POLITEKNIK BANTING SELANGOR

AVIATION FRIENDLY DUSTBIN (AFD)

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DEPARTMENT OF AIRCRAFT MAINTENANCE

SESSION: 1 2023/2024

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

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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.

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ABSTRACT

This abstract highlights how important it is to dispose of waste properly, especially by using dustbins, in order to reduce the risks related to foreign object debris (FOD) in the aviation sector. The safety of personnel and equipment is seriously threatened by foreign objects in food (FOD), with aviation engines being especially susceptible to consuming foreign objects from maintenance lines and operating regions. There could be anything from minor harm to disastrous breakdowns. One major cause of FOD is waste produced in maintenance lines, which includes packaging, used supplies, and disposable items. The presence of sharp objects, debris, and even poisonous substances in this trash increases the risk in maintenance areas. Effective waste disposal procedures are essential since ingesting FOD can have serious effects on aircraft engines or other essential components. During maintenance or ground activities, small particles like loose screws, nuts, or tools might be dangerous. These particles have the potential to harm or malfunction vital aircraft parts if they are unintentionally drawn into the engine. The ramifications of this include not just costly repairs but also disruptions to operations and decreased safety during flight. This abstract concludes by highlighting the necessity of implementing strong waste management procedures, such as the careful use of dustbins, in order to reduce the risks related to FOD in the aviation industry. Proactive waste management enhances the general safety and effectiveness of aircraft operations while also protecting persons and equipment.

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SYMBOLS	MEANINGS
cm	Centimeter
mm	Millimeter
m	Meter
V	Voltage
kg	Kilogram
km	Kilometer
h	hour

LIST OF ABBREVIATIONS

AFD	Aviation Friendly Dustbin
FOD	Foreign Object Debris
HDPE	High-Density Polyethylene
DC	Direct Current
IR	Infra Red
MGB	Mobile Garbage Bin

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CHAPTER 1

INTRODUCTION

1.1. BACKGROUND OF STUDY

As we all know, using a dustbin to dispose of trash or foreign objects is essential on a daily basis. Foreign Object Debris (FOD) can provide serious risks to both equipment and personnel's safety. Aircraft engines may ingest foreign objects from the base maintenance line or other operational areas, which could result in damage or even catastrophic failures. Furthermore, waste products from maintenance lines, such as packaging, old supplies, and disposable goods, are produced in large quantities and sharp items, potentially toxic compounds, and detritus are frequently encountered in maintenance lines. FOD can seriously harm aircrafts, particularly if it gets inside the engines or other vital components. During maintenance or ground operations, even tiny particles like loose screws, nuts, or tools can get sucked into the engine and cause failures or damage to other parts. This could lead to exorbitant repairs, operational hiccups, and diminished flying safety.

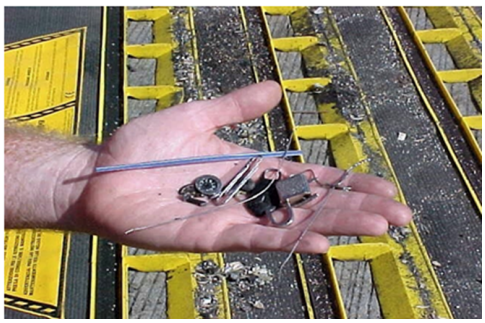


Figure 1.1: Example of FOD can be found in hangar of base maintenance line (Google,n.d)

Figure 1.1 shows that equipment and machinery are susceptible to severe damage from FOD. If loose particles or foreign items are left close to moving parts or systems, they may be eaten, jam, or result in malfunctions, which could result in equipment failure and expensive repairs. In other words, FOD events demand time and money to handle. When FOD is found, maintenance work may need to be put on hold or delayed while the problem is investigated and fixed. Incidents with FOD can harm a base or a maintenance facility's reputation. Accidents or occurrences using FOD can raise questions about the organization's safety and quality standards. In the event that FOD occurrences result in injury, property damage, or legal action, the institution may also be held liable. Therefore, the Aviation Friendly Dustbin (AFD) can be a convenient option as it allows you to relocate it easily to different areas of aircraft hangar, line maintenance. It also can save sometimes for maintenance personnel to locate a FOD dustbin.

1.2. PROBLEM STATEMENT

The most secure and safest mode of transportation nowadays is aircraft. This is partly due to the thorough pre-flight security and safety procedures, but what most people aren't aware of is the remarkable lengths to which airlines will go. As straightforward as ensuring that after routine maintenance, no Foreign Object Debris (FOD), including tools, is left inside any section of the machinery.

The first problem is that the tools are not locked away. The Western Airlines Swearingen SA226TC Metro II N158WA sustained significant damage on March 20, 2017, during a pre-dawn take-off for a single pilot positioning trip out of Boise Air Terminal/Gowen Field (BOI), Idaho. Damage from a forgotten tool to a foreign object.

The similar incident occurred when a Jet connect-operated Boeing 737-800 (ZK-ZQG) that was scheduled for maintenance in Auckland was discovered to have unexplained damage to its stabiliser trim control system that did not appear to be of recent origin. Only maintenance staff can access this compartment. FOD was identified as the damage's primary cause. At Auckland

International Airport on June 7, 2013, a Jet connect Limited Boeing 737-8382 was getting routine maintenance. Metal shavings were discovered near.

1.3. PROJECT OBJECTIVE

1.3.1 General Project Objective

The project objectives are:

1. To design Aviation Friendly Dustbin (AFD) especially for base maintenance line, and aircraft hangar
2. To develop AFD that can work efficiently and not interfere with maintenance work.
3. To evaluate user's satisfaction towards the cleanliness in the hangar and at base maintenance line.
4. Being able to move it conveniently to various locations within an airport terminal, line of maintenance, or aircraft hangar.
5. This Aviation Friendly Dustbin could assist you carry the scrap effortlessly.
6. Can make cleaning simpler because you don’t have to transfer trash to a stationary dustbin.

1.3.2 Specific Individual Project Objective:

1.3.2.1 Product Structure

1. To develop AFD with functioning compartment consist of dustbin compartment and tools compartment

2. To design a dustbin compartment that can withstand scrap material with no problem and a tools compartment that can fit medium size tools that are necessary to use on specific maintenance tasks.

3. To demonstrate the functionality of the dustbin compartment and tools compartment successfully

1.3.2.2 Mechanical Mechanism

1. The innovative sensor technology of the aviation friendly moves its tyre automatically when it detects the user when it's being switched on, giving the personnels a hands-free and hygienic way to dispose of their waste.

2. Made from strong, lightweight materials, the aviation friendly dustbin blends in well with the inside of the hangar, offering a stylish and room-saving option for managing waste while doing work at base maintenance.

3. The dustbin's sturdy but quiet shutting mechanism guarantees a noise-free operation, adding to the peaceful and cosy hangar atmosphere for users and people around.

1.3.2.3 Software / Electronic

This project aimed:

1. To create a smart dustbin that can move using sensors.
2. To design a power efficient system using a rechargeable battery.
3. To create and develop a programming and electronic system for the sensor so that it will detect objects and movement in front and move by using DC Motor.
4. To create and implement suitable software that integrates the Arduino programming language into the system

1.3.2.4 Accessories & Finishing

This project aimed:

1. To increase safety precautions and make it simple to find the dustbin in crowded or low-light situations, which will lower the likelihood of accidents or collisions.
2. To enable maintenance staff and the general public to easily understand and use the smart dustbin, guaranteeing its effective use and maintenance.
3. To improve safety by giving users or maintenance staff prompt visual signals or warnings that clearly indicate certain conditions such as full capacity, maintenance needs, or operational status and encourage them to take appropriate action.

1.4. PURPOSE OF PRODUCT

This product gives the maintenance line flexibility in waste management. They are simple to place at various locations, ensuring easy access for staff performing maintenance duties. By making it more accessible and decreasing the possibility of waste being left improperly, this encourages a culture of good waste disposal. Furthermore, Movable dustbins make rubbish collection and disposal more effective. The procedure of disposing of waste is streamlined by the ease with which maintenance staff may move the dustbins to various workstations or locations where waste is produced. As a result, maintenance duties can be completed more quickly and with less effort and the possibility of foreign object debris (FOD) or

other garbage posing safety risks or cluttering the maintenance line is decreased by the strategically arranged placement of mobile trash cans. To reduce the likelihood of mishaps, slips, or falls, staff can swiftly dispose of rubbish in the designated dustbins. Improved overall safety and hygiene are also benefits of a cleaner working environment. Moreover, the maintenance line and the base as a whole benefit from maintaining a clean and organised working environment. The existence of portable trash cans shows a dedication to orderliness, professionalism, and ethical waste disposal. It fosters a culture of excellence and environmental responsibility and makes a good first impression on employees, guests, and stakeholders.

1.5. SCOPE OF PROJECT

The primary objective of this project was to build a movable dustbin with storage for engineers or technicians so they could dispose of all FOD with just one call. With an integrated torch light for engineers to use during maintenance and inspection in the hangar and additional storage for temporarily storing tools or equipment used for maintenance, engineers' or technicians' work can be made easier and more dependable. Engineers will find it easier to complete their work without having to worry about leaving the job site to dispose of FOD thanks to the smart dustbins' system, which allows them to continue operating until it will be called by someone to assist them with maintenance or FOD. This project focuses on the area where FOD can be disposed of and where all tools can be kept together with a moving mechanism that doesn't use a lot of energy. With dimensions of roughly 120 cm in height, 100 cm in length, and 50 cm in width, it can hold a lot of trash for the duration of working hours. An additional compartment can be used to temporarily store all tools and equipment. Moving trash cans are helpful for environmental sustainability initiatives. The maintenance line can better support recycling activities by offering distinct containers for recyclable goods like paper, plastic, or metal. As a result, the operation becomes greener and more environmentally friendly and less garbage is transferred to landfills.

