POLITEKNIK BANTING SELANGOR

AIRCRAFT PITOT STATIC SYSTEM TRAINING KIT

NAME	MATRIC NO.
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DEPARTMENT OF AIRCRAFT MAINTENANCE

SESSION 1 2024/2025

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

SUPERVISOR:

AZLIZUL BIN SULI

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Date : 3rd December 2024

CERTIFICATION OF PROJECT ORIGANILITY & 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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SIGNATURE: WRITER 3

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ABSTRACT

This project focuses on creating an innovative training solution for understanding and troubleshooting aircraft pitot-static systems. It involves developing a physical training kit alongside an e-learning platform. The pitot-static system is vital for measuring key flight parameters such as airspeed, altitude, and vertical speed, which are essential for safe aircraft operation.

The training kit is designed to closely mimic the actual pitot-static system, featuring components like an airspeed indicator, altimeter, and vertical speed indicator mounted on a durable metal frame. Each part is selected for its accuracy in simulated scenarios, allowing students to engage with the system and observe its real-time behaviour. A detailed user manual provides step-by-step instructions for setup and operation, with a strong emphasis on safety through rigorous testing.

Complementing the physical kit is an interactive e-learning platform that offers theoretical knowledge and remote training support. This online resource includes tutorials, animations, instructional videos, and to deepen learners' understanding of pitot-static principles and troubleshooting techniques. The combination of hands-on training with digital resources creates a blended learning experience that enhances both skill acquisition and comprehension.

Overall, this project modernizes aviation training by providing an affordable and accessible alternative to traditional methods. By integrating physical interaction with digital learning, it equips students and technicians with the confidence to manage real-world aircraft systems effectively. The completed training kit and e-learning platform are valuable resources for polytechnics, training centres, and educational institutions in aviation.

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LIST OF ABBREVIATIONS

APSSTK – Aircraft Pitot Static System Training Kit

VSI – Vertical Speed Indicator

ASI - Airspeed Indicator

CAAM - Civil Aviation Authority of Malaysia

ICAO - International Civil Aviation Organization

FAA - Federal Aviation Administration

EASA - European Union Aviation Safety Agency

ADI - Artificial Design Intelligence

CAD - Computer-Aided Design

QR -Quick Response

AC -Alternating Current

DC -Direct Current

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1BACKGROUND OF STUDY

Figure 1.1: Aircraft Six Pack

At the core of every aircraft's cockpit lie two foundational principles that ensure pilots have the critical information necessary for safe and efficient flight of the pitot-static system and gyroscopic instruments. These principles, embodied in the Six Pack basic flight instruments, form the backbone of aviation instrumentation, providing pilots with essential data about the aircraft's performance, orientation, and spatial awareness. The Pitot-Static System operates on the principle of air pressure differentials, utilising the Pitot tube and static port to measure airspeed, altitude, and vertical speed. In contrast, gyroscopic instruments rely on the inherent stability of gyroscopes to provide accurate indications of the aircraft's attitude, heading, and rate of turn. Together, these principles underpin the functionality of the Six Pack instruments, empowering pilots with the situational awareness needed to navigate the skies with precision and confidence.

For the final year project, we will produce a learning product that uses the pressure principle in flight instruments, namely, the Aircraft Pitot Static System Training Kit. The Pitot-Static System stands as a cornerstone of flight instrumentation, providing vital data essential for safe and controlled operations. Among the array of instruments found in the cockpit, those governed by the Pitot-Static System hold a unique significance in providing critical flight parameters. Comprising the airspeed indicator, altimeter, and vertical speed indicator, these instruments collectively form a subset known as the Pitot-Static System indicators. They function by harnessing the principles of air pressure differentials, utilizing the Pitot tube and static port to measure key parameters such as airspeed, altitude, and vertical speed.

It is crucial for students to understand the aircraft pitot static system before they enter the aviation industry, due to several key reasons. Firstly, comprehensive knowledge of these instruments ensures that students can accurately diagnose, troubleshoot, and rectify any issues, thereby upholding the safety of flight operations. Secondly, adherence to aviation regulations necessitates proficiency in maintaining Pitot-Static System instruments to ensure airworthiness and regulatory compliance. Thirdly, understanding the interconnection of the Pitot-Static System with other aircraft systems enables students to diagnose complex issues comprehensively.

1.2PROBLEM STATEMENT

PROBLEM STATEMENT 1:

Challenging to understand and learn about Aircraft Pitot Static System work.

Based on Figure 1, survey respondents are having difficulty understanding how static pressure and dynamic pressure work on pitot-static system indicator which Airspeed indicator, Altimeter, and vertical speed indicator is. This lack of understanding affects their ability to understand concepts, which possible to delay in industry filed.

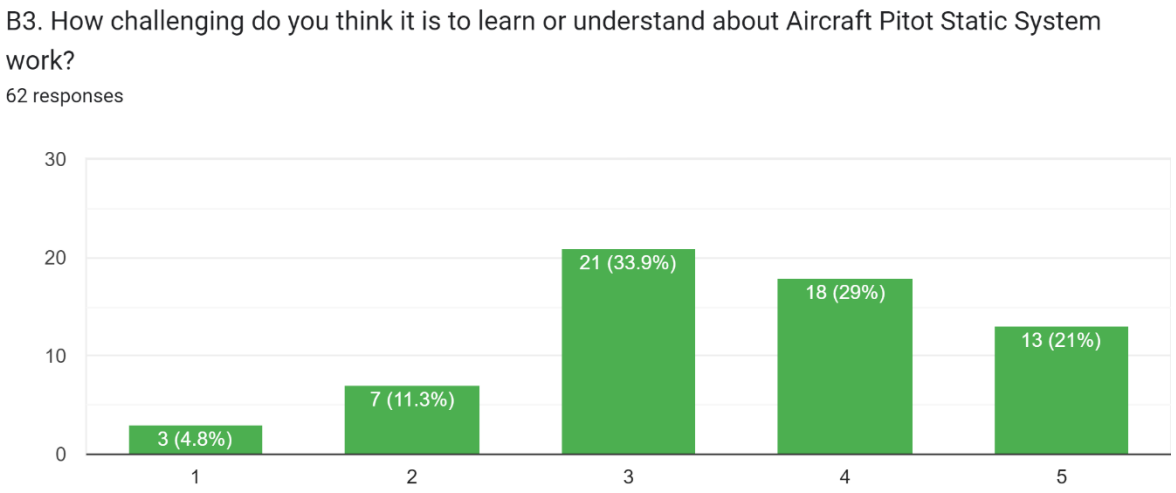


Figure 1.2.1: Problem Statement 1

PROBLEM STATEMENT 2:

<u>What reason that make them difficult to know about Aircraft Pitot Static System.</u>

Refer to figure 2, respondents didn't know the reason what consist in Aircraft Pitot Static System, how the three pitot pressure instruments work on aircraft and what mechanism that operate for the instruments. These instruments also make them confuse because less knowledge on learning session.

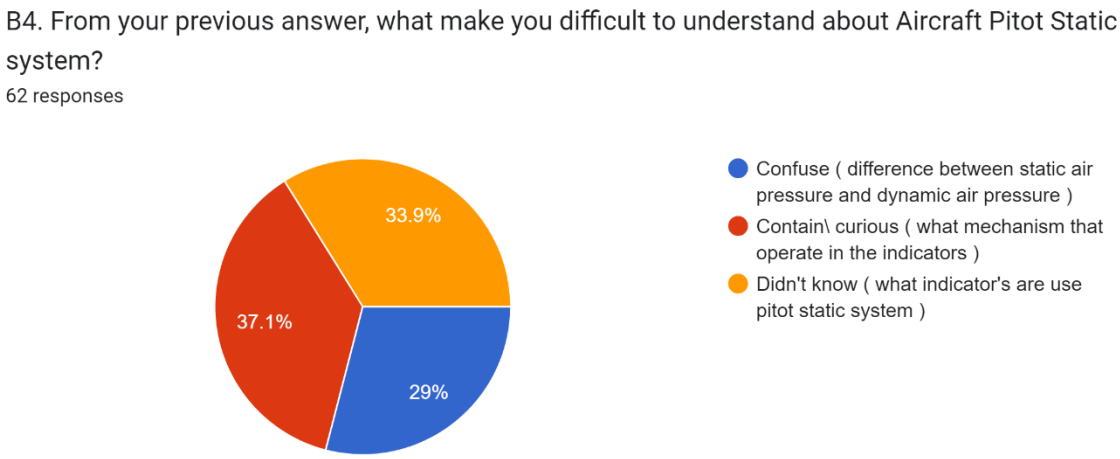


Figure 1.2.2: Problem Statement 2

PROBLEM STATEMENT 3

Problem with learning method with using external sources.

Through the Figure 3, respondent having problem in learning by using external sources like textbook and internet for gaining knowledge and finding info about Aircraft Pitot Static System. Most of them agree that external sources have less effectiveness for learning and do practical task is more effective.

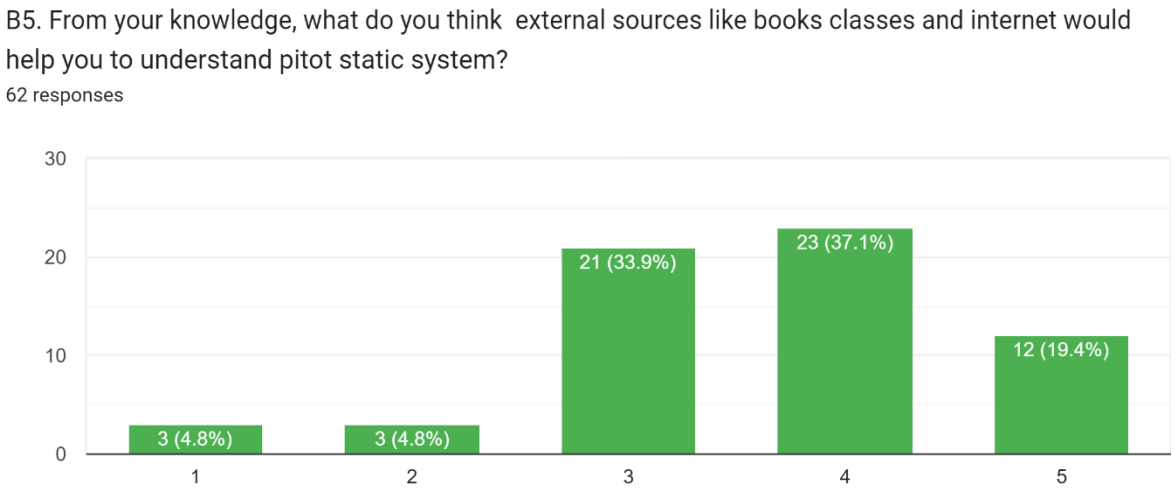


Figure 1.2.3: Problem Statement 3

1.1 PROJECT OBJECTIVES

1.3.1 General Project Objective

The project objectives are:

i)To design aircraft pitot static training kit to stimulate how the pitot static operate on the aircraft.

ii) To develop aircraft pitot static system with an affordable price that a very person can gain hands-on experience in diagnosing and resolving pitot-static system issues using realistic simulations and scenarios.

iii) To evaluate the project that suits users' demands and needs to ensure this project is very useful or not for the user to increase knowledge and better understanding.

1.3.2 Specific Individual Project Objectives

1.3.2.1 Product Structure

i) To develop Aircraft Pitot Static System Training Kit which comes with main components which are Airspeed indicator, Altimeter and Vertical Speed indicator also main body of this product structure that hold the indicators and keeps compressors.

ii) To develop a workable indicator which powered by compressor and plastic syringe that used to get indicator reading.

iii) To furnish the Aircraft Pitot Static System Training Kit with material that have high durability to resist shock for safety and material that can be designed well for aesthetic looks.

1.3.2.2 Product Mechanism

i)To design the place to put the Aircraft Pitot Static System Training Kit is suitable and not to complex build.

ii) To develop a portable Aircraft Pitot Static System Training Kit and easy to carry to make students learn this system at everywhere without a problem.

iii) To demonstrate the function place to put Aircraft Pitot Static System Training Kit more attractive and interesting for student to not bored about this product when learning.

1.3.2.2 Accessories & Finishing

i)To design a vertical indicator pattern to provide visual feedback, especially for parameters, and choosing reliable components ensures longevity, and incorporating fail-safe mechanisms can alert users in case of malfunctions.

ii) To develop the size of the indicator that should be suitable for the available space and easily readable from the typical viewing angle and distance.

iii) To demonstrate durability especially if the project operates in harsh environments, requiring the indicator to withstand moisture, dust, and temperature extremes. This can enhance this project's usability and effectiveness, ensuring it provides clear and reliable visual feedback.

1.4 PURPOSE OF PRODUCT

Our purpose in the Aircraft Pitot-Static System Training Kit for the final year project is to make a full, practical learning experience that connects theory to practice. We have created this kit and e-learning to aid students in full understanding of the aircraft pitot-static system, which is very essential for people in aviation.

The training kit enables the student to practice directly with important instruments such as the airspeed indicator, altimeter, and vertical speed indicator. It simulates real-life situations with controlled air and pressure systems, allowing the student to see and understand how changes in pressure affect instrument readings. This hands-on experience improves learning, solving the common problem of not fully understanding when only using theory.

E-learning helps to achieve this goal since it is interactive with content, guides, and videos that clarify the pitot-static system clearly. It is online; hence, students may review their understanding of the subject at any time and from any location. Used together with the training kit, this platform really combines hands-on and digital learning tools, hence making our project one of the important educational sources for aircraft maintenance technicians and aviation students in the near future.

1.5 SCOPE OF PROJECT

1.5.1 General Project Scopes

The project aims to develop a comprehensive training kit tailored for aircraft maintenance students enrolled in aviation institutions, focusing specifically on the intricate workings of pitot static instrument systems. This project seeks to give the learning experience by prioritizing hands-on practical training over traditional theoretical methods. By immersing students in interactive learning activities, This learning kit is to enhance understanding, engagement, and retention of vital concepts related to pitot static systems. With a clear emphasis on safety protocols, the project not only aims to impart knowledge but also instill a culture of responsible practice when handling aircraft instrumentation. Through integration into existing aircraft maintenance task and support from trained instructors, the kit promises to empower students with the knowledge, skills, and confidence necessary for successful careers in the aviation industry.

Certain aircraft models, like the Cessna 172, still have the three instruments that will be uses in this training kit. The Badin Variometer type Vertical Speed Indicator, the Jaeger type Altimeter type 553, and the Badin Anemometer type Air Speed Indicator.

1.5.2 Specific Individual Scopes

1.5.2.1 Product structure

Aircraft Pitot Static System Training Kit focuses on attention and attracting students interested in pitot static systems with fascinating indicators pattern which is vertical that follow standard pattern in aircraft cockpit.

1.5.2.2 Product Mechanisms

The Aircraft Pitot Static Training Kit comprises a streamlined product mechanism tailored for efficient and reliable functionality within the aircraft pitot static. This compact system is designed with a focus on essential components, featuring a compressor to generate air pressure to supply the altimeter, vertical speed indicator and airspeed indicator. A compressor is a mechanical device that increases the pressure of an atmosphere by reducing its volume.

