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POLITEKNIK BANTING SELANGOR

SMART AERO TOOLS CLEANSING DEVICE

NAME	MATRIC NO.
TENGKU NUR AINUL ARFAH BINTI TENGKU MOHD NAZDRI	24DAM22F1037
NUR ALIYAH SHUHADA BINTI SHAH RIZAL	24DAM22F2005
SYAHMAA PUJAA A/P CHANDARAN	24DAM08F1034

DEPARTMENT OF AIRCRAFT MAINTENANCE

MAY 2025

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

SUPERVISOR:

MR. KHAIRUL IZWAN BIN ISMAIL

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Politeknik Banting Selangor

Date : 16 May 2025

CERTIFICATION OF PROJECT ORIGINALITY & OWNERSHIP

SMART AERO TOOLS CLEANSING DEVICE

SESSION: MAY 2025

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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

Endorsed by,

(SUPERVISOR'S SIGNATURE)

KHAIRUL IZWAN BIN ISMAIL
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SUPERVISOR'S STAMP

DATE: 16 May 2025

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ABSTRACT

The Smart Aero Tools Cleansing Device is an innovative solution designed to enhance the maintenance and cleanliness of aircraft tools used in the aviation industry. Proper cleaning of these tools is crucial to ensure safety, efficiency, and compliance with industry regulations. This project aims to develop an automated, efficient, and eco-friendly cleansing system that minimizes human intervention while ensuring thorough cleaning. The device incorporates advanced cleaning mechanisms such as chemical detergent to effectively remove grease, oil, and other contaminants from tools. Additionally, it features smart monitoring capabilities. By implementing this device, the aviation industry can reduce maintenance time, improve tool longevity, and enhance operational efficiency. The system's automation and smart features make it a cost-effective and sustainable alternative to traditional manual cleaning methods. This project contributes to the advancement of maintenance technology, ultimately supporting the high safety standards required in the aviation sector.

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CHAPTER 1

INTRODUCTION

1.1BACKGROUND OF STUDY

Tool cleanliness and preparedness are critical factors for maintaining safe, reliable, and accurate aircraft servicing in the aircraft maintenance field. Greasy, oily, or debris-contaminated tools pose a threat to maintenance integrity, introduce potential foreign object damage (FOD), and go against stiff aviation cleanliness regulations. Conventionally, aerospace tool cleaning and drying is manually performed, which is time, labour, and consistency intensive, particularly for high-demanding sectors like maintenance, repair, and overhaul (MRO) facilities in order counter all these issues, the Smart Aero Tools Cleansing Device has been created. This cleansing device washes and dries automatically within a set time limit, promoting consistency and efficiency. Made of acrylic material, it is lightweight, durable, and water-resistant, which makes it an ideal vessel for holding mechanical components with a guarantee of accessibility of the inner process. The cleaning system is designed using a timed cycle, which makes users able to manage washing and drying time, enhancing workflow. For drying purposes, an internal exhaust fan promotes air circulation for moisture extraction from tools with speed and effectiveness. By integrating automation with effective yet straightforward engineering, the tool facilitates a healthier working space and lowers maintenance safety risks. Implementing such smart systems is consistent with ongoing developments within the field of aviation, wherein digitalization and process enhancement are being used more and more to increase maintenance efficiency and adherence to safety regulations (Smith, 2020). [1] Smith, J. (2020). *Advances in Aircraft Maintenance and Safety Systems*. Aviation Technology Press.

1.2 PROBLEM STATEMENT

In the aviation industry, maintaining the cleanliness of tools used in aircraft maintenance, repair, and assembly is paramount to ensuring safety, precision, and adherence to regulatory standards. Contaminated tools can introduce foreign particles or residues into aircraft systems, potentially compromising component integrity and leading to failures in critical systems. A significant issue arises when maintenance tools are left dirty post-use. This often stems from a lack of standardized cleaning procedures, where the importance of thorough cleaning may be underestimated. Consequently, maintenance personnel might not prioritize tool cleanliness, leading to cross-contamination between parts and introducing particles that compromise sensitive components. Manual methods for cleaning work tools are prevalent but present challenges. These methods are time-consuming and often yield inconsistent cleaning quality. Technicians must individually handle and scrub each tool to remove contaminants, a process that is physically demanding and detracts from time that could be allocated to other maintenance tasks. Moreover, the quality of manual cleaning is highly dependent on the individual's skill and attention to detail, resulting in variability in cleaning outcomes.

Beyond efficiency concerns, manual cleaning poses health and safety risks. Workers handling chemicals and sharp objects during the cleaning process are exposed to potential hazards. Many industrial cleaning agents contain toxic substances, such as solvents and degreasers, which can cause skin irritation, respiratory issues, and long-term health effects. Additionally, the use of water and lubricants can create slippery surfaces, increasing the risk of slips and falls, especially in confined or cluttered areas. To address these challenges, the Smart Aero Tools Cleansing Device has been conceptualized. This device automates the washing and drying of aerospace tools, incorporating a time-controlled system to ensure consistent and efficient cleaning. Constructed from durable acrylic material and equipped with an exhaust fan for effective drying, the device minimizes manual handling, reduces safety risks, and ensures uniform cleaning quality. By integrating automation into tool maintenance practices, this device aims to enhance safety, efficiency, and compliance within aerospace environments [2].

1.3 PROJECT OBJECTIVES

1.3.1 GENERAL PROJECT OBJECTIVES

The Smart Aero Tools Cleansing Device project is designed to provide an automatically controlled cleaning and drying process for aerospace maintenance tools, which is effective and safe. The main objective is decreasing labor and time consumption for hand cleaning through a time-regulated wash and dry cycle. The project is also concerned with increasing safety in the working environment through a hands-free enclosed setup with minimal direct handling of harmful cleaning solutions and sharp tools. The solution is designed to increase quality consistency in cleaning and contribute to more productive and secure maintenance operations within the aerospace field.

1.3.2 SPECIFIC INDIVIDUAL PROJECT OBJECTIVES

1.3.2.1 PRODUCT STRUCTURE

The objective to design an automated cleaning system focuses on developing a device that can independently perform the cleaning and drying of aircraft maintenance tools without requiring continuous manual intervention. This system is intended to improve operational efficiency by automating the entire process, ensuring consistent and thorough cleaning results every time. Unlike traditional manual methods that rely heavily on the technician's effort and precision, the automated system will follow a programmed cycle that controls water flow, cleaning duration, and drying time. It incorporates user-friendly controls and a compact design using acrylic material to ensure durability and ease of maintenance. By integrating features such as a high-pressure wash mechanism and a built-in exhaust fan for drying, the system not only saves time but also ensures that tools are ready for use faster and with minimal contamination risk. This design supports the aviation industry's need for reliability, cleanliness, and efficiency in tool maintenance processes.

1.3.2.2 PRODUCT MECHANISMS

The aim of increasing safety within the workplace by creating a hands-free device is centered on decreasing direct human interaction with potentially harmful cleaning processes, hence decreasing health hazards and enhancing overall safety within the working environment. Conventional manual cleaning of aircraft tools includes handling needle-sharp tools and using strong substances, which is a source of injury, irritation, respiratory complications, or permanent damage. In this project, there is a totally enclosed, automated device that is designed to perform the cleaning and drying processes without manual handling by an individual. To further complement workplace safety, the device employs a moderately alkaline detergent—not strong enough to present a danger of chemically mediated damage, yet strong enough to be effective for grease and dirt removal without posing harm to either a human or environmental context. This is aligned with occupational health improvement and complementing a safer working environment within the airline industry.

1.3.2.3 SOFTWARE / PROGRAMMING

The objective to develop a time-efficient cleaning system involves creating an automated solution that significantly reduces the time required to clean and dry aircraft maintenance tools while ensuring high standards of cleanliness. The system utilizes an Arduino Uno microcontroller to control the timing of both the washing and drying processes. The Arduino Uno acts as the central control unit, allowing precise programming of the wash and dry cycles based on predetermined time intervals. By automating the process, the system eliminates manual intervention and ensures that tools are consistently cleaned within the set time limits. The wash cycle is designed to remove dirt, grease, and contaminants effectively, while the drying cycle uses an exhaust fan to accelerate the drying process, ensuring tools are quickly ready for reuse. This time-controlled system optimizes workflow in maintenance operations, allowing technicians to focus on other critical tasks, reducing tool downtime, and increasing overall operational efficiency. Using Arduino Uno, the system can be easily customized and calibrated for different tools, providing flexibility and scalability for various maintenance environments.