1.5.1 General Project Scopes

Building a mobile dustbin with storage for engineers or technicians to be able to dispose of all FOD with a single call was the main goal of this project. Engineers' or technicians' work

can be made easier and more reliable with an integrated torch light for use during maintenance and inspection in the hangar and additional storage for temporarily storing tools or equipment used for maintenance. The smart dustbins' technology makes it easy for engineers to do their work without having to worry about leaving the job site to dispose of FOD. It lets them keep working until someone calls for help with FOD or maintenance.

1.5.2 Specific Individual Scope

1.5.2.1 Product Structure

AFD will consist of two separate parts for the structure, one is the dustbin compartment and other is tools compartment. The dustbin compartment will be most of the chassis itself while the tools compartment will be made from aluminium sheet inside the chassis of the dustbin. The chassis of the AFD is mostly from HDPE (High-Density Polyethylene) Plastic that is strong enough to withstand the load. The base of the AFD will be made from acrylic board because it is strong and rigid to withstand the chassis while protecting the electronics inside it.

1.5.2.2 Mechanical Mechanism

1. **Research and Development:** Examine in-depth the technologies and methods now in use for in hangar waste management. Determine where there are chances for creativity and productivity gains in the creation of an aviation friendly dustbin.
2. **Design and Conceptualization:** Create creative ideas that take into account material, weight, size, and compatibility for the aviation-friendly trash can. Verify that the design complies with all applicable aviation safety guidelines.
3. **Compatibility and Modular Design:** Make sure the dustbin is compatible with a variety of hangar environments and has an easy-to-install modular construction. Enable any Part 145 Organisations wishing to implement the new waste management system to integrate seamlessly.
4. **Planning for manufacture and Production:** Create a thorough plan for the dustbin's manufacturer and production that is conducive to aviation. Throughout the production process, take quality control, cost-effectiveness, and scalability into account.

5. **Documentation and User directions:** To help airlines and maintenance teams deploy and maintain the aviation-friendly dustbin, prepare thorough paperwork that includes user directions and maintenance procedures.

1.5.2.3 Electronic / Programming

This product is designed to help maintenance personnel to minimise the usage of energy to find a dustbin and throw their FOD in it. It is also to help make the workspace more clean and FOD free. This problem is solved by making a smart dustbin that uses an ultrasonic sensor and infrared sensor to detect movement and objects in front of it. The smart dustbin will follow the maintenance personnel to their work space so that it will be easier to throw FOD away.

1.5.2.4 Accessories & Finishing

The sophisticated coatings and finishes used in Avition Friendly Dustbin are designed to provide strong resistance against rust, corrosion, and bad weather. The coatings have been carefully crafted to facilitate uncomplicated cleaning and maintenance, thereby prolonging the dustbin's lifespan. By utilizing materials that are renowned for their resilience and environmentally beneficial qualities, the dustbin's finishing not only satisfies strict requirements but also promotes sustainability. In addition to being aesthetically pleasing, the colors selected also have practical uses; they offer an attractive finish that is resistant to environmental stresses and is long-lasting and simple to clean and maintain.

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL LITERATURE REVIEW

2.1.1 Aviation Industry in Malaysia

The demand for innovative solutions in the aviation industry is on the rise, and one area that has garnered significant attention is the implementation of smart dustbins. These smart dustbins are designed to address the waste management challenges faced by airports, airlines, and other aviation stakeholders.

Firstly, there is a growing need for efficient waste disposal systems in base maintenance to maintain cleanliness and hygiene and avoid any FOD. Smart dustbins equipped with sensors and AI technology, including recyclables and non-recyclables compartments. This feature reduces the burden on airport staff and ensures proper waste segregation.

Secondly, the aviation industry is actively seeking sustainable initiatives to reduce its environmental footprint. Smart dustbins with built-in compactors can optimise waste storage capacity by compressing the garbage, minimising the frequency of emptying and reducing the number of waste collection vehicles on the tarmac. This not only improves operational efficiency but also contributes to reducing carbon emissions.

Furthermore, smart dustbins can provide real-time monitoring of waste levels, enabling airports to streamline waste management processes. By receiving alerts when the bins reach

capacity, airport authorities can schedule waste collection more effectively, preventing overflowing bins and enhancing overall cleanliness standards.

Another advantage of implementing smart dustbins in aviation is the potential for data analysis and insights. By collecting data on waste generation patterns, airports can identify areas of improvement and implement targeted waste reduction strategies. This data-driven approach can lead to cost savings, as well as increased environmental sustainability.

Lastly, the demand for smart dustbins in aviation extends beyond airports or base maintenance. Airlines can also benefit from these innovative solutions on their aircraft. Implementing smart dustbins in cabins and galley areas can streamline waste collection during flights, ensuring a more efficient use of space and enhancing the passenger experience.

In conclusion, the demand for aviation smart dustbins is driven by the need for efficient waste management, sustainability initiatives, operational efficiency, and data-driven decision-making. These innovative solutions have the potential to revolutionise waste disposal in the aviation industry, improving cleanliness, reducing environmental impact, and enhancing overall passenger satisfaction.

2.2 SPECIFIC LITERATURE REVIEW

2.2.1 Product Structure

The selection of materials for the product structure plays a very significant role in achieving the project objectives. The main structure consists of two parts which are the dustbin and tools compartment and base of the structure. For the first part , the dustbin and tools compartment is made from HDPE (High-Density Polyethylene) Plastic, it should be strong and rigid enough to support if there is load inside of it. The tools compartment is made from aluminium sheet which can withstand the heavy tools. While the durability of the material for the main structure is the priority, other factors to be considered are the weight, workability, and the cost. The second part of the structure is the base which is an acrylic board. The acrylic board is where the chassis is mounted and it is the most crucial part that withstand most of the load. The strength of the acrylic board is considered perfect for this project due to its strength while maintaining its lightweight.

2.2.1.1 Basic Design of dustbin

As in the 21st century, most workplaces and houses had a dustbin. It is now considered as an essential supply for the purpose of waste disposal. According to PERSTORP.MY, whatever name you would like to give your bin. The main idea behind it is very simple. It is a means of storage for where you place your rubbish.

Figure 2.1: MGB120 Two Wheel Bins (Perstorp.my, n.d.)

Most dustin construction consist of a lid purposely to make sure the odour is controlled. And some dustbins had a wheel to help move them for disposal purposes. The shape of most dustbins is also cuboid in shape due to the shape stability. These are the main basic design for dustbin as it is the most efficient way for them.

2.2.1.2 Minimum Safety Requirements

A safe workplace is one that complies with the standards, regulations, and guidelines set out by the Occupational Safety and Health Administration (OSH Act) and is free from major recognized dangers, as described by US Department of Labor's 18 OSH Act. Based on this statement, the chosen design for the dustbin that will be used should be safe and not causing any

harm to the user, environment, and surrounding area. The size should be big enough to be seen and not too big as it can cause waste of space and can be a burden to its user.

Eculabs.com states that The risks associated with picking up and managing overflowing garbage for waste collection workers include accidents, chronic diseases, and infections. Direct contact with garbage can lead to a number of health problems, including intestinal diseases spread by flies feeding on the waste, different illnesses from animal bites, and skin and blood infections from infected wounds. Because of the possibility of toxic waste, sharp items, and needles, picking up overflowing garbage can be dangerous.

2.2.1.3 Type of Material for Product Structure

2.2.1.3.1 HDPE dustbin

The primary structure of the AFD is made from High-Density Polyethylene Plastic (HDPE). The main reason for this is because it is a durable and strong type of plastic commonly used for outdoor bins. HDPE is known for its durability and impact resistance, which makes it perfect for enduring outdoor elements like exposure to weather, temperature changes, and physical strain. Because of their strength, HDPE bins are guaranteed to withstand harsh handling and environmental conditions without breaking or deforming easily.

Figure 2.2: 240L HDPE Wheelie Waste Bin (reflexeuquip.com,n.d.)

HDPE bins come in multi shape and colour so that users can choose their option based on their preference.

2.2.1.3.2 Clear Acrylic Perspex

A solid, transparent plastic composed of polymethyl methacrylate is called Perspex. Acrylic Perspex is an excellent material for product development, especially when building panels for preparation sections. Its properties include excellent optical clarity and transparency, high temperature and impact resistance, lightweight compared to glass, and high resistance to numerous chemicals.

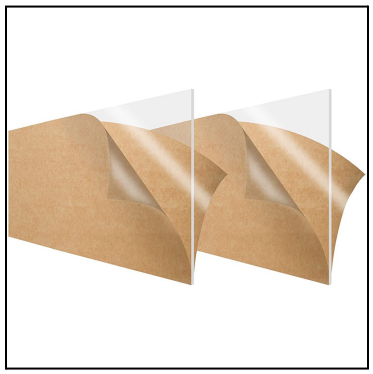


Figure 2.3: Acrylic Sheet Clear Cast Panel (lazada.com.my, n.d.)

The thickness of an acrylic sheet determines its strength. The thickness is in the range of 30 to 100 mm.

2.2.1.3.3 Aluminium Sheet

Aluminium sheet was used in AFD as a tools compartment inside of the structure because it is a strong material to withstand the weight of the AFD. Besides, The low density, superior corrosion resistance, and ease of formation of aluminium are the reasons behind its selection.

