POLITEKNIK BANTING SELANGOR

HIGH UPLIFT

NAME	MATRIC NO.
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DEPARTMENT OF AIRCRAFT MAINTENANCE

SESSION 1 2023/2024

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A REPORT SUBMITTED TO DEPARTMENT OF AIRCRAFT MAINTENANCE
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR A DIPLOMA
ENGINEERING IN AIRCRAFT MAINTENANCE

SUPERVISOR:
MADAM NORLIA BINTI GHAZALI

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CERTIFICATION OF PROJECT ORIGINALITY & OWNERSHIP

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"We hereby declare that this report is the result of our own work, except excerpts that we have outlined its sources and this project will be the ownership of polytechnic.

SIGNATURE: WRITER 1

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DATE: 18/12/2023

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ABSTRACT

The High Uplift project presents an innovative Hydraulic Scissor Lift mechanism developed for effective lifting and lowering of platforms in tight spaces, catering primarily to the demands of maintenance staff operating at elevated locations during aircraft repair. The hydraulic pressure-driven technology assures precision in operations, while user-friendly controls priorities maintenance personnel comfort and safety by adding security components such as button controls. This project aims to provide an ideal solution for tiny aircraft maintenance in constrained places. The hydraulic scissor lift's small design demonstrates its versatility, requiring minimal spaces and height than conventional lifters. This tiny form makes it ideal for the often-tight working circumstances that surround aircraft repair. The lift not only precisely raises and lowers platforms, but it also has extra aspects for improved usage and safety. On the upper platform, warning lights, a little toolbox, and strategically attached sheet metal add to the project's comprehensive approach to security and convenience. As a result of this project, which solves an important interest in the aviation sector. Maintenance personnel in high-level positions may now take use of a tool designed expressly for their needs, considerably enhancing operating efficiency and safety. The High Uplift project demonstrates the power of inventive engineering, delivering a versatile and efficient lifting mechanism that has the potential to revolutionize aircraft maintenance practices in confined places.

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LIST OF SYMBOLS

V	Voltage
s	Seconds
W	Watt
N	Newton
m	Meter
cm	Centimeter
kg	Kilogram
km/h	Kilometer Per Hour
/ ²	Velocity
g	Gravity
F	Force
I/O	Input/Output
MHz	Megahertz

LIST OF ABBREVATIONS

AEM	Aero Engineering Management
AEP	Aero Engineering Practical
CFR	Code of Federal Regulations
DC	Direct Current
et al	And Others
IDE	Integrated Development Environment
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
N/A	Not Available
n.d	No Date
NPN	Negative, Positive, Negative
OLED	Organic light-emitting diode
PC	Personal Computer
PCB	Printed Circuit Board
PNP	Positive, Negative, Positive
PVC	Poly Vinyl Chloride
PWM	Pulse Width Modulation
UID	Unique Identifier
USB	Universal Serial Bus

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Maintaining aircraft is crucial for ensuring the dependability and safety of air travel. Maintenance personnel frequently must access difficult-to-reach places of aircraft, which may be difficult and time-consuming. Standard scissor lifts are useful, but they may be heavy and challenging to use in tight places. Safety risks and inefficiency may result from this. This might result in inefficiencies and safety hazards.

Figure 1.1: General scissor lift (Rapid Access , Google , n.d.)

Figure 1.1 shows a general scissor lift utilized in the aviation industry. Aside from the aviation industry, hydraulic scissor lifts are often used in the industrial, automotive, and construction sectors.

"*A scissor lift elevator is a vertical transportation cab which is raised and lowered from underneath, somewhat like a traditional hydraulic elevator, except that instead of a hydraulic cylinder the extendable mechanism is a folding lattice of crisscrossed beams similar to a pantograph. The entire mechanism extends upward when pressure is applied to the lowest members.*" (Standards.phorio.com 2013).

Based on the above remark, scissor lift lifts are a sort of vertical transportationequipment that raises and lowers a platform using a folding lattice mechanism. They are distinguished by their small size, excellent stability, smooth operation, adaptability,and ease of use. These features make them useful tools in a variety of industries, including construction, maintenance, manufacturing, and retail.

The idea behind a hydraulic scissors lift is derived from Pascal's law, which is used in hydraulic rams and automotive jacks. It states that **"*pressure exerted anywhere in a conformed incompressible fluid is transmitted equally in all directions throughout the fluid such that the pressure ratio remains the same*"** (Hydraulics online 2013).

1.2 PROBLEM STATEMENT

Professionals in the field of aircraft maintenance have expressed grave worry about the limitations of current lifting methods. While current hydraulic scissor lifts are useful in specific instances, they have been criticized for their inability to adapt to small places and small aircraft maintenance work. Feedback from maintenance professionals' highlights occasions when conventional lifts were challenging and impracticable, impeding operating efficiency.

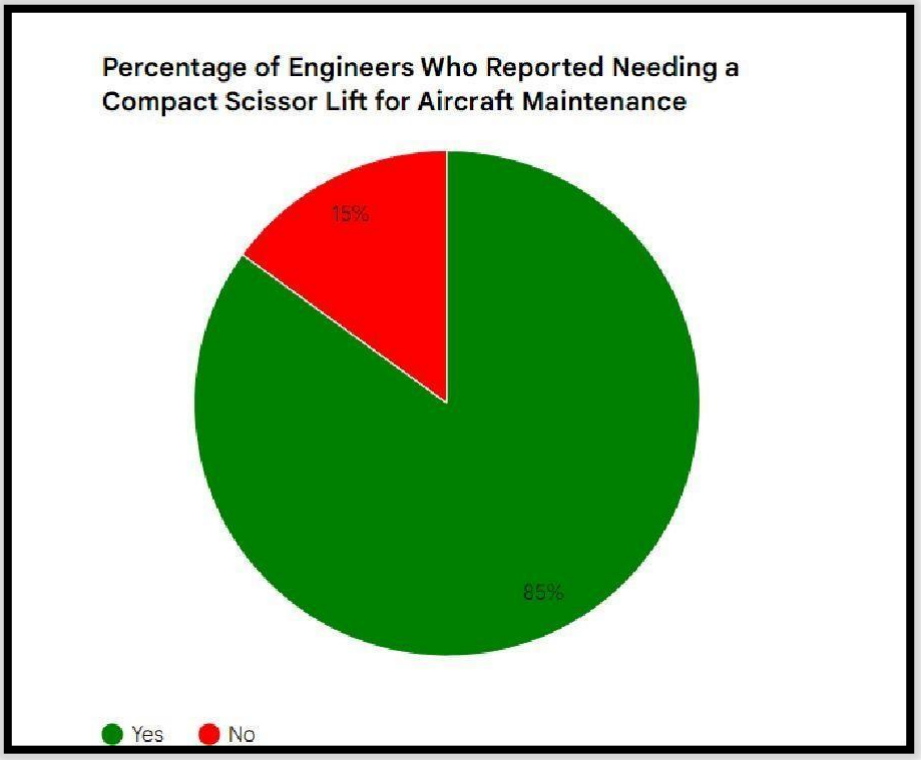


Figure 1.2: A Survey Conducted with Experienced Aircraft Maintenance Technicians (Google n.d.)

Figure 1.2 shows the results of a survey of experienced aircraft maintenance technician, in which 85% stated a need for a lifting mechanism particularly developed for limiting places for Aircraft Maintenance. According to the interviews, the bulkiness of present solutions has caused operational delays and increased the complexity of maintenance processes. Respondents emphasized the significance of a small and flexible lifting mechanism capable of navigating tight locations without sacrificing safety or performance.

In addition, discussions with industry experts highlighted the need for improved user-friendliness and security aspects in lifting mechanisms. Professionals emphasized the need of a holistic solution that covers not just limitations on location but also operator comfort, safety, and simplicity of use.

1.3 PROJECT AIMS

1.3.1 General Project Objectives

This project is aimed:

- To design a compact and flexible High Uplift structure suitable for use in small aircraft maintenance.
- To develop a hydraulic system that allows precise control over the lifting mechanism.
- To demonstrate the framework utilized in the High Uplift by assisting engineers in inspecting small aircraft.

1.3.2 Specific Individual Project Objectives

1.3.2.1 Product Structure and Furnishing

This project is aimed:

- To design a strong and reliable scissor lift structure
- To develop a durable and comfortable platform utilizing sheet metal
- To demonstrate comprehensive testing that confirms the dependability of the mechanical design

1.3.2.2 Mechanical and Design

This project is aimed:

- To design a flexible lifting mechanism
- To develop the amount of maintenance required by optimizing the mechanical parts
- To demonstrate the development of a versatile lifting mechanism

1.3.2.3 Electrical / Electronic / Programming

This project is aimed:

- To design and integrate electronic and electrical components into the High Uplift that may be connected to the electrical system
- To develop suitable software that converts Arduino programming and displays the platform's height
- To develop controls with simple button layouts that are easy for users to utilize

1.4 PURPOSE OF PRODUCT

In the field of aviation maintenance, the hydraulic scissor lift project is essential since it offers a customized solution for workers in difficult conditions. Fundamentally, the device is designed to make aeroplane maintenance operations easier and more efficient, with a focus on the unique needs of tiny aircraft. The project solves the limitations caused by space limits by implementing a flexible lifting mechanism, providing a flexible and adaptive solution that is distinct from bigger, less maneuverable lifters.

The intention of the project is to maximize aircraft maintenance efficiency, not only functioning. The lift's precise control throughout operations is made possible by the creation of a dependable hydraulic lifting system, which eventually reduces downtime and boosts overall operational efficiency. By emphasizing efficiency, this approach fits in with the larger goal of attending to the particular requirements of maintenance staff and provides a small, flexible solution that fits well into the cramped areas that are frequently seen in aeroplane maintenance.

1.5 SCOPE OF PROJECT

1.5.1 General Project Scopes

This project aims to provide an ideal solution for tiny aircraft maintenance in constrained places. The hydraulic scissor lift's small design demonstrates its versatility, requiring minimal spaces and height than conventional lifters. This tiny form makes it ideal for the often-tight working circumstances that surround aircraft repair.

1.5.2 Specific Individual Scope

1.5.2.1 Product Structure and Furnishing

The product structure of the high uplift project is made with usefulness and durability in mind. Strong construction of the frame gives the hydraulic scissor lifting mechanism the necessary support. A long-lasting and environmentally resistant coating guarantees longevity, and a sturdy, non-slip base improves stability while in use. The platform has sheet metal for further security measures and is constructed from lightweight yet sturdy materials. The product's overall finish has a contemporary, polished look in addition to being functional.

1.5.2.2 Mechanical and Design

The high uplift project's mechanical components are based on a dependable hydraulic system. Smooth raising and lowering operations are made possible by high-quality hydraulic cylinders, which place a strong emphasis on appropriate sealing and lubrication to reduce maintenance needs. In addition to being specifically designed to fulfil the needs of aviation maintenance jobs, the lifting capacity also includes safety features like manual override in case of emergency and pressure release valves. The tiny form factor and swivel casters make it easier to use in confined situations,emphasizing maneuverability in the design.

1.5.2.3 Electrical / Electronic / Programming

The high uplift project's electrical components are made to function seamlessly and be easy to operate. The control panel has an easy-to-use interface with controls that are labelled properly. It also has an emergency stop button that allows you to immediately stop operations. The project includes warning lights to improve visibility and safety, and redundancy is built into the electrical components for extra security. Continuous and consistent functioning is ensured by a dependable power supply that is compatiblewith common electrical outlets and has built-in surge protection.

The high uplift project's software characteristics add to its effectiveness and security. The control system offers operators an easy-to-use interface and is intuitive. To avoid dangerous situations during lifting and lowering operations, safety algorithms are implemented. The project has automation features that streamline operation with automated lifting and lowering sequences, as well as diagnostic tools for effective troubleshooting and maintenance. Safety is improved by sensor integration since it allows for obstacle avoidance and detection.

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL LITERATURE REVIEW

2.1.1 Demand in Aviation

Scissor lifts are in high demand in the aviation industry because they are essential to safe, effective aircraft repair procedures. These lifts are essential instruments that allow maintenance staff to reach high spots necessary for thorough inspections and repairs, such the complex parts of aircraft engines and the wings and tail sections. Scissor lifts' small footprints are especially useful in hangar settings when space is at a premium. They may be used in a variety of ways and stored conveniently without taking up too much floor space.

Aviation safety is still of utmost importance, and scissor lifts are in high demand because of their strong security measures. These consist of emergency stop buttons, warning lights, and secure platform attachment mechanisms, all of which help to createa safe and secure work environment for maintenance workers. Another important consideration is maneuverability, as the ever-changing field of aviation repair demandsthe capacity to precisely maneuver within confined locations. Additionally, scissor liftsgreatly increase the effectiveness of maintenance operations by providing rapid and accurate lifting capabilities, which in turn decrease aircraft downtime and improve overall operational efficiency.

Scissor lifts are essential to the aviation industry, but their use goes beyond simple elevation. It depends on the incorporation of cutting-edge technologies, strict adherence to safety regulations, and a dedication to offering dependable and long-lasting solutions for the complex and dangerous world of aircraft maintenance.

2.1.2 Types of scissor lift in market

2.1.2.1 Electric Scissor Lifts

Figure 2.1: Electric scissor lifts (Google, n.d.)

Electric scissor lifts are the most prevalent form of scissor lift due to its versatility, quiet operation, and environmental friendliness. These battery-powered lifts reduce noise pollution and toxic emissions, making them perfect for interior usage in warehouses, retail stores, and other sensitive locations. Their small size and lightweight construction allow for simple movement and maneuvering, especially in limited locations. Electric scissor lifts normally have a modest lifting capability and are appropriate for a variety of jobs such as maintenance, installations, and equipment access.

2.1.2.2 Hydraulic Scissor Lifts

Figure 2.2: Hydraulic Scissor Lifts (Google , n.d.)

Hydraulic scissor lifts are well-known for their sturdy design, strong performance, and ability to tolerate harsh outdoor environments. These hydraulic scissor lifts provide superior lifting powers, allowing them to handle bigger loads and reach greater heights than electric scissor lifts. Because of their increased resilience, they are ideal for building sites, landscaping projects, and other settings with uneven terrain or difficult circumstances.

2.1.2.3 Diesel Scissor Lifts

Figure 2.3: Diesel Scissor Lift (Google , n.d.)

Diesel scissor lifts are the lifting power and endurance champions, making them the obvious option for the most demanding and intense applications. These lifts, powered by diesel engines, have extraordinary lifting capacity and can run continuously for lengthy periods of time. Because of their tough design and strong performance, they can tackle heavy-duty duties in hostile locations such as industrial sites, mining operations, and large-scale building projects.

2.1.2.4 Rough terrain scissor lifts

Figure 2.4: Rough terrain scissor lifts (Google , n.d.)

Rough terrain scissor lifts are particularly built to work on uneven and difficult ground, making them invaluable for building sites, landscaping projects, and outdoor maintenance activities. These lifts, which have bigger tyres and improved ground clearance, can easily negotiate rugged terrain, uneven surfaces, and inclines. Because of their increased stability and traction, they can operate safely and efficiently in areas where standard scissor lifts may struggle.

2.1.2.5 Pneumatic Scissor Lifts

Figure 2.5: Pneumatic Scissor Lifts (Google , n.d.)

Pneumatic scissor lifts are distinguished by their silent operation, cleanliness, and emission-free performance. These compressed air-powered lifts offer a unique mix of environmental friendliness with modest lifting capacity. Their silent operation makes them excellent for noise-sensitive situations such as food processing factories, hospitals, and office buildings, while their cleanliness assures little contamination in sterile surroundings.

2.2 SPECIFIC LITERATURE REVIEW

2.2.1 Product Structure

"***A sturdy frame is essential to withstand the dynamic loads encountered during lifting operations, ensuring the safety of both maintenance personnel and the aircraft being serviced".*** (Smith et al. ,2018)

Based on the above statement the literature on aircraft maintenance equipment emphasizes the critical relevance of a strong, well-designed product structure in maintaining the safety and efficiency of aircraft maintenance operations. Previous research has continuously emphasized the requirement for lifting mechanisms that provide stability and longevity, with a focus on the structural integrity of frames and bases.

The selection of materials for the product construction is critical to fulfilling the project objectives

"A study by Kim et al. (2018) found that using scissor lifts instead of ladders for overhead tasks reduced worker fatigue and musculoskeletal strain in workers."

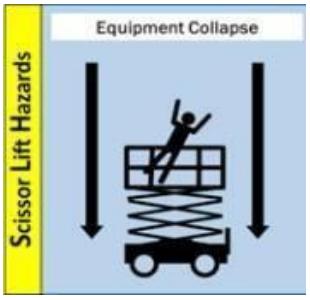
A 2018 research published in the journal "Applied Ergonomics" compared the usage of scissor lifts in building to traditional techniques such as ladders. The study discovered that scissor lifts reduced worker tiredness, reduced the risk of musculoskeletal strain, and increased overall job productivity. In short , the statement clearly states that the scissor lifter is essential in reduce the workload for workers .

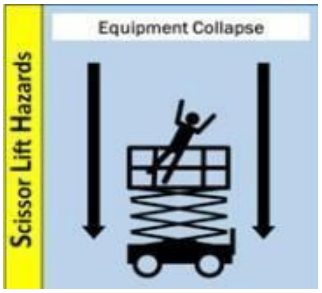
In ***"Design Review of Scissors Lifts Structure for Commercial Aircraft Ground Support Equipment using Finite Element Analysis"*** (2012), the significance of platform height adjustments for various aircraft models is highlighted along with the critical role that scissor lifts play in catering equipment for effective aircraft servicing.

2.2.1.1 Safety Requirement

Guardrails on scissor lifts are required to prevent personnel from falling (see 29 CFR 1926.451(g) or 29 CFR 1910.29(a)(3)(vii)).

Table 2.1 : Safety Requirement Guidelines for Scissor Lift

Types of hazards	Description
 Tip overs	• Follow the manufacturer's recommendations for safe movement—this typically means not moving the lift while it is up. • Isolate the scissor lift or apply traffic control measures to guarantee that other equipment does not come into touch with it.
 Equipment collapse	• Ensure that safety systems meant to prevent collapse are not bypassed. • Never allow the weight of the work platform to exceed the load rating specified by the manufacturer. • Keep other moving equipment on the worksite from colliding with the lift.
 Falls from work platform	• Employers who utilize scissor lifts must assess and apply adequate measures for fall prevention, stabilization, and positioning. • Employers must analyze the location of work to identify any potential dangers before selecting the proper equipment for the activity.

 Equipment collapse	• Never use anything other than the scissor mechanism to lift the work platform.

2.2.1.2 Types Of Material for Product Structure

2.2.1.2.1 Sheet Metal

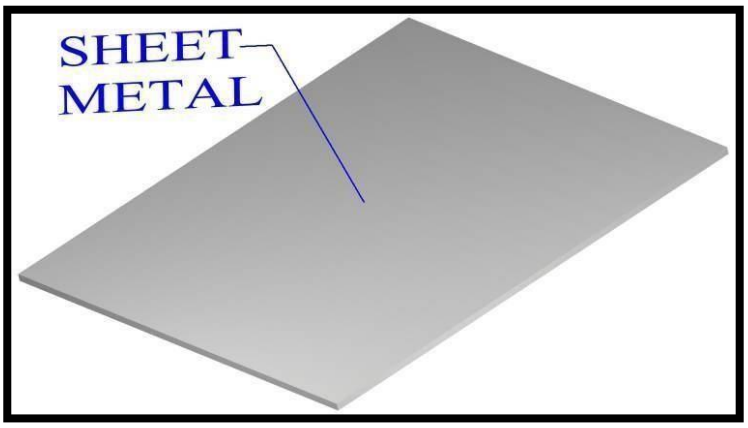


Figure 2.6 : Sheet Metal (The library of Manufacturing , n.d.)

Sheet metal installation on the top platform adds another level of protection, acting as a protective barrier for maintenance personnel operating at heights. Sheet metal's robust and sturdy character contributes to the platform's overall structural integrity, creating a safe working environment. The visual impact of sheet metal application and its compatibility with industry requirements for aviation equipment. The size of the sheet metal is (5ft x 10 ft x 0.21mm).

2.2.1.2.2 Mini Toolbox

Figure 2.7: Mini Toolbox (November 19 Market, 2023)

The mini toolbox provides a simple and organized storage option for keeping specialized equipment easily available, improving overall at ease. The mini toolbox is a designated location for keeping tools accessible, reducing misplacement or loss of important goods. This guarantees that the necessary tools are always available when needed.

2.2.2 Accessories and Furnishing of the Product

The accessories and furnishings in high uplift are intended to improve the function of the product, including the user's experience. High uplift is completed in such a manner that the product's function is not compromised while maintaining a high aesthetic value.

2.2.2.1 Black Spray Paint

Figure 2.8: MR.DIY Black Spray Paint (MR.DIY, n.d.)

The spray can function is critical for improving the overall appearance and protective features of the product. The paint is also flexible enough to retain paint integrity in a variety of weather conditions due has the capacity to withstand petrol and cracks for structure and sheet metal.

2.2.2.2 Anti Rust Lubricant Spray

The anti-rust spray is vital to the high uplift project since it is a multi-purpose solution that protects the sheet metal from corrosion caused by external circumstances. Additionally, lubrication for the hydraulic jack piston ensures smooth, friction-free movement throughout the hydraulic system.