1.5.2.3 Accessories & Finishing

Designing and producing physical accessories to make the project more attractive and get more attention from student to study this. Longevity is ensured by selecting dependable parts, and fail-safe features can notify consumers in the event of failures. This training kit can appropriate for the available space and clearly readable at the standard viewing distance and angle.

1.5.2.4 Software/Programming

This project is all about creating a user-friendly software application designed to boost productivity for students. We want to include essential features like user authentication, data processing, and reporting tools, ensuring that it works seamlessly on both web and mobile platforms. Our plan involves not just building the software but also focusing on its design, conducting thorough testing, and providing clear documentation and training for users. Over the course of [specify duration], we'll hit key milestones like completing the design, finishing development, and finally launching the app. We're also clear about what's not included in this project, such as any features outside our main focus and support for outdated technologies. By defining this scope, we aim to keep everyone on the same page and ensure that we deliver a successful product that meets our objectives.

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL LITERATURE REVIEW

The aviation industry in Malaysia places significant emphasis on safety and quality training, including the proper maintenance and operation of aircraft systems like the pitot static system. A pitot static system training kit tailored for Malaysian aviation institutions would need to meet the industry's specific needs and standards.

Firstly, regulatory compliance the training kit must comply with the regulations set by Malaysia's civil aviation authority, the Civil Aviation Authority of Malaysia (CAAM) as well as international aviation regulatory bodies such as the International Civil Aviation Organization (ICAO) and the Federal Aviation Administration (FAA). Compliance with these regulations ensures that the training provided using the kit meets industry standards.

After that, industry collaboration. Collaboration with industry stakeholders such as airlines, maintenance organizations, and training institutions is crucial. Their input can help identify specific training needs, ensure relevance to real-world scenarios, and validate the effectiveness of the training program.

In addition, hand on learning. Understanding the complexity of aircraft systems, it is crucial to incorporate hands-on learning. The kit should encompass practical exercises, simulation tools, and interactive components, enabling students to apply theoretical knowledge in a simulated aircraft environment. This hands-on approach will enhance the understanding and retention of concepts.

Lastly, safety emphasis. Safety is of utmost importance in aviation. The training kit should include safety protocols, procedures, and best practices related to pitot-static system maintenance and operation. This will help ensure that students comprehend the significance of safety and are prepared to apply it in their future aviation careers.

2.1.2 Demand For Aircraft Pitot Static System Training Kit

The demand for training kits for aircraft pitot-static systems is influenced by various factors related to the aviation industry's need for skilled personnel, advancements in aviation technology, regulatory requirements, and global market dynamics. Despite the aviation industry's shift towards digital and glass cockpit-Technologies, analog systems remain crucial in aviation education. These systems provide essential insights into the workings of pitot-static systems, helping students understand the core principles of airspeed, altitude, and vertical speed measurements. Manche aviation education programs include mandatory training on analog systems to meet accreditation and certification requirements set by authorities like the FAA and EASA. Analog training kits are generally more affordable compared to their digital counterparts, making them accessible for educational institutions with limited budgets. Additionally, many aircraft still in operation, especially in general aviation and certain commercial sectors, use analog pitot-static systems, ensuring students are prepared to work on a wide range of aircraft.

Analog systems also provide a tactile learning experience, beneficial for understanding mechanical and pressure-based processes, and allow for realistic troubleshooting practice. As more students enroll in aviation programs worldwide and new training centers are established, the demand for diverse training tools, including analog systems, rises. Training programs must comply with safety and regulatory standards, which often include proficiency with analog systems, and students need to demonstrate competence in both analog and digital systems to meet comprehensive certification requirements. The demand for analog aircraft pitot-static-system training kits remains robust, due to their foundational importance in aviation education, cost-effectiveness, and industry relevance. These kits ensure that students are well-prepared for diverse aircraft maintenance and operational roles, supporting the development of well-rounded aviation professionals, as the industry continues to grow, and educational programs expand. Overall, the increasing demand for aircraft pitot-static-system

training kits is expected to continue as the aviation sector expands and evolves, emphasizing the importance of comprehensive training solutions for future aviation professionals.

2.1.3 Type of Aircraft Pitot Static System Training Kit

Aircraft pitot static system kit is instrumental in providing comprehensive education about aircraft pitot static system, addressing the requirements of prospective pilots and maintenance workers. This kit is not diverse in their approach. Due to limited company that manufactured the aircraft pitot static system training kit, there is no various type of the training kit.

Static training kits serve as an initial point of engagement, featuring non-moving, static models of landing gear components. The advantage of having a static kit is accessibility, which is static trainers can be set up in classrooms or training facilities, making them readily available for pilot instruction without needing access to an aircraft. This foundational level aids students in becoming acquainted with the intricate parts that constitute a landing gear system.

1. **Physical Model Kits**

   Physical model of aircraft pitot static system training kit are tangible, three-dimensional replicas of actual pitot static system like airspeed indicator, vertical speed indicator and altimeter. These kits provide hands on learning experience, allowing to touch, feel, and visually inspect the various parts of the pitot static system. Physical model kits are particularly useful for basic familiarization and understanding of the physical system of pitot static systems components. They are valuable in introducing students or aircraft maintenance technicians to the tactile aspects of pitot static systems, enhancing their ability to identify and recognize components in real world scenarios.

2.2 SPECIFIC LITERATURE REVIEW

2.2.1 Product Structure

The product structure for an aircraft pitot-static system training kit typically includes a range of meticulously crafted components and assemblies. These are specifically designed to replicate the intricate details and functionality of the actual pitot-static system of an aircraft. This detailed structure allows trainees to gain an in-depth understanding of the operation, maintenance, troubleshooting, and repair of these crucial systems, providing comprehensive learning experience. Firstly, the pitot tube is to simulate the actual pitot tube found on aircraft, which measures the dynamic air pressure to determine airspeed. After that, static ports is to simulates static ports that measure static air pressure used for altitude and airspeed calculations. In addition, this training kit has various tubes and hoses that connect the pitot tube and static ports to the instruments, replicating the actual layout of the aircraft. Moreover, Instruments such as the airspeed indicator display airspeed based on pressure differential between pitot and static ports. The altimeter measures and displays altitude using static pressure, while the vertical speed indicator shows the rate of climb or descent by measuring changes in static pressure.

2.2.1.1 Type of material used for product structure.

Aluminum

Aluminium is an excellent choice due to its unique combination of properties that make it highly versatile and widely used across various industries. Its lightweight nature, high strength-to-weight ratio, and corrosion resistance make it ideal for applications where weight reduction and durability are crucial, such as in aerospace, automotive, and consumer electronics. Aluminium's ductility and malleability allow it to be easily shaped and formed into various forms through processes like rolling, extrusion, and drawing, making it suitable for structural components and intricate designs. Additionally, aluminium's excellent thermal and electrical conductivity makes it valuable in heat exchangers, electrical transmission lines, and electronic enclosures.

When using aluminum, considerations include choosing the right alloy based on machining and fabrication processes, selecting appropriate joining techniques, and potentially applying surface treatments like anodizing or powder coating to enhance corrosion resistance and aesthetics. Additionally, accounting for aluminum's higher coefficient of thermal expansion and its cost, which is generally higher than steel, is essential in the design process. Overall, aluminum's versatility, performance, and durability make it a highly advantageous material for a wide range of applications in this project.

Figure 2.2.1.1: Aluminium

2.2.1.2 Type of Power Source For Product Structure

Dry cell battery

When choosing a 12V dry cell battery for your project, there are several important factors to keep in mind to ensure everything runs smoothly and safely. First, consider the type of battery you need. There are various options available, such as alkaline and lithium batteries, each with its own strengths. Make sure to select one that fits the specific requirements of your project.

Next, pay attention to the current and voltage ratings. It's essential that the battery can handle the maximum current your project will draw. This will help prevent any issues related to power overload and ensure reliable performance. To do this, calculate the total power consumption of all your components; this will guide you in selecting a battery that meets your needs without running out of juice too quickly.

Safety is another crucial aspect. Look for batteries that come with built-in protections against over-discharge and short circuits. These features can help safeguard your project and give you peace of

mind while it's in operation. Additionally, be mindful of local regulations regarding battery disposal and recycling to avoid any environmental concerns. Don't forget about practical considerations! Think about the physical size of the battery and how it will fit into your project design. Ensure there's enough space for it and that it can be easily installed or replaced when needed.

By taking the time to carefully evaluate the type and specifications of the 12V dry cell battery, ensuring it aligns with your project's power requirements, prioritizing safety features, and considering practical aspects, you'll set yourself up for success. A well-chosen battery is key to keeping your project reliable and safe, ultimately contributing to its overall effectiveness and compliance with relevant standards.

Figure 2.2.1.2: Dry cell battery

2.2.2 PRODUCT MECHANISMS

2.2.2.1 Type of component

2.2.2.1.1 Selection of compressor for static pressure

For the selection of the mechanism to give static pressure to the indicator, we chose a small compressor. Small compressors are highly effective in supplying static pressure to instrument indicators, providing a consistent and uninterrupted flow of compressed air necessary for precise measurements and control. Unlike systems that rely on stored air, which can suffer from pressure fluctuations as the air depletes, these compressors generate air on demand, maintaining stable and reliable pressure levels. This continuous air generation is crucial for instrument indicators that require steady pressure to function accurately.

Equipped with pressure regulators, flow control valves, and pressure switches, small compressors can finely adjust the output to meet the specific requirements of instrument indicators. This ensures that the instrument indicators receive the exact pressure needed for accurate readings and performance. The ability to continuously generate and supply air also eliminates the downtime associated with refilling air tanks, enhances space efficiency by reducing the need for large storage tanks, and can improve energy efficiency by minimising energy losses during air storage and retrieval. Additionally, these compressors typically have lower maintenance requirements compared to managing large air storage systems, making them an indispensable tool for applications requiring precise and reliable static pressure.

Figure 2.2.2.1.1: Compressor for Static Pressure

2.2.2.1.2 Selection of compressor for pitot pressure

For the selection of the mechanism to give pitot pressure to the indicator, we chose a plastic syringe. Using a plastic syringe to supply pitot pressure to an instrument indicator is a practical and cost-effective method for simulating or testing the pitot-static system in various applications. The setup involves selecting a suitable plastic syringe, typically between 10 mL and 60 mL, and connecting it to a pitot tube using an airtight flexible hose. By manipulating the syringe's plunger, users can precisely control the generated pressure, which is then transmitted through the pitot tube to the instrument indicator. This approach allows for fine-tuned adjustments, ensuring accurate calibration and performance of the instrument, making it highly useful in aviation for testing airspeed indicators, in educational settings for demonstrating fluid dynamics principles, and in scientific research for controlled air pressure simulations.

This method's benefits include its precision, cost-effectiveness, versatility, and ease of use. Plastic syringes are inexpensive and widely available, offering an economical solution for budget-conscious projects. The simplicity of the setup makes it accessible to users without specialised training, facilitating quick tests and demonstrations. However, it is essential to ensure airtight connections to prevent pressure leaks and to regularly calibrate the setup against known standards to maintain accuracy. Overall, using a plastic syringe for pitot pressure applications provides a reliable and efficient means of testing and calibrating pitot-static systems across various fields.

Figure 2.2.2.1.2: Compressor for Dynamic Pressure

2.2.3 Software

1. Autodesk AutoCAD 2023

AutoCAD, developed by Autodesk, is a widely used computer-aided design (CAD) software that serves as a powerful tool for professionals in architecture, engineering, and design. Offering a versatile platform, AutoCAD enables users to create precise and detailed 2D drawings as well as complex 3D models. Its intuitive interface, featuring a command line and graphical user interface, facilitates efficient navigation and execution of commands. AutoCAD's extensive set of drawing and drafting tools, coupled with customization options, allows users to create, edit, and annotate designs with ease. As an industry standard, AutoCAD continues to evolve, incorporating new features to meet the evolving needs of designers and architects, making it an indispensable software for digital design and drafting across various disciplines.

Figure 2.2.3.1: Autodesk AutoCAD 2023

2. Wix App

Wix is a versatile cloud-based platform that enables users to create and manage websites without needing any coding skills. At its core, Wix offers an intuitive drag-and-drop interface, allowing users to easily add and arrange elements like text, images, and videos on their site. With over 800 customizable templates available, users can choose a design that fits their needs and personalize it to reflect their brand. Wix also includes advanced features such as Wix ADI (Artificial Design Intelligence), which can automatically build a tailored website based on user preferences. Additionally, the platform supports mobile optimization, ensuring that websites look great on smartphones and tablets. Users can further enhance their sites by integrating various apps from the Wix App Market, which provides additional functionalities like e-commerce capabilities, booking systems, and marketing tools. The Wix mobile app allows users to manage their websites on-the-go, enabling updates, customer interactions, and online store management directly from their devices. Overall, Wix is designed to empower individuals and small businesses to establish a professional online presence easily and effectively.

Figure 2.2.3.2: Wix App

2.2.4 Accessories & Finishing Indicator Vertical Pattern

The pattern chosen is based on the real-life conditions of the three instruments found in the ship's cockpit, namely the airspeed indicator (ASI), the vertical speed indicator (VSI), and the altimeter. This pattern is L-shaped.This pattern is essential in various applications, such as aviation for altimeters and vertical speed indicators, consumer electronics for battery and volume levels, and industrial control panels to display process statuses. The size of the indicator should be suitable for the available space and easily readable from the typical viewing angle and distance. Durability is important, especially if the project operates in harsh environments, requiring the indicator to withstand moisture, dust, and temperature extremes. Choosing reliable components ensures longevity, and incorporating fail-safe mechanisms can alert users in case of malfunctions. By carefully considering these factors, we can enhance this project's usability and effectiveness, ensuring it provides clear and reliable visual feedback.

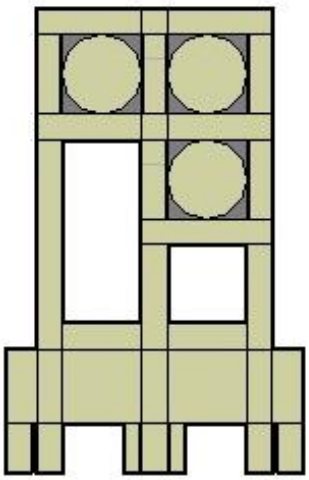


Figure 2.2.4.1: Accessories & Finishing Indicator Vertical Pattern

2.3 Review of Recent Research / Related Products

2.3.1 Related Patent Product

Table 2.3.1: Related Patent Product

No.	Patented Product	Patented summary
1.		Product name: AS-70-5 Pitot-Static Maintenance Practice Trainer Publish Year: 2018 Inventors: Aerotrain Description: The pitot-static lines and fittings installation trainer provides hands on training to the students for inspection, removal and installation procedures for a pitot-static instrument system. The trainer also provides training for pitot and static system testing using standard pitot static test set. An air speed indicator, an altimeter and a vertical speed indicator along with a pitot tube and two static port are installed on the trainer panel. A pneumatic switch allows selection between the main and alternate static port. Further the selected static port can be connected to the pitot static tester using standard AN fitting.

No.	Patented Product	Patented Summary
2.		Product name: Cockpit Instrumentation System Trainer AS76 Publish Year: 2019 Inventors: Avotek Description: The Avotek Cockpit Instrumentation System is a complete, functional simulation of a standard aircraft cockpit. It includes standard gyro, pitot-static, and engine gauges found on most aircraft. It can be used for demonstration of the systems or for teaching instrument removal and replacement. The system is powered by 110V AC.