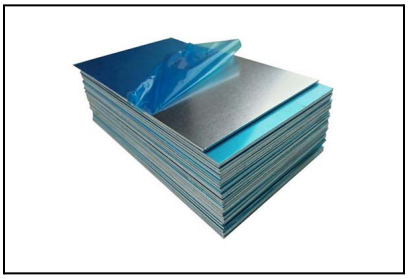


Figure 2.4: 3003 Aluminum Sheet (steeltd.com, n.d.)

Pure aluminium has a low tensile strength. Alloying aluminium with copper, manganese, magnesium, and silicon, on the other hand, results in an alloy with a very high strength-to-weight ratio. The thickness of aluminium sheet available ranges from 0.2 mm to 6.5 mm.

2.2.2 Product Mechanisms

2.2.2.1 DC Motor

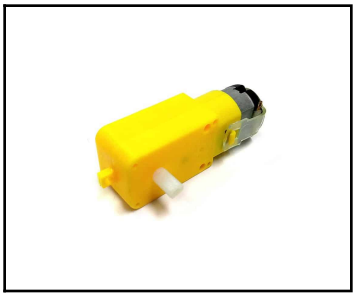


Figure 2.5: Dual-shaft 12V DC Motor (Google, n.d.)

An electric motor that runs on direct current (DC) power and has two output shafts that extend from either end of the motor is known as a dual shaft 12-volt DC motor. Every shaft has a distinct purpose, and the motor's general construction offers adaptability for a range of uses.

2.2.2.2 Servo Motor

Figure 2.6: Servo Motor (Google, n.d.)

The servo motor plays a crucial role in the opening and closing function of the dustbin lid, ensuring precise and controlled movements. When it comes to closing the dustbin lid, the servo motor receives signals from the control system, initiating the movement. The motor's high torque and position control capabilities allow it to bring the lid down smoothly and accurately, creating a secure seal to contain the waste within the bin. The servo motor's ability to maintain a specific position ensures that the lid is tightly closed, preventing any unwanted odours or litter from escaping.

On the other hand, when it's time to open the dustbin lid, the servo motor receives signals indicating the desired action. With its precise control over rotation, the servo motor enables a controlled and gradual upward movement of the lid. This controlled opening mechanism prevents any sudden or abrupt motions that could potentially cause accidents or damage surrounding objects. Additionally, the servo motor's ability to hold a specific position allows the lid to stay open while users dispose of their waste conveniently.

2.2.2.3 Wheel

Figure 2.7: Wheel (Google, n.d.)

The wheel function plays a crucial role in the design and functionality of smart dustbins, particularly in the aviation industry. These wheels are specifically engineered to enhance the mobility and manoeuvrability of the dustbins, making waste collection and transportation more efficient.

First and foremost, the wheels used in smart dustbins are designed for smooth and effortless movement. They are typically made from durable materials such as rubber or polyurethane, which provide excellent traction and shock absorption. This ensures that the dustbins can be easily manoeuvred across various surfaces within the airport, including smooth floors, ramps, and even outdoor areas. Furthermore, the wheels are equipped with swivel mechanisms, allowing the dustbins to change direction smoothly and navigate tight spaces with ease. This is particularly important in

2.2.2.4 Tool Compartment

Figure 2.8: Tool Compartment (Google, n.d.)

The tool compartment function is an additional feature integrated into smart dustbins to assist maintenance personnel in carrying their regular tools for maintenance purposes.

This innovative feature aims to enhance the efficiency and convenience of maintenance operations in the aviation industry. By incorporating a dedicated tool compartment within the smart dustbin design, maintenance personnel can have easy access to essential tools while performing their duties. The tool compartment is strategically placed within the dustbin structure, ensuring that it does not interfere with the primary function of waste collection and management. It is designed to securely hold and organize a variety of tools commonly used in routine maintenance tasks. Maintenance personnel can store tools such as screwdrivers, wrenches, pliers, and other necessary equipment in the designated compartment. This eliminates the need for carrying a separate toolbox or searching for tools in different locations, streamlining the maintenance process and saving valuable time.

In conclusion, the tool compartment function in smart dustbins serves as an added convenience for maintenance personnel in the aviation industry. It provides a dedicated space for storing and accessing essential tools, promoting efficiency and effectiveness in routine maintenance operations.

2.2.3 Electronic / Programming

AFDs can also be operated by electrical mechanisms. The electrical mechanism does not rely on mechanical components like hinges, rivets, bolts, or nuts. The focus is more on software programming and using electronic components, such as Arduino boards.

2.2.3.1 Types of Arduino

Arduino is an open-source platform for creating electronic creations. There are two parts to Arduino: a physical programmable circuit board (also called a microcontroller) and software that allows you to create and upload computer code on your computer.

2.2.3.1.1 Arduino IDE

Arduino IDE is an open-source electronics platform based on easy-to-use hardware and software. Arduino IDE makes creating code and uploading it to the board simple. Any Arduino board can be used with this software. includes a message section, a text console, a toolbar with buttons for common functions, a text editor for writing code, and a number of menus. In order to upload and interact with programmes, it establishes a connection with the Arduino hardware.

Arduino IDE has been applied to this project as it is easy to upload coding and not complicated to other programming software.

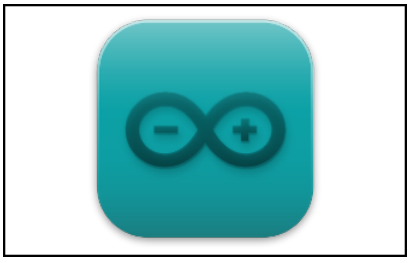


Figure 2.9 Arduino IDE (n.d.)

2.2.3.1.2 Arduino UNO R3

The Arduino board plays a crucial role in the functioning of the smart dustbin, enabling it to perform various tasks and operations seamlessly.

Firstly, the Arduino board serves as the main control unit of the smart dustbin, housing a microcontroller that processes and executes commands. It acts as the brain of the system, coordinating the different components and sensors to perform their designated functions. Furthermore, the Arduino board interfaces with a range of sensors integrated into the smart dustbin. These sensors, such as proximity sensors or load sensors, provide essential data to the microcontroller. For instance, proximity sensors detect the presence of objects or hands near the dustbin, triggering the lid to open automatically for convenient waste disposal. In addition, the Arduino board processes the data received from the sensors and applies predefined logic to make decisions. For instance, it can analyze the level of waste in the dustbin using ultrasonic sensors and determine when it requires emptying. It can also identify different types of waste using optical sensors or infrared technology, facilitating the segregation of recyclable and non-recyclable materials.

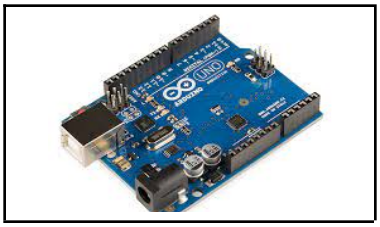


Figure 2.10 Arduino Uno R3

2.2.3.2 Type of Motor Driver Shield

2.2.3.2.1 L293D Motor Driver Shield

DC motors, servo motors, and stepper motors can all be controlled simultaneously with a motor driver shield such as the L293D. Servo motors, stepper motors, and DC motors can all be controlled with this unit. The Arduino UNO or MEGA can be easily connected to it. Arduino projects such as robotics and CNC can benefit from the L293D dual-channel H-bridge motor driver. Arduino projects, particularly robotics and CNC, benefit from it. A single IC can control two DC motors or one stepper motor. In 4.5 V to 36 V, it provides 600 mA bidirectional drive current. It has two enable inputs, allowing it to be enabled or disabled regardless of the input signal. It has 1.2 A per channel peak output current. Two L293D motor driver integrated circuits are on the motor driver shield. This allows the L293d shield to control four DC motors or one stepper

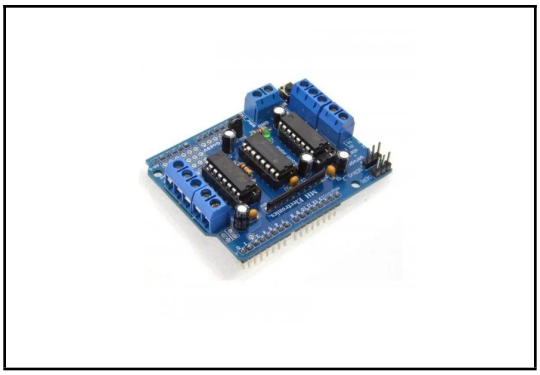


Figure 2.11 L293D Motor Driver Shield

2.2.3.3 Type of Sensor

2.2.3.3.1 HC - SR04 Ultrasonic Sensor

Sensors used with ultrasonic waves can detect waves or movements by analyzing their reflection patterns. Humans cannot hear the high-frequency sound waves emitted by these sensors. In response to the sound waves emitted, the sensor receives them when they bounce back from an object. The sensor can determine the distance between itself and the object by analyzing the time taken for the sound waves to return. In the same way that bats and dolphins use sonar systems for locating prey, ultrasonic sensors function in a similar way. The emitted sound waves are bounced off moving objects and returned to the sensor at a different time interval when a person waves their hand or moves within the sensor's range. The sensor can detect if the reflected sound waves have changed by monitoring them and comparing them to a predetermined threshold. Automation, robotics, security, and automation are among the applications of ultrasonic sensors. Using them for gesture control, object detection, and occupancy sensing makes sense because they detect motion accurately and in real time.