Figure 2.9: ARROW Multi - Purpose Lubricant & Anti Rust Aerosol (Lazada, 2021)

The anti-rust spray's compatibility with hydraulic systems and capacity to endure varied climatic conditions make it an essential element of the maintenance routine, encouraging the long-term durability and performance of the hydraulic scissor lift in aircraft maintenance settings.

2.2.2.3 Caution Tape

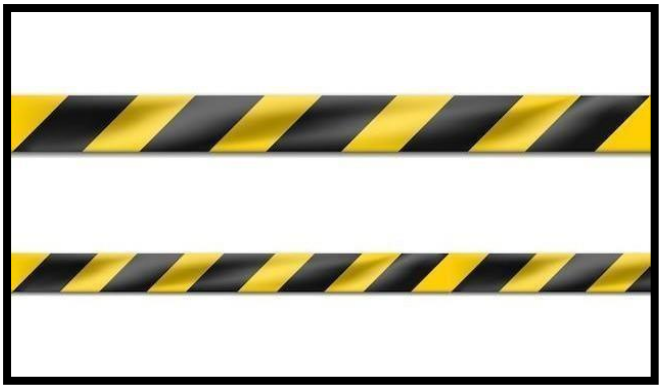


Figure 2.10: Caution Tape (Google, n.d.)

The caution tape performs an important safety purpose by functioning as a visual warning indication to improve overall safety measures surrounding the hydraulic scissor lift. Its major aim is to establish a visible and clearly recognizable border or barrier around the working area of the lift, alerting those in the vicinity to take caution and keep a safe distance.

2.2.2.4 Beacon Light

Figure 2.11 : Beacon Light (Google , n.d.)

The beacon light plays an important role in improving safety by giving a visible warning signal, identifying the working condition of the hydraulic scissor lift, and assuring straightforward identification of its position. This proactive safety precaution helps to provide a safe working environment for maintenance personnel and corresponds with industry requirements for equipment operation.

2.2.3 Product Mechanism (Mechanical)

HIGH UPLIFT is a structure to innovation in that it has a broad array of mechanical systems that have been precisely built to improve operational efficiency and assure sturdy stability. These deliberately designed mechanical parts play an important role in optimising the whole product process, demonstrating the company's dedication to ongoing improvement and refinement. HIGH UPLIFT, by using the power of these innovative mechanical mechanisms, not only improves operating performance but also places a premium on safety, establishing itself as a cutting-edge solution that prioritises precision and reliability during operation.

2.2.3.1 Hydraulic Cylinder

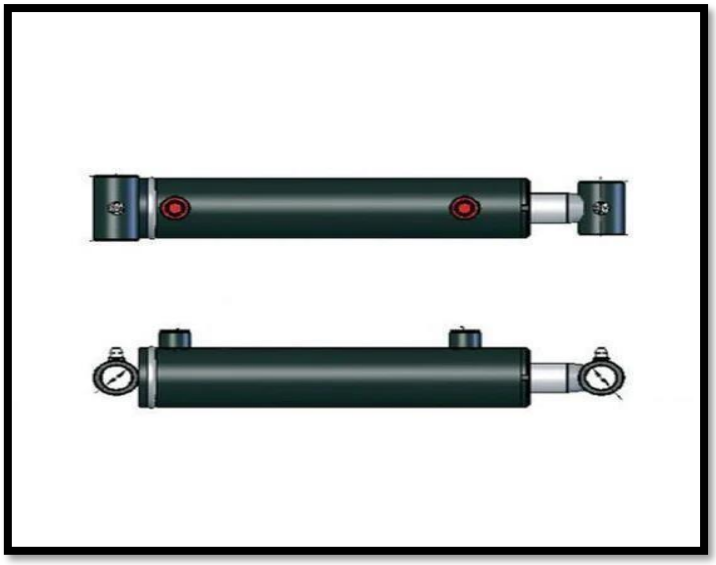


Figure 2.12: Hydraulic Cylinder (google n.d)

The hydraulic cylinder undergoes bending stress on the rod due to direct compressive force, and the pressure applied by the fluid along the circumference of the container and longitudinally on the walls must be ductile, robust, and rugged, ideally mild steel.

2.2.3.2 PVC Caster Wheel

Figure 2.13: PVC Caster Wheel (Amazon n.d)

PVC caster wheels are long-lasting and versatile mobility solutions that may be used in a variety of situations. These caster wheels, made of high-quality polyvinyl chloride (PVC), are extremely durable and resistant to wear and tear. PVC caster wheels, with their smooth and silent rolling characteristics, are great for furniture, carts, and a variety of equipment, enabling seamless manoeuvrability while ensuring floor protection.

2.2.3.3 Linear Motion Motor

Figure 2.14: Linear Motion Motor (Lazada n.d)

A linear motion motor is a type of electric motor that generates linear mechanical motion rather than the more usual rotating motion. These motors, which operate on electromagnetic principles, provide precise straight-line movement, making them

perfect for applications ranging from robotics and automation to manufacturing operations.

2.2.3.4 Scissor Lift

Figure 2.15: Scissor lift (google n.d)

A scissor lift is a versatile mechanical platform built for vertical elevation, with a crisscrossing, scissor-like mechanism that extends and retracts to provide a stable and controlled lifting motion. Scissor lifts are widely utilised in a variety of industries, from building to maintenance, and provide a viable solution for safely and efficiently accessing elevated places.

2.2.3.5 Bicycle Brake Lever

Figure 2.16: Bicycle Brake Lever (Amazon n.d)

The hydraulic scissor lift retraction mechanism is controlled by the bicycle brake lever, which offers an intuitive control interface. Its ergonomic design enables the operator to easily engage the hydraulic system, smoothly retracting the lift with precision and ease, resulting in a seamless and user-friendly experience for efficient operation in a variety of settings.

2.2.4 Electrical / Electronic / Programming

This section goes into further detail regarding the electronics and software that the High Uplift uses to monitor the height and allow our product to descend.

2.2.4.1 Type of Arduino Board

Electronic creations can be made using the open-source Arduino platform. A hardware programmable circuit board, sometimes referred to as a microcontroller, and software, which operates on your computer and is used to write and upload computer code to the physical board, are the two components that make up Arduino. The Arduino type is:

2.2.4.1.1 Arduino Uno (R3)

Built around the ATmega328P processor, the Arduino Uno R3 is a flexible open-source micro controller board. It has 14 digital and 6 analogue I/O ports and operates at 16 MHz, making it perfect for connecting a range of sensors and actuators. It facilitates simple computer connectivity with a USB interface for programming and power supply. The board can be used with various shields and add-on, which promotes a wide-ranging and cooperative environment. Its user-friendly IDE makes programming in a C/C++ subset easier, making it popular for instructional and prototyping applications. The Arduino Uno R3 platform, being open-source, fosters a thriving community that contributes to its ongoing development.

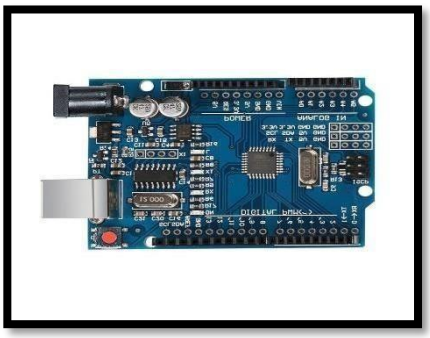


Figure 2.17: Arduino Uno (R3) (Lazada, 2023)

2.2.4.1.2 Arduino Micro

The ATmega32U4 chip is found on the small, USB-enabled Arduino Micro micro controller board. It is perfect for applications with limited area because of its tiny form factor. It effortlessly integrates with PCs for communication and programming thanks to USB connectivity. With its PWM output, digital and analogue ports, and shield compatibility, it can support a wide range of parts and uses. Pin 13's inbuilt LED helps with testing. Being a member of the Arduino family, it supports open-source ideas and encourages community collaboration. The Arduino Micro is a popular choice for a variety of electronic projects due to its open architecture, ease of use, and versatility, catering to both novice and experienced developers.

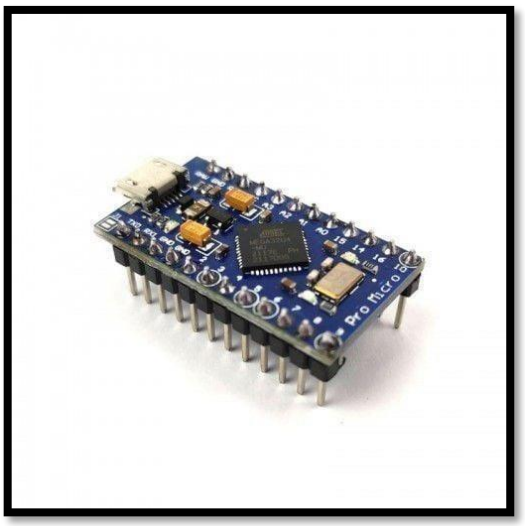


Figure 2.18: Arduino Micro (Cytron , 2022)

2.2.4.1.3 Arduino Nano

With an Atmel ATmega328P chip, the Arduino Nano is a small and powerful micro controller board. It is perfect for projects with limited space because of its credit card-sized form factor. It offers flexible communication with digital and analogue pins, PWM outputs, UART, I2C, and SPI. Simple serial communication and programming are made possible by the integrated USB port. With a broad input voltage range and 5 volt operation, it can accept multiple power sources. It is programmable via the ArduinoIDE and makes C/C++ code creation easier. The Nano is a popular option for a varietyof electrical projects due to its small size and versatility. It is widely used in robotics, home automation, and the Internet of Things.

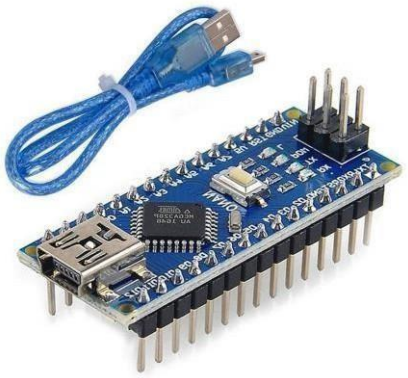


Figure 2.19: Arduino Nano (Amazon, 2014)

2.2.4.2 Type of motor driver

An electrical circuit known as a motor driver regulates a motor's speed and direction. It accomplishes this by giving the motor the appropriate voltage and current as well as by turning on and off the motor's current. Numerous fields, such as robotics, home automation, and automotive systems, employ motor drivers.

2.2.4.2.1 L298n motor driver

For robotics and electronics projects, the twin H-bridge motor driver integrated circuit L298N is essential. Two motors may be controlled in both directions independently thanks to its H-bridge construction. It supports a variety of motor types with voltage support up to 46V and a continuous output of about 2A per channel. Its integrated diodes provide circuit safety by guarding against back EMF. Microcontrollers provide digital inputs that enable motor direction and speed modifications. A built-in or external heat sink is used to address heat dissipation in certain models, which also have current monitoring capabilities. The L298N is a popular choice for amateur projects since it efficiently simplifies motor control.

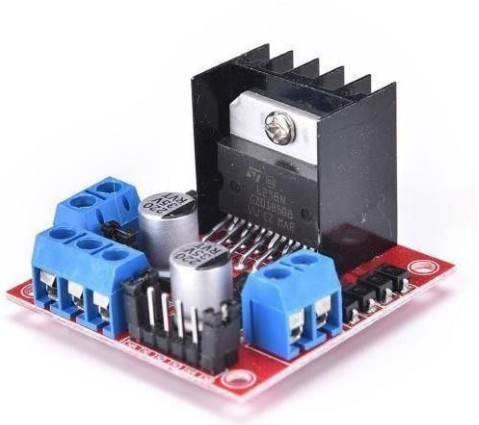


Figure 2.20: L298n motor driver (Ebay, 2020)

2.2.4.2.2 MC33926 motor driver

NXP Semiconductors' MC33926 is a twin H-bridge motor driver that can operate two DC motors independently. Specifically designed for robotics and automation applications, it has current sensing for precise current management and overcurrent protection. It guarantees the longevity of the motors with incorporated protection measures like temperature shutdown and under-voltage lockout. It allows for easy integration into digital control systems with support for Pulse Width Modulation (PWM) control and possible communication interfaces like I2C or SPI. Its small form factor increases adaptability, yet it is crucial to consult the NXP Semiconductors datasheet for exact usage instructions.

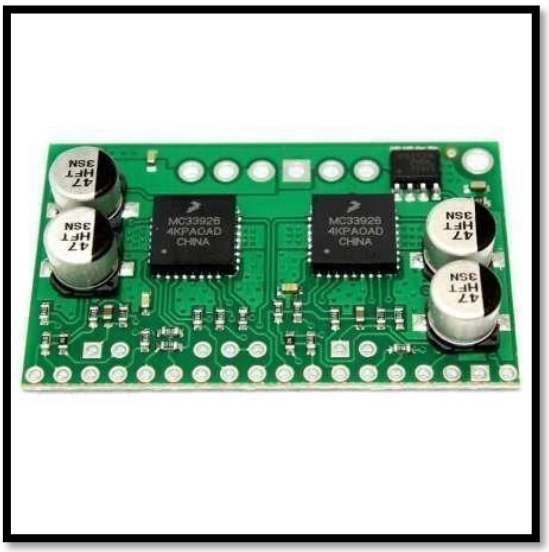


Figure 2.21: MC33926 motor driver (Ebay, 20201)

2.2.4.2.3 MD13Smotor driver

Up to 30V and 13A brushed DC motors can be driven by the MD13S single-channel DC motor driver. Because of its affordability and ease of use, it is a well-liked option for makers and hobbyists. PWM signals can be used to precisely and smoothly control the speed of the MD13S. In addition, it contains other features including heat protection, under voltage protection, and over current protection that guard against damage to the motor.

Figure 2.22: MD13Smotor driver (Cytron , 2022)

2.2.4.3 Type of Display

Displays are used as visual outputs in Arduino projects to show data or images. Common varieties include OLEDs for high-resolution graphics, TFTs for complex GUIs, papers for low-power, persistent displays, LED matrices for straightforward animations, and LCDs for basic text. TFTs deliver high-resolution color, OLEDs offer vivid visuals, LED matrices display dynamic content, LCDs are economical, and papers use less energy and have persistent images. Think about pin requirements, color, resolution, and size while making your selection. Programming is made easier by libraries such as Adafruit and Liquid Crystal. To ensure a smooth integration with Arduino, choose a display that complements the functional and aesthetic requirements of the project.

2.2.4.3.1 LCD (Liquid Crystal Display)

Because of its clarity and low power consumption, LCD (Liquid Crystal Displays) are a flat-panel technology that are frequently used in Arduino projects. It is made of liquid crystals sandwiched between layers of glass, which manipulate light to show data. Usually, an LCD module with an integrated controller is used with Arduino. The LCD must be connected, a particular library such as Liquid Crystal must be included, the setup() function must initialize the display, and the loop() must update the content. As an illustration, a little piece of code initializes a 16x2 LCD and prints "Hello, Arduino!" This adaptable and modular technology is useful for displaying graphics or text in a variety of electronic applications.

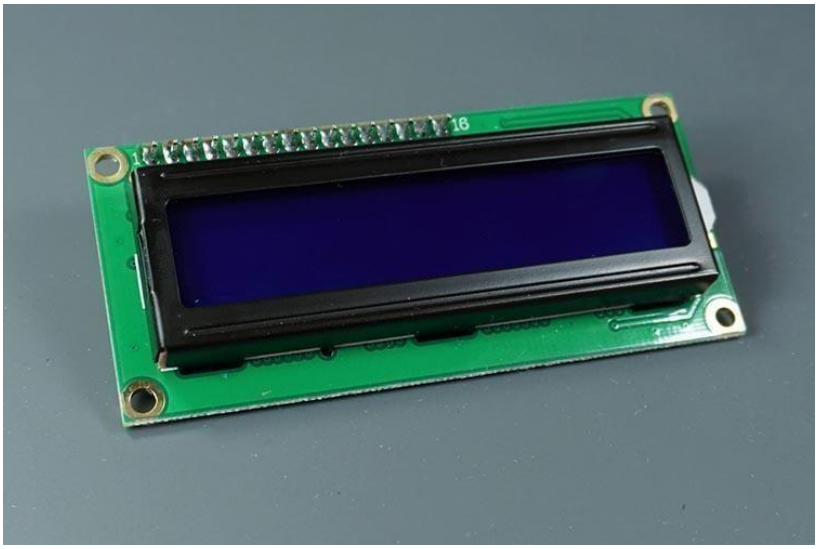


Figure 2.23: LCD (Liquid Crystal Display) (Random Nerd Tutorials, 2020)

2.2.4.3.2 (OLED)Organic light-emitting diode

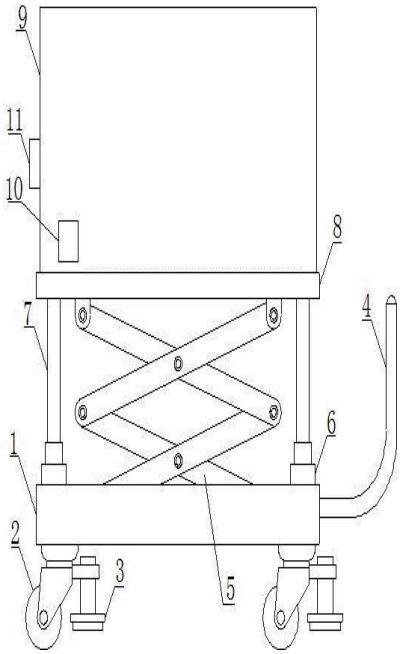
Organic light-emitting diode (OLED) screens are popular in Arduino projects because they use organic materials that, when powered on, emit light. Since they don't have a backlight like LCDs do, they offer sharp color, excellent contrast, and low power consumption. Real-time applications benefit from quick reaction times, and curved designs are made possible by inherent flexibility. SPI and I2C are two protocols that make Arduino compatible. Interfacing becomes easier when libraries like Adafruit SSD1306 are used. OLEDs provide small, eye-catching displays, making them perfect for wearable, devices, and instruments. They are a popular option because of their adaptability and lack of a backlight, which effectively and succinctly increases the diversity of Arduino-based projects.

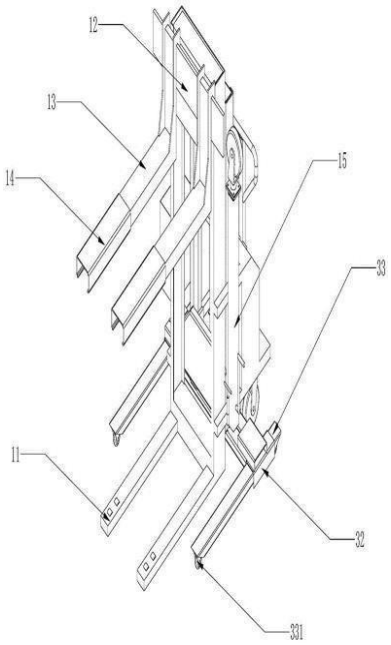
Figure 2.24: (OLED)Organic light-emitting diode (Autobotic Sdn Bhd, n.d.)

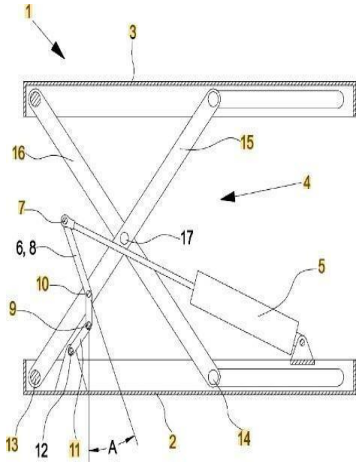
2.3 REVIEW ON RECENT RESEARCH / RELATED PRODUCTS

2.3.1 Related Patented Products

Table 2.2 : List of Scissor Lifters / Patented Products

NO	PATENT PRODUCTS	PATENT SUMMARY
1.		**Patent Title:** Lifting device for transport inspection tool box **Patent Number:** CN112320667A **Patent Office Country:** China **Inventors:** Zhao Yeru , Guo Zhihong **Abstract** : The invention relates to a lifting device for a transportation and inspectiontool box, which comprises a base and a remote controller, wherein universal wheels are arranged on the left side and the right side below the base, a brake mechanism is arranged on one side of each universal wheel, a handrail is arranged on the upper side of the right side of the base, first installation seats are arranged on the left side and the right side above the base, first telescopic rods are arranged above the first installation seats, a bottom plate is arranged above the first telescopic rods, cast steel hinge lugs are arranged on the left side and the right side below the bottom plate, a shaft pin is arranged in the middle of the front of each cast steel hinge lug, a box body is arranged above the bottom plate, a storage box is arranged below the left side of the front of the box body, a receiving box is arranged below the left side of the box body, three

		springs are uniformly arranged below the inner part of; the invention has the advantages of reasonable structure, convenient use, remote control and improvement of working efficiency.
2.		**Patent Title**: Self-lifting forklift truck **Patent Number**: CN216889974U **Patent Office Country**: China **Inventors**: Wang Lide, Li Xiaowu **Abstract** : The utility model discloses a vehicle-mounted self-lifting forklift which comprises a forklift body, a first lifting mechanism, a supporting travelling mechanism and a first control unit, wherein the forklift body is connected with the supporting travelling mechanism through the first lifting mechanism, a first supporting leg is arranged on the forklift body, the first control unit is connected with a control end of the first lifting mechanism, so that after the first lifting mechanism is controlled to lift the forklift body to a target height, the supporting travelling mechanism moves the forklift body to a target position, the first supporting leg supports the forklift body at the target position, and the supporting travelling mechanism is retracted by the first lifting mechanism. The utility model can be carried to different sites along with trucks toload and unload the truck, thereby needing no additional loading and unloading tools on the site and greatly saving the economic cost.