2.4 Comparison Between Recent Research and Current Project

Table: 2.4.1: Comparison Between Recent Research and Current Project

Product	AS-70-5 Pitot Static	Aircraft Pitot Static System Training kit
Design		
Price	Expensive	Affordable
Portability	Yes	Yes
Weight	30KG	6 KG
Easy to Operate	No	Yes
Overall size	Big	Small
Features	Detail operation about standard practice on pitot static system.	Detail in how real-life operation on aircraft pitot static system

Product	Cockpit Instrumentation System Trainer AS76	Aircraft Pitot Static System Training kit
Design		
Price	Expensive	Affordable
Portability	Yes	Yes
Weight	40KG	6KG
Easy to Operate	Yes	Yes
Overall Size	Big	Small
Features	Have variety about indicators and more than just pitot static system	Detail in how real-life operation on aircraft pitot static system

2.4.1 Explanation

2.4.1.1 Product Price

Comparison product price between our project is way cheaper than AS-70-Pitot -Static Maintenance Practice Trainer. Our project just cost only RM 196 (roughly) and the other product is RM 6000. The objective is to make an affordable for training school.

2.4.1.2 Product Portability/Weight/Overall size

Talk about the portability of product, it relates with many aspects like weight and overall size. Portability of AS-70-Pitot-Static Maintenance Practice Trainer and our projects has wide range movement, it can bring anywhere but side on weight and overall size, our project have advantages because it smaller and lighter than AS-70-Pitot-Static Maintenance Practice Trainer.

2.4.1.3 Features

Features on AS-70-Pitot-Static Maintenance Practice Trainer has a lot of procedure for students to learn about Maintenance Practice in pitot static system for example removal and installation. Our project has all the features on AS-70-Pitot-Static Maintenance Practice Trainer but with an improvement with simulation on real aircraft scenarios.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 PROJECT BRIEFING & RISK ASSESSMENT

This chapter will list the various steps that were successfully completed to achieve the goals and objectives of the project. These included filling out all the necessary forms and obtaining approvals from the supervisor. Throughout the project, various stages were involved in the production and assembly of the pitot-static system training kit, such as metal cutting, mechanism construction, and component testing. Safety measures were strictly adhered to by the team, and proper equipment was utilized at each stage.

3.1.1 Utilisation of Polytechnic's Facilities

Utilisation of Polytechnic's Facilities In order to utilise all the facilities such as equipment, consumable materials and tools provided by Polytechnic, permission has to be granted from the supervisor and workshop coordinator by filling up the necessary form. This form will specify the tools and equipment that are being used in order to complete the project. Example of Polytechnic's facilities that our group use:

1) General Workshop

2) Airframe workshop

3) Composite Workshop

4)Electronic Instrument Lab

3.2 OVERALL PROJECT GANTT CHART

3.2.1.1: Gantt Chart for AEM

PROJECT ACTIVITIES		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15
Briefing And Group Formation Create a group with 3 members • All members have their own idea for project • Meet supervisor and present our own idea • Only 1 idea accepted	P															
	E															
Project Registration Form • Make research about pitot system • Make a research static system	P															
	E															
Assignment Chapter 1: Introduction	P															
	E															

Assignment Chapter 2: Literature Review	P															
	E															
Assignment 3	P															
	E															
Pre-Proposal Presentation • Do a power point slide about the project	P															
	E															
Write up chapter 1 • Do background of study of the project • Do problem statement and objective about the project • Do project aim, impact and scope	P															
	E															
Write up chapter 2 • Do introduction of product • Do recent research of product • Do comparison of product	P															
	E															
Write up chapter 3 • Product description • Product sketching and modelling • List of material and expected expenditure	P															
	E															
Final Proposal Presentation	P															
	E															

3.2.1: Gantt Chart for AEP

Table AEP 3.2.1.2: Gantt Chart

PROJECT ACTIVITIES		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15
MATERIAL ACQUISITION.	P															
	E															
STRUCTURE CONSTRUCTION.	P															
	E															
PROJECT ASSEMBLY.	P															
	E															
PRODUCT TESTING & TROUBLESHOOTING.	P															

	E																
PROJECT PROGRESS PRESENTATION	P																
	E																
PRODUCT IMPROVEMENT.	P																
	E																
POSTER & VIDEO COMPLETION.	P																
	E																
PROJECT PRESENTATION	P																
	E																
PROJECT REPORT SUBMISSION	P																
	E																