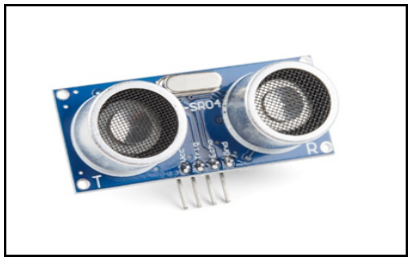


Figure 2.12 HC - SR04 Ultrasonic Sensor

2.2.3.3.2 Infrared Sensor

As infrared radiation is emitted from their environment, infrared sensors detect it. It is possible to use infrared sensors to measure objects' heat or temperature, convert their output into electrical signals, and use the output in a wide range of applications. The presence or absence of an object can be detected by IR sensors by detecting the infrared radiation emitted or reflected by the object. Robotics and touchless faucets are both examples of applications that utilize proximity sensors with this capability.

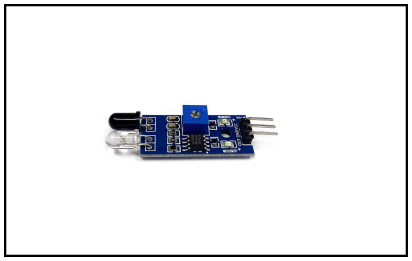


Figure 2.13 Infrared Sensor (n.d.)

2.2.3.4 Software and Programming

The Arduino Software (IDE) includes a text editor for writing code, a message area, a text terminal, a toolbar with buttons for basic operations, and a series of menus. It links to Arduino and Genuino hardware in order to upload and interact with programmes. Sketches are programmes created with the Arduino Software (IDE). These drawings were created with a text editor and saved with the.Uno file extension. Cutting/pasting, as well as searching/replacing text, are all available in the editor. The message box highlights problems and provides feedback while storing and exporting. The Arduino Software (IDE) outputs text to the console, which includes comprehensive error messages and other information. The configured board and 50 serial ports are displayed in the window's bottom right hand corner. You may check and upload programmes, generate, save, and save drawings, and open the serial monitor using the toolbar buttons.

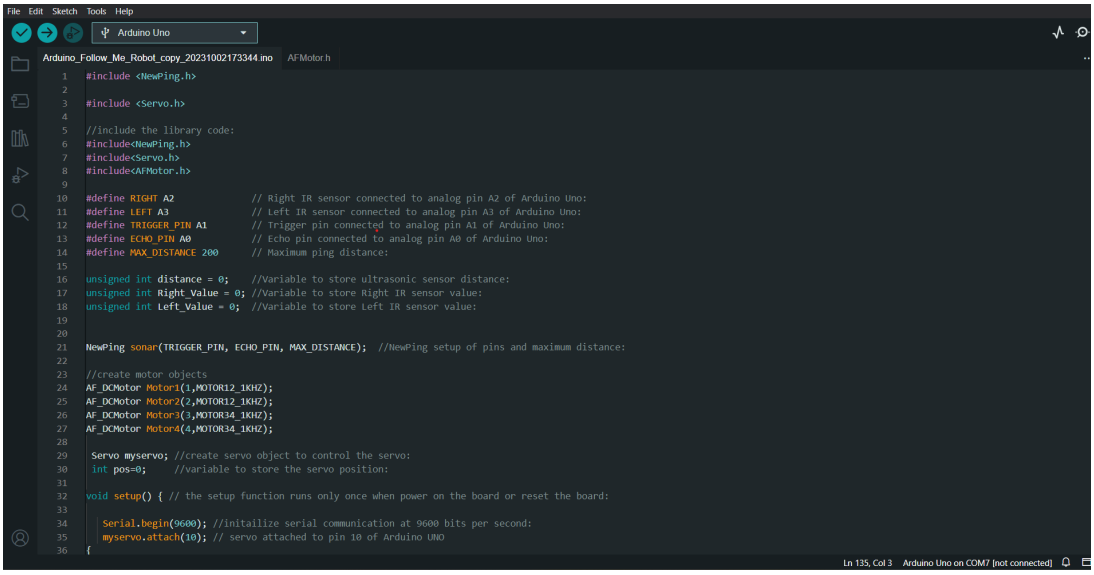


Figure 2.14 Arduino Software

2.2.4 Accessories & Finishing

2.2.4.1 Reflective Tape

Figure 2.15 Reflective Tape

The reflective tape on the smart dustbin serves as a safety reminder to the surrounding area, enhancing visibility and promoting awareness of its presence.

2.2.4.2 Strobe Light

Figure 2.16 Strobe Light

The strobe light function serves as a vital warning signal, ensuring that everyone in the surroundings remains alert and attentive. These powerful flashing lights are designed to grab attention and convey a sense of urgency, especially in aviation and emergency situations. When activated, the strobe lights emit intense, rapid pulses of light, creating a highly visible and attention-grabbing effect. This functionality is crucial in aviation, where strobe lights are mounted on aircraft wings, tail sections, and sometimes on top of fuselages. The bright flashes help other pilots and ground personnel identify the presence and position of an aircraft, even in low light or adverse weather conditions.

In emergency situations, such as during evacuations or in hazardous environments, strobe lights play a critical role in ensuring the safety of individuals. By rapidly flashing and illuminating the surroundings, these lights provide a clear visual signal that alerts people to the presence of danger or the need for immediate action. This helps to minimize confusion, promote swift response, and prevent accidents or injuries. Strobe lights are also commonly used in construction zones, roadworks, and other hazardous areas to enhance safety. Their distinctive flashing pattern ensures that drivers and pedestrians are aware of the potential dangers ahead, encouraging them to slow down, exercise caution, and stay alert.

In summary, the strobe light function serves as a crucial warning mechanism, keeping individuals in the surroundings alert and responsive. Whether in aviation, emergencies, construction zones, or on emergency vehicles, the rapid and intense flashes of light generated by

strobe lights play a significant role in promoting safety, minimizing risks, and ensuring effective communication in critical situations.

2.3 REVIEW OF RECENT RESEARCH / RELATED PRODUCTS

2.3.1 Related Patented Products:

2.3.1.1 Trash can by Eko Development Ltd.

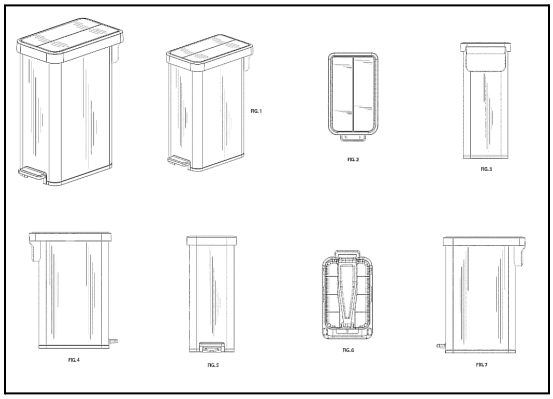


Figure 2.17 Trash can by Eko Development Ltd.(uspto.report, September 24, 2019)

Patent Title:Trash can
Patent No.: D861,076
Published Date: September 24, 2019
Patent Office Country : Guangzhou, China
Inventors: Chen; Yizhi
Abstract: U.S. patent number D861,076 [Application Number D/635,953] was granted by the patent office on 2019-09-24 for *trash can*. This patent grant is currently assigned to Eko Development Ltd. The grantee listed for this patent is EKO DEVELOPMENT LTD.. Invention is credited to Yizhi Chen.

2.3.1.2 Sulo MGB Bin (Industrial Garbage Bin)

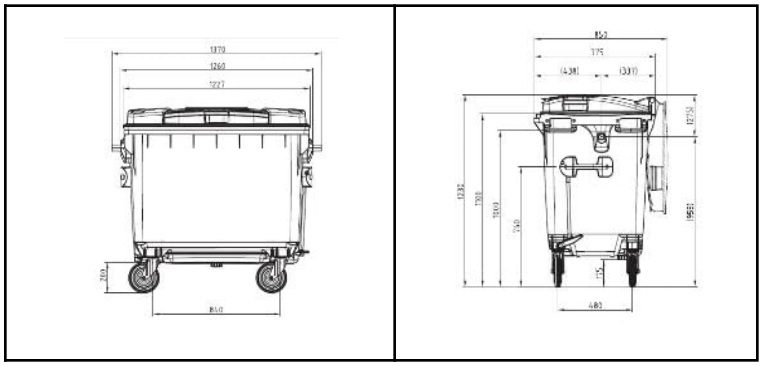


Figure 2.18: Sulo MGB Bin Large Bin (Amazon, n.d.)

Patent Title: Sulo MGB Bin Large Bin 660 Litres with Flat Lid (FD) Rubbish Bin Waste Bin (Blue)
Patent No.: N.A.
Published Date: N.D.
Patent Office Country : France, Germany and Sweden
Inventors: Sulo Global
Abstract:

- Original SULO 660 litre container with a maximum filling weight of 264 kg.
- Made in Germany, High-quality materials, careful workmanship, many years of functional safety.
- Numerous accessories available.
- Width x height x depth (cm): 137 x 123 x 775.
- Supplied directly from the manufacturer. Delivery time depending on demand 4-6 weeks.

2.3.1.3 Smart Garbage Bin

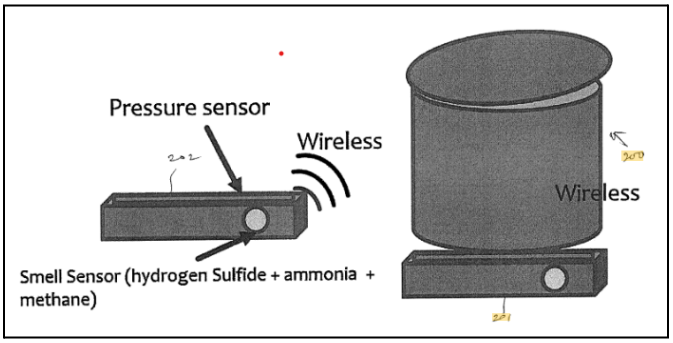


Figure 2.19: Smart Garbage Bin (n.d.)

