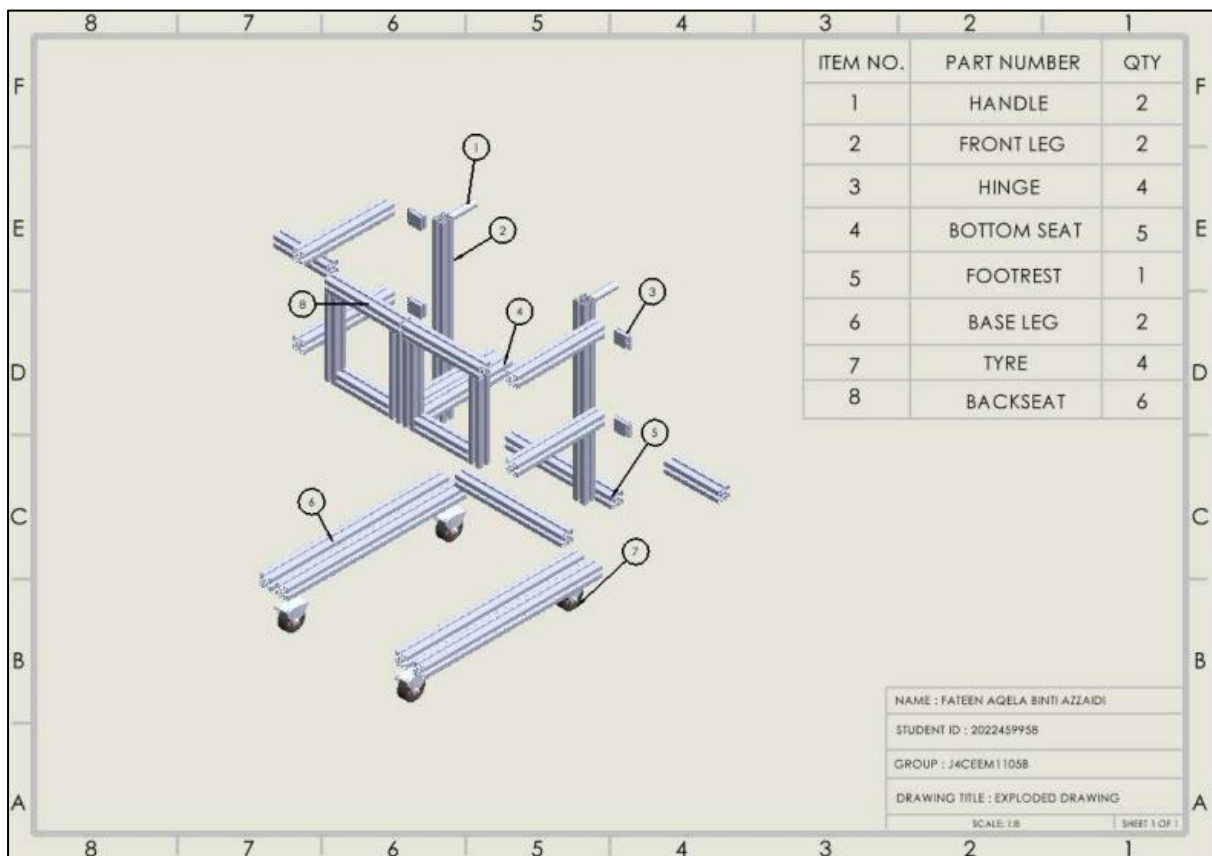
Manual patient transfers between beds and wheelchairs pose significant risks of injury for both caregivers and patients, necessitating the development of a safer and more efficient assistive device. This project focuses on the design and fabrication of a patient transfer aid equipped with a sturdy frame, sliding mechanism, and ergonomic support system to enhance mobility and reduce physical strain. The design process involved concept development, CAD modeling, material selection, and fabrication using lightweight yet durable mild steel for structural stability. Engineering analysis determined the maximum load capacity (120kg), force distribution, and stress analysis on critical components to ensure reliability. The prototype was tested under simulated patient transfer conditions, with results indicating reduction in caregiver effort and decrease in transfer time compared to manual methods. Performance evaluation showed smooth operational movement and adequate weight support, though refinements in frame adjustability, padding comfort, and maneuverability are recommended for future improvements. The findings demonstrate the feasibility of integrating mechanical transfer aids in healthcare environments, offering a safe, user-friendly, and efficient alternative to traditional patient handling methods.

Keywords: *Transfer aid, Mobility*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 4

Prototype of a Donut Topping Machine

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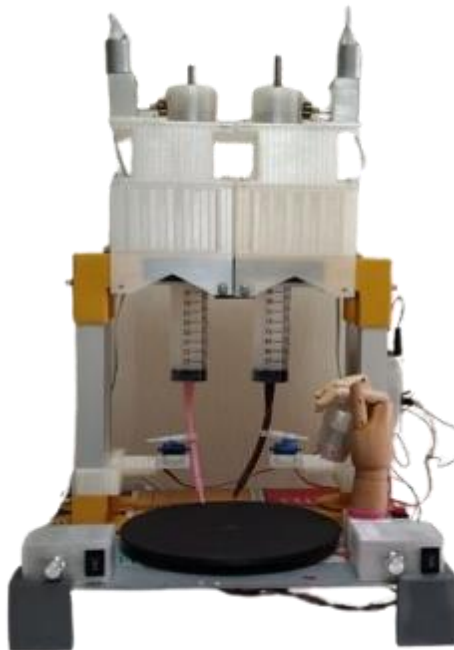
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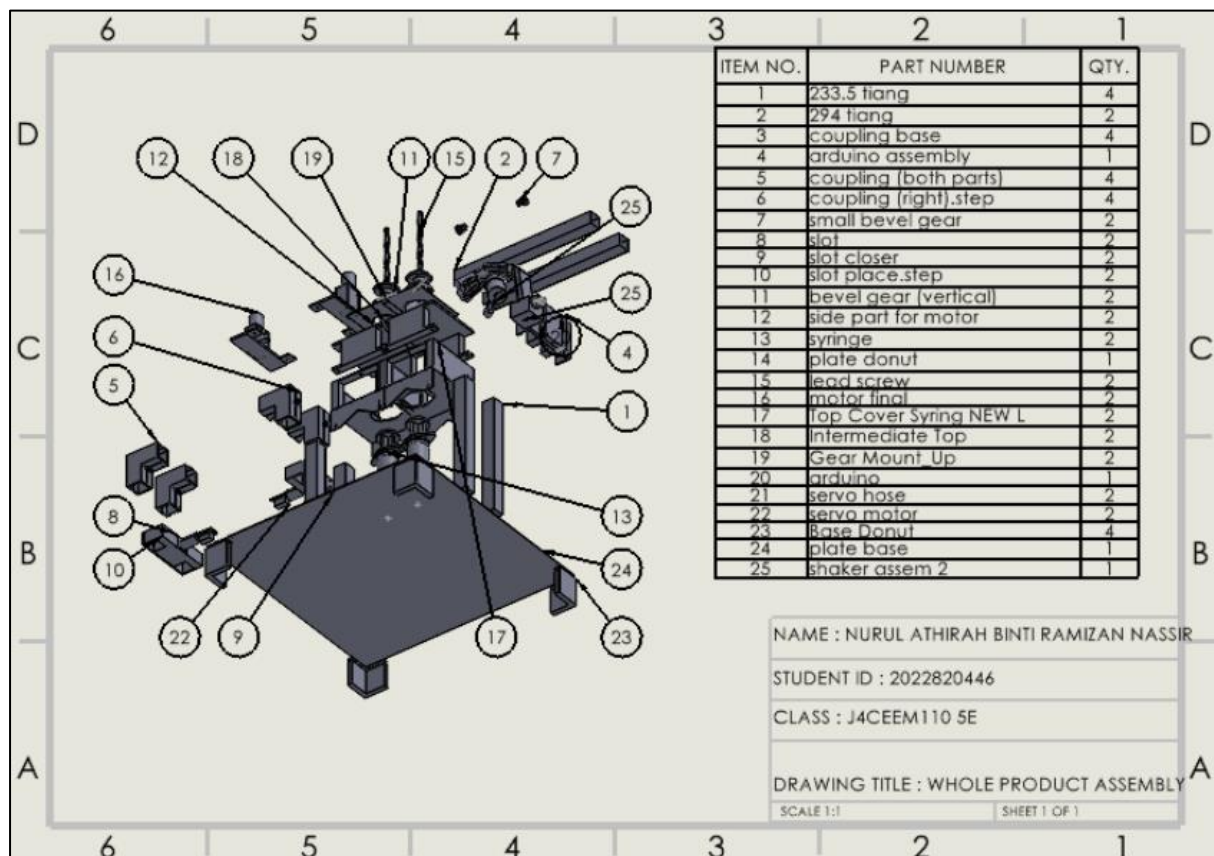
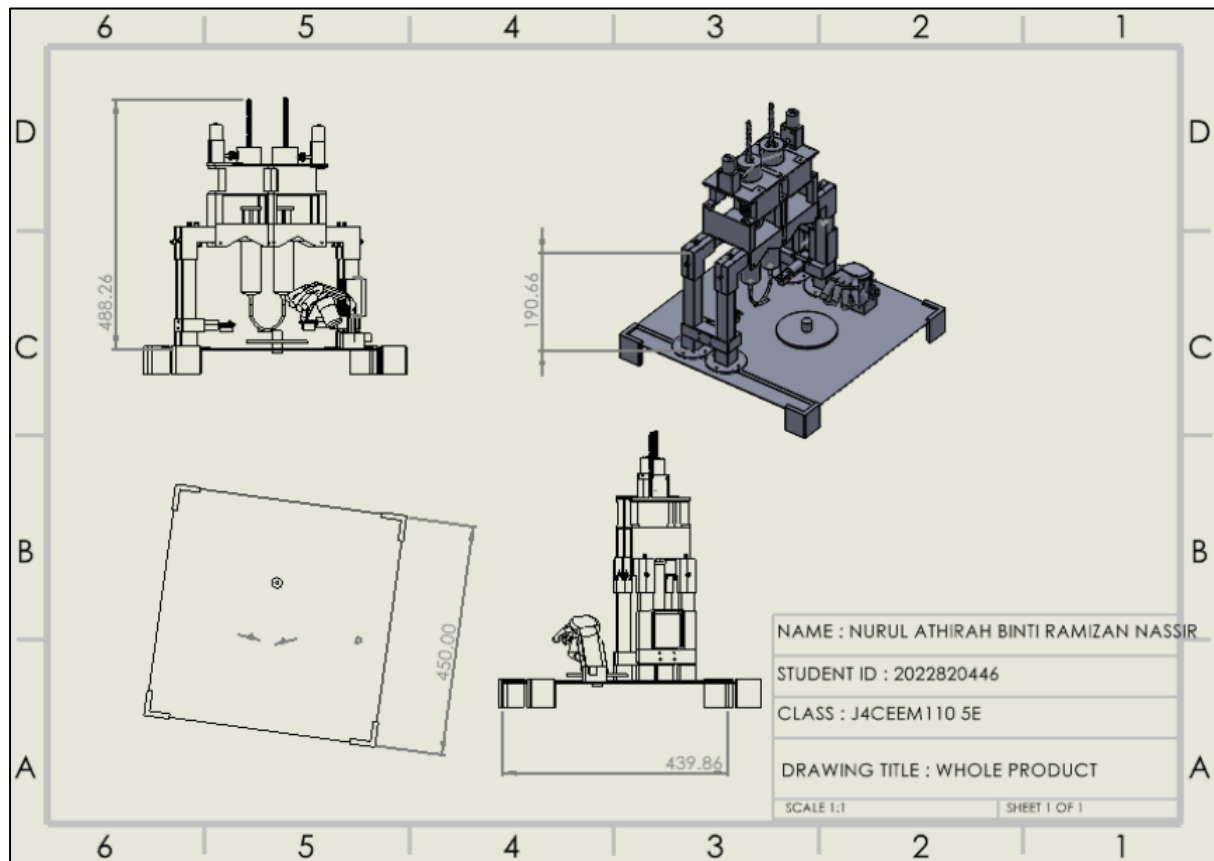
This project presents a prototype of a donut topping machine designed to enhance the efficiency and consistency of topping application in donut production. The system addresses the common challenges faced by donut vendors in achieving uniform topping coverage and fast operation. The machine features two automated dispensers capable of applying various dry toppings, such as sprinkles and icing sugar. During operation, the dispensers move in a zig-zag pattern, while the donut is automatically rotated on its base to ensure full surface coverage. An optional sprinkler function is included to apply an additional layer of topping when selected by the user. The system is powered by a 12V DC motor and controlled via an Arduino microcontroller for precise timing and movement coordination. The dispenser motion is driven by a power screw mechanism, with adjustable speed control enabled by a bevel gear system. This prototype demonstrates a low cost, semi-automated solution aimed at improving topping application consistency and reducing manual labor in small to medium scale donut operations.

Keywords: *Donut machine, Donut topping*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 5

Prototype of a PLA Filament Extruder

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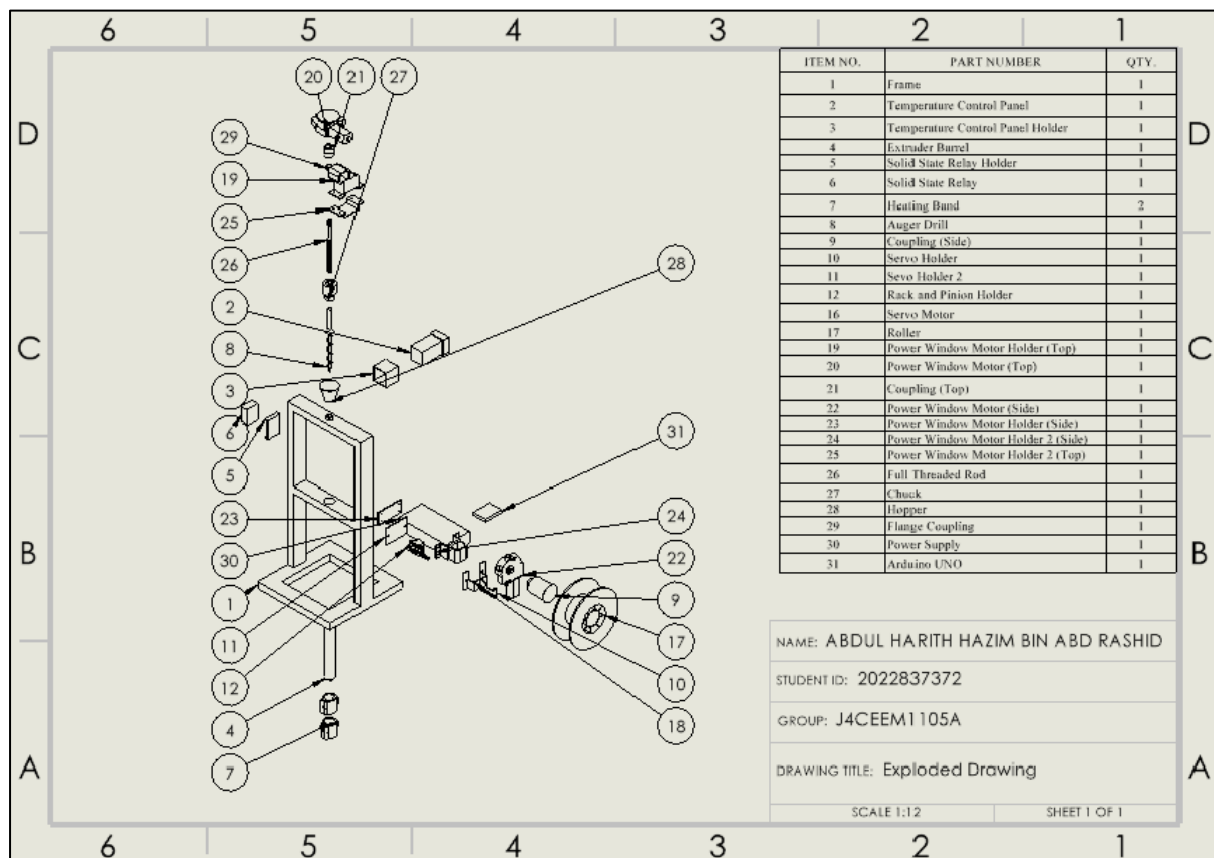
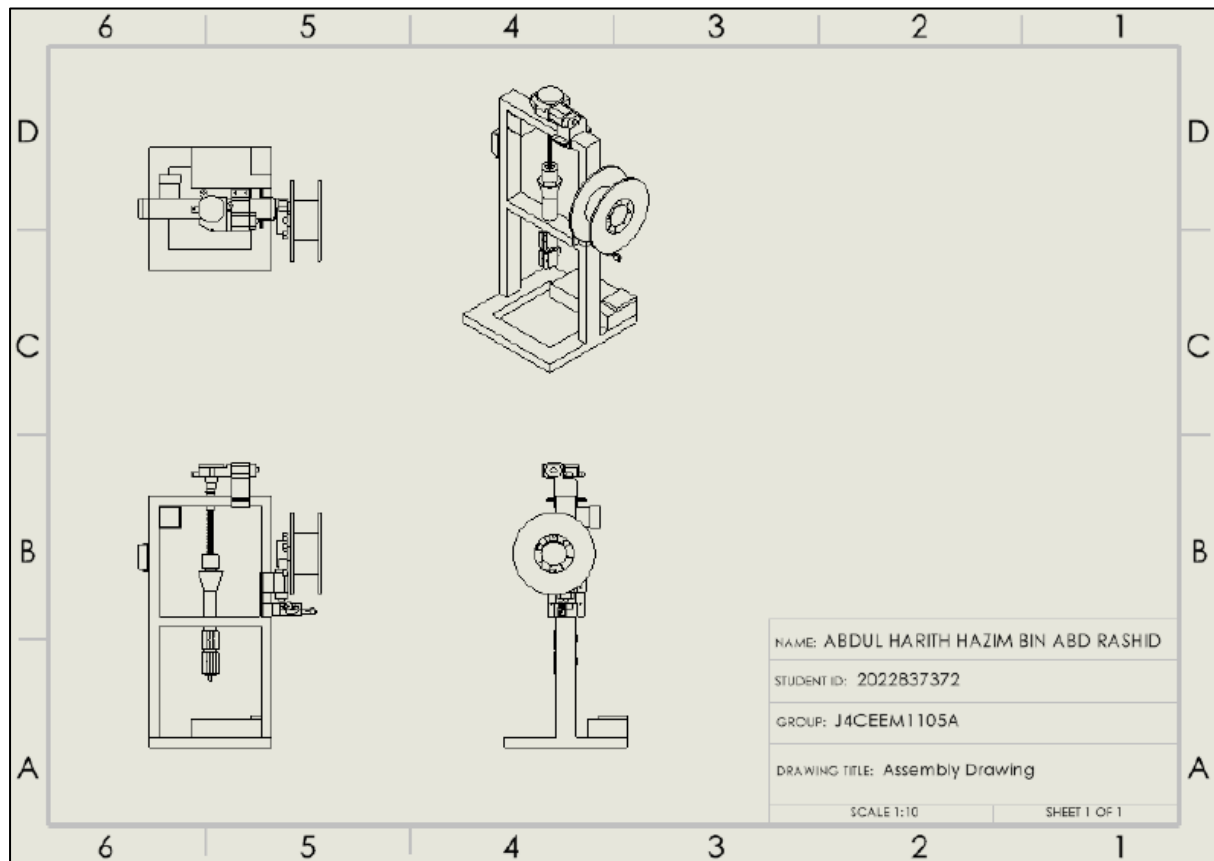
This project aims to design, develop and fabricate a low cost prototype of a PLA filament extruder as a proof of concept. The extruder features a horizontal extrusion process and is equipped with a heating element controlled by a temperature controller to ensure consistent melting. A 12V DC motor is used to regulate the extrusion speed providing better control over filament quality. The system is designed to produce filament with a uniform diameter of 1.7mm. The design process involves studying existing models, redesigning using computer-aided design (CAD) software and performing mechanical and electrical fabrication. This project promotes sustainability, reduces filament cost and makes filament recycling accessible for home users. The goal is to produce a compact, affordable and functional filament extruder that supports sustainable practices, reduces filament costs and increases accessibility for personal or small scale use. This prototype could significantly contribute to eco friendly 3D printing and promote responsible material usage within the growing community of 3D printing enthusiasts and professionals.

Keywords: *Filament, Filament extruder*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 6

Prototype of a Candy Sorting Machine

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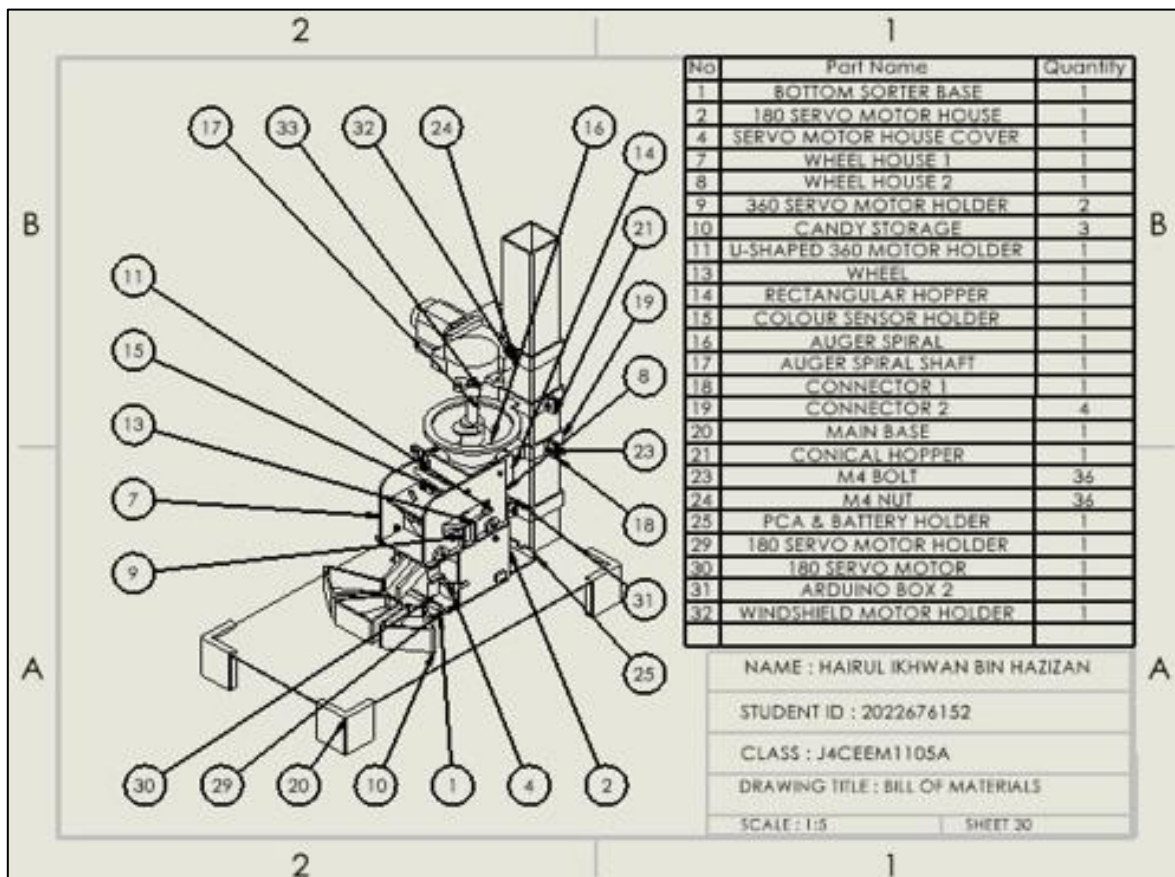
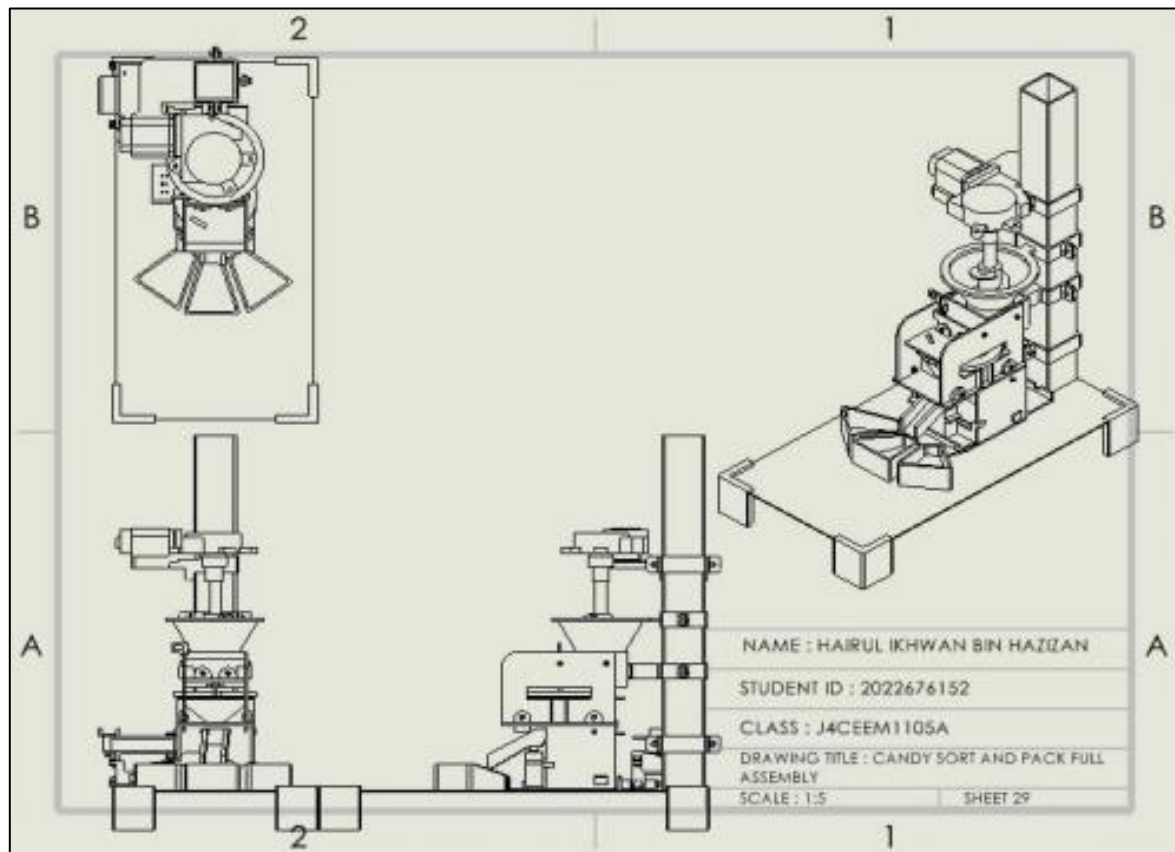
This project presents a prototype of a candy sorting machine designed to streamline the sorting process based on color detection. As the demand for efficient candy production increases, manual sorting becomes time-consuming and prone to errors. The proposed machine addresses this issue by automatically identifying and sorting candies according to their colors in a systematic and organized manner. The main objective is to achieve accurate color detection, uniform distribution, and efficient sorting using Arduino-based control. The system's design incorporates an Arduino microcontroller, color sensors, and motors to drive the sorting mechanism. The development also includes custom Arduino code to handle color detection and implement the sorting logic. This prototype provides a cost-effective and scalable solution to enhance productivity in small- to medium-scale candy manufacturing environments.

Keywords: *Candy sorting, Color sensors*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 7

Prototype of a 3D Printing Scrap Recycling Machine

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PROJECT DESCRIPTION

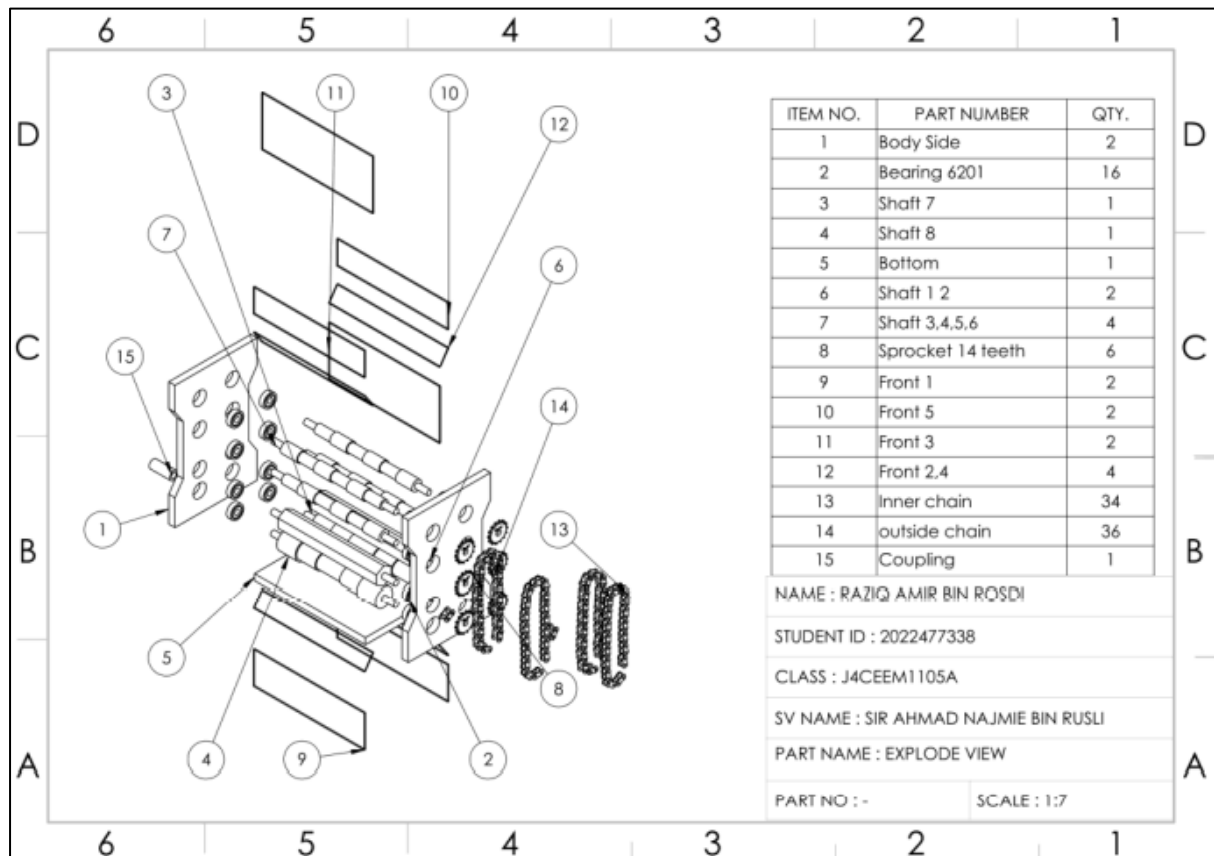
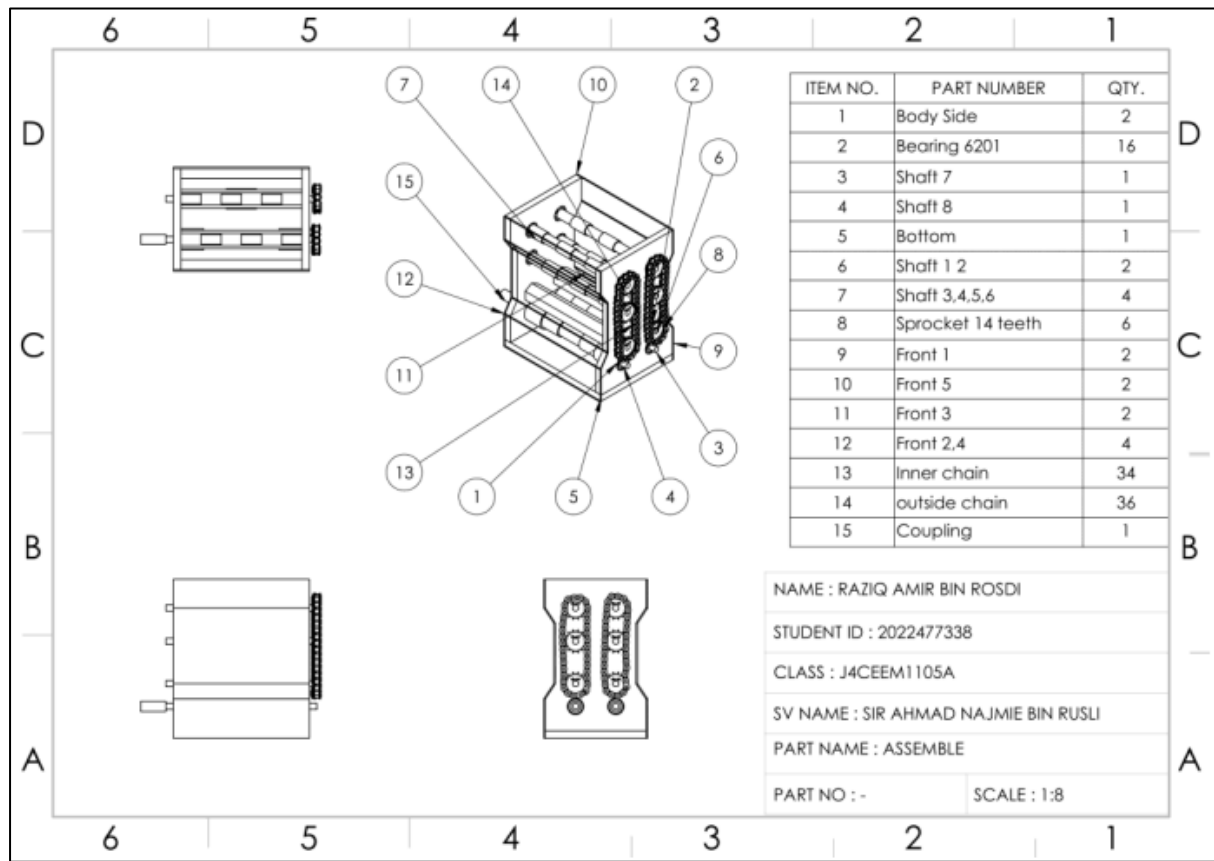
This project presents a prototype of a 3D printing scrap recycling machine, designed to process and reduce waste from failed or excess PLA prints. The structure of the prototype is constructed primarily from acrylic and wood, providing a lightweight yet stable frame for demonstration purposes. The core component of the machine is a shredder unit made from solid mild steel cylinders, featuring a three layers shredder system. Each layer having a different shredder diameter. This design enables the machine to efficiently shred large 3D printed parts up to 50mm x 50mm in size. The output from the shredder consists of coarse PLA debris, which can then be further processed into finer particles using an external blender machine for filament re-extrusion or other recycling processes. The system is powered by a 12V DC motor, with power transmission to the shredder layers achieved via a gear and chain mechanism ensuring synchronized and efficient operation across all layers. This prototype demonstrates a scalable and low cost solution for reducing 3D printing waste in small scale or desktop 3D printer.

Keywords: *Shredder, Waste 3D printer*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 8

Manual Compaction Machine for Casting

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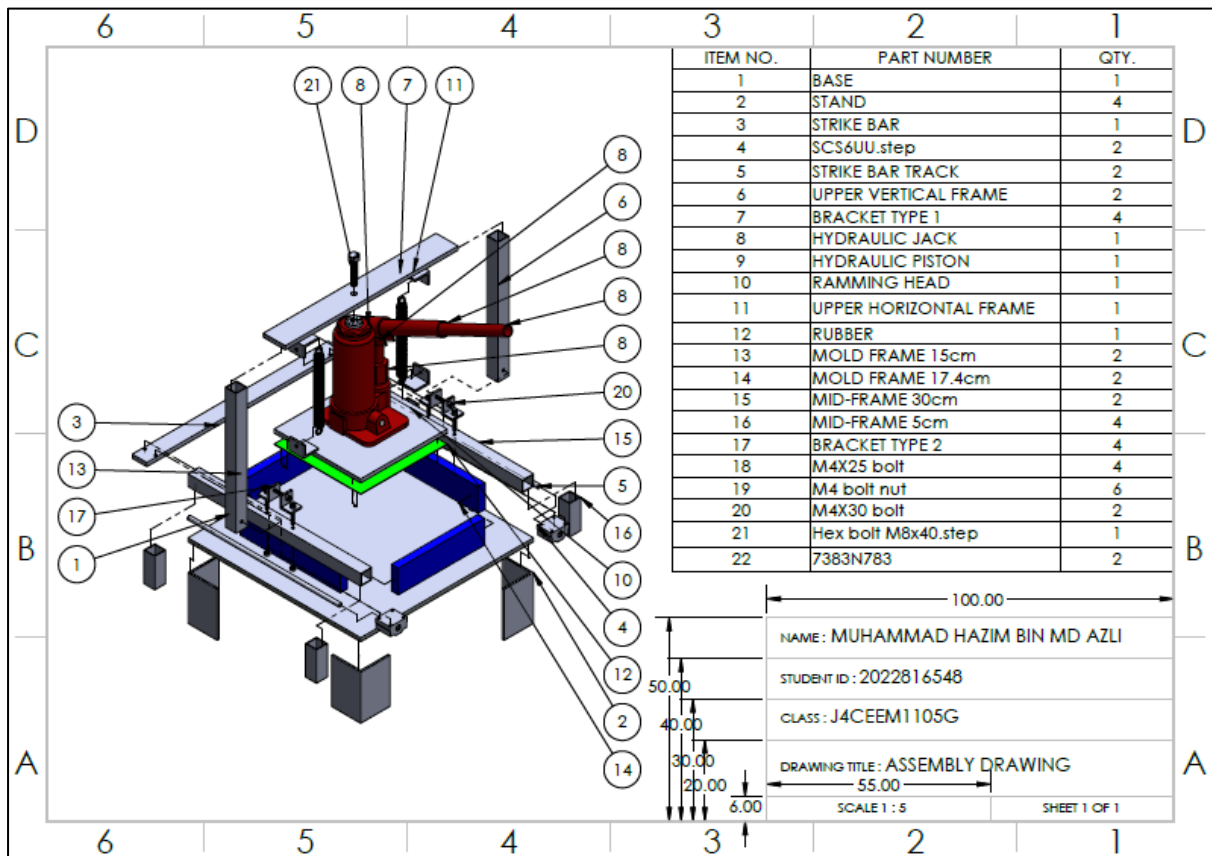
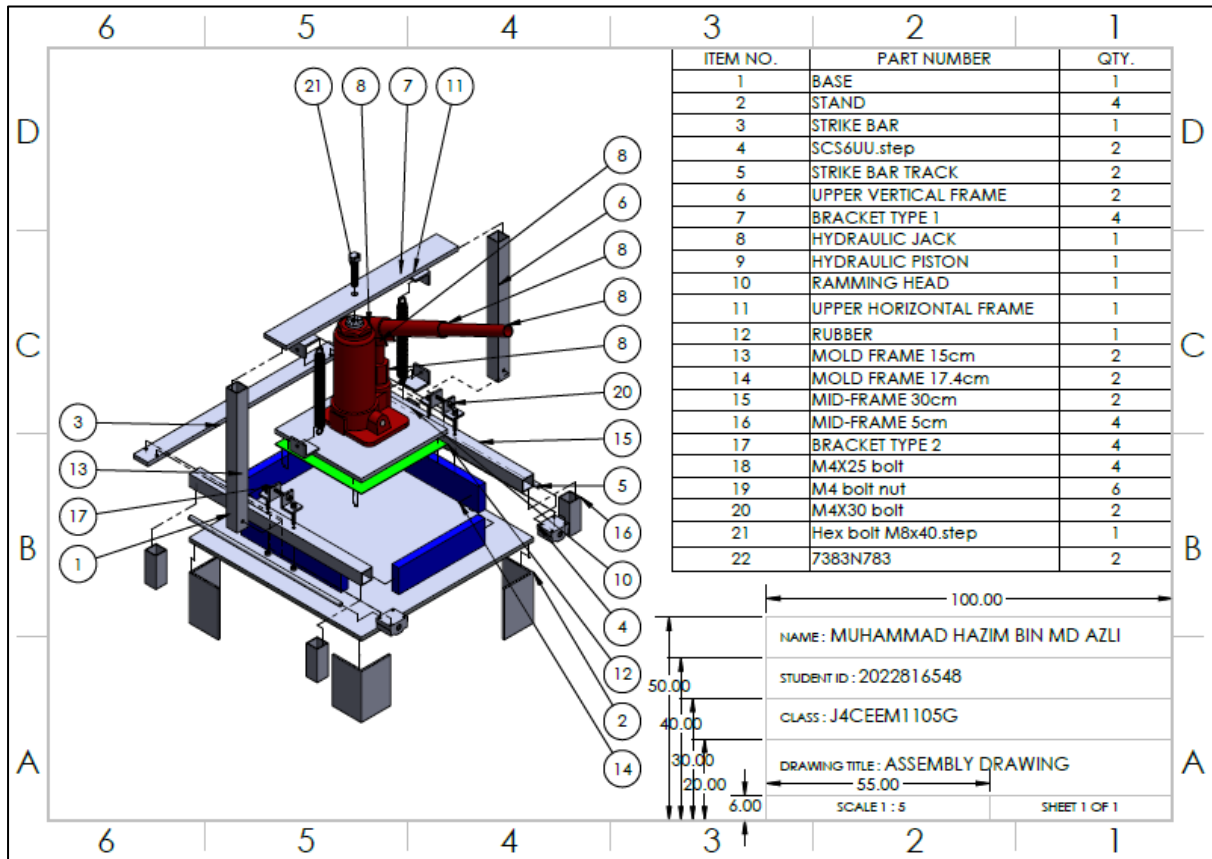
The production of sand molds for casting is a critical process in modern manufacturing, particularly in industries such as automotive, construction, and machinery. However, existing ramming tools and machines face several inefficiencies, including uneven compaction, high costs, and ergonomic concerns. This study focused on the design and fabrication of a manual ramming machine tailored for small-scale workshops and educational purposes, offering a low-cost and user-friendly solution for efficient mold-making. The proposed manual ramming machine is designed using SolidWorks and incorporates a 2-ton hydraulic jack to ensure uniform sand compaction. Fabrication methods included cutting, welding, and mechanical assembly using durable and recyclable materials. The final prototype is compact, portable, and manually operated, reducing energy consumption and promoting sustainability. Testing confirmed the machine's capability to achieve uniform compression with minimal operator effort, producing high-quality molds in under one minute. The design prioritizes safety and simplicity, making it ideal for students and small-scale manufacturers. Furthermore, the incorporation of recyclable materials and manual operation underscores its environmental benefits. This research highlights the potential of the manual ramming machine to address inefficiencies in current tools, improve accessibility, and enhance the learning experience in casting workshops.