3.		**Patent Title:** Scissor lift **Patent Number:**US20130341984A1 **Patent Office Country:** United States Of America **Inventors:** Martin OLESEN **Abstract :** Disclosed is a scissor lift including a bottom frame, a top frame, a scissor mechanism arranged between the bottom frame and the top frame to displace the bottom frame and the top frame in relation to each other by means of the force provided by a linear actuator, a gearing arranged between the scissor mechanism and the linear actuator, where the linear actuator has a linear actuator point of attack at one end of a lever arm of the gearing, where the bottom frame is connected to a bottom frame point of attack at another end of the lever arm and where the scissor mechanism is connected to the lever arm through a lever arm pivotal joint arranged between the linear actuator point of attack and the bottom frame point of attack.

2.3.2 Recent Market Products

Table 2.3: Recent Market Products

No	Marketed Product	Product Summary
1.		**Product Name:** Haulotte HS18D Diesel Scissor Lift **Published Date:** 2015 **Inventors:** Haulotte **Description:** The Haulotte HS18D is a diesel scissor lift that is intended for outdoor use. It features an 18-foot operating height and a lifting capability of 4,000 pounds. It also boasts characteristics that make it simple to use and maneuver, such as a rough-terrain chassis and four-wheel drive.
2.		**Product Name:** Sinoboom GTJZ3012D Diesel Scissor Lift **Published Date:** 2014 **Inventors:** Sinoboom **Description:** The Sinoboom GTJZ3012D is a Chinese-made diesel scissor liftrecognized for its low cost and dependability. It features a 30-foot operating height and a 2,500-pound lifting capability. It also has several safety measures such as guardrails, non-slip surfaces, and emergency stop buttons.

3.		**Product Name:** Skyjack SJ3215 Electric Scissor Lift **Published Date:** 2016 **Inventors:** Skyjack **Description:** The Skyjack SJ3215 is a heavy-duty electric scissor lift built for construction and industrial use. It features a 32-foot operating height and a liftingcapability of 3,500 pounds. It alsohas characteristics that make it simple to operate and move, such as a self-propelled propulsion system and a foldable platform.

2.4 COMPARISON BETWEEN RECENT RESEARCH AND CURRENT PROJECT

2.4.1 Lifting Inspection Toolbox vs High Uplift vs Diesel Scissor Lift

Table 2.4: Lifting device for transport inspection tool box vs High Uplift vsHaulotte HS18D Diesel Scissor Lift

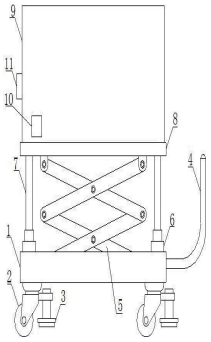
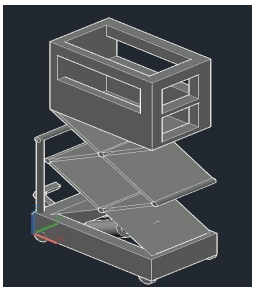
Product	Lifting device for transport inspection tool box	High Uplift	Haulotte HS18D Diesel Scissor Lift
Design			
Extendable and Retractable	Yes	Yes	Yes
Power Source	Pneumatic / Telescopic	Hydraulic	Diesel
Lifting Capacity	N/A	350 kg	1814 kg
Working Height	N/A	175 cm	550 cm
Features	-Reasonable structure -Convenient use -Remote control	-Sheet metal -Height monetization -Beacon light - Emergency retract	-Rough-terrain chassis -Four-wheel drive

Table 2.5: Self-lifting forklift truck vs High Uplift vs Sinoboom GTJZ3012D Diesel Scissor Lift

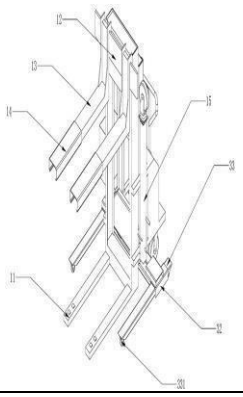
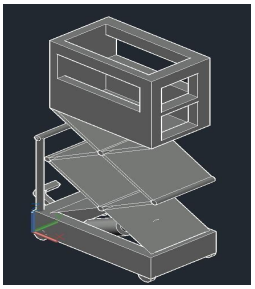
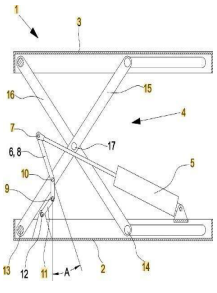
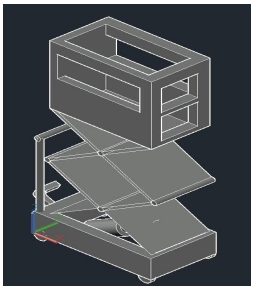
Product	Self-lifting forklift truck	High Uplift	Sinoboom GTJZ3012D Diesel Scissor Lift
Design			
Extendable and Retractable	Yes	Yes	Yes
Power Source	Hydraulic	Hydraulic	Diesel
Lifting Capacity	N/A	350 kg	1133 kg
Working Height	200 cm	175 cm	914 cm
Features	-Needing no additional loading and unloading tools on the site	-Sheet metal -Height monetization -Beacon light - Emergency retract lever	-Guardrails -Non slip surface - Emergency stop buttons

Table 2.6: Scissor Lift vs High Uplift vs Skyjack SJ3215 Electric Scissor Lift

Product	Scissor Lift	High Uplift	Skyjack SJ3215 Electric Scissor Lift
Design			
Extendable and Retractable	Yes	Yes	Yes
Power Source	Hydraulic	Hydraulic	Electric
Lifting Capacity	N/A	350 kg	1588 kg
Working Height	N/A	175 cm	975 cm
Safety features	-Non slip surface	-Sheet metal -Height monetization -Beacon light - Emergency retract lever	-Self-propelled propulsion system -Foldable platform

CHAPTER 3

RESEARCH METHODOLOGY

3.1 PROJECT BRIEFING & RISK ASSESSMENT

This chapter will detail the different stages that were successfully performed in order to achieve the project's aims and objectives. These included completing the relevant forms and obtaining supervisor permission. Various stages of the project involved in the manufacture of hazardous materials such as sheet metal cutting, drilling, painting, and testing. The team members took this safety precaution seriously, and correct equipment was used.

3.1.1 Utilization of Polytechnic’s Facilities

To use all of the Polytechnic's facilities, such as equipment, consumable materials, and tools, authorization must be obtained from the supervisor and workshop coordinator by filling out the required paperwork. This form will detail the tools and equipment required to accomplish the project.

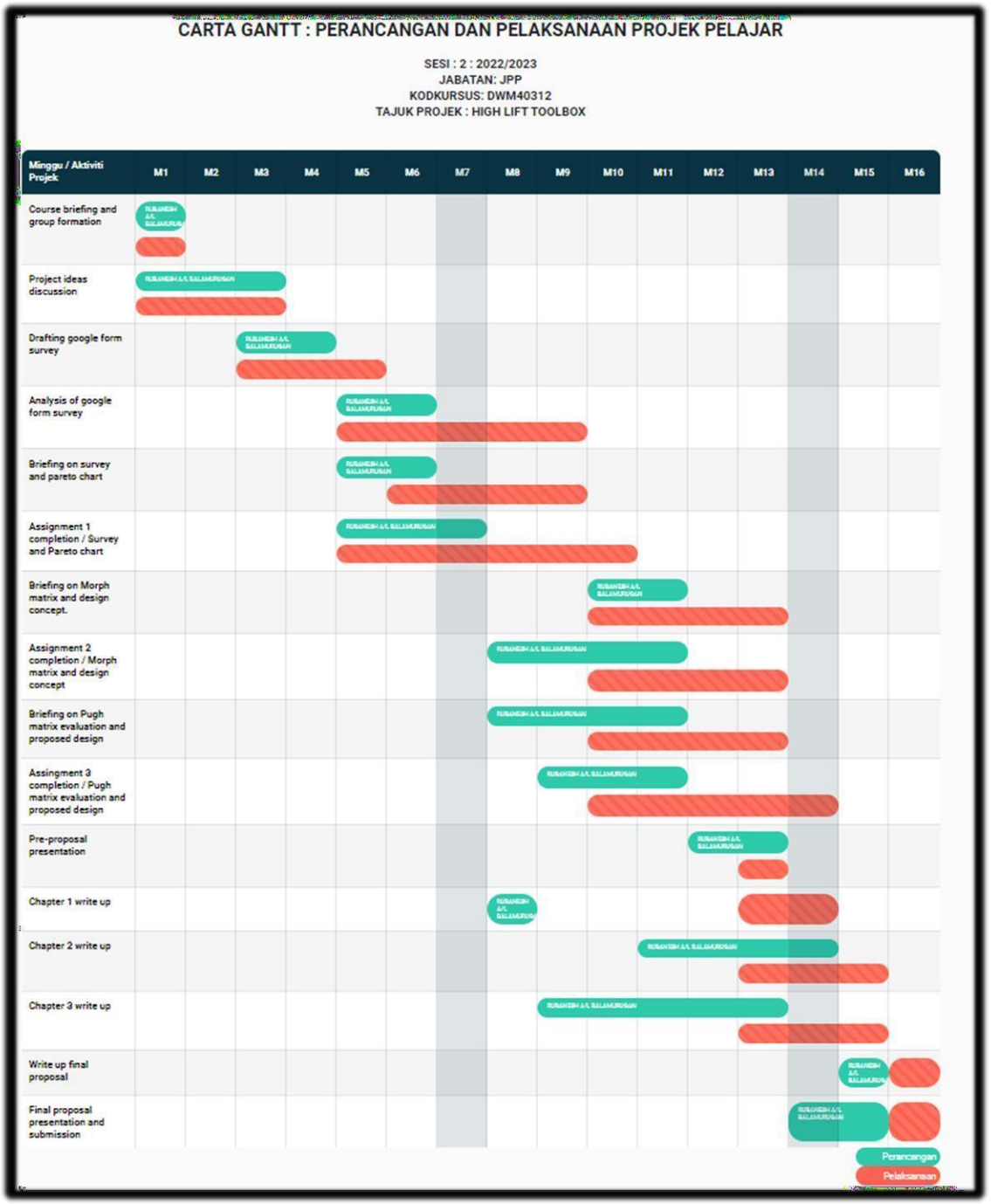
Several facilities were used by our group, including :

- Composite Workshop
- General Workshop
- Electronic Instrument Lab

3.2 OVERALL PROJECT GANTT CHART

3.2.1 Gantt Chart for AEM

Table 3.1: AEM Gantt Chart



3.2.2 Gantt Chart for AEP

Table 3.2: AEP Gantt Chart

3.3 PROJECT FLOW CHART

3.3.1.1 Overall AEM Flow Chart

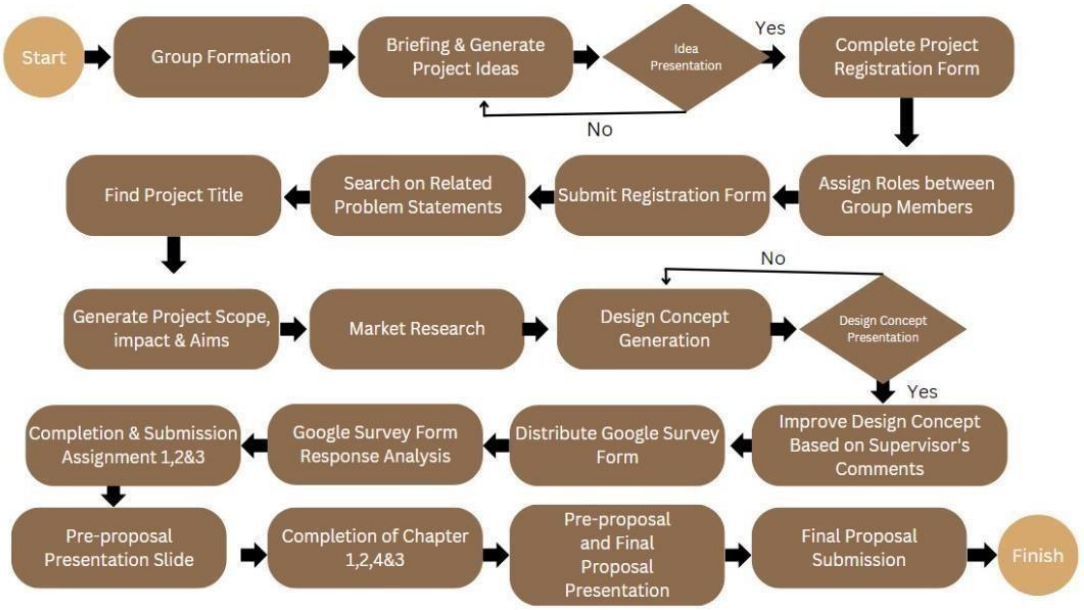


Figure 3.1: Overall AEM Flow Chart

3.3.1.2 Overall AEP Flow Chart

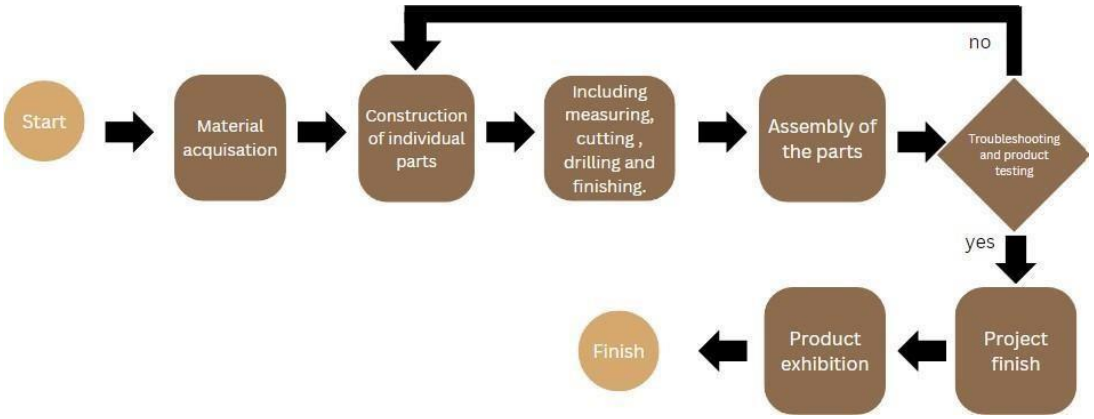


Figure 3.2: Overall AEP Flow Chart

3.3.2 Specific Project Design Flow / Framework

3.3.2.1 Product Structure and Furnishing

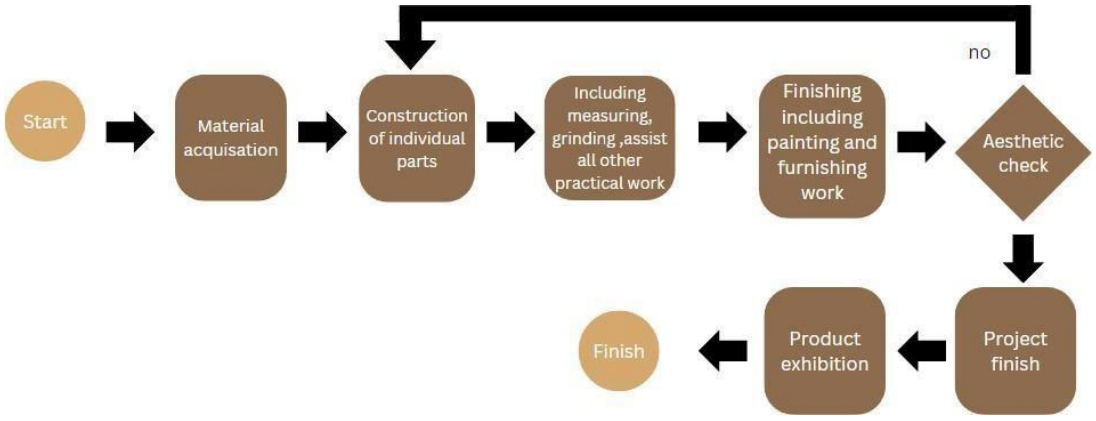


Figure 3.3: Product Structure and Furnishing Flow

3.3.2.2 Mechanical and Design

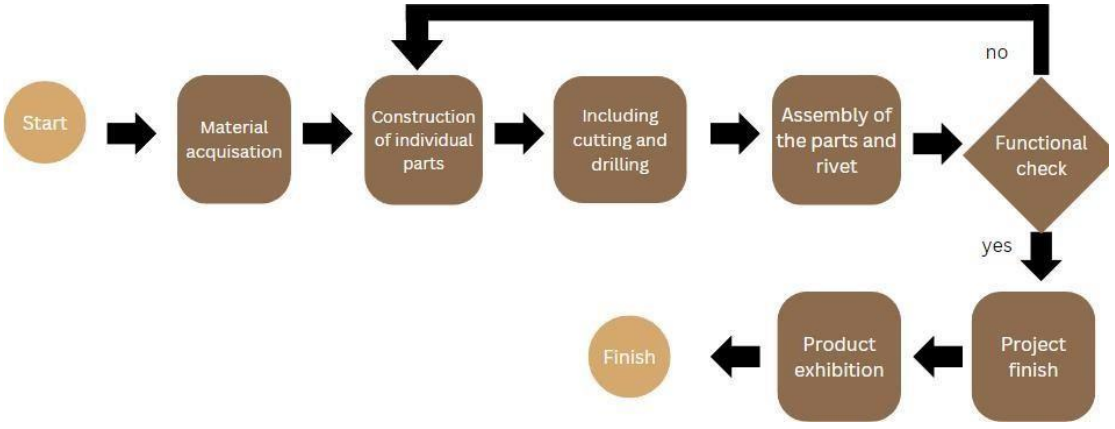


Figure 3.4: Mechanical and Design Flow

3.3.2.3 Electrical / Electronic / Programming

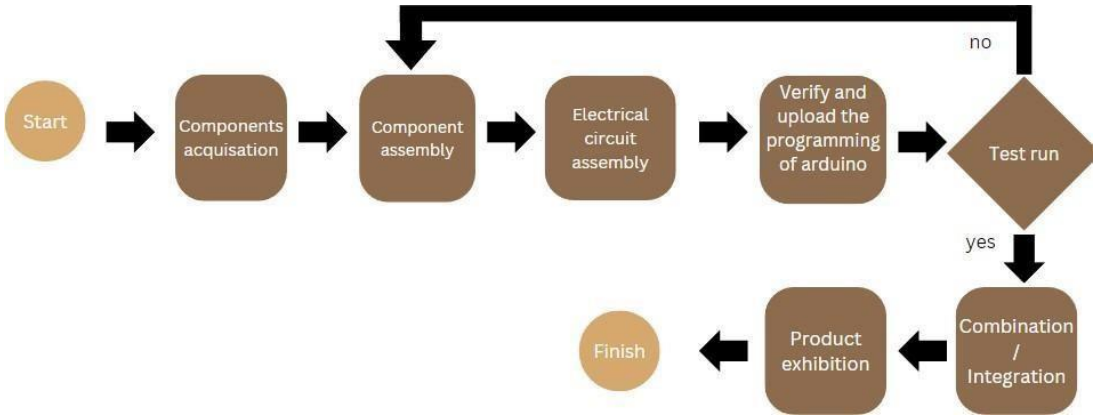


Figure 3.5: Electrical / Electronic / Programming Flow

3.4 DESIGN ENGINEERING TOOLS

3.4.1 Design Requirement Analysis

3.4.1.1 Questionnaire Survey

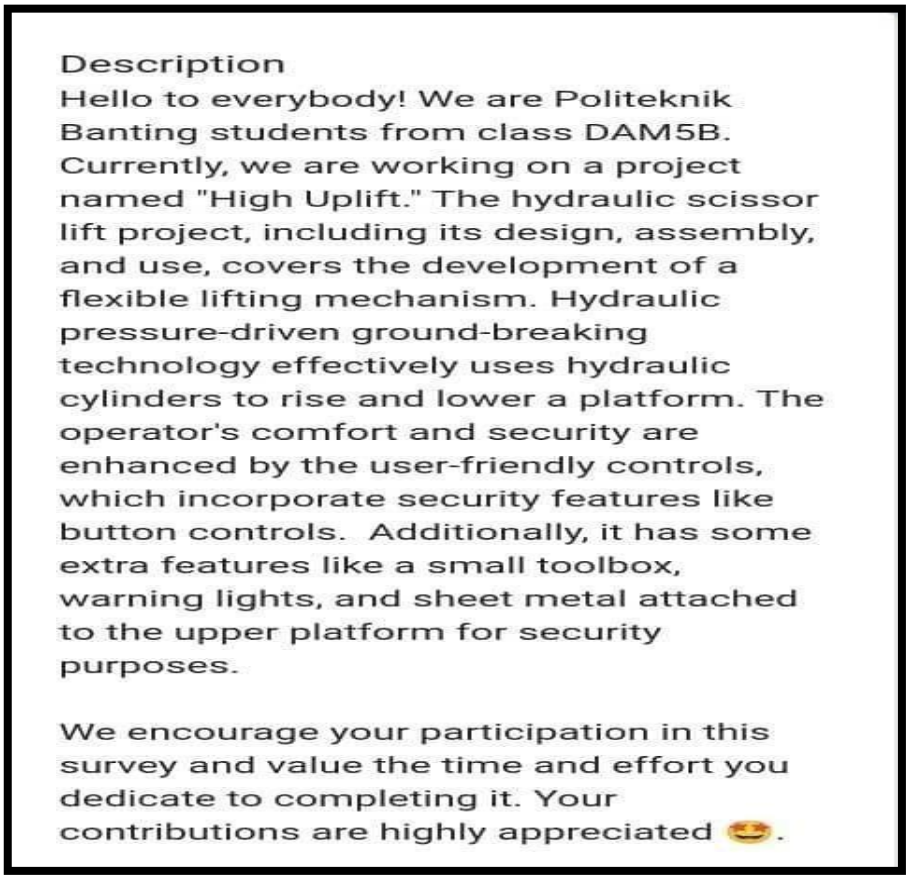


Figure 3.6: Questionnaire Survey through Google Form

The survey was carried out using Google Forms, and the questions were split into FIVE (5) sections.