1.4 PURPOSE OF PRODUCT

The purpose of the Smart Aero Tools Cleansing Device is to provide an efficient, safe, and automated solution for cleaning and drying aerospace maintenance tools. This product is designed to reduce tool downtime by implementing a time-controlled system, managed by an Arduino Uno, that automates both washing and drying cycles. It aims to improve the consistency and speed of the cleaning process while reducing reliance on manual labor. Additionally, the device enhances workplace safety by operating hands-free and using a moderately alkaline detergent that is effective yet gentle, minimizing exposure to harsh chemicals and reducing the risk of physical injury. Overall, the product supports better maintenance practices in the aviation industry by ensuring cleaner tools, safer procedures, and improved operational efficiency.

1.5 SCOPE OF PROJECT

1.5.1 GENERAL PROJECT SCOPES

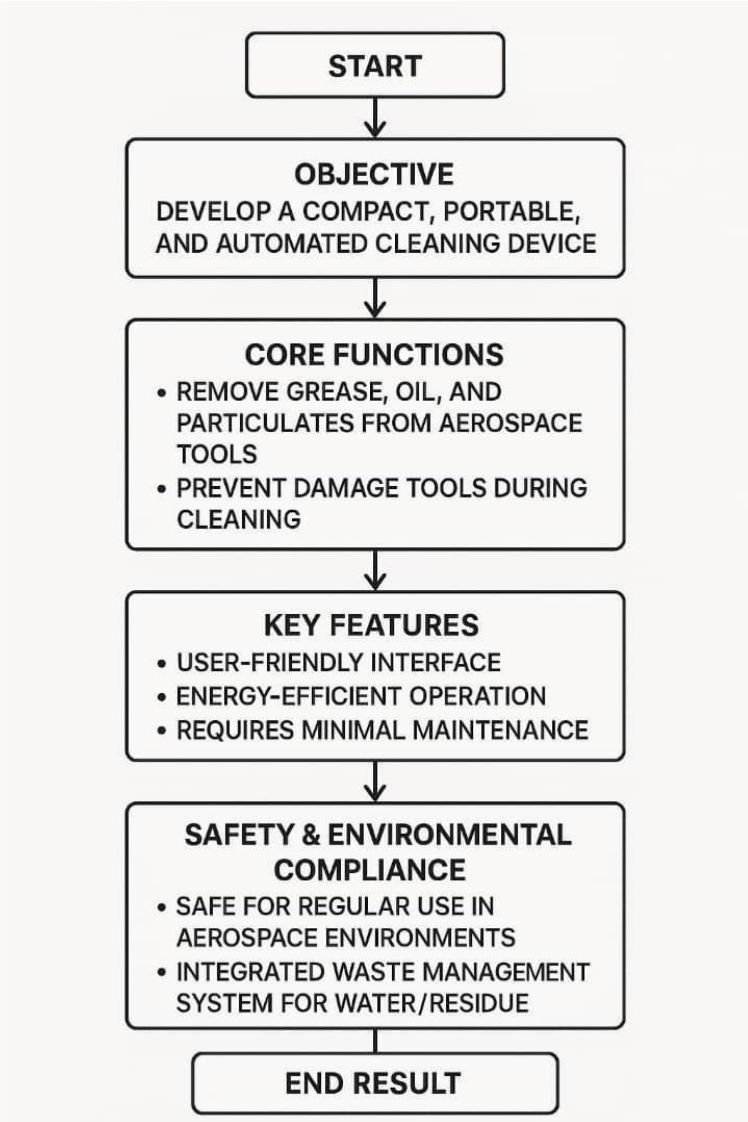

Figure 1.1: Project scope

1.5.2 SPECIFIC INDIVIDUAL SCOPE

1.5.2.1 PRODUCT STRUCTURE

The Smart Aero Tools Cleansing Device includes six main parts. The User Interface offers easy controls to operate the device. The Power Supply provides efficient energy use. The Housing protects all parts and keeps the device durable and portable. The Waste Collection System safely collects contaminants for easy disposal. The Cleaning Mechanism removes grease and particles using methods like ultrasonic waves or brushes. Finally, the Cleaning Chamber holds the tools safely during cleaning. This design ensures the device is practical, efficient, and safe for aerospace maintenance.

1.5.2.2 PRODUCT MECHANISMS

Developing an alerting system is an implement an alarm system that can detect missing or misplaced tools and promptly alert the user through audible alarms and warning lights to reduce the risks of tools being lost or left behind. Designing moving mechanism is to ensure the autonomous moving mechanism operates smoothly and reliably, with minimum risk of jams or malfunctions.

1.5.2.3 SOFTWARE / PROGRAMMING

The Smart Aero Tools Cleansing Device utilizes Arduino Uno as its central microcontroller for software programming, enabling the automation of washing and drying cycles. The programming is written in Arduino C/C++ language using the Arduino IDE, where specific time delays and sequences are coded to control components such as the water pump and exhaust fan. The code includes instructions to activate the washing process for a fixed duration, followed by the drying process, ensuring time efficiency and repeatability. Inputs from on/off buttons allow the user to start or pause the cycle, while the program handles the precise timing and coordination of all actions. This simple yet effective software logic makes the device easy to operate, energy-efficient, and adaptable for different cleaning requirements in aircraft tool maintenance.

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL LITERATURE REVIEW

The Industrial Revolution refers to the profound economic and social transformation that most people worked on farms or made things by hand. But after the Industrial Revolution, machines and factories became the main way to make products. This process fundamentally altered methods of production, introduced new technologies, and significantly changed the ways people worked and lived. Originating in Britain during the 18th century, the Industrial Revolution gradually spread to other regions of the world, reshaping global economic landscapes. The term “Industrial Revolution” was first popularized by English economic historian Arnold Toynbee (1852–1883), who used it to describe Britain's economic development between 1760 and 1840. Although the concept had been mentioned earlier by French writers, Toynbee's work helped establish the term within academic discourse.

Over time, the definition has expanded beyond a specific time frame or geographic location and is now commonly understood as a general process of economic and industrial transformation. It is important to note that different regions experienced industrialization at varying times. For instance, countries such as China and India did not undergo their initial phases of industrialization until the 20th century. In contrast, nations like the United States and Western Europe had already embarked on their so-called Second Industrial Revolution by the late 19th century, characterized by further technological advancements and expanded industrial capacity [5]. In the modern era, technology has become so advanced and powerful that a single failure can have catastrophic consequences, for example, the Chernobyl disaster in 1986 [6].

In response, safety standards have risen significantly, with strict regulations being implemented and enforced to prevent accidents and minimize potential harm. However, despite the advancements in automation, safety protocols, medical technology, and procedural improvements, accidents continue to occur. The primary reason is human error. According to the Federal Aviation Administration (FAA), human error remains the leading cause of both commercial airline crashes and general aviation accidents. More than 88% of all general aviation accidents are attributed to human error [7]. This is a staggering figure, especially considering the aviation industry's reputation for maintaining high safety standards. equipped with a dryer and an emergency stop button. The system is powered by Arduino Uno-based electronics, designed to streamline the washing and drying of tools while providing additional safety measures. The emergency button allows technicians to immediately stop the process in case of malfunctions or emergencies.

This device aims to enhance tool management practices and provide an extra layer of precaution for maintenance personnel. In the context of aircraft maintenance, human error often arises from carelessness and negligence. Mishandling tools during maintenance can result in catastrophic outcomes, potentially leading to the loss of multiple lives. Therefore, rigorous double-checking of maintenance work and tool accountability is crucial. However, tool handling is often left solely to the technician. For example, if aa technician accidentally leaves a flashlight inside an engine intake, it may go unnoticed, posing a serious safety risk. Consequently, it is important for engineers and technician working in critical areas to maintain strict vigilance regarding their tools. Traditionally, this responsibility is addressed through habitual cleaning and returning of tools to the toolbox after use. However, reliance on manual habits can be insufficient, as it depends heavily on individual discipline and attention to detail. To address this issue, our project introduces a Smart Aero Tools Cleansing Device.