Keywords: *Manual, Casting*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 9

Convertible Cart-Ladder

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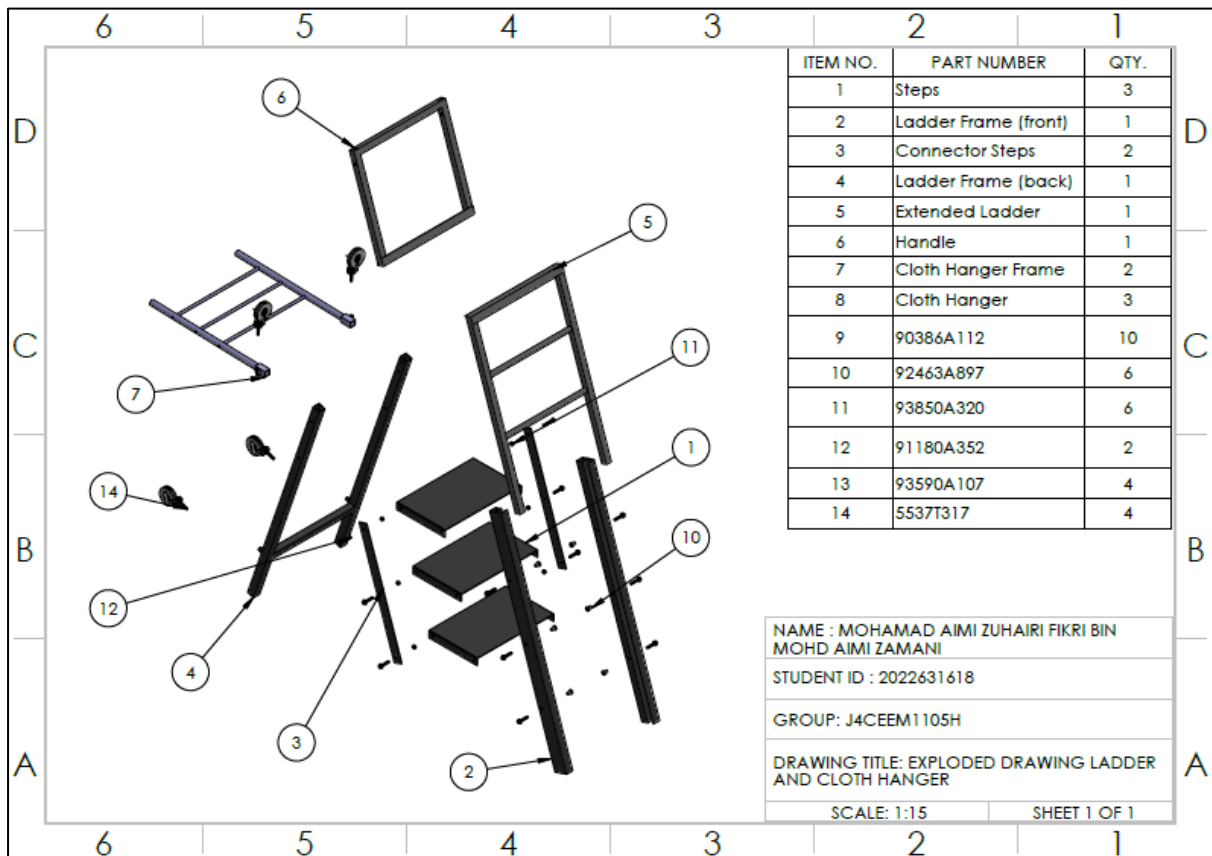
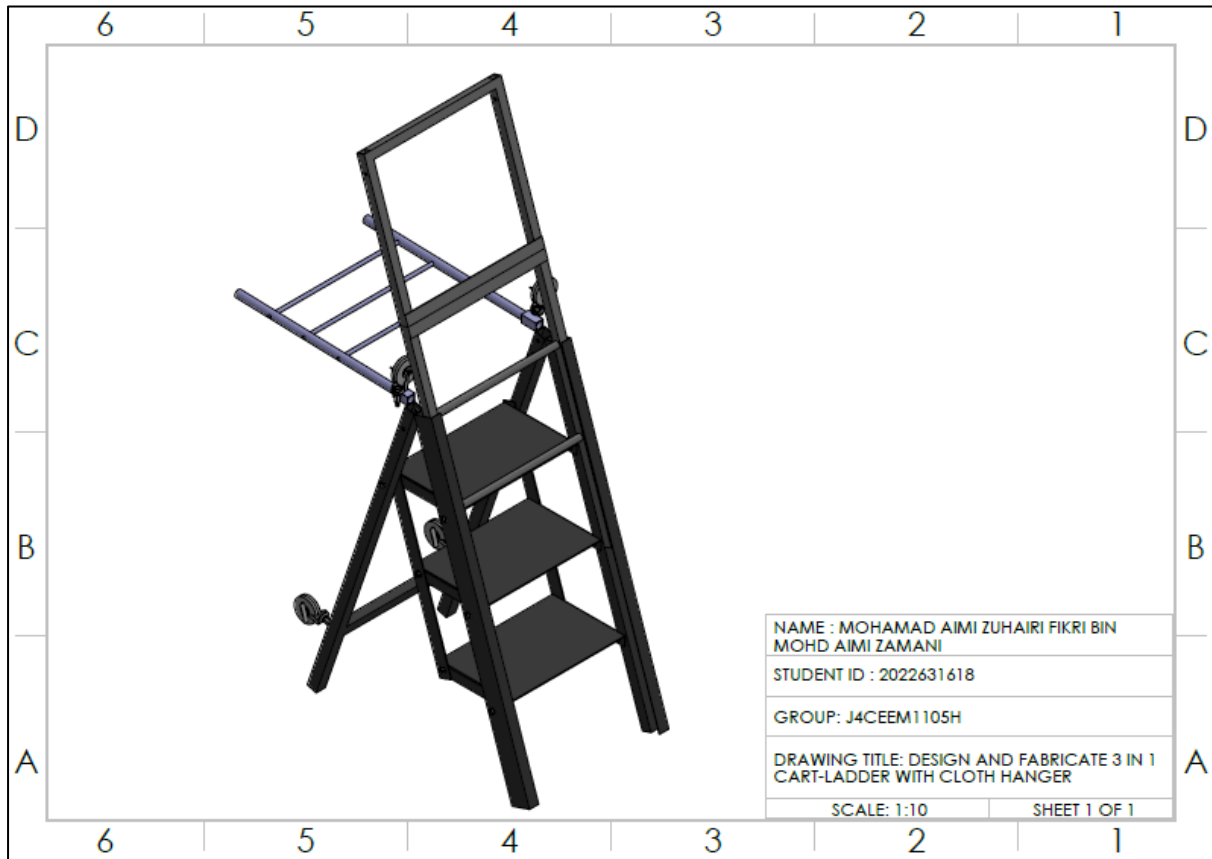
A multipurpose product is one that can be used for a variety of functions or tasks, making it versatile and cost-effective as well as allowing consumers to save space, money, and time by purchasing a single item that can handle different needs. In this case, a convertible cart-ladder with a built-in cloth hanger is an innovative solution that combines versatility and efficiency in a compact, multi-functional unit has been developed. The fabrication process was taking three phases. The first phase includes the ladder frame followed by the ladder step and its extended. Second phase is including the hanger part and last phase is for cart function. This compact design, with all parts that can be folded, makes it easy to store and saves a lot of space when not in use. The frame is designed to support all its functions, with a folding mechanism that allows it to be easily transformed between the three modes. The cart section consists of a platform for carrying materials, while the ladder section used the platform as a step for climbing. The cloth hanger components have its own feature to hang the cloth and supported by a connector. In conclusion, the multipurpose cart-ladder helped to improve the productivity of the work and solved the storage problem when it not in use. This makes it ideal for use in various settings, including warehouses, retail stores, and homes, where space is limited..

Keywords: *Convertible, Cart-ladder*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 10

Design and Fabrication of Mini Firefighting Device

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PROJECT DESCRIPTION

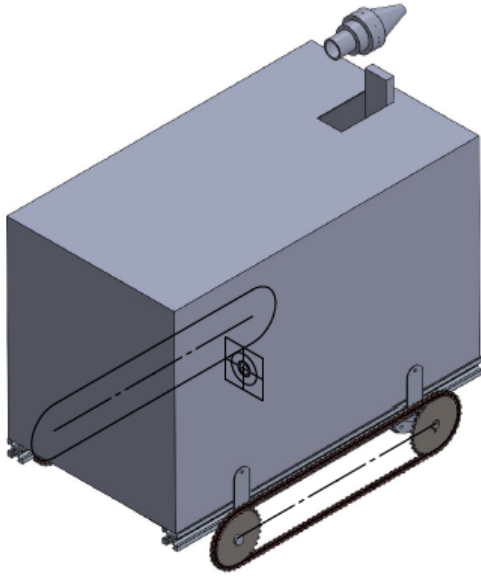
Firefighting remains one of the most hazardous occupations, with personnel frequently required to navigate confined and unstable environments. In such conditions, limited manoeuvrability and delayed response times can result in severe injuries or fatalities. This project presents the design and development of a compact, automated firefighting device intended to address the limitations of existing market solutions, which are often oversized, irregularly shaped, and cumbersome to deploy in restricted spaces. The proposed device features a streamlined form factor optimised for navigating narrow gaps within collapsed structures. An integrated flame sensor enables autonomous water discharge, eliminating the need for manual activation and reducing critical response time. Components are selected based on cost-effectiveness, availability, and ease of maintenance to ensure practicality in large-scale deployment. The design is modelled in SolidWorks 2021 and manufactured using appropriate techniques, with emphasis on minimising weight and enhancing portability. Fabrication involves three primary mechanical processes: bending, joining, and cutting. Control is managed by an Arduino-based system, which aims to reduce operational errors under high-stress emergency conditions. The anticipated outcome is a lightweight, agile, and user-friendly firefighting device capable of operating effectively in confined environments while supporting faster, safer intervention. By combining compact mechanical design, autonomous sensing, and low-cost production, this project seeks to advance firefighting technology, improving both efficiency and safety in critical rescue operations.

Keywords: *Firefighting, Automation*

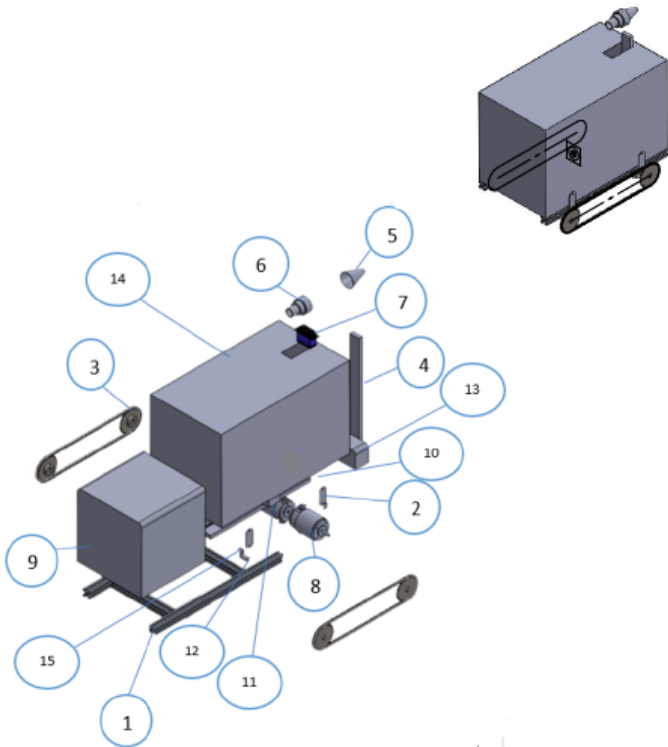
PROTOTYPE



DESIGN PARAMETER



FAKULTI KEJURUTERAAN MEKANIKAL (FKM) UNIVERSITI TEKNOLOGI MARA (UiTM) JOHOR KAMPUS PASIR GUDANG					
Course Name MEC299 - FINAL YEAR PROJECT 1 SESSION: MARCH 2024 - AUGUST 2024					
Group J4CEEM1104B					
Approved		Checked		Drawn ADAM FARIS AHMAD ZADY 26/6/2024	
Drawing Title ASSEMBLY OF MINI FIREFIGHTING DEVICE					
Part Name					
Part No.					
Rev.	Scale	Projection	Weight	Sheet	
0	1:4		8.0 kg	1 of 1	



BOM Table		
ITEM NO.	PART NUMBER	QTY.
1	Frame	1
2	Latch	4
3	chain and sproket	2
4	rod	2
5	nozzle	1
6	pipe insert	1
7	DC motor	2
8	water tank	1
9	Water Pump	1
10	pump mount	1
11	Back shaft	2
12	Battery	1
13	Kotak	1
14	Plate	6

FAKULTI KEJURUTERAAN MEKANIKAL (FKM) UNIVERSITI TEKNOLOGI MARA (UiTM) JOHOR KAMPUS PASIR GUDANG					
Course Name MEC299 - FINAL YEAR PROJECT 1 SESSION: MARCH 2024 - AUGUST 2024					
Group J4CEEM1104B					
Approved		Checked		Drawn ADAM FARIS AHMAD ZADY 26/6/2024	
Drawing Title ASSEMBLY OF MINI FIREFIGHTING DEVICE					
Part Name					
Part No.					
Rev.	Scale	Projection	Weight	Sheet	
0	1:10		8.0 kg	1 of 1	

CHAPTER 11

Design and Fabrication of Shuttlecock Launcher Machine

Ahmad Amsyar Zuhdi Bin Ahmad Rizal ¹ and Muhamad Faris Syafiq Bin Khalid ^{2*}

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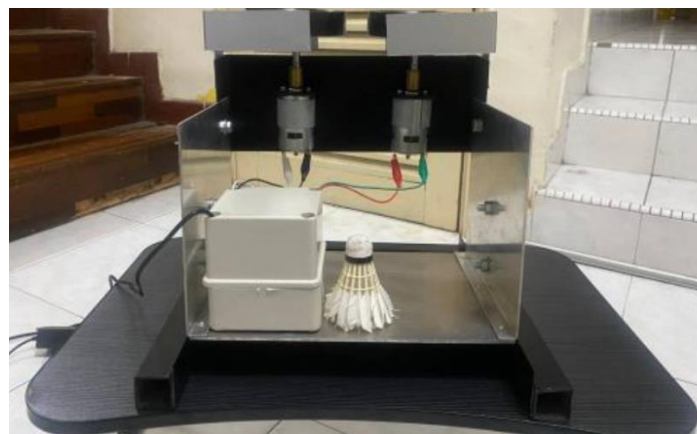
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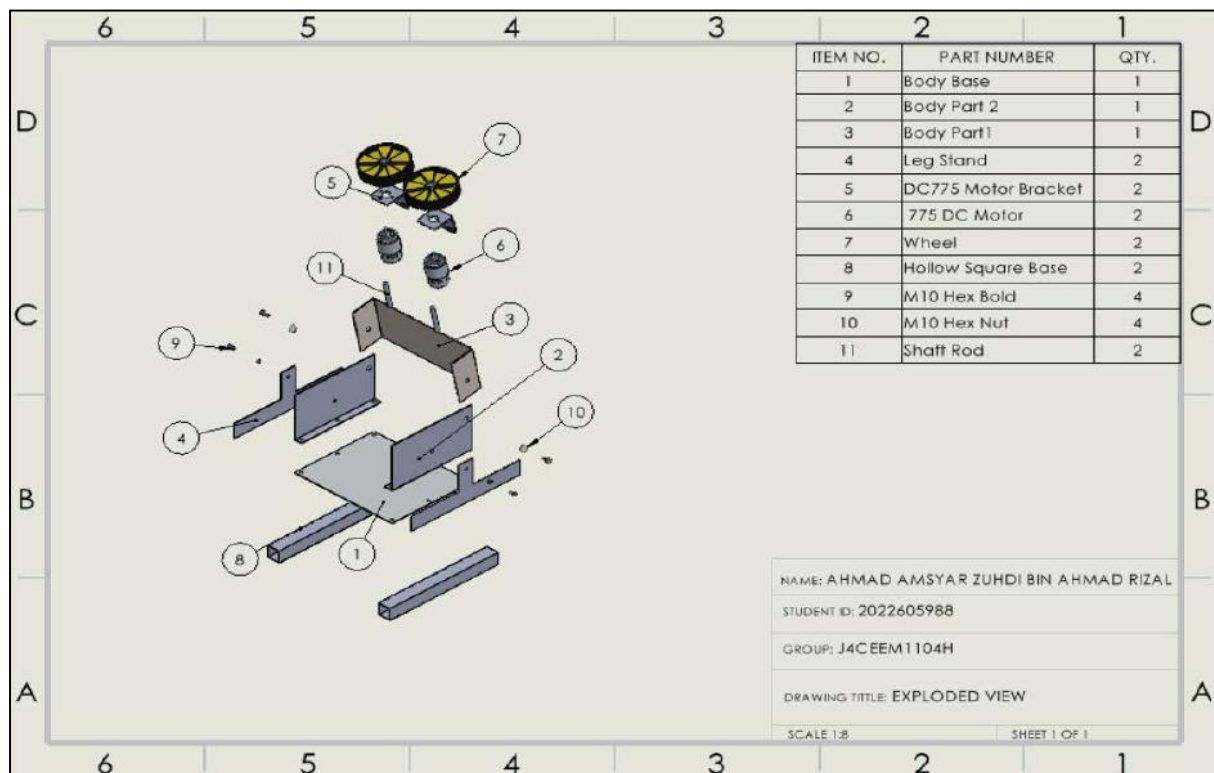
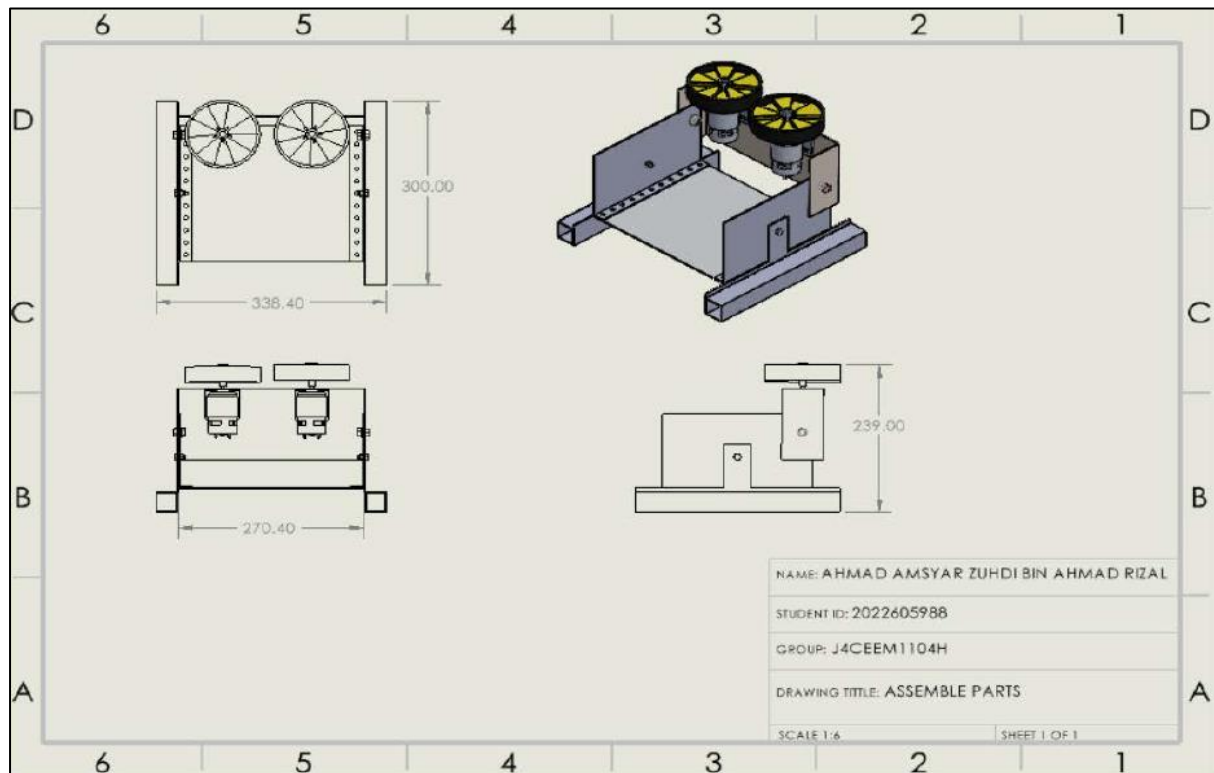
This project focuses on the design and fabrication of a shuttlecock launcher specifically developed to enhance badminton training without reliance on a playing partner. Conventional practice methods often depend on the skill and consistency of a training partner, limiting practice opportunities and reducing training efficiency. To address this limitation, a compact and efficient shuttlecock launching machine is developed, utilising DC motor technology to deliver shuttlecocks at adjustable speeds, trajectories, and directions. The system integrates a motor-driven pitching mechanism with a shuttlecock hopper, supported by safety features designed to prevent accidental operation and ensure user protection. The machine's versatility allows players to independently practice a variety of shots, improving technical precision, reaction time, and overall performance. Its user-friendly design ensures accessibility for players of varying skill levels, while its portable structure supports convenient transport and setup. In addition to functionality, the project incorporates sustainability considerations, including energy-efficient operation, responsible material selection, and an environmental impact assessment to reduce the device's ecological footprint. These measures align with sustainable manufacturing and usage practices, reinforcing the project's commitment to environmental responsibility. By combining engineering design principles, sports technology, and sustainable innovation, this project contributes to the advancement of autonomous training tools in badminton. The resulting device offers a practical, safe, and effective solution for skill development, enabling athletes to train more frequently, independently, and efficiently.

Keywords: *Shuttlecock Launcher, Sports Technology*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 12

Luggage Scooter

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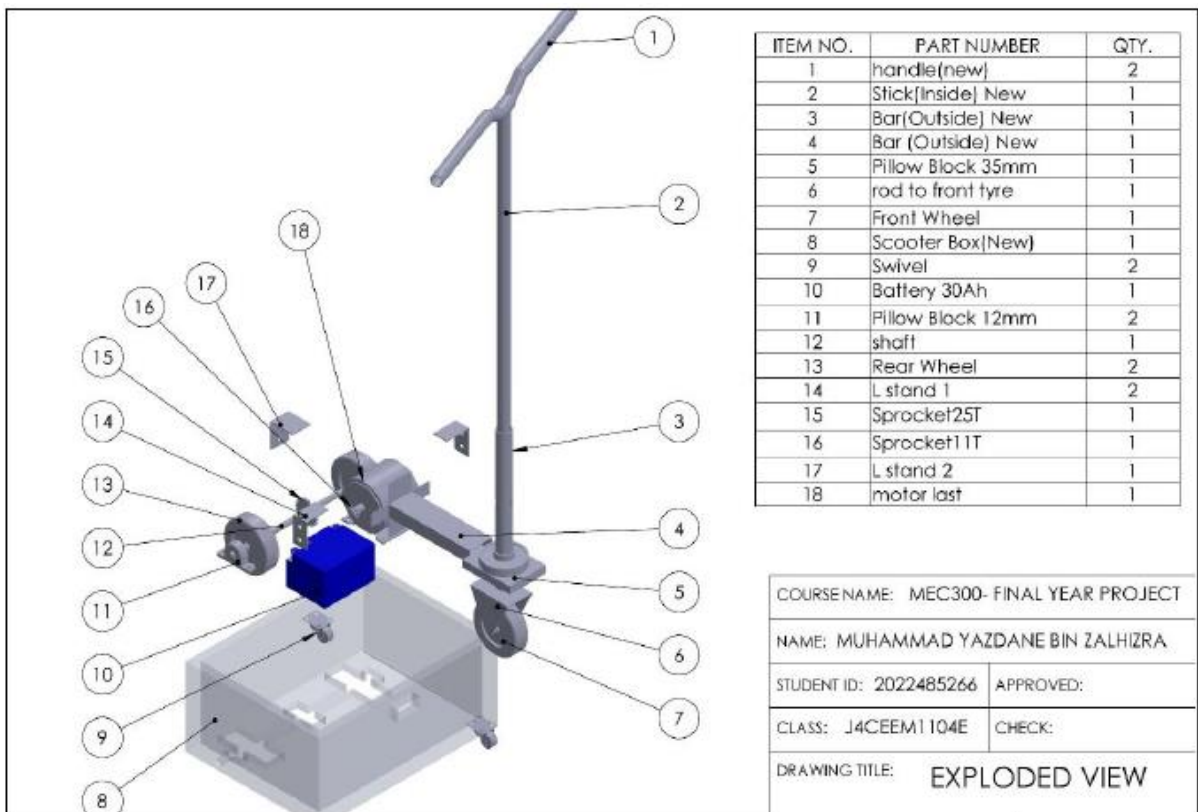
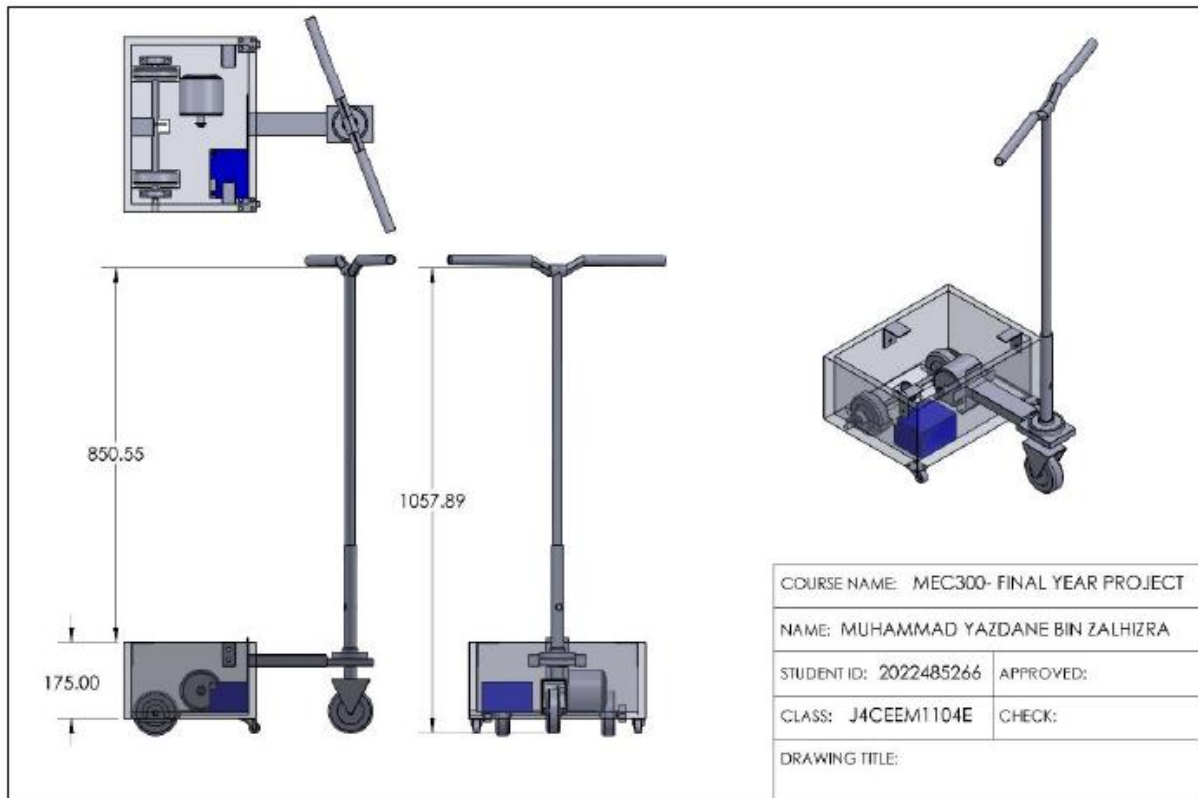
The use of luggage is essential for travelers navigating airports, train stations, and urban environments. Conventional luggage, however, frequently presents logistical and ergonomic difficulties. Travelers frequently experience fatigue and inefficiency when transporting heavy bags across large transit hubs. Furthermore, the motorized luggage options currently available on the market are often prohibitively expensive and inaccessible to budget-conscious users. This study tackles these problems by designing and developing a motorized luggage scooter as an affordable and practical substitute. The aim of this project is to design and fabricate a prototype that combines a 38-liter luggage compartment with a small electric scooter. The methodology involves 3D modelling and structural simulation using SolidWorks, followed by rigorous engineering calculations to determine torque requirements and optimize gear ratios. Fabrication was carried out using MIG welding, precision drilling, threading and assembly, employing materials selected for their strength-to-weight ratio and affordability. The resulting prototype, powered by a 36V, 350W brushed DC motor, successfully demonstrated reliable propulsion, maneuverability and structural stability under a load of up to 100 kg. The prototype achieved all functional and economic objectives with a total production cost of RM383.73. In conclusion, the project confirms the feasibility of a low-cost, sustainable and ergonomically efficient rideable luggage solution, offering a practical and scalable alternative for last-mile mobility and short-distance travel.

Keywords: *Luggage Scooter, Low-cost*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 13

Coconut Grating Machine

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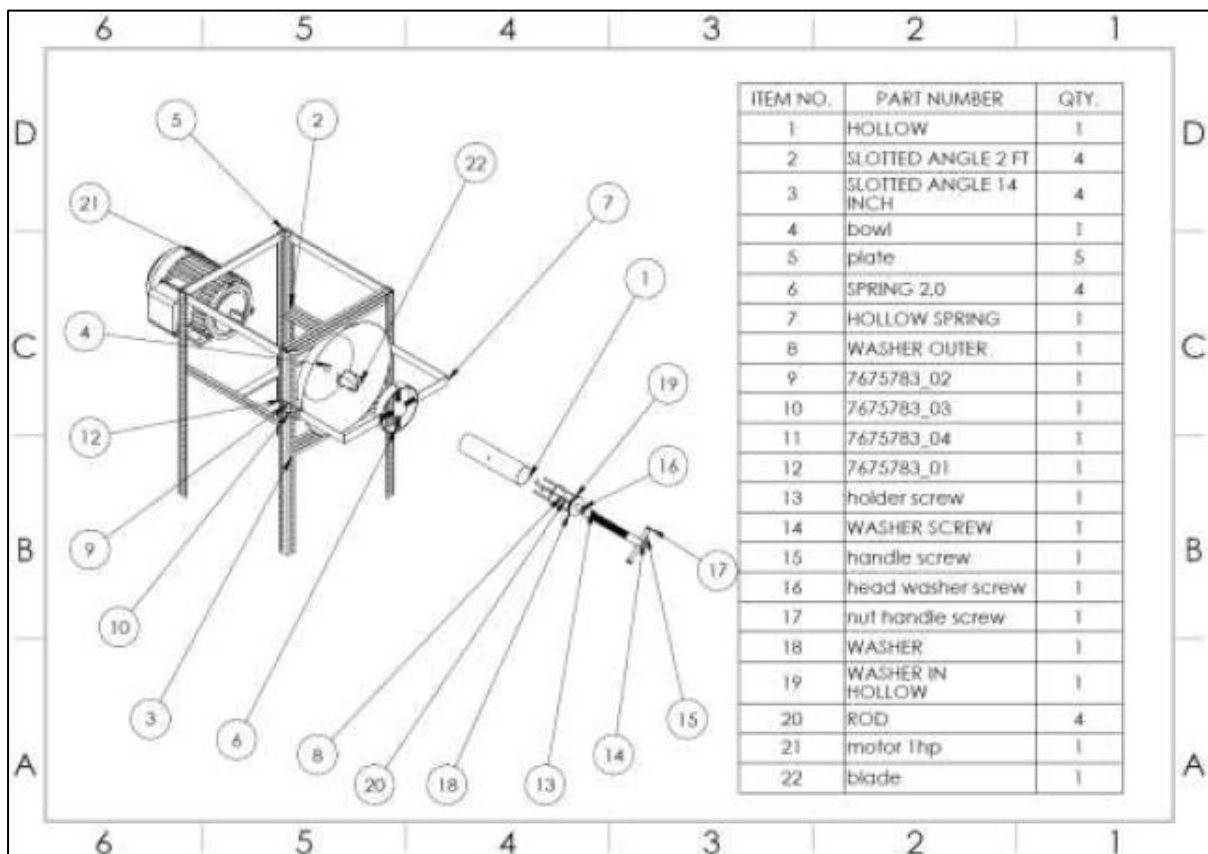
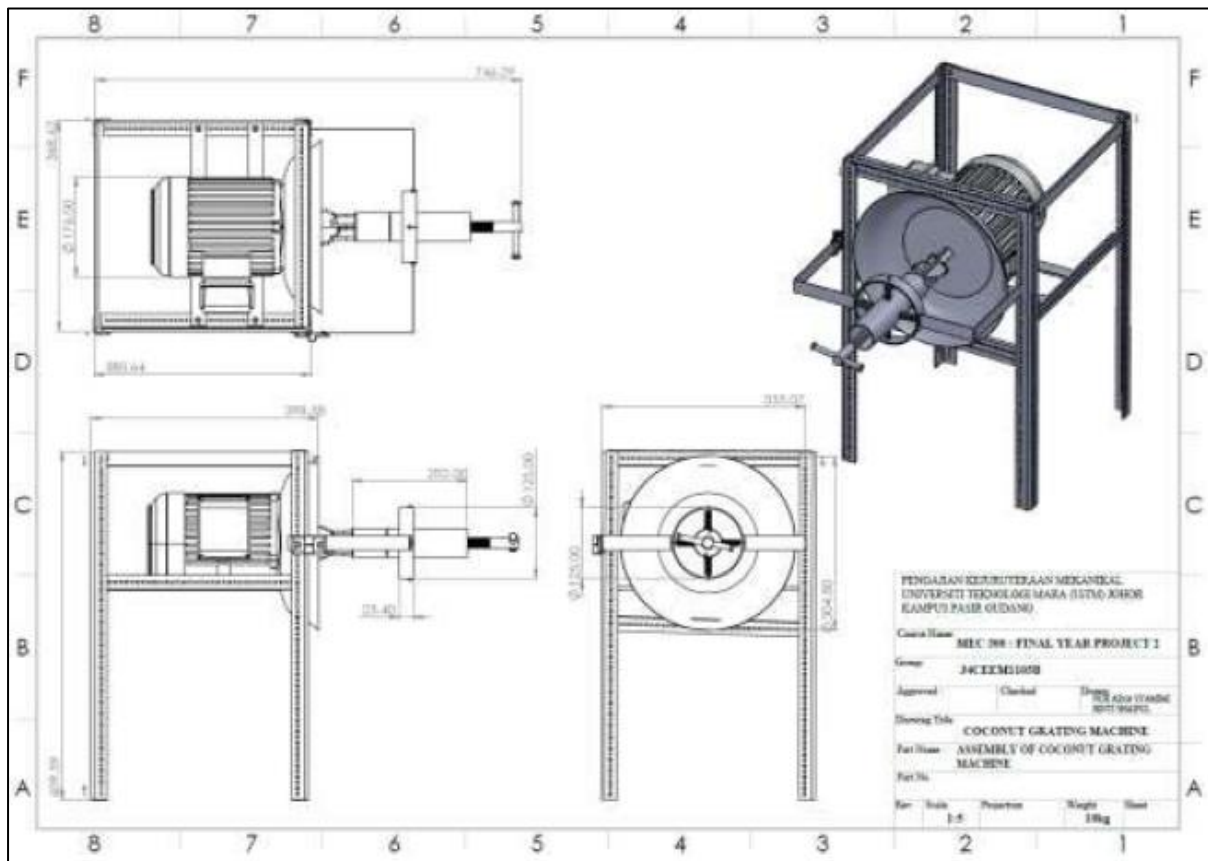
Coconut is a widely used ingredient in traditional and modern cooking. Existing grating methods, however, often pose safety hazards, require high physical effort, involve bulky and expensive equipment. This study addresses the dual challenges of user safety and machine compactness in conventional coconut grating machines. The aim of this project is to design and fabricate a low-cost coconut grating machine that is safe, efficient and suitable for household and small-scale use. The methodology involves a systematic engineering approach comprising conceptual design, material selection and computer-aided design using SOLIDWORKS. Fabrication processes were carried out through a series of operations including cutting, drilling, welding and assembling. A coconut clamping mechanism was incorporated to prevent direct hand contact with the rotating blades and reduce the risk of injury. The machine prototype incorporates a slotted angle bar frame, a 2800 rpm AC motor and a stainless-steel bowl as the grating base. The final prototype demonstrated effective coconut grating performance, user-friendly and improved safety, all in a compact design and at a cost below RM300. In conclusion, the developed machine provides a cost-effective and practical solution for safe and efficient coconut grating. Future improvements in ergonomics and automation could further enhance its performance and support sustainability in household food processing.

Keywords: *Coconut Grating, Low-cost*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 14

Portable Hydraulic Bending Machine with Various Types of Shape

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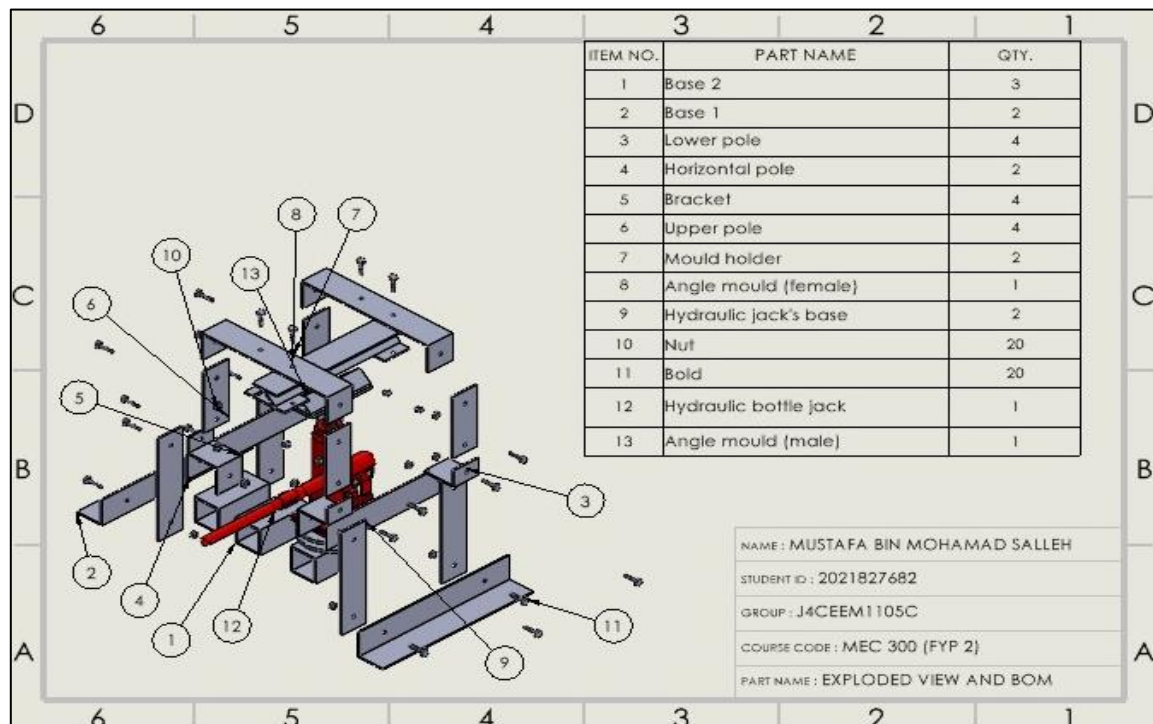
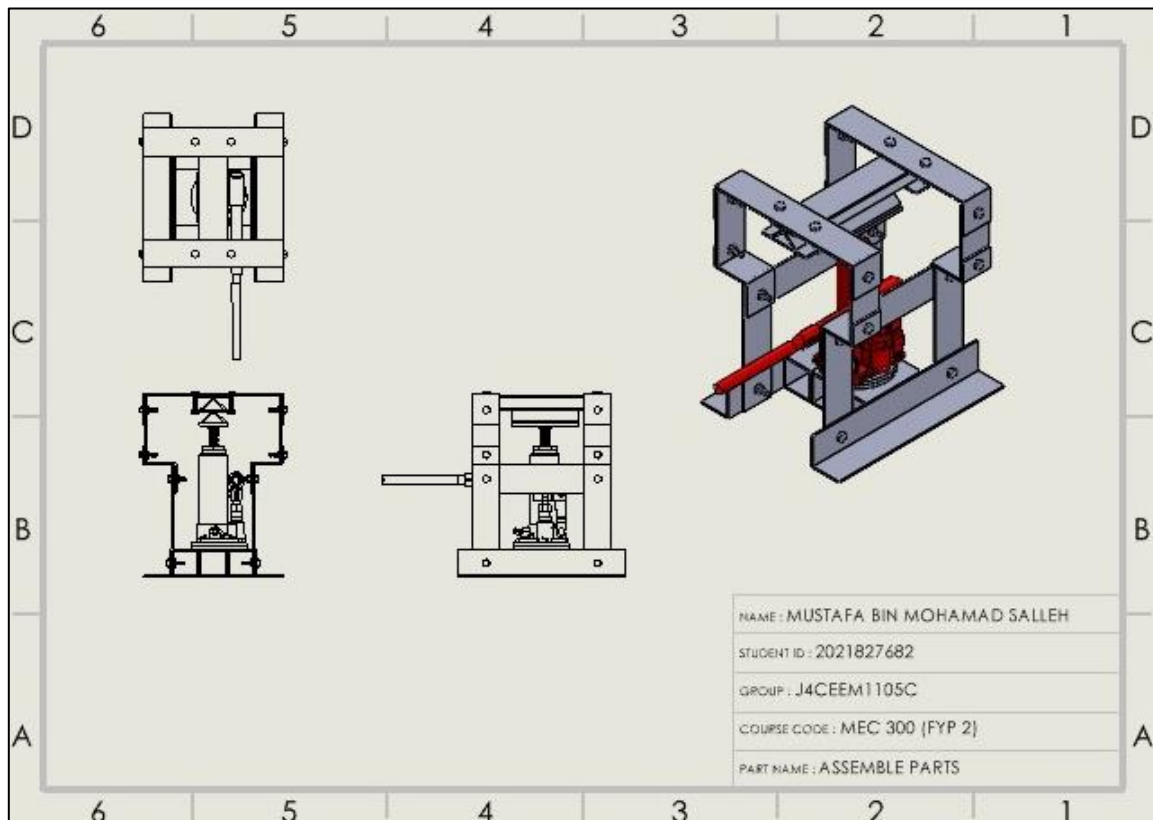
Sheet metal hydraulic bending machine is used to bend the sheet metal to get the required shape. For example, V-shape, and U-shape. The standard of existing bending machine for sheet metal is commonly placed at a single location which is fixed and there will be a limit for user to use the machine due to the machine location. So, to improve the existing design, the objective of this project is to create a portable hydraulic sheet metal bending machine which is very affordable and reasonable for the user. This project will show how detail the process to make the machine, such as final comprehensive design, cost-efficiency of material, product specifications and how to fabricate a new design of improvement for portable hydraulic sheet metal bending machine that will make the user become easier to complete the production. The expected result from this planning is the bender will function very well to withstand the forces which are applied to bend the sheet metal. The most important component for this project is the hydraulic jack because it is the main item that must function to bend the workpiece. In conclusion, this affordable and reasonable project will give a lot of benefit to the user because it is very easy to handle it, especially to those who have the bending task, such as college student and vocational also technical school.