- **PART A: Respondent's Demographic**
- **PART B: User's Experience (Hardware)**
- **PART C: User's Experience (Electrical and Software)**
- **PART D: Overall Product**
- **PART E: Product Improvement**

- **The survey was delivered to LAE's, lecturers, industrial training students, and semester 5 students of Banting Polytechnic in Selangor.**

3.4.1.2 Pareto Diagram

Table 3.3: Extracted Pareto Data from Survey Response

User Experience	Frequency	Cummulative	Cummulative Percentage	Pareto Baseline
Inadequate storage capacity	23	23	30%	80%
Carrying the toolbox at higher place	20	43	57%	80%
Holding tools at higher place	17	60	79%	80%
Tools often falling	16	76	100%	80%

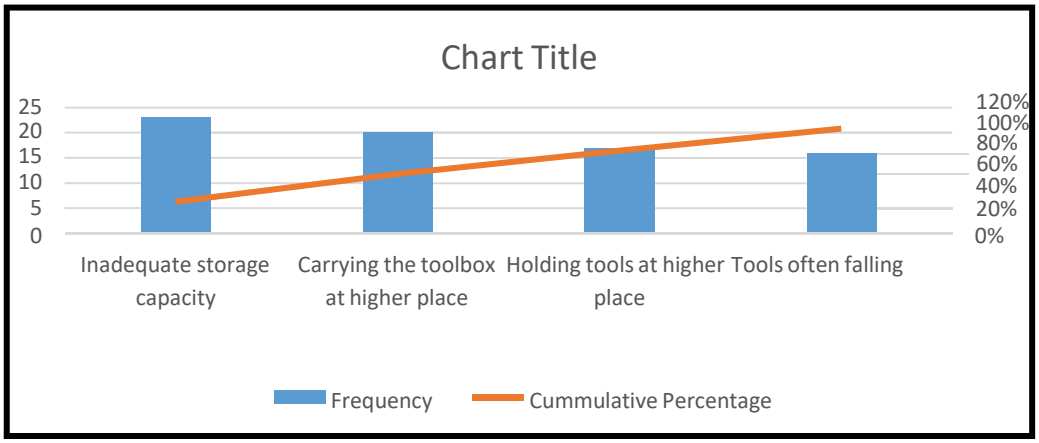


Figure 3.7: Pareto Diagram of High Uplift

3.4.2 Design Concept Generation

3.4.2.1 Function Tree

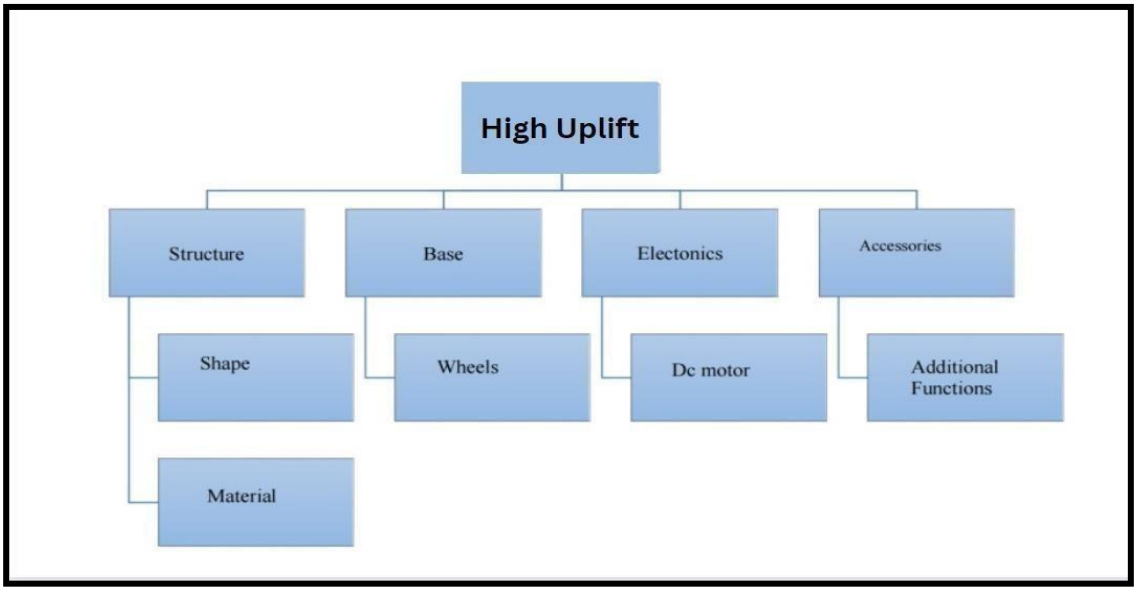


Figure 3.8: Function Tree of High Uplift

After analyzing the responses from the Google Survey Form, the design idea development process begins with the construction of an High Uplift Function Tree. Product development is separated into many Functions, which are further subdivided into Sub-functions.

3.4.2.2 Morphological Matrix Table

3.4 Table : Morphological Matrix of High Uplift

FUNCTION	IDEA 1	IDEA 2	IDEA 3	IDEA 4
MOBILITY	BY WHEEL	Motorized	BY WHEEL	Motorized
LIFTING CAPACITY	100Kg	150KG	350KG	200 KG
COMPARTMENT STYLE	RECTANGULAR SHAPE	RECTANGULAR SHAPE	RECTANGULAR SHAPE	RECTANGULAR SHAPE
MOVING MECHANISM	THE WHOLE PART	THE WHOLE PART	THE WHOLE PART	FREE MOVE
MATERIAL	STAINLESS STEEL	METAL	Aluminium	ABS, IRON (PLATING)
SHAPE & SIZE	RECTANGULAR SHAPE	RECTANGULAR SHAPE	RECTANGULAR SHAPE	RECTANGULAR SHAPE
ACCESSORIES	-	-	Tools Holder	-
LOCK & SECURITY	NUTS, BOLTS AND RIVET	NUTS AND BOLTS	NUTS, BOLTS AND DOOR HINGE	SCREW AND NUTS
COLOUR	ROYAL BLUE	GREEN	BLACK & YELLOW	BLACK / STEEL
LIFTING MECHANISM	Pneumatic	Pneumatic	Hydraulic	DC linear actuator

After creating the High Uplift Function Tree, the next step is to create ideas for each function and sub-function.

3.4.2.3 Proposed Design Concept 1

Table 3.5: Proposed Design Concept 1

FEATURES/FUNCTION	IDEATION 1	JUSTIFICATION
MATERIAL	STAINLESS STEEL	THE MATERIAL WITHSTAND CORROSION
SHAPE AND SIZE	RECTANGULAR SHAPE	MORE STABLE
ACCESSORIES	NONE	NONE
MOBILITY	WHEELS	EASIER TO TRANSPORT
CAPACITY	100 KG	SMALL AND EASY TO MANEUVRE
COMPARTMENT STYLE	RECTANGULAR SHAPE	EASILY FITTED AND NEAT LOOKING
LOCK AND SECURITY	NUTS , BOLTS RIVETS	AUTOMATIC MECHANISM
COLOUR	ROYAL BLUE	DARK AND LOOKS ELEGANT
LIFTING MECHANISM	PNEUMATIC	PNEUMATICALLY ACTUATED
MOVING MECHANISM	TOGETHER	EASY TO MOVE TO ONE PLACE TO ANOTHER

3.4.2.4 Proposed Design Concept 2

Table 3.6: Proposed Design Concept 2

FEATURES/FUNCTION	IDEATION 2	JUSTIFICATION
MATERIAL	METAL	RELIABLE AND RESILIENT
SHAPE AND SIZE	RECTANGULAR SHAPE	EASY TO KEEP THINGS
ACCESSORIES	NONE	NONE
MOBILITY	MOTORIZED	EASIER TO BRING ANYWHERE
CAPACITY	150 KG	SMALL AND EASE
COMPARTMENT STYLE	RECTANGULAR SHAPE	EASILY FITTED
LOCK AND SECURITY	NUTS AND BOLTS	SECURED
COLOUR	GREEN	DARK AND LOOKS PREMIUM
LIFTING MECHANISM	PNEUMATIC	COST EFFECTIVE
MOVING MECHANISM	MANUALLY	HANDLE BY HAND

3.4.2.5 Proposed Design Concept 3

Table 3.7: Proposed Design Concept 3

FEATURES/FUNCTION	IDEATION 3	JUSTIFICATION
MATERIAL	ALUMINIUM	LIGHTWIEGHT AND WONT RUST
SHAPE AND SIZE	RECTANGULAR SHAPE	DIFFERENT THAN OTHERS
ACCESSORIES	TOOLS HOLDER	ABLE TO HANG TOOLS OUTSIDE
MOBILITY	WHEELS	BE MORE FLEXIBLE AND EASIER TO TRANSPORT
CAPACITY	350KG	SUITABLE FOR USAGE IN SMALL AIRCRAFT
COMPARTMENT STYLE	RECTANGULAR SHAPE	EASILY FITTED AND NEAT LOOKING
LOCK AND SECURITY	NUTS , BOLTS , DOOR HINGE	SECURED
COLOUR	BALCK AND YELLOW	UNIQUE AND ATTRACTIVE
LIFTING MECHANISM	HYDRAULIC	ABLE TO CARRY MORE LOADS
MOVING MECHANISM	FREE MOVE	CAN MOVE FREELY AND CONTROL BY HAND

3.4.2.6 Proposed Design Concept 4

Table 3.8: Proposed Design Concept 4

FEATURES/FUNCTION	IDEATION 4	JUSTIFICATION
MATERIAL	ABS , IRON {PLATING}	LIGHTWEIGHT AND LONG LAST
SHAPE AND SIZE	RECTANGULAR SHAPE	CAN FIT ASSEMBLY EASILY
ACCESSORIES	NONE	NONE
MOBILITY	MOTORIZED	EASY TO CARRY ANYWHERE
CAPACITY	200 KG	FIXED CAPACITY AND CAN MANEUVRE EASILY
COMPARTMENT STYLE	RECTANGULAR SHAPE	EASY FITTING
SECURITY AND LOCK	SCREWS AND NUTS	SECURED
COLOUR	BLACK / STEEL	PREMIUM LOOKS
LIFTING MECHANISM	DC LINEAR MOTOR	ELECTRICALLY ACTUATED AND COST EFFECTIVE
MOVING MECHANISM	FREE MOVE	EASY TO TAKE OUT THE THINGS WE NEED IT SEPERATELY .

3.4.2.7 Accepted vs Discarded Solution

Table 3.9: Accepted Vs Discarded Solution

CRITERION	CONCEPT 1	CONCEPT 2	CONCEPT 3	CONCEPT 4
STRENGTH (Material)	High (Stainless steel structure)	High (Metal structure)	Highest (Aluminium structure)	Low (Abs , Iron Plating structure)
SAFETY (USER)	High (Stable design to avoid mislead)	High (Stable design to avoid mislead)	High (Stable design to avoid mislead)	High (Stable design to avoid mislead)
RELIABILITY	High (Ease of maintenance)	High (Ease of maintenance)	Highest (Adherence to Safety Standards)	High (Adherence to Safety Standards)
USER-FRIENDLY (CONVENIENCE)	Low (Bulky)	Moderate (Moderate design)	High (Adaptable to varied condition)	Low (Bulky)
COST	High (High cost due to material)	High (High cost due to material)	Moderate (Affordable due to material)	Low (Cost effective due to material)

After obtaining sufficient options for the concept, all concepts are evaluated side by side using five criteria including strength, safety, reliability, user friendly, and cost. These criteria are used to evaluate the ideas. Following the review, Concept 3 is chosenas the acceptable option. Other alternatives are abandoned and used as project backup.

3.4.3 Evaluation & Selection of Conceptual Design

3.4.3.1 Pugh Matrix

Table 3.10: Concept Design Evaluation Using Pugh Matrix

CRITERION	DATUM	CONCEPT 1	CONCEPT 2	CONCEPT 3	CONCEPT 4
STRENGTH	0	0	1	1	1
SAFETY	0	1	0	1	1
RELIABILITY	0	0	0	1	1
USER-FRIENDLY	0	1	0	1	0
COST	0	1	1	0	0
Total Score	0	3	2	4	3
Ranking	-	2nd	3rd	1st	2nd

The selected solution (Concept 3) is demonstrated to be the best solution with the data using the Pugh Matrix. All concepts are graded based on five criteria including strength, safety, reliability, user friendly, and cost

3.5 PRODUCT DRAWING / SCHEMATIC DIAGRAM

3.5.1 General Product Drawing

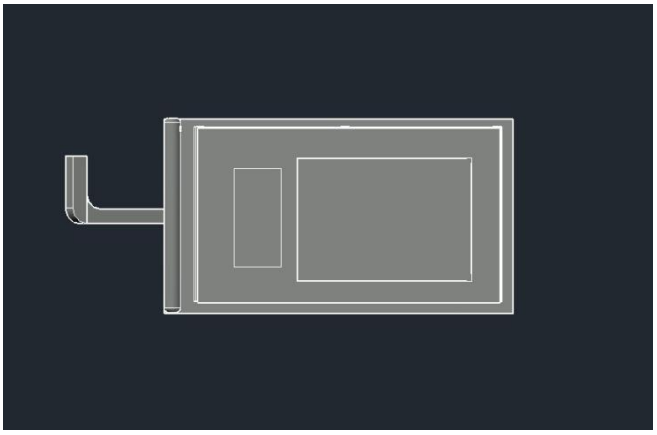


Figure 3.9: Top view of High Uplift

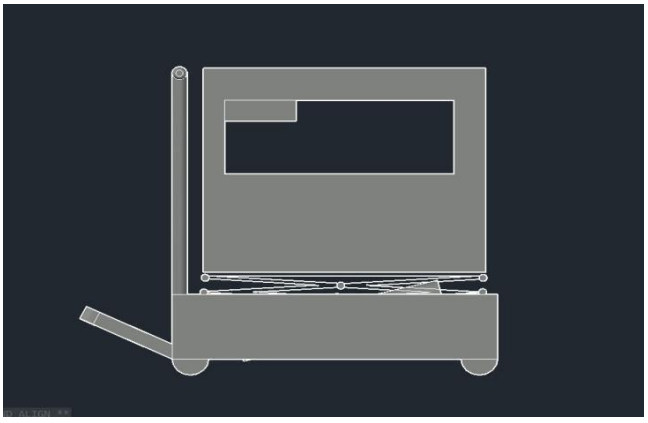


Figure 3.10: Front view of High Uplift

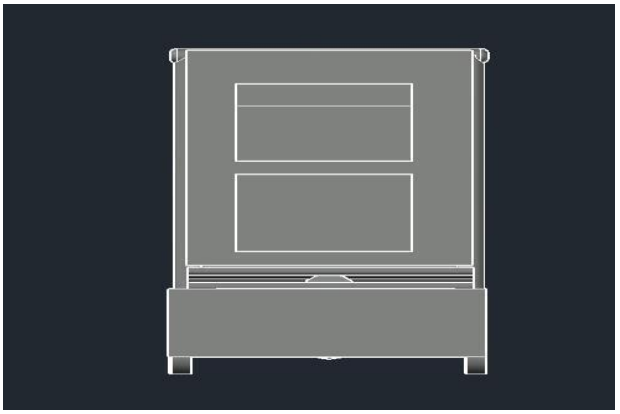


Figure 3.11: Side view of High Uplift

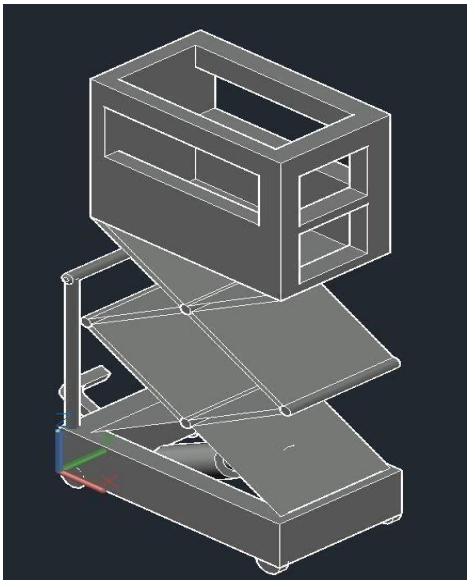


Figure 3.12: Isometric view of High Uplift

3.5.2 General Product Dimension

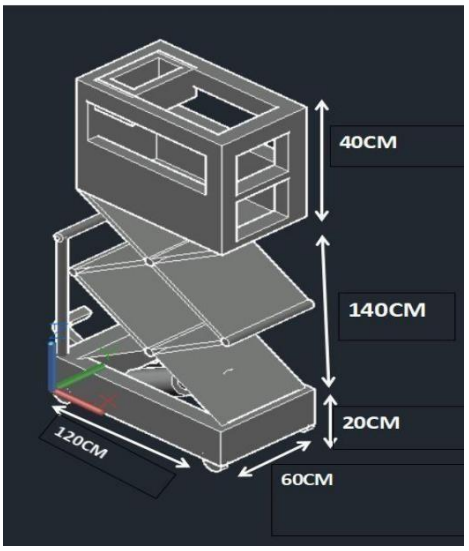


Figure 3.13: Isometric view of High Uplift (Extended)

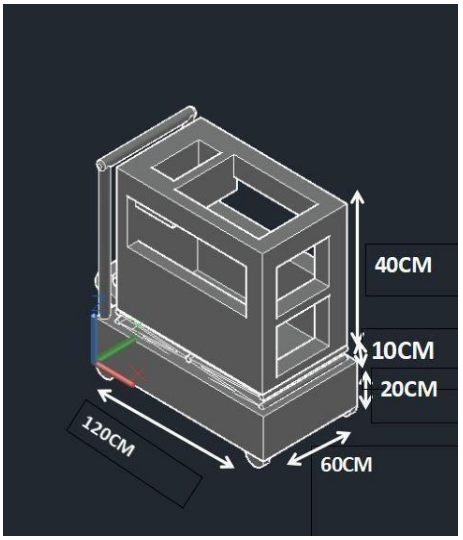


Figure 3.14: Isometric view of High Uplift (Retracted)