Patent title : Smart Garbage Bin

Published date : 2016

Patent Office Country: United State

Investor : Junaith Ahemed Shahabdeen

Abstract : A container has a sensor to detect a quantity that indicates how many objects have been placed within, such as a trash can or document disposal bin, and a local controller that can connect wirelessly to a remote controller for communicating with the remote controller the sensed data.The sensor could be placed at the bottom of the container. One possible sensor mounted on the cover is a rangefinder, which gauges the separation between the container and its contents. Placing the sensor at the base of the container could be delicate to its own weight and its contents. The sensor could be a force sensing resistor or a reflecting infrared range finder, for example. Furthermore, the detected amount can also be the existence of a gaseous substance like methane, ammonia, or hydrogen sulphide.

2.3.1.4 Garbage Bin with Cover

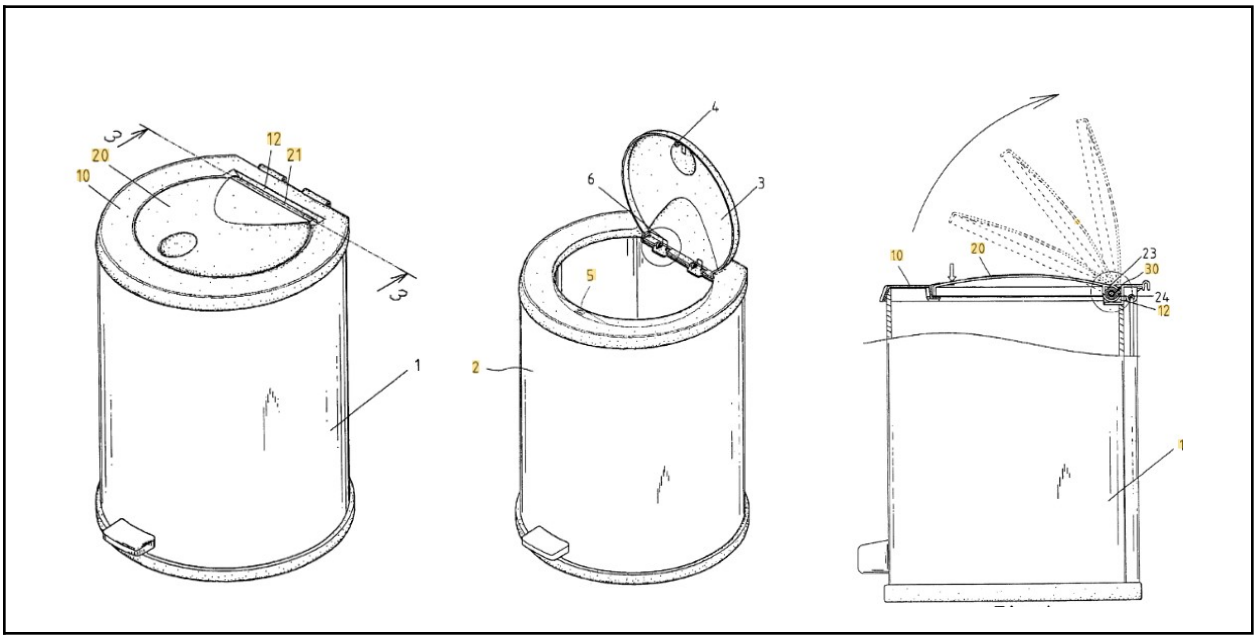


Figure 2.20 : Garbage bin with cover (Google, n.d)

Patent Title:Garbage bin with cover
Patent No.: US 6,857,538 B2
Published Date: 22 February 2005
Patent Office Country : Taichung Hsien,China
Inventors: Tsong-Yow Lin
Abstract: A slow pivot device is used to slowly pivot the cover in relation to the ring, and a cover attached on the ring completes the cover assembly. The ring is mounted on a rubbish bin. Between the ring and the cover is a slow pivot element that is part of the slow pivot device. The slow pivot element consists of an external tube that surrounds the internal tube, an interior tube, and a spring that is attached to both the external and internal tubes. The torque applied to the spring is a result of the internal tube's rotation with respect to the exterior tube. The spring's end is connected to the internal tube by virtue of its reception in the tube.An end of the internal tube is connected to the internal tube by way of its reception in the internal tube. In order to link the opposite end of the spring to the exterior tube, the internal tube is placed inside the external tube. A clip for clipping the spring's end is constructed on the inside side of the internal tube. An internal side of the external tube has a clip designed to clip the spring's opposite end. In order to allow the internal tube to rotate with respect to the external tube, damping oil is positioned between the two tubes.

2.3.2 RECENT MARKET PRODUCTS

2.3.2.1 TORI HOME Small Dustbin

Figure 2.21 TORI HOME Small Dustbin 5L(shopee.com, n.d.)

roduct name :TORI HOME Small Dustbin

Published date : n.d.

Investor : n.d.

Description :

MATERIAL - PP PLASTIC

COLOUR - RANDOM COLOUR

SIZE - 5L

2.3.2.2 Plastic Waste Bin

Figure 2.22 Plastic Waste Bin Green 240 Liter Outdoor Trash Can HDPE (Google, June 4 2021)

Product Name: Plastic Waste Bin Green 240 Liter Outdoor Trash Can HDPE Garbage Dustbin Waste Container

Published Date: N.D.

Inventors: Zhejiang Huanqun Plastic Co., Ltd.

Description:

- safe and easy to handle
- easy assemble
- stable and light weight lid
- user-friendly desgin.
- water drainage plug as standard.
- easy to clean due to smooth and rounded internal corners.
- Reinforced base,front and rear panels for greater stablility.

- Logo printing is available on request.
- Certificated according to ISO9001:2008 and Din EN840.

2.3.2.2 Swing Top Garbage Bin With Swing Lid

Figure 2.23 Swing Top Garbage Bin with swing lid (n.d.)

Product name : Swing Top Garbage With Swing Lid

Published date : n.d.

Investor : n.d.

Description : With the size of 240 x 390 x 600 mm, it has a 40 litre capacity. It features a vibrant and trendy design. The lid can be removed for easy cleaning, making it perfect for home and office.

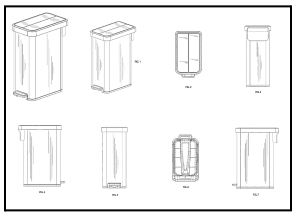
2.3.2.4 Nakada Smart Dustbin

Figure 2.24 Nakada Smart Dustbin

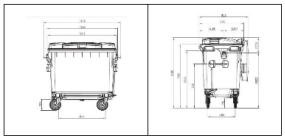
Product Name: Nakada Smart Dustbin
Published Date: n. d
Inventors: Nakada
Description:
- 2x AA Alkaline Batteries
- 3 Ways To Open The Cover
- O.S Level Induction Cover Open Level
- Long Standby Time
- Quiet And Light Open/Close
- 4 Seconds Automatic Cover Close
- 12 Litre Large Capacity

2.4 COMPARISON BETWEEN RECENT RESEARCH AND CURRENT PROJECT

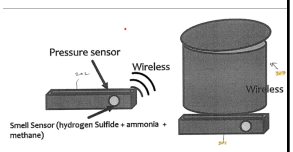
2.4.1 Table 2.1: Trash can by Eko Development Ltd vs. TORI HOME Small Dustbin vs. AFD

Product	Trash can by Eko Development Ltd.	TORI HOME Small Dustbin	AFD
Design			
Movability	no	no	yes
Purpose	Dispose trash in kitchen, room	Dispose trash in kitchen or room	Dispose thrash or FOD at base maintenance
Dimensions	n.d	16.5cm x 16cm x 22com	12 inch x 10 inch x 16 inch
Cover	yes	yes	yes
features	Can be open by leg	Auto close lid mechanism	Strobe light, automatically open lid,reflective tape, and tools compartment

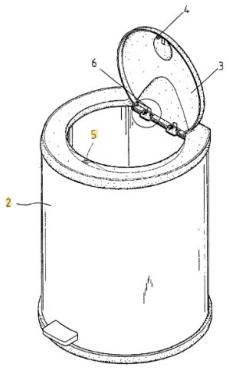
2.4.2 Table 2.2 : Sulo MGB Bin vs. Plastic Waste Bin vs. AFD

Product	Sulo MGB Bin	Plastic Waste Bin	AFD
Design			
Movability	yes	yes	yes
Purpose	Commonly use at industrial places	Dispose trash in industrial area	Dispose thrash or FOD at base maintenance
Dimensions	Width x height x depth (cm) = 137 x 123 x 775.	730 x 570 x 1120mm	12 inch x 10 inch x 16 inch
Cover	yes	yes	yes
features	Common industrial garbage bin.	Open by step on the trample and water drainage plug as standard.	Strobe light, automatically open lid,reflective tape, and tools compartment