3.3 PROJECT FLOW CHART

3.3.1.1 Overall Project Flow Chart

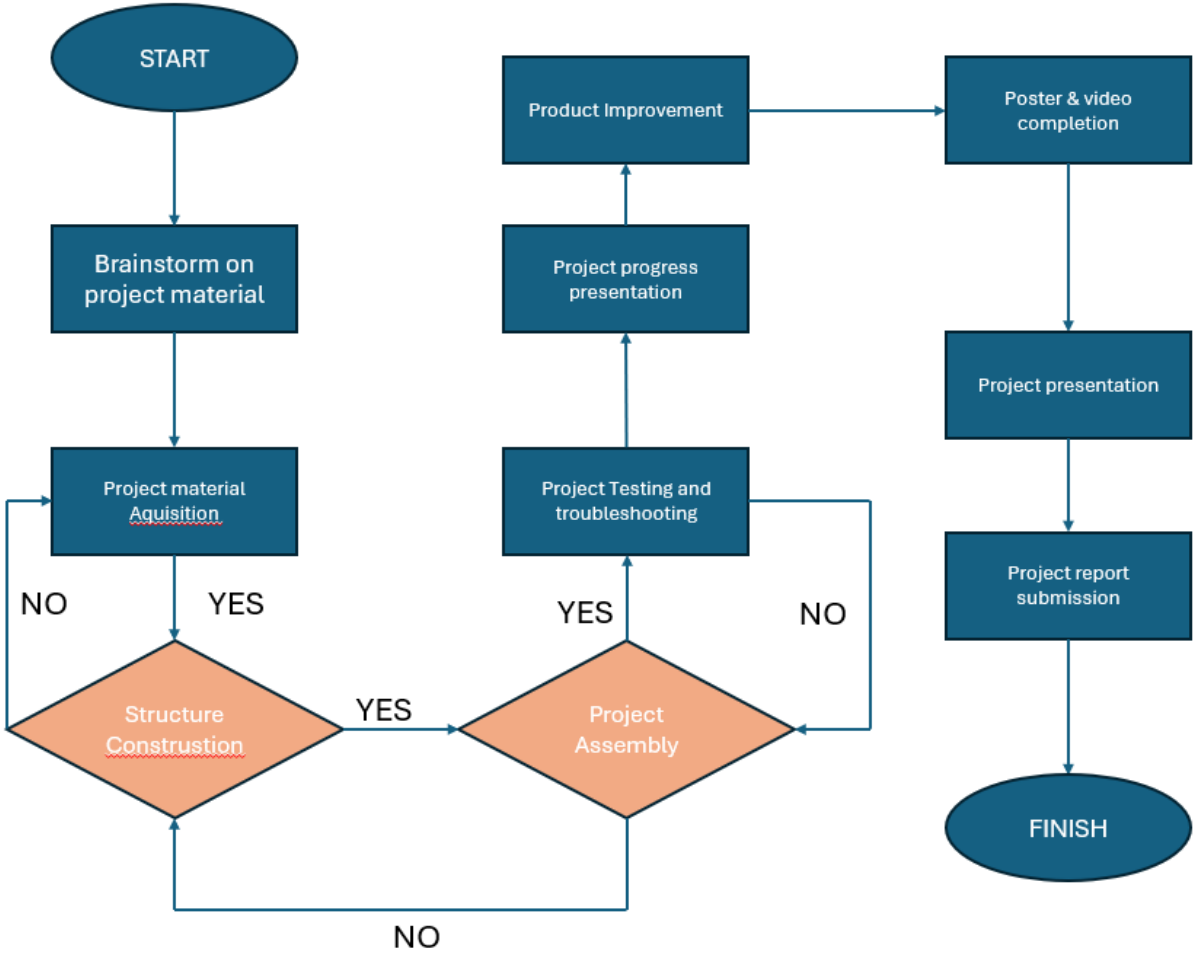


Figure 3.3.1.1 Overall Project Flow Chart

3.3.2 Specific Project Design Flow / Framework

3.3.2.1 Product Structure

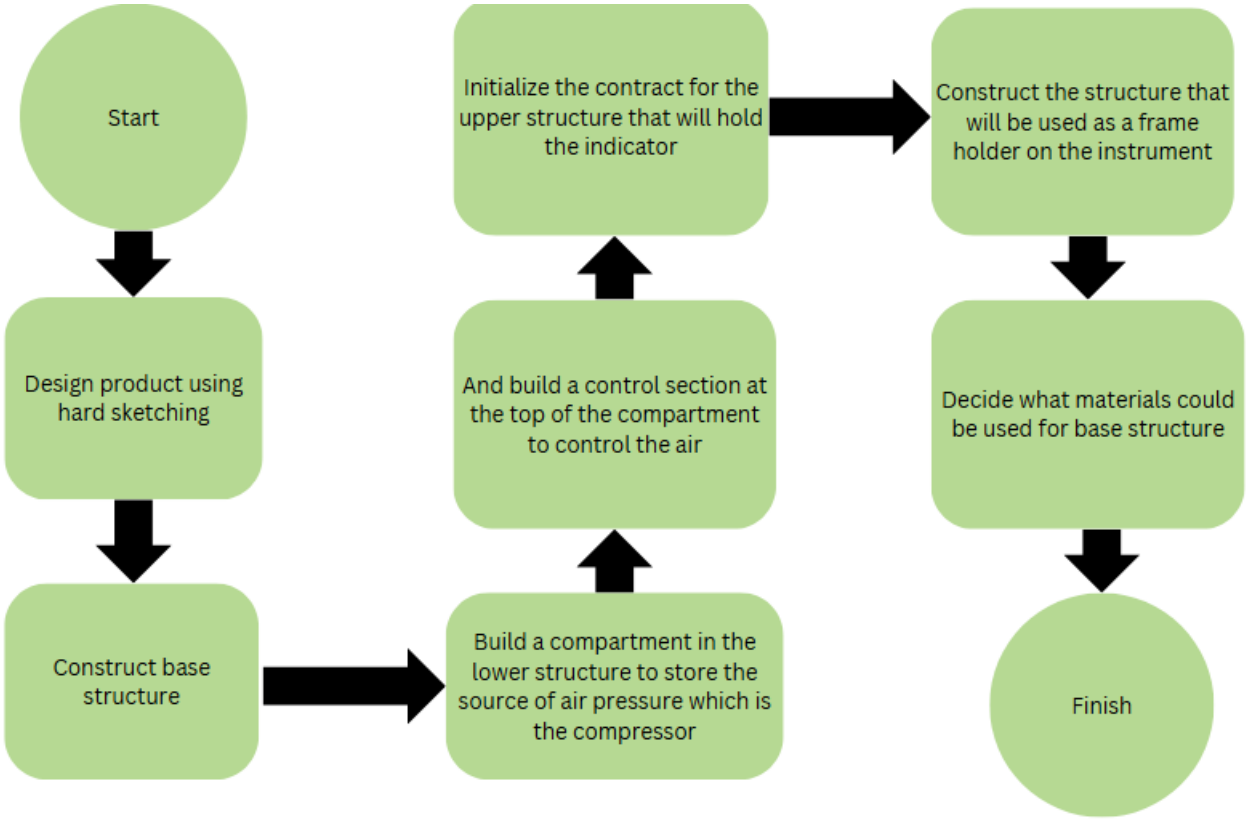


Figure 3.3.2.1: Product Structure Design Flow

3.3.2.2 Product Mechanisms

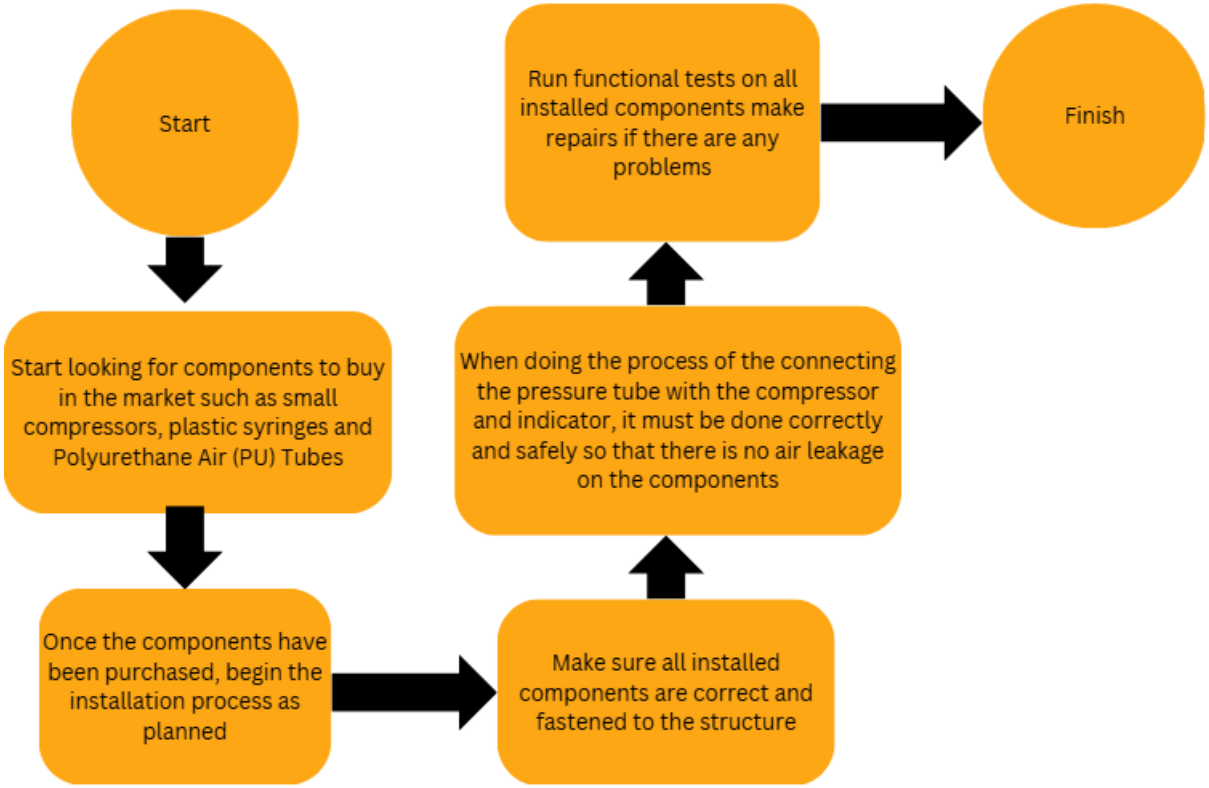


Figure 3.3.2.2 Product Mechanism Framework

3.3.2.3 Programming/software

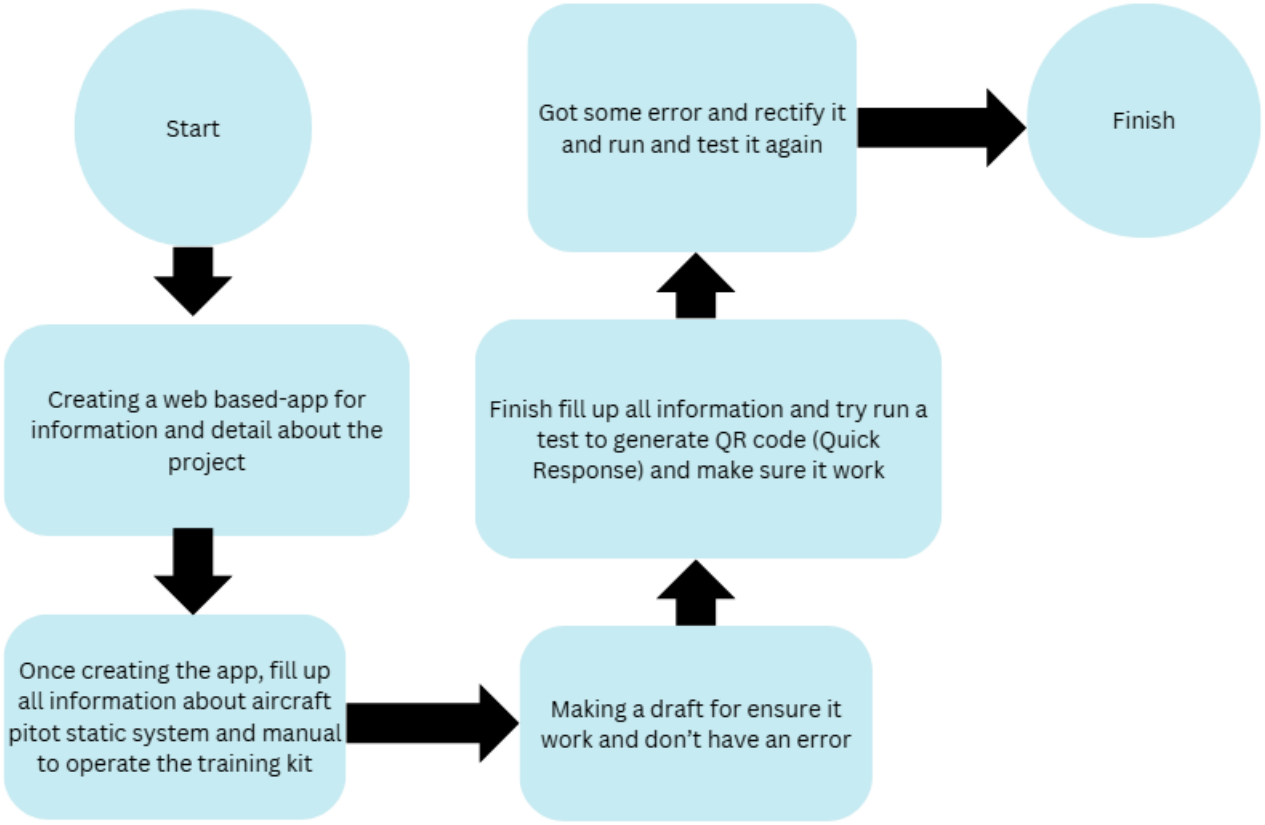


Figure:3.3.2.3 Programming / Software

3.4 DESIGN ENGINEERING TOOLS

3.4.1 Design Requirements Analysis

3.4.1.1 Questionnaire Survey

A structured set of written or electronic questions intended to elicit information or opinions from a person or group of people is called a questionnaire. It is a commonly used technique in surveys, research, and data collection that seeks to collect quantifiable and standardised information on a given topic or subject. In addition to covering a wide range of topics, including demographic data and attitudes, behaviours, preferences, and experiences, questionnaires can be distributed in a variety of formats, such as paper-based forms, online surveys, or interviews. A questionnaire's questions are deliberately constructed to elicit precise and pertinent answers, and the information gathered can be analysed to draw conclusions, make defensible choices, or obtain understanding of the viewpoints of the people surveyed.

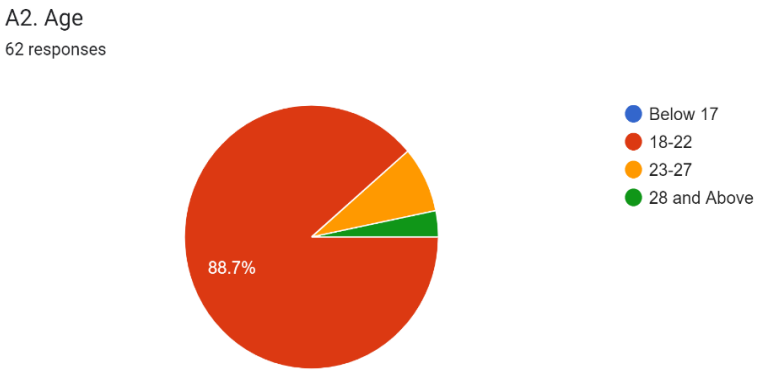


Figure 3.4.1.1.1: Questionnaire A2

The survey collected data from 62 respondents. From analysis, the majority that we found approximately 88.7% or 55 individuals in age range between 18-22 years old. The eldest respondents were 2 individuals aged 28 and above and the remaining respondents were within the age range between 23 until 27 years old.

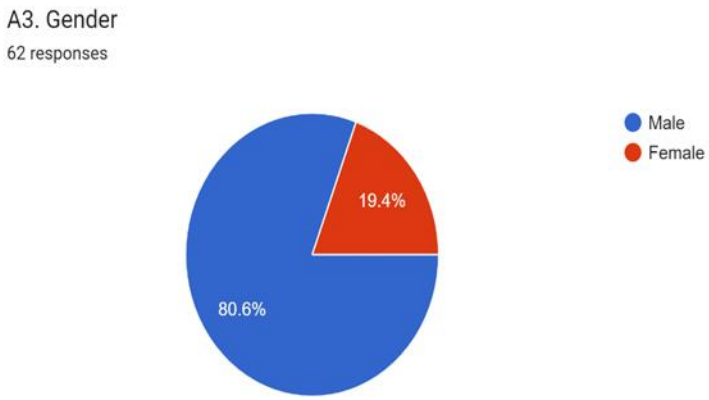


Figure 3.4.1.1.2: Questionnaire A3

From the 62 survey respondents, the data collected indicates the most responders are male. According to the data that show 80.6% of the respondent are male while the remaining 19.4% are female. For easy to understand, there are 50 males and 24 females among them.

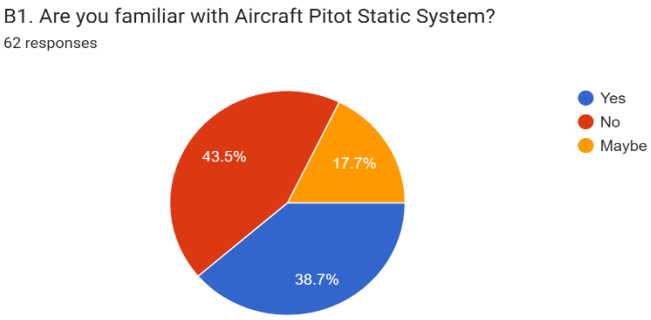


Figure 3.4.1.1.3: Questionnaire B1

Data from the survey respondents was collected from 62 people to determine their familiarity with aircraft pitot static system. Most of them show from the results are didn't know about aircraft pitot static system also approximately 43.5% of the respondents answer no. There were another majority of respondents that know the aircraft pitot static system and approximately 38.7% of the respondents answer yes.

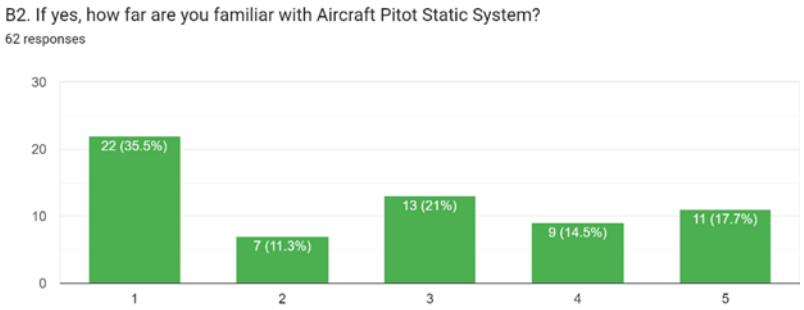


Figure 3.4.1.1.4: Questionnaire B2

The survey respondents give information about their familiarity with Aircraft Pitot Static System. The majority of respondents are not well known about Aircraft Pitot Static System. After that, there is a minor respondent that is familiar with the system. Around 29 people score poorly, in grade 1 or 2, this could tell us that people lack understanding about the system. Besides that, 20 survey respondents gave a grade between 4 and 5, this also indicates that they are familiar with the system. The remaining gave a moderate response.

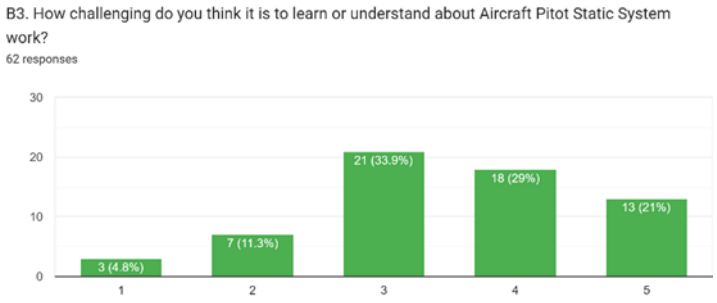


Figure 3.4.1.1.5: Questionnaire B3

From the data we collect, almost 21 respondents think learning about aircraft pitot static system is difficult. We conclude that maybe they do not know how mechanisms operate in the indicators and the function. After that, 18 respondents think that understanding this system is challenging. We think they may be very confused because it is hard to know the difference between static air pressure and dynamic air pressure. Next, 13 respondents think it is difficult because maybe they didn't know what indicators are used at pitot static system. Lastly, the remaining respondents think that learning this system is not very challenging to them.

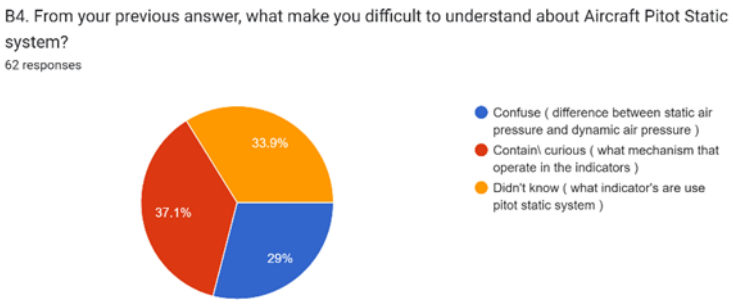


Figure 3.4.1.1.6: Questionnaire B4

We found out that our respondent almost 37.1% very curious about how Aircraft Pitot Static system operate and want to know mechanism that operate in the indicators. After that, approximately 33.9% of respondents didn't know what indicators were using pitot static system and the remaining 29% respondent was very confused because didn't know the difference between static air pressure and dynamic air pressure.

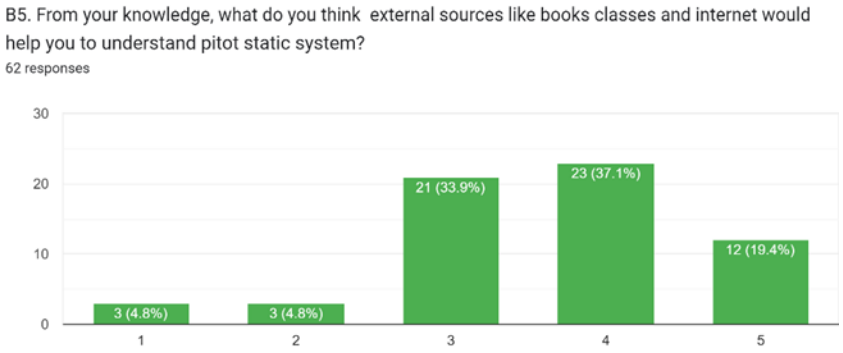


Figure 3.4.1.1.7: Questionnaire B5

Most of our respondents think that external sources like books classes and internet would help them to understand because nowadays it is very easy to find information about something in more detail at the internet and have more in- depth explanation about pitot static system in video form. After that, the other respondents think theoretical may not help them in understanding the system so they may need to have practical to help them to more understand about pitot static system.

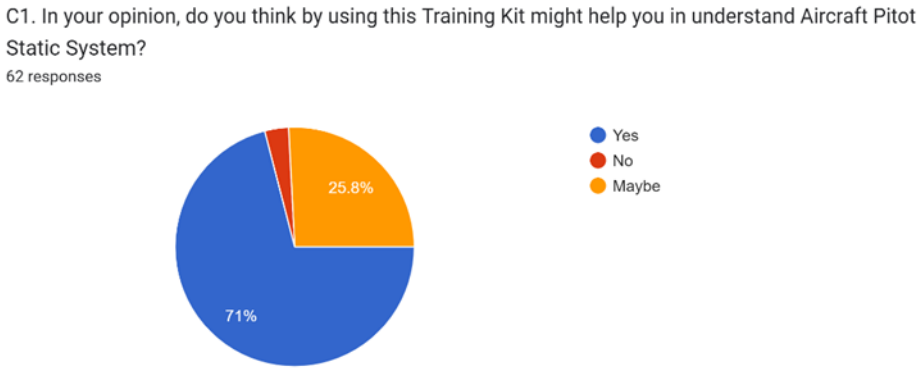


Figure 3.4.1.1.8: Questionnaire C1

The majority of the respondents 71% or 44 people answered Yes, indicating that they found the learning kit helpful in understanding Aircraft Pitot Static System. This show that the learning kit was generally well- received by the survey participants.

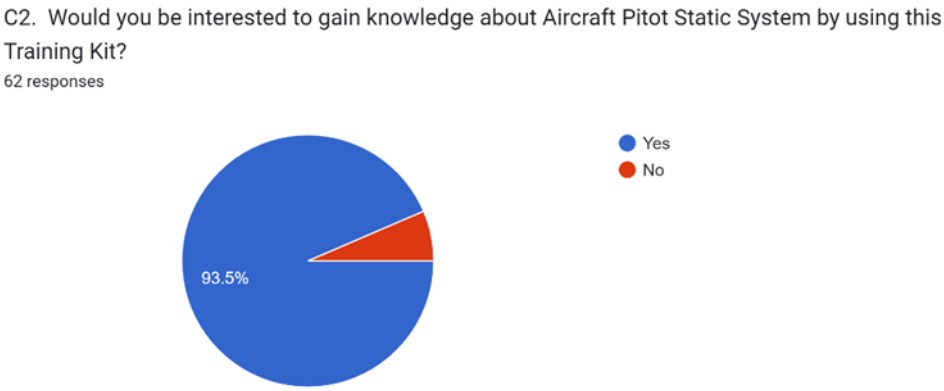


Figure3.4.1.1.9: Questionnaire C2

The majority of survey respondents said they would like to use a training kit. To increase their understanding of the Aircraft Pitot Static System. This suggests that the respondents have a strong desire and incentive to learn more about this subject.