3.5.3 Specific Part Drawing / Diagram

3.5.3.1 Product Structure

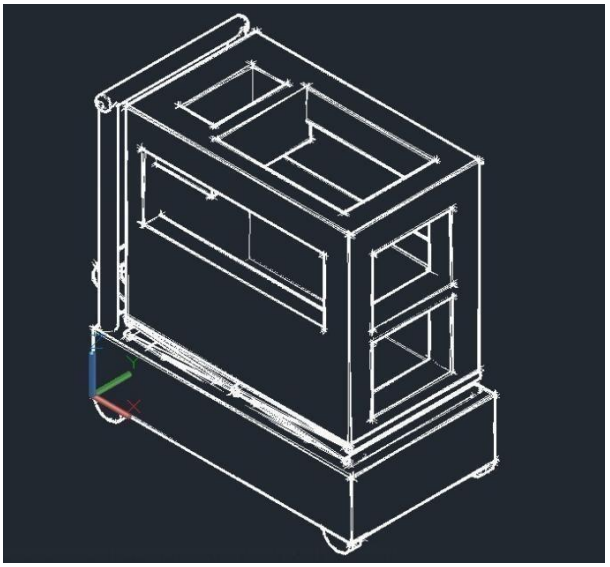


Figure 3.15: Isometric View of Panels of the Cage and Platform

3.5.3.2 Mechanical

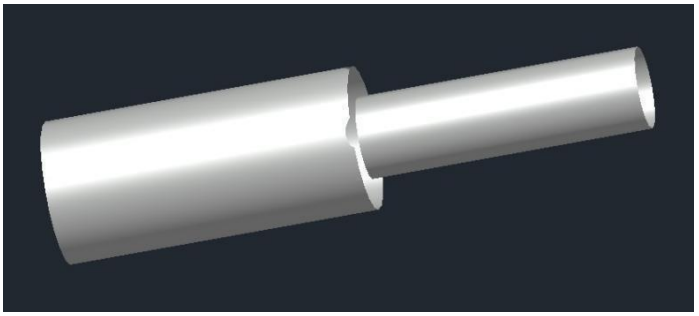


Figure 3.16: Isometric View of Hydraulic jack

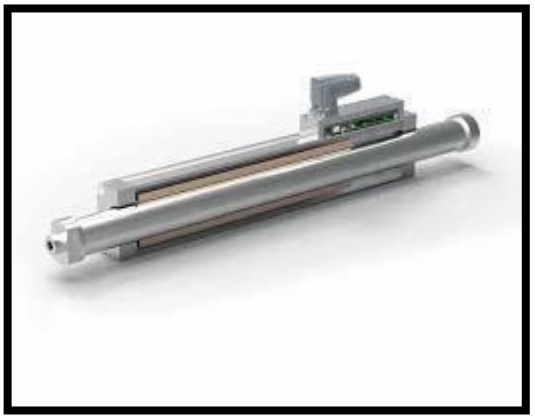


Figure 3.17: Linear Motor

3.5.3.3 Electronic Circuit Schematic

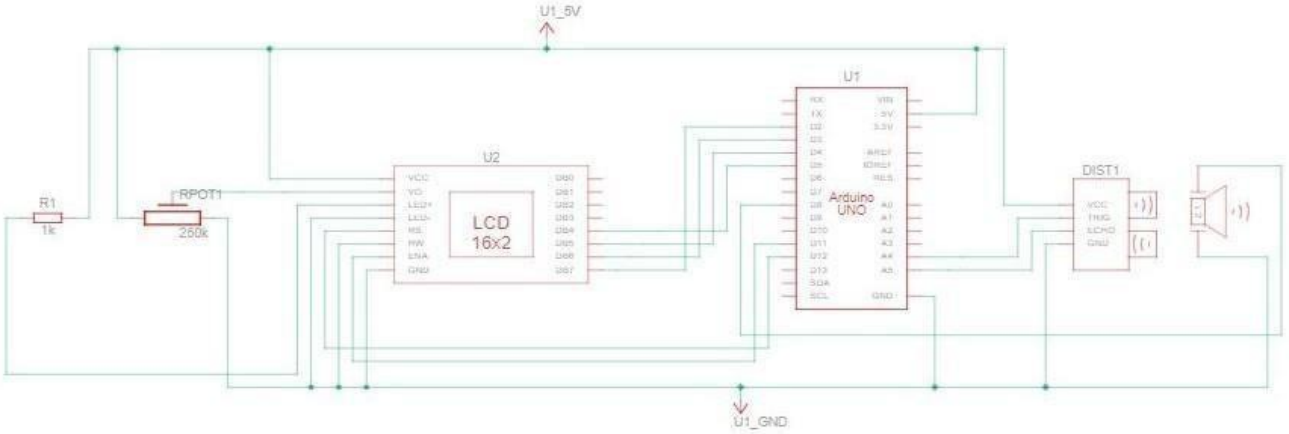


Figure 3.18: Arduino Schematic

3.5.3.4 Light Circuit Schematic

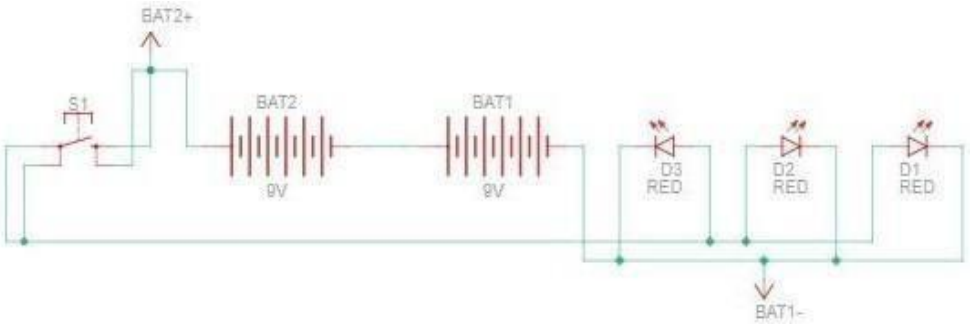


Figure 3.19: Light Schematic

3.5.3.5 Motor Circuit Schematic

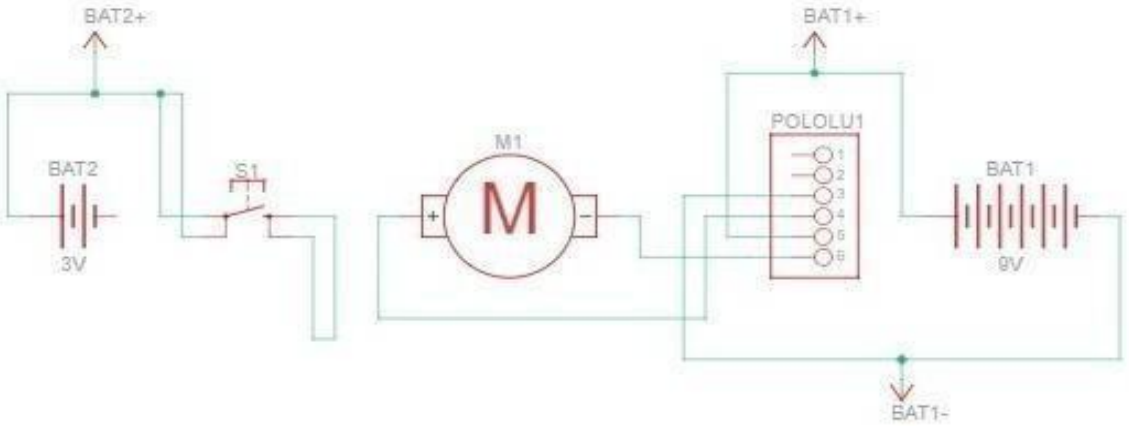


Figure 3.20: Motor Schematic

3.5.3.6 Arduino Coding for Sensors

```
#include <LiquidCrystal.h>
#define trigger 18
#define echo 19
#define tonePin 8

LiquidCrystal lcd(12,11,5,4,3,2);

float time=0,height=0;

void setup()
{
 lcd.begin(16,2);
 pinMode(trigger,OUTPUT);
 pinMode(echo,INPUT);
 pinMode(tonePin, OUTPUT);
 lcd.print("WELCOME To");
 lcd.setCursor(0,1);
 lcd.print("HIGH UPLIFT");
 delay(3000);

}

void loop()
{
 lcd.clear();
 digitalWrite(trigger,LOW);
 delayMicroseconds(2);
 digitalWrite(trigger,HIGH);
 delayMicroseconds(10);
 digitalWrite(trigger,LOW);
 delayMicroseconds(2);
 time=pulseIn(echo,HIGH);
 height=time*340/20000;
 lcd.clear();
 lcd.print("HEIGHT:");
 lcd.print(height);
 lcd.print("cm");
 lcd.setCursor(0,1);
```

Figure 3.21: Arduino Coding for Sensors in Arduino Software IDE

3.6 Development of Product

3.6.1 Material acquisition

3.6.1.1 Structure and Furnishing

Table 3.11: List of Materials Used for High Uplift Structure

No	Material	Description
1	 5ft x 10 ft x 0.21mm sheet metal	5ft x 10 ft x 0.21mm sheet metal were bought. The sheet metal are to attach in cage of the project act as safety features as well as aesthetic look.
2	 Pop aluminum blind rivet, 4.8mm	Pop aluminum blind rivet, 4.8mm . The rivet function is to attach the sheet metal to the cage of platform.

3	 Mini Toolbox	The mini toolbox is for keeping specialized equipment easily available, improving overall at ease. It is attached in the cage of the platform.
4	 Beacon Light	The beacon light improving safety by giving a visible warning signal, identifying the working condition of the hydraulic scissor lift. The beacon light is attached in the upper part of the project or in the cage.
5	 Caution tape	Caution tape is attached around the cage part of the project ensures a warning indication.
6	 Black Spray Paint	The product's exterior or sheet metal part is finished with flat black spray paint.

7	 Anti rust lubricant spray	Anti-rust lubricant is used as the base coating as well as to remove corrosion from sheet metal.
8	 Acrylic tape	The tape is utilized to attach the electrical box and also for furnishing parts.

3.6.1.2 Mechanical

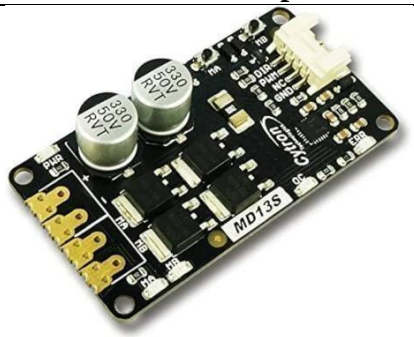
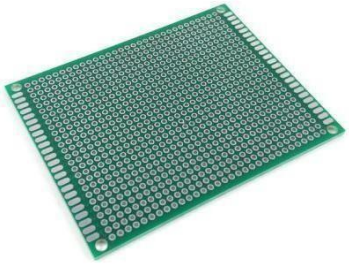
Table 3.12: List of expenditure for mechanical part

No	Material	Description
1	 Linear motor	The linear motor is utilized to retraction the hydraulic jack, which will be attached beneath the project.
2	 Steel band	The steel band is used to attach the linear motor to the hydraulic jack, to make the attachment stronger.
3	 Cable tight	The cable tight is used to secure the linear motor to the hydraulic jack.

3.6.1.3 Electrical / Electronic / Programming of High Lift

Table 3.13: List of Components & Software Used for High Lift Electronics

No	Material	Description
1	 **Push on button**	Used to control Md13s motor driver for the descent
2	 **Toggle switch**	Used to control the beacon light circuit
3	 **Rocker Switch**	Used to control the power supply for the DC linear actuator
4	 **Wires**	Used to connect the Md13s motor driver to the push on button

5	 **Male to male Jumper wire**	Used to connect the pins of the sensors to the Arduino UNO R3.
6	 **Female to male Jumper wire**	Used to connect the pins of the display to the Arduino UNO R3.
7	 **Md13s motor driver**	Used to control the DC linear actuator extension and retraction
8	 **Donut board**	Used as a permanent basis for all of the electronic components.

9	 **Potential meter**	Used to regulate the current going to the display
10	 **Piezo buzzer**	Used to produce a warning sound if the High Uplift exceeds the safety height
11	 **Arduino UNO R3**	Arduino UNO R3 used as the microcontroller to receive data from the sensors and send the data to the display and Piezo buzzer
12	 **Ultrasonic sensor**	Used to monitor the height of High Uplift

13	 **Lcd (liquid crystal display) 2 X 16**	Used to display the current height while lifting
14	 **9v battery**	Supplies power to Arduino UNO R3, DC linear actuator and beacon light
15	 **AA battery**	Supplies power to the Md13s motor driver as an input
16	 **Arduino IDE**	It is the main program used to code the Arduino Uno R3.

17	 **PVC tape**	Used to secure the wiring connection
18	 **Electronic box**	Used to contain all of the electronic components

3.6.2 Machines and Tools

3.6.2.1 Machine for High Uplift Fabrication

Table 3.14: List of Machines Used for High Uplift Fabrication

No	Machine	Description
1	 Squaring shear	To cut the sheet metal into pieces
2	 Pneumatic drill gun	To drill holes for the installation of sheet metal
3	 Portable electrical drill	To drill holes for the installation of sheet metal
4	 Air riveter	To install blind rivets used in sheet metal attachment

5	 Grinder	To cut sheet metal and clean the surface of rust.
6	 Welding machine	To hold or attach bracket for the linear motor

3.6.2.2 Tools Used for HIGH UPLIFT Fabrication

Table 3.15: List of Tools Used for HIGH UPLIFT Fabrication

No	Tools	Description
1	 Screwdriver	Used to rotate the electrical connection screws for switches and plug top
2	 Soldering iron set	The electronic components are assembled onto the breadboard using solder.
3	 Measurement tape	To measure the product and also to measure the sheet metal before cut.
4	 Bastard files	To make sure the sheet metal has a perfect finishing.

3.6.3 Specific Project Fabrication

3.6.3.1 Base Structure

Table 3.16: Project Fabrication for Base Structure

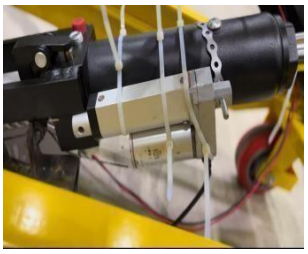
No	Fabrication Process	Description
1	 Material acquisition	Sheet metal bought to attach in our product.
2	 Measuring and marking	The sheet metal length is measured and marked in accordance with the cage's specifications.
3	 Cutting	The sheet metal was cut by utilizing the squaring shear machine
4	 Drilling	Holes in the sheet metal drilled to meet the needs of riveting.

5	 Riveting	The rivets installed into the holes that attach the sheet metal installed.
5	 Brushing	All of the rust from the sheet metal eliminated by using the power brush.
6	 Apply anti rust lubricant and black spray	Anti-rust lubricant used to prevent more rusting. Several coats of paint are used to enhance the finishing's consistency and texture.
7	 Final look after paint	To achieve the desired appearance, every sheet of metal was thoroughly examined to check for any discolorations.

3.6.3.2 Mechanical

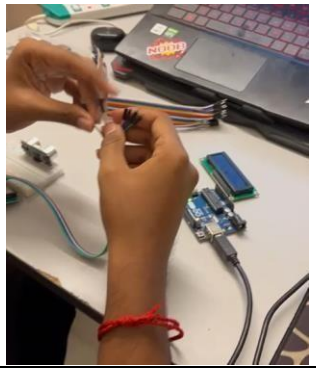
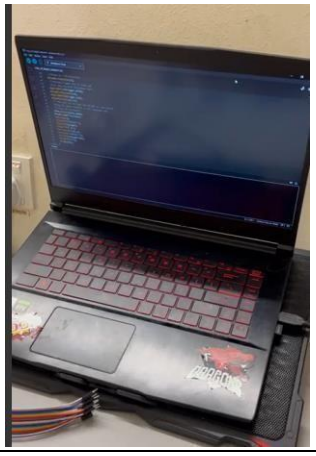
Table 3.17: Project Fabrication for Mechanical Part

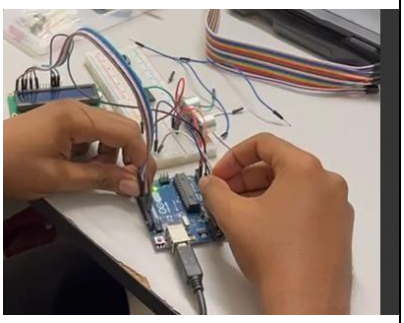
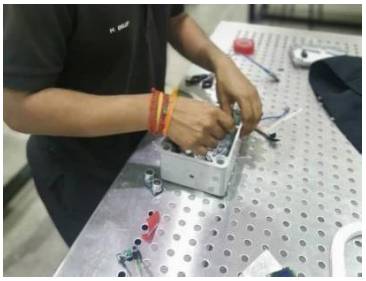
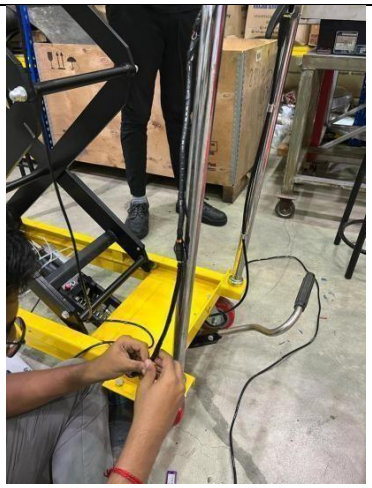
No	Fabrication Process	Description
1	 Material acquisition	Bought a linear motor
2	 Grinding	The linear motor mounting bracket was grinded.
3	 Welding	The bracket for the linear motor placement were welded.

4	 Welded bracket	The welded bracket was attached.
5	 Linear motor attachment	The linear motor was attached to hydraulic jack by using cable tight and also steel band.
6	 Final touch and test run	The attached motor was tested to ensure it worked properly and then sprayed black.

3.6.3.3 Electrical / Electronic / Programming Table

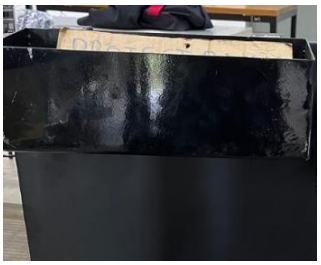
Table 3.18: Electronics Assembly & Programming

No	Fabrication Process	Description
1		Assembly and testing of DC linear actuator circuit.
2		Process of soldering the motor circuit on a donut board.
3		Process of assembling Arduino Uno board and components on a breadboard.
4		Process of uploading the code to the Arduino Uno board via Arduino IDE.

5		Testing process of the components by building the circuit on a breadboard.
6		Process of soldering the arduino Uno board and the components on a donut board.
7		All component has been assembled to in the electronic box. Which later had been divided in to 2 categorizes upper part and lower part.
8		All of the expose wiring we covered by a spiral wrap

3.6.3.4 Finishing

Table 3.19: Project Fabrication for Mechanical Part

No	Project Fabrication	Description
1	 Caution tape	Caution tape was utilized to guarantee that the warning signal was visible.
2	 Beacon light	A beacon light was installed to indicate a warning signal.
3	 Mini toolbox	A mini toolbox was attached to keep the tools that were needed.

3.7 PRODUCT TESTING / FUNCTIONALITY TEST

After completing our project, we all did a lot of testing to ensure that our project was functional. The first step is performance testing. our high uplift works excellently in a variety of circumstances. we all tested its lifting and lowering capacities, speed, and ability to handle the specified weight capacity, which was the maximum of 350 kg. we tested with one of our team members at a time, and luckily the product was stable and capable of lift and lowering smoothly.

Following that, come the safety checks. Check that all safety measures, including button controls, are operational. This includes testing emergency stop features, validating the reliability of security aspects, and confirming that warning lights perform as intended.

Furthermore, testing for space efficiency. We undertake testing to guarantee that the lift can navigate and operate properly in limited places since the High Uplift project focuses on tight spaces. We perform the testing with our supervisor in order to have more solid evidence. We assess its maneuverability and adaptability to different workstation arrangements.

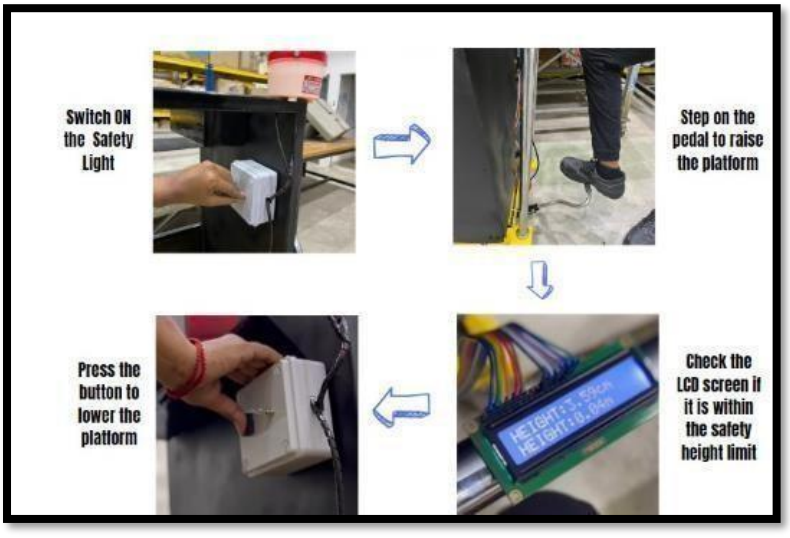


Figure 3.22: Product Operation

3.8 LIST OF MATERIALS & EXPENDITURES

Table 3.20: List of Materials & Expenditures

Product Structure and Furnishing				
No.	**Item details**	**Unit**	**Price/Unit (RM)**	**Total (RM)**
1	Spray paint (MR.DIY) black	4	6.90	27.60
2	Spray paint (Anchor) black	1	9.00	9.00
3	Arrow multipurpose (anti- rust spray)	2	7.00	14.00
4	Caution tape 50mm x 60m HP 146075738	1	3.50	3.50
5	Acrylic tape D/S Tape 24mm x 2m HP115075741	1	7.80	7.80
Product Mechanisms				
1	Aluminium sheet (5ft x 10 ft x 0.21mm)	1	25.00	25.00
2	Hydraulic actuator / Linear motor	1	100.00	100.0
Electric and Electronic				
1	Battery wireless doorbell	1	17.90	17.90
2	Solder tin	1	6.90	6.90
3	Heat shrink tube set	1	2.90	2.90
4	Terminal block	1	2.70	2.70
5	Red DC 12V LED King-sway	1	27.00	27.00
6	HEK/OPS wire tape black	1	0.60	0.60
7	1.5mm single cable - red	5	0.90	4.50
8	1.5mm single cable - black	5	0.90	4.50
9	40pcs DuPont jumper cable (30cm)	1	5.50	5.50
10	16x2 LCD blue/green backlight	1	15.00	15.00
11	Transistor S8050 NPN 40V 0.5A	4	0.25	1.00
12	Transistor S8550 PNP 40V 0.5A	4	0.25	1.00
13	TRAN-0009 BC 557 PNP TO -92	2	0.50	1.00
14	TRAN-0001 2N 2222 NPN TO-92	2	0.40	0.80
15	SWH - 0028 Rocker switch 3 pin	2	3.50	7.00

16	IC-0090 SN74HC00N IC 7400 DIP 14	1	1.50	1.50
17	IC-0014 SN74HC08N IC 7408 DIP 14	2	3.00	6.00
18	BDT - 0006 Donut board 9cm x 15 cm	1	4.90	4.90
Others				
1	65mm cup brush	1	7.60	7.60
2	3 pieces 3.0mm HSS - CO Drill (set)	3	5.10	5.10
3	1 piece 3.5mm Bosch HSG - G Drill	1	3.40	3.40
Grand Total				313.70

CHAPTER 4

RESULT AND DISCUSSION

4.1 PRODUCT DESCRIPTION

4.1.1 General Product Features & Functionalities

High uplift is a hydraulic scissor lift innovation. In general, this piece of machinery is divided into two compartments or sections, with the lower half housing the hydraulic scissor lift and the upper section serving as a platform for standing while carrying out maintenance tasks.