Keywords: Sheet metal bender, Hydraulic jacks, Various shape

PROTOTYPE



DESIGN PARAMETER



CHAPTER 15

Design Concept of Semi-Automatic Barbeque Grill

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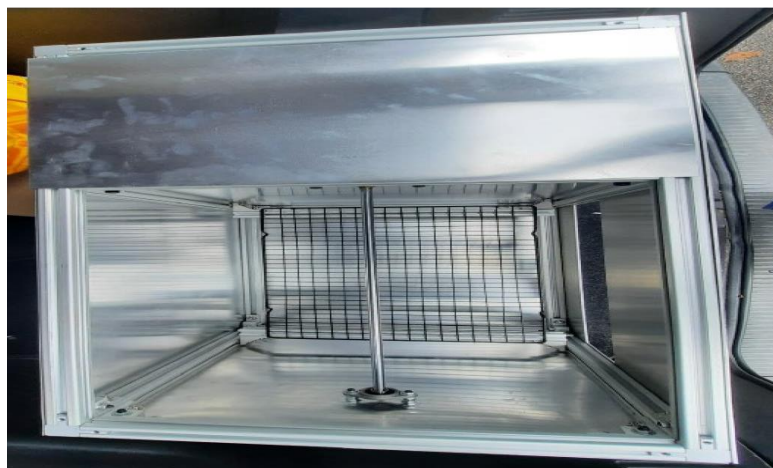
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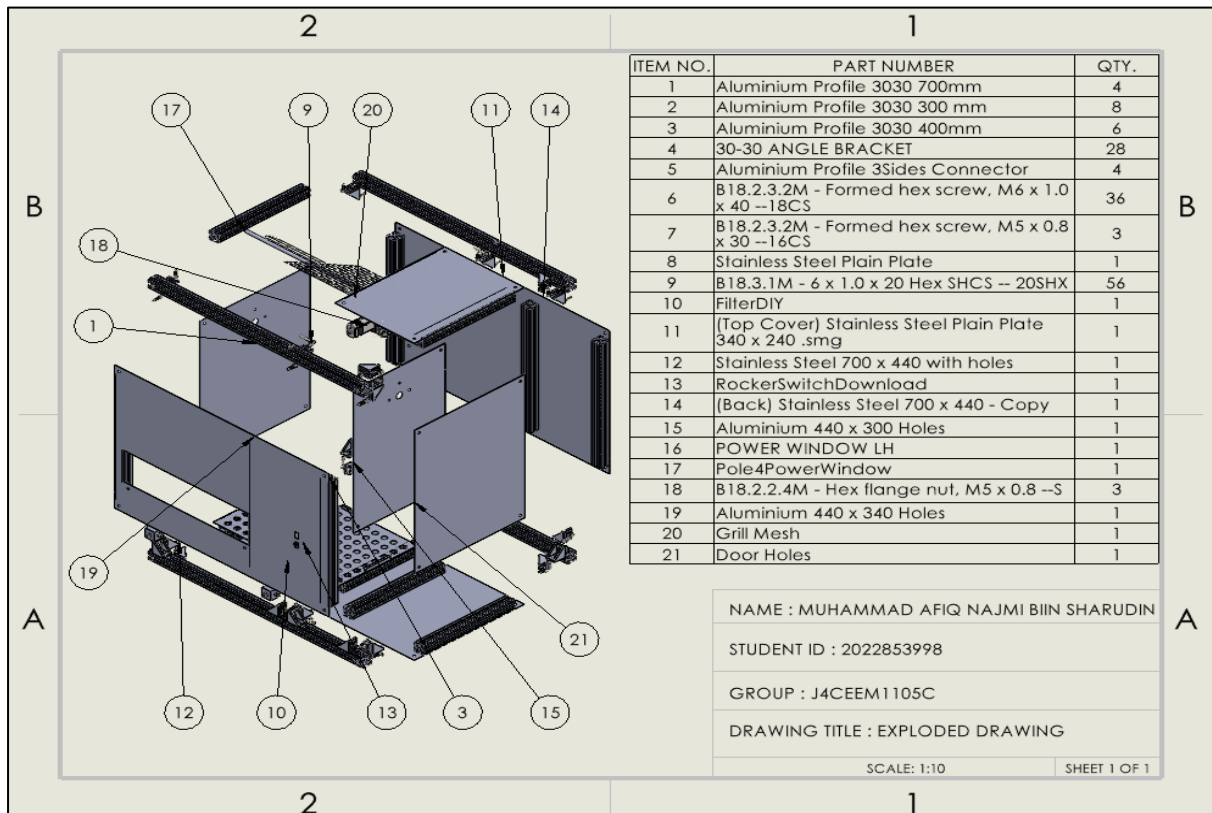
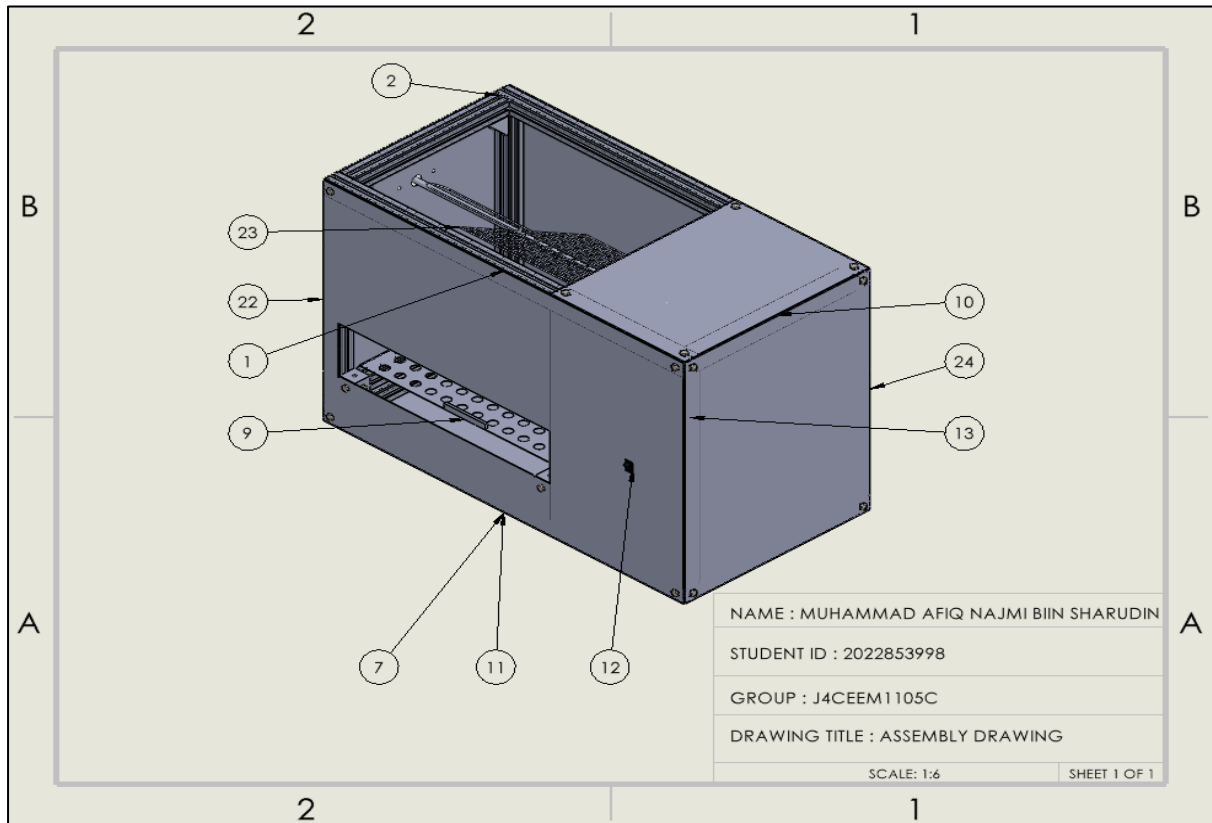
The semi-automatic barbeque grill is a project targeted at designing and fabricating a novel barbeque grilling solution that will involve convenience as well as modern technological advancement. Major objectives of this paper include the design a semi-automatic barbeque grill using SolidWorks, produce as a proof of its concept, enhance creativity and productivity using mechanical systems. Issues in traditional grilling addressed here are uneven heat distribution, potential health risks from environmental dust and waste or inefficiency in energy application. This semi-automatic barbeque grill achieves consistent results with minimal supervision and easy to disassemble and reassemble. In addition, saving energy remains one of the features with which the grill design is concerned, hence environmentally friendly. The outcome anticipated is a hassle-free, time-saving and reliable grilling experience while upholding the high quality of food preparation standards. It will also serve as a learning resource for Do-It-Yourself (DIY) electronics and mechanical design skills due to the fact that it will give out new skills and knowledge. The semi- automatic barbeque grill will bring revolution in this outdoor cooking by making the grilling solution practical, enjoyable and technologically advanced.

Keywords: *Barbeque, Design, Semi-automatic*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 16

Design Concept of Paper Shredder Machine

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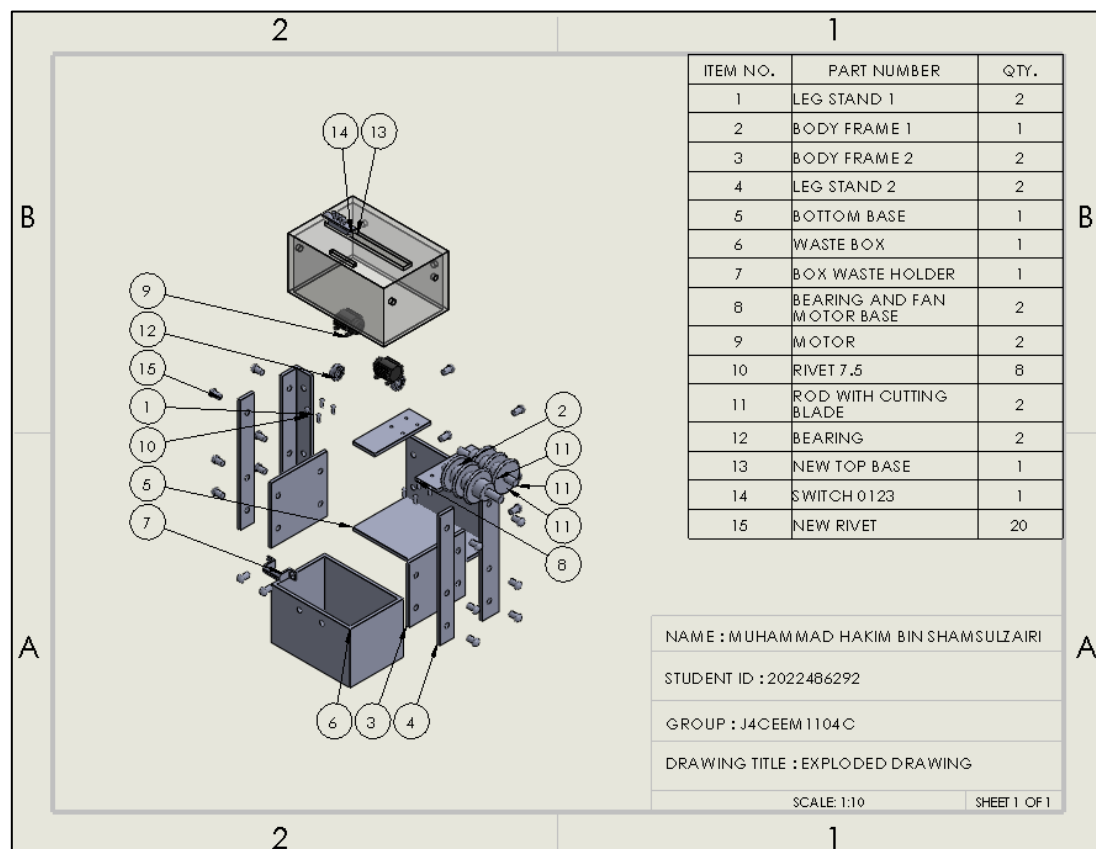
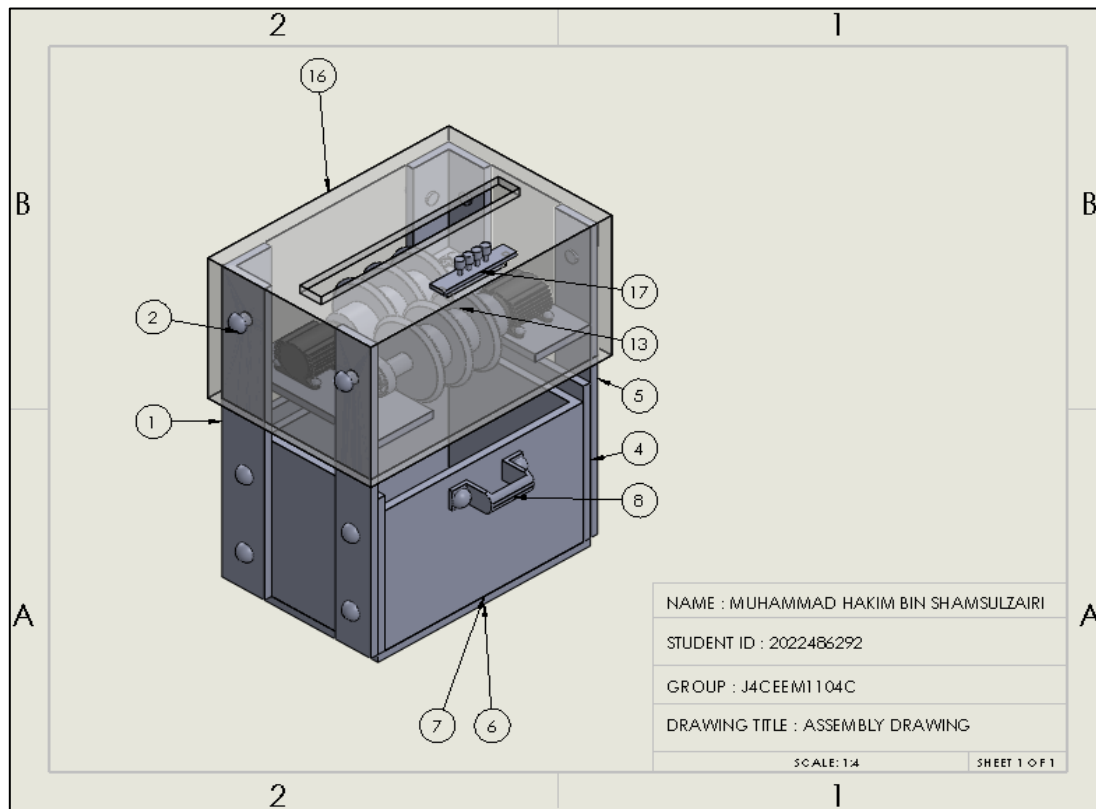
This paper deals with the design of a paper shredder machine that will safely, efficiently, and without wastes shred documents. Much information is very private in nature, so it must be protected with the advent of information technology; hence, efficient destruction by way of document shredding remains a need at offices and personal levels. The goal is the realization of an affordable, user-friendly machine able to shred paper into small, unreadable pieces to ensure all useful data are destroyed, thus preventing unauthorized disclosure of any information. The project is intended to address the current weaknesses in document disposal methods, including inefficient manual tearing and unsafe burning implications on the environment. These will incorporate a detailed mechanical design phase, careful choice of materials and components, rigorous testing aimed at ensuring operational safety and efficiency, and complete documentation of the process from the development of a concept to the constructed prototype. The result should be an operative paper shredder that has predefined shredding capacities and is constructed ensuring noise reduction with a little disturbance effect, also including all the necessary precautions as to its safe use, and applicable in all situations where one needs a practical means for the secure disposal of documents. Such a project does not only meet technical requirements but also helps raise awareness with respect to data security and further track sustainable waste management practices in modern society.

Keywords: *paper shredder, design, machine*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 17

Design and Development of Coconut De-Husking Machine

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^{1,2}*Faculty of Mechanical Engineering, Universiti Teknologi MARA Johor Branch, Pasir Gudang Campus, 81750 Masai, Bandar Seri Alam, Johor Darul Ta'zim.*

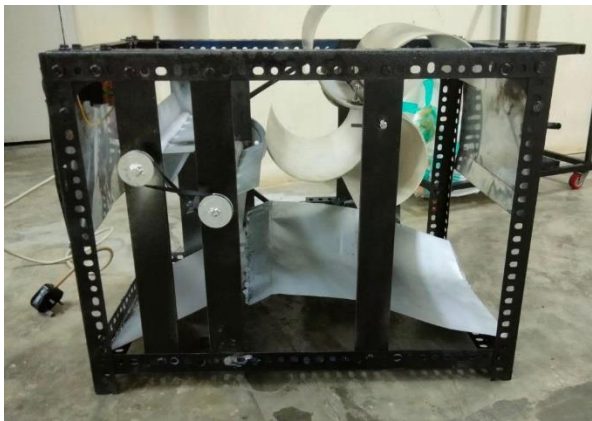
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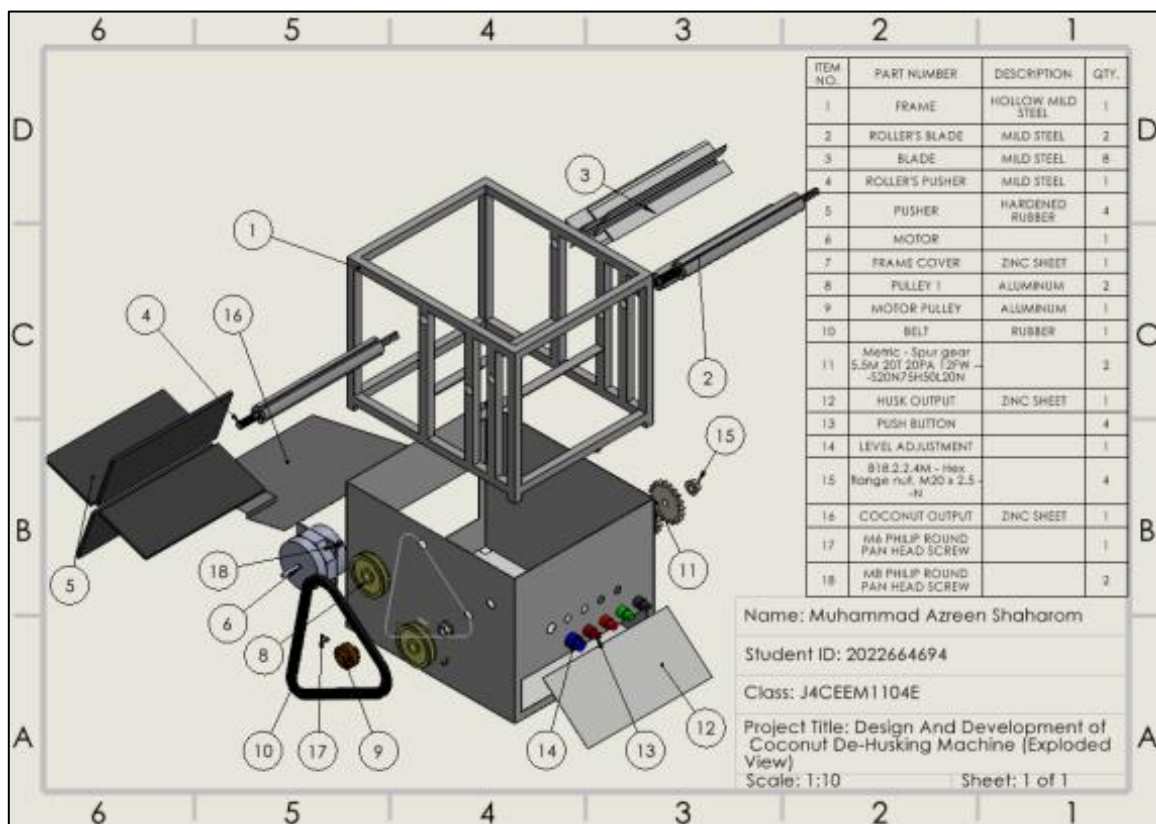
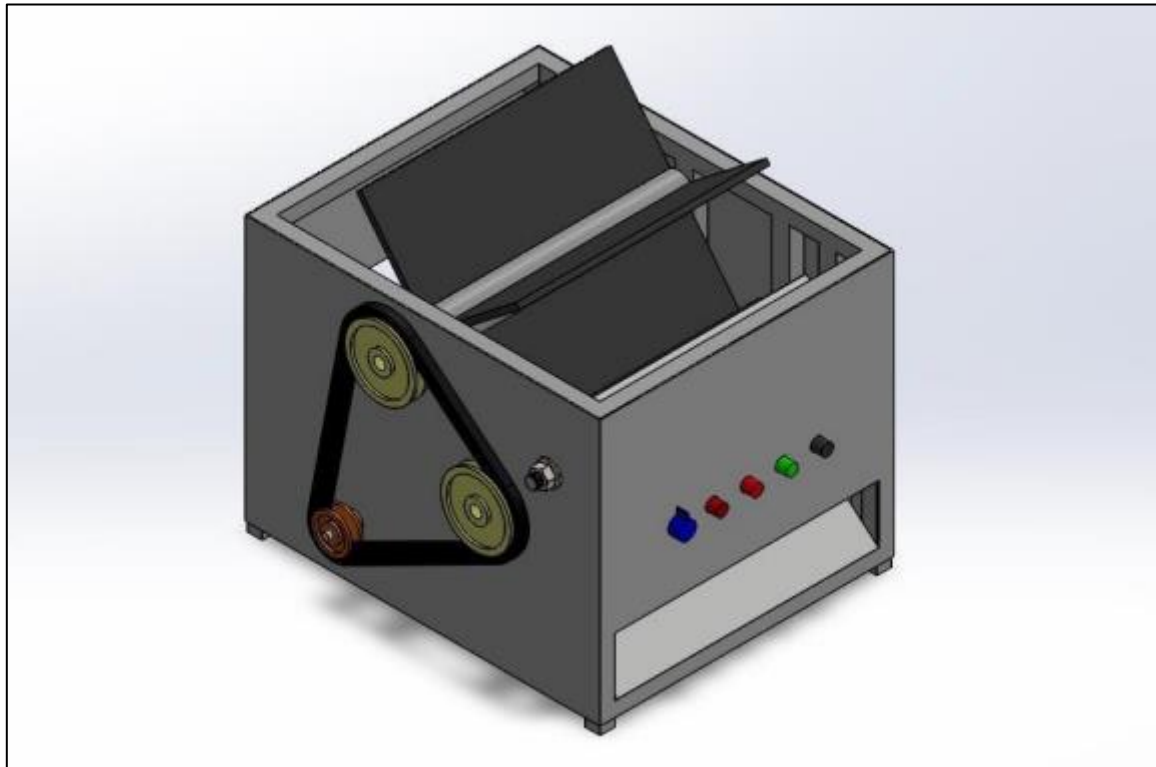
In Malaysia, the coconut industry faces challenges related to the labor-intensive and hazardous de-husking process. This project aims to design and develop a coconut de-husking machine to address these issues. The main objectives are to enhance the efficiency, safety, and cost-effectiveness of the de-husking process. The proposed machine will be designed using SolidWorks 2023 and powered by a single motor. Key methodologies include the conceptual design, engineering analysis, and fabrication of the machine. The expected outcomes are improved processing speed, reduced labor costs, and enhanced worker safety. This project not only aims to benefit the local coconut industry but also has the potential to contribute to global agricultural practices.

Keywords: *Coconut, Machine*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 18

Design and Fabrication of 2-in-1 Sand Sieving Machine

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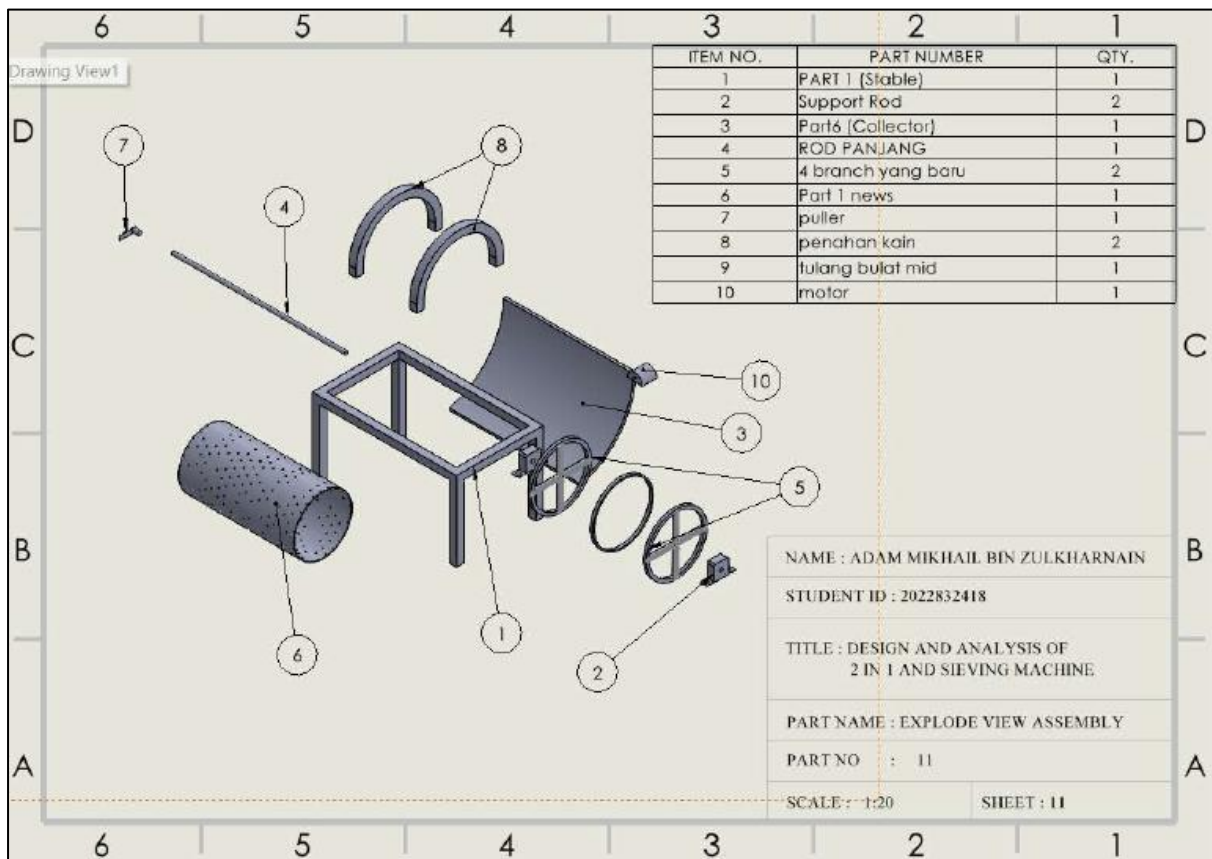
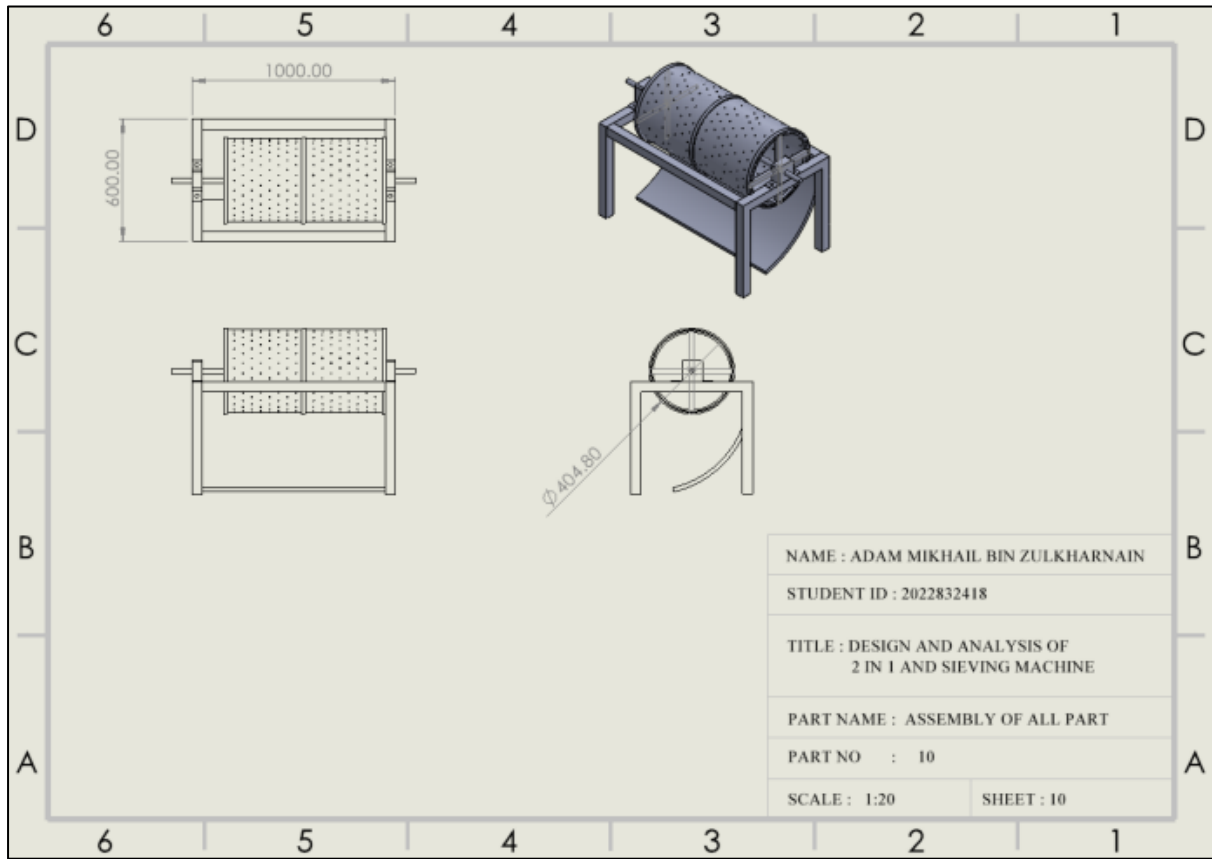
Sand sieving is a crucial process in construction, manufacturing, and other industrial applications where fine and coarse particles must be separated to ensure optimum material used. Conventional sieving methods, which often rely on manual labor, are time-consuming, inefficient, and physically demanding. Thus, this project aims to design and fabricate a 2-in-1 sand sieving machine, which integrates both manual and motorized operations to enhance efficiency and flexibility. The combination of manual and automated sieving mechanisms makes the system cost-effective, reducing labor thus improving productivity. This machine operates using a roller sieving mechanism, where a rotating cylindrical sieve filters sand particles based on size. As the roller rotates, finer sand particles pass through the mesh while larger impurities are separated, ensuring high-quality sieved sand. In manual mode, the user rotates the roller by hand, while in motorized mode, an electric motor drives the roller, automating the sieving process for improved efficiency and reduced labor effort. For the fabrication part, the process involves designing the product, selecting raw materials, and shaping them through machining and forming.

Keywords: *Sand Sieving, Sieving*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 19

Design and Fabrication of Automatic Cat Litter Box

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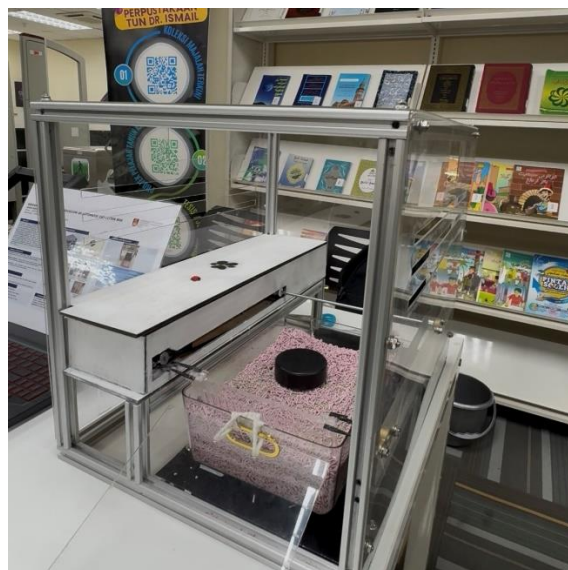
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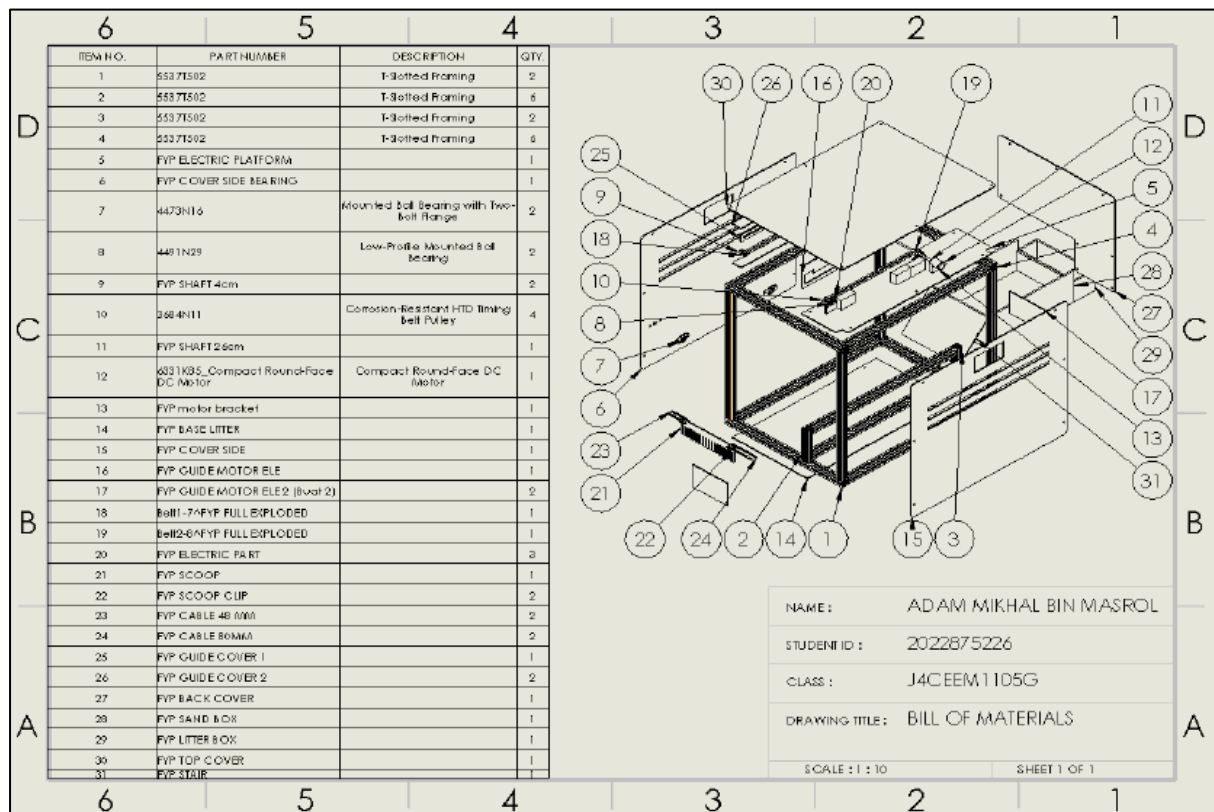
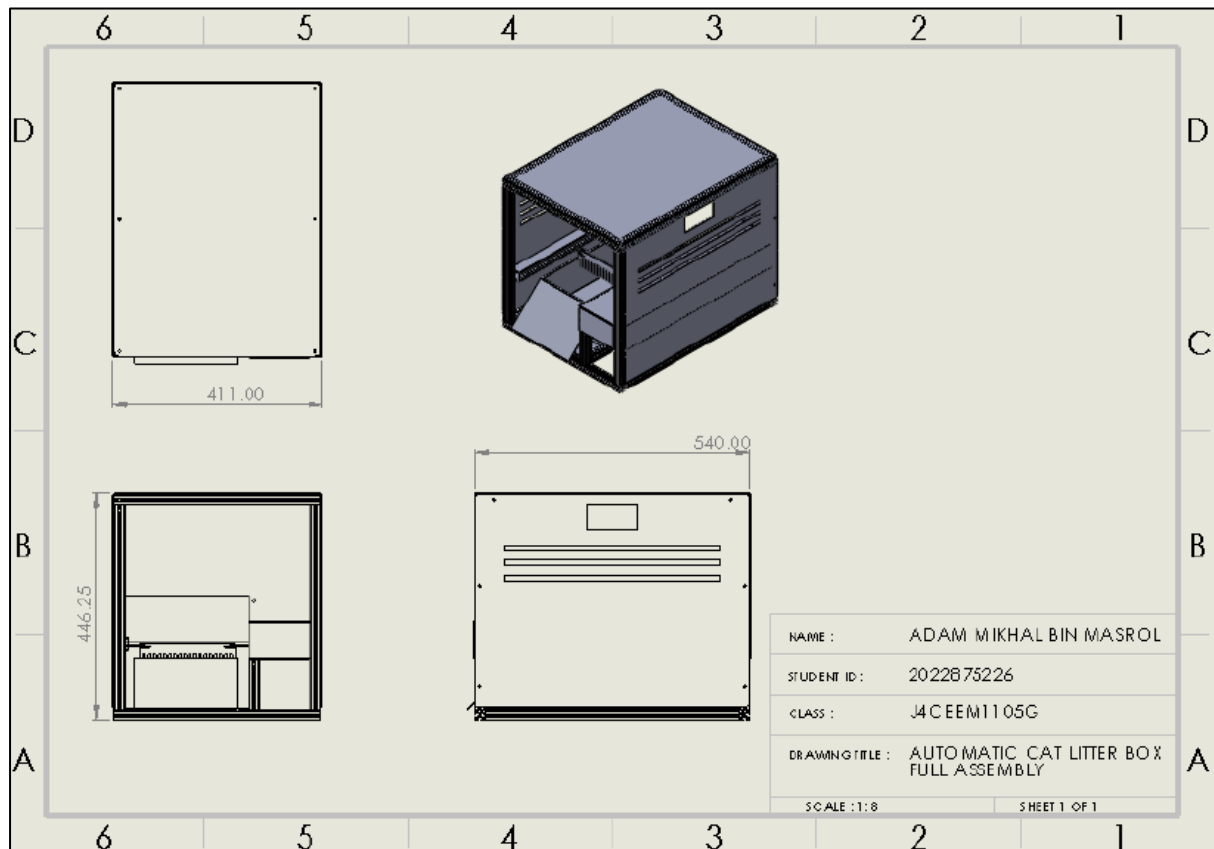
Many cat owners face challenges in maintaining a clean litter box due to time constraints, hygiene concerns, and the manual effort required for regular cleaning. These issues can lead to unpleasant odors and potential health risks for human. Hence, this project presents the development of an automatic cat litter box, consist of self-cleaning system designed to reduce human intervention in managing feline waste. The main objective of this project is to design and fabricate a fully functional automatic litter box that improves hygiene, saves time, and reduces the owner's workload. The design is developed using SolidWorks, while the control system is programmed using an Arduino UNO microcontroller. The litter box utilizes sensors and a timer-based mechanism to detect when a cat enters and exits the box. After a preset countdown, the cleaning system is activated, automatically raking the waste into a separate compartment. The completed product has an approximate dimension of 540mm (L) × 411mm (W) × 446mm (H), weighs 9kg, supports a sand capacity of 2.5kg, and is powered by a 12V battery. The project has successfully achieved its stated objectives, resulting in a fully operational automatic litter box that has been tested and proven to function effectively under real conditions.