2.4.3 Table 2.3 : Smart Garbage Bin vs Swing Top Garbage Bin with Swing lid

Product	Smart Garbage Bin	Swing Top Garbage Bin With Swing Lid	AFD
Design			
Movability	no	no	yes
Purpose	Dispose trash in kitchen and office room	Dispose trash in kitchen or office room	Dispose thrash or FOD at base maintenance
Dimensions	n.d	240 x 390 x 600 mm	12 inch x 10 inch x 16 inch
Cover	yes	yes	yes
features	Can detect if the bin is full and send the indication through smartphone	Open by push the lid	Strobe light, automatically open lid,reflective tape, and tools compartment

2.4.4 Table 2.4 : Garbage bin with cover vs Nakada Smart Dustbin vs AFD

Product	Garbage bin with Cover	Nakada Smart Dustbin	Aviation Friendly Dustbin (AFD)
Design			
Movability	no	no	yes
Purpose	Dispose trash in the kitchen area and office area	Dispose trash in the office area,bedroom area and also kitchen area	Dispose trash and FOD in base maintenance. Its also can save a small tools that use while repair in the mainenance
Dimensions	n.d	26 cm x 29 cm x 32 cm	12 inch x 10 inch x 16 inch
Cover	yes	yes	yes
Features	Open by push the button at the body of the dustbin	Automatically open lid by sensor	Strobe light, automatically open lid,reflective tape, and tools compartment

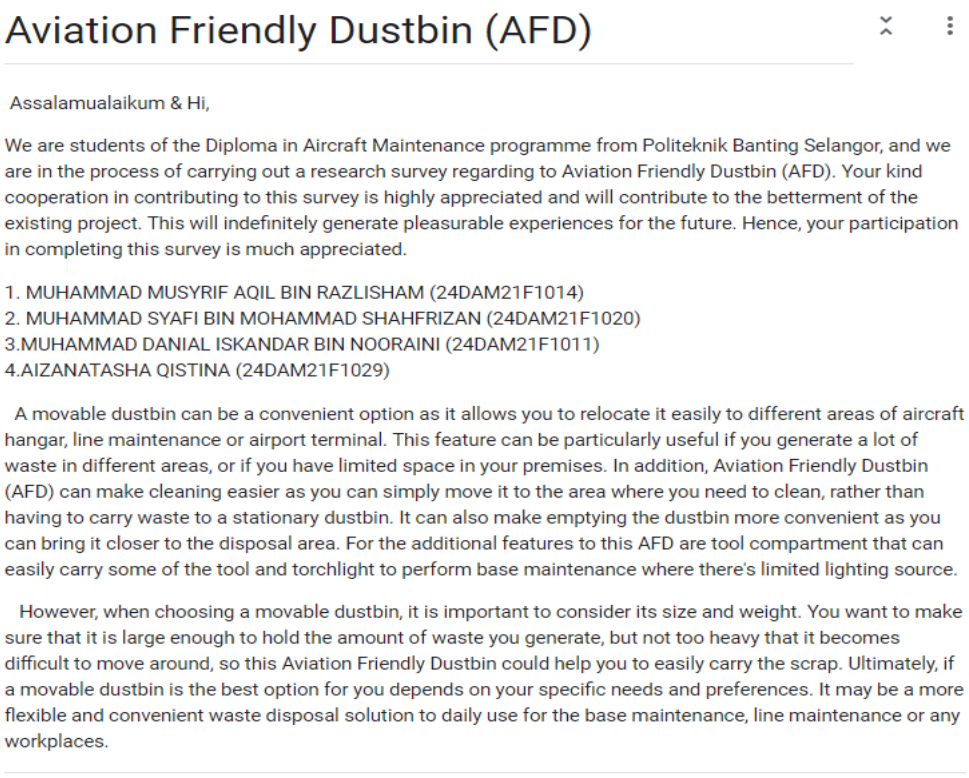
CHAPTER 3

RESEARCH METHODOLOGY

3.1 DESIGN ENGINEERING TOOLS

3.1.1 Design Requirement Analysis

3.1.1.1 Questionnaire Survey



Aviation Friendly Dustbin (AFD)

Assalamualaikum & Hi,

We are students of the Diploma in Aircraft Maintenance programme from Politeknik Banting Selangor, and we are in the process of carrying out a research survey regarding to Aviation Friendly Dustbin (AFD). Your kind cooperation in contributing to this survey is highly appreciated and will contribute to the betterment of the existing project. This will indefinitely generate pleasurable experiences for the future. Hence, your participation in completing this survey is much appreciated.

1. MUHAMMAD MUSYRIF AQIL BIN RAZLISHAM (24DAM21F1014)
2. MUHAMMAD SYAFI BIN MOHAMMAD SHAHFRIZAN (24DAM21F1020)
3.MUHAMMAD DANIAL ISKANDAR BIN NOORAINI (24DAM21F1011)
4.AIZANATASHA QISTINA (24DAM21F1029)

A movable dustbin can be a convenient option as it allows you to relocate it easily to different areas of aircraft hangar, line maintenance or airport terminal. This feature can be particularly useful if you generate a lot of waste in different areas, or if you have limited space in your premises. In addition, Aviation Friendly Dustbin (AFD) can make cleaning easier as you can simply move it to the area where you need to clean, rather than having to carry waste to a stationary dustbin. It can also make emptying the dustbin more convenient as you can bring it closer to the disposal area. For the additional features to this AFD are tool compartment that can easily carry some of the tool and torchlight to perform base maintenance where there's limited lighting source.

However, when choosing a movable dustbin, it is important to consider its size and weight. You want to make sure that it is large enough to hold the amount of waste you generate, but not too heavy that it becomes difficult to move around, so this Aviation Friendly Dustbin could help you to easily carry the scrap. Ultimately, if a movable dustbin is the best option for you depends on your specific needs and preferences. It may be a more flexible and convenient waste disposal solution to daily use for the base maintenance, line maintenance or any workplaces.

Figure 3.1 Questionnaire survey through Google Form

There were FOUR (4) distinct sections to the survey, which was administered via Google Form.

- PART A Respondent Demographic
- PART B User Experience
- PART C Problem Faced By User
- PART D Product Improvement

The survey was sent to Banting Polytechnic, Selangor students enrolled in Semester 5 Session 1: 2023/2024 as well as Licenced Aircraft Maintenance Technicians and Engineers.

3.1.1.2 Pareto Diagram

Features	Frequency	Cummulative Percentage	Pareto Baseline
Movability	12	21%	80%
Cleanliness	13	45%	80%
Other Functions & Usage	9	61%	80%
Compactible	5	70%	80%
Reducing Contamination & Pollution	10	88%	80%
Durability	7	100%	80%
GRAND TOTAL	56		

Figure 3.2 Pareto Data extracted from survey response

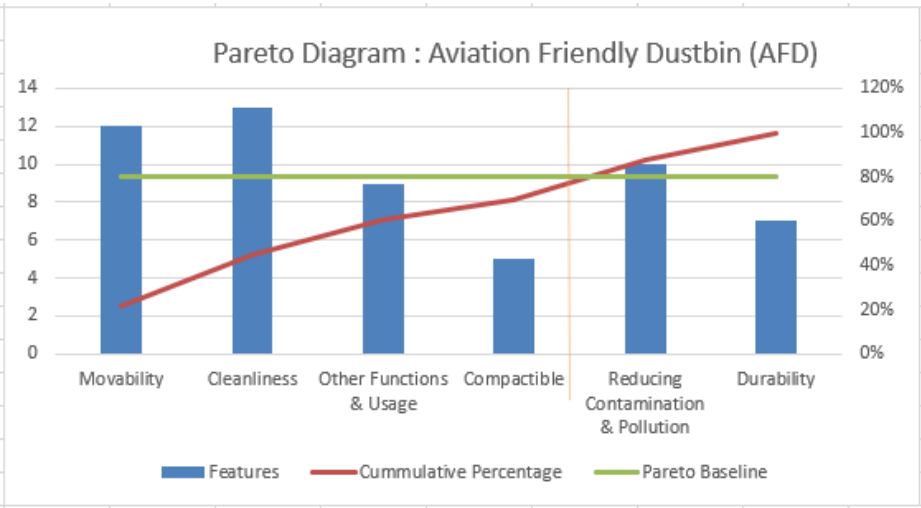


Figure 3.3 Pareto Diagram of AFD

3.1.2 DESIGN CONCEPT GENERATION

3.1.2.1 Function Tree

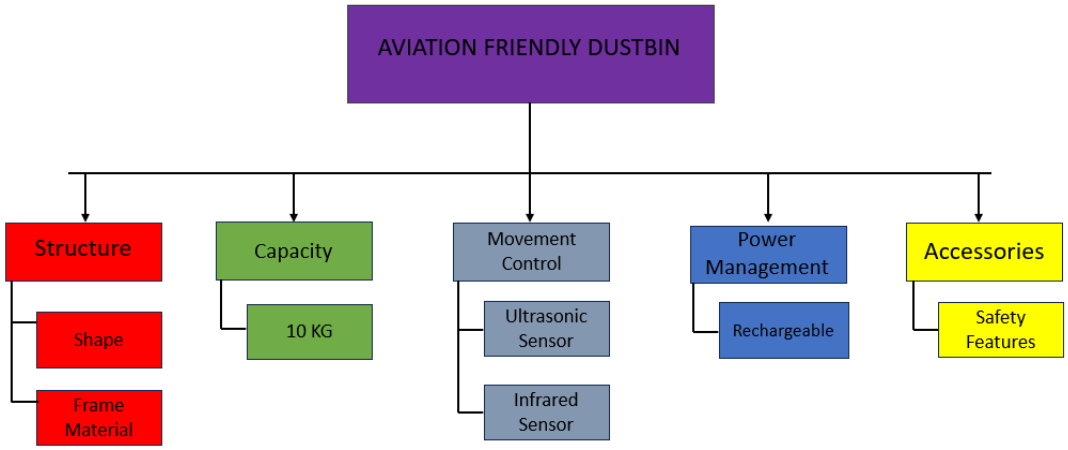


Figure 3.4 Function Tree of AFD

The process of creating a function tree for AFD starts the design concept generation after the Google Survey Form result has been analysed. The process of developing a product is divided into a number of functions, each of which has sub-functions.