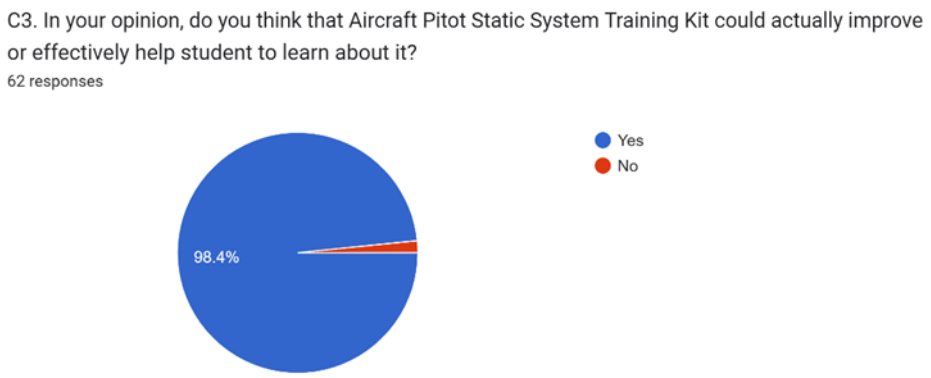


Figure 3.4.1.1.10: Questionnaire C3

Almost all of the respondents think that the learning kit can effectively help them learn about the Aircraft Pitot Static System. This indicates that the learning kit is a highly valued and useful educational tool among the respondents.

3.4.1.2 PARETO DIAGRAM

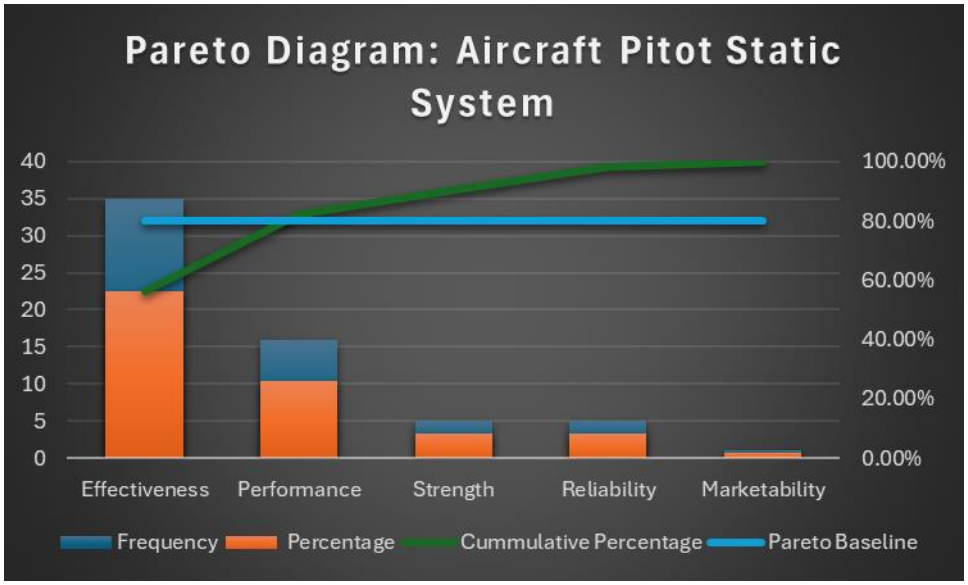


Figure 3.4.1.2

Features	Frequency	Percentage	Cumulative Percentage	Pareto Baseline
Strength	5	7.94%	8%	80%
Reliability	5	7.94%	16%	80%
Effectiveness	35	55.56%	71%	80%
Performance	16	25.40%	97%	80%
Marketability	2	3.17%	100%	80%
TOTAL	63			

Figure 3.4.1.2

The Pareto diagram for the Aircraft Pitot Static System highlights the key features influencing its performance, ranked by their frequency of occurrence. Effectiveness stands out as the most significant factor, contributing 55.56% to the overall issues, followed by performance at 25.40%. Together, these two features account for 80% of the cumulative frequency, aligning with the Pareto Principle, which states that most effects come from a minority of causes. The remaining factors—strength, reliability, and marketability—contribute marginally, with percentages of 7.94%, 7.94%, and 3.17%, respectively. This suggests prioritizing improvements in effectiveness and performance to achieve the most significant impact on the system's overall functionality and success.

3.4.2 DESIGN CONCEPT GENERATION

3.4.2.1 Morphological Matrix

Table 3.4.2.1: Morphology Matrix

FUNCTION (SUBFUNCTION)	CONCEPT 1	CONCEPT 2	CONCEPT 3	CONCEPT 4
MATERIAL	Acrylic 	Steel/aluminum 	Wood 	Steel/aluminum 
POWER SOURCES	AC power plug current 	Dry cell battery 	DC generators 	Dry Cell Battery 
INDICATOR PATTERN	Lateral pattern	Triangle pattern 	Lateral pattern 	Invert L Pattern 
COMPONENT (STATIC PRESSURE)	Hand pump 	Compressed air tank 	Small Compressor 	Small Compressor 
COMPONENT (PITOT PRESSURE)	Plastic syringe 	Bulb blower 	Hairdryer 	Plastic Syringe 

3.4.2.2 Proposed Design Concept 1

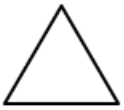
Table 3.4.2.2: Concept 1

FUNCTION	CONCEPT 1	JUSTIFICATION
MATERIAL	Acrylic 	Despite its strength, polycarbonate is remarkably lightweight compared to other material
POWER SOURCES	AC Power plugs current 	Efficient Transmission AC allows for efficient transmission of electricity over long distances. AC is easier and cheaper to generate power compared to DC.
INDICATOR PATTERN	Lateral pattern	A lateral pattern for an indicator can be efficient because it allows the viewer to see things side by side for faster analysis, but a lateral pattern may not be suitable because it takes up a lot of space compared to other patterns.
COMPONENT (STATIC PRESSURE)	Hand pump 	A hand pump is lightweight for easy to carry also be deflator but it has cons which are it needs a lot of human power to give pressure and low efficiency
COMPONENT (PITOT PRESSURE)	Plastic Syringe 	Simple and readily available Syringes are easy to find and often inexpensive. Precise control You can control the pressure somewhat by injecting air slowly or quickly.

From concept 1, material use for project casing is acrylic panel or Perspex panel because of an advantage of transparent view or clear view for students to understand the operation. Power source that we use is AC Power plug current because it has power efficiency and very long-lasting supplying power. Move into indicator pattern, which is lateral or horizontal pattern, this pattern make student can see indicators side by side for comparison. Component for static pressure is hand pump because of it is lightweight. Lastly, component for dynamic pressure, which is big plastic syringe, this item can easily operate because the pressure can be control and injecting pressure slowly.

3.4.2.3 Proposed Design Concept 2

Table 3.4.2.3: Concept 2

FUNCTION	CONCEPT 2	JUSTIFICATION
MATERIAL	Aluminium 	It can withstand heavy loads, impacts, and high pressure without deforming easily but the high density makes weight heavy
POWER SOURCES	Dry cell battery 	Dry cells come in various sizes, from tiny button cells to AA and D batteries. This compact size and lightweight design make them perfect for portable electronics, but they have limited capacity. Dry cells have a finite amount of energy and cannot be recharged. Once depleted, they need to be replaced
INDICATOR PATTERN	Triangle Pattern 	For the triangle pattern, it has an attraction to its more unique and modern shape compared to other patterns, but this pattern has the drawback that every indicator arranged in it will overlap, and it is difficult to produce this pattern.
COMPONENT (STATIC PRESSURE)	Compressed air tanks 	Compressed air tanks act as a reservoir for compressed air, providing a readily available source for various applications but the size and weight are larger which can be bulky and heavy, making them difficult to move around.
COMPONENT (PITOT PRESSURE)	Bulb blower 	Bulb blowers are very basic tools with no complex mechanisms. This makes them highly portable and convenient for use in various locations but the amount of air a bulb blower can move in a single squeeze is limited.

From concept 2, material that we use is aluminium or aluminium profile, it is because it robust and lightweight material also most suitable for our project. Power source that we use is dry cell battery, overall dry cell battery is come in many size and lightweight. Indicator pattern that we use is tringle pattern, it is because it was a unique pattern and has more attraction for student. Component for static pressure is compressed air tank, which is high capacity for compressed air and component for dynamic pressure is bulb blower, this bulb blower is a basic tools or item with no complex mechanism.

3.4.2.4 Proposed Design Concept 3

Table 3.4.2.4: Concept 3

FUNCTION	CONCEPT 3	JUSTIFICATION
MATERIAL	Wood 	Wood is strong and durable, a natural insulator, and has aesthetic appeal but it is susceptible to moisture damage and susceptible to insect and pest damage.
POWER SOURCES	DC Generator 	DC generator has a simple design or compact design, smoother power output, and parallel output but it has limited power rating and limited transmission efficiency, experiencing higher energy loss.
INDICATOR PATTERN	Vertical pattern 	Vertical patterns excel in making use of tall, narrow spaces. They can create a sense of height and grandeur, making signage more usable and attracting people's attention.
COMPONENT (STATIC PRESSURE)	Small Compressor 	The airflow and pressure amount can be precisely controlled by the compressor. Unlike mechanisms that rely on stored air, compressors can continuously generate compressed air as long as they are powered. This ensures a consistent and uninterrupted supply for tasks requiring a constant flow of pressurized air.
COMPONENT (PITOT PRESSURE)	Hairdryer 	A hair dryer is a common household appliance, making it an easy source of compressed air that is easily available, but the hair dryer has inconsistent pressure in maintaining a consistent air pressure due to its motors.

From concept 3, material that we use for our project is wood, it is because wood has high vibration shock absorbed and durable. Power source that we use is DC generator, which has smooth constantly supplying power. Indicator pattern that we use is vertical pattern, reason we choose vertical pattern is it follow the exact pattern on aircraft cockpit also have a narrow space. Component for static pressure is small compressor, this thing has advantages which are the pressure can be regulate by pressure regulator and the small size make it can be store in limited space. Component for dynamic pressure is we use hairdryer; it can supply a dynamic pressure for indicator.

3.4.2.5 Proposed Design Concept 4 Finalize

Table 3.4.2.5: Concept 4 Finalize

FUNCTION	CONCEPT 1	JUSTIFICATION
MATERIAL	Aluminium 	It can withstand heavy loads, impacts, and high pressure without deforming easily but the high density makes weight heavy.
POWER SOURCES	Dry Cell Battery 	Dry cells come in various sizes, from tiny button cells to AA and 12v batteries. This compact size and lightweight design make them perfect for portable electronics
INDICATOR PATTERN	Invert L Pattern 	Invert L patterns excel in making use of real cockpit config. They can create a sense of height and making signage more usable and attracting people's attention.
COMPONENT (STATIC PRESSURE)	Small Compressor 	The airflow and pressure amount can be precisely controlled by the compressor. Unlike mechanisms that rely on stored air, compressors can continuously generate compressed air as long as they are powered. This ensures a consistent and uninterrupted supply for tasks requiring a constant flow of pressurized air.
COMPONENT (PITOT PRESSURE)	Plastic Syringe 	Simple and readily available Syringes are easy to find and often inexpensive. Precise control You can control the pressure somewhat by injecting air slowly or quickly.

3.4.2.6Accepted Vs Discarded Solution

Overall, after analysing all the concepts that we have discovered, we decided to choose Concept 4 for our aircraft pitot-static system training kit project. This is based on the evaluation that has been done on the function of each aspect of the three concepts. Firstly, aluminium/steel is selected for It can withstand heavy loads, impacts, and high pressure without deforming easily, which makes it the best choice for this project. Next for power sources in Concept 4 is the best, which is the dry cell battery, because it allows for efficient V also our compressor need a DC source power. For the pattern, we chose the Invert L pattern due to cockpit config and because it is the most suitable pattern for our project. Besides, for component (static pressure), we choose Concept 4 because a small compressor is used to precisely control airflow and pressure, providing a consistent and uninterrupted supply for tasks requiring a constant flow of pressurized air, while for component (pitot pressure), it is also similar to choosing Concept 1 because a plastic syringe is mentioned for its simplicity, availability, and inexpensiveness. It allows for controllable pressure, which can be adjusted by injecting or withdrawing the plunger.

3.4.3 Evaluation and Selection of Conceptual Design

3.4.3.1 Pugh Matrix

Table 3.4.1.1 Pugh Matrix

CRITERIA	CONCEPT 1	AIRCRAFT PITOT STATIC TRAINING KIT	CONCEPT 3	CONCEPT 2
Material	3	3	D A T U M	3
Power Sources	3	3		2
Indicator Pattern	2	2		2
Component 1	1	3		1
Component 2	3	3		2
Total Score	12	14		11
Ranking	2	1	-	3

3.4.3.1 Concept Evaluation Using Pugh Matrix: Concept 3 As Datum

Go through all the Pugh Matrix, we've been comparing all the concept and us finalize concept which is Aircraft Pitot static System Training Kit. We use all concept to be Datum for concept comparison which concept is near to our project. It maybe has a weakness but the most effective design in those 4 concepts.

3.5 PRODUCT DRAWING / SCHEMATIC DIAGRAM

3.5.1 General Product Drawing

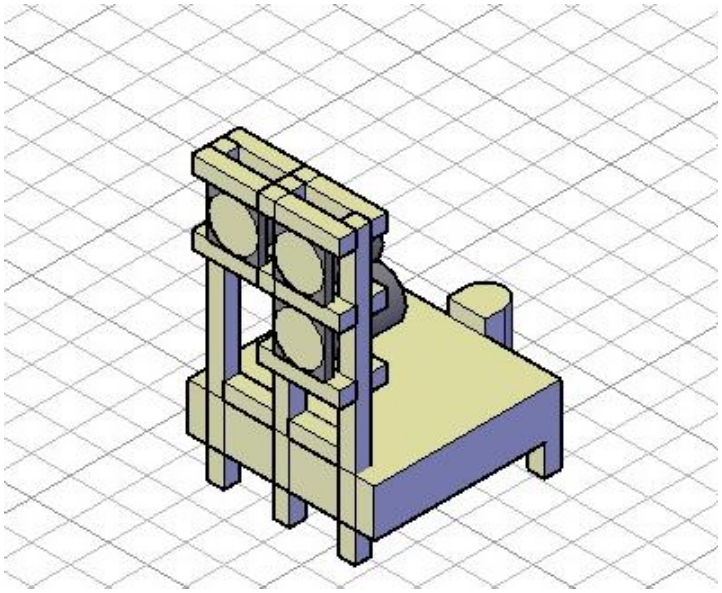


Figure 3.5.1.1: Isometric View of APSSTK in Three Dimension (3-D)