2.1.1 INCIDENTS THAT HAPPEN BECAUSE OF IMPROPER CLEANING TOOLS

2.1.1.1 EASTERN AIR LINES, INC, FLIGHT 855, A LOCKHEAD L-1011, N334EA

On May 5, 1983, Eastern Air Lines Flight 855, a Lockheed L-1011 TriStar aircraft, experienced a critical in-flight emergency when all three engines failed due to oil loss.[14] The failure was traced back to a maintenance error the night before, when mechanics replaced the magnetic chip detectors in each engine but failed to reinstall the necessary O-ring seals that prevent oil leakage. This oversight occurred because of improper handling and inspection of tools and parts during maintenance. After replacing the chip detectors, the maintenance crew conducted only a brief 10-second engine run-up, which was not enough to reveal the resulting oil leaks. During the flight, oil pressure warnings appeared for all three engines, leading to their sequential shutdowns. Fortunately, the crew managed to restart one engine and performed an emergency landing back in Miami. The investigation by the National Transportation Safety Board (NTSB) [13] [14] concluded that the missing O-rings directly caused the oil leaks and engine failures. This incident highlights how improper tool and part management, lack of thorough inspection, and insufficient cleaning procedures during maintenance can result in catastrophic consequences. It also emphasizes the need for strict adherence to maintenance protocols and the importance of reliable systems to double-check the completeness and cleanliness of tools and components before an aircraft is cleared for flight.

2.1.1.2 ALASKA AIRLINES FLIGHT 261, A MCDONNEL DOUGLAS MD-83 (N963AS)

On January 31, 2000, Alaska Airlines Flight 261, a McDonnell Douglas MD-83 (N963AS), crashed into the Pacific Ocean near Anacapa Island, California, resulting in the deaths of all 88 people on board. [15] The National Transportation Safety Board (NTSB) investigation concluded that the primary cause of the accident was the failure of the horizontal stabilizer trim system's jackscrew assembly, specifically the acme nut threads, which became excessively worn due to improper maintenance practices. A significant contributing factor was the use of non-standard tools by maintenance personnel for measuring the wear of the jackscrew assembly. These tools were not approved by the aircraft manufacturer and lacked the precision necessary for accurate measurements, leading to a false assessment that the jackscrew was within acceptable limits. Furthermore, Alaska Airlines extended lubrication intervals beyond manufacturer recommendations, which further accelerated the wear. This tragic event highlights how using tools that do not meet industry standards, combined with poor maintenance practices, can result in catastrophic mechanical failures. The incident emphasizes the vital importance of adhering to correct tool specifications, maintenance procedures, and inspection intervals to ensure aviation safety.

2.1.2 TECHNIQUES USED BY TECHNICIANS FOR TOOLS CLEANING BEFORE THE SMART AERO TOOLS CLEANSING DEVICE

Before to introducing the Smart Aero Tools Cleaning Device, industry technicians mostly used compressed air blowers and manual cleaning techniques to maintain their tools. Tools were manually cleaned by wiping them down with cloths soaked in solvents like degreasers or isopropyl alcohol to get rid of dirt, oil, and grease. Technicians applied soapy water and brushes to more stubborn contaminants, then dried them with fresh cloths or allowed them to air dry. [18] Despite being less expensive, this approach was time-consuming and highly dependent on the technician's attention to detail, which raised the possibility of inconsistent cleaning and possible foreign object debris (FOD) incidents. Compressed air blowers, on the other hand, used high-pressure air to reach places that were hard to reach to remove dust and debris from tools. Although it worked well for dry contaminants, [16] compressed air had disadvantages. It could aerosolize [17] contaminants and release them into the environment, and it was not appropriate for sticky or greasy contaminants. Additionally, using compressed air incorrectly may result in inhalation hazards or flying debris, which might harm one's health and safety. The need for a more automated and reliable tool-cleaning solution was highlighted by the lack of efficiency and standardization of these traditional methods, despite their wide application.

2.1.3 OVERVIEW OF TOOLS CLEANING SYSTEMS BEFORE THE SMART AERO TOOLS CLEANSING DEVICE

Many industrial machines have been used to improve the effectiveness and effectiveness of tool cleaning in a range of industries, including the manufacturing, medical, and automotive sectors. Among these, ultrasonic cleaners are well known for their ability to clean sensitive and complex parts. These devices work by generating high-frequency sound waves in a liquid a soak which cause tiny bubbles to burst and remove impurities like oils, dirt, and tiny debris from delicately shaped tools. [19] Despite their efficiency, ultrasonic cleaners have a few disadvantages, such as a high initial cost, long cleaning cycles, and restrictions on using large or very dirty tools that are frequently used in aviation maintenance.

Additionally, to prevent damage to sensitive instruments, their use needs the use of chemicals and cautious handling. making them even less useful for routine tool cleaning duties. Steam cleaning machines, which use high-pressure steam to dissolve and remove strong grease, oil, and other remaining contaminants, are another often used technique. Because steam cleaning eliminates the need for chemical solvents,[20] it is often used for its environmental advantages. However, this approach has disadvantages of its own, including the high-power consumption needed to produce enough steam pressure and the safety hazards, which include the possibility of operator burns.

Additionally, steam cleaning may not be appropriate for all kinds of tools, especially those that are at risk to high temperatures or moisture intrusion, which restricts its use in aviation environments. A lot of dirt, mud, and debris are also removed from tools using high-pressure water jet cleaners, which use high-velocity water force. [21] Although this method works well for general cleaning, it is not as precise as aviation hand tools and operates the risk of physically damaging sensitive components. These systems are also frequently condemned for using excessive amounts of water and for having the potential to spread contaminants rather than completely remove them, which makes them less suitable for industries like the aviation industry maintenance that have high standards for cleanliness.

2.1.4 PROBLEM SOLUTION FOR TOOLS CLEANING

A specialized tool cleaning system that guarantees consistent cleaning performance, improves workplace safety, reduces human error, and meets with strict Foreign Object Debris (FOD) prevention protocols is required by the aviation industry considering these difficulties. By providing an integrated solution that combines automated washing mechanisms, effective drying systems, emergency stop functions, and Arduino-based programming controls, the Smart Aero Tools Cleansing Device meets these important needs. This tool, which was created especially for aviation hand tools, improves the efficiency of maintenance procedures, reduces the need for manual labor, and lowers the possibility of contamination, all of which led to safer and more dependable aircraft operations. The Smart Aero Tools Cleansing Device closes a big gap left by typical cleaning techniques and all-purpose industrial equipment by offering a personalized approach to tool cleanliness.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 OVERALL PROJECT GANTT CHART

Figure 1.2 Gantt chart session 1 2024/2025

Based on **figure 1.2**, this image is a Gantt Chart titled "Carta Gantt: Perancangan dan Pelaksanaan Projek Pelajar" (Gantt Chart: Planning and Implementation of Student Project) for the project titled “Smart Aero tools Cleansing Device”. It outlines the project schedule across Semester 4 (Session 1 2024/2025), broken down by months (M1 to M15), showing planned and actual progress. It is used to track and manage project activities over a 15-month period. Each row represents a major project activity, and the horizontal axis indicates the timeline (M1 = Month 1, M2 = Month 2, etc.). The chart uses two colored bars which is green bars (Planned schedule) and red bars (Actual progress)

3.2 PROJECT FLOW CHART

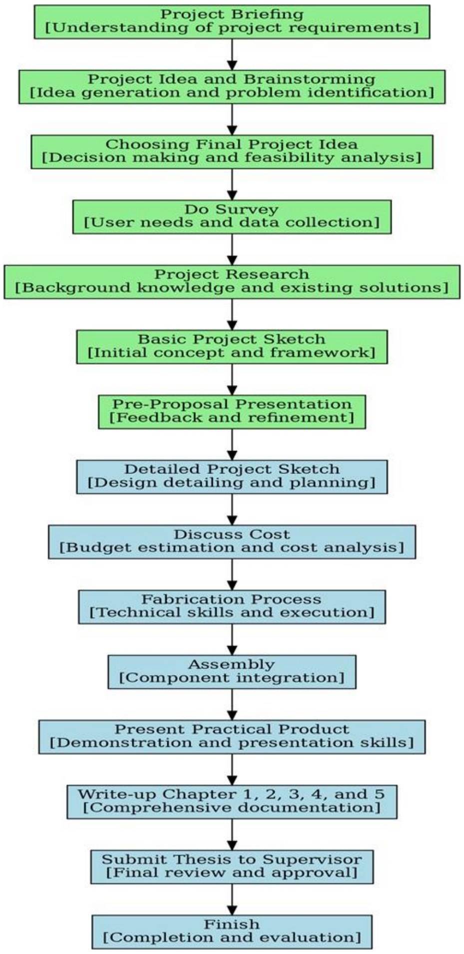

Figure 1.3 Project Flow Chart

Based on **figure 1.3**, This flow chart illustrates the structured sequence of activities throughout of the Final Year Project (FYP). The chart is divided into two main phases, representing Semester 4 and Semester 5. In Semester 4, the focus is on ideation and planning. Activities include project briefing, brainstorming, finalizing the project idea, which is Smart Aero Tools Cleansing Device, conducting surveys which is our respondents is from students and lecturers from polytechnics banting Selangor, and performing preliminary research. These activities culminate in a basic project sketch and a pre-proposal presentation. Knowledge gained includes understanding project requirements, ideation techniques, survey analysis, and foundational technical concepts. In Semester 5, students transition into execution and documentation. This includes detailed project sketching using SolidWorks, discussing total costs and resources, the fabrication divides by 3 which is mechanical, electronics and electrical and assembly process, presenting the working prototype, and completing the thesis chapters. Knowledge in this phase depends into practical design, budgeting, assembly, and technical writing.