Keywords: *Automatic cat litter, Cat litter*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 20

Design and Fabrication of 2-In-1 Convertible Chair-Ladder

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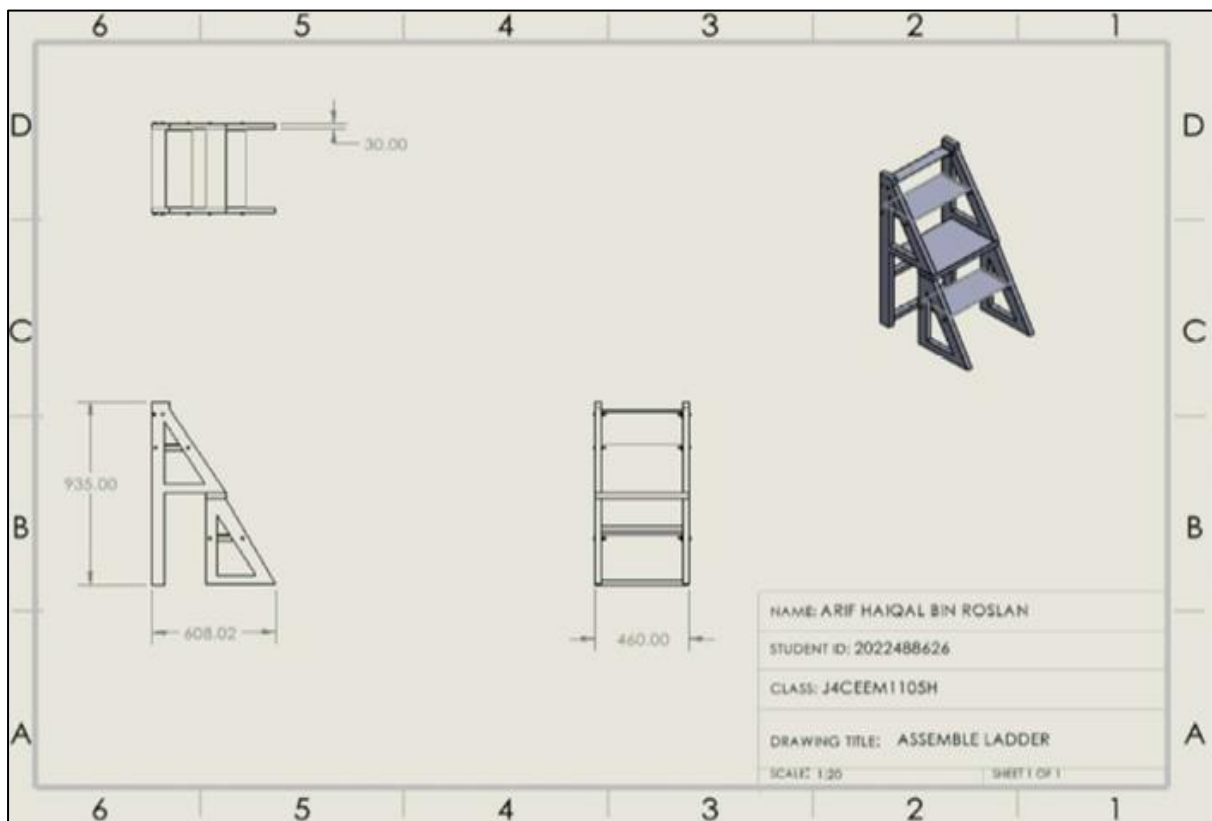
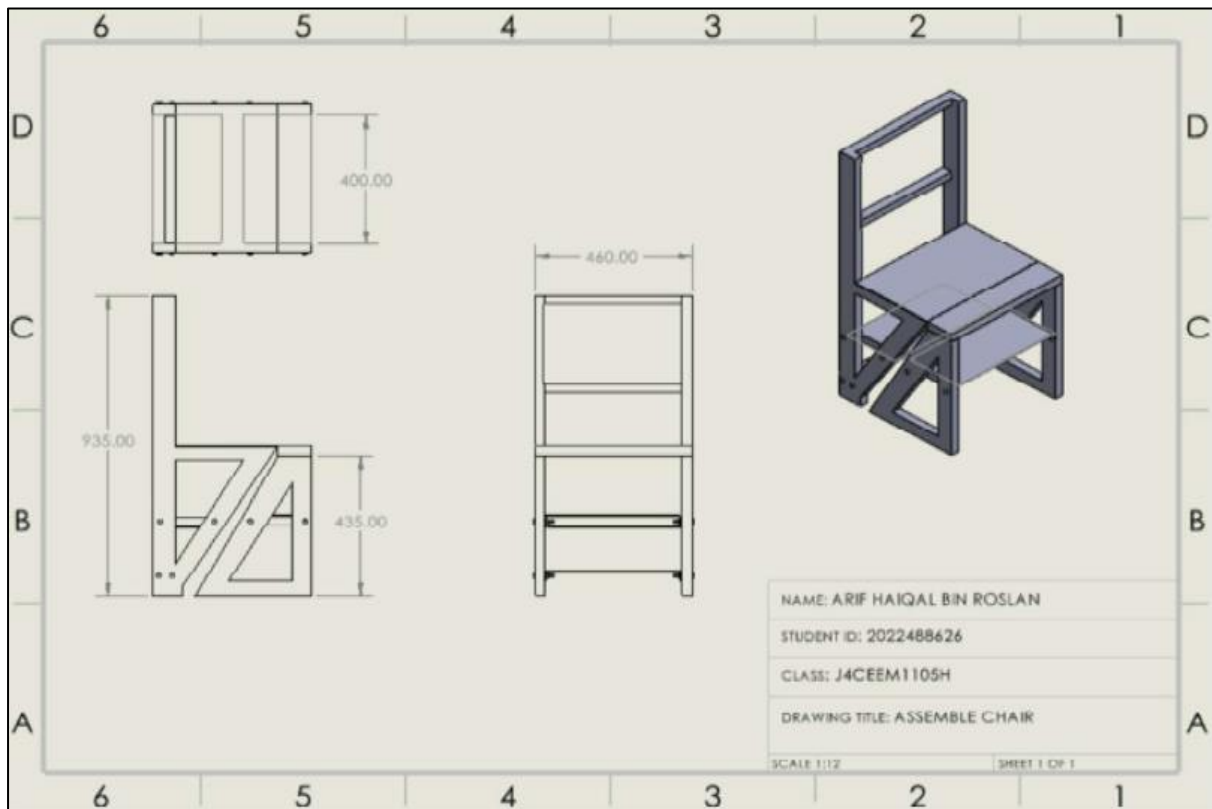
This project introduces a practical solution for optimizing workspace in workshops by designing and fabricating a 2-in-1 convertible chair-ladder. Workshops often struggle with clutter and limited space, which can lead to stress and inefficiency. This innovative product combines the functionality of a chair and a ladder into one compact design. As a chair, it offers comfortable seating, and as a ladder, it provides a stable platform for reaching elevated areas. Built with durable materials and designed with safety and ergonomics in mind, this chair-ladder not only saves space but also simplifies tasks, making it a versatile and cost-effective addition to any workshop.

Keywords: *Convertible, Chair-ladder*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 21

Mini Robotic Arm for Educational Purpose

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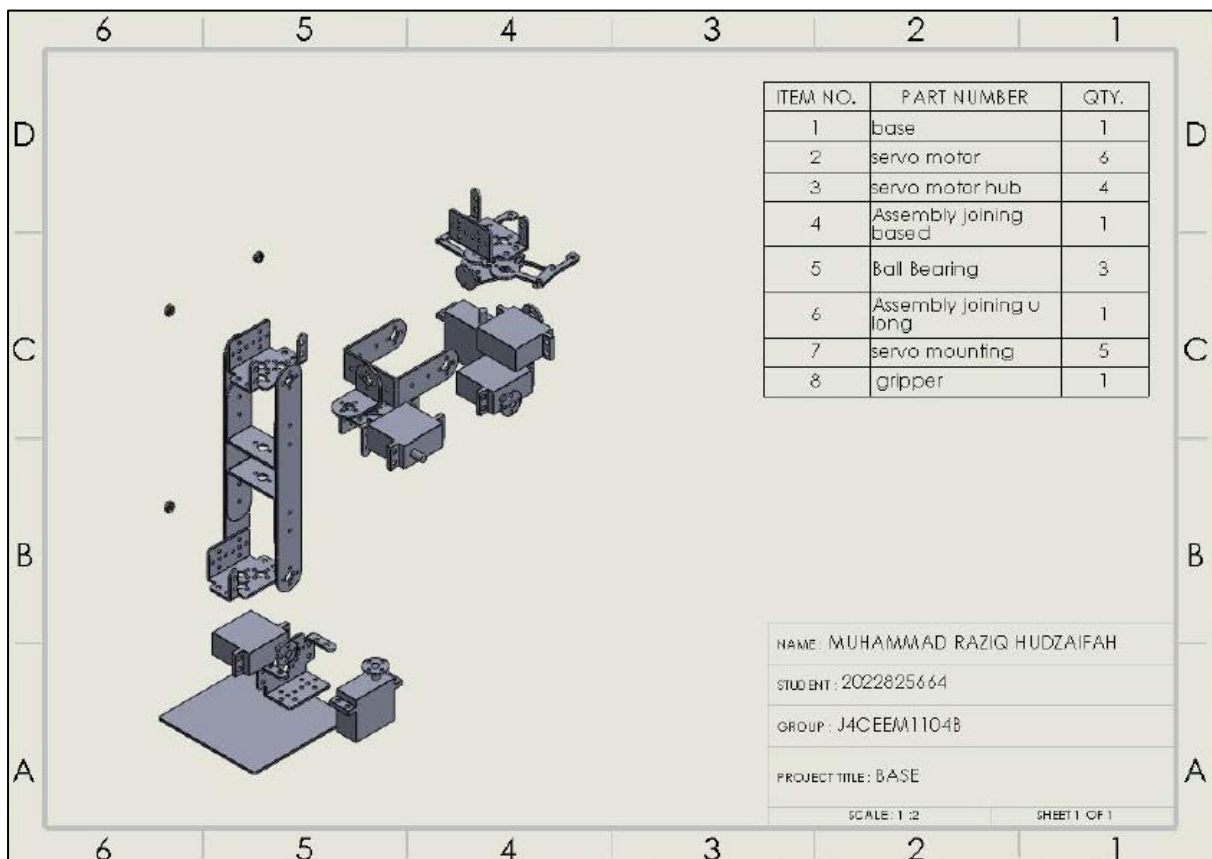
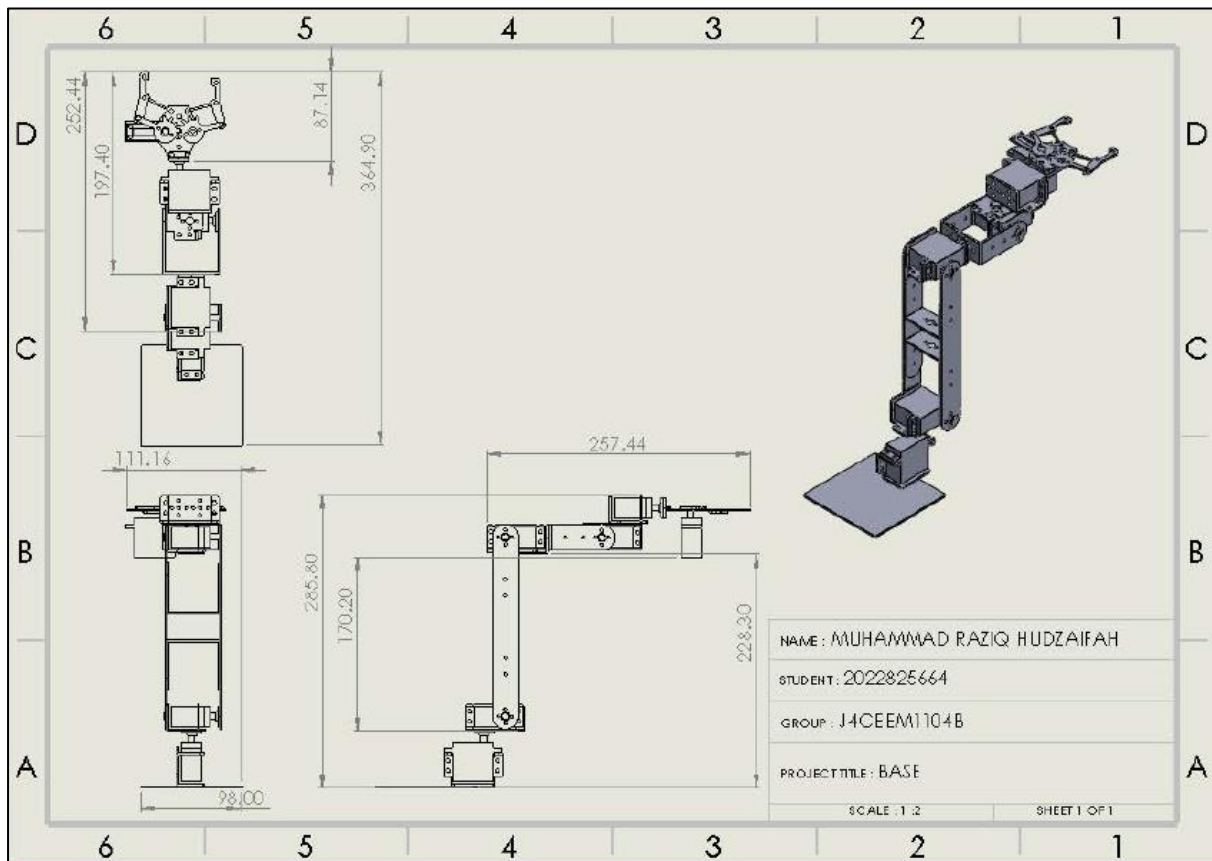
The rapid advancements in robotics have increased the demand for hands-on educational tools that enhance students' understanding of automation, control systems, and programming. However, many existing robotic arms are either too expensive or too complex for beginners, limiting accessibility in educational settings. To address this issue, this project focuses on the design and fabrication of a mini robotic arm with six degrees of freedom (DOF) for educational purposes. The methodology involves the design of mechanical components, selection of appropriate servo motors, electronic circuit integration, and programming using Arduino IDE. The robotic arm is constructed from aluminum, ensuring durability while maintaining a lightweight structure. It is powered by servo motors for precise movement and is controlled via an Arduino microcontroller, making it an ideal platform for learning embedded systems and robotics programming. The system is operated using a 3-axis analog controller, providing an intuitive and user-friendly interface for students to manipulate the arm in real-time. The performance of the robotic arm is evaluated based on movement accuracy, response time, and ease of control. The results indicate that the mini robotic arm successfully performs basic pick-and-place operations with considerable articulation and precision. It provides an affordable and effective tool for students to explore robotics concepts, motion control, and automation techniques. Future improvements may include integrating sensors for enhanced functionality and expanding control options through wireless connectivity.

Keywords: *Robotic, Arm*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 22

Design and Fabrication of an Automated LED Bulb Replacement Device

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PROJECT DESCRIPTION

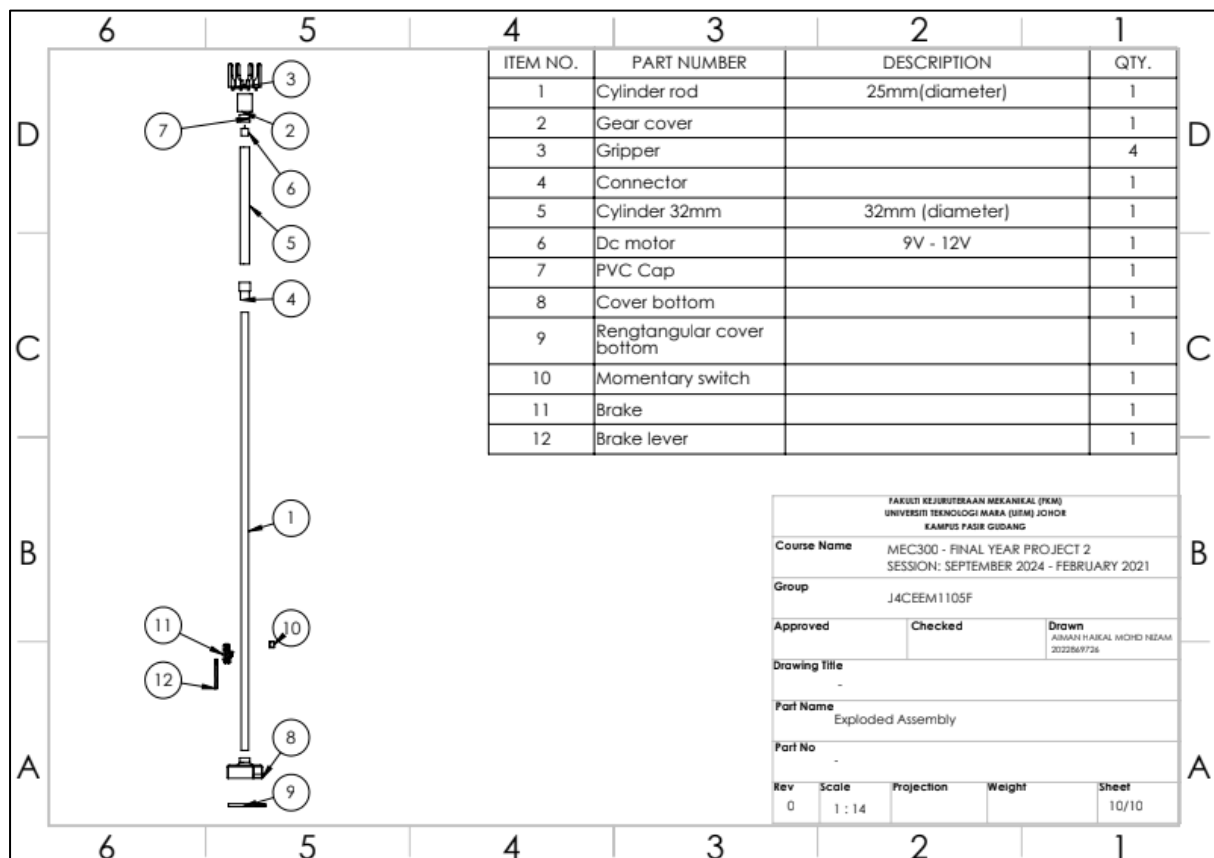
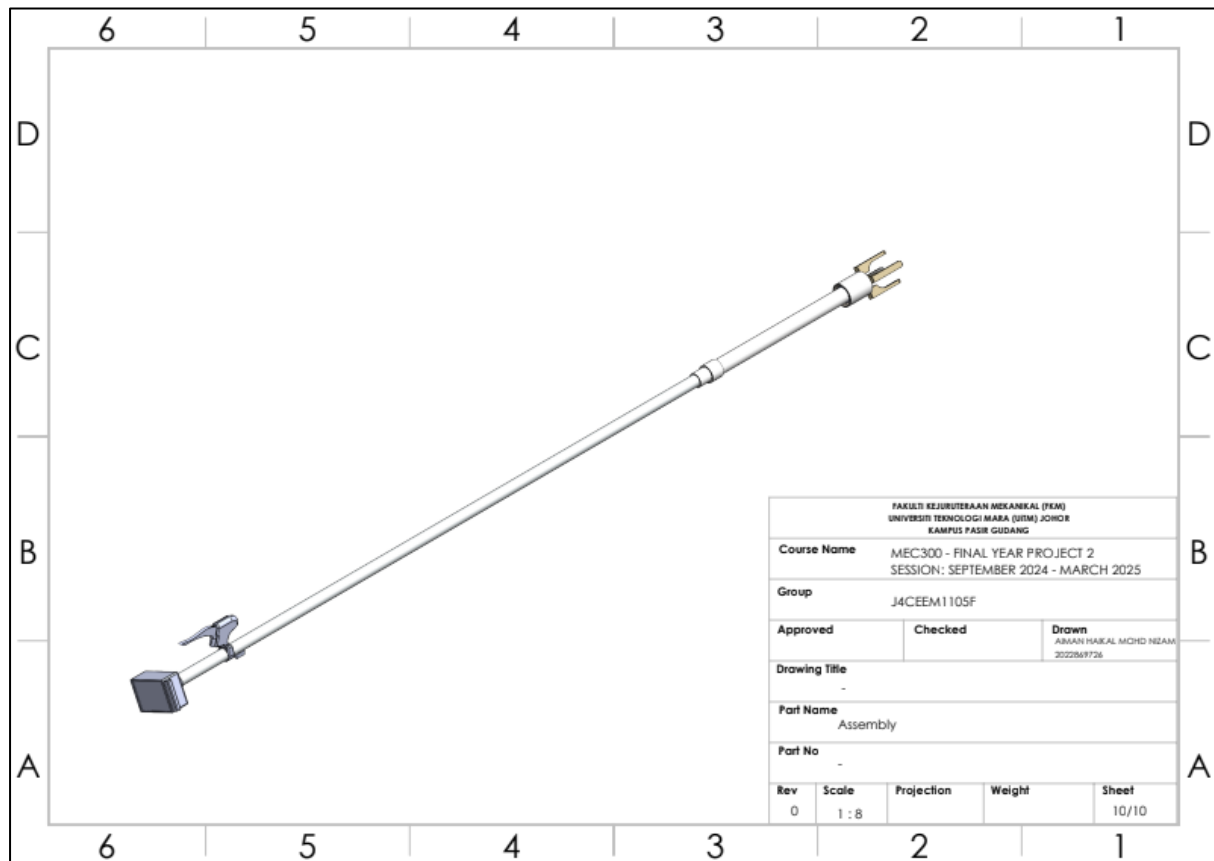
Manual LED bulb replacement poses safety risks, particularly in high-ceiling installations where ladder use increases the likelihood of falls. This project focuses on the design and fabrication of an automated LED bulb replacement device equipped with a motorized gripping mechanism enhance efficiency. The design process involved concept development, CAD modeling, material selection, and fabrication using lightweight aluminum for durability and ease of handling. Engineering analysis determined the motor torque specifications, and stability considerations for various ceiling heights. Testing validated that the device successfully removed and installed LED bulbs with the gripper ensuring a secure hold without damaging the bulb. Performance evaluation indicated smooth mechanical operation, though refinements in grip adjustability, automation response time, and improved maneuverability are recommended for future iterations. The findings demonstrate the feasibility of automated bulb replacement systems in reducing workplace hazards and providing a convenient, user-friendly alternative to traditional methods.

Keywords: *Automated Bulb Replacement, Motorized Gripping Mechanism*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 23

RFID Smart Attendance System

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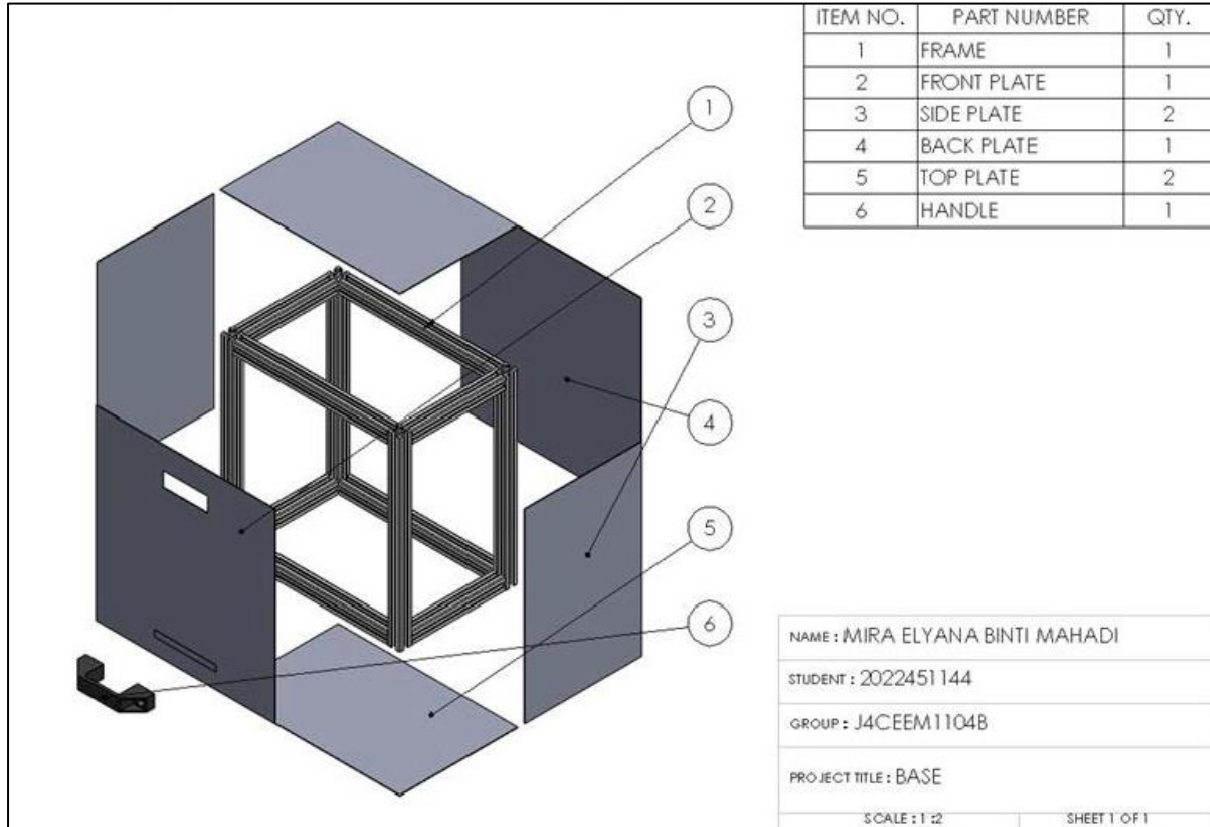
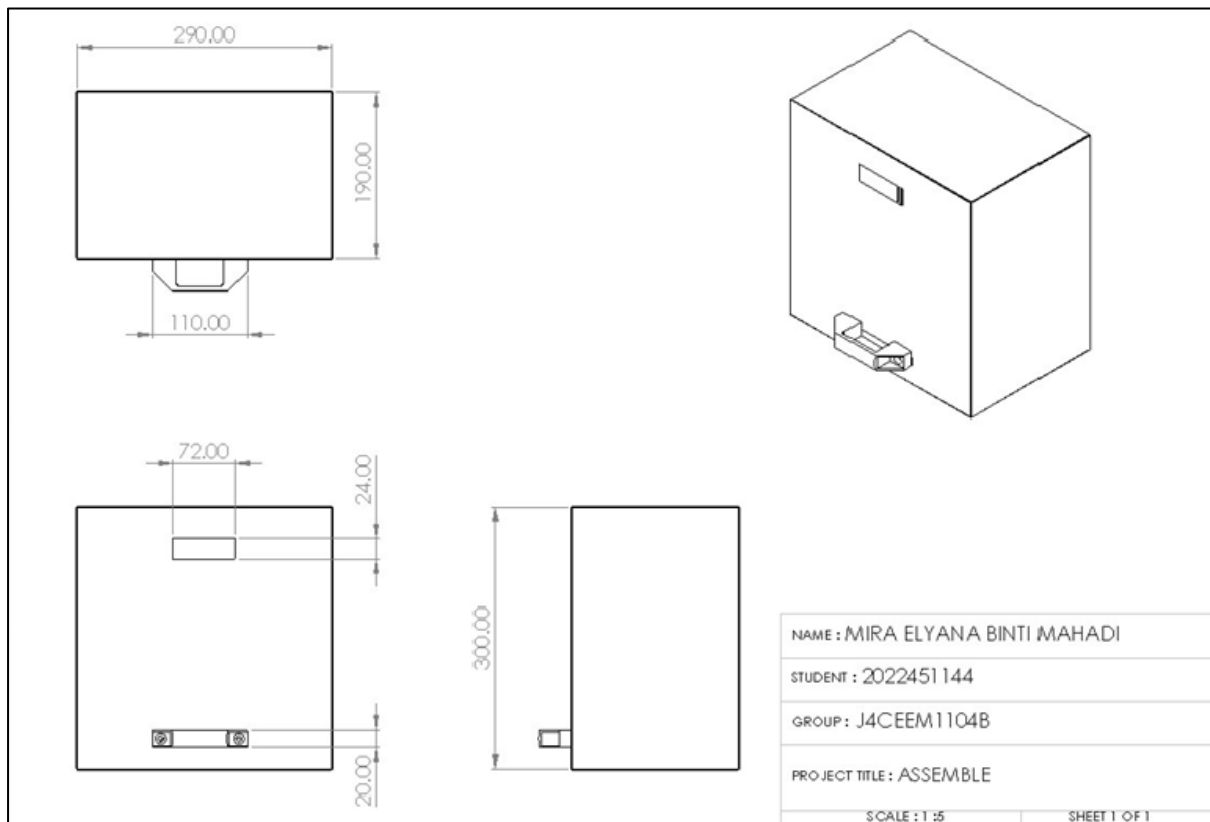
The concept of attendance involves people, either individually or as a group, appearing at a location for a previously scheduled event. The measurement of attendance is of significant concern for many organizations, as such information can be used to gauge the effectiveness of their efforts and to plan for future endeavours. Attendance has traditionally been done manually, fostering student-teacher relationships but prone to errors and time-consuming. The RFID (Radio Frequency Identification) Smart Attendance System project aims to revolutionize the traditional method of tracking attendance by leveraging Radio Frequency Identification (RFID) technology to streamline the process efficiently and accurately. This innovative system seeks to address the problem of time-consuming manual roll calls and the potential for inaccuracies in attendance records. The objective of this project is to develop a user-friendly, automated attendance management system that minimizes human error and maximizes reliability. This project involves integrating RFID tags with an attendance management software, which records each student or employee's attendance as they enter or exit the premises. This system not only simplifies the attendance tracking process but also provides real-time data analytics for better management. By minimizing human intervention, this solution not only streamlines attendance tracking but also strengthens data integrity and operational efficiency.

Keywords: *RFID, Attendance*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 24

Portable Water Filter Device

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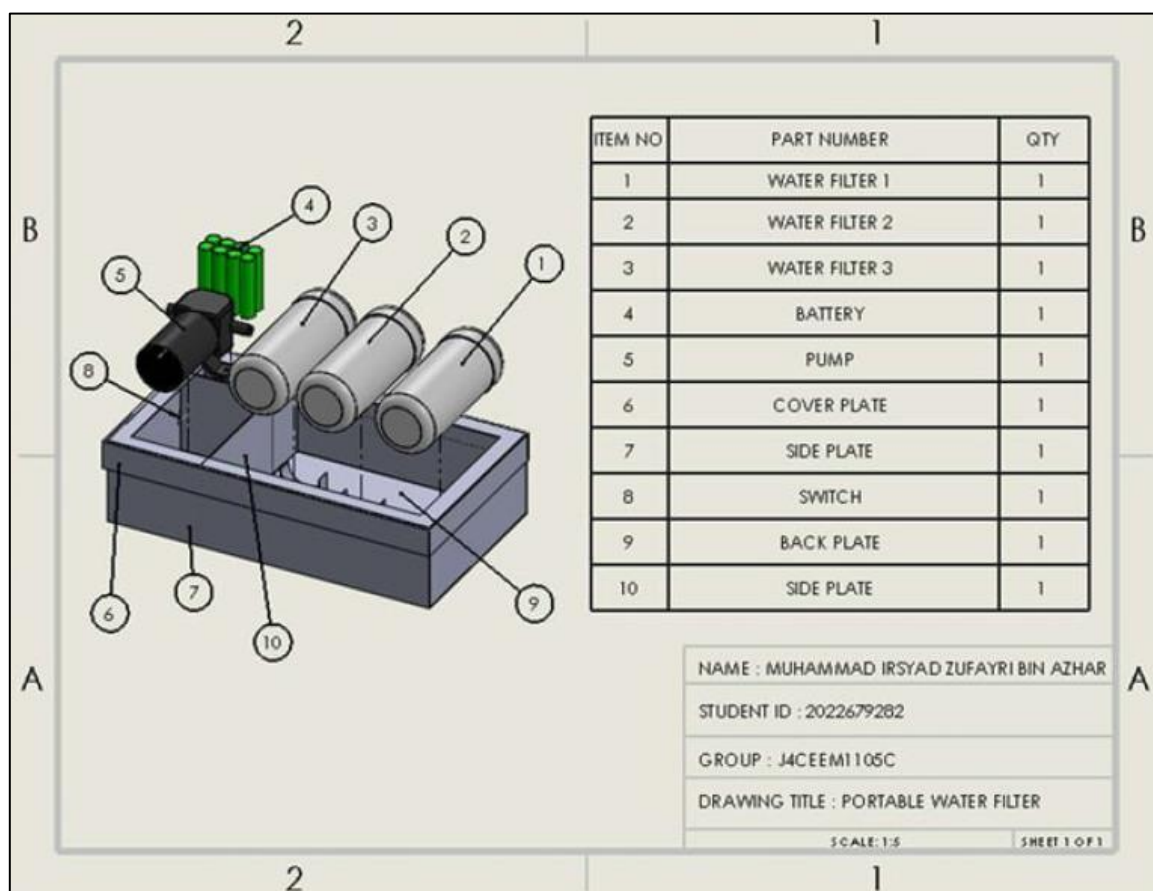
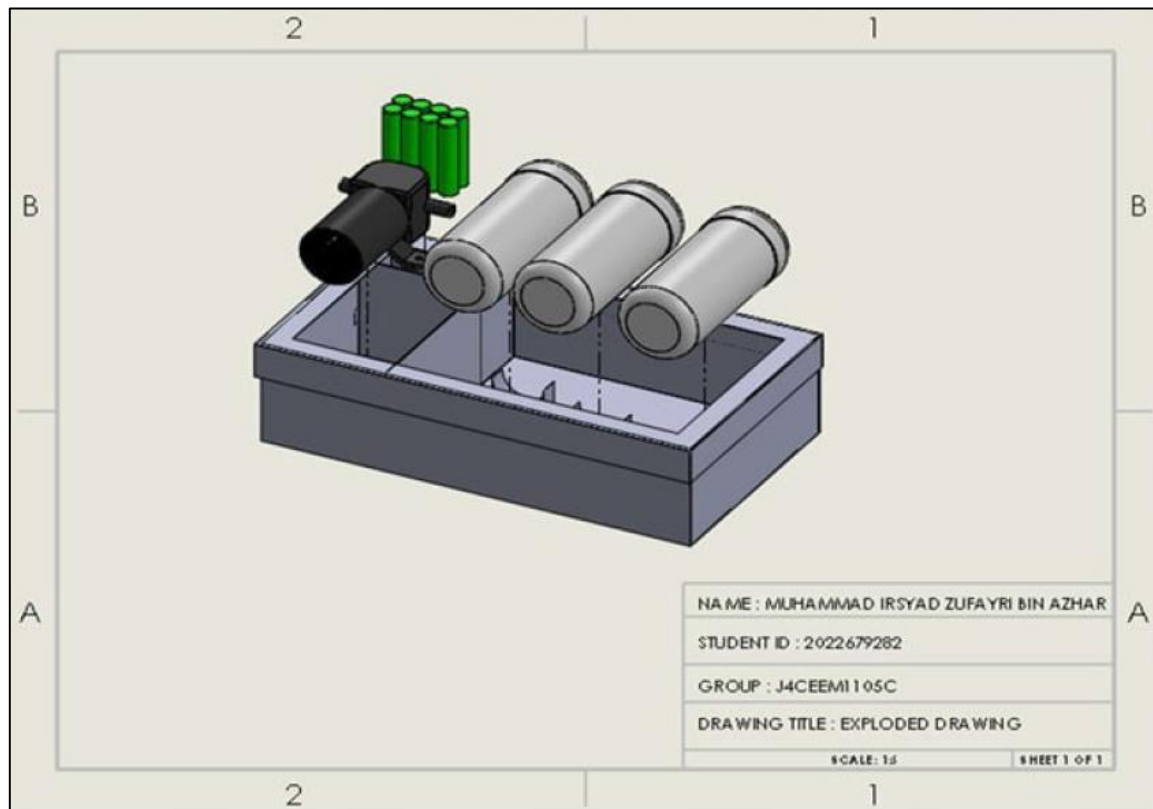
Access to clean and safe drinking water remains a critical global challenge, especially in remote and disaster-stricken areas. Contaminated water sources pose severe health risks, leading to waterborne diseases that affect millions worldwide. To address this issue, this project focuses on the design and fabrication of a portable water filter device that provides a reliable, cost-effective, and user-friendly solution for water purification. The proposed device utilizes a multi-stage filtration system, including 12V water pump, ceramic filtration and activated carbon to effectively remove impurities, bacteria, and harmful contaminants. The methodology involves material selection, prototype development, and performance testing under different water conditions to ensure optimal efficiency. The design emphasizes portability, durability, and ease of use, making it suitable for outdoor activities, emergency situations, and rural communities with limited access to clean water. The results demonstrate that the device able to improve water quality by reducing turbidity, eliminating harmful microorganisms, and removing odor and undesirable tastes. By offering an affordable and practical solution, this portable water filter device contributes to public health improvements, disaster relief efforts, and sustainable access to safe drinking water. Future advancements may incorporate additional purification technologies and smart monitoring features to enhance usability and efficiency.

Keywords: *Water, Filter*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 25

Coin Sorter Machine

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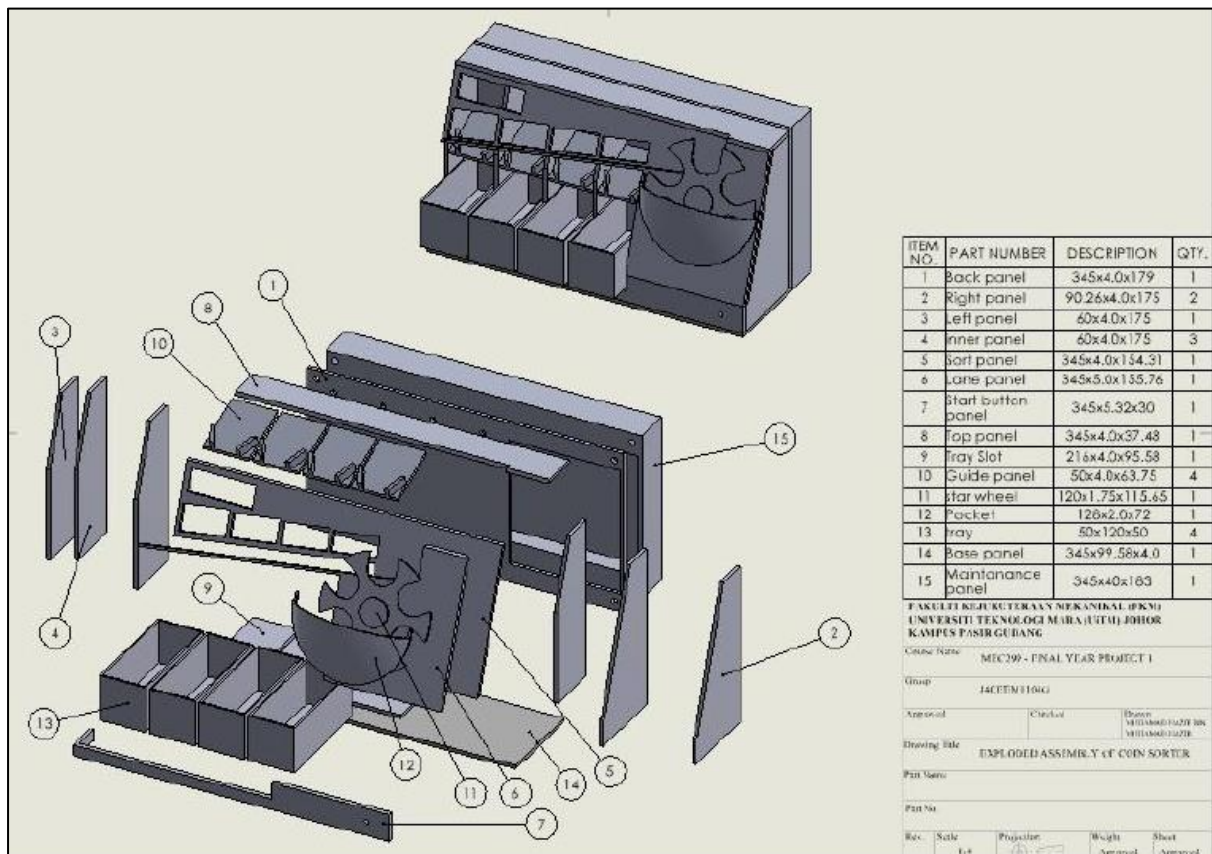
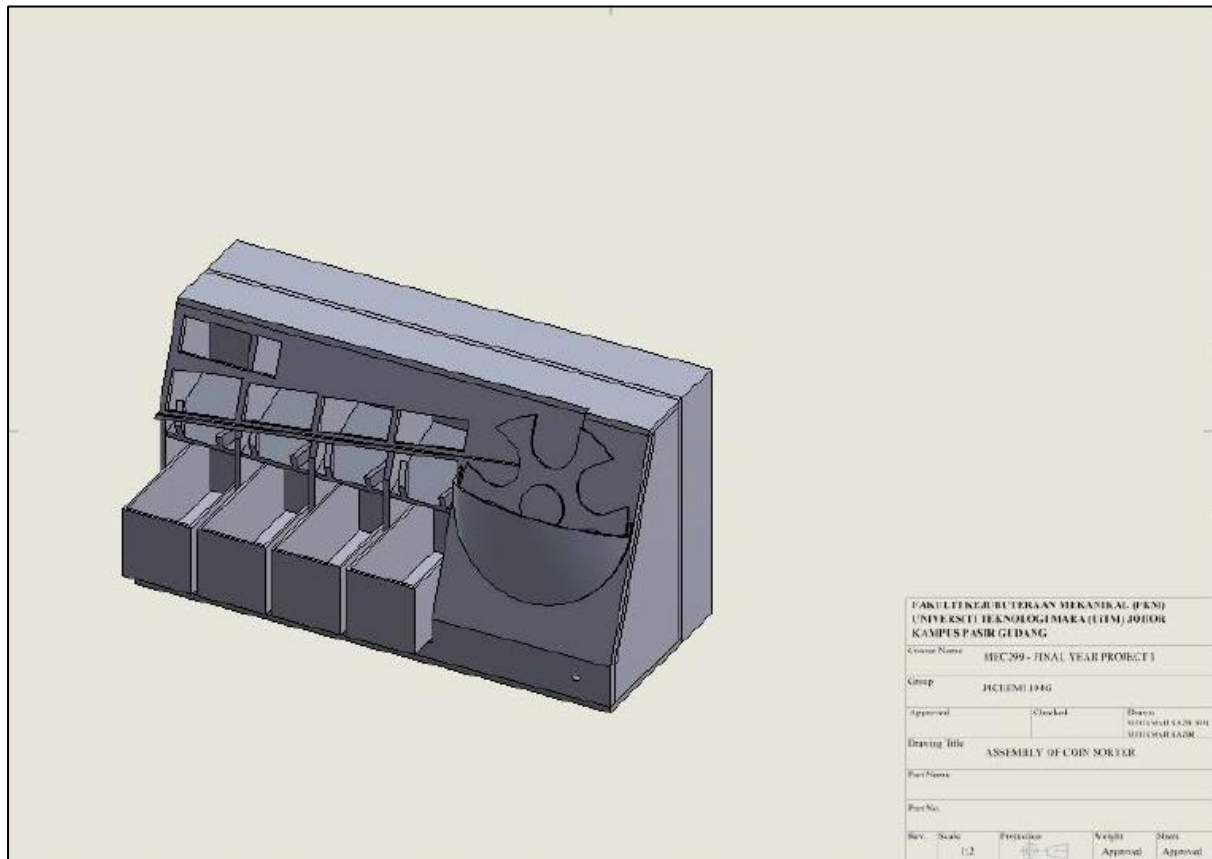
Manual coin handling poses significant challenges for small businesses due to its inefficiency, inaccuracy and labour-intensive nature. It made even more difficult by the expensive and bulky nature of commercial sorting machines. This study addresses these issues by developing a low cost and compact prototype coin sorter machine designed for Malaysian coin denominations. The aim of this project is to design and fabricate a user-friendly sorting device that enhanced sorting accuracy and operational reliability. The methodology involved a structured design approach using SolidWorks for modelling and analysis, followed by material selection such as steel for the body and acrylic for coin trays. The prototype was then fabricated through cutting, joining, and assembly processes. Experimental results demonstrate that the coin sorter machine operates effectively, accurately distinguishing and sorting 5, 10, 20, and 50 cent coins using size-calibrated channels. The machine demonstrated reliable performance in terms of sorting speed, energy efficiency, and ease of use. In conclusion, the project proves the viability of an affordable automated coin sorter, offering improved productivity, cost savings and convenience for small-scale applications.