The major goal of this innovation is to build a compact and flexible structure suited for use in small aircraft, as well as with the product's height constraint to execute a maintenance operation in a hangar.

Second, it is to create a hydraulic system that supports the product and permits precise control of the lifting mechanism. When the upper platform is withdrawn and retracted with the use of a hydraulic system, this is referred to as a lifting mechanism.

Last but not least, it aims to show the High Uplift framework by supporting engineers in inspecting small aircraft.

4.1.2 SPECIFIC PART FEATURES

4.1.2.1 Product Structure

In general, the high up lift is divided into two compartments: upper and lower. The product is entirely constructed of metal. The upper section measures 90cm x 51cm, while the lower section measures 120cm x 60cm.

The upper platform is covered with a cage in dimension of 90cm x 51cm x 126cm. It is to let people stand on the upper platform safely and perform maintenance task on small aircraft any other aircraft with the sustainable height.

4.1.2.2 Mechanical Mechanism

The lower component is intended to house the hydraulic jacking system and scissor lift, which support the upper platform's extraction and retraction procedure.

The upper platform with the cage bottom half is coated with aluminium sheet metal to make it more secure, such as preventing tools from falling from the gap and people from falling from it accidentally.

4.1.2.3 Electrical / Electronics / Programming

The electronics of HIGH UPLIFT are consisting of button system which is connected to the motor which is fixed with hydraulic jacking system. It is used to retract the upper platform automatically from the button system which is fixed on the upper platform.

Not only that, but a sensor has been included to measure the height of the upper platform, which will be measured and shown on the LCD with the help of the ARDUNOUNO. It also includes a buzzer, which will sound if the upper platform exceeds the safelimit.

4.1.2.4 Accessories and Finishing

The HIGH UP LIFT is completely painted in black and yellow, which is the colour of warning. As part of that, there is a beacon light on the higher platform to alert people that maintenance work is being done and there are individuals are on the upper level.

Furthermore, as a product safety feature, the cage on the upper level is enclosed by a caution label.

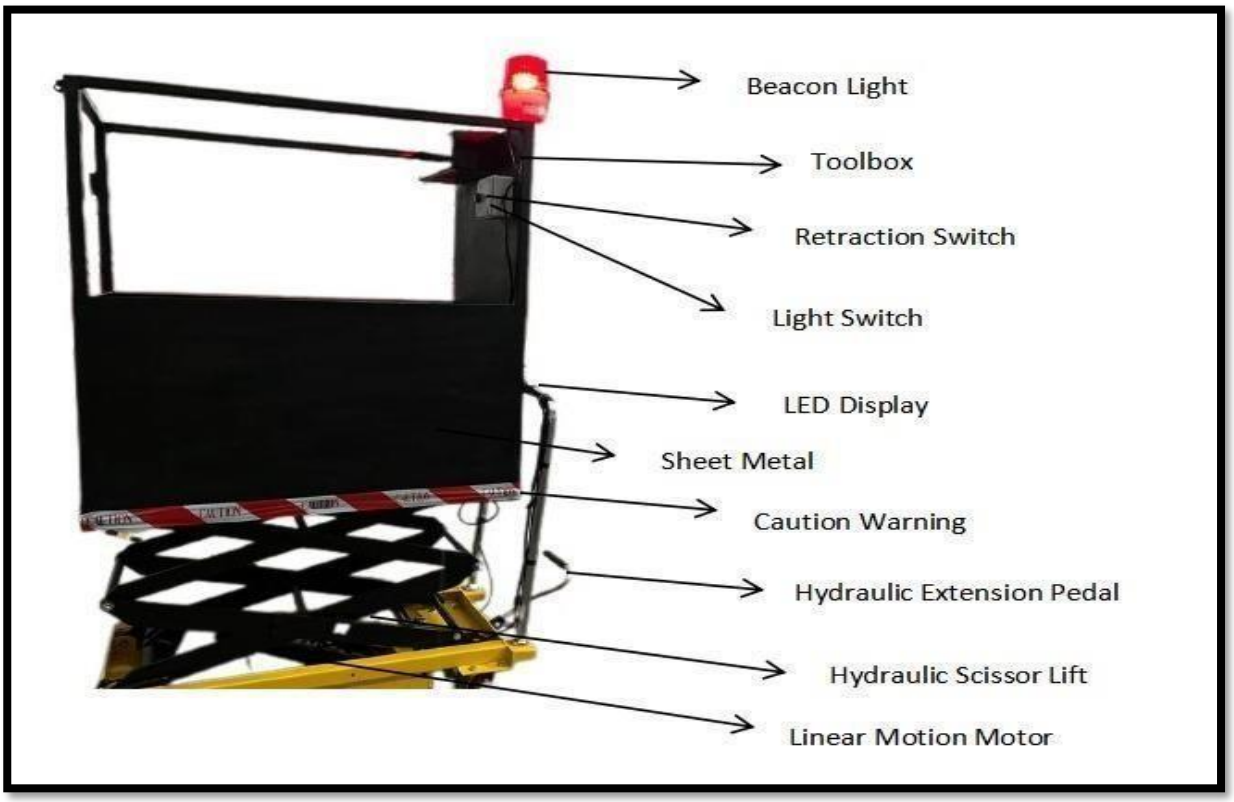


Figure 4.1: Front View of Finished Product with Labels

Figure 4.2: Top View of Finished Product

Figure 4.3: Product View Before Extraction

Figure 4.4: Product View After Extraction

4.1.3 Result for Product Extraction

Figure 4.5: Extraction of Hydraulic Scissor Lift

The hydraulic cylinder slides. The force that lifts the weight retained on the platform is determined by three factors: the angle of the connecting rod relative to the floor or base, the linked cylinder, and the connecting rod length. When the connecting rod is closed, the force acting on it is the maximum.

4.1.4 Result of Sensor on Measuring the Height

Figure 4.6: Reading of Height

The height sensor is fixed to indicate the difference in height between the lower and upper platforms. It is a method of ensuring that the upper platform is stable enough to execute the maintenance task and does not exceed the height limits of 1. 15m.Furthermore, if the height exceeds the height limitation, the buzzer will sound as a warning to the maintenance staff that it is not safe to perform the maintenance operation.

4.1.5 General Product Operation

Before the maintenance person enters the cage of the upper platform, the PVC Caster Wheel must first be locked. The purpose is to ensure that it does not move while doing aircraft maintenance tasks. Second, the individual entering the cage can keep the tools in the portable toolbox located close to the electrical box. Once inside the cage, the person must ensure that the door is secured and that he stands behind the caution sticker that is stuck on the threshold to protect his safety and stability while in a high place. Not only that, but he must activate the beacon light switch to alert the ground crew that maintenance is being performed.

Once the person in the cage is ready, another maintenance technician can step on the pedal connected to the hydraulic jack to lift up the scissor lift which is connected to the upper platform. When the upper platform has achieved the required height for the maintenance task, the maintenance assistance can cease pedaling. The maintenance technician on the higher platform can then perform the maintenance task with the tools he brought together and stored in the toolbox.

The ultrasonic sensor installed on the lower platform will measure the height of the upper platform to ensure its stability at that height. If the individual on the upper platform requests that the scissor lift be lifted higher, it is conceivable and safe, but the height should not exceed 1.5m. When the maintenance operation is completed, the operator on the upper platform can use the motor extraction switch to retract the scissor lift or release the jack. If the motor extraction switch is not working, the maintenance assistant on the ground can use the bicycle brake lever to release it, which is connected to the hydraulic jack via a control cable. However, it is just for emergency use.

4.1.6 Operation of the Specific Part of the Product

4.1.6.1 Product Structure

The HIGH UPLIFT product is entirely made of metal, which makes it more compact and stable while operating on the ground. The cage on the upper level where people stand is composed of metal as well. Aside from that, thin mild steel sheet metal have been riveted around the lower half of the cage as an added safety element. It aids in ensuring that tools dropped from the higher platform do not slip and fall to the ground. Not only that, but it also makes the maintenance workers on the upper platform feel more secure when performing maintenance tasks on aircraft.

4.1.6.2 Product Mechanism

This HIGH UPLIFT product includes a total of four mechanisms. First and foremost, there is the hydraulic scissor lift. The hydraulic scissor lift is the project's backbone, connecting the top and lower surfaces. When it comes to the hydraulic scissor lift extraction method, a leg pedal has been put on the bottom platform of the project and is connected to the hydraulic. When someone presses the pedal with their leg, thehydraulic scissor lift will extend.

There are two hydraulic methods for retracting the upper platform. First and foremost, there is a lever at the handle bar that is linked to the hydraulic via a control cable. It's more akin to a bicycle brake mechanism. When someone presses the lever, the control cable connected to the hydraulic releases it. Second, next to the hydraulic is a 12W DC actuator motor. A little piece of metal has been welded to the control cable's bolt; when the motor is engaged by pressing the button on the upper platform, it begins to extract and pushes the metal piece that is attached to the control cable. Then hydraulic scissor lift will then retract automatically.

4.1.6.3: Product Electrical / Electronics / Programming

The HIGH UPLIFT product is made up of a few electronics and electrical components, as well as programming components such as an ARDUINO R3, an ultrasonic sensor, and many others. A button system has been installed on the upper platform and is wired all the way to the 12W DC Motor located next to the hydraulic system. The button is used to lower the hydraulic scissor lift, which is controlled by those on the higher level.

The ARDUINO UNO R3 comes next. The component of this HIGH UPLIFT product's function is to measure the height difference between the lower and upper platforms. An ultrasonic sensor has been installed on top of the lower platform to assist the ARDUINO UNO R3 in measuring height. Not only that, but a buzzer has been included in this circuit to ring if the top platform exceeds the safe height limit. All the components have been safely and neatly stored in electrical box.

4.1.6.4 Accessories and Finishing

A beacon light has been placed to the upper platform as part of the accessories and finishing. Beacon lights serve as warning systems for the majority of people, keeping them safe, especially in dangerous situations. Not only that, but caution tape has been placed around the cage to prevent anyone from accidently hitting it.

4.1.7 Post Survey

A post-survey was conducted to determine how our product was used by users. The post-survey was issued to all PBS students, as well as lecturers and licenced aircraft engineers, to get their thoughts on our project and their level of satisfaction.

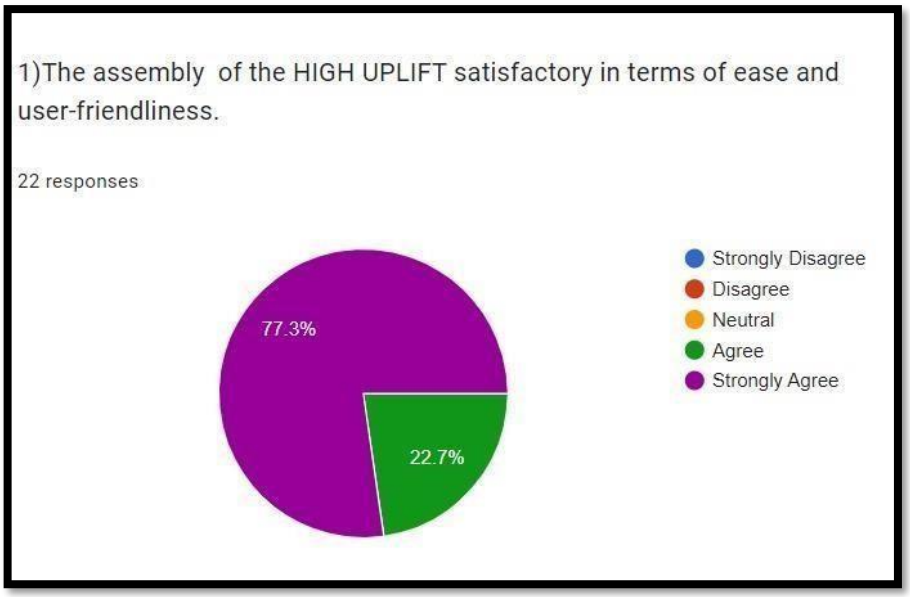


Figure 4.7: Respondents Perception that the Assembly of the HIGH UPLIFT Satisfactory in Terms of Ease and User-Friendliness

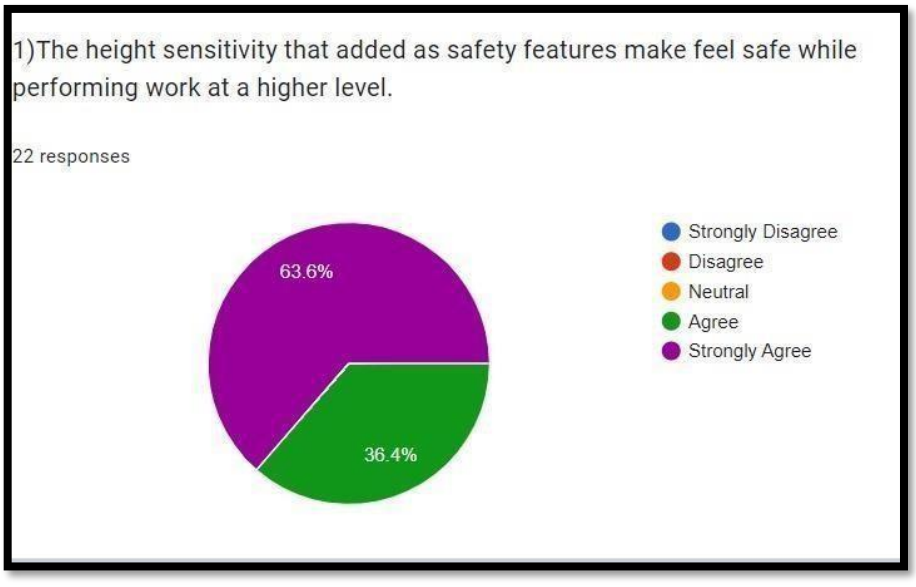


Figure 4.8: Respondent's Perception that the Height Sensitivity That Added as Safety Features Make Feel Safe while Performing Work at a Higher Level

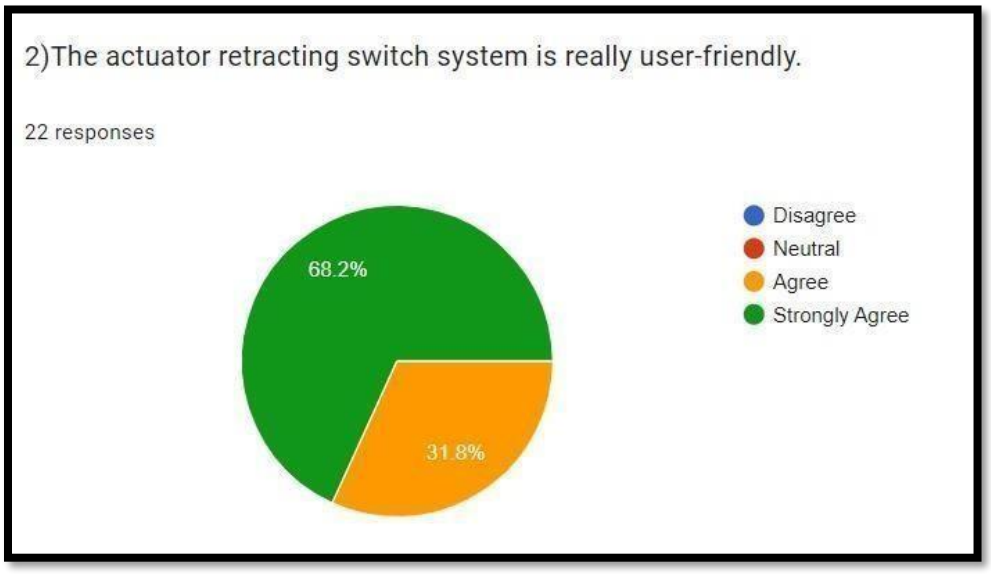


Figure 4.9: Repondent's Perception that the Actuator Retracting Switch System is Really User-Friendly

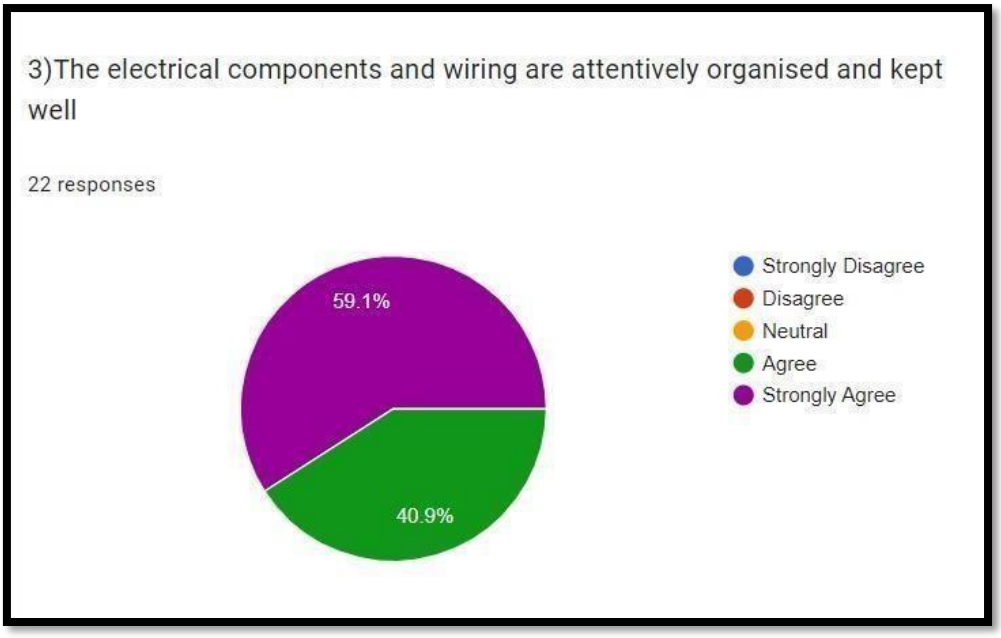


Figure 4.10: Rspondent's Perception that the Electrical Components and Wiring are Attentiively Organised and Kept Well

100% of the respondents agrees that the assembly of the HIGH UPLIFT satisfactory in terms of ease and user-friendliness and height sensitivity that added as safety features make feel safe while performing work at a higher level. 68.2% of respondents has strongly agrees that actuator retracting switch system is really user-friendly.

4.2 PRODUCT OUTPUT ANALYSIS

4.1 Table of Product Output Analysis

NO	Parameters	Results	Remarks/Description	Analysis
1.0	**Speed Limit**			
1.1	Speed Limit (Unloaded)	4.5km/h	A maximum speed that a hydraulic scissor lift can reach during unload	In terms of speed limit, High Uplift is capable to move in speed of 4.5km/h top speed during unloaded. However, it is not advisable to move during loaded.
1.2	Speed Limit (Partially Load)	0km/h	Not advisable to move when partially load	It could lose its stability and not advisable to move
1.3	Speed Limit (Fully Loaded)	0km/h	Strongly not advisable to move	Possible to lose its stability and strongly not advisable to move
2.0	**Time of Operation**			
2.1	Max time	-60s to extract -15s to retract	The time taken to pedal the hydraulic jack to reach the max height is 60s and time taken to retract is 15s by using linear motor	
I.	Weight / Load	350kg		
II.	Turning Radius	None		
III.	Capacity / Volume	Lower Platform:1440m³ Upper Platform: 5140.08m³		
IV.	Output Power / Voltage	294W power needed to pedal the hydraulic jack 12V of linear motor needed to retract		

CALCULATION FOR CAPACITY / VOLUME

Lower platform: (120cm x 60cm x 20cm) ÷ 100cm

: 144000cm ÷ 100cm

: 1440m^3

Upper Platform: (90cm x 51cm x 112cm) ÷ 100cm

: 514080cm ÷ 100cm

: 5104.08cm^3

Figure 4.11: Calculation of Capacity / Volume

CALCULATION OF OUTPUT POWER

F = m. g

F = (180kg x10N) x 9.8m/s^2

F = 1800N x 9.8m/s^2

F = 17640N

POWER = FORCE / TIME

Power = 17640N / 60s

Power = 294W

Figure 4.12: Calculation of Output Power

4.3 ANALYSIS OF PROBLEM ENCOUNTERED & SOLUTIONS

4.3.1 Product Structure

One of the difficulties we had in completing the project on time was riveting the thin mildsteel sheet that covered the cage. Because the mild steel was completely rusted and bent,it was too heavy to transport. As a first step, we marked the measurement that we neededto utilise on the cage with a scriber. After we finished marking, we moved on to the nextstage, which was to cut the parts we needed from the thin mild steel sheet.