3.3 DESIGN ENGINEERING TOOLS

The Pareto chart was selected as a method to analyze survey data due to its effectiveness in visually identifying the most significant factors based on respondent input. Given that the survey respondents consisted of students and lecturers, the data collection was conducted via Google Forms—an accessible and efficient platform that allowed for quick distribution and high response rates. Utilizing the Pareto chart enabled a straightforward and impactful representation of the results, aligning well with the objective of prioritizing key issues or preferences expressed by the participants. This method was particularly appropriate for highlighting the most frequent concerns or behaviors, which is essential for guiding design decisions in this project

3.3.1 QUESTIONNAIRE SURVEY

Figure 1.4 google form questionnaire (1)

based on **Figure 1.4**, This chart provides insight into user behavior and hygiene practices related to tool maintenance. Based on the responses from 30 participants, 66.7% (20 respondents) clean their tools after each use, indicating a strong preference for regular and immediate maintenance, which reflects a high level of discipline and awareness regarding tool hygiene. Meanwhile, 16.7% (5 respondents) clean their tools at the end of the day, possibly due to a preference for batch cleaning or limited access to cleaning facilities during use. Another 13.3% (4 respondents) clean their tools once a week, and only 3.3% (1 respondent) reported rarely cleaning their tools, suggesting that this minority may face time constraints, lack awareness, or work in environments where frequent cleaning is not critical.

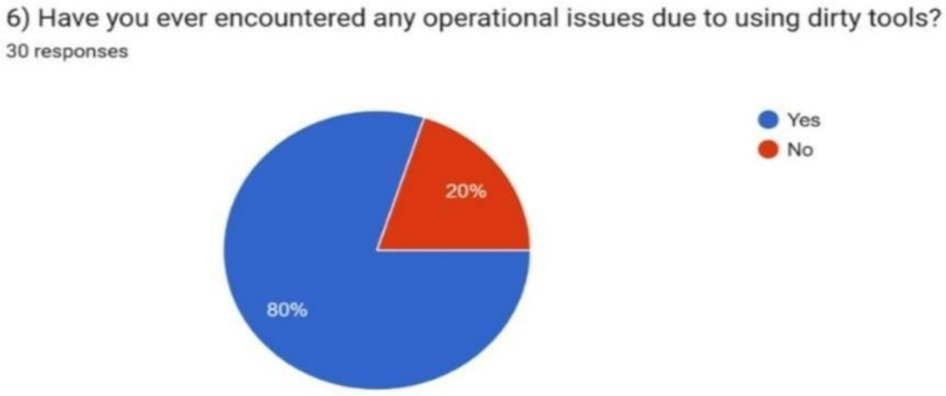

Figure 1.5 google form questionnaire (2)

Based on **figure 1.5**, The chart reveals that a significant majority 80% of respondents have experienced operational issues caused by using dirty tools, while only 20% have not faced such problems. This strongly suggests that tool cleanliness is a critical factor in maintaining operational efficiency and avoiding potential malfunctions, errors, or safety hazards. The high percentage of affirmative responses highlights the real-world impact of improper tool maintenance and reinforces the importance of implementing an effective and consistent tool-cleaning process. This data supports the relevance and necessity of a dedicated tool cleansing solution, such as the proposed Smart Aero Tools Cleansing Device.

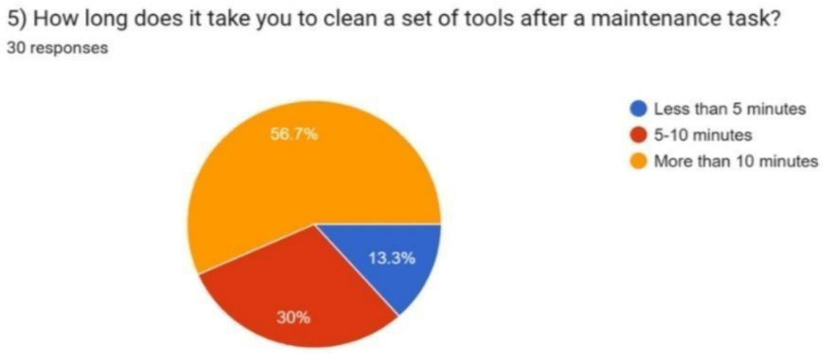

Figure 1.6 google form questionnaire (3)

Based on **Figure 1.6**, most respondents 56.7% stated that cleaning a set of tools takes them more than 10 minutes, indicating that the current cleaning process is time-consuming and potentially inefficient. Meanwhile, 30% reported spending 5 to 10 minutes, and only 13.3% managed to clean their tools in less than 5 minutes. These results highlight the need for a faster and more convenient tool-cleaning solution. The time invested in this routine task could be significantly reduced with the implementation of a smart, automated cleaning device, ultimately improving workflow productivity and encouraging more consistent cleaning habits.

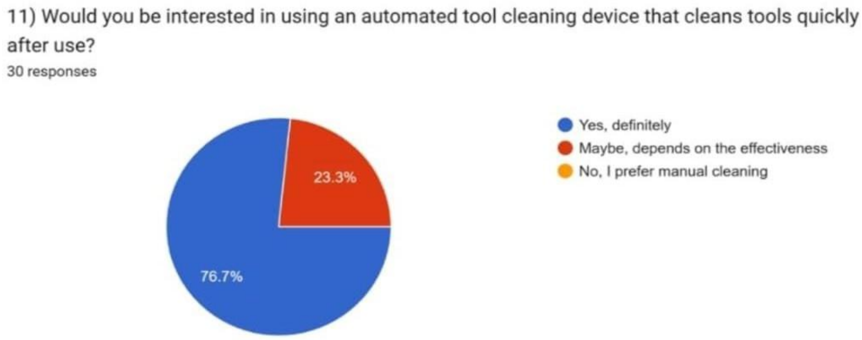

Figure 1.7 google form questionnaire (4)

based on figure 1.7, The chart indicates a strong interest in an automated tool cleaning solution, with 76.7% of respondents expressing definite interest in using such a device. This majority response demonstrates a clear demand for innovation in tool maintenance practices. Additionally, 23.3% of participants stated that they might be interested depending on the device's effectiveness, suggesting that user confidence in performance and reliability is a key consideration. Notably, no respondents preferred manual cleaning, further reinforcing the need for a time-saving and efficient automated alternative. These findings support the relevance and potential acceptance of the proposed Smart Aero Tools Cleansing Device in the target market.

3.4.2 Design Concept Generation

3.4.2.1 Morphological Matrix

A morphological matrix for a Smart Aero Tools Cleansing Device helps systematically explore design possibilities by breaking down key functions and listing alternative solutions. The device could be powered by water sprinkle, AC Axial exhaust fan, water pump and chemical detergent for cleaning and drying. Control panel could be through a button panel. Water Waste disposal can involve water drainpipe. Safety features include auto shut off by an emergency stop button. By push ON button, users can enjoy an optimal and effectives cleaning solution for aircraft tools.

3.4.2.2 Proposed Design Concept 1

CONCEPT GENERATION OF 6 BASIC INSTRUMENT ON TOOLS CLEANER
CONCEPT 1 (TENGKU)

FUNCTION	CONCEPT 1	JUSTIFICATION
Material used for product	Acrylic and plastic	Acrylic and plastic made racks is known for its high strength and durability. This material is long-lasting and resist hard water, and plastic rack allow airflow to dry tools more quickly.
Wheel configuration		Have low/high temperature resistance, trackless, floor protection, and low noise features.
Types of blowers	AC exhaust fan	It has simple installation and maintenance. Also, this item has fast response times to starting, stopping, and acceleration. It's also less energy consumed
Effectiveness	Depends on factors	If used wisely, it will reduce electricity consumption.
Ease of use	easy to remove	if it's not too heavy to move and it doesn't break easily.
Activation method	Button panel	The button panel is simple and familiar to the user. This makes it easy for anyone to understand the operation.