Keywords: *Coin Sorter, Sorting Device*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 26

Dry Chili Seed Remover

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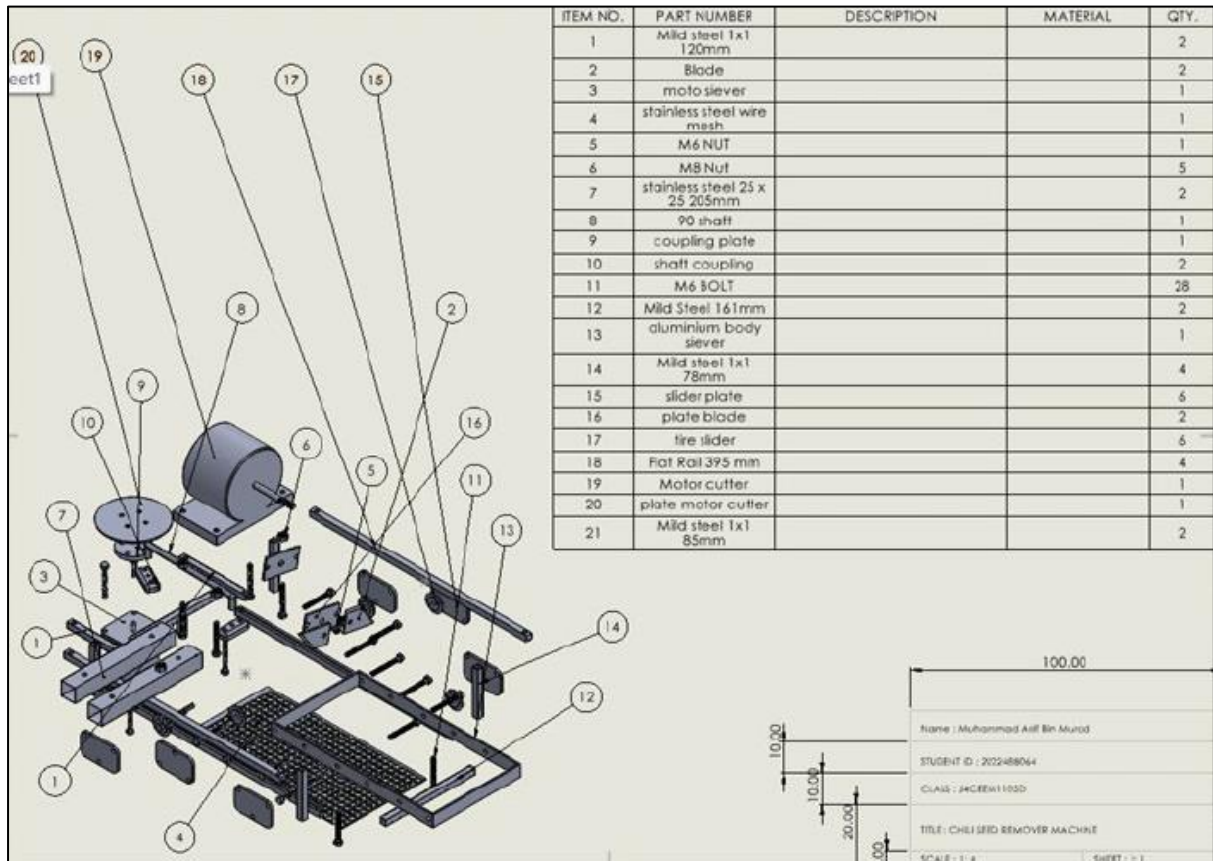
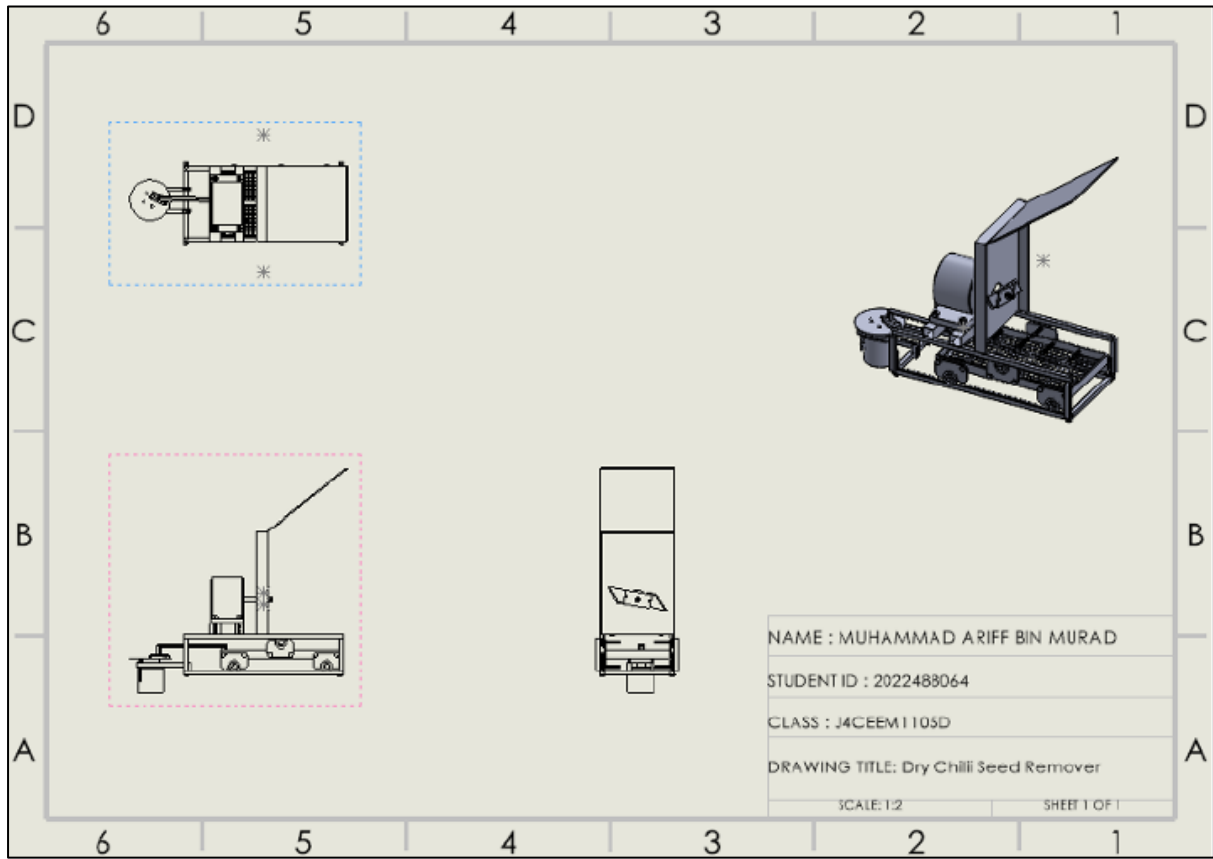
This project presents the design and fabrication of a dry chili seed remover machine aimed at improving the efficiency, safety and hygiene of separating seed from dried chili peppers. Traditional manual methods are labor intensive, time consuming and pose risks of injury. The main objective of this project were to design and fabricate a cost effective prototype suitable for domestic and small scale use. The prototype features a compact design, incorporating a motor powered rotating blade to cut chili peppers and a crank slider mechanism that drives a sieve for seed separation. The machine is constructed using mild steel and stainless steel to ensure strength and food safety. The final prototype, measuring 600 x 270 x 210 mm was successfully tested and demonstrated efficient seed removal with minimal effort and reduced risk of injury. This project offers a practical solution for small food processing operations, promoting productivity, safety and sustainability.

Keywords: *Chili Seed Remover, Agricultural Machinery*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 27

Design and Fabrication of Platform Trolley

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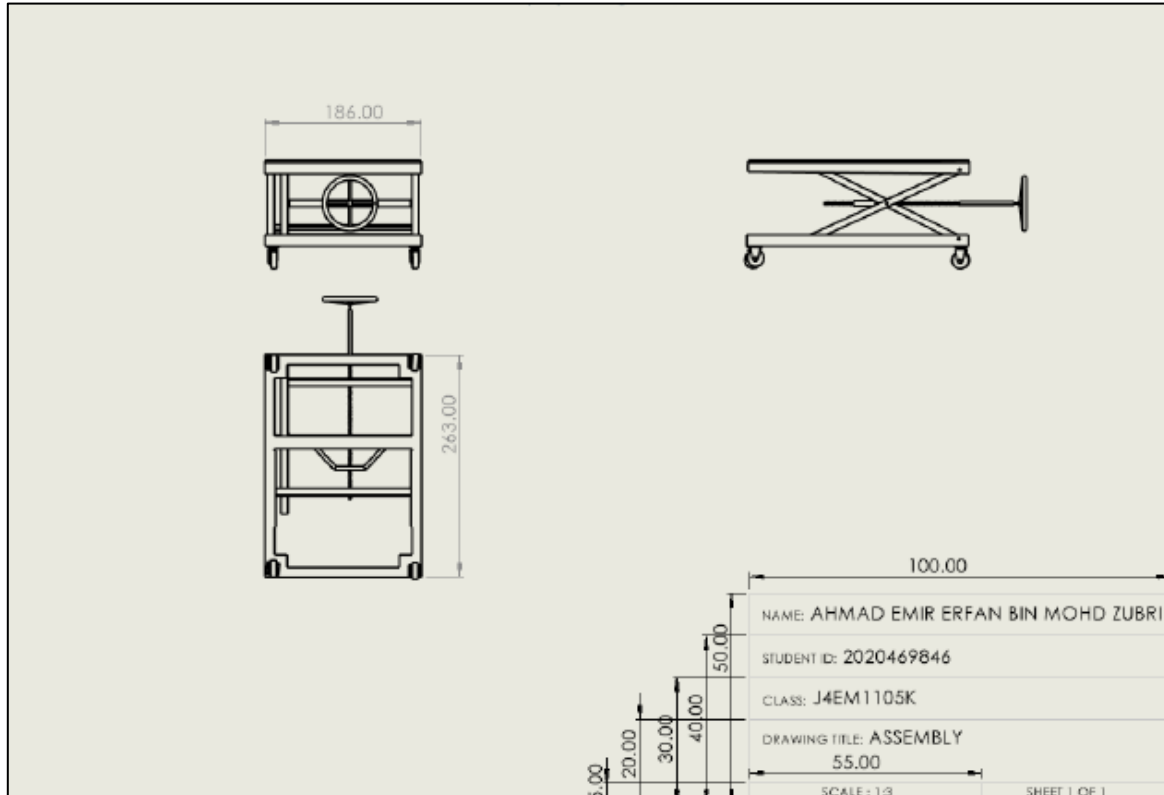
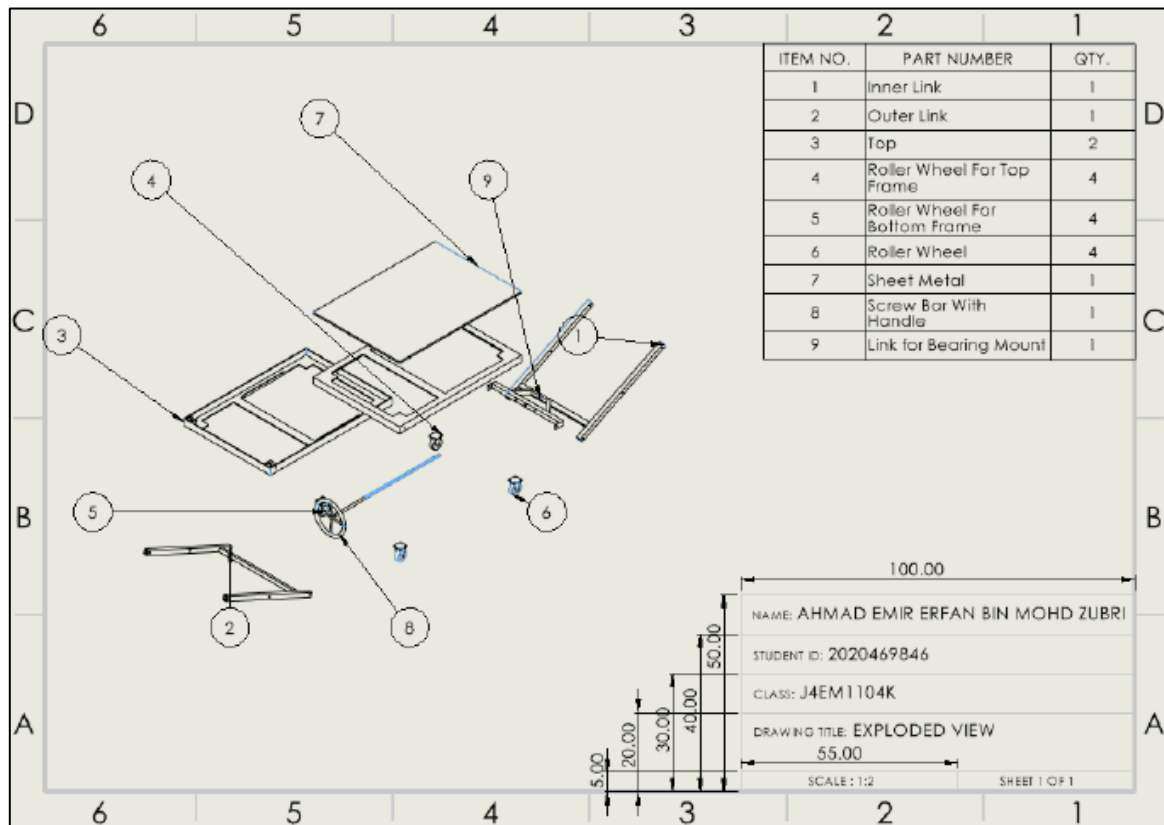
Material handling is a critical operation in manufacturing, warehousing, and logistics sectors, where the movement and positioning of heavy loads are frequent. Manual lifting not only reduces productivity but also poses a risk of musculoskeletal injuries to workers. In many small and medium-scale industries, workers are often required to lift and move heavy objects manually, which can lead to physical strain, reduced productivity, and long-term musculoskeletal injuries. This project addresses these issues by developing a manually operated lift trolley that combines both mobility and vertical lifting capability. The primary objective is to design a cost-effective, user-friendly, and durable platform that can be easily maneuvered and adjusted in height without the use of electrical power. This makes the system especially suitable for environments where electricity is limited or where powered lifting devices are not economically feasible. The problem being solved is the lack of affordable lifting equipment that offers both transportation and vertical lift functionality in a compact form. The proposed trolley incorporates a scissor lift mechanism actuated by a mounted on a wheeled base for easy movement. The design process involves detailed CAD modeling, selection of appropriate materials such as mild steel for structural strength, and fabrication using welding, cutting, and machining techniques. The platform is reinforced to ensure stability during load lifting, while swivel caster wheels with brakes are added for enhanced control and safety.

Keywords: Keyword 1, Keyword 2

PROTOTYPE



DESIGN PARAMETER



CHAPTER 28

Design the Concept of Semi-Automatic Screen-printing Machines

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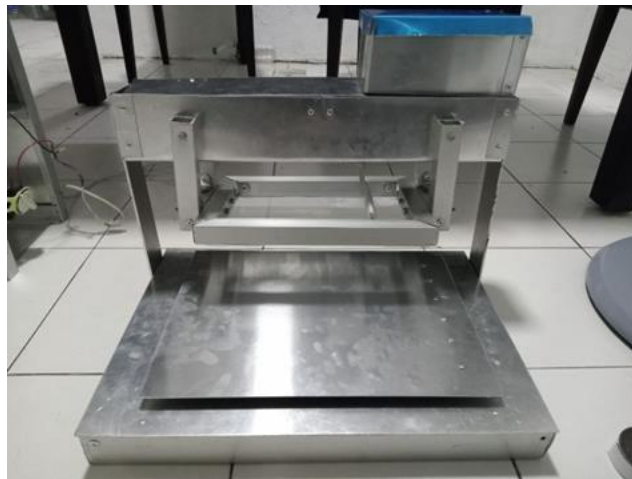
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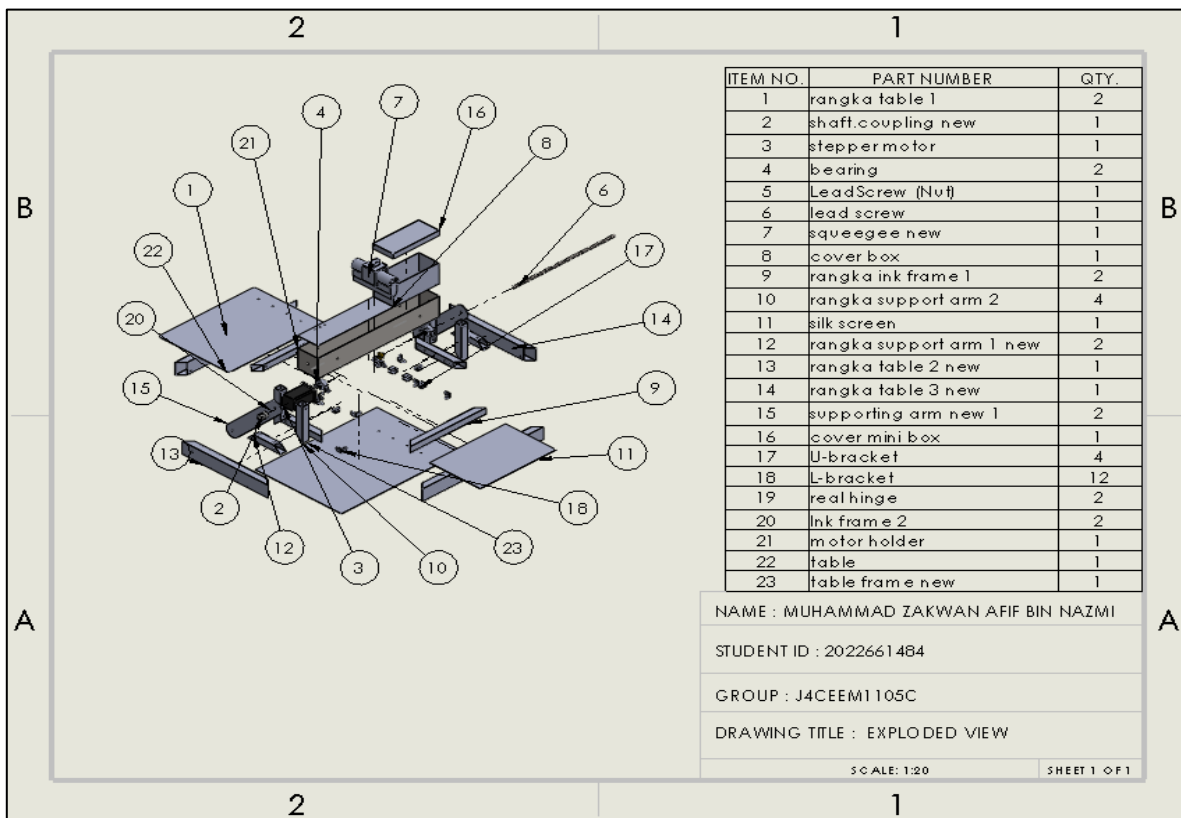
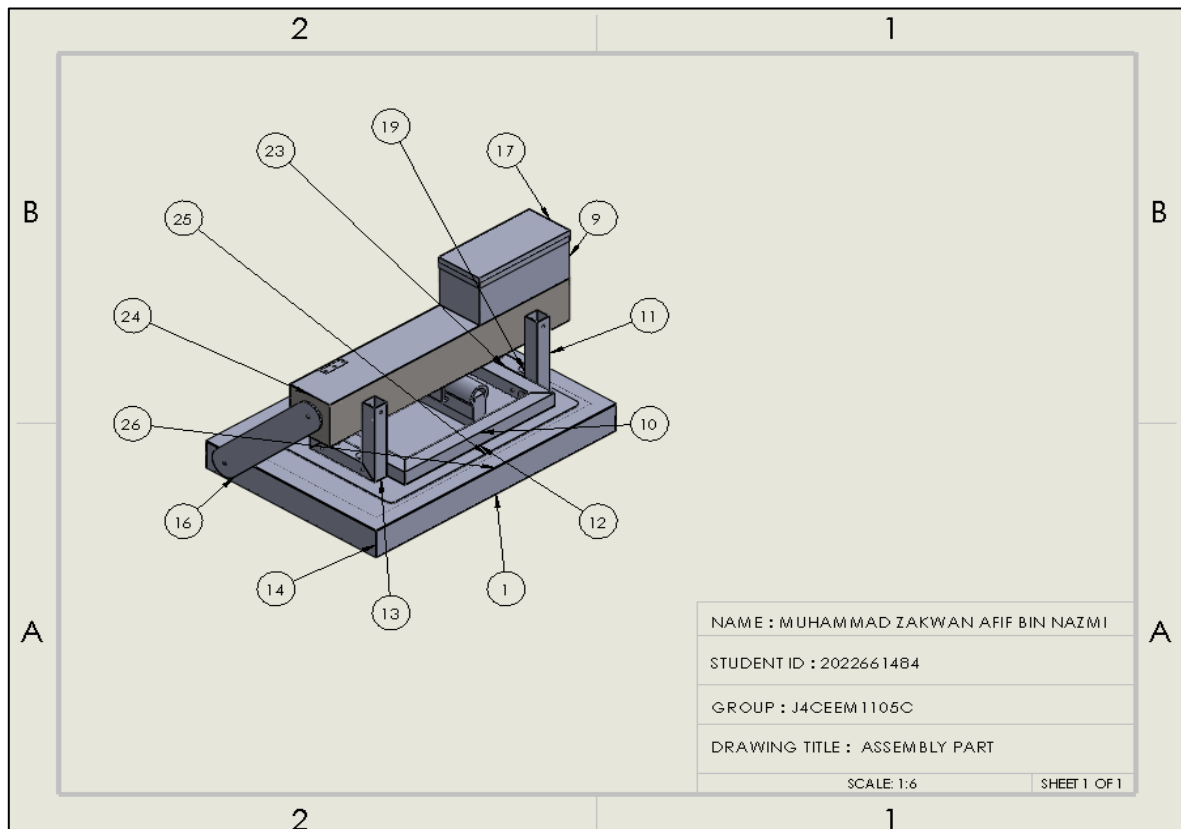
Printing is rather a text and image reproduction process. Usually, this process is carried out through print machines. This is a machine that exerts ink on other objects. With regrets, many people out there do not take a story of the importance of printer machines. Most of the printer machines out there are large sizes. This makes the printer machine hard to carry. Probably the printing section is far away from where the document needs to be used. But in general, most of the printing machines are big in size. The objective of this project is to design and develop our mission for a user-friendly, easy-to-carry printing machine. We also aspire to support new entrants in the printing sector to limit the investment cost they would wish to bear. The characteristic of this machine would be that it needs no connection with a plug and hence reduces energy extractions.

Keywords: *Print, Design, Semi-automatic*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 29

Development of an Automatic Wrapping Machine

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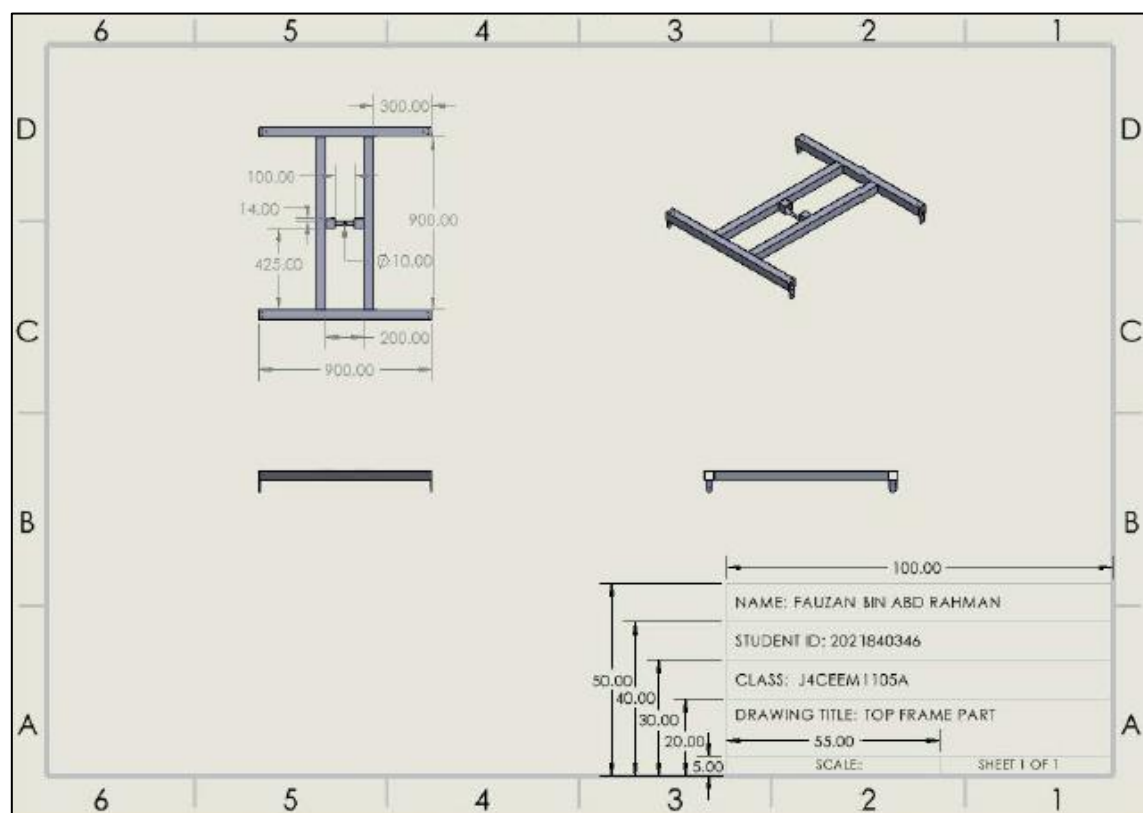
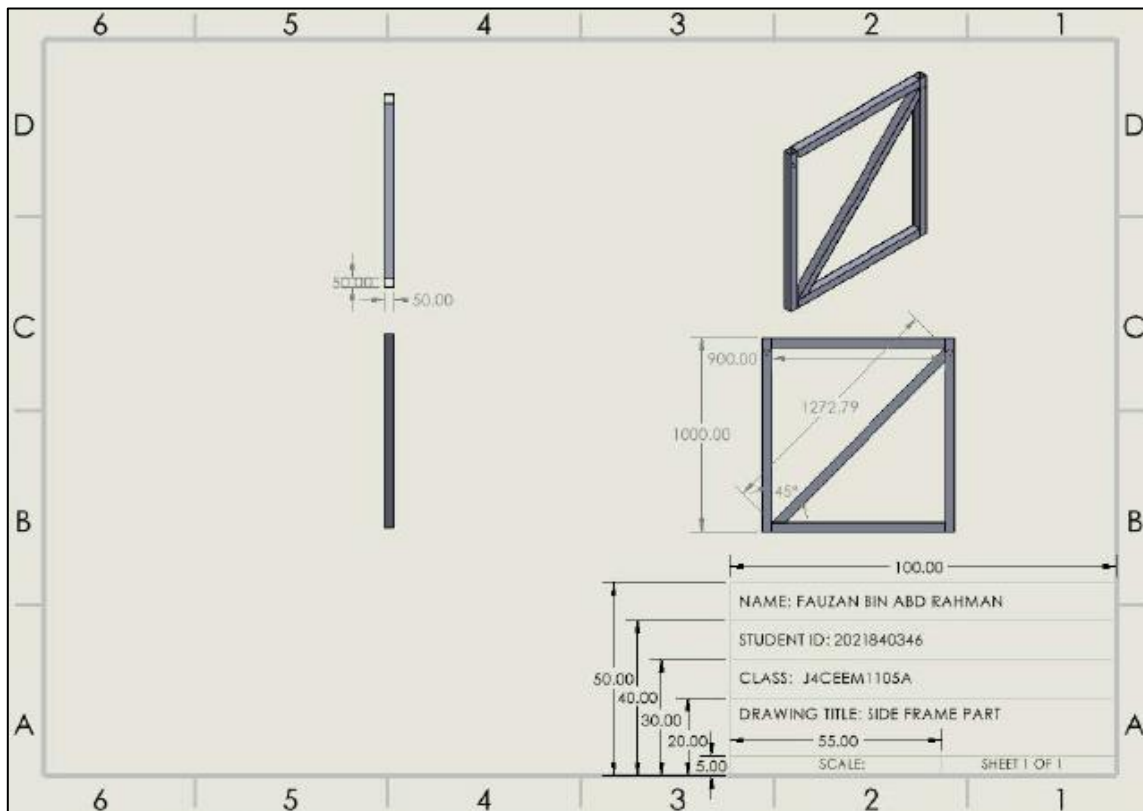
Current automatic wrapping machine that being develop has the problem in terms of design and performance. Available automatic wrapping machine that's being develop previously cannot withstand the load subjected to it which causing the wrapper machine to tilt. The objective of this project is to redesign and reanalyse the force that are acting on the body frame of the machine. This project fabricates a wrapping machine. Mild steel is cut and welded (SMAW, 80-120V) into a frame, then ground smooth. 5cm drilling allows frame disassembly and caster attachment. Rotating arms (rectangular and 'U' shaped mild steel) connect to a 24V DC motor and handle; 9cm holes adjust wrapping size. Aluminium 30 series profiles are attached with M6 hardware. An AC-DC converter and power regulator power the motor. The final product created a portable, automatic pallet wrapper. It works well, is made of strong steel, and helps factories wrap pallets faster with less work. It's easy to use and move.

Keywords: *Automatic, Wrapping*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 30

Design and Fabrication of Manual Gearbox Transmission Systems for STEM Educational Kits

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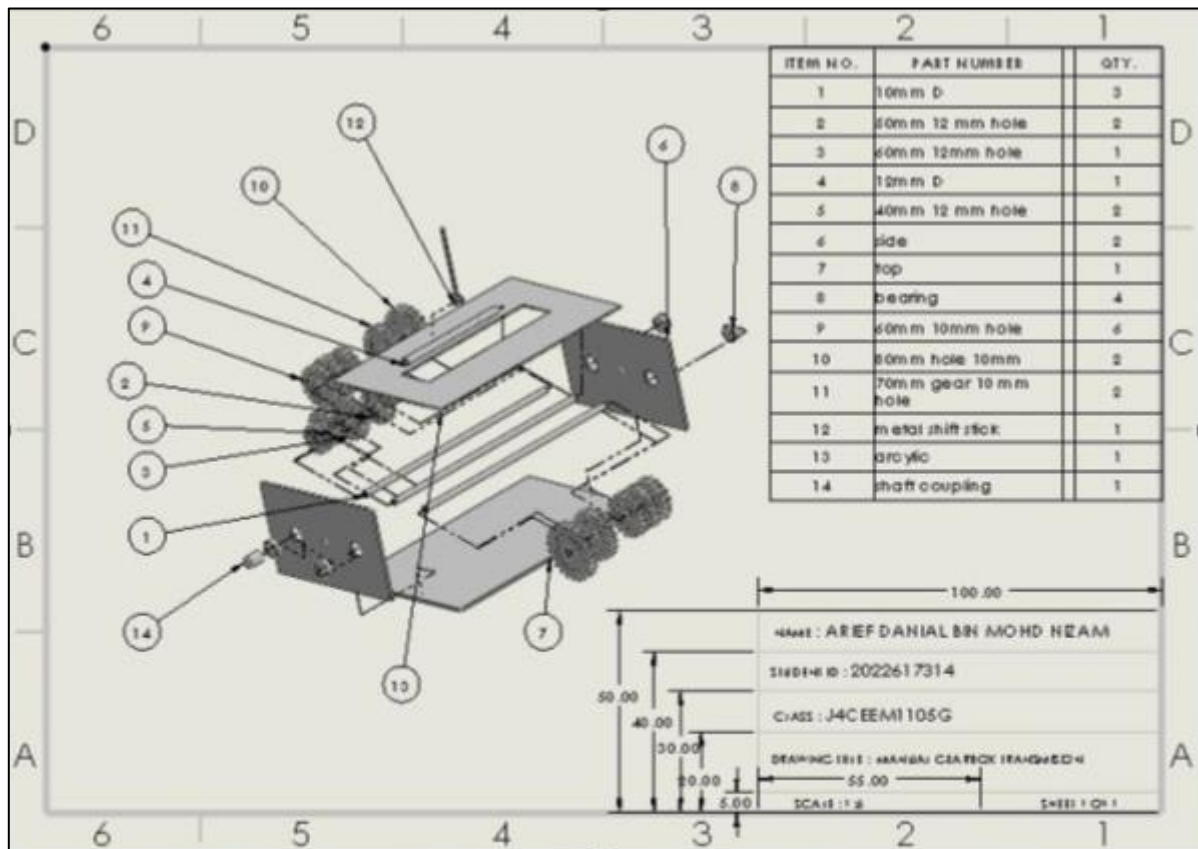
This project aims to enhance the Science, Technology, Engineering, and Mathematics (STEM) education of Malaysian students by introducing them to the practical application of manual gearbox transmissions. The project addresses the gap in students' understanding of manual transmission systems, which are commonly used in vehicles, but often not thoroughly grasped in educational settings. By providing an engaging, hands-on kit, students will explore the fundamental principles of manual gearboxes, developing a deeper comprehension of how these systems work. The kit is designed to integrate key STEM concepts while encouraging students to engage in real-world problem-solving and practical investigations. Through activities focused on the diagnosis, repair, and assembly of manual transmissions, students gain valuable skills applicable to automotive engineering careers. This initiative not only aims to improve STEM education but also sparks an interest in the automotive field, preparing students for future employment in related industries. The project includes a combination of theoretical lessons, hands-on exercises, and evaluations, ensuring students understand both the science behind and the practical application of manual gearbox systems.

Keywords: *STEM, Transmissions*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 31

Design, Analysis and Assembly of a 4-Axis Left Robotic Arms for STEM Educational Aids

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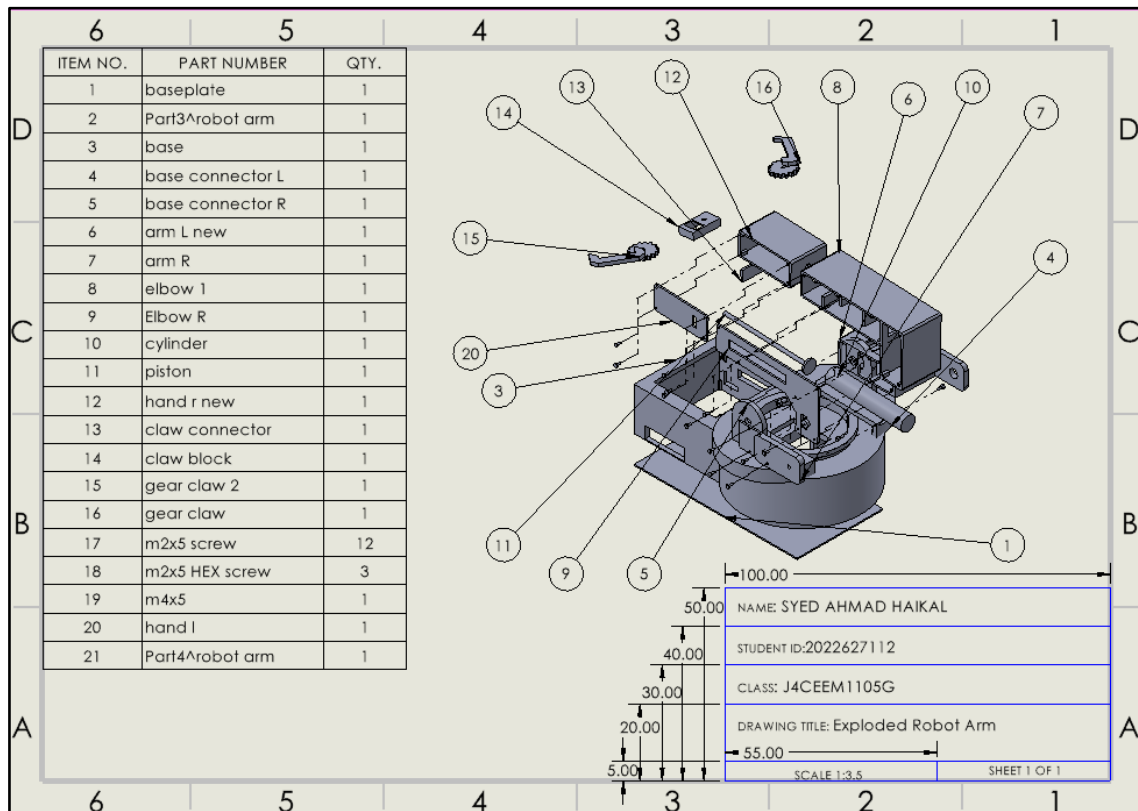
This initiative seeks to tackle the difficulties encountered by Malaysian students in comprehending Science, Technology, Engineering, and Mathematics (STEM) subjects, with a specific focus on engineering. The typical curriculum's emphasis on theoretical knowledge leaves many students insufficiently equipped for the actual application of these principles. Current trends, including heightened absenteeism at pivotal evaluations such as the SPM, indicate a deterioration in academic involvement, particularly in theoretical disciplines. The project implements a 4-axis left robotic arm as an educational tool to connect STEM theory with practical application. The robotic arm prototype was developed with SolidWorks, amalgamating mechanical engineering ideas with programming notions. It was meticulously designed, produced, and assembled to guarantee both operational efficacy and pedagogical worth. This initiative offers an interactive and engaging method for students to cultivate vital STEM abilities, so enriching their educational experience and equipping them for future challenges in automation and engineering.