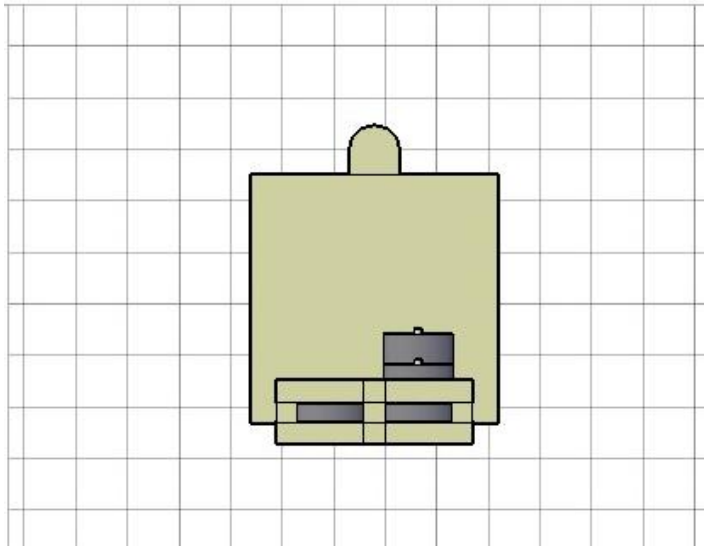


Figure 3.5.1.2: Top View of APSSTK

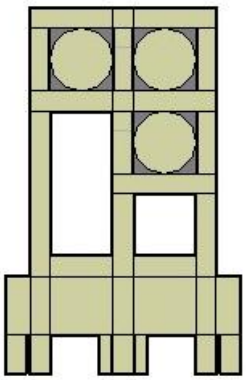


Figure 3.5.1.3: Front view of APSSTK

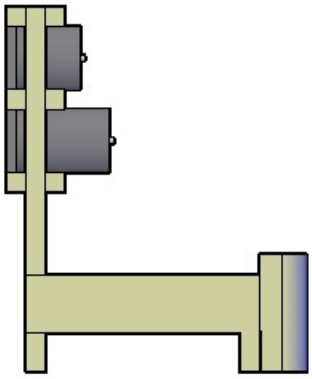


Figure 3.5.1.4: Side view of APSSTK

3.5.2: Specific Part Drawing

3.5.2.1 Product Structure

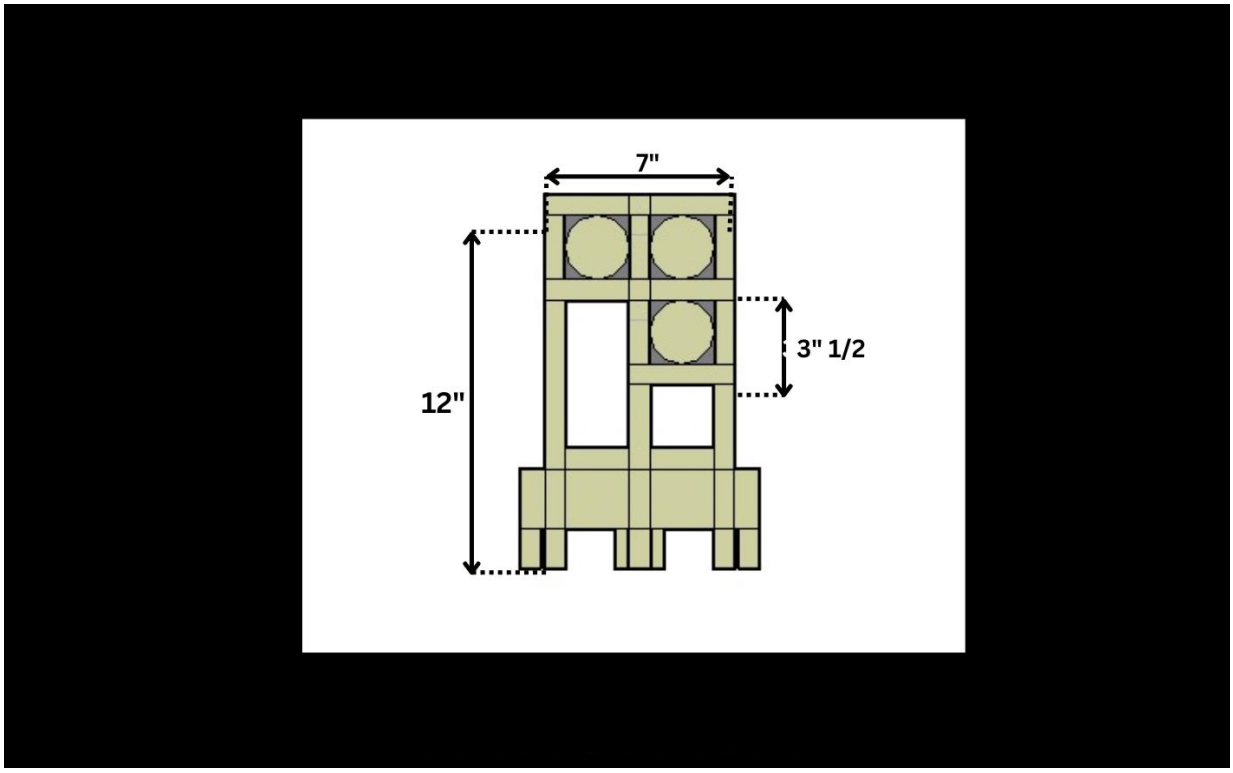


Figure 3.5.2.1: Structure AutoCAD drawing

The Aircraft Pitot-Static System Training Kit is thoughtfully designed as a compact and durable educational tool, combining practicality with ease of use. It features a strong foundation made from a 12”x12” aluminium base, ensuring excellent stability and support for the entire structure. The main frame is constructed using hollow steel, carefully cut to precise sizes and securely assembled with bolts, nuts, and steel adhesives. This ensures the kit is sturdy and reliable, even with frequent use.

To make assembly and understanding even easier, an AutoCAD drawing is provided. The drawing includes an isometric view of the full setup, clearly highlighting key parts such as the aluminium base, hollow steel frame, instrument panel, and mounted instruments. This schematic serves as a clear visual guide, ensuring that anyone working with the kit can construct or study it with confidence.

3.5.2.2 Product Mechanisms

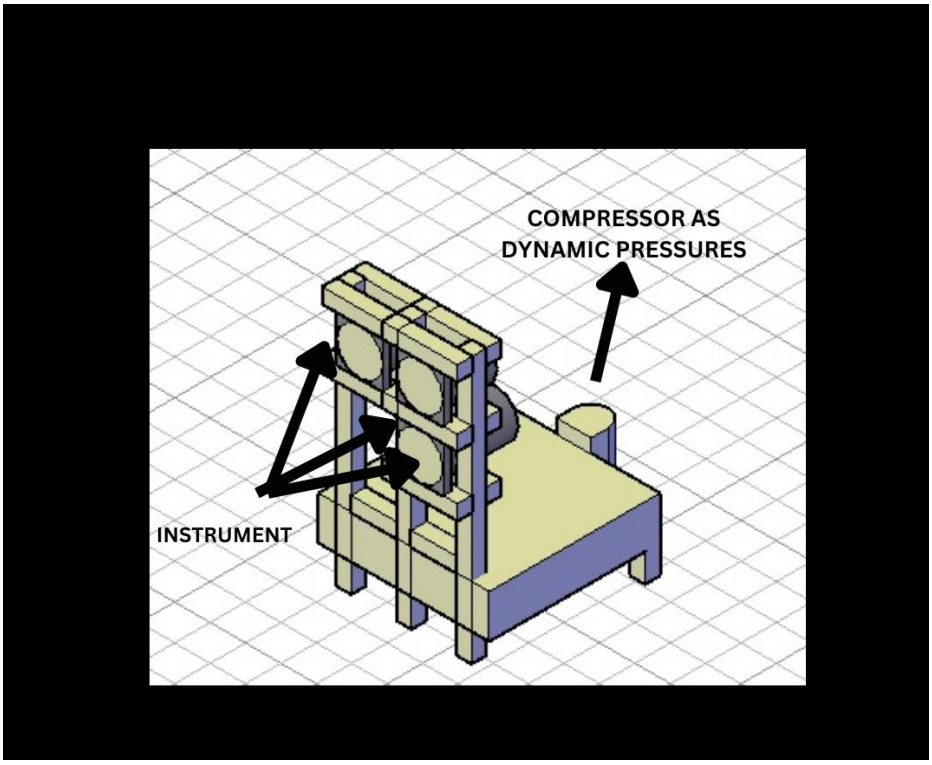


Figure 3.5.2.2: Mechanism on AutoCAD drawing

AutoCAD drawing is a reference to the arrangement of mechanisms found in APSSTK. This helps us in planning to launch the installation process of all the mechanisms, such as the three instruments, 12V light-duty DC compressor, and plastic syringe.

3.5.2.3 Electrical and Software

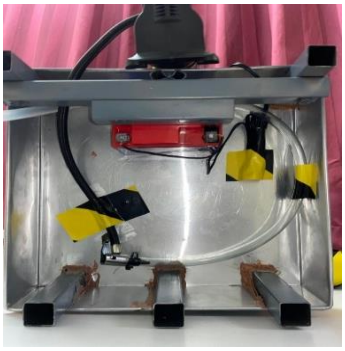


Figure 3.5.2.3: Electrical circuit of APSSTK

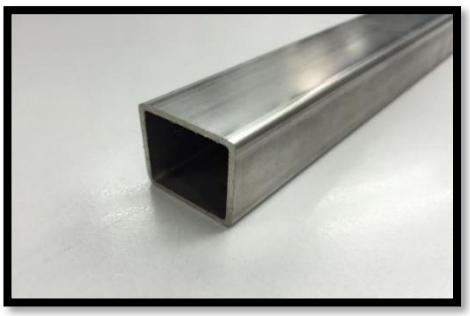
All electrical connections between the mechanism and the power source, from the battery to the compressor, are done simply and neatly so that it is easy to maintain and safe. As in the figure above, the connection between the electric compressor and the battery is direct because the compressor has its own control switch on the top.

3.7 DEVELOPMENT OF PRODUCT

3.7.1 Material Acquisition

3.7.1.1 Base Structure of APSSTK

Table 3.7.1.1: Base Structure of APSSTK

Description	Material
-The hollow square steel used as a main material for main structure.	 1/2 inch hollow square steel
-The Nut & Boly used as a connector between hollow square steel. -Also,it used as a connector between hollow square and aluminium square cake Tin.	 3/8 inch Nut & Bolt
-The Aluminium Square Cake Tin 12x12 Inches use as main structure compartment for APSSTK project	 Aluminium Square Cake Tin 12x12Inches

-The aluminium plate use as housing for all instruments.	 Aluminium plate

3.7.1.2 Electrical and Electronic Component

Table 3.7.1.2: Electrical and Electronic Component

Description	Material
-Portable air compressor use as air pressure source Air speed indicator instrument.	
- DC Battery 12volt used as main power source to our compressor.	 Battery 12volt

3.7.1.3 Mechanical Component of APSSTK

Table 3.7.1.3: Mechanical Component for APSSTK

Explanation	Component
-The plastic syringe use as static air pressure source.	 Plastic syringe
. -The control valve use as regulator to control amount of air pressure go to instrument.	LAIZE 莱泽  The control valve
- The Pu tube used as pressure connection for our project.	 Pu tube

-Hose pipe clamp use as safety device for all connection point.	 Hose pipe clamp

3.7.2 Machine and tools

Table 3.7.2 List of Tools Used for Project Fabrication.

No.	Machine Description & Usage	Types Of Machine
1.	•**General Purpose:** Used for cutting, grinding and polishing steel and other material. •**Project Purpose:** **1.**Used for grinding and cut stell hollow surface	 Hand Grinder
2.	**General Purpose**: To perform various of task include screw driving and drilling that usually used in woodworking, metalworking, construction and do-it-yourself projects. **Project Purpose**: The machine used for screw and drill our project	 Portable Electric Drill

3	• **General Purpose**: Used for drilling hole • **Project Purpose:** The machine used for drill holes onto the hollow steel and aluminum	 Drill machine

3.7.3 Specific Project Fabrication
3.7.3.1 (Base Structure)

Table 3.7.3.1 List of Tools For Base Structure

No.	Description	Types of hand tool
1.	•**General purpose:** The tool used to remove surplus fine amounts of material from a workpiece. •**Project Purpose:** To file the side of the Hollow steel and aluminium to become flat surface and smooth	 File
2.	**General purpose :** It used to secure an object to allow work to be performed on it during saw ,drilling , filing and other task **Project Purpose:** Used to grip the alumoium and hollow steel	 Vice Bench

3.	•**General purpose:** The instrument used to measure internal and external distances such as diameter and length of the object. •**Project Purpose:** It is used to measure the diameter of the rivet and hole of the drill.	 Vernier Caliper
4.	•**General purpose:** The tool suitable for carpenters use. It used for measurement, especially for right-angles. •**Project Purpose**: Used to mark vertical line.	 Steel Square (L- rule)
5.	•**General purpose:** The instrument to measure distances or to rule straight line especially in geometry, technical drawing, printing, engineering and building. •**Project Purpose:** Used for measured length and make a horizontal line.	 Rule

3.7.3.2 (Accessories & Mechanisms)

Table 3.7.3.2 List of Accessories & Mechanisms

1.	•**General purpose:** These caps also provide insulation, protecting users from sharp edges or exposed ends of steel tubes. This safety feature is particularly important in industrial settings where workers may come into contact with these components. •**Project Purpose:** Use rubber caps to protect the ends of hollow steel from dents and scratches during transit.	 Rubber Protection Cap
2.	•**General purpose:** This tape use for enhancing safety awareness and caution when handling instruments. •**Project Purpose:** Use this tape to make it visible and cosmetic decoration.	 Warning tape

3.7.3.3 (Software and electrical circuit)

Table 3.7.3.3: List of Software and electrical circuit

1.	•**General purpose:** QR codes (Quick Response codes) are versatile tools used across various sectors for a multitude of purposes**.** •**Project Purpose:** QR code use for student access information and detail about pitot static system.	 **QR codes(Quick Response code)**
2.	•**General purpose:** The Wix app is a powerful mobile application designed to help users manage their websites and businesses conveniently from their smartphones. •**Project Purpose:** Wix app use a platform to generate a website to fill all information and detail about our project also manual to operate the project.	 Wix App