Figure 1.8: Concept 1

3.4.2.2 Design generation of concept 2

CONCEPT GENERATION OF 6 BASIC INSTRUMENT ON TOOLS CLEANER
CONCEPT 2 (SYAHMAA)

FUNCTION	CONCEPT 2	JUSTIFICATION
Material used for product	Sheet metal	Sheet metal such as aluminum alloy is known for its strength and durability. This metal is long-lasting and anti-corrosion.
Wheel configuration		allowing tool loads to be moved easily, reducing physical effort, and increasing operational efficiency
Types of blowers	Radial blower	It has durability and versatility suitable for specific pressure and flow requirements.
Effectiveness	Highly effective	Due to save energy, cost less, and are easy to maintain, but they tend to sound loud.
Ease of use	Portable but hard to remove	Heavy loads on shelves that are difficult to remove
Activation method	Voice command	Voice commands can speed up the learning process. It can also provide fast and accurate communication and is easy for anyone to use, especially the elderly.

Figure 1.9: Concept 2

3.4.2.3 Design generation of concept 3

CONCEPT GENERATION OF 6 BASIC INSTRUMENT ON TOOLS CLEANER
CONCEPT 3 (ALIYAH)

FUNCTION	CONCEPT 3	JUSTIFICATION
Material used for product	Sheet metal and plastic	Sheet metal such as stainless steel and plastic made racks is known for its high strength and durability. This metal is long-lasting and resist hard water, and plastic rack allow airflow to dry tools more quickly.
Wheel configuration		Have low/high temperature resistance, trackless, floor protection, and low noise features.
Types of blowers	Axial blower	It is designed to generate high airflow at low pressure, making it suitable for applications that require large volumes of air to be moved across spaces or through ducts.
Effectiveness	Speed up the drying process	Axial blowers excel at providing high airflow, which can help speed up the drying process, especially for tools with large surface areas.
Ease of use	Portable and easy to remove	if it's not too heavy to move and it doesn't break easily.
Activation method	Button panel and scan code	The button panel is simple and familiar to the user. This makes it easy for anyone to understand the operation. The code only using for data and for trace who last person use the product.

Figure 2.0: Concept 3

3.4.2.4 Accepted vs Discarded Solution

Accepted Solution – Concept 1

After discussing among team member, Concept 1 has been selected as the preferred solution for the project. This concept offers several advantages that make it a compelling choice. Firstly, it provides a more cost- effective option compared to the other concepts considered, allowing for efficient utilization of resources. Concept 1 emphasizes simplicity while retaining the majority of the desired functions. By focusing on essential features, it ensures practicality and ease of use for technicians and engineers in the aviation industry. The streamlined design optimizes functionality, making it intuitive and straightforward to operate, ultimately enhancing productivity and reducing potential complexities. Concept 1's small design is one noteworthy feature. The smart aero tools cleansing device's efficient use of space enables it to effortlessly integrate into a variety of work contexts, including the constrained or tight areas frequently encountered in aircraft maintenance operations. Its small size helps make greater use of the area that is available while making sure that the necessary tools and equipment are comfortable to use. The Concept 1's outstanding mobility is yet another salient characteristic. The cleansing tool device has been given maneuverability features that make moving it about the aviation facility simple. The smart aero tools cleansing device's easily portable, making it possible to move between workplaces, hangars, or other airport locations while always keeping equipment clean. This improved mobility increases workflow effectiveness and reduces needless travel.

In summary, Concept 1 presents a comprehensive solution that meets the project requirements effectively. Its cost-effectiveness, simplicity, compactness, and excellent mobility make it a compelling choice for the intended application in the aviation industry. By implementing this concept, the project aims to decreasing labor and time consumption for hand cleaning, and to increase quality consistency in cleaning and contribute to more productive and secure maintenance operations within the aerospace field.

3.4.3 Evaluation & Selection of Conceptual Design

3.4.3.1 PUGH MATRIX AS DATUM

FUNCTION	CONCEPT 1	CONCEPT 2	CONCEPT 3	CONCEPT 4
Material used for product	D	1	3	3
Wheel configuration	A	3	1	2
Types of blowers	T	1	2	3
Effectiveness	U	2	1	2
Ease of use	M	1	2	2
Activation method	-	1	2	3
Total Score	-	9	11	15
Ranking	-	2	3	5

Figure 2.1: Comparison between 3 concepts

According to the matrix, Concept 4 received the highest total score of 15, making it the most favorable option among the four evaluated. It ranked highest in several categories, including activation method and types of blowers, which significantly contributed to its top score. The remaining concepts scored as follows: Concept 3 with 11 points (Rank 3), Concept 2 with 9 points (Rank 2), and Concept 1choose as a datum.

3.5 PRODUCT DRAWING / SCHEMATIC DIAGRAM

3.1.1 General Product Drawing

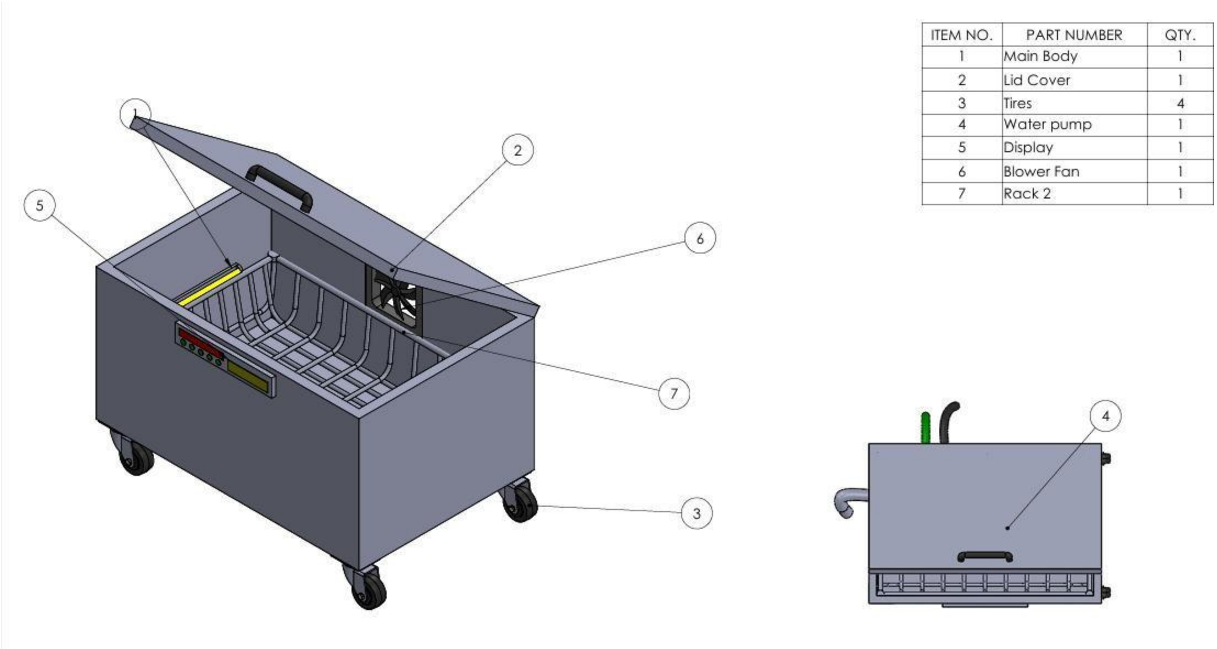

Figure 2.2: Project sketch

The Smart Aero tools Cleaning Device's assembly view lists the major parts that include the system. A protective enclosure for tools and internal components is provided by the structure's main body and lid cover (2), which is made of acrylic (1). For smooth movement, it is mounted on four tires (3). Washing is made easier by the installation of a water pump (4), and status monitoring and user interaction are made possible by an I2C display (5) and push and emergency buttons. The rack (7) keeps the tools safely in place while they are in use, and the blower fan, which is an AC exhaust fan (6), helps to dry the tools after washing. Every component is essential to maintaining the device's overall effectiveness and functionality.