3.1.2.2 Morphological Matrix

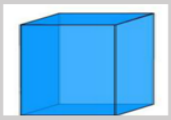
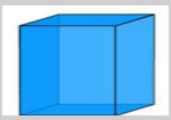
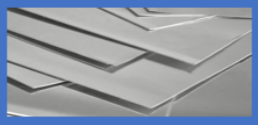
FUNCTION	CONCEPT 1	CONCEPT 2	CONCEPT 3
STRUCTURE (SHAPE)	 Rectangular	 Cube	 Rectangular
MATERIAL	 Acrylic Board	 Impra board	 Aluminium
MOBILITY	 Wheels	 Rubber Track	 Wheels

Table 3.1 Morphological Matrix of AFD

3.1.2.3 Proposed Design Concept 1

FEATURES/FUNCTION	IDEATION	JUSTIFICATION
MOBILITY	WHEELS	LARGE AND FLEXIBLE TO CARRY SCRAP AND STUFF
CAPACITY	10 KG	ENOUGH TO CARRY SCRAP OR TRASH
DESIGN	RECTANGULAR SHAPE	STABLE TO MOVE AND CARRY THINGS

MATERIAL	**ACRYLIC BOARD**	**USING HARD PLASTIC TO ENSURE EVERYTHING BEING CARRY SAFELY**
SIZE	**100CM x 120CM x 50CM**	**ENOUGH SPACE TO CARRY THINGS**
ACCESSORIES	**WARNING LIGHT (INDICATOR), RUBBER GUARD, PLACARD, REFLECTIVE TAPE, TORCHLIGHT, TOOL COMPARTMENT**	**· WARNING LIGHT: TO GIVE INDICATION.** **· RUBBER GUARD: TO MAKE SURE THERE IS NO DAMAGE TOWARD THE PROJECT AND SURROUNDING.** **· PLACARD: TO WARN THE PEOPLE AROUND IT** **· REFLECTIVE TAPE: EASY TO SEE IN THE DARK.** **· TORCHLIGHT: USE DURING MAINTENANCE AT DARK AREA.** **· TOOL COMPARTMENT: TO STORE TOOLS TEMPORARY.**

COLOUR	YELLOW AND BLACK	EASY TO SEE AND EASY TO NOTICE
NUMBER OF COMPARTMENT	2	TO PUT DIFFERENTS THINGS

Table 3.2 Proposed Design Concept 1

3.1.2.4 Proposed Design Concept 2

FEATURES/FUNCTION	IDEATION	JUSTIFICATION
MOBILITY	RUBBER TRACKS	MORE CONTACT AREA NO FLAT TIRE ISSUE
CAPACITY	15 KG	SUITABLE FOR SCRAP AND TRASHES
DESIGN	CUBE	BETTER STABILITY DUE TO LOW CENTER GRAVITI
MATERIAL	IMPRABOARD	IMPACT RESISTENT AND LIGHTWEIGHT
SIZE	100CM x 50CM x 100CM	ENOUGH SPACE TO CARRY THINGS

ACCESSORIES	**WARNING LIGHT (INDICATOR), RUBBER GUARD, PLACARD, REFLECTIVE TAPE, TORCHLIGHT, TOOL COMPARTMENT**	• **WARNING LIGHT: TO GIVE INDICATION.** • **RUBBER GUARD: TO MAKESURE THERE IS NO DAMAGE TOWARD THE PROJECT AND SURROUNDING.** • **PLACARD: TO WARN THE PEOPLE AROUND IT** • **REFLECTIVE TAPE: EASY TO SEE IN THE DARK.** • **TORCHLIGHT: USE DURING MAINTENANCE AT DARK AREA.** • **TOOL COMPARTMENT: TO STORE TOOLS TEMPORARY.**
COLOUR	**ORANGE**	**BRIGHT AND NOTICEABLE COLOUR**
NUMBER OF COMPARTMENT	**3**	**ABLE PUT DIFFERENTS THINGS**

Table 3.3 Proposed Design Concept 2

3.1.2.5 Proposed Design Concept 3

FEATURES/FUNCTION	IDEATION	JUSTIFICATION
MOBILITY	WHEELS	EASY TO MOVE
CAPACITY	10 KG	ENOUGH TO CARRY RUBBISH AND TRASH
DESIGN	RECTANGULAR SHAPE	MORE STABLE
MATERIAL	ALUMINIUM	RESISTANT TO CORROSION
SIZE	100CM x 70CM x 120CM	ENOUGH SPACE TO CARRY THINGS
ACCESSORIES	WARNING LIGHT (INDICATOR), RUBBER GUARD, PLACARD, REFLECTIVE TAPE, TORCHLIGHT, TOOL COMPARTMENT	· WARNING LIGHT: TO GIVE INDICATION. · RUBBER GUARD: TO MAKE SURE THERE IS NO DAMAGE TOWARD THE PROJECT AND SURROUNDING. · PLACARD: TO WARN THE PEOPLE AROUND IT · REFLECTIVE TAPE: EASY TO SEE IN THE DARK. · TORCHLIGHT: USE DURING MAINTENANCE AT DARK AREA. · TOOL COMPARTMENT: TO STORE TOOLS TEMPORARY.

COLOUR	GREY	EASY TO KNOW THE DUSTBIN
NUMBER OF COMPARTMENT	2	CAN EASILY DIVIDE TRASH PART AND TOOLS PART

Table 3.4 Proposed Design Concept 3

3.1.2.7 Accepted vs Discarded Solution

FEATURES/FUNCTION	IDEATION	JUSTIFICATION
MOBILTY	WHEELS	LARGE AND FLEXIBLE TO CARRY SCRAP AND STUFF
CAPACITY	10 KG	ENOUGH TO CARRY SCRAP OR TRASH
DESIGN	RECTANGULAR SHAPE	STABLE TO MOVE AND CARRY THINGS
MATERIAL	PLASTIC	USING HARD PLASTIC TO ENSURE EVERYTHING BEING CARRY SAFELY
SIZE	100CM x 120CM x 50CM	ENOUGH SPACE TO CARRY THINGS

ACCESSORIES	WARNING LIGHT (INDICATOR), RUBBER GUARD, PLACARD, REFLECTIVE TAPE, TORCHLIGHT, TOOL COMPARTMENT	· WARNING LIGHT: TO GIVE INDICATION. · RUBBER GUARD: TO MAKE SURE THERE IS NO DAMAGE TOWARD THE PROJECT AND SURROUNDING. · PLACARD: TO WARN THE PEOPLE AROUND IT · REFLECTIVE TAPE: EASY TO SEE IN THE DARK. · TORCHLIGHT: USE DURING MAINTENANCE AT DARK AREA. · TOOL COMPARTMENT: TO STORE TOOLS TEMPORARY.
COLOUR	YELLOW AND BLACK	EASY TO SEE AND EASY TO NOTICE
NUMBER OF COMPARTMENT	3	TO PUT DIFFERENTS THINGS

Table 3.5 Accepted Design

After several evaluations, concept 1 has been selected as our main design for the AFD project. With characteristics like large, flexible wheels, a sturdy 10 kilogramme capacity, and a sturdy, 100 cm by 120 cm by 50 cm hard plastic rectangle shape, this clever, mobile scrap and rubbish carrier has been painstakingly created. Selected for its usefulness, the addition of extras that guarantee utility and safety include warning lights, rubber guards, placards, reflective tape, a tool pocket, and a torchlight. The three compartments offer well-organised storage for various

item categories, and the striking black and yellow colour scheme improves visibility and makes it simple to notice. This well-made device is chosen for its adaptability, durability, and mobility, which guarantee effective and secure management of waste and scrap in a variety of settings.

3.1.3 Pugh Matrix

CRITERION	FACTOR	AVIATION FRIENDLY DUSTBIN	CONCEPT 2	CONCEPT 3
MOVABILITY	0.167	D	1	2
CLEANLINESS	0.167		3	3
OTHER FUNCTION AND USAGE	0.167	A	3	3
COMPACTIBLE	0.167	T	1	2
REDUCING CONTAMINATION AND POLLUTION	0.167	U	2	2
DURABILITY	0.167	M	1	1
TOTAL SCORE	1.0		1.84	2.2
RANKING				

Table 3.6 Pugh matrix for AFD design

3.2 PROJECT BRIEFING & RISK ASSESSMENT

This chapter will detail the different steps that were successfully performed in order to achieve the experiment's goals and objectives. These included completing the relevant documents and obtaining supervisor permission. Throughout the duration of the project. Several phases are involved in the manufacturing of hazardous materials such as aluminium sheet and acrylic board. Cutting, riveting, painting, and testing are all part of the process. The team took this safety precaution seriously.