3.8 PRODUCT TESTING

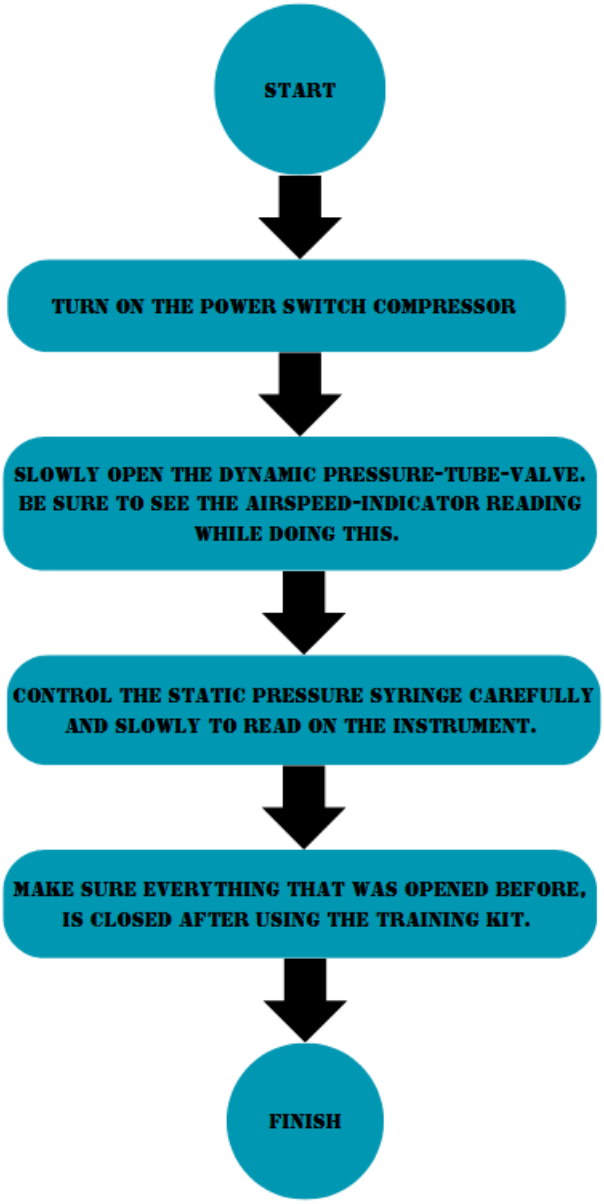


Figure: 3.8 product testing

3.9 LIST OF MATERIAL & EXPENDITURES

Table: 3.9 list of material & expenditures

3.9.1 Product Structure				
No	Items Details	Unit	Price/Unit	Total(RM)
1	Square hollow steel 1”X1”(20 feet)	1	14.00	RM 14
2	Bolt and Nut	2	12.00(1kg)	RM 24
3	PU air tube	3	3.00(1 Meter)	RM 9
4	Aluminium plate 10”X10”	-	-	-
5	Square Aluminium Cake mould 12”X12”	1	17.00	RM 17
3.9.2 Product Mechanisms				
No	Items Details	Unit	Price/Unit	Total(RM)
1	3 Instrument	-	-	-
2	12V light duty DC compressor	1	26.00	RM 26
3	Plastic syringe	1	11.00	RM 11
4	Small control valve	1	3.00	RM 3
5	4 way PU connector	1	4.00	RM 4
3.9.3 Software				
No	Items Details	Unit	Price/Unit	Total(RM)
1	Wix.com platform	-	-	-
3.9.4 Accessories & Finishing				
No	Items Details	Unit	Price/Unit	Total(RM)
1	Spray paint	2	9.00	RM 18
2	Plastic hollow cover	20	0.40	RM 8
3	Floor marking tape	1	8.00	RM 8
4	Steel hollow hose clip(200mm)	2	3.00	RM 6
5	Steel hollow hose clip(20mm)	5	0.80	RM 4
6	12V Gel battery	1	55.00	RM 55
GRAND TOTAL				RM 207.00

CHAPTER 4

RESULT & DISCUSSION

4.1 PRODUCT DESCRIPTION

4.1.1 GENERAL PRODUCT FEATURES & FUNCTIONALITIES

Figure:4.1.1 General product APSSTK

Aircraft Pitot Static System Training Kit (APSSTK) is one of development of effective educational tools in aviation education. APSSTK have several key features that make it both practical and engaging for learners. First, it has a modular design that breaks down the pitot-

static system into easily understandable parts, such as the pitot tube, static port, and measuring instruments. This design helps students see how each component functions on its own and as part of the overall system.

One of the main features of this kit is its ability to simulate real-time pressure changes. The kit is equipped with an airflow mechanism that mimics real-world conditions, allowing users to observe live changes in the readings on connected instruments. This feature helps students understand how changes in airspeed and altitude affect instrument readings, making the learning experience highly practical.

To add to the educational value, the kit includes multiple aviation instruments like the airspeed indicator, altimeter, and vertical speed indicator. These tools show how changes in air pressure impact the information that pilots and engineers rely on to navigate and maintain aircraft safety. Each component is connected through transparent tubing, giving students a clear view of airflow and pressure changes throughout the system. We have also prepared the software element in our project, which is e-learning, by using the wix.com platform. The e-learning produced has various features, such as complete information on the aircraft pitot static system, information on each instrument, and a manual book to handle our training. Kit

4.1.2 SPECIFIC PART FEATURES

4.1.2.1 Product Structure

Figure:4.1.2.1 Product structure on APSSTK

Starting with the structure that is constructed with hollow steel it is designed to have instrument placement and holder of all things. Apart from holding all the hollow steel rods, the square aluminium cake mould is also used as a housing to store all the electrical connections and pressure air connections. The connection of hollow steel is all use bolts and nut to make it easier for the user to open to take the instrument.

4.1.2.2 Product Mechanisms

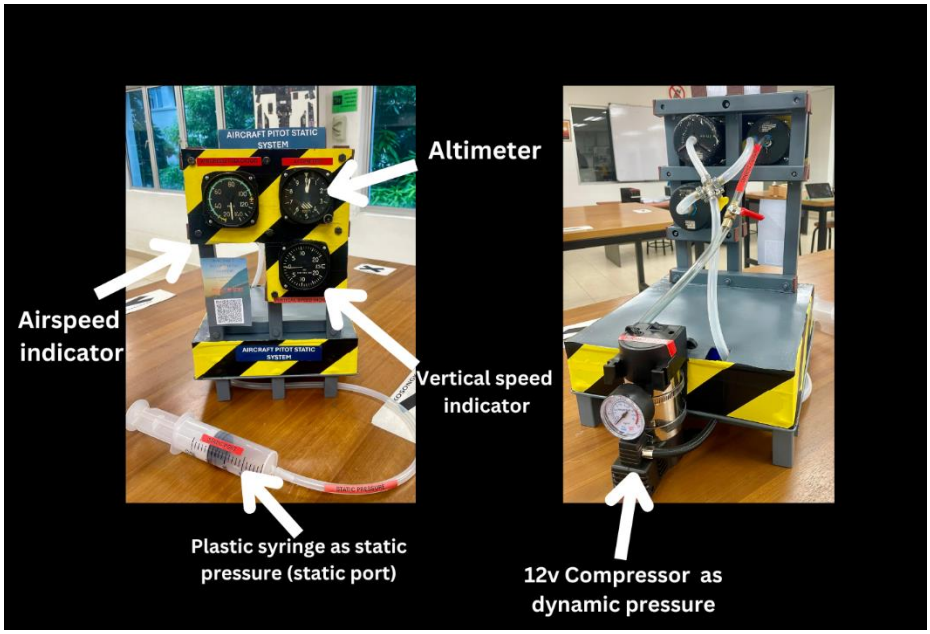


Figure:4.1.2.2 Product mechanism on APSSTK

Among the product mechanisms at APSSTK are instruments, an airspeed indicator, a vertical speed indicator, and an altimeter. These three instruments get air pressure from two sources, one of which is from a compressor that acts as a pitot tube that transmits dynamic air pressure to the ASI, while another source is from a plastic syringe that acts as a static port that will send static air pressure to all three instruments. Utilize a compressor to ensure reliable airflow to the airspeed indicator and incorporate a control valve to precisely manage this airflow for optimal performance.

4.1.2.3 Electrical and Software

Figure:4.1.2.3 E-learning QR code APSSTK

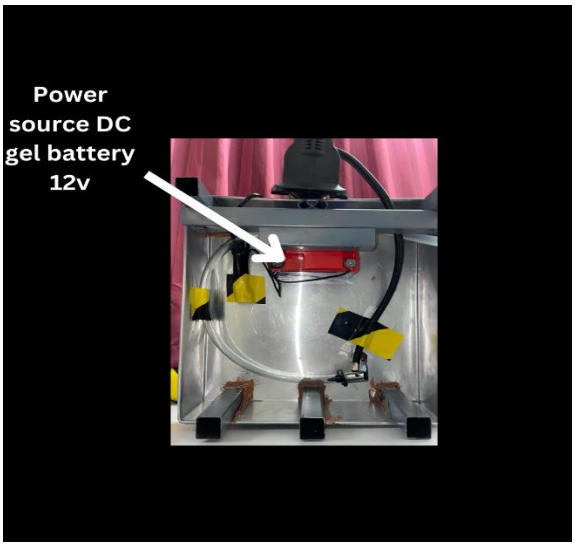


Figure:4.1.2.3 Electrical connection on APSSTK

The e-learning produced has various features, such as complete information on the aircraft pitot static system, information on each instrument, and a manual book to handle our training. Kit. Users can use our e-learning easily; that is, they only need to scan the available QR code. E-learning APSSTK not only has a phone view but also a desktop view. This allows users to use it on any device. As seen in the figure above as well, electrical connections between the mechanism

and the power source, from the battery to the compressor, are done simply and neatly so that it is easy to maintain and safe.

4.1.2.4 Accessories & Finishing

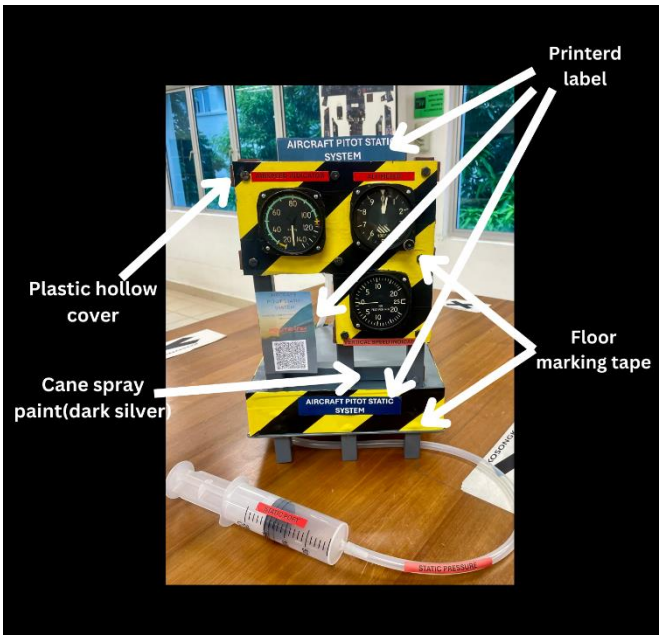


Figure:4.1.2.4 Accessories finishing on product

For the accessories and finishing, use hole rubber cover to close all the hollow steel holes as a finishing touch to the product. After that, spray all part of the product to make the product more beautiful and attractive. Each component in APSSTK has its own label; this is to make it easier for users to understand. Apart from that, APSSTK also uses floor marking tape to attract users.

4.1.3 GENERAL OPERATION OF THE PRODUCT

The general operation of Aircraft Pitot Static Training Kit is when use the product, users must scan to QR code to know safety and precaution when using this product and how to handle the product more carefully. Check Clamp-Condition on each Connector of Pressure-Tube. Make sure the dynamic Pressure-Tube-Valve is closed and secure. Check the compressor and regulator on compressor condition are good After that, switch ON the compressor to make the airflow go to the instrument and open the valve slowly. Use plastic syringes as dynamic pressure. Control the static pressure syringe carefully and slowly to read on the instrument.

4.1.4 OPERATION OF THE SPECIFIC PART OF THE PRODUCT

4.1.4.1 Product Structure

The training kit housing panel is made of aluminium, which is a 12”x12” rectangular base cake. To build the main training kit structure, use hollow steel cut to the specified size. Next, for the instrument holder, we use an aluminium plate; it also acts as a panel for 3 instruments. All structures are connected using bolts and nuts and steel adhesives to ensure that all joined structures are firm.

4.1.4.2 Product Mechanisms

The using of valve is to make sure airflow in control and not excessive which may cause damage to the instrument. After that, the airspeed indicator uses the pressure differential between the pitot tube and the static port to determine airspeed. The altimeter calculates altitude by measuring static pressure and comparing it to a preset sea-level pressure. The vertical speed indicator measures the rate of climb or descent by analysing changes in static pressure over time. The plastic syringe is use as static pressure for this instrument. The kit is designed for easy assembly and maintenance, making it a practical tool for educational purposes.

4.1.4.3 Electrical and Software Mechanism

The using of battery is for supply power to the compressor. When use battery is make product more portable than use switch plug that have to find it when want to use the product. After that, this product have QR code that when user scan, it will go to the website that we make it about the product. That website have various information about pitot static system and safety precaution when use the product.

4.1.4.4 Accessories & Finishing

The using of spray is for finishing to make the product more neater and the using of sticker is for attract people to use the product. After that, the using of hole rubber cover to close the hole at the hollow steel for safety because at the end of hollow steel is sharp that can endanger the user.

4.2 PRODUCT OUTPUT ANALYSIS

This is reading on the APSSTK instrument. All these data are based on real-life standard readings on board Cessna 172:

Table:4.2 product output analysis

NO.	Instrument	Results	Remarks/ Description	Analysis
1.0	Reading on Instrument			
1.1	Altimeter	1000 feet and above	During climbing	These are typical values for a Cessna 172 under normal conditions. Real reading are based on current weather and environmental factors.
	Vertical speed indicator	700 to 800 ft/min		
	Airspeed indicator	75 to 85 knots		
1.2	Altimeter	5000 feet and above	During cruise	
	Vertical speed indicator	0 ft/min		
	Airspeed indicator	95 to 100 knots		
1.3	Altimeter	3000 feet and Below	During decent	
	Vertical speed indicator	-500 to -800 ft/min		
	Airspeed indicator	90 to 120 knots		

4.3 ANALYSIS OF THE PROBLEM ENCOUNTERED & SOLUTIONS

4.3.1 Product Structure

The problem we encountered on constructing the structure was the delay of the product shipping and the limited time access to the workshop. There's no solution on the delay of the product shipping so we had to speed up our work progress and due to limited time access to the workshop, we managed to buy tools to continue our work more efficiency.

4.3.2 Product Mechanisms

We faced a significant challenge with the regulator, as it failed to deliver the airflow we required, its design only accommodates large airflow readings. To overcome this issue, we recommend utilizing a pressure valve instead. This solution will empower us to precisely control the airflow to meet our specific needs effectively.

4.3.3 Electrical and Software Mechanism

We faced a challenge with our compressor when we attempted to use it with AC current from a plug, but unfortunately, it was incompatible. To ensure optimal performance, we switched to a battery providing DC current, and the results were impressive. This solution not only resolved the issue but also maximized the compressor's effectiveness.

4.3.4 Accessories & Finishing

The problem we encountered while finishing the Aircraft Pitot Static Training Kit was hole rubber cover did not fit to hollow steel hole. We managed to conclude this problem by buy again hole rubber cover but with other stores.

CHAPTER 5

CONCLUSION & RECOMMENDATIONS

5.1 ACHIEVEMENT OF THE AIM & OBJECTIVES OF THE RESEARCH

5.1.1 General Achievement of the Project

Our product performs exceptionally well, fully aligned with our goals and objectives. The instruments are designed to effectively support our mission of creating a reliable indicator powered by a compressor and a plastic syringe for accurate readings. Furthermore, we are thrilled to present our innovative portable Aircraft Pitot Static System Training Kit, which is lightweight and easy to carry. This allows students to master this essential system anywhere, ensuring they have the tools they need for successful learning without any constraints.

5.1.2 Specific Achievement of Project Objectives

5.1.2.1 Product Structure

Our goal is to create a highly effective and portable Aircraft Pitot Static Training Kit that delivers precise readings. To ensure exceptional accuracy, it is essential for us to identify the correct readings while gaining a comprehensive understanding of aircraft instruments. Our dedicated team has successfully developed this training kit in accordance with the AUTOCAD drawings, setting a new standard in aviation training.

5.1.2.2 Product Mechanisms

Throughout the process of designing the real product of the Aircraft Pitot Static Training Kit. The objectives and aims that were stated at the beginning of the work are considered successfully accomplished. The main reason of this mechanical mechanism is to design the place to put the Aircraft Pitot Static System Training Kit is suitable and not to complex build and easy to carry to make students learn this system at everywhere without a problem.