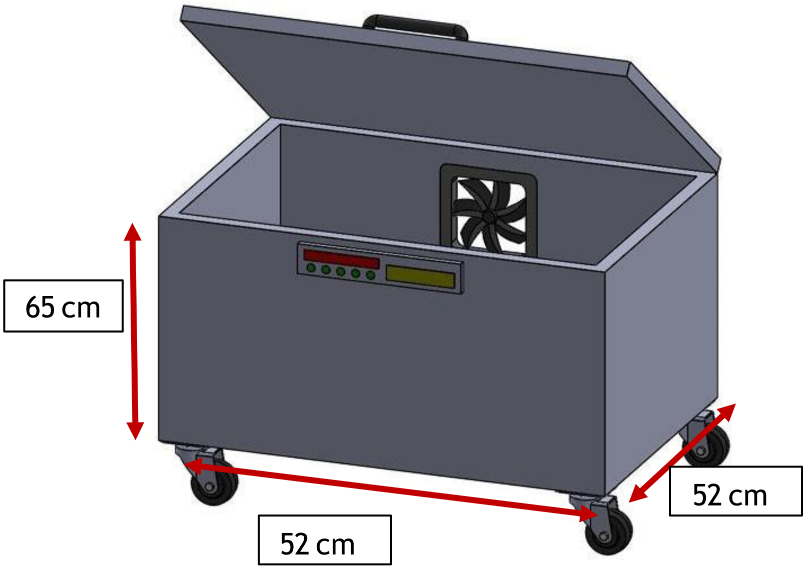

Figure 2.3: measurement project sketch

Based on figure 2.3, The Smart Aero tools Cleaning Device's finished design is a small and compact that measures 52 cm in length, 52 cm in width, and 65 cm in height. It has a front-mounted control panel with an I2C LCD display and push buttons to show the current process and duration, an internal exhaust fan to help with drying, and a hinged top lid for convenient access. Because it is mounted on four wheels, it can be used in a variety of applications, including labs, workshops, and classrooms. Functionality, ease of use, and effective cleaning performance are all highlighted in this design.

3.5.2: SPECIFIC PART SOFTWARE PROGRAMING / DIAGRAM

```
  lcd.setCursor(0, 0);
  lcd.print("     PRESS START");
  lcd.setCursor(0, 1);
  lcd.print("Duration of Time");

  lcd.setCursor(0, 2);
  lcd.print("Washing : 3.5 Min");
  lcd.setCursor(0, 3);
  lcd.print("Drying  : 2 Min   ");
}
```

Figure 2.4: programing coding

The total washing cycle of the device is 3.5 minutes, which is divided into two phases: the first 1.5 minutes are for normal water, followed by 2 minutes of detergent. After the washing cycle is completed, the system proceeds to a drying phase that lasts for 2 minutes. Upon completion of the drying process, the system emits three short beeps using a buzzer to notify the user that the cleaning cycle has completed. The system then automatically powers off, ensuring both user convenience and energy efficiency.

3.5.3 specific project fabrication

3.5.3.1 fabrication of mechanical

To guarantee the product's effectiveness and functional reliability, the mechanical fabrication process included several essential steps. First, suitable materials were chosen based on characteristics like easy fabrication, water resistance, and durability. To guarantee appropriate fitting and ideal fluid flow throughout the system, hole diameters and hose sizes were determined after material selection. To act as structural elements for the casing and support components, accurate measurements of the acrylic material were taken. To ensure consistent water distribution throughout the cleaning procedure, an appropriate water sprinkler was also found and chosen. Finally, a suitable water pump was selected in accordance with the overall design specifications and flow rate requirements.

3.5.3.2 fabrication of electrical

Assembling and integrating necessary electrical components to support the system's operation was the main objective of the electrical fabrication process. The first step in the process was choosing an appropriate AC exhaust fan, which was determined by the fan's airflow capacity and suitability for the ventilation requirements of the system. Following that, wiring finished, which involved extending the exhaust fan and water pump wires to fit the device's design. While the electronics team worked on creating and uploading the system's control code, the electrical team helped them out by soldering and making sure that all the components had the correct electrical connections. The smooth integration of software and hardware components was guaranteed by this collaborative approach.

3.5.3.3 fabrication of electronic

The development of the control system through coding was the primary focus of the electronic fabrication process to guarantee the smooth operation of every component. This section of the project was crucial because any mistakes in the code could cause the system to malfunction. As a result, the electronic component required more care, accuracy, and testing. To show the system status, the team used an Arduino Uno microcontroller as the central control unit along with an I2C LCD display. To improve accessibility and functionality, the display indicates which stage is active at the duration time and shows how long each process (drying and washing) takes. Along with coding, the electronics team helped the electrical team, especially with soldering and circuit connection checks as well as creating secure and efficient connections. The overall performance of the system depends on the hardware and software components interacting accurately which was ensured by this cooperative effort.

3.6 LIST OF MATERIALS & EXPENDITURES

No	Item	Unit	Price	Total (RM)
1.	Brushless motor submersible water pump	2	23.50	47.00
2.	Arduino Uno R3	1	96.50	96.50
3.	Display 4 column	1	26.70	26.70
4.	Water sprinkle	1	10.40	10.40
Total Amount				RM180.60

CHAPTER 4

RESULT AND DISCUSSION

4.1 PRODUCT DESCRIPTION

The Smart Aero Tools Cleansing Device is an innovative solution designed to automate the cleaning and drying processes of aircraft maintenance tools. This device aims to enhance the efficiency, safety, and reliability of tool maintenance in the aviation industry. The device is primarily constructed from acrylic, known for its strength, transparency, and resistance to corrosion. The compact design includes compartments for organizing and cleaning tools, maximizing storage capacity while minimizing space requirements. The cleaning mechanism employs a 360-degree water sprinkler system powered by a brushless motor submersible water pump, ensuring thorough cleaning by evenly spraying water and detergent on the tools. For drying, an AC-powered exhaust fan is integrated to remove moisture, speeding up the drying process and preventing rust and corrosion. The control system is operated using an Arduino Uno microcontroller, which automates the washing and drying cycles. An I2C LED display provides real-time status updates, and push buttons allow for manual control. Safety features include an emergency stop button to half operations immediately in case of any issues, ensuring user safety.

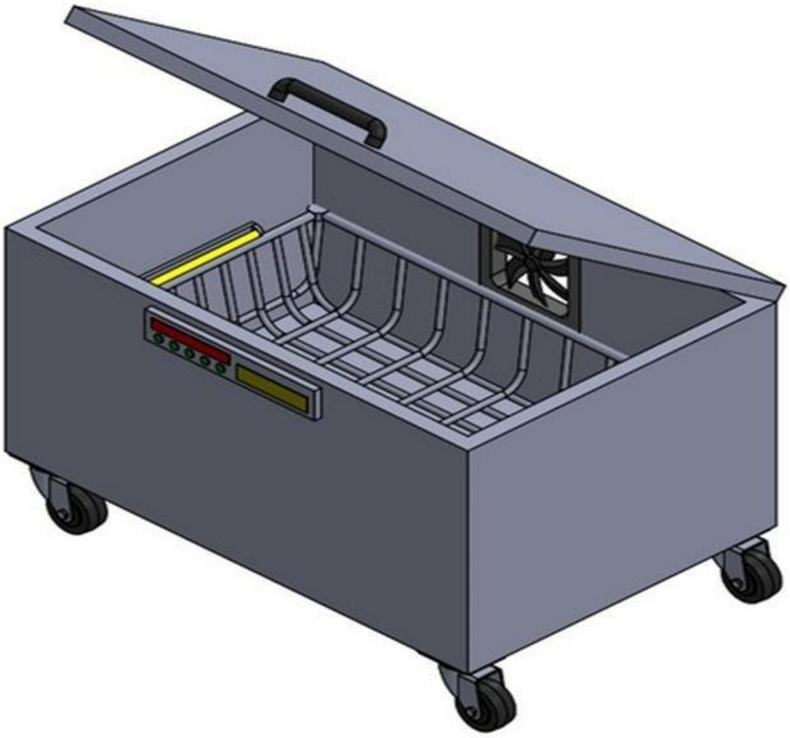

Figure 4.0

4.2 Project Impacts / Purpose of Product

The Smart Aero Tools Cleansing Device significantly impacts the aviation maintenance industry by providing a reliable, efficient, and automated solution for tool cleaning. By automating the cleaning process, the device reduces the time and effort required for manual cleaning, allowing maintenance personnel to focus on more critical tasks. Regular and thorough cleaning prevents the buildup of contaminants, thereby extending the lifespan of tools and ensuring their optimal performance. Clean tools are essential for maintaining the safety and integrity of aircraft components, helping meet stringent cleanliness standards and regulatory guidelines. The device is designed to be energy-efficient and incorporates a waste management system to minimize environmental impact. The automation of cleaning and drying processes leads to consistent and high-quality maintenance, reducing the risk of human error. By optimizing water and energy use and reducing the need for manual labor, the device lowers overall maintenance costs. Safety enhancements such as the emergency stop button and real-time monitoring ensure a safer working environment for maintenance personnel.