As a next step, we put in a power brush into the drill and cleaned up the surfaces of the thin mild steel sheet that we cut to the dimensions we need.After removing all of the rust using a power brush, we put anti-rust spray to the sheet metal surfaces to prevent corrosion before beginning to paint the sheet metal.

4.3.2 Mechanical mechanism

We had an issue when it came to welding.We had to weld a little piece of metal into the control cable bolt so that when we fixed the linear motion motor, it would aid to drive the control cable back by putting pressure on the bolt.We were unable to weld with the equipment provided to us at the Composite Workshop because there was insufficient electricity to support it. So, in order to overcome this, we had to proceed to General Workshop 1 and experiment with the Arc Welding Machine there, and we were eventually able to finish the mission.

Another issue we ran into was with the hydraulic jack. The hydraulic was gradually giving us problems, because when we tried to jack the scissor lift, some kind of sound would come out. We had poured oil in it after some advice from a few lecturers to make the hydraulic action smoother. Finally, the advice was quite effective.

4.3.3 Electrical and Electronics / Progamming

We ran into trouble while organising all of the electrical components in the electrical box. During the test, all of the electrical components on the breadboard worked correctly and effortlessly. When we transferred all of the components onto the PCB / Donut board one by one, they began to lose their life. We found the soldering process to be quite challenging because the equipment provided to us was not functioning properly and the soldering wire wasn't sticking well to the board. So, when we attempted to arrange the components into the electrical box, they began to loosen and fall out one by one. To

solve this difficulty, we had to be patient and solder gently, making it thick with soldering wire so that it didn't losen.

4.3.4 Accessories and Furnishing

During the finishing process, we ran into an issue with hiding the wire that connects the switch on the top platform to the lower platform linear motion motor on the hydraulic jack.To solve this issue, we had to apply black spiral wrap to conceal the wire. Not only that, but we also painted the spiral wrap throughout the painting process to make it less obvious.

CHAPTER 5

CONCLUSION & RECOMMENDATIONS

5.1 ACHIEVEMENT OF AIM & OBJECTIVES OF THE RESEARCH

5.1.1 General Achievements of the Project

After doing final project testing, High Uplift is able to generate the desired results. The capacity of High Uplift to securely lift and descend the user is the criterion that determines the success of the product. In addition, a post-survey is carried out to collect information regarding customer satisfaction. The majority of responders concurred that performing maintenance in higher locations is easier based on the facts gathered.

5.1.2 Specific Achievement of Project Objectives

5.1.2.1 Product Structure and Finishing

The goal of creating the High Uplift structure has been accomplished. To achieve this goal, the proper structure's shape and dimensions are determined, and High Uplift is created to optimize the stabilizing impact of the product to the greatest extent feasible. AUTOCAD is used to create the structure, and this design is implemented in the finished product.

5.1.2.2 Mechanical and Design

The goals and objectives to improve the effectiveness and safety of doing inspections in higher places were met throughout the development of the High Uplift. The primary goal of incorporating the hydraulic actuator-driven scissor lift system's mechanical mechanism into our project is to facilitate and secure the user's work in elevated environments. The first product created and designed by High Uplift is the scissor lift system. In order to safely raise and lower the user, our project, High Uplift, makes use of a scissor lift system, which offers a complete mechanical mechanism throughout the High Uplift operation.

5.1.2.3 Electrical / Electronic / Programming

A height sensor built into High Uplift allows users to keep an eye on their current height when lifting, and if the lift surpasses its operating height limit, a warning sound will alert users to the danger. Consequently, the creation of the height monitoring and warning system represents the accomplishment of the project's Electrical, Electronic, and Programming mechanism goal.

5.1.2.4 Accessories and Furnishing of the Product

The completed product has a number of features that improve its safety characteristics and facilitate the inspection procedure. First, sheet metal was added to the upper portion of the High Uplift to prevent user-dropped equipment from falling to the ground. Second, a portable toolbox was added to store tools while performing inspections at higher locations. Apart from that, the product has a beacon light attached to it that may be utilized to alert people when the product is near.

5.2 CONTRIBUTION OR IMPACT OF THE PROJECT

The hydraulic scissor lift of the High Uplift project is revolutionizing aviation servicing. It maximizes productivity and versatility with its user-friendly controls, improved safety measures, and compact design for confined situations. In addition to providing increased safety and comfort, the lift's innovative technology and other features like warning lights and a small toolkit also help to save time and resources. This innovativeapproach meets particular requirements in small aviation maintenance organizations, resulting in a notable increase in productivity.

5.3 IMPROVEMENT & SUGGESTIONS FOR FUTURE RESEARCH

5.3.1 Product Structure

Further research on High Uplift with regard to the structure is advised in order to strengthen the foundation with a redesigned base and optimize structural support to enhance stability during lifting operations. This will guarantee a safe platform for maintenance workers performing elevated aircraft maintenance tasks.

5.3.2 Mechanical Mechanism

As we conduct further research and development, we hope to replace the hydraulic actuator with a linear DC motor actuator and a 2-way switch, which will operate as the actuator to raise the scissor lift system and boost the efficiency of the process of elevating the user to the inspection. By using a 2-way switch, the user can elevate and descend automatically because the linear DC motor actuator can lift and descend the High Uplift.

5.3.3 Electrical / Electronic / Programming

In order to make the High Uplift more user-friendly, we would like to add a feature that allows us to control the lifting and descending system wirelessly via our phones via Bluetooth connections. This will allow us to conduct further research into the

electronics and programming of the High Uplift. It would also be preferable to be able to develop a stand-alone programmed designed especially to be utilized with the High Uplift.

5.3.4 Accessories and Furnishing of the Product

An integrated LED lighting system on the platform for the accessories greatly improves vision in dimly lit regions during aircraft maintenance. Adjustable lights provide accuracy and efficiency for maintenance operations in a variety of settings by focusing on particular work zones

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APPENDIX A: DECLARATION OF TASK SEGREGATION

SUB-CHAPTERS	DESCRIPTION
RUBANESH BALAMURUGAN	
1.1	Background of Study
1.3.1	General Project Objectives
1.3.2.1	Specific Individual Project Objectives: Product Structure and Furnishing
1.4	Purpose of Product
1.5.1	General Project Scopes
1.5.2.1	Specific Individual Scope : Product Structure and Furnishing
2.1.1	Demand in Aviation
2.1.2.4	Types of scissor lift in market :Rough terrain scissor lifts
2.1.2.5	Types of scissor lift in market : Pneumatic Scissor Lifts
2.2.1	Specific Literature Review : Product Structure
2.2.1.2	Types Of Material for Product Structure
2.2.1.3	Accessories and Furnishing of the Product
2.3.1	Related Patented Products
2.3.2	Recent Market Products
2.4.3	Scissor Lift vs High Uplift vs Skyjack SJ3215 Electric Scissor Lift
3.1	Project Briefing & Risk Assessment
3.2.1	Overall Project Gantt Chart : Gantt Chart for AEM
3.2.2	Overall Project Gantt Chart : Gantt Chart for AEP
3.3.1.2	Overall AEP Flow Chart
3.3.2.1	Specific Project Design Flow / Framework : Product Structure and Furnishing
3.4.2	Design Concept Generation
3.5.3.1	Specific Part Drawing / Diagram : Product Structure
3.6.1.1	Material acquisition : Product Structure
3.6.2	Machines and Tools
3.6.3.1	Specific Project Fabrication : Base Structure
3.6.3.4	Specific Project Fabrication : Finishing
3.8	List Of Materials & Expenditures
4.1.2.1	Specific Part Features : Product Structure

4.1.2.4	Specific Part Features : Accessories and Finishing
4.1.6.1	Operation of the Specific Part of the Product : Product Structure
4.1.6.4	Operation of the Specific Part of the Product : Accessories and Finishing
4.3.1	Analysis Of Problem Encountered & Solutions : Product Structure
4.3.4	Analysis Of Problem Encountered & Solutions : Accessories and Finishing
5.1.2.1	Specific Achievement of Project Objectives : Product Structure
5.1.2.4	Specific Achievement of Project Objectives : Accessories and Finishing
5.3.1	Improvement & Suggestions For Future Research : Product Structure
5.3.4	Improvement & Suggestions For Future Research : Accessories and Finishing
DILIP NANDAKUMAR	
1.2	Problem Statements
1.3.2.2	Specific Individual Project Objectives: Mechanical and Design
1.5.2.2	Specific Individual Scope : Mechanical and Design
2.1.2.2	Types of scissor lift in market : Hydraulic Scissor Lifts
2.2.2	Specific Literature Review : Product Mechanical
2.4.1	Lifting device for transport inspection tool box vs High Uplift vs Haulotte HS18D Diesel Scissor Lift
3.3.2.2	Specific Project Design Flow / Framework : Mechanical and Design
3.4.3	Evaluation & Selection of Conceptual Design
3.5.1	PRODUCT DRAWING / SCHEMATIC DIAGRAM :General Product Drawing
3.5.3.2	Specific Part Drawing / Diagram : Mechanical
3.6.1.2	Material acquisition : Mechanical
3.6.3.2	Specific Project Fabrication : Mechanical
3.7	Product Testing / Functionality Test
4.1.1	General Product Features & Functionalities
4.1.2.2	Specific Part Features : Mechanical Mechanism
4.1.5	General Product Operation
4.1.6.2	Operation of the Specific Part of the Product : Product Mechanism
4.1.7	Post Survey
4.2	Product Output Analysis
4.3.2	Analysis Of Problem Encountered & Solutions : Mechanical mechanism
5.1.2.2	Specific Achievement of Project Objectives : Mechanical and Design
5.3.2	Improvement & Suggestions For Future Research :Mechanical mechanism

AVINAASH GOGULA KRISHNAN	
1.3.2.3	Specific Individual Project Objectives:Electrical/Electronic/Programming
1.5.2.3	Specific Individual Scope : Electrical / Electronic / Programming
2.1.2.1	Types of scissor lift in market : Electric Scissor Lifts
2.1.2.3	Types of scissor lift in market : Diesel Scissor Lifts
2.2.3	Specific Literature Review :Electrical / Electronic / Programming
2.4.2	Self-lifting forklift truck vs High Uplift vs Sinoboom GTJZ3012D Diesel Scissor Lift
3.3.1.1	Overall AEM Flow Chart
3.3.2.3	Specific Project Design Flow / Framework : Electrical / Electronic / Programming
3.4.1	Design Requirement Analysis
3.5.3.3	Specific Part Drawing / Diagram : Electronic Circuit Schematic
3.6.1.3	Material acquisition : Electrical / Electronic / Programming
3.6.3.3	Specific Project Fabrication : Electronics Assembly & Programming
4.1.2.3	Specific Part Features :Electrical / Electronics / Programming
4.1.3	Result for Product Extraction
4.1.4	Result of Sensor on Measuring the Height
4.1.6.3	Operation of the Specific Part of the Product : Product Electrical / Electronics / Programming
4.3.3	Analysis Of Problem Encountered & Solutions : Electrical / Electronics / Programming
5.1.1	General Achievements of the Project
5.1.2.3	Specific Achievement of Project Objectives : Electrical / Electronics / Programming
5.2	Contribution Or Impact Of The Project
5.3.3	Improvement & Suggestions For Future Research : Electrical / Electronics / Programming

APPENDIX B: TURNITIN SIMILIRATY REPORT

Final Thesis

by Avinaash Gogula krishnan

Submission date: 06-Dec-2023 07:26PM (UTC+0800)
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Final Thesis

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46	Anh-Tuan Dang, Thi Thanh Nga Nguyen. "Investigation on the Design of Double-Stage Scissor Lifts Based on Parametric Dimension Technique", Machines, 2023 Publication	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	Off		

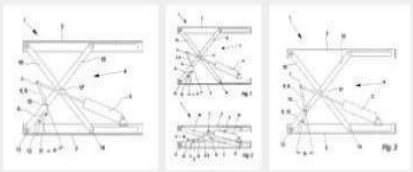
APPENDIX C: PATENTED PRODUCT FOR SCISSOR LIFT

Scissor lift and use of a scissor lift

Abstract

Disclosed is a scissor lift including a bottom frame, a top frame, a scissor mechanism arranged between the bottom frame and the top frame to displace the bottom frame and the top frame in relation to each other by means of the force provided by a linear actuator, a gearing arranged between the scissor mechanism and the linear actuator, where the linear actuator has a linear actuator point of attack at one end of a lever arm of the gearing, where the bottom frame is connected to a bottom frame point of attack at another end of the lever arm and where the scissor mechanism is connected to the lever arm through a lever arm pivotal joint arranged between the linear actuator point of attack and the bottom frame point of attack.

Images (3)



Classifications

B66F7/065 Scissor linkages, i.e. X-configuration

View 2 more classifications

US8888070B2
United States

Download PDF | Find Prior Art | Similar

Inventor: Martin OLESEN

Current Assignee : develtex ApS

Worldwide applications

2013 · DK EP ~~US~~

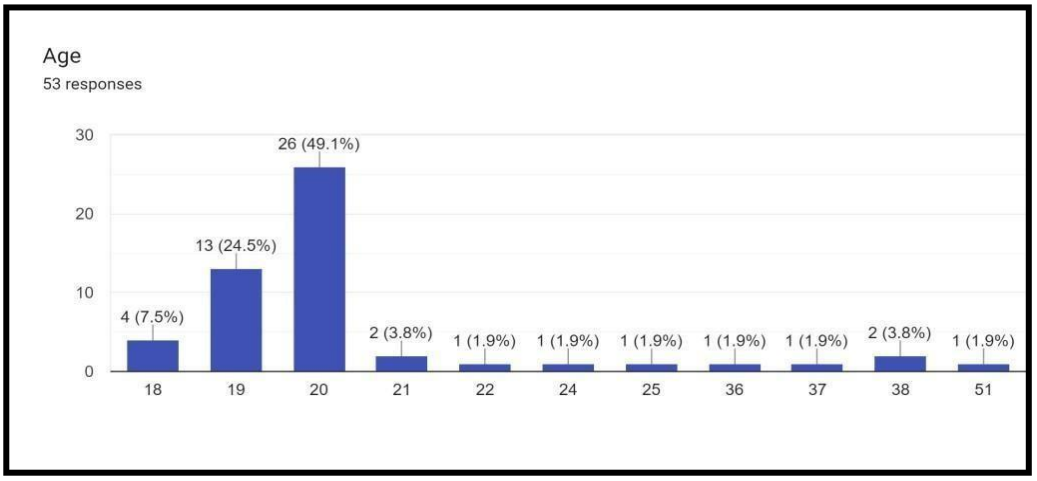
Application US13/911,360 events

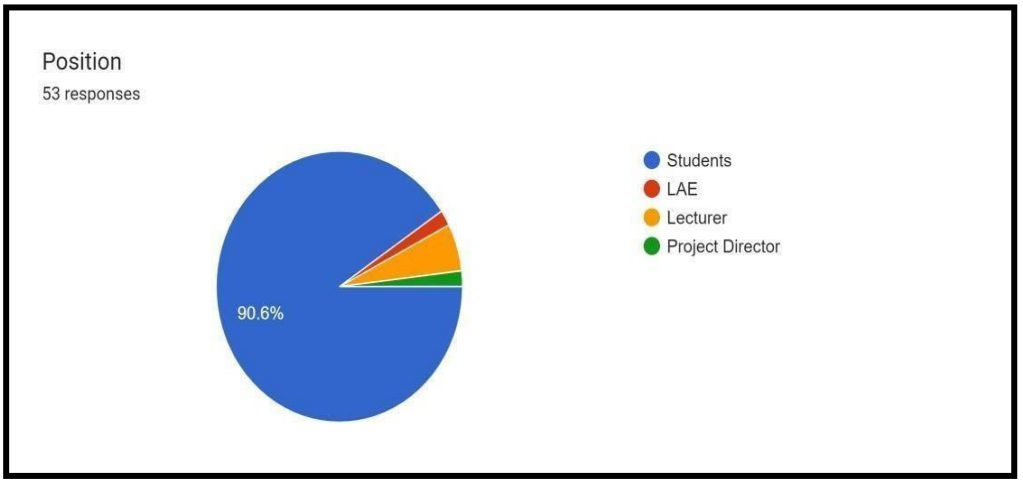
2013-06-06 • Application filed by develtex ApS
2013-07-31 • Assigned to develtex ApS
2013-12-26 • Publication of US20130341984A1
2014-11-18 • Application granted
2014-11-18 • Publication of US8888070B2
Status • Expired - Fee Related
2033-06-06 • Anticipated expiration

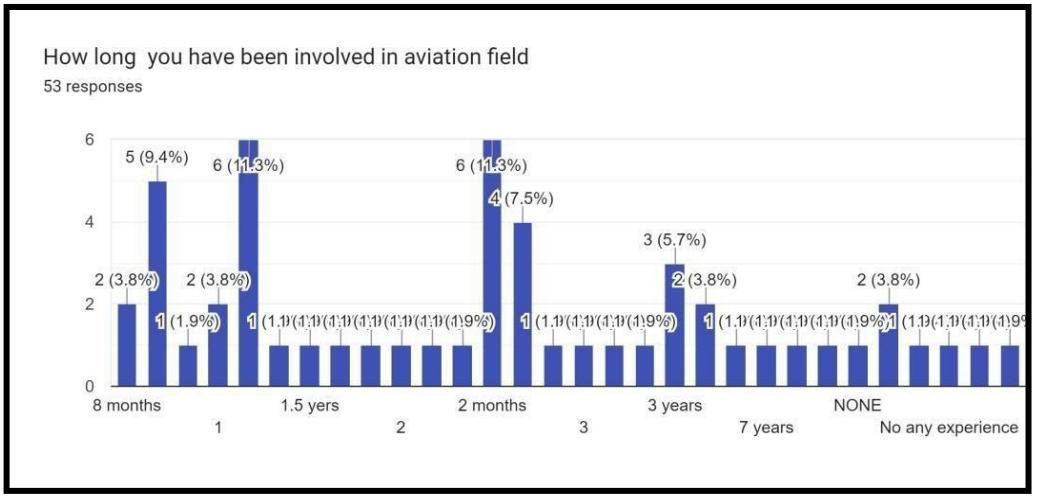
Info: Patent citations (18), Non-patent citations (1), Cited by (36), Legal events, Similar documents, Priority and Related Applications

External links: USPTO, USPTO PatentCenter, USPTO Assignment, Espacenet, Global Dossier, Discuss

APPENDIX D: PRE-SURVEY FORM

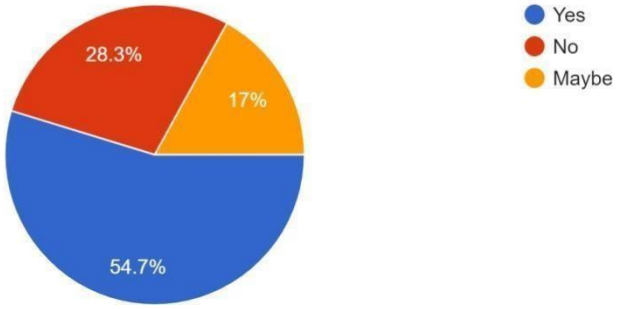






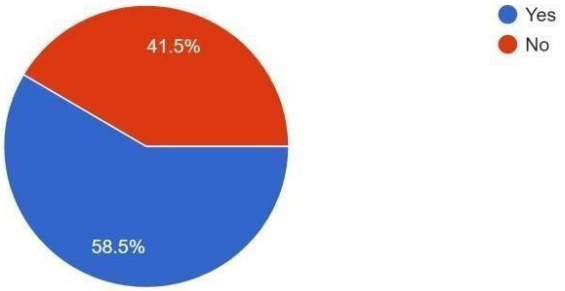
Have you ever misplaced any tools during maintenance work

53 responses



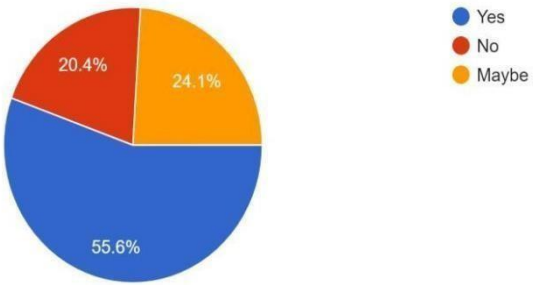
Do you own a toolbox

53 responses



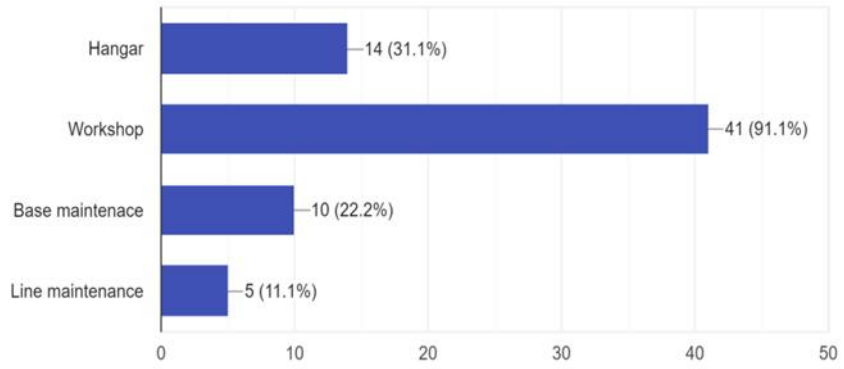
Do you frequently use toolbox or just carry tools by using your own hands