A product of the Aircraft Pitot Static Training Kit comes with a suitable, not to complex build and easy to carry has been develop and designed first, using hollow steel as the frame and the structure of the instruments. Before the product was designed, a series of experimental phases were carried out to determine the most perfect shape that made people interested about this product.

5.1.2.3 Electrical and Software Mechanism

APSSTK features a simple electrical mechanism that utilizes a compressor. It also includes an app that provides various information. Consequently, the objectives for both the electrical and software components have been successfully achieved. The system creates the desired pressure, and the app offers extensive information about pitot-static systems, which will assist users in effectively utilizing the product.

5.1.2.4 Accessories & Finishing

Our product stands out in the market due to its exceptional user-friendly design, allowing anyone to grasp its operation effortlessly. This is why we engineered the Aircraft Pitot Static Training Kit with clarity and simplicity at its core. We meticulously prioritized the accessories and finishes to ensure a polished final product. Moreover, the thoughtful application of stickers and spray paint not only improves its functionality but also elevates its visual appeal, making it a worthwhile investment for users seeking quality and ease of use.

5.2 CONTRIBUTION OR IMPACT OF THE PROJECT

This project significantly enhances our society by transforming the learning experience through real-world simulation. Unlike conventional classroom lectures or static textbook illustrations, this kit empowers students with an interactive platform to explore how airspeed indicators, altimeters, and vertical speed indicators react to changes in pitot and static pressure. By simulating authentic flight conditions, the kit not only bridges the gap between theory and practice but also equips students with the essential skills and knowledge needed for their future careers, ensuring they are well-prepared for real-world challenges.

In summary, the Pitot-Static System Training Kit project not only enriches aviation education but also equips future engineers, pilots, and technicians with practical skills essential to aircraft safety and maintenance. Its hands-on, interactive approach makes a lasting impact by deepening students' understanding of critical aviation concepts, enhancing safety awareness, and ultimately advancing the quality of aviation training.

5.3 IMPROVEMENT & SUGGESTIONS FOR FUTURE RESEARCH

5.3.1 Product Structure

The improvement that we seek in the future is to change the option of material used for the making Aircraft Pitot Static Training Kit such as using aluminium alloy as the base structure instead of hollow steel which is slightly heavier.

5.3.2 Product Mechanisms

We envision a future where our consistent dedication and hard work transform this project into an exceptional product. To elevate the Aircraft Pitot Static Training Kit, we propose incorporating a model aircraft that accurately simulates altitude settings chosen by the user. This feature will enhance user comprehension and significantly improve the training experience, making it more effective and engaging.

5.3.3 Electrical and Software Mechanism

The improvement & suggestion for electrical and software mechanisms is to install an electronically controlled valve with a variable speed motor to regulate airflow in response to the microcontroller. This setup allows for precise, automatic adjustments to simulate various flight conditions without manual intervention, resulting in smoother and more efficient experiments.

5.3.4 Accessories & Finishing

The refinement of the product in accessories are to add more stickers to attract interest people using this product.

LIST OF REFERENCES

1. Wix, “Wix.com,” *Wix.com*, 2023. https://www.wix.com/

2. P. Institute, “The Six Pack: Basic Flight Instruments,” Pilot Institute, Dec. 06, 2021. https://pilotinstitute.com/six-pack-instruments/

3. T. Lefebvre, “The Six Pack Explained,” Mid-Continent Instruments and Avionics, Jul. 24, 2019. https://www.mcico.com/resource-center/articles/six-pack-aircraft-instruments-explained

4. Media, “Aero Train,” Aerotrain. aero, 2018. [Online] https://aerotrain.aero/page-aircraft-maintenance-practices-trainer-model-as-70-5

5. Important Pitot Static System in Aircraft Control System, January 2014 [Online] https://www.researchgate.net/publication/298850588_Important_Pitot_Static_System_in_Aircraft_Control_System

6. Simulation of Dynamic Qualities of The Aircraft Pitot Static Systems, 2006, [Online] https://web.archive.org/web/20180430192809id_/https://mtc-aj.com/library/63_EN.pdf

7. M. P. - imedia.com.pk, “Aero Train,” aerotrain.aero. [Online] http://aerotrain.aero/page-aircraft-maintenance-practices-trainer-model-as-70-5

8. SKYbrary, “Pitot Static System,” SKYbrary Aviation Safety, May 29, 2021. [Online]https://skybrary.aero/articles/pitot-static-system

9. SRCOE pune, “Why practical knowledge is more important than theoretical knowledge?,” *Medium*, Jul. 23, 2016. https://medium.com/@srespune/why-practical-knowledge-is-more-important-than-theoretical-knowledge-f0f94ad6d9c6

10. J. Tallman, “How It Works: Pitot-static system,” *www.aopa.org*, Jan. 11, 2018. https://www.aopa.org/news-and-media/all-news/2018/november/flight-training-magazine/how-it-works-pitot-static-system

11. J. Hardiman and L. Bodell, “What Are Pitot Tubes and How Do They Work?,” Simple Flying, Dec. 04, 2020. https://simpleflying.com/pitot-tubes/

12. “What Does a Pitot Tube on an Aircraft Do?,” National Aviation Academy, Oct. 19, 2021. https://www.naa.edu/pitot-tube/

13. Altimeters: how they work and their role in aviation,” Nov. 14, 2023 https://www.aerotime.aero/articles/altimeters-how-they-work-and-their-role-in-aviation

14. “How Does A Vertical Speed Indicator Work? https://www.boldmethod.com/learn-to-fly/aircraft-systems/how-does-a-vsi-work/

15. Hardiman, J., & Bodell, L. (2020, December 4). *What Are Pitot Tubes and How Do They Work?* Simple Flying. https://simpleflying.com/pitot-tubes/

16. *The Aircraft Pitot Static System | AeroToolbox*. (2020, June 30). https://aerotoolbox.com/pitot-static-system/

17. Pilot Institute. (2022, March 26). *The Pitot-Static System: How It Works*. Pilot Institute. https://pilotinstitute.com/pitot-static-system

18. *How Does Your Airspeed Indicator Work, And What Happens When It Fails?* (n.d.). Www.boldmethod.com. https://www.boldmethod.com/learn-to-fly/aircraft-systems/how-does-an-airspeed-indicator-work/

19. *Airspeeds*. (n.d.). Flight Mechanics for Pilots. https://agodemar.github.io/FlightMechanics4Pilots/mypages/airspeeds/

20. *Northstar Aviation References*. (2024, June 30). Northstar Aviation References. https://northstarvfr.com/blogs/news/what-is-the-pitot-static-system-and-how-does-it-work?srsltid=AfmBOorltHykVRHsQLnJIIumV-RwMiy-OmGpW_XW3-z4LBTnYDcGPOPQ

21. Glazer, N. (2020, October 5). *How it Works: Airspeed Indicator (Extensive Guide)*. PilotMall.com. https://www.pilotmall.com/blogs/news/how-it-works-airspeed-indicator-extensive-guide?srsltid=AfmBOoopC2OS4nBeGxygk3uvZZokNPLnIuNPvhO8-yJPF2a4B69FYxvb

22. Johnston, M. (2020, November 3). *What Is a Vertical Speed Indicator and How Does It Work?* CAU. https://calaero.edu/aeronautics/flight-instruments/vertical-speed-indicator-work/

23. Rosa. (2022, July 12). *How the aircraft altimeter works*. Grupo One Air. https://www.grupooneair.com/what-is-an-altimeter/

24. Johnston, M. (2023, July 6). *How to Read an Altimeter*. CAU. https://calaero.edu/aeronautics/flight-instruments/how-to-read-an-altimeter/

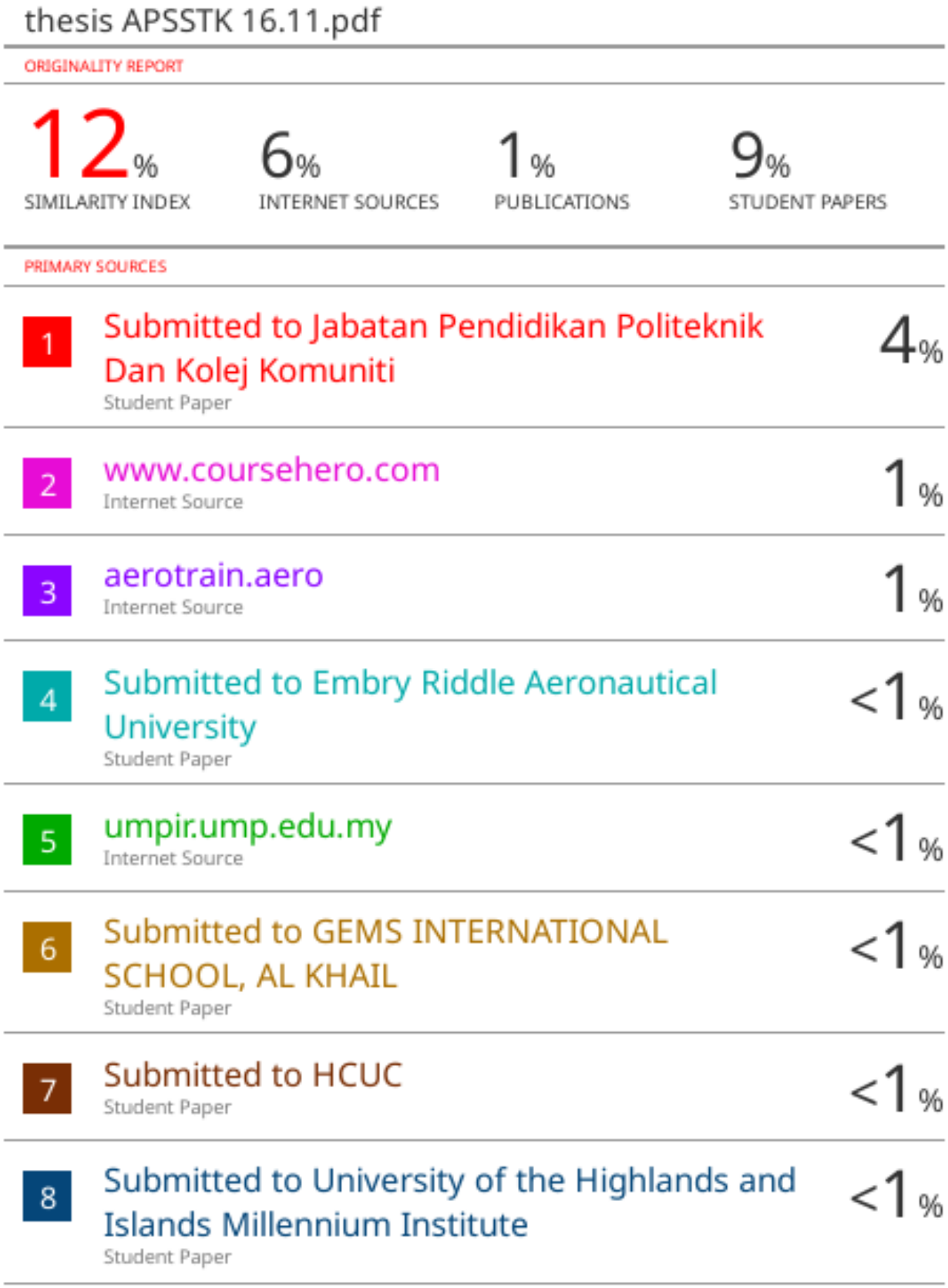
APPENDIX A : DECLARATION OF TASK SEGREGATION

SUB-CHAPTERS	DESCRIPTION
	MUHAMMAD HIFZHAN BIN MOHD ROSLI
1.3.2.3	Specific Individual Project Aims: Accessories
1.4.2.3	Specific Individual Scope: Accessories & Finishing
1.5.2.4	Specific Individual Scope: Software/Programming
2.2.3	Specific Literature Review:Software
2.4.1.3	Explanation: Features
3.3.2.3	Specific Project Design Flow /Framework: Programming / Software
3.4.2.4	Proposed Design Concept 3
3.5.2.3	Specific Part Drawing: Electrical & Software
3.7.3.3	Specific Project Fabrication: Software & Electrical Circuit
4.1.2.3	Specific Part Features: Electrical & Software
4.1.4.3	Operation Of The Specific Part Of The Product: Electrical & Software Mechanisms
4.1.4.4	Operation Of The Specific Part Of The Product: Accessories & Finishing
4.3.3	Analysis Of The Problem Encountered & Solutions: Electrical & Software Mechanism
5.1.2.3	Specific Achievement of Project Objectives: Electrical & Software Mechanisms
5.3.3	Improvement & Suggestions For Future Research: Electrical & Software Mechanisms
5.3.4	Improvement & Suggestions For Future Research: Accessories & Finishing

SUB-CHAPTER	DESCRIPTION
	DANISH DARWISY BIN MOHD HAFFIZY
1.3.2.2	Specific Individual Project Objectives: Product Mechanism
1.5.2.2	Specific Project Scope: Product Mechanism
2.2.2	Specific Literature Review: Product Mechanism
2.4.1.2	Explanation: Product Portability/ Weight / Overall Size
3.3.2.2	Specific Project Design Flow / Framework: Product Mechanism
3.4.2.3	Proposed Design Concept 2
3.5.2.2	Specific Part Drawing: Product Mechanism
3.7.3.2	Specific Project Fabrication: Accessories & Mechanisms
4.1.2.2	Specific Part Features: Product Mechanisms
4.1.4.2	Operation Of the Specific Part Of The Product: Product Mechanisms
4.3.2	Analysis Of the Problem Encountered & Solutions: Product Mechanisms
5.1.2.2	Specific Achievement of Project Objectives: Product Mechanisms
5.1.2.4	Specific Achievement of Project Objectives: Accessories & Finishing
5.3.2	Improvement & Suggestions for Future Research: Product Mechanisms

SUB-CHAPTER	DESCRIPTION
	MOHAMED RIEFAI BIN MOHAMED IDRIS
1.3.2.1	Specific Individual Project Objectives: Product Structure
1.5.2.1	Specific Individual Scope: Product Structure
2.2.1	Specific Literature Review: Product Structure
2.2.4	Specific Literature Review: Accessories & Finishing Indicator Vertical Pattern
2.4.1.1	Explanation: Product Price
3.3.2.1	Specific Project Design Flow / Framework: Product Structure
3.4.2.2	Proposed Design Concept 1
3.5.2.1	Specific Part Drawing: Product Structure
3.7.3.1	Specific Project Fabrication: Base Structure
4.1.2.1	Specific Part Features: Product Structure
4.1,2,4	Specific Part Features: Accessories & Finishing
4.1.4.1	Operation Of the Specific Part Of The Product: Product Structure
4.3.1	Analysis Of The Problem Encountered & Solutions: Product Structure
4.3.4	Analysis Of The Problem Encountered & Solutions: Accessories & Finishing
5.1.2.1	Specific Achievement of Project Objectives: Product Structure
5.3.1	Improvement & Suggestions For Future Research: Product Structure

APPENDIX B: SUMMARY OF SIMILARITY REPORT (TURNITIN)



thesis APSSTK 16.11.pdf

ORIGINALITY REPORT

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