Table 4.2: Comparison between manual cleansing and smart aero tools cleansing device

CRITERIA	MANUAL CLEANING	SMART AERO TOOLS CLEANSING DEVICE
Time taken	5-10 minutes	5-7 minutes (more than 5 tools)
Consistency	Varies depending on operator	High consistent automation
Water usage	Often not regulated	Moderate, optimized usage
Chemical usage	Uncontrolled, potentially wasteful	Controlled and measured
Tool lifespan impact	Risk of over scrubbing or corrosion	Gentle and consistent better tool lifespan
Labor requirement	1-5 persons per session	1 person to supervise
Hygiene level	Moderate	High
Cost over time	Higher due to labor and material waste	Lower due to efficiency

4.3 Analysis of Problems Encountered & Solutions

During the development of the Smart Aero Tools Cleansing Device, several challenges were encountered. Manual cleaning methods often resulted in inconsistent cleaning outcomes due to varying levels of skill and attention to detail among technicians. The implementation of a 360-degree water sprinkler system and automated control via Arduino ensured uniform cleaning quality, regardless of the operator. Manual cleaning was physically demanding and time-consuming, reducing overall maintenance efficiency. Automation of the cleaning and drying processes significantly reduced the time required for tool maintenance, allowing technicians to allocate their time more effectively. Manual handling of cleaning agents and tools posed health and safety risks, including exposure to toxic chemicals and potential injuries. The device's automated system minimized human intervention, reducing exposure to harmful substances and the risk of accidents. The inclusion of an emergency stops button further enhanced safety. Traditional cleaning methods often involved excessive use of water and chemicals, leading to environmental concerns. The device was designed to be energy-efficient and incorporated a waste management system to reduce water and chemical usage, promoting more sustainable maintenance practices.

CHAPTER 5

CONCLUSION & RECOMMENDATIONS

5.1 ACHIEVEMENT OF AIM & OBJECTIVES OF THE RESEARCH

5.1.1 General Achievements of the Project

The Smart Aero Tools Cleansing Device successfully achieves its primary objective of automating the washing and drying processes for aviation tools. This contributes to improved efficiency, consistency, and safety in aircraft maintenance procedures. The device is operated using an Arduino Uno microcontroller, which automates the activation of the washing and drying systems without the need for continuous manual control. A key feature of the device is the integration of an emergency stop button, ensuring safe operation in the event of malfunction or user intervention. The system is designed to be user-friendly, and reliable, making it a practical solution for maintenance environments. Overall, the project has met its goals by developing an effective, automated tool cleansing system tailored for aerospace applications.

5.1.2 Specific Achievement of Project Objectives

5.1.2.1 Product Structure

The Smart Aero Tools Cleansing Device is designed with several components to support the washing and drying process. The outer body is made of acrylic, which is strong and transparent, allowing the user to see the tools during operation. Inside the device, there is a plastic rack to hold the tools in place. A water sprinkler is installed to spray water 360 degree evenly on the tools for cleaning. A water pump is used to give water pressure. The device has one inlet hole for clean water and detergent and one outlet hole to drain dirty water. An exhaust fan is added to help dry the tools by removing moisture from the inside of the device. The system is controlled by an Arduino Uno, which operates the washing and drying process automatically. An I2C LED display is used to show the status of the system, such as operation mode and time. The device also has 2 push buttons to start and stop the system manually. All parts are arranged to make the device easy to use, safe, and efficiency.

5.1.2.2 Product Mechanisms

The Smart Aero Tools Cleansing Device includes several important mechanisms that support its automatic washing and drying functions. The main cleaning mechanism is a 360-degree water sprinkler system, which ensures that all surfaces of the tools are evenly cleaned. Water is delivered through the sprinkler using a water pump, and the system is designed with both inlet and outlet holes for water flow and drainage. For drying, the device uses an AC-powered exhaust fan that removes moisture from inside the unit, helping the tools dry faster. The whole system is operated by an Arduino Uno, which controls the timing and sequence of the washing and drying processes. A push button is used to manually start or stop the system, while the status of the operation is shown on an I2C LED display. All these mechanisms are built into a strong acrylic body that supports visibility, safety, and easy maintenance. The integration of automatic control and mechanical components makes the device reliable and efficient for use in aircraft tool cleaning.

5.1.2.3 SOFTWARE / PROGRAMMING

The Smart Aero Tools Cleansing Device is programmed using the Arduino IDE (Integrated Development Environment), which is used to write and upload code to the Arduino Uno microcontroller. The software controls the main functions of the device, including the automatic operation of the water pump, exhaust fan, and the LED display. The program uses conditional statements and timing functions to control how long each component runs. For example, when the push button is pressed, the Arduino activates the water pump for a set time to wash the tools. After washing, the system automatically switches to the drying process by turning on the exhaust fan. The I2C LED display shows messages such as "WASHING," or "DRYING," to inform the user of the status. The code is kept simple and efficient to ensure smooth operation and to reduce the risk of programming errors or system delays. The software was tested and modified several times during development to improve performance and ensure the system operates reliably under working conditions.

5.1.2.4 Accessories & Finishing

The Smart Aero Tools Cleansing Device includes several accessories and finishing touches to improve safety, appearance, and reliability. One of the main accessories is the emergency stop button, which allows the user to stop the device immediately during any problem or emergency, adding an important safety feature. The device also includes an I2C LED display to show real-time status updates such as washing or drying. The sliding lid provides easy access to the inside of the device while keeping water and detergent from escaping. For finishing, the device uses smooth edges and a clear acrylic surface, giving it a professional and clean appearance. The plastic basket inside helps organize the tools during operation. Acrylic barrier is applied around openings to prevent leaks, and all wires and components are neatly arranged for easy maintenance. These accessories and finishes make the device not only functional but also safe, user-friendly, and visually interactive

5.2 CONTRIBUTION OR IMPACT OF THE PROJECT

The contribution of this project lies in providing an effective and automated solution for cleaning and drying aviation tools. By automating these processes, the Smart Aero Tools Cleansing Device improves the efficiency and safety of tool maintenance in aircraft operations. The use of an Arduino Uno microcontroller ensures precise control over the system, enabling reliable and consistent performance. This project also contributes to sustainability by reducing the need for manual cleaning and ensuring efficient water usage, helping to promote more eco-friendly maintenance practices. The addition of an emergency stop button and automatic safety features adds an important layer of safety for maintenance personnel, minimizing the risk of accidents during operations.

The device's design and functionality improve workflow in maintenance environments by offering a user-friendly system for cleaning tools. The combination of automated operation and a clear interface (via the I2C LED display and push button) enhances tool maintenance and reduces mistakes, making it easier for maintenance teams to maintain clean tools consistently. In summary, this project makes a significant contribution to the field of aviation tool industry by providing an automated, safe, and efficient system for cleaning and drying tools, thus improving operational efficiency and ensuring follow airworthiness of safety in tool maintenance

5.3 IMPROVEMENT & SUGGESTIONS FOR FUTURE RESEARCH

5.3.1 Product Structure

While the Enhanced Mobility Maintenance Toolbox have been a resounding success, it is important for continued progression to be made for the product to stay relevant and following the latest technological advancement.

Following list are the recommended improvement and suggestion for further models:

1. **User Interface and Accessibility Improvements:**

- The current I2C LED display provides basic operational information. However, to improve user experience, the interface could be upgraded to a touchscreen display or a more user-friendly interface that offers real-time status updates, maintenance alerts, and remote-control capabilities. Additionally, the Arduino system could be enhanced with wireless connectivity, allowing the device to be monitored and controlled through a smartphone or tablet. These improvements would not only make the system easier to use but also enable real-time feedback and simplify the troubleshooting process.

2. **Sustainability Considerations:**

- With growing attention on environmental sustainability, future research should focus on reducing the environmental impact of the device. This may include the use of energy-efficient pumps, recycled or eco-friendly materials for construction, and the addition of a water filtration system to allow water to be reused during the cleaning process. These improvements can help lower water consumption and support more environmentally responsible maintenance practices.

3. **portable and independent:**

- include a portable water tank as part of the device. This would allow the system to operate without being directly connected to a fixed water supply, making the device more portable and flexible for use in different locations. By adding a built-in or attachable water tank, the device can support tool cleaning operations in remote or temporary maintenance areas where plumbing is not available.