Keywords: *STEM, 4-axis left robotic arms*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 32

Lifted Platform Industrial Trolley

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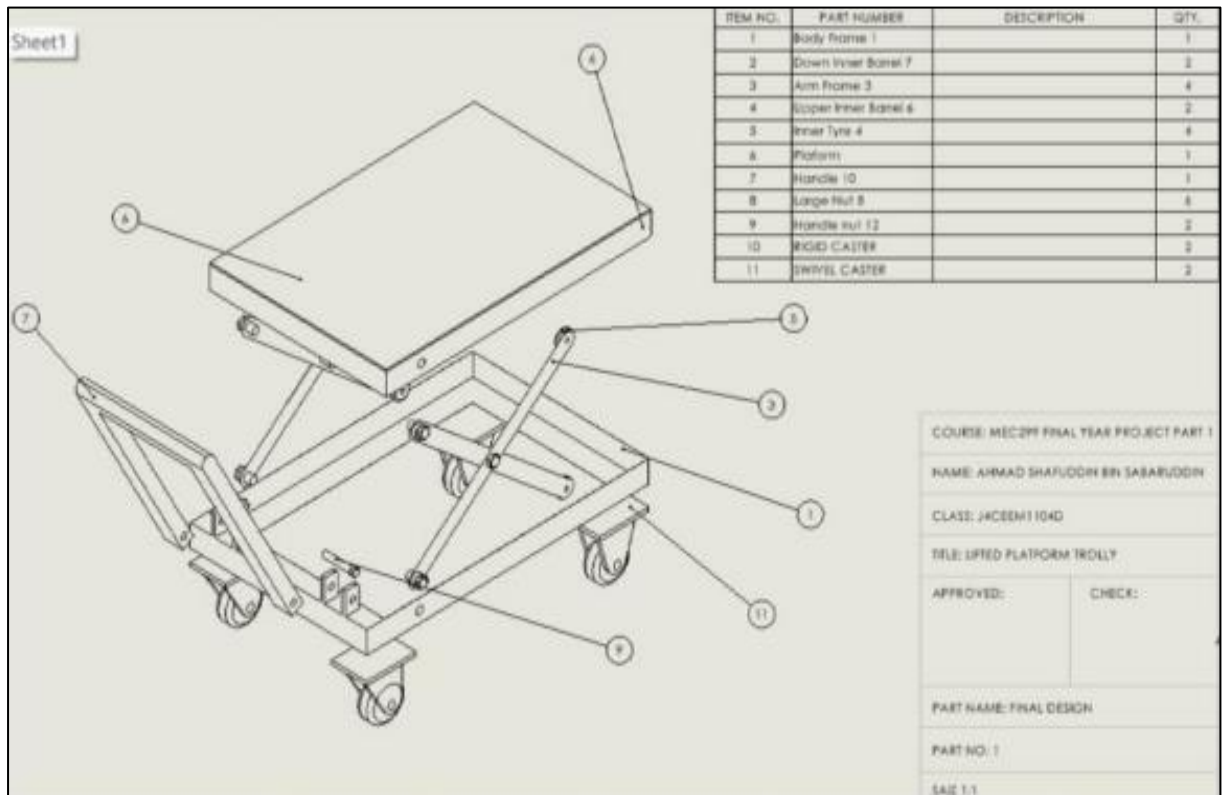
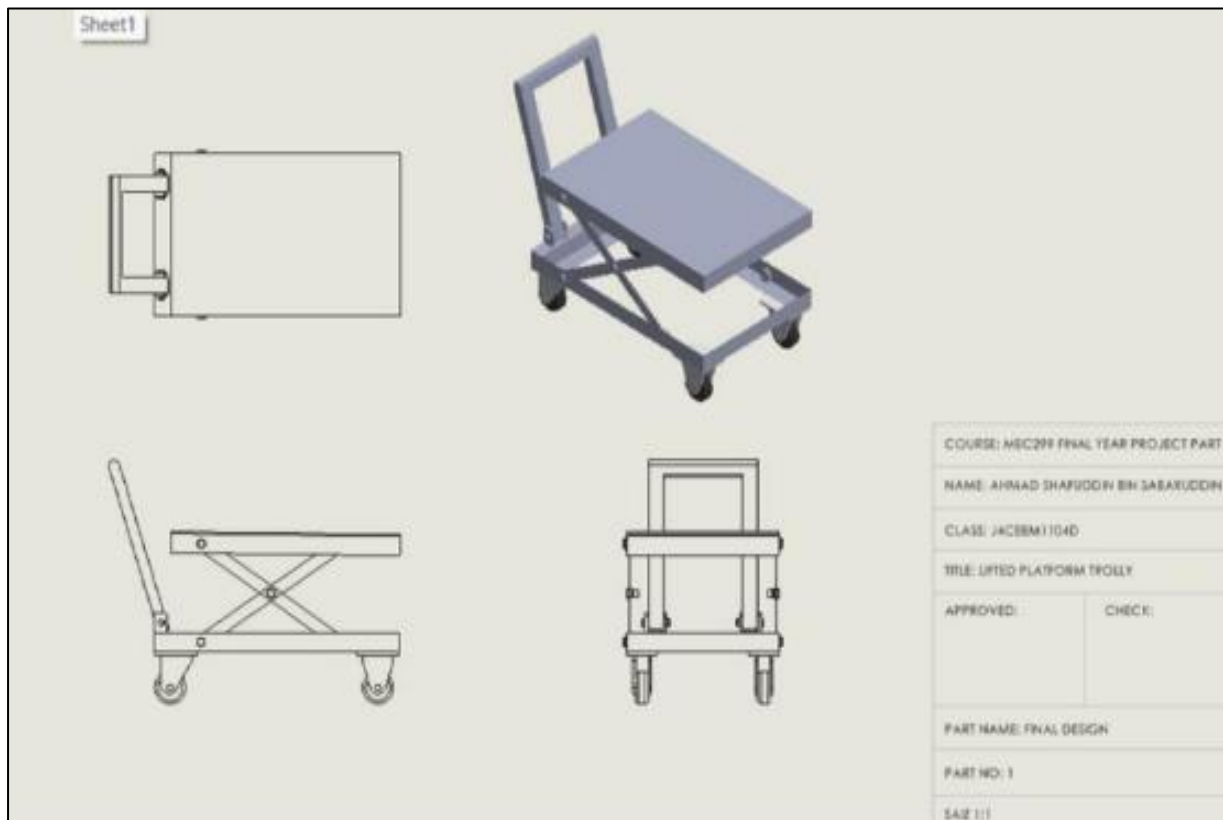
In today's world, industries must produce a large number of products to ensure they reach sellers efficiently. To increase the production rate, workers in these industries must operate and maintain machines smoothly. As we all know, industrial settings involve handling heavy objects, such as large boxes and transfer machines. This makes it challenging for workers to manage these burdens while ensuring their safety. A lifted platform industrial trolley is a versatile material handling device designed to transport and lift heavy loads efficiently in various industrial settings. This equipment typically features a robust steel frame, a hydraulic or electric lifting mechanism, and a platform that can be elevated to different heights. The trolley is equipped with durable wheels or casters for smooth mobility and often includes safety features such as locking mechanisms and guardrails. It is commonly used in warehouses, manufacturing plants, and distribution centers to streamline operations, reduce manual labor, and enhance workplace safety by facilitating the easy movement and positioning of bulky or heavy items. The adaptability and ergonomic design of lifted platform industrial trolleys make them essential tools for improving productivity and operational efficiency in industrial environments..

Keywords: *Trolley, Machine*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 33

Development of an Automated Sand Sieve Machine

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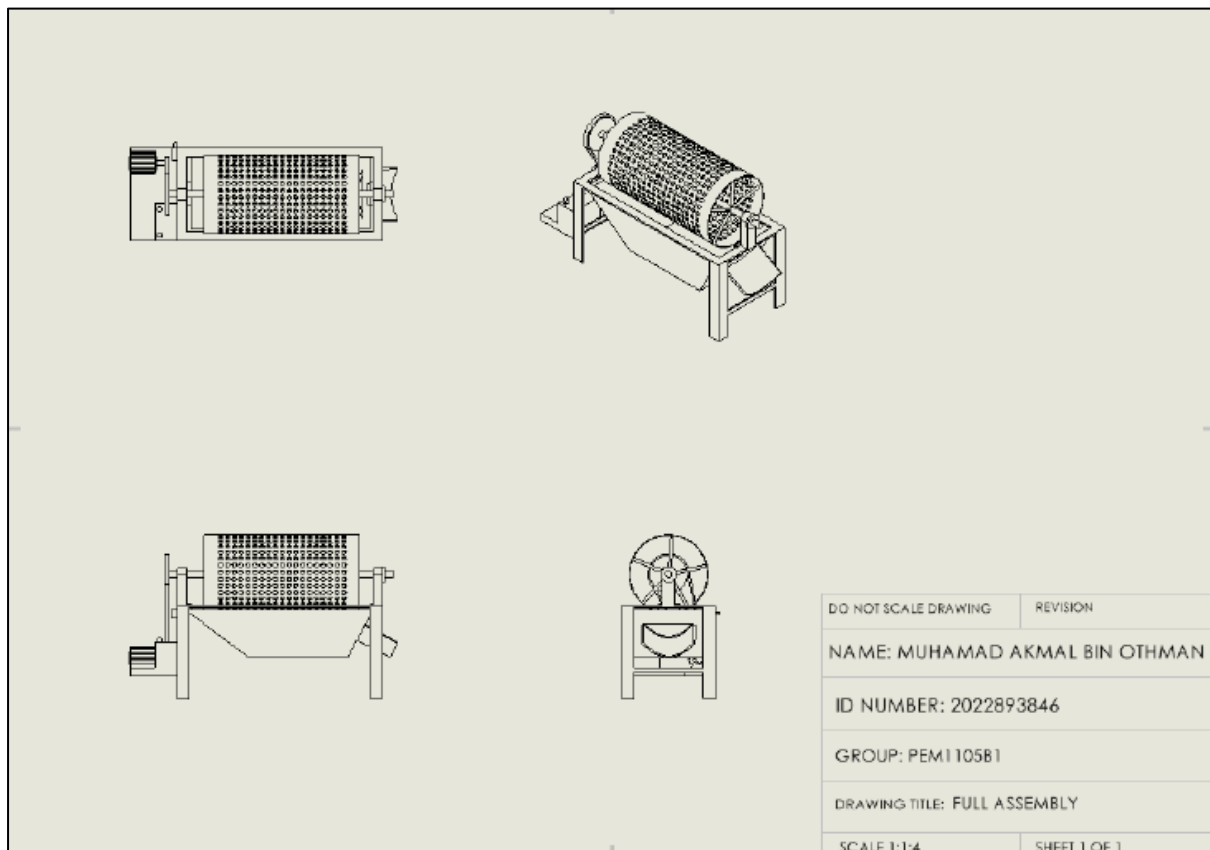
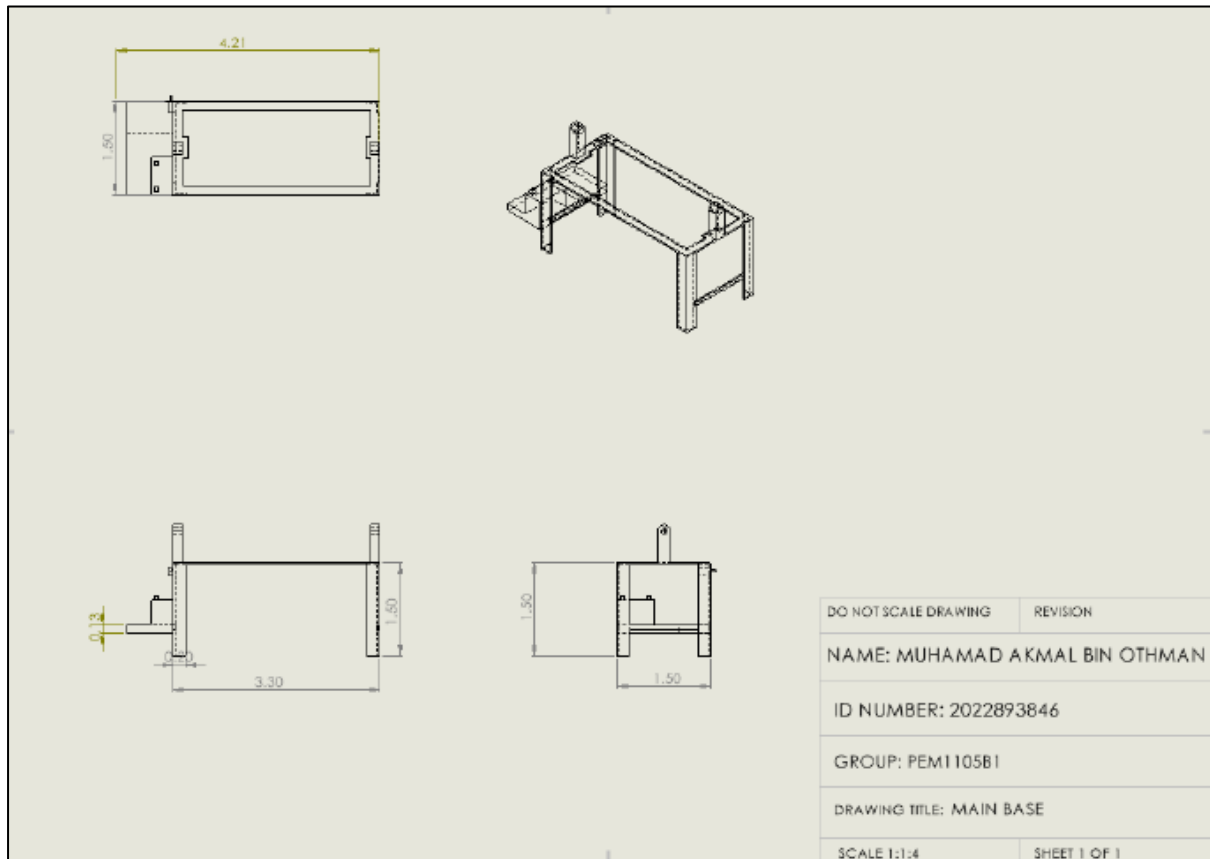
The project aims to develop an automatic sand sieve machine to enhance efficiency at construction sites by separating sand from stones more effectively than traditional manual methods. The manual method requires human effort, more time consuming and labour cost. By using this automated sand sieve machines, these issues can be effectively addressed. The design process begins with studying the limitations of existing methods and examining user requirements to develop improved design concepts. Detailed engineering drawings are produced using SolidWorks to direct the fabrication process, which includes component assembly, cutting, welding, and material selection. Improved sand filtering effectiveness as well as a decrease in the effort and cost involved in the sand sieving process are the expected outcomes.

Keywords: *Automated machine, Sand sieve*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 34

Development of an Innovation Beach Cleaner Machine

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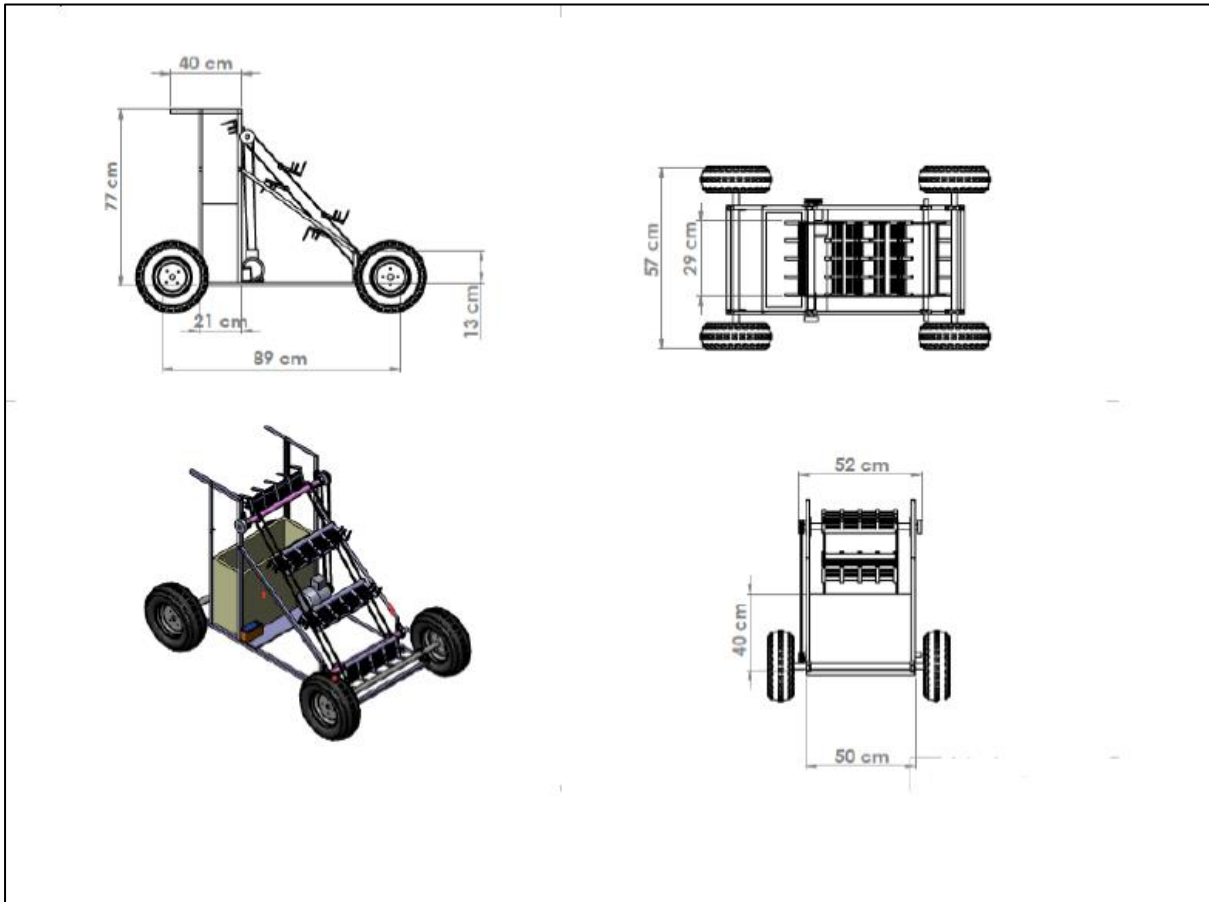
The goal of this project is to develop a beach cleaning machine that is more energy efficient, cost effective, and easy to use. The machine operates using a simple push and pull mechanism, enabled by its wheel-based design. While there are many beach cleaning machines available on the market, most are complex and expensive. This device is designed to automatically collect trash from the beach, eliminating the need to manually dig through the sand for debris. It also includes a mechanism to separate waste from sand, making it easier to maintain and well-suited for use in sandy environments. One of the key innovations in the design is a built-in separation system that efficiently distinguishes between sand and waste materials, ensuring that only trash is collected while the clean sand is returned to the beach. This not only improves the effectiveness of the cleaning process but also minimizes environmental disruption. The machine is lightweight, easy to transport, and requires minimal maintenance, making it suitable for frequent use in various sandy environments. Overall, the development of this machine aims to promote environmental sustainability through practical, accessible and affordable technology.

Keywords: *Beach cleaner, Sand cleaner*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 35

Design and Fabrication of a Helmet Washing Machine

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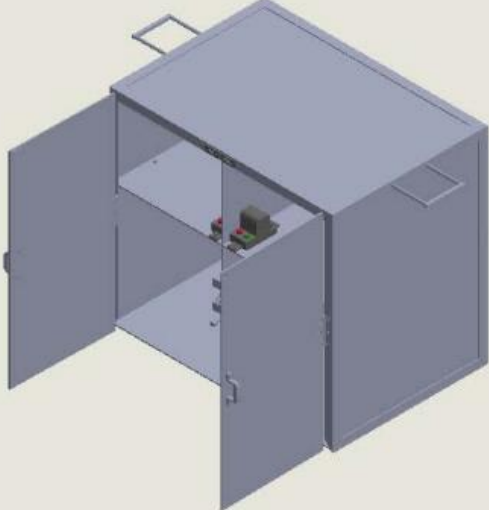
Motorcycle helmets are essential for rider safety, but their inner linings accumulate sweat, dirt, and bacteria over time, leading to hygiene issues and unpleasant odors. Traditional cleaning methods are often time-consuming and ineffective in reaching hidden crevices. This study focuses on the design and fabrication of an automated helmet washing machine to simplify the cleaning process. The machine incorporates a rotating nylon brush for scrubbing, a controlled water spraying system for rinsing, and a PTC air heater for drying. The design was developed using SolidWorks, followed by material selection and prototype fabrication. Mild steel was used for the structural frame, while aluminum composite panels were chosen for their durability and corrosion resistance. Structural integrity was evaluated using stress analysis in SolidWorks, and theoretical calculations were performed to determine the torque requirements for the rotating brush mechanism. The project successfully demonstrates the feasibility of a cost-effective and user-friendly helmet washing machine. While the prototype operates as intended, further testing is required to assess cleaning efficiency, drying performance, and long-term durability. Future improvements include optimizing water usage, enhancing the drying mechanism, and integrating an automated timer for improved user convenience.

Keywords: *Helmet washing machine, automated cleaning*

PROTOTYPE



DESIGN PARAMETER

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Group		J4CEEM1105F													
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Drawing Title		ASSEMBLY OF HELMET WASHING MACHINE													
Part Name		-													
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CHAPTER 36

Flexydry Rack

Jasmeen Emira Binti Nasarudin ¹ and Mohd Ghazali Mohd Hamami ^{2*}

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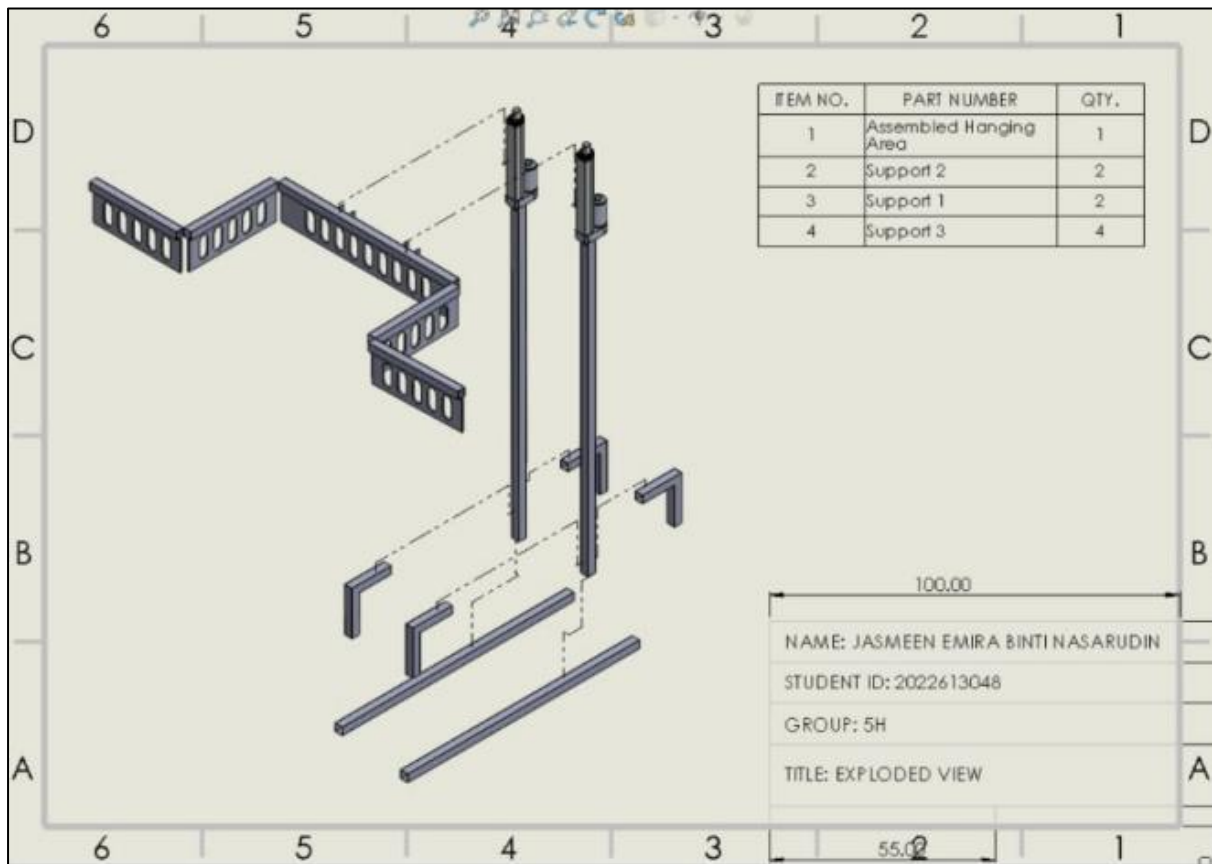
Clothes racks are widely used globally for air-drying laundry, especially for clothes that cannot be dried in a dryer machine. Hanging clothes racks are commonly used by those who live in apartment-style houses. However, due to the minimum hanging space provided, the amount of clothes that can be dried at one time is small, which may result in difficulty for individuals living in an apartment. Therefore, the primary objective of this project is to design a flexible drying rack that can offer maximum versatility, functionality, and space efficiency. The methodologies used in this project are requirements analysis and material selection. This project will be using the concept of expansion and compression. By using this concept and mechanism, individuals will be able to dry more clothes at one time.

Keywords: *Flexible, Hanging dry rack*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 37

Ezballretriever: The Fast & Simple Tennis Ball Collector

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PROJECT DESCRIPTION

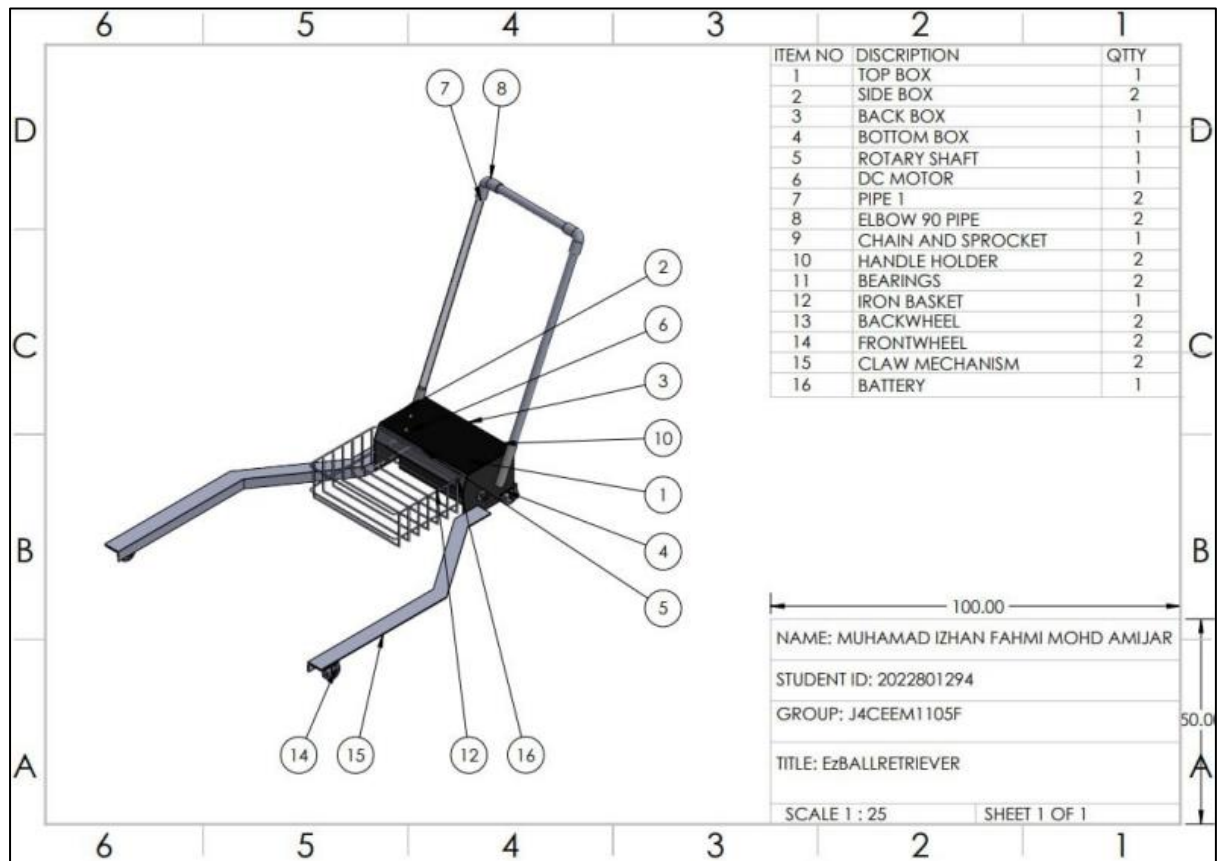
The sport of tennis is becoming increasingly popular, played by millions of people worldwide. However, players face challenges during training sessions, particularly when collecting tennis balls, which is time-consuming, energy-draining, and can lead to spinal strain. The objective of this project is to improve the efficiency and speed of the ball collection process while ensuring player comfort during training. The EZBallRetriever was designed to address these issues by incorporating a simple yet effective mechanism for collecting tennis balls quickly and efficiently. The device uses rollers, brushes, and a collection basket to gather the balls with minimal effort from the player. A battery-powered system ensures portability and ease of use, while the user-friendly design allows for simple operation. The outcome of this project is a functional and efficient tennis ball collector that reduces the time and energy spent by players during training sessions. The EZBallRetriever also helps prevent physical strain, making training more comfortable and productive. Additionally, the device's low-maintenance design ensures long-term reliability, with easily replaceable components to prolong its lifespan.

Keywords: *Efficiency , Tennis ball retriever*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 38

Design and Fabrication of Portable Mini Air Cooler

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PROJECT DESCRIPTION

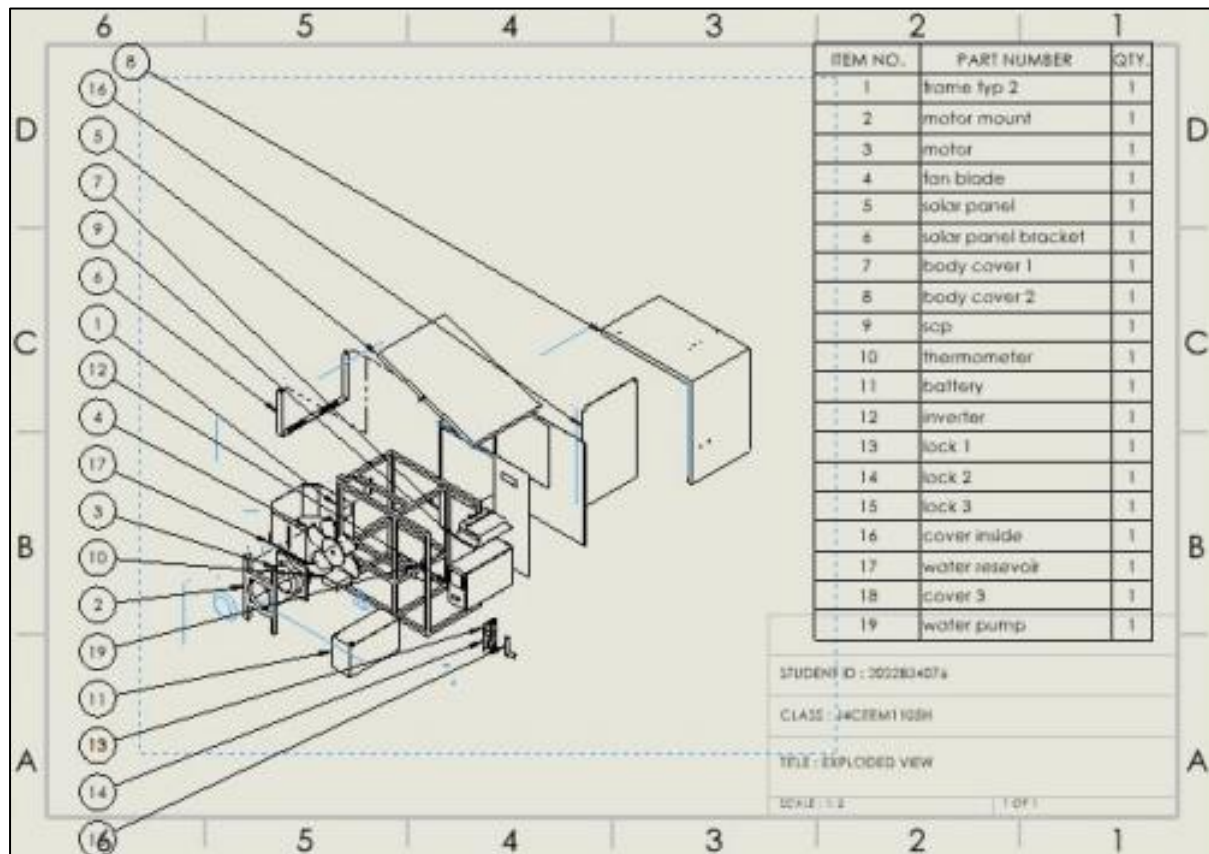
The need for air coolers has increased in recent years, as global temperatures have become unpredictable. The necessity for an air cooler is critical for people who live or work in cities, to have a pleasant location to work or live in hot weather. Unlike standard air conditioners which have the compressor unit to keep the air cool, bulkiness of the inside and outdoor unit and complicated to install, these coolers use evaporative cooling technology, which draws in heated air, passes it through a moistened filter, and then releases a stream of cold, humidified air into the surrounding area. This method not only reduces the ambient temperature but also adds moisture to the air, reducing dryness and increasing comfort, particularly in arid conditions. Thus, the main objective of this project is to develop a compact and lightweight 3 in 1 cooling device that is capable to humidified, purify and cooled the air in the area without the complex installation like the standard air conditioner. Furthermore, this mini air cooler can easily be portable and suitable for use in various environments, with its own power source and rechargeable battery, allowing the user to bring the product anywhere. In conclusion, portable mini air coolers are a versatile and efficient alternative for personal cooling, cleaning the air and humidity. Their small size, internal energy, and improved functions make them useful companions for anyone looking for comfort and relief from the heat in a variety of indoor and outdoor locations.

Keywords: *Portability , Mini air cooler*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 39

Slick & Shine Semi-Automated Shoe Care

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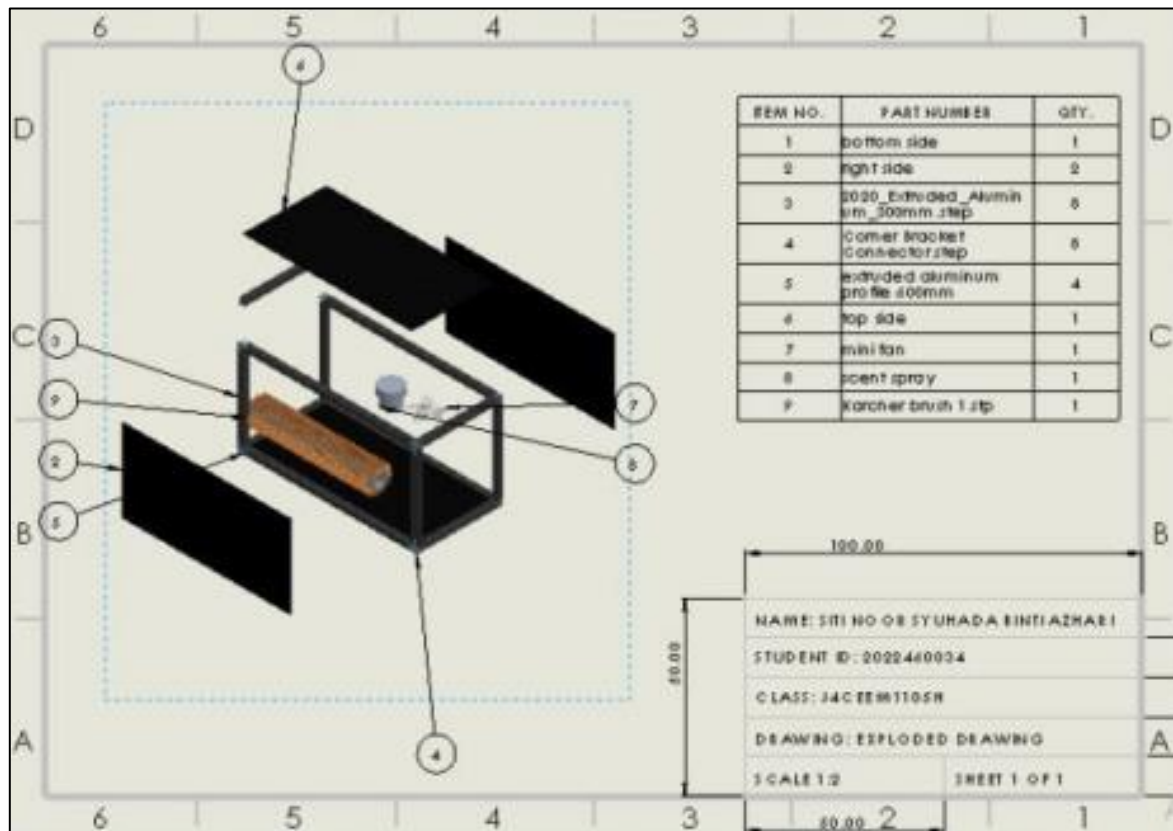
Teenagers frequently remain at the forefront of this modern with new fashions and trends. Shoes are accessories that capture the spirit of the culture and the individual. Although teenagers prefer to show off their stylish footwear, maintaining the shoe's shine is challenging. It is because brushing away with polish to remove stains makes people lack manual polishing. The objective is to keep the polishing process simple and guarantee the shoes come out spotless, avoiding moisture and even scent fresh. Moreover, the network of sensors and modern types of equipment are positioned to detect every polishing phase. A light pre-treatment helps dry the shoe after deep polishing. A slight scent offers a finishing touch, so every shoe is a shining and refreshing perfume.

Keywords: *Semi-automated , Shoe care machine*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 40

Design and Fabricate Mini Lathe Machine

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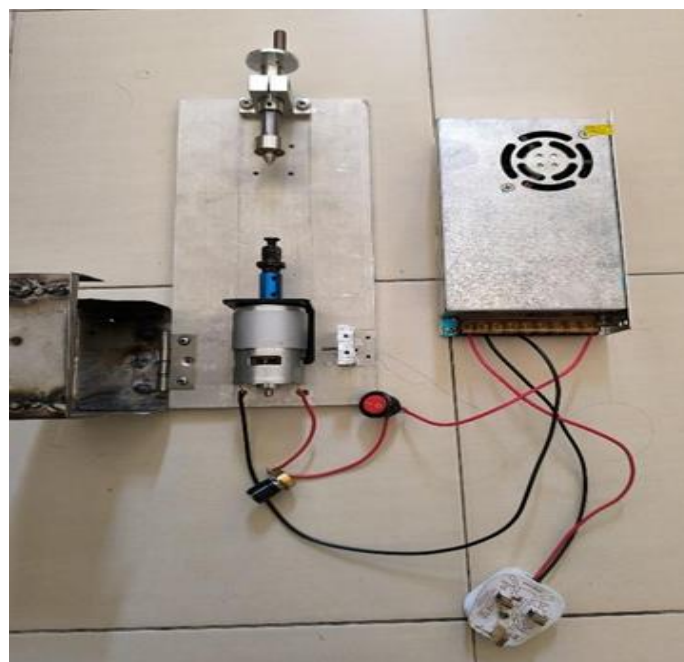
**Corresponding author (e-mail): abaziz86@uitm.edu.my*

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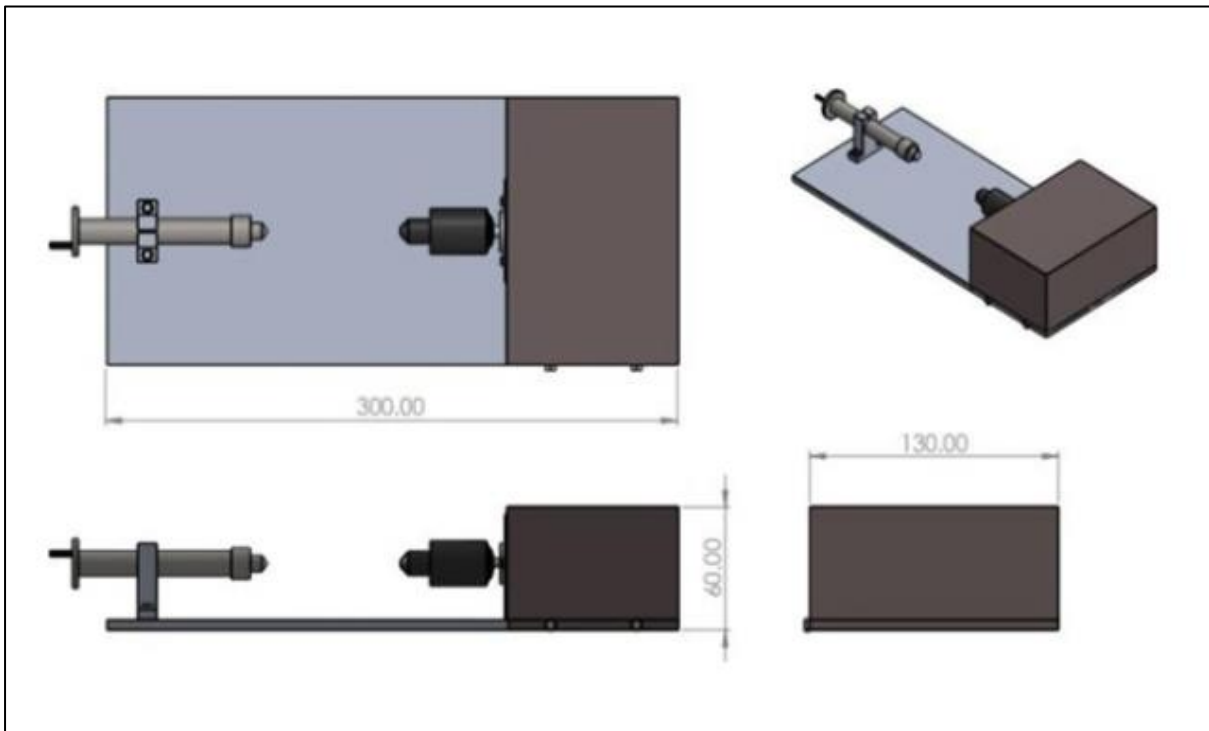
Lathe machines are commonly used in workshops for various machining operations such as cutting and turning, with different types including CNC, engine, and bench lathes. These machines consist of three main components: the headstock, tailstock, and bed. A key challenge in this project is designing the bed of a mini lathe machine, as it must be sufficiently heavy to stabilize the structure and prevent excessive shifting. The machine will be designed specifically for machining wood, which is softer and easier to shape than metal but produces significant waste in the form of shavings and dust. The project has two main objectives: first, to design a prototype of a mini lathe machine using SolidWorks, and second, to fabricate the machine based on the developed design. Engineering analysis will identify high-stress areas and determine the factor of safety, while detailed design drawings will provide a clear visualization of the machine's components and assembly.