54 responses



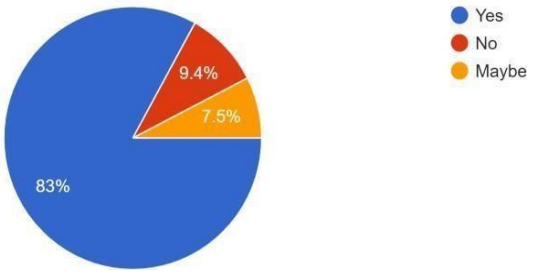
If yes, where do you use the toolbox

45 responses



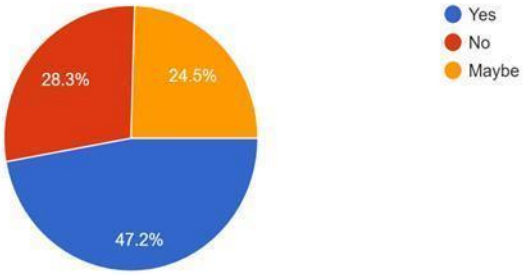
Is that really convenience to use a toolbox in workplace

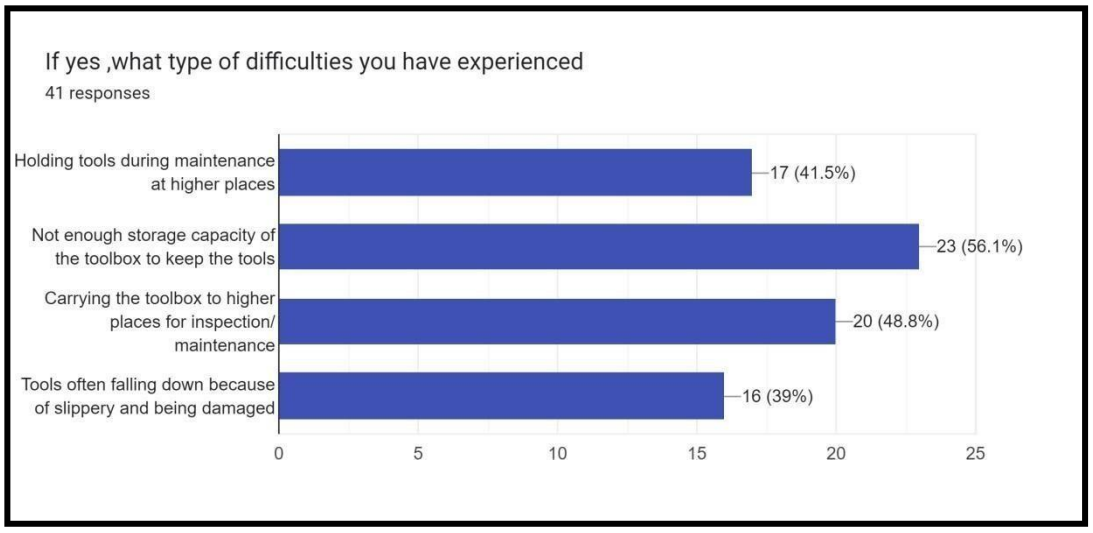
53 responses

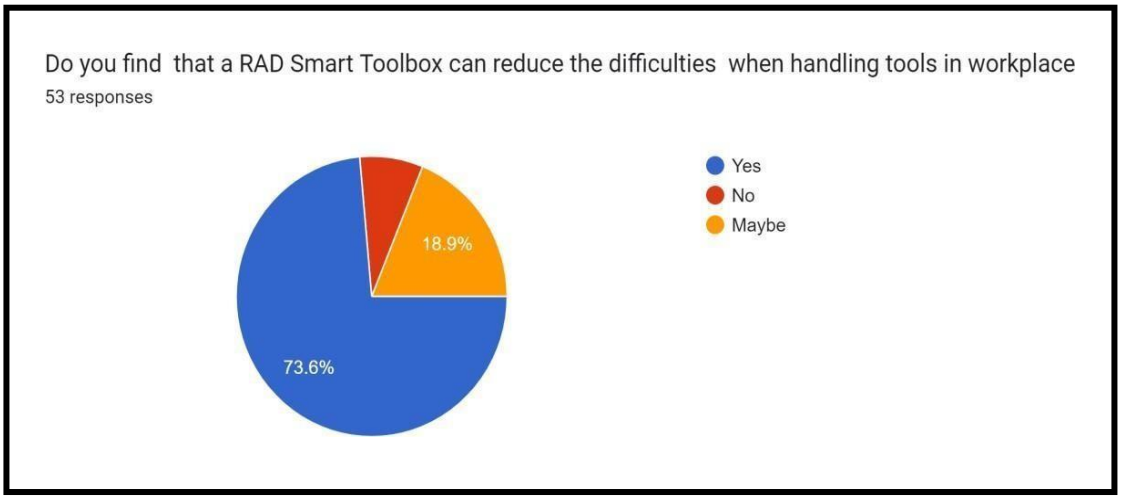


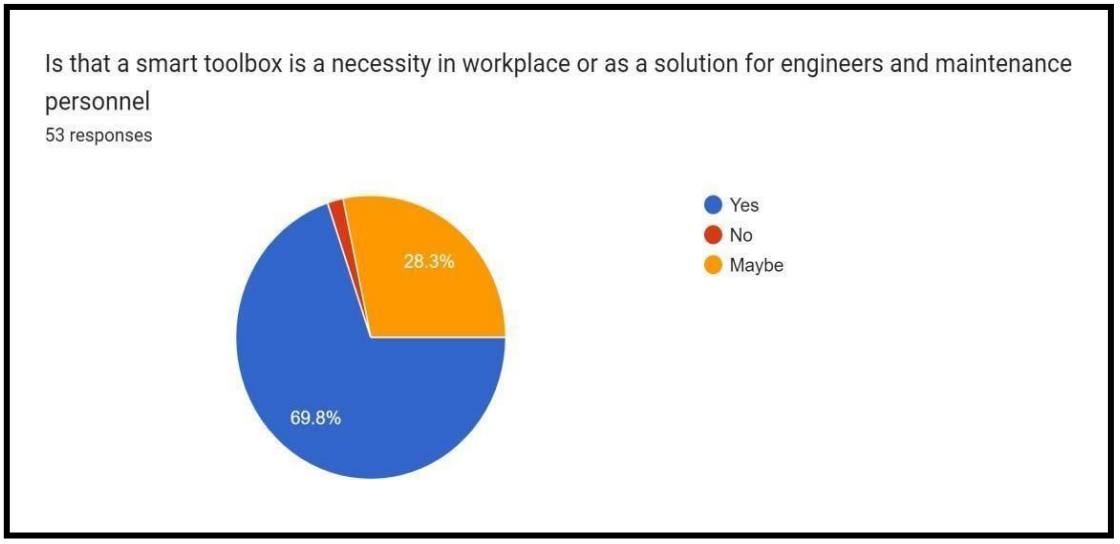
Do you ever find any difficulties when handling the toolbox

53 responses

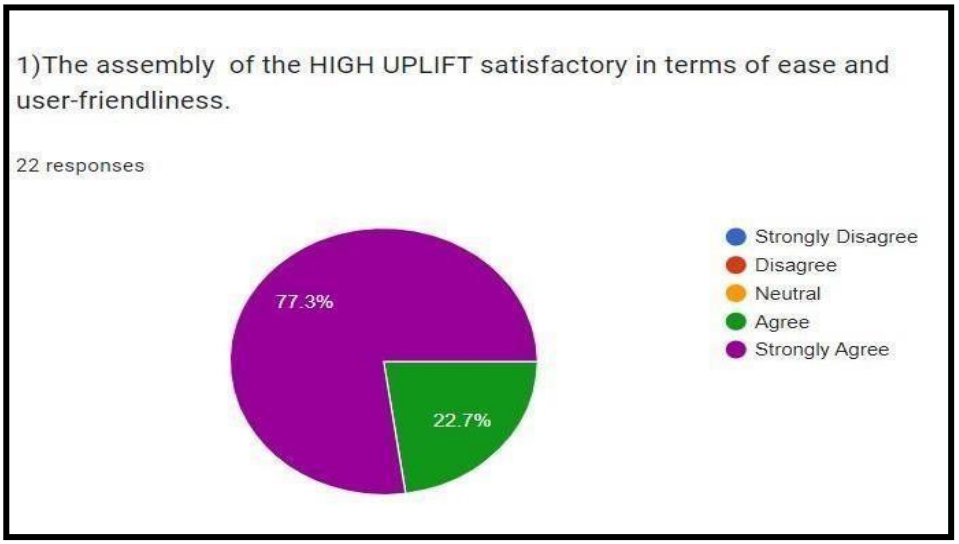


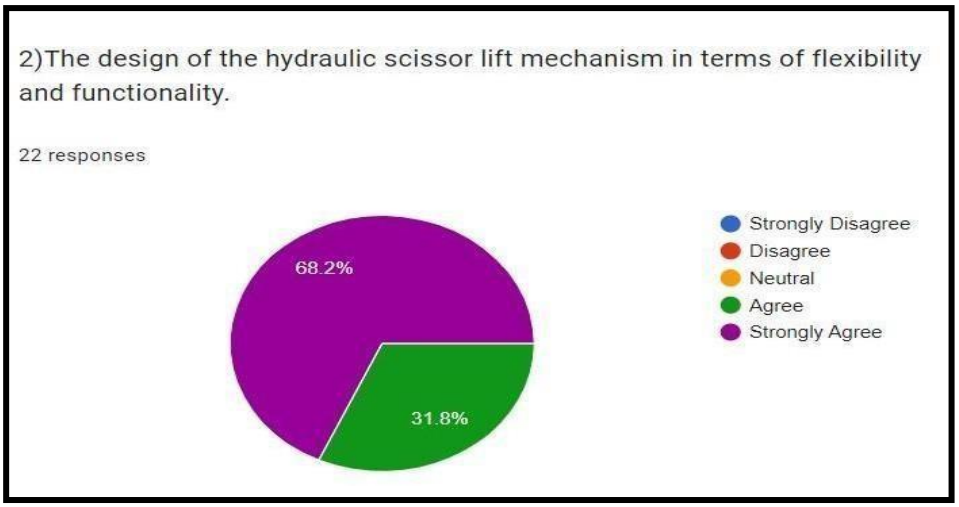

If yes ,what type of difficulties you have experienced
41 responses
Holding tools during maintenance at higher places
17 (41.5%)
Not enough storage capacity of the toolbox to keep the tools
23 (56.1%)
Carrying the toolbox to higher places for inspection/ maintenance
20 (48.8%)
Tools often falling down because of slippery and being damaged
16 (39%)
0
5
10
15
20
25


Do you find that a RAD Smart Toolbox can reduce the difficulties when handling tools in workplace
53 responses
Yes
No
Maybe
18.9%
73.6%


Is that a smart toolbox is a necessity in workplace or as a solution for engineers and maintenance personnel
53 responses
Yes
No
Maybe
28.3%
69.8%

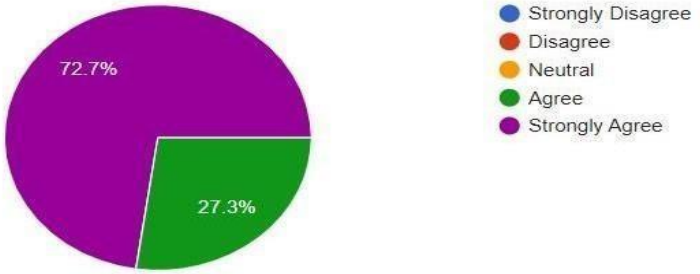
APPENDIX E: POST SURVEY FORM





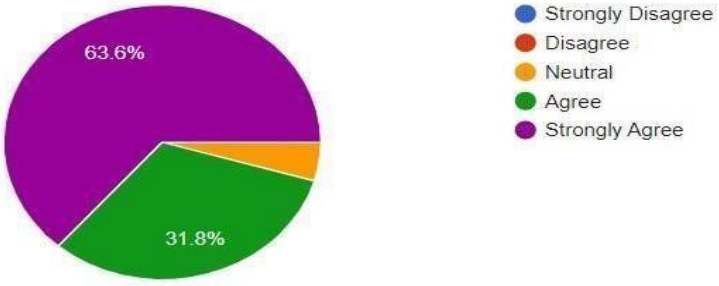
3)The adaptable of the lifting mechanism to various loads and operational conditions.

22 responses



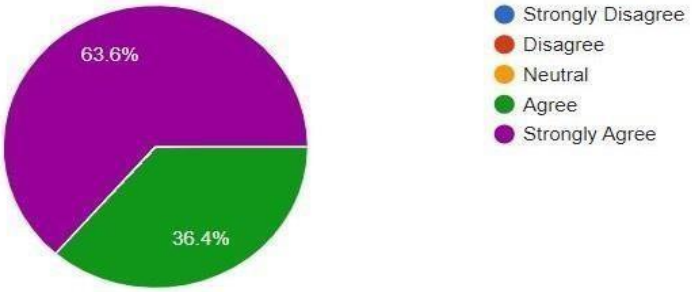
4)The overall quality of the components used in the assembly of the hydraulic scissor lift

22 responses



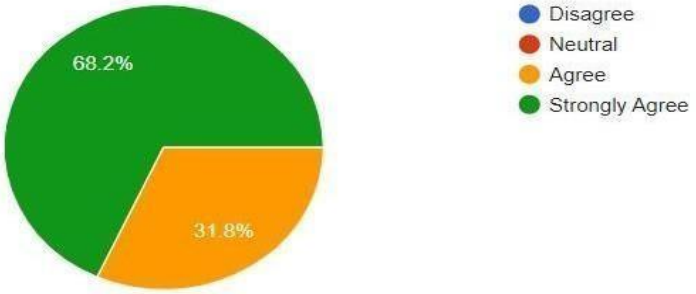
1)The height sensitivity that added as safety features make feel safe while performing work at a higher level.

22 responses



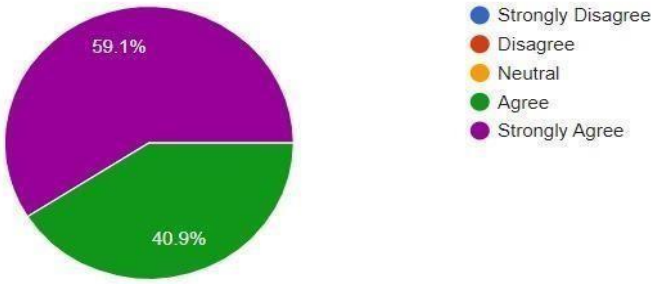
2)The actuator retracting switch system is really user-friendly.

22 responses



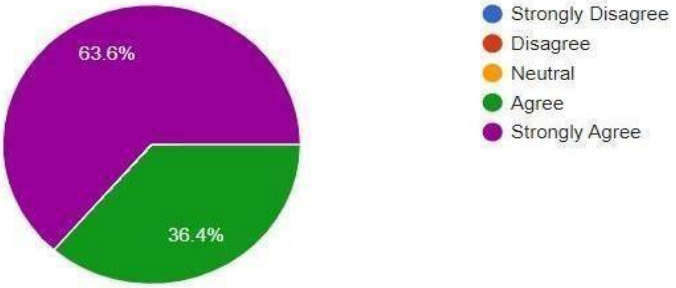
3)The electrical components and wiring are attentively organised and kept well

22 responses



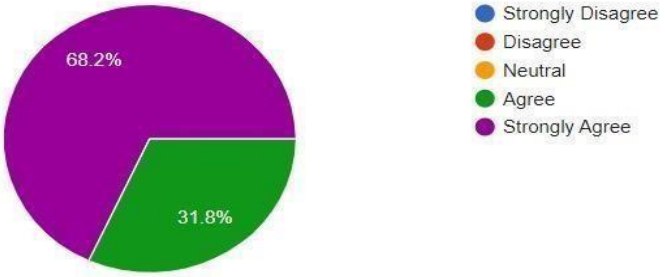
1)Do you believe this innovation will make it easier for you to complete your task?

22 responses



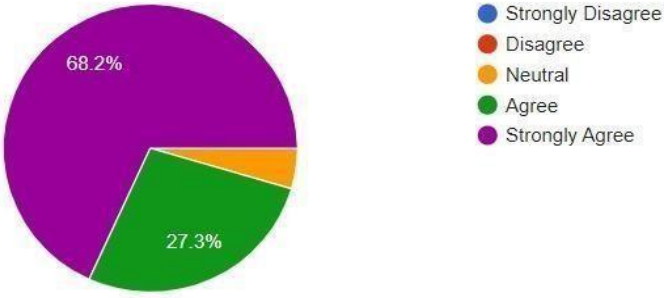
2)How satisfied are you with the comfort and ease of use provided by the lifting mechanism?

22 responses



3)Overall , are you satisfied with innovation of HIGH UPLIFT.

22 responses



Comment/ideas for future improvement.

9 responses

banana
Very good innovation
No
Need to make improvements on design and reliability of product
Nope
None
GOOD INOVATION
Make the base become larger so it will not fall down when lift to high
Good project

APPENDIX E: CODING FOR SENSORS IN ARDUINO IDE SOFTWARE

```
#include <LiquidCrystal.h>
#define trigger 18
#define echo 19
#define tonePin 8

LiquidCrystal lcd(12,11,5,4,3,2);

float time=0,height=0;

void setup()
{
 lcd.begin(16,2);
 pinMode(trigger,OUTPUT);
 pinMode(echo,INPUT);
 pinMode(tonePin, OUTPUT);
 lcd.print("WELCOME To");
 lcd.setCursor(0,1);
 lcd.print("HIGH UPLIFT");
 delay(3000);

}
```

```
void loop()
{
 lcd.clear();
 digitalWrite(trigger,LOW);
 delayMicroseconds(2);
 digitalWrite(trigger,HIGH);
 delayMicroseconds(10);
 digitalWrite(trigger,LOW);
 delayMicroseconds(2);
 time=pulseIn(echo,HIGH);
 height=time*340/20000;
 lcd.clear();
 lcd.print("HEIGHT:");
 lcd.print(height);
 lcd.print("cm");
 lcd.setCursor(0,1);
 lcd.print("HEIGHT:");
 lcd.print(height/100);
 lcd.print("m");
 if(height>=115)
```

APPENDIX F: TESTIMONIAL FROM LAE's & LECTURERS

MAKLUMBALAS PENGGUNAAN PRODUK INOVASI

HIGH UPLIFT

NAMA : ABD RAZAK BIN RAZALI

JAWATAN : LECTURER JPP / LAE

MAKLUMBALAS PRODUK :

A very good product with lot of safety features included.
Easy to use mostly for small aircraft.

COP & T/TANGAN :

ABD RAZAK BIN RAZALI
Lecturer (DM47)
Dept. Of Aircraft Maintenance
Politeknik Banting Selangor

MAKLUMBALAS PENGGUNAAN PRODUK INOVASI

HIGH UPLIFT

NAMA : MOHAMAD FAIZAL BIN DAUD

JAWATAN : PENSYARAH / LAE

MAKLUMBALAS PRODUK :

THE PRODUCT CAN IMPROVE THE SAFETY AND SECURITY OF MAINTENANCE PERSONEL DURING CARRING OUT THEIR DUTY AND TASK ON THE AIRCRAFT

COP & T/TANGAN :

MOHAMAD FAIZAL BIN DAUD
Lecturer (DM47)
Dept. of Aircraft Maintenance
Politeknik Banting Selangor

MAKLUMBALAS PENGGUNAAN PRODUK INOVASI

HIGH UPLIFT

NAMA : MUHD HAFIZUDDIN BIN OTHMAN

JAWATAN : PENSYARAH JPP /LAE

MAKLUMBALAS PRODUK :

PRODUCT FEAUTURES WELL FUNCTION AND EASY TO USE. IT ALSO EQUIPPED WITH SAFETY FEATURES IN CASE ANY EMERGENCY.

COP & T/TANGAN :

MUHD HAFIZUDDIN BIN OTHMAN
Pensyarah
Jabatan Penyenggaraan Pesawat
Politeknik Banting Selangor

MAKLUMBALAS PENGGUNAAN PRODUK INOVASI

HIGH UPLIFT

NAMA : SHALHAYUNI BINTI SARIPUDEN
Pensyarah

JAWATAN : Jabatan Penyenggaraan Pesawat
Politeknik Banting Selangor

MAKLUMBALAS PRODUK :

Very creative innovation. Good luck.

COP & T/TANGAN :

SHALHAYUNI BINTI SARIPUDEN
Pensyarah
Jabatan Penyenggaraan Pesawat
Politeknik Banting Selangor