5.3.2 Product Mechanisms

We hope that with continued effort and commitment in the future. This project has the potential to be upgraded or improved into a superior product. Here are some potential enhancements and future research directions for the Smart Aero Tools Cleansing Device project:

Improvements:

i. **Enhanced Cleaning Efficiency**

- As the Smart Aero Tools Cleansing Device already utilizes a 360° rotating water sprinkler, further improvement can focus on optimizing the water pressure and spray pattern to ensure more efficient cleaning. The addition of pressure sensors could help adjust the water flow based on the dirtiness or type of tools being cleaned, ensuring the system uses the optimal amount of water and energy for each cleaning cycle.

ii. Improved Drying System

- The current exhaust fan can be enhanced by incorporating a heated fan or heating element to speed up the drying process. This would reduce drying time for tools, particularly metal tools that are more prone to rust and corrosion. The heated fan or heating element would ensure that the air circulating around the tools is warm enough to effectively dry them, enhancing the overall functionality and preventing moisture buildup.

5.3.3 Software / Programming

For future research regarding the software and programming of the Smart Aero Tools Cleansing Device, we would like to improve: -

a. Sensor Integration for Smart Operation

- To make the device smarter and more automated, sensors such as water level sensors, temperature sensors, and tool presence detectors can be added. These sensors would help adjust the cleaning and drying cycles automatically, improving safety and efficiency.

5.3.4 Accessories & Finishing

We hope that the Smart Aero Tools Cleansing Device can be widely use in all industries. This project has potential to be upgrade into more advance function and provide convenient to user and increase the working efficiency for the workers.

Improvement: -

a) Durability

- While the acrylic casing provides transparency, future models may benefit from using more scratch-resistant materials or impact-resistant acrylic. This would reduce the risk of damage due to frequent handling or environmental conditions, extending the lifespan of the device.

b) Upgraded Water Pump and Filtration System

- Consider upgrading the water pump to a more energy-efficient model that reduces power consumption while maintaining the same high performance. Additionally, integrating a water filtration system could help maintain water quality, preventing debris and impurities from contaminating the tools during the cleaning process.

REFERENCES

1. S. N. Robbins and Individual, “US20110297464A1 - Self propelled toolbox - Google Patents,” Jun. 05, 2010. https://patents.google.com/patent/US20110297464A1/en

2. P. Solution, “Rousseau R7ghe-30509L3: R-go tool box 48"W X 24"D x 40 1/2"H,” ProQuip Solutions, https://proquip.solutions/rousseau-r7ghe-30509l3-r-go-tool-box- 48w-x-24d-x-40-1-2h/

3. L. Schenk, K. Feychting, A. Annas, and M. Öberg, “Calls made to the Poisons Information Centre reveal need for improved risk management of cleaning agents in the workplace,” International Journal of Occupational Safety and Ergonomics, vol. 26, no. 1, pp. 140–148, Nov. 2018, doi: 10.1080/10803548.2018.1550297.

4. The Editors of Encyclopaedia Britannica, “Industrial Revolution | Definition, History, Dates, Summary, & Facts,” *Encyclopedia Britannica*, Apr. 11, 2025. https://www.britannica.com/event/Industrial-Revolution

5. “Chernobyl Accident 1986 - World Nuclear Association.” https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/chernobyl-accident

6. Winingham, W. K. (2022, May 17). Aviation Accidents: human error. WKW. https://www.wkw.com/aviation-accidents/blog/aviation-accidents-human-error/

7. “Must-Have Dishwasher Features for Modern Living - Standard,” *Standard TV and Appliance*, 2023. https://www.standardtvandappliance.com/blog/the-must-have-dishwasher-features-for-modern-living (accessed May 12, 2025).

8. "Aviation Research and Training Tools (ARTT) | SKYbrary Aviation Safety," *Skybrary.aero*, 2020. https://skybrary.aero/articles/aviation-research-and-training-tools-artt (accessed May 12, 2025).

9. "Acrylic Plastic | Compare Plastics & View Acrylic Material Properties," *Curbell Plastics*, 2023. https://www.curbellplastics.com/materials/plastics/acrylic/

10. T. Teo, "Acrylic Properties and Uses - Malaysia Acrylic Plastic Manufacturer," *Malaysia Acrylic Plastic Manufacturer*, Jan. 30, 2020. https://www.acrylic-plastic.com.my/acrylic-properties-and-uses/ (accessed May 12, 2025)

11. "Exhaust Fan Malaysia - Best Ventilation Fan - Milux Sales & Service," *Milux*, 2020. https://milux.com.my/product-category/milux-products/fan-series/exhaust-ventilation-fan/ (accessed May 12, 2025).

12. NTSB ACCIDENT REPORT AAR-84/04. (n.d.). http://www.rvs.uni-bielefeld.de/publications/Incidents/DOCS/ComAndRep/Eastern/Ntsb8404.html

13. Ranter, H. (n.d.). Accident Lockheed L-1011 TriStar 1 N334EA, Thursday 5 May 1983. https://asn.flightsafety.org/wikibase/327655

14. McDonnell Douglas MD-83. (n.d.). Federal Aviation Administration. https://www.faa.gov/lessons_learned/transport_airplane/accidents/N963AS

15. Government of Canada, Canadian Centre for Occupational Health and Safety. (2024, May 10). Cleaning with Compressed Air. https://www.ccohs.ca/oshanswers/safety_haz/compressed_air.html

16. aerosolize. (2025). In Merriam-Webster Dictionary. https://www.merriam-webster.com/dictionary/aerosolize

17. Tools, J. H. (2024, November 18). How to clean hand tools: An ultimate guide to keep them sharp, shiny, and functional. JCBL Hand Tools. https://jcblhandtools.com/blog/how-to-clean-hand-tools/

18. Best Technology. (2025, April 30). How do ultrasonic cleaners work? | Ultrasonic cleaning machines. https://www.besttechnologyinc.com/ultrasonic-cleaning-systems/how-do-ultrasonics-work/

19. What is Steam Cleaning? How It Works and Its Benefits. (n.d.). Achoo! Blog. https://www.achooallergy.com/blog/learning/steam-cleaning-101-top-seven-reasons-to-steam-clean/?srsltid=AfmBOopbZYX5zxlLg7Seq-235YLcb9FdbXBvrGG7SXxuregb8Z-DIoTm

20. BtaliAdmin. (2025, April 9). The Benefits of Using a High Pressure Washer for Cleaning - Btali International. Btali International. https://btaliinternational.com/the-benefits-of-using-a-high-pressure-washer-for-cleaning/

21. Smith, J. (2020). *Advances in Aircraft Maintenance and Safety Systems*. Aviation Technology Press.

22. National Aviation Academy. (n.d.). *Aviation Maintenance Safety 101: Best Practices for a Safe Workplace*. Retrieved from https://www.naa.edu/aviation-maintenance-safety/

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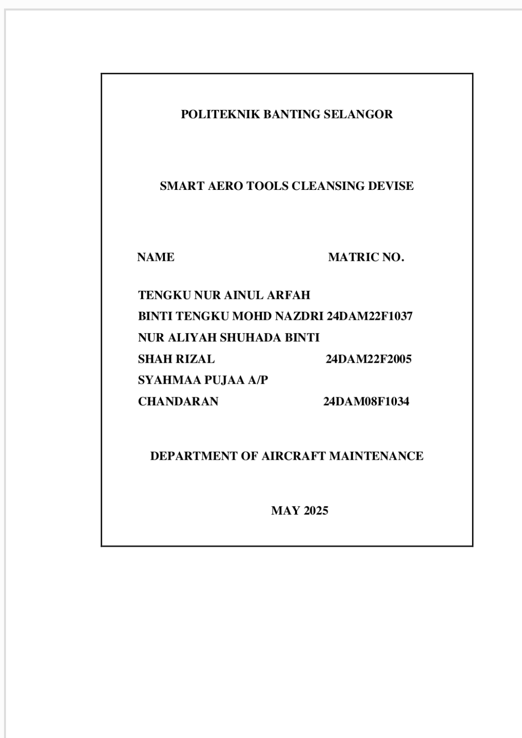

POLITEKNIK BANTING SELANGOR

SMART AERO TOOLS CLEANSING DEVISE

NAME	MATRIC NO.
TENGKU NUR AINUL ARFAH BINTI TENGKU MOHD NAZDRI	24DAM22F1037
NUR ALIYAH SHUHADA BINTI SHAH RIZAL	24DAM22F2005
SYAHMAA PUJAA A/P CHANDARAN	24DAM08F1034

DEPARTMENT OF AIRCRAFT MAINTENANCE

MAY 2025