Keywords: *Design and fabrication, Mini lathe*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 41

Prototype Solar Hydroponic System

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PROJECT DESCRIPTION

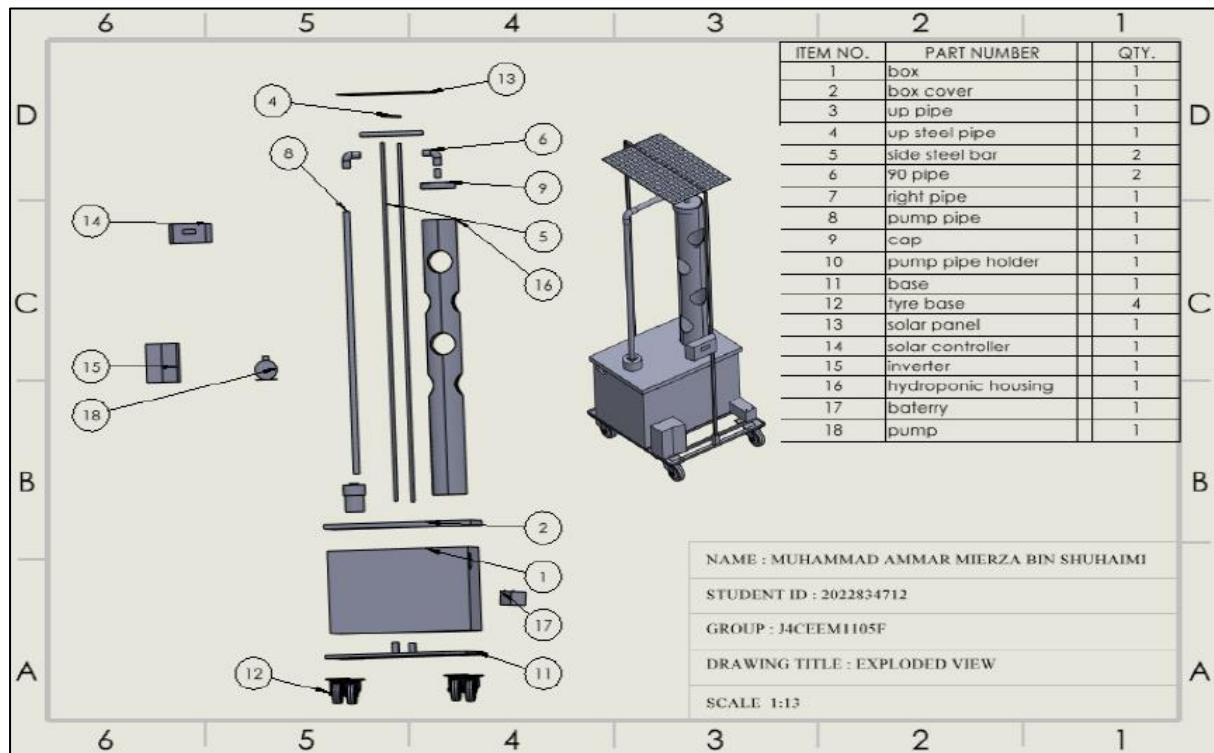
This study focuses on the development of a prototype solar hydroponic system to enhance sustainable agriculture through renewable energy integration. The system aims to address the increasing demand for eco-friendly food production while reducing reliance on conventional farming methods. The objectives of this project include designing and fabricating a solar-powered hydroponic unit, optimizing its energy efficiency, and evaluating its performance under various environmental conditions. The research methodology involves computational modeling using SolidWorks, material selection for structural integrity, and experimental validation of energy capture and water-use efficiency. The prototype integrates photovoltaic panels, an energy storage unit, and a hydroponic nutrient delivery system to ensure optimal plant growth. Performance testing assesses factors such as solar energy conversion, water consumption, and crop yield. Results indicate that the solar hydroponic system significantly reduces water usage while maintaining high crop productivity. The system demonstrates operational stability under fluctuating sunlight conditions, with optimized nutrient delivery improving plant health. Future enhancements include advanced automation, IoT-based monitoring, and improved energy storage to increase scalability. This research supports global food security and sustainable development goals by demonstrating an efficient, eco-friendly farming solution.

Keywords: *Solar Hydroponics, Sustainable Agriculture*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 42

Umbrella Dryer Machine

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PROJECT DESCRIPTION

The Umbrella Dryer Machine is designed to address the inconvenience and safety hazards associated with wet umbrellas in indoor spaces. Wet umbrellas contribute to slippery floors, increased maintenance, and potential theft risks when left unattended. This project aims to develop an efficient, compact, and user-friendly solution for drying umbrellas quickly, enhancing cleanliness and safety in public and private facilities. The project involves the design, fabrication, and evaluation of a prototype that integrates centrifugal drying and controlled heating mechanisms. The methodology includes computational design using SolidWorks, material selection for durability, and experimental validation to assess drying efficiency and safety compliance. The system operates by spinning the umbrella at high speeds to remove excess water, combined with a controlled heating element to accelerate the drying process while ensuring user safety. Performance testing demonstrates that the prototype significantly reduces drying time compared to conventional methods while preventing water spillage. The system effectively minimizes maintenance costs for building facilities and enhances user convenience. Future improvements include incorporating automatic sensors for user detection, optimizing energy efficiency, and refining airflow mechanisms to accommodate various umbrella sizes.

Keywords: *Umbrella Dryer, Indoor Safety*

PROTOTYPE



DESIGN PARAMETER

ITEM NO.	PART NUMBER	QTY.
1	assem blower	1
2	Assom INNER OUTER	1
3	bearing + conveyor	1
4	hair dryer	1
5	motor	1
6	Assem PVC INNER	1
7	M12-1.75 x 45	1
8	bearing + conveyor 1	1
9	aluminium profile 300mm width x 935mm length	2
10	aluminium profile 160mm width x 935mm length	2
11	Aluminium 160mm x 300mm length	1
12	top Aluminium 160mm x 300mm length	1

NAME: AIN NUR MAWADDAH

STUDENT ID: 2022828932

CLASS : J4CEEM1104C

PART NAME : EXPLODED VIEW UMBRELLA DRYING MACHINE

SCALE : 1:2

CHAPTER 43

Free Energy Water Generator

Muhammad Farhaan Bin Mohd Fauzan ¹ and Haszeme Bin Abu Kasim ^{2*}

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PROJECT DESCRIPTION

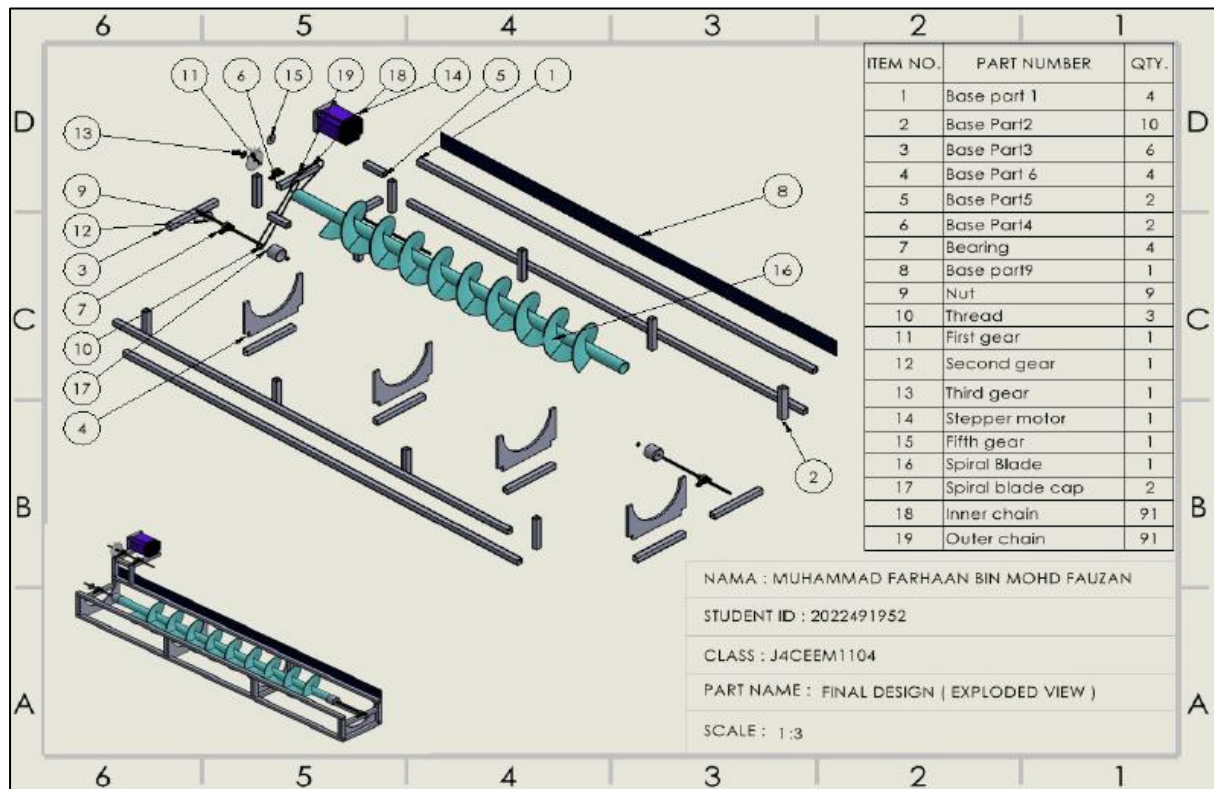
The Free Energy Water Generator is designed to provide a sustainable and renewable electricity source by utilizing water flow as its primary energy input. This project aims to develop a compact and efficient generator capable of producing electricity without reliance on conventional fuels, making it ideal for remote areas and off-grid applications. The research methodology involves the design and fabrication of a small-scale water turbine system integrated with a stepper motor and capacitor-based energy storage. The turbine converts kinetic energy from flowing water into mechanical motion, which is then transformed into electrical energy using a stepper motor. Computational simulations in SolidWorks guide the optimization of turbine blade efficiency, while experimental testing evaluates power output, stability, and durability. Results indicate that the generator effectively harnesses water flow to generate electricity, maintaining stable output with minimal maintenance. This study contributes to the advancement of green energy solutions by demonstrating an accessible and sustainable power generation method. Future work will focus on improving efficiency through enhanced turbine materials, integrating smart energy management systems, and expanding applicability across diverse water environments.

Keywords: Renewable Energy, Water Turbine Generator

PROTOTYPE



DESIGN PARAMETER



CHAPTER 44

Wind Electric Generator

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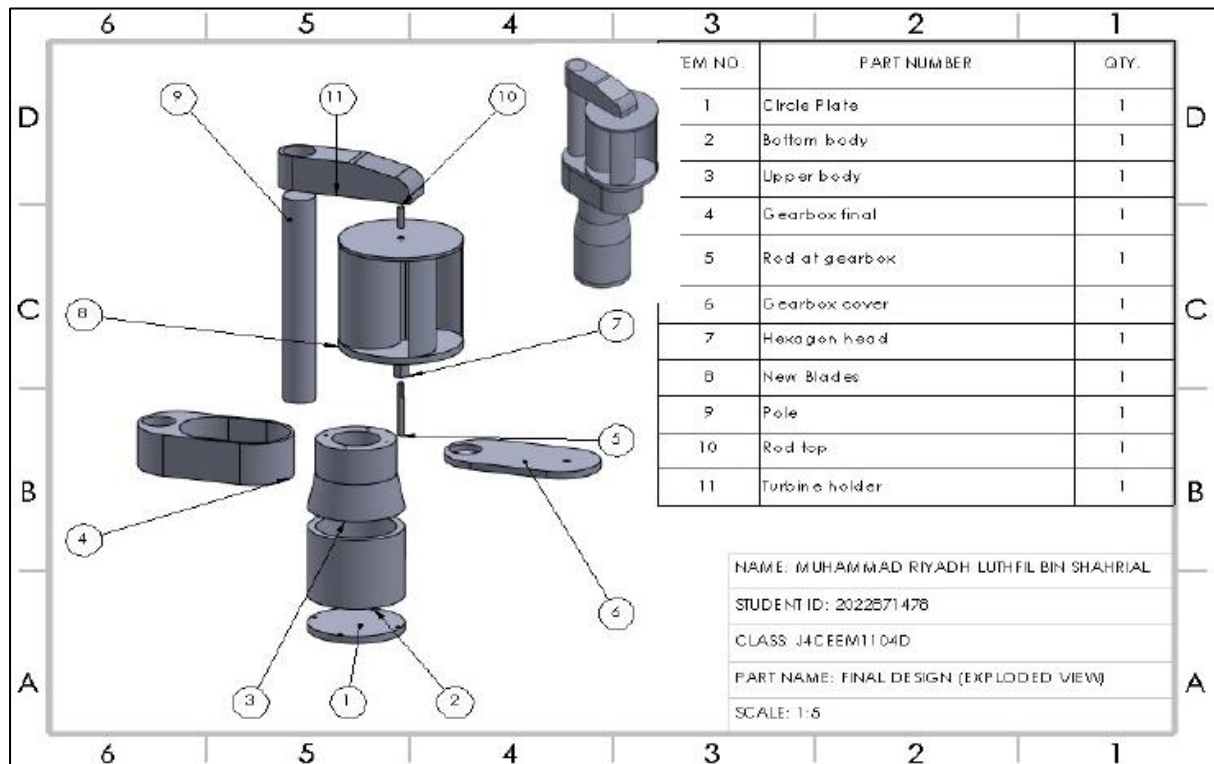
The Wind Electric Generator project aims to develop a compact and efficient renewable energy solution by harnessing wind power for electricity generation. Given the growing demand for sustainable energy sources, this study focuses on optimizing wind turbine design for enhanced performance, cost-effectiveness, and adaptability to various environmental conditions. The primary objective is to design, fabricate, and test a wind electric generator that can operate efficiently even at low wind speeds, making it suitable for small-scale applications. The methodology involves computational modeling using SolidWorks to simulate turbine aerodynamics, followed by material selection and prototype fabrication. A pulley system is integrated to optimize energy transfer from the rotating blades to a DC generator, which then charges a battery for power storage. Experimental testing evaluates power output, structural stability, and operational efficiency under different wind conditions. Preliminary results demonstrate that the optimized design enhances energy capture efficiency while maintaining low production costs. The prototype successfully generates electricity with minimal mechanical resistance, making it a viable alternative for off-grid applications. However, challenges such as wind variability and mechanical wear require further refinements.

Keywords: *Wind Turbine, Renewable Energy*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 45

Amir Automatic Wrapping Machine

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PROJECT DESCRIPTION

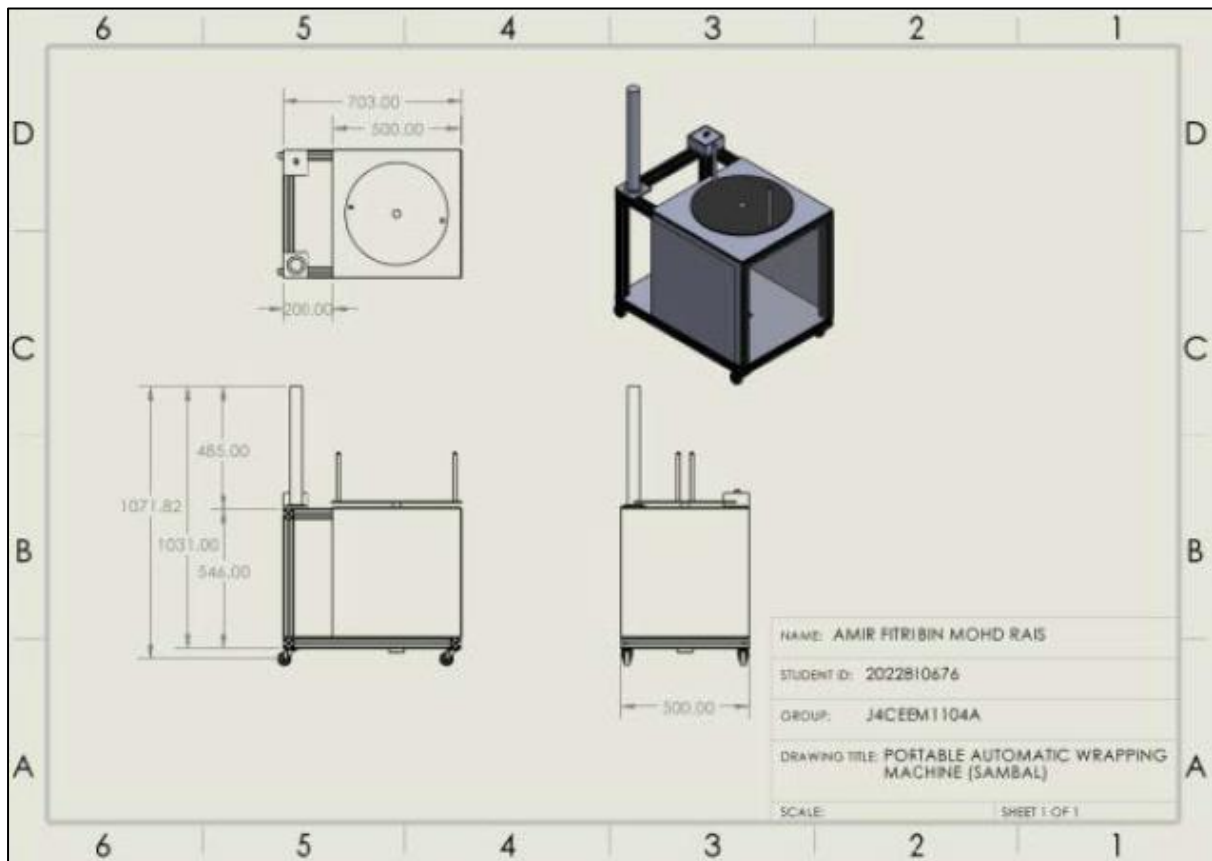
Existing wrapping machines provide issues for small-scale producers and distributors because of their high cost, enormous size, and lack of portability. The goal of this project is to design and build a low-cost, portable automatic wrapping machine to address these challenges. The machine was created by gathering data from existing products, assessing essential design components, and utilizing CAD software for design optimization. The manufacturing process included cutting, welding, and assembling of lightweight yet robust components to ensure affordability and ease of movement. The resulting prototype has a compact form with a smaller footprint, improved portability with wheels, and a cheaper production cost of RM 555, making it affordable for small firms. Testing confirmed the machine's ability to efficiently wrap items, with a cycle time of 15-25 seconds. The equipment can support goods weighing up to 30 kg and operates ergonomically. This study met its aims by proposing a viable alternative to standard wrapping machines that is affordable, portable, and efficient. Future enhancements, such as the addition of a film height detector and a gearbox, could improve functionality and adaptability to a broader set of applications

Keywords: *Automatic, Wrapping*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 46

Development of a Prototype for 2 in 1 Folding Smart Chair and Stroller

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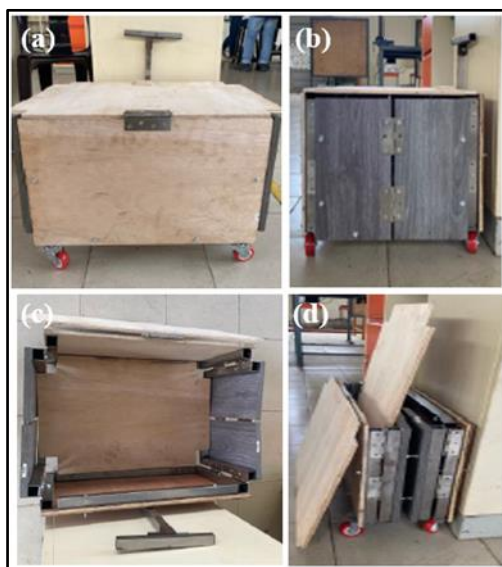
**Corresponding author (e-mail): ainaa7609@uitm.edu.my*

PROJECT DESCRIPTION

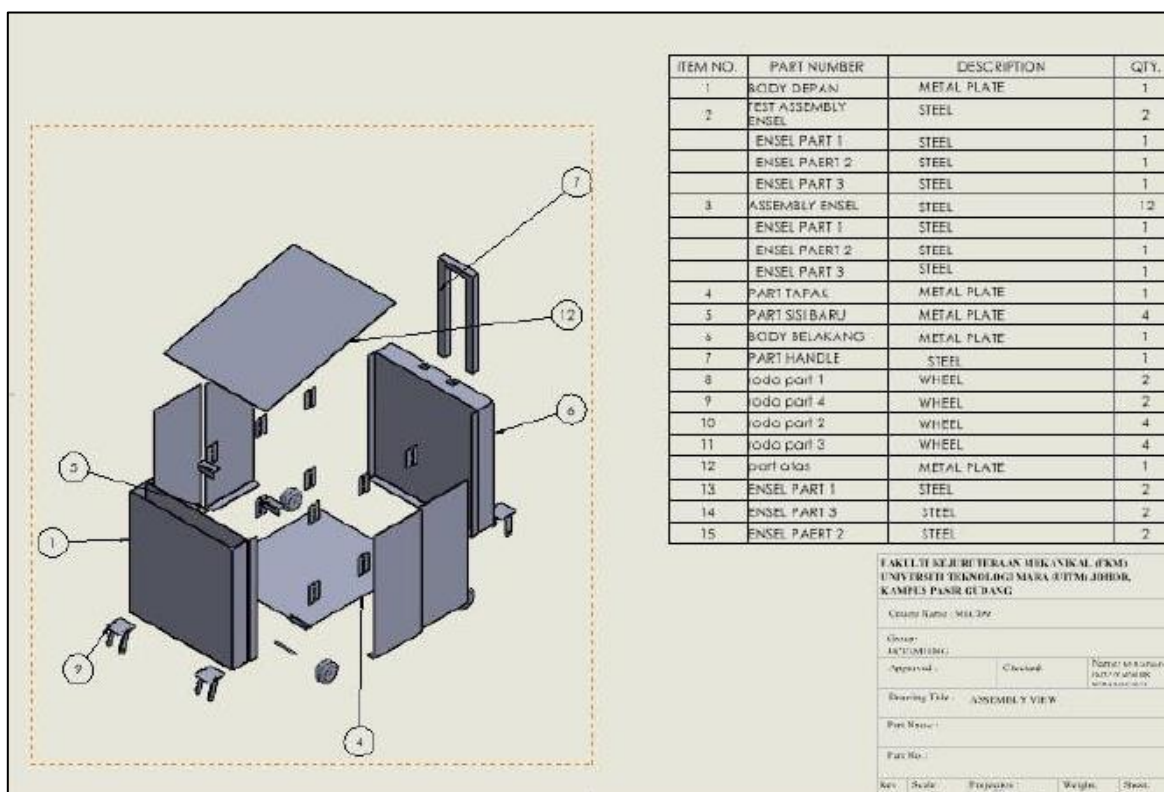
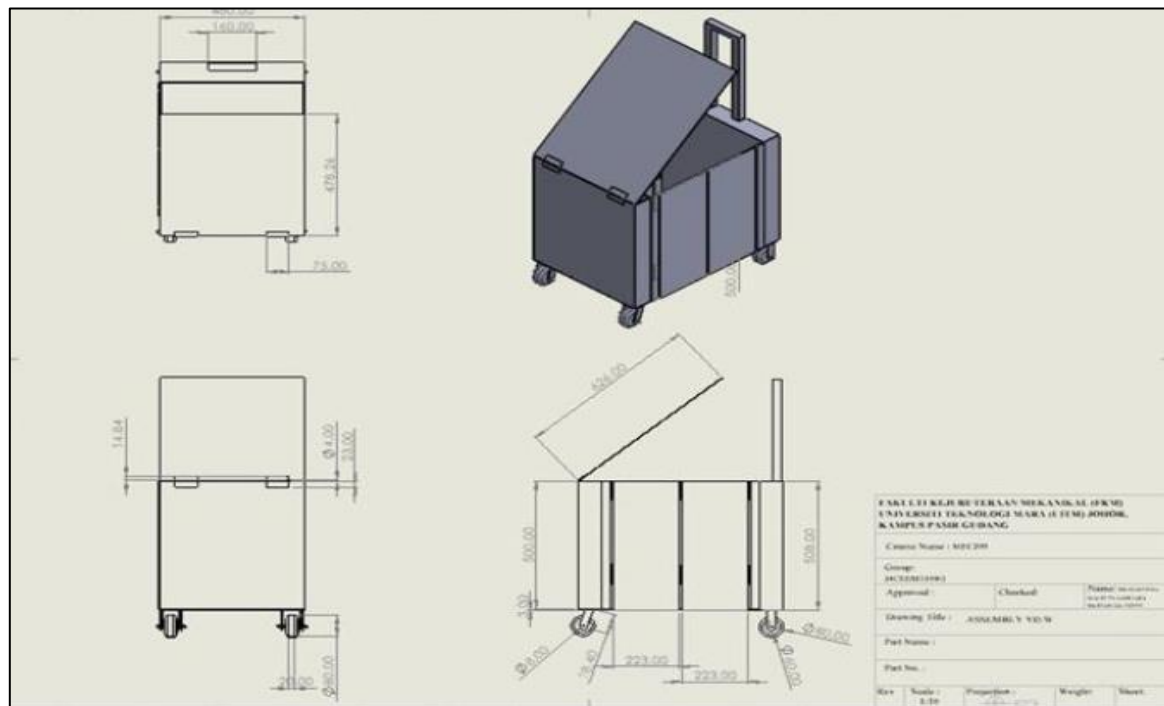
A simple and comfortable lifestyle plays a crucial role in enhancing overall well-being, especially in the preservation of good health. Foot health is a crucial aspect that significantly influences human mobility. Studies indicate that conditions like leg pain, chronic wounds, and various lower limb complications are often misdiagnosed and inadequately managed. The 2-in-1 Folding Smart Chair and Stroller was developed as a solution to enhance foot health and mobility. This multifunctional product facilitates convenient item transport and serves as a reliable seating option, thereby reducing the need to seek distant resting places. The device integrates ergonomic chair comfort with the functionality of a compact trolley, emphasising versatility. The lightweight and durable construction, combined with a sleek aesthetic, renders it suitable for small living spaces, offices, and outdoor environments. The intelligent folding mechanism facilitates a smooth transition between chair and pram functionalities, providing convenience and optimising space utilisation. The 2-in-1 Folding Smart Chair and Stroller offers an efficient solution for improving mobility, comfort, and overall quality of life.

Keywords: *Mobility Aid, Foot Health*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 47

Prototype of a Multipurpose Pan Machine

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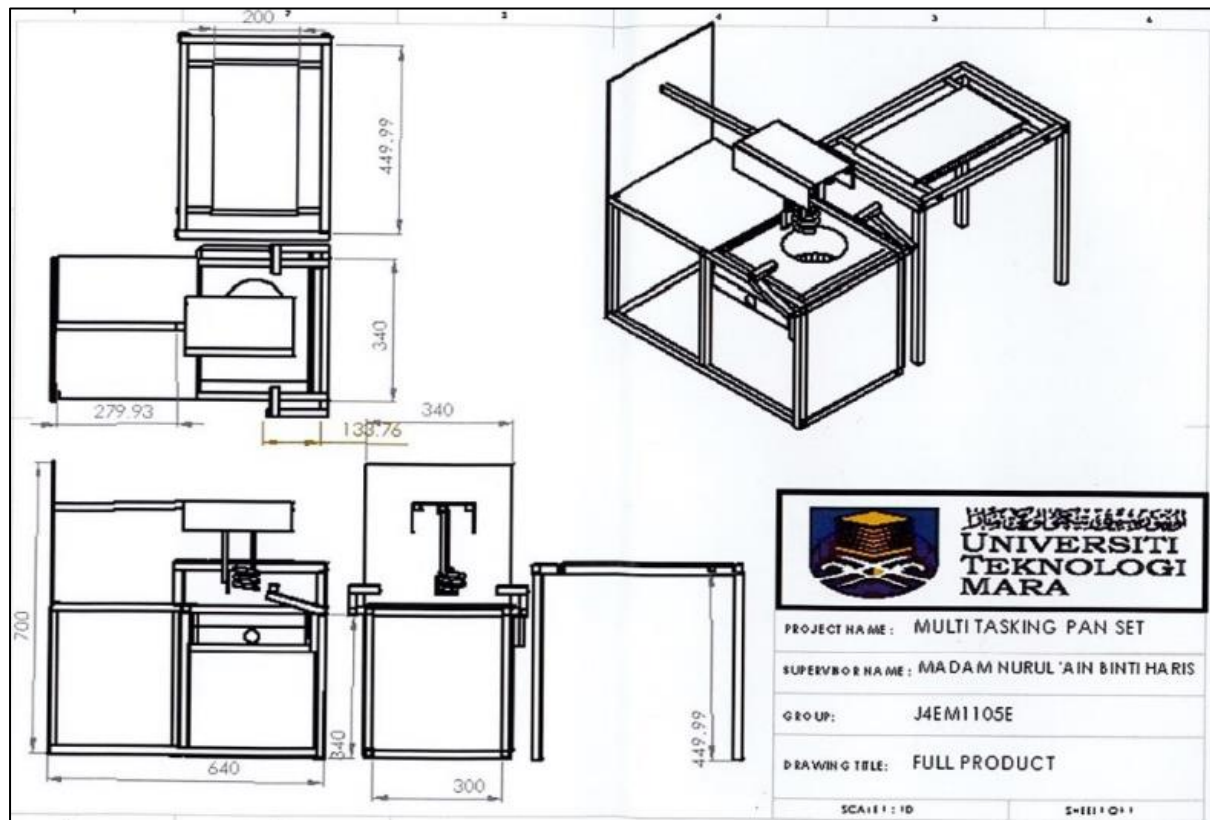
The Prototype of a Multipurpose Pan Machine is an innovative, automated cooking system designed specifically for small stalls and food preparation environments. This compact machine combines a cutting-focused table with an automatic frying pan, streamlining both ingredient preparation and cooking processes. The cutting table allows for precise chopping and slicing, enabling quick and accurate food preparation. Once ingredients are prepped, they are automatically transferred to the frying pan, which is designed to fry any dish without the need for constant supervision. This efficiency makes the machine ideal for fast paced food stalls, small scale kitchens. Constructed with food-grade materials, including high quality stainless steel, the prototype ensures durability and safety while meeting hygiene standards for food preparation. Stainless steel is easy to clean, resistant to corrosion, and ideal for environments where cleanliness is a priority. The design emphasizes simplicity and practicality with the cutting table serving as a dedicated workspace and the automatic frying pan handling the cooking, allowing users to multitask with ease..

Keywords: *Automated Pan, Multipurpose machine*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 48

Design and Fabricate A Go – Kart Back Suspension System

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PROJECT DESCRIPTION

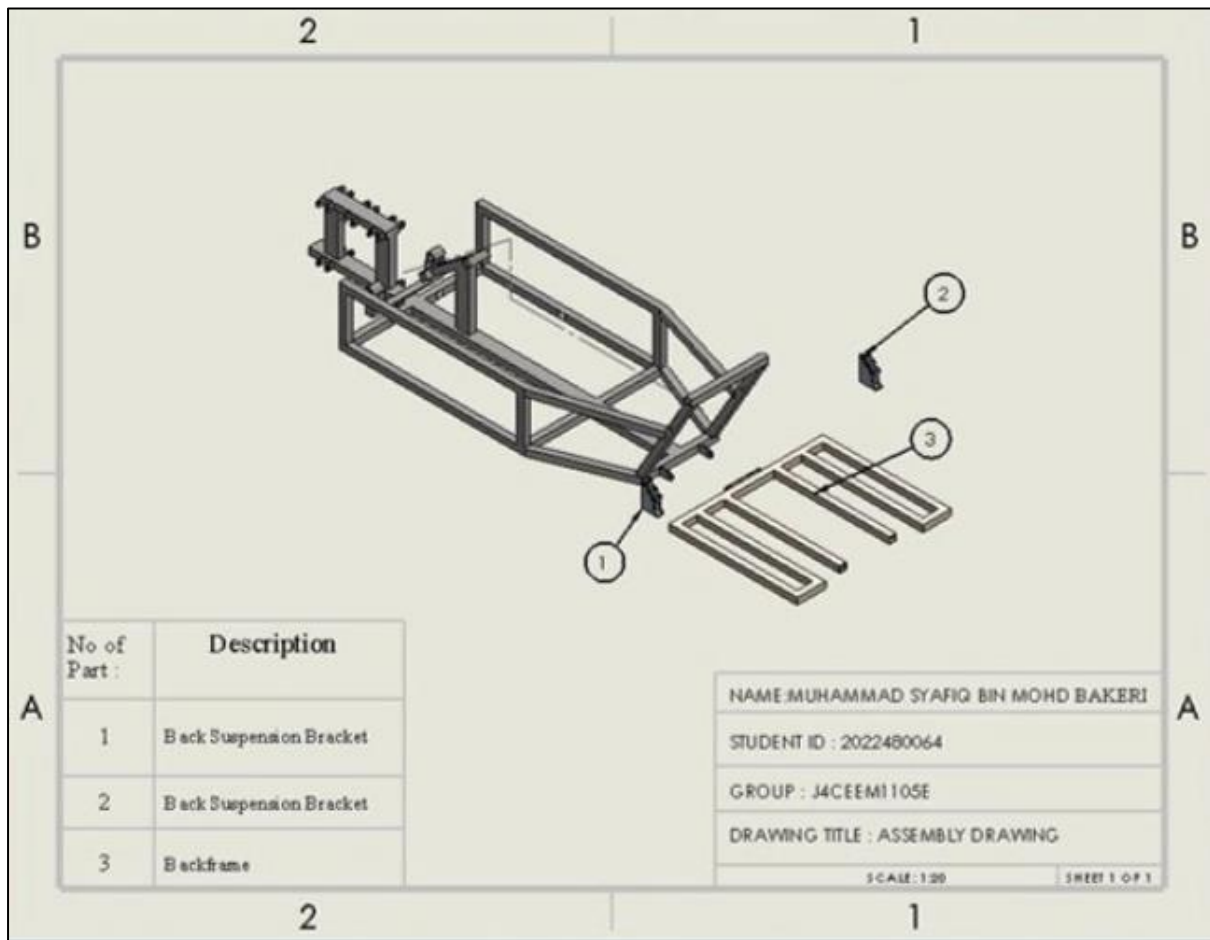
This project aims to develop a go-kart rear suspension system that enhances safety, handling, and ride comfort. The main challenge is selecting the optimal suspension type, such as independent or solid axle suspension, while balancing weight, adjustability, and chassis compatibility. The goal is to improve grip and stability, especially on uneven tracks and at high speeds. The approach involves analyzing existing suspension designs, focusing on key factors like balance and weight distribution, and developing a system that is lightweight, easily adjustable, and seamlessly integrates with the go-kart frame. Prototypes will undergo real-world testing, while computer simulations will predict performance. Advanced technologies, including lightweight materials and electronic controls for real-time adjustments, will be explored to optimize efficiency. Safety remains a priority, ensuring robust components and fail-safe mechanisms are in place.

Keywords: *Design and fabrication, Back Suspension*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 49

Design and Fabrication of Go-kart Front Suspension System

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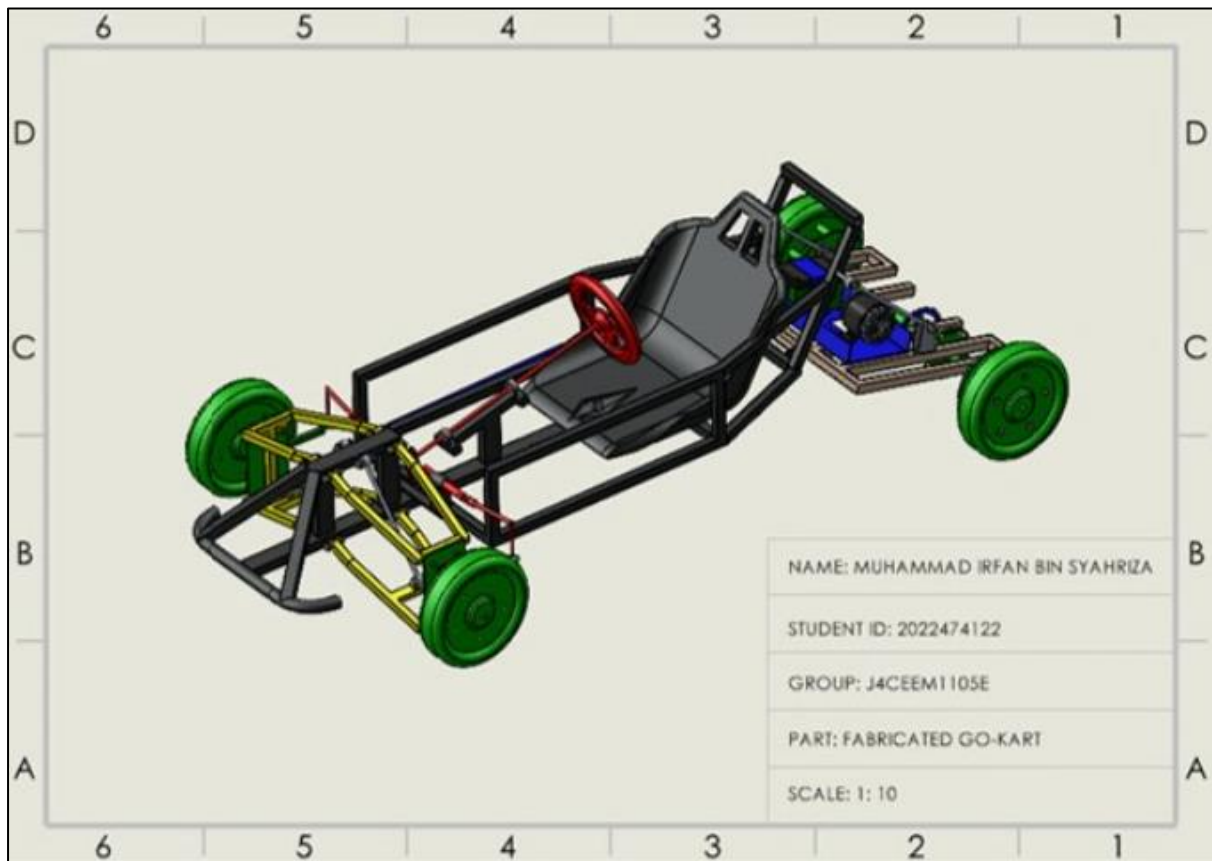
The suspension system is a crucial component of an automotive vehicle, ensuring smooth rides by absorbing shocks while maintaining handling performance and keeping all tires in contact with the road. This project focuses on developing a functional front suspension for a go-kart, selecting the most suitable type to integrate into its frame. Through mock-ups and testing of different suspension types, an optimal choice will be determined. Comprehensive research and evaluation will contribute to enhancing the go-kart's overall performance and ride quality.

Keywords: *Design and fabrication, Front Suspension*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 50

Go-Kart Mechanical Linkage Steering System

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PROJECT DESCRIPTION

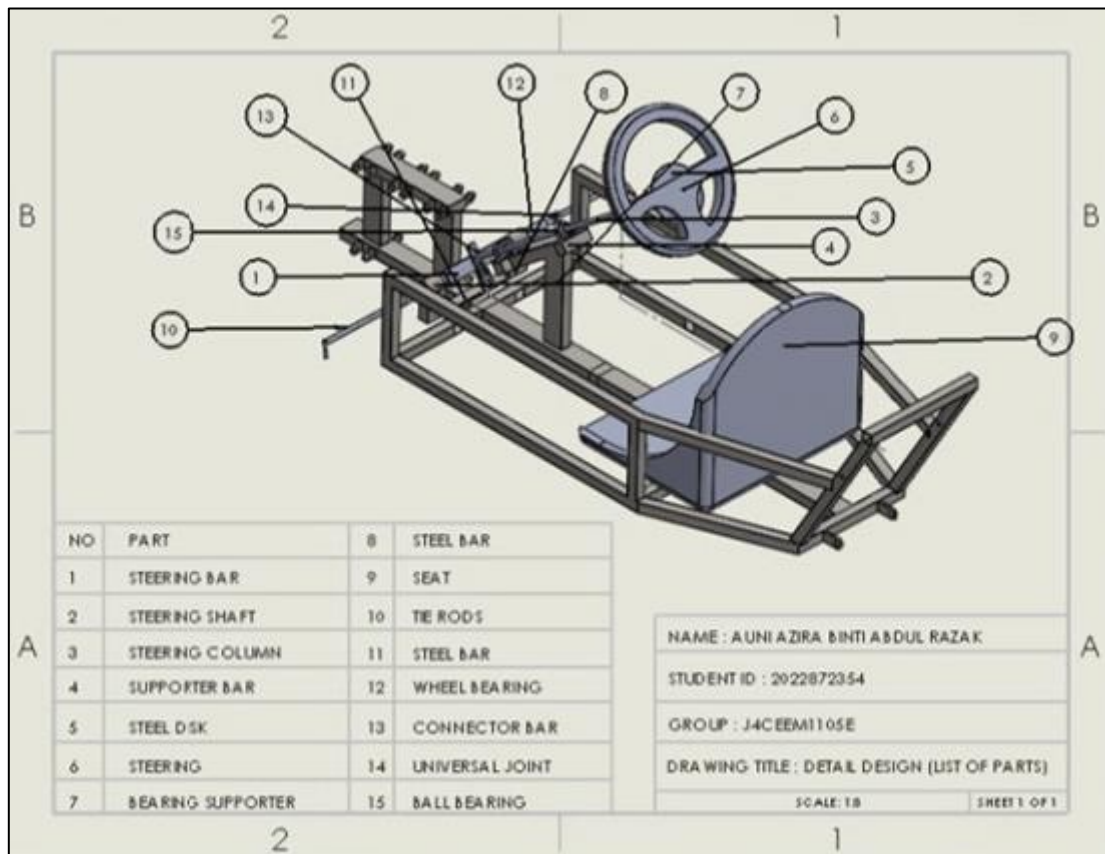
The evolution of go-kart steering systems has progressed from traditional mechanical linkage systems to more advanced designs incorporating technologies such as rack and pinion and hydraulic systems for improved performance and control. A go-kart steering system consists of key components, including the steering column, tie rods, steering knuckles, steering wheel, and linkage systems, all working together to ensure smooth and precise wheel movement based on driver input. This study aims to explore the performance characteristics and applications of go-kart steering systems by analyzing factors such as movement, direction, material selection, and pressure affecting mechanical linkage systems. Additionally, it will identify suitable components and evaluate the effectiveness of different steering mechanisms. The findings from this research will enhance the understanding of go-kart steering systems and contribute to further improvements in their design and functionality.

Keywords: *Design and fabrication, Mechanical Linkage Steering*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 51

Design and Fabricate A Go-kart Motor Fixing Holder and Gearing System

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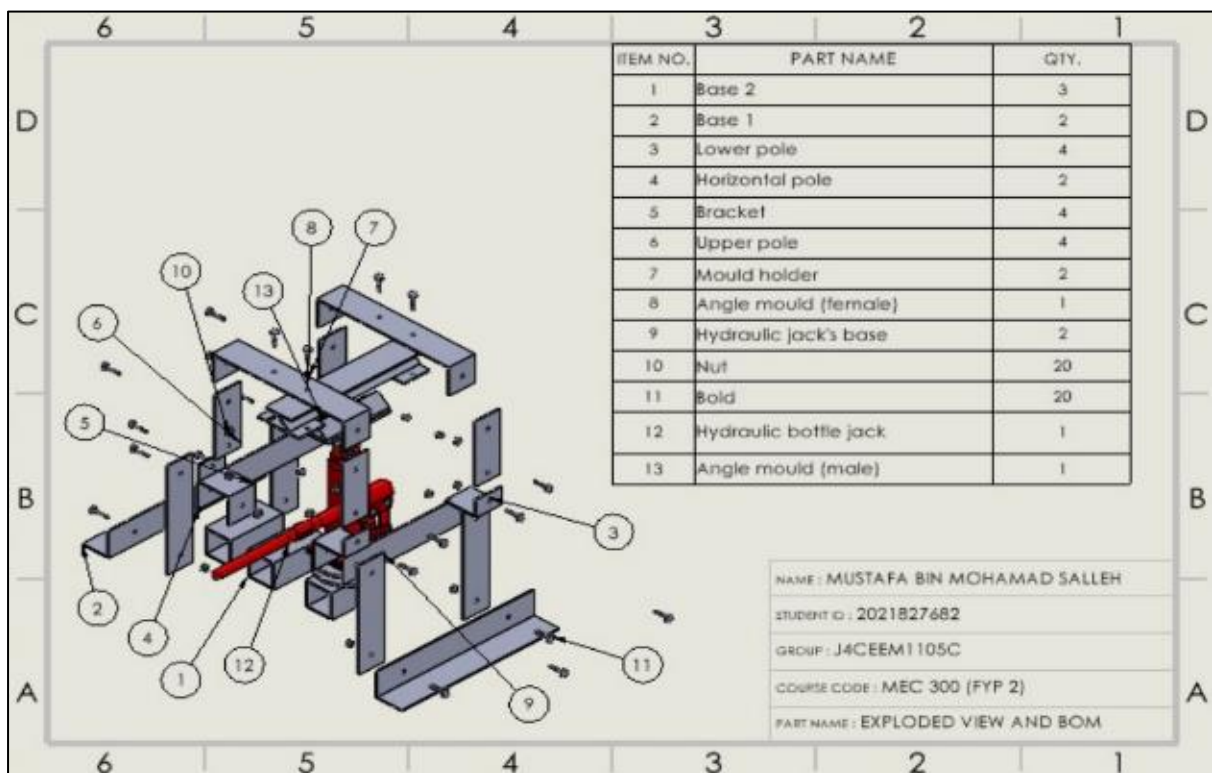
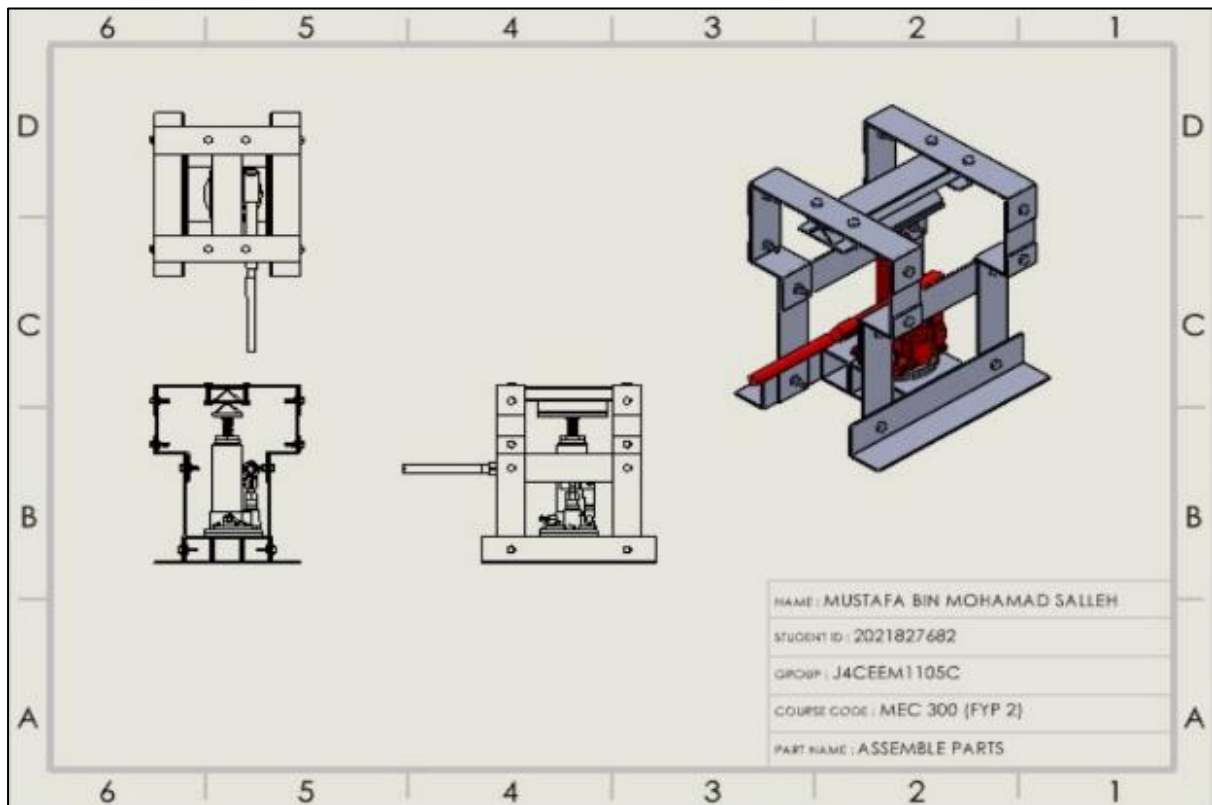
This study focuses on the design and analysis of motor fixing holders and gearing systems for small-scale vehicles, specifically go-karts. The primary objective is to achieve an optimal balance of power output, torque, and speed to enhance both performance and efficiency. The research involves selecting suitable motors, whether gasoline or electric, and integrating gearing systems such as centrifugal clutches and torque converters. Through theoretical analysis and practical experimentation, various gear ratios will be evaluated to assess their effects on acceleration, top speed, and handling. Additionally, the study examines weight distribution in relation to the power-to-weight ratio and its impact on system performance and safety. The findings will provide guidelines for designing efficient and reliable motor fixing holders and gearing systems, contributing to a better understanding of their applications in both recreational and competitive go-karting. Ultimately, this research advances vehicular engineering by offering insights into the interaction between mechanical components and dynamic performance.

Keywords: *Design and fabrication, Gearing system*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 52

Design and Fabrication of Steering System for Student Formula Race Car

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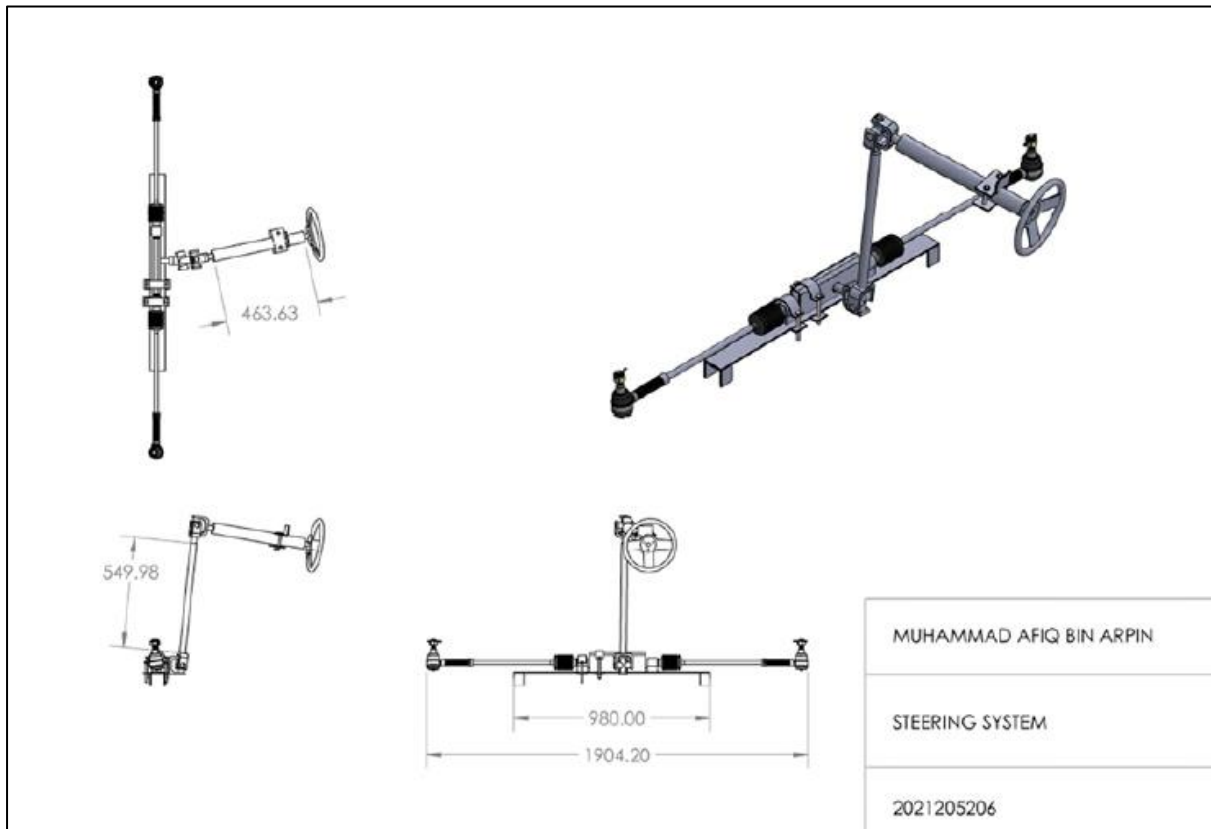
The steering system plays an integral role in determining the car's handling, reactivity, and driver control. A common problem with formula racing cars is loose steering, which can be caused by wear and damage to the steering linkage components. This can have an impact on other parts attached to the linkage components, such as the steering wheel, and develop excessive play when rotating the wheels. Therefore, this study's aim is to produce an existing steering system that uses the best mechanism and is supported by a support that can hold it all the time through the use of high-quality materials, precision manufacturing techniques, and rigorous testing and validation processes. Elements like weight, strength, ergonomics and manufacturability must be considered in the design process. Examination of new ideas and technologies through extensive research improves the performance of the steering system. The primary objective of this project is to design and fabricate a complete steering system with its support system, which was accomplished after the project was completed. By means of rigorous design iterations and testing phases, it has met the goals with noteworthy success. In conclusion, this steering system prototype can be used in a single-seated race car to improve vehicle handling and turning.

Keywords: *Formula race car, Keyword 2*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 53

Design and Fabrication of Suspension System for Formula Racing Car

Muhammad Faiz Najwan Bin Tajul Ariffin ¹ and Hazim Sharudin ^{2*}

^{1,2}*Faculty of Mechanical Engineering, Universiti Teknologi MARA Johor Branch, Pasir Gudang Campus, 81750 Masai, Bandar Seri Alam, Johor Darul Ta'zim.*

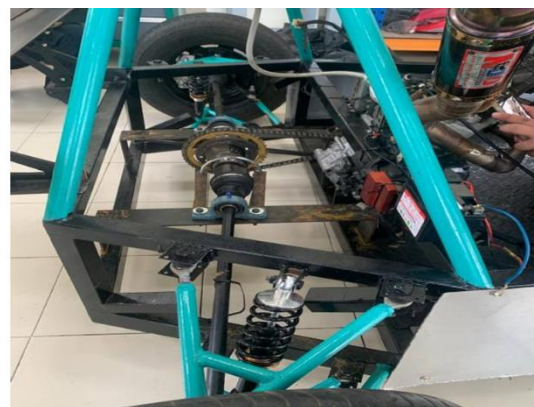
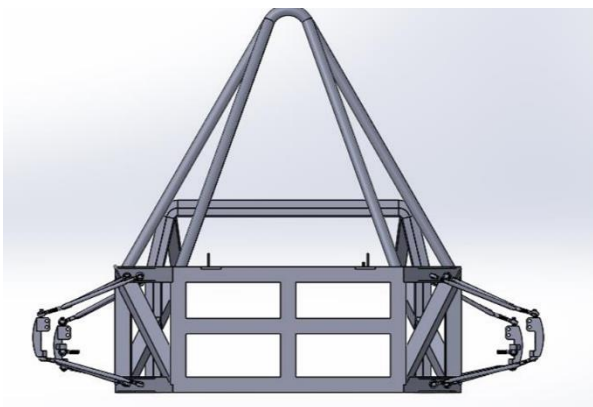
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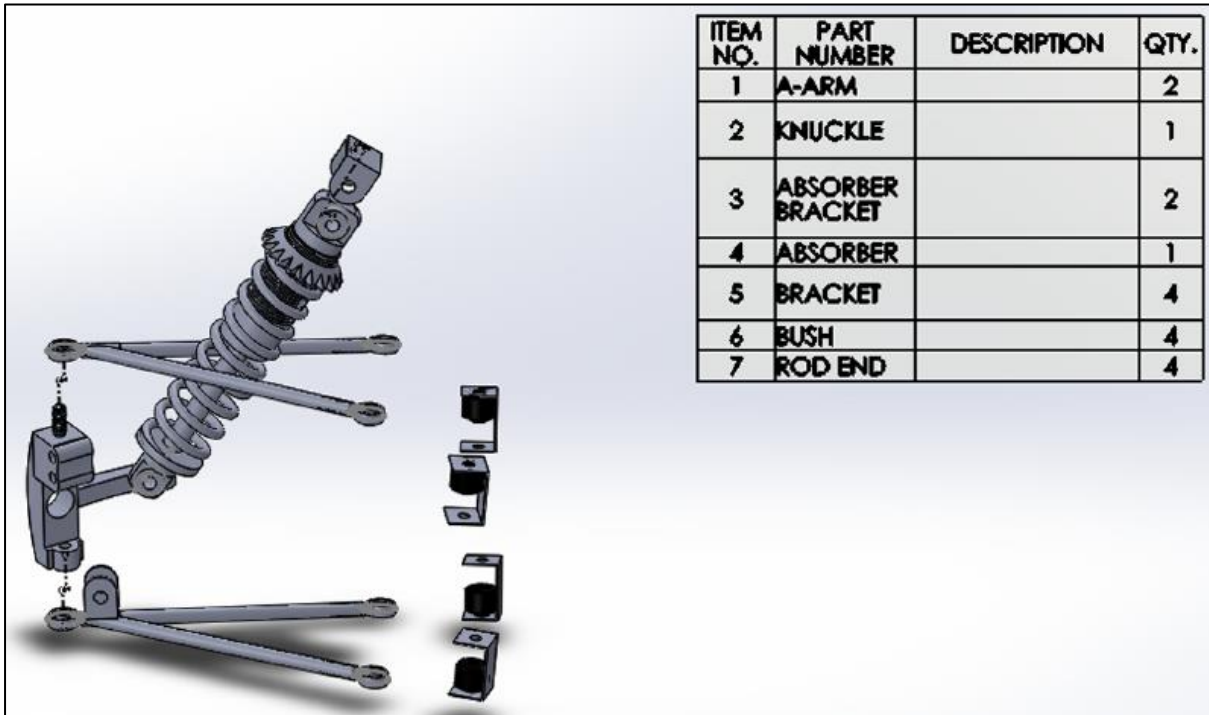
Suspension is generally used for the vehicle to support the vehicle body and increase ride comfort. The suspension system also prevents road disturbances that affect passenger comfort while increasing riding capabilities and performing a smooth driving experience. Most suspension has a problem with power transfer that affects the driving experience for the driver for certain road surface quality when cornering or when handling the vehicle. Due to the quality of suspension, many vehicles have gone into an accident, for example, lost control when performing the driving experience. This project is conducted to give more driving comfort to the driver when performing a drive on any type of road obstacle like sharp corners, up and downhill roads, slippery roads, and so on. The project is also to retain stability and give smooth driving experience using the ride material or best quality for vehicles and can handle certain loads like body frame, body kit, engine system, driver's load, and other loads that are related. For the method, the suspension system will be set up using the correct ways like the angle of the suspension, and the right place to put the suspension so it will not give any major problems when handling the vehicle.

Keywords: *Formula race car, Suspension System*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 54

Design and Fabrication of Exhaust and Fuel Systems for a Formula Student Race Car

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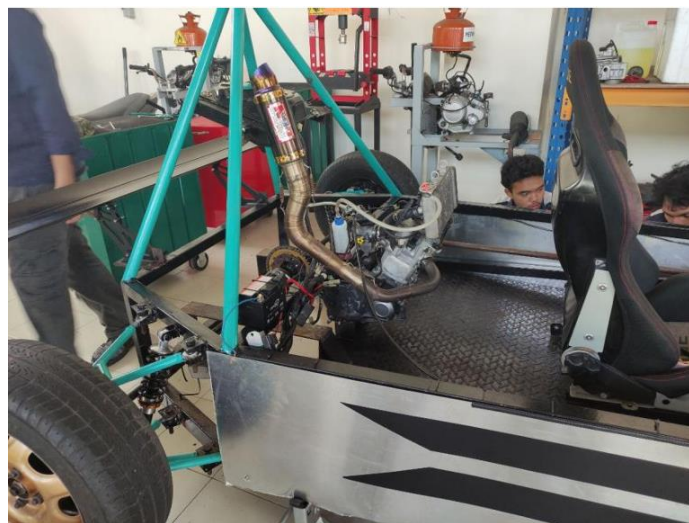
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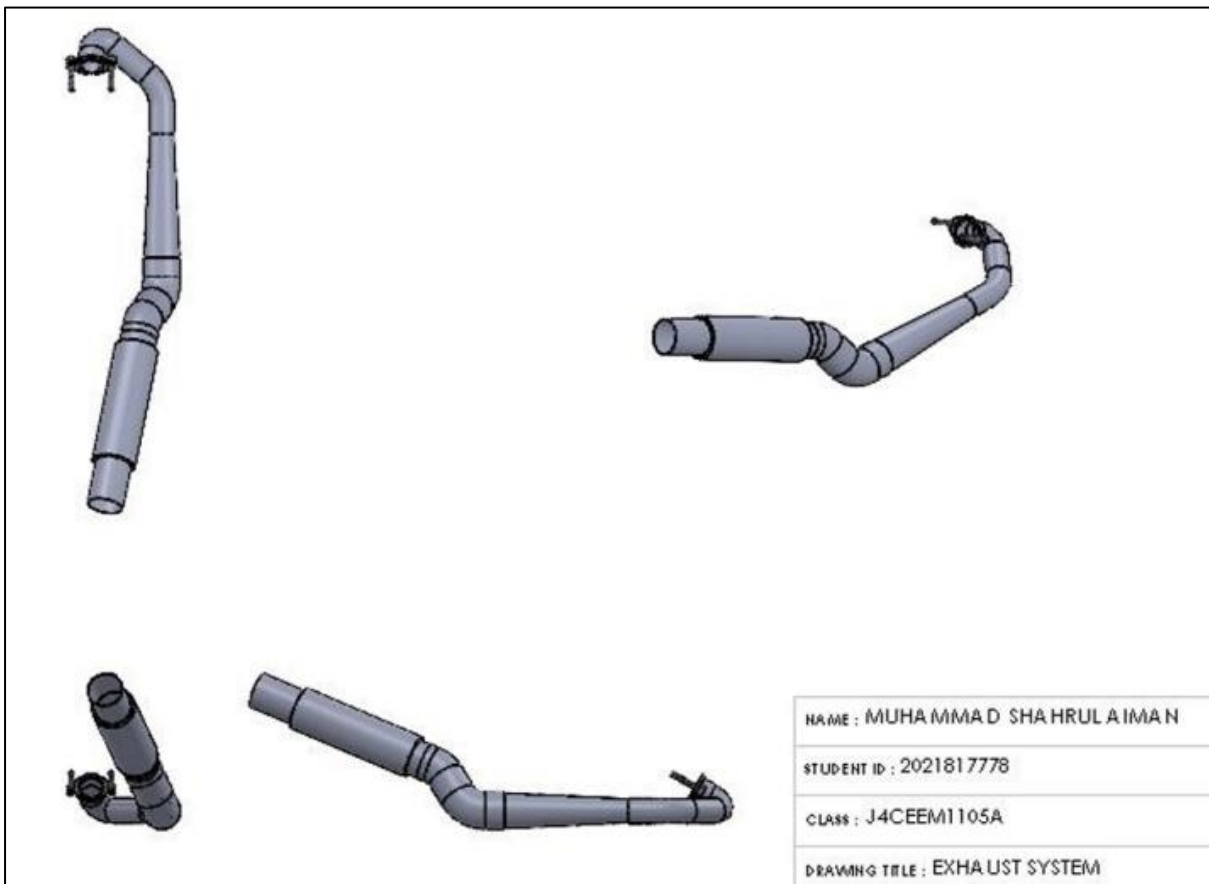
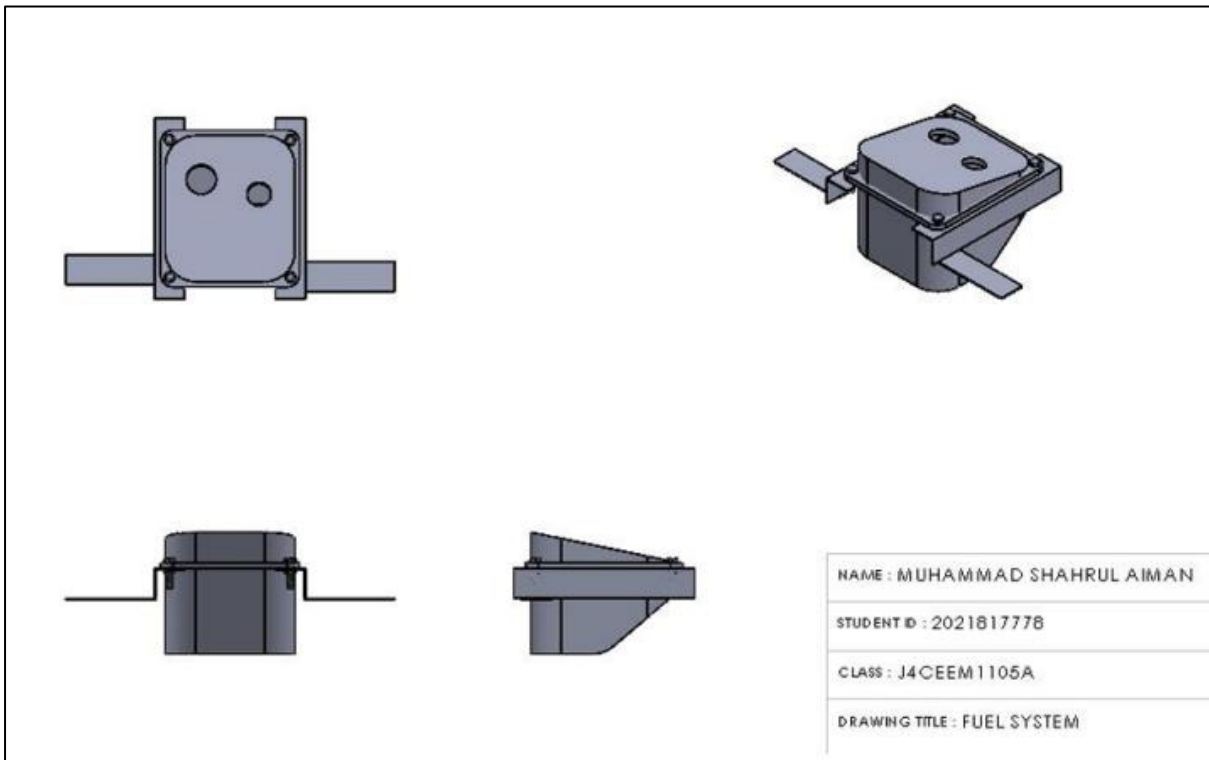
The Formula Student race car's exhaust system play a crucial role in engine performance and overall speed. For fuel system, it ensure's driver's safety, comfort, and fuel delivery. The current system is not efficient, leading to high backpressure in the exhaust and danger for driver. To address these issue, the project aims to design and fabricate an optimized exhaust and fuel systems using Computer-Aided Design (CAD) software and metal fabrication techniques. The optimized system is expected to reduce backpressure, and improve engine performance, resulting in a faster race car. Also, ensures driver's safety, efficient fuel delivery and efficient throttle control for the race car. The project involves analyzing the current system, designing the optimized system, and fabricating it to match specifications. In conclusion, the prototype was successfully designed at Solidworks according to the desired criteria, which to maximize the power output. Also, containing the fuel that needed by the engine to operate. Next, this project also successfully installe the fuel tank and exhaust to the formula student race car that going to be use on the competition. The efficient exhaust and fuel systems are essential for the performance of a Formula Student race car and can enhance engine performance and speed.

Keywords: Formula race car, Exhaust System and Fuel System

PROTOTYPE



DESIGN PARAMETER



CHAPTER 55

Design and Fabrication of Spoilers on A Formula Student Race Car

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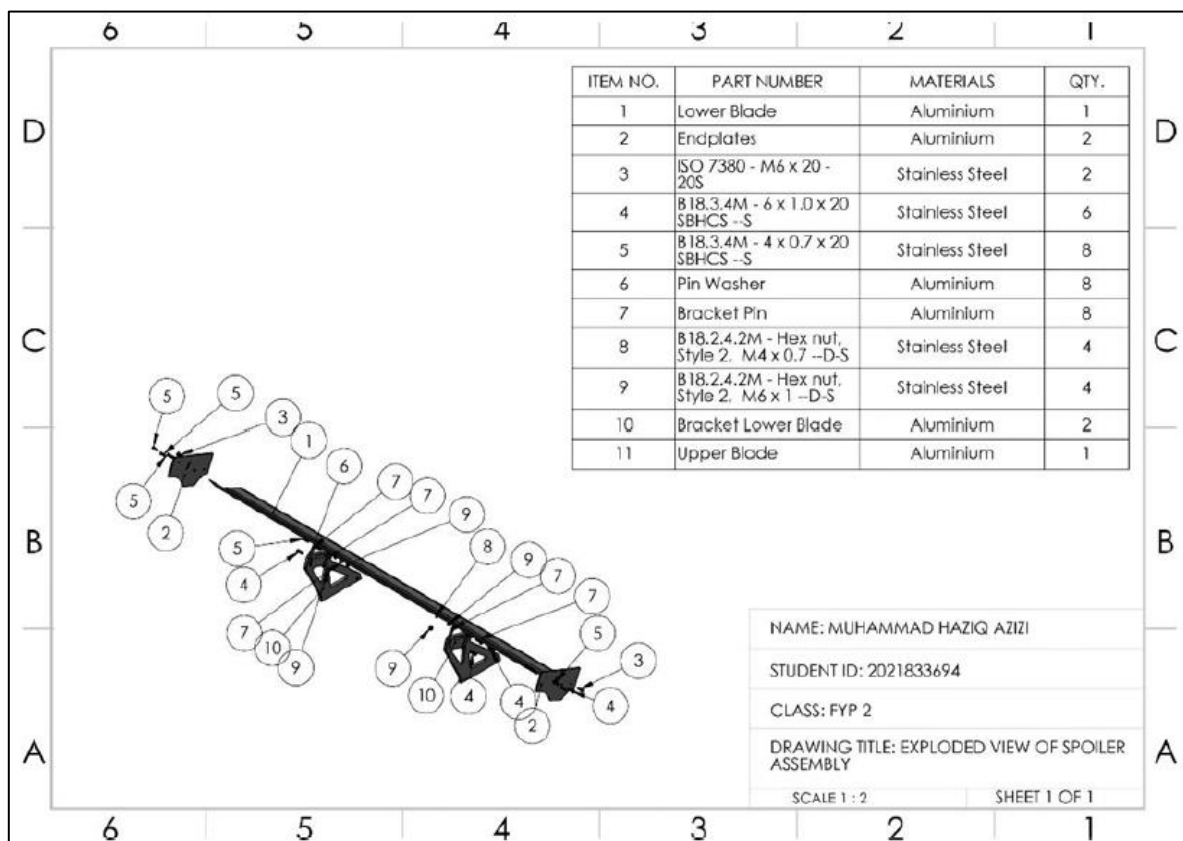
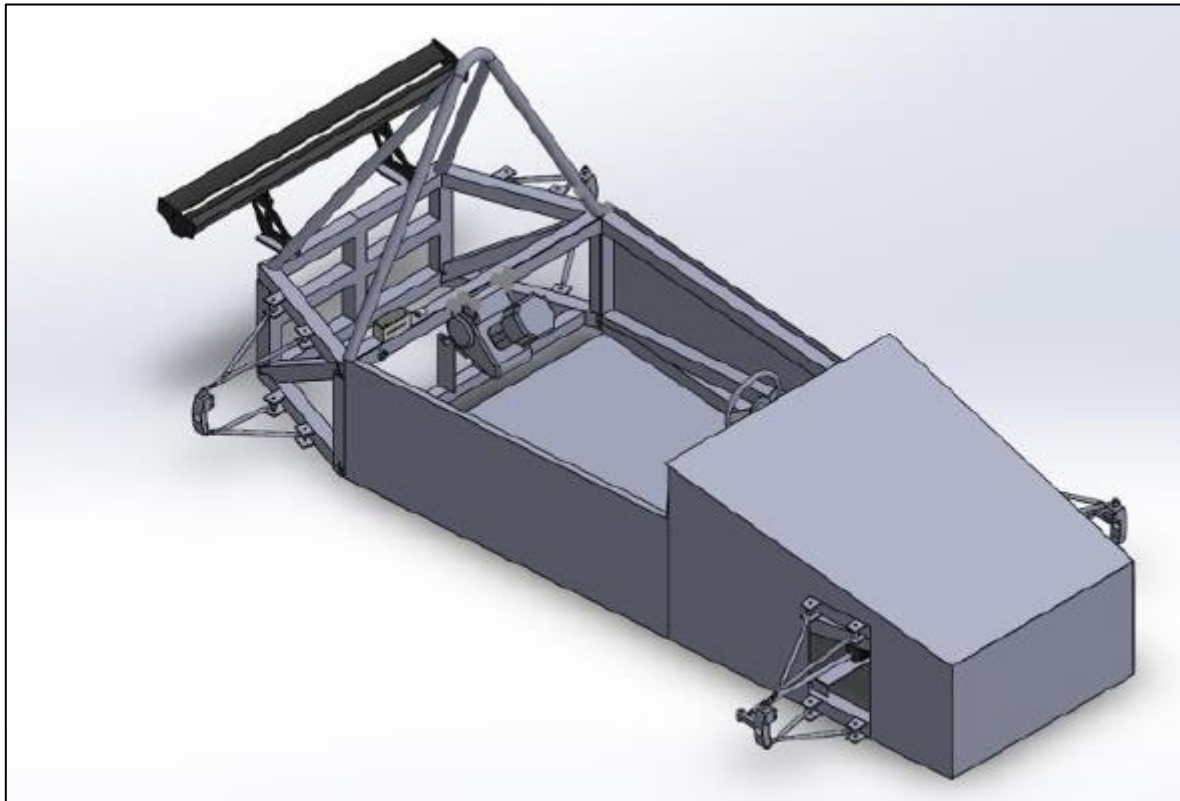
This study focuses on the aerodynamic analysis and design optimization of a spoiler and mounting bracket for a Formula Student race car. The challenge at hand is to develop an effective spoiler and mounting brackets for a Formula Student race car, with a limited budget and advanced knowledge and access to sophisticated machinery. This project aims to create a spoiler that, while budget friendly, incorporates a simplified yet efficient design. The task involves leveraging limited resources, combining advanced aerodynamic knowledge with innovative engineering techniques to craft a spoiler that enhances the car's performance while being cost-effective. Computational Fluid Dynamics (CFD) simulations testing is employed as methodologies to analyze the airflow, visualize flow patterns, calculate drag and lift forces, and validate the proposed design modifications. From the obtained results, it can be conclude that the aim of this project has been achieved, which is to create an efficient spoiler system for a formula student racing car that also adheres to the safety regulations and requirements. The spoiler system setup was managed to get done, but not perfect enough due to limited time and budget. This product also was successfully fabricated within the specification time given. This spoiler system will be improved in the future to achieve the better quality and performance if given the time for development.

Keywords: *Formula race car, Spoilers and Mounting Bracket*

PROTOTYPE



DESIGN PARAMETER



CHAPTER 56

Design and Fabrication of Body Kit Material for Student Formula Racing Car

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PROJECT DESCRIPTION

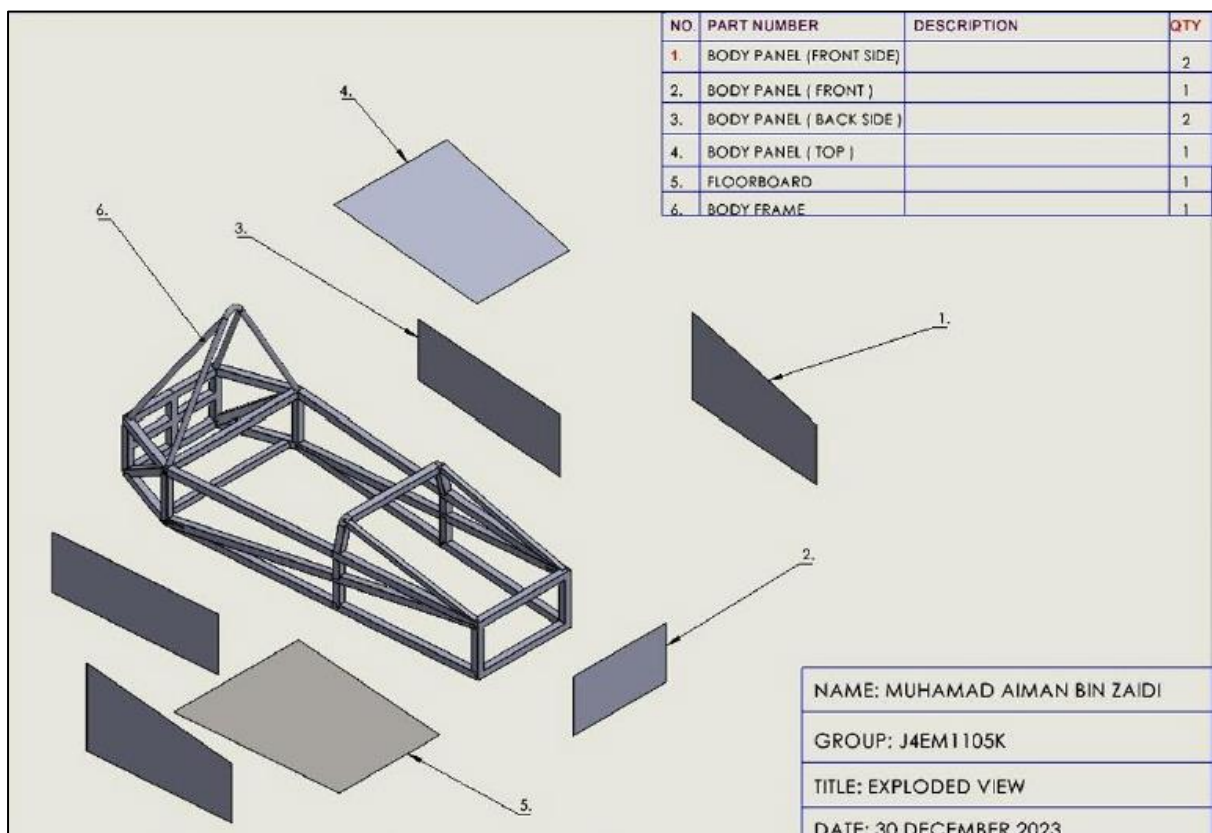
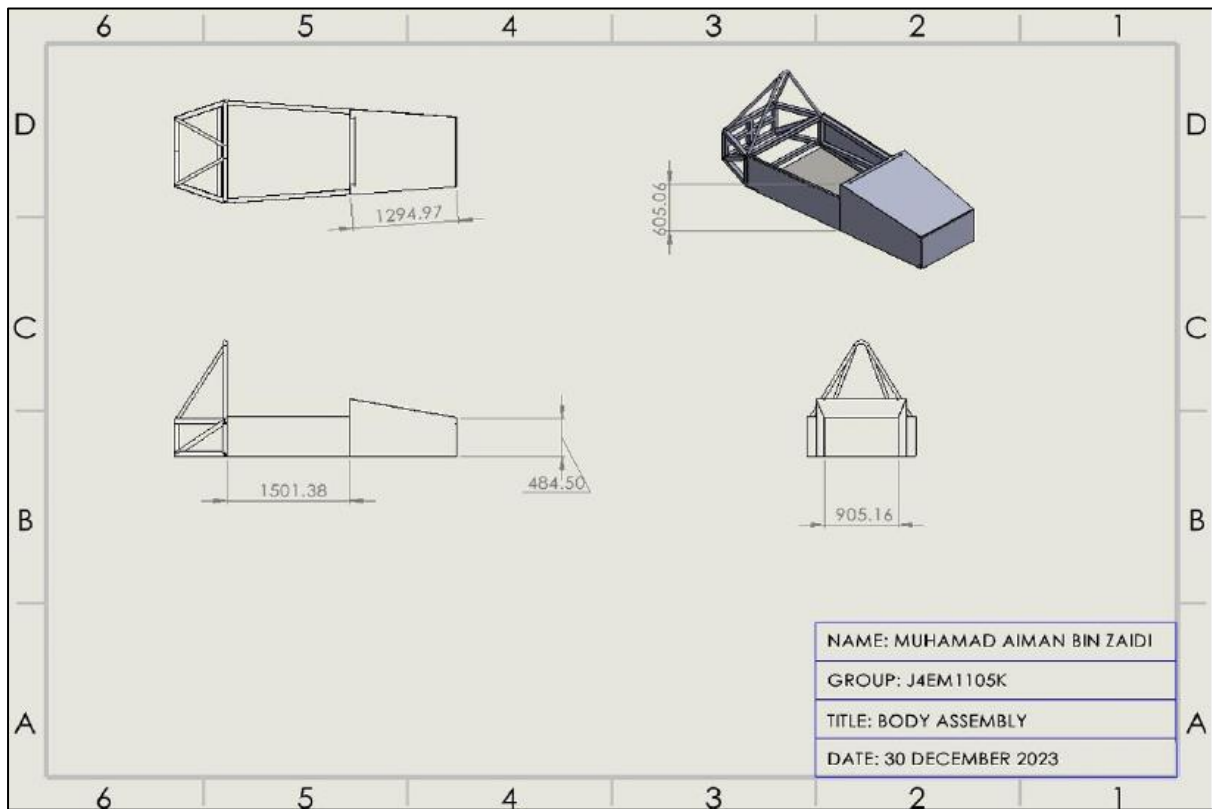
This project is presenting body kits components that are designed to complement each other and work together as a complete design. The material used for each component should be considered to make sure it is suitable. The material used in a body kit will depend on the specific design and application. The lack of choosing the material that can cause the car has a low durability. It also causes a high-cost maintenance if the material chosen are not suitable for the body kits. The purpose of this product is to construct a solid reasonable and affordable material and to find the most suitable material for the body kits. Some of the most common materials used in body kits include fiberglass, polyurethane, carbon fiber and aluminum. The expectation for this body kit is the success of selecting the material especially in terms of mechanical resistance, easy manufacturing, and durability. In conclusion, a solid, reasonable, and suitable material is produced at the end of the product.

Keywords: Formula race car, Body kit material

PROTOTYPE



DESIGN PARAMETER



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