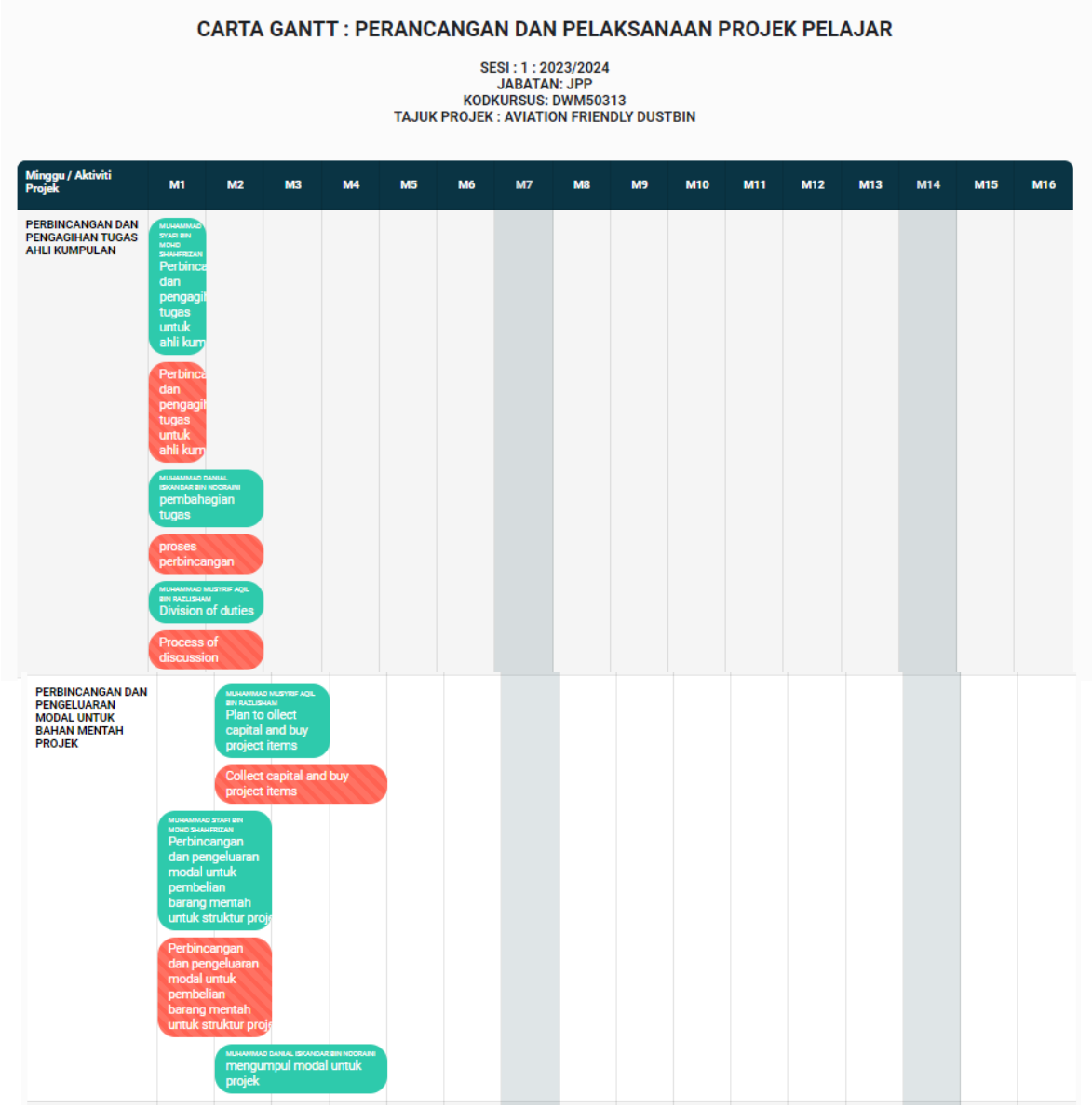
3.2.1 Utilisation of Polytechnic's Facilities

To use all of the facilities supplied by Polytechnic, such as equipment, consumable materials, and tools, permission must be obtained from the supervisor and workshop coordinator by filling out the relevant paperwork. This form will detail the tools and equipment that is being used in order to execute the project.

Our group makes use of the following Polytechnic facilities:

- Workshop 1
- Workshop 2
- Composite Workshop
- Electronic Instrument Lab

3.3 OVERALL PROJECT GANTT CHART



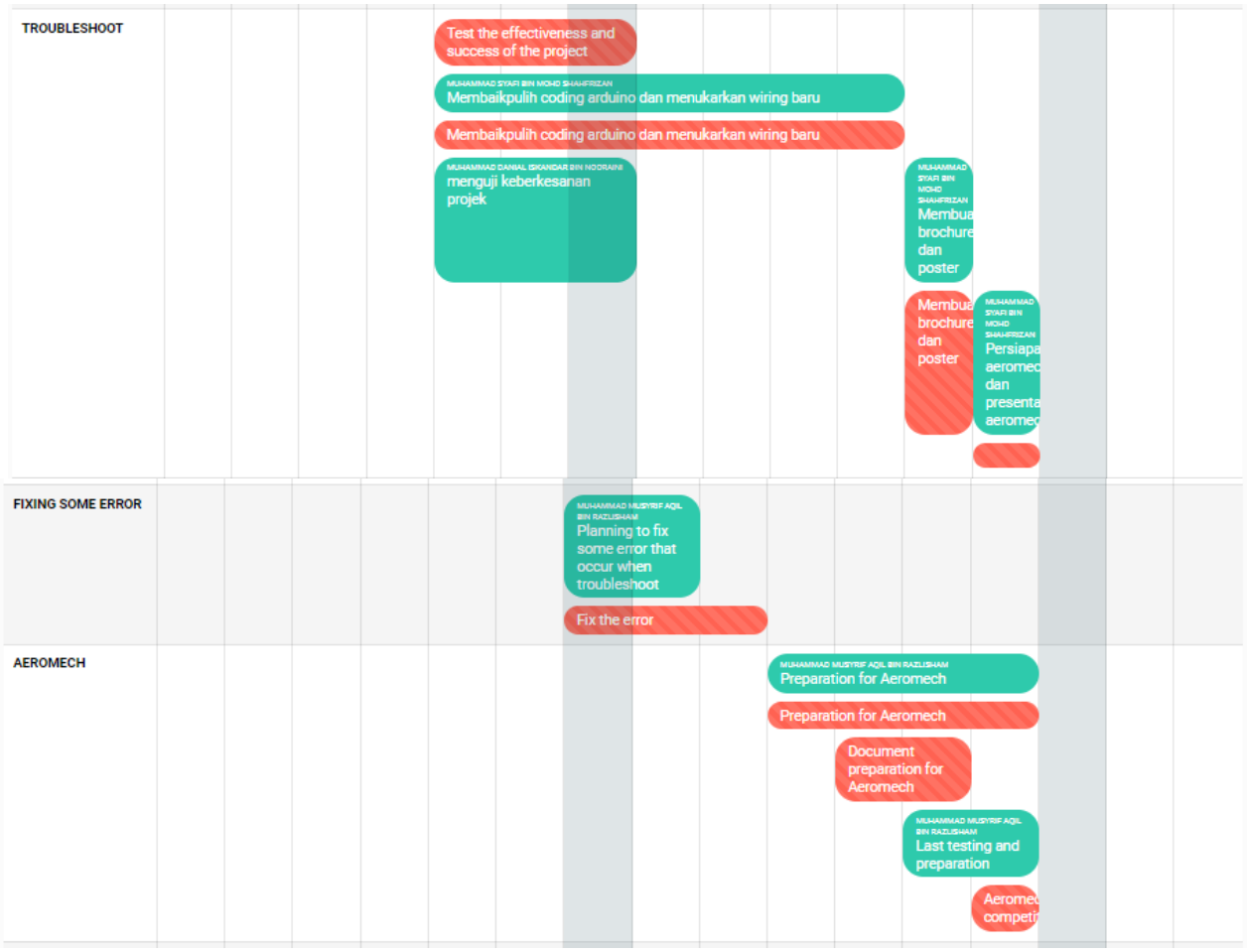


Table 3.7 Project Gantt Chart

3.4 PROJECT FLOW CHART

3.4.1 Overall Project Flow Chart

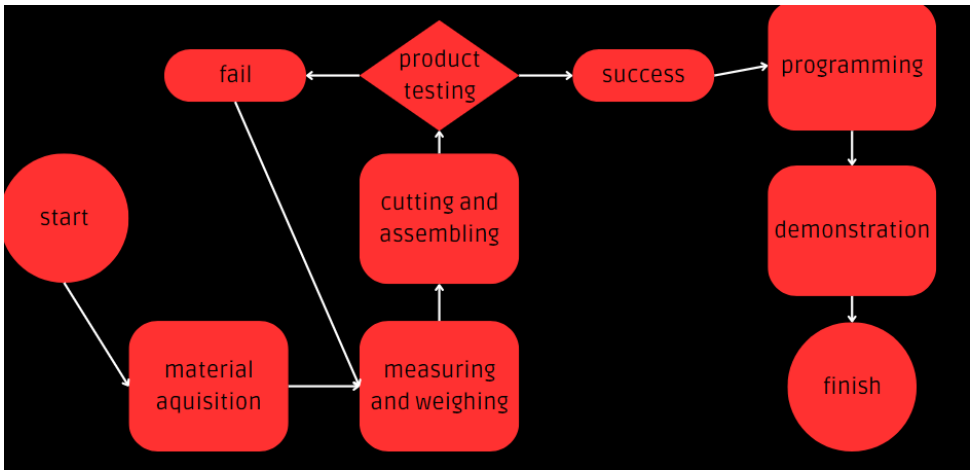


Figure 3.5 Overall Project Flow Chart

3.4.2 SPECIFIC PROJECT DESIGN FLOW CHART / FRAMEWORK:

3.4.2.1 Product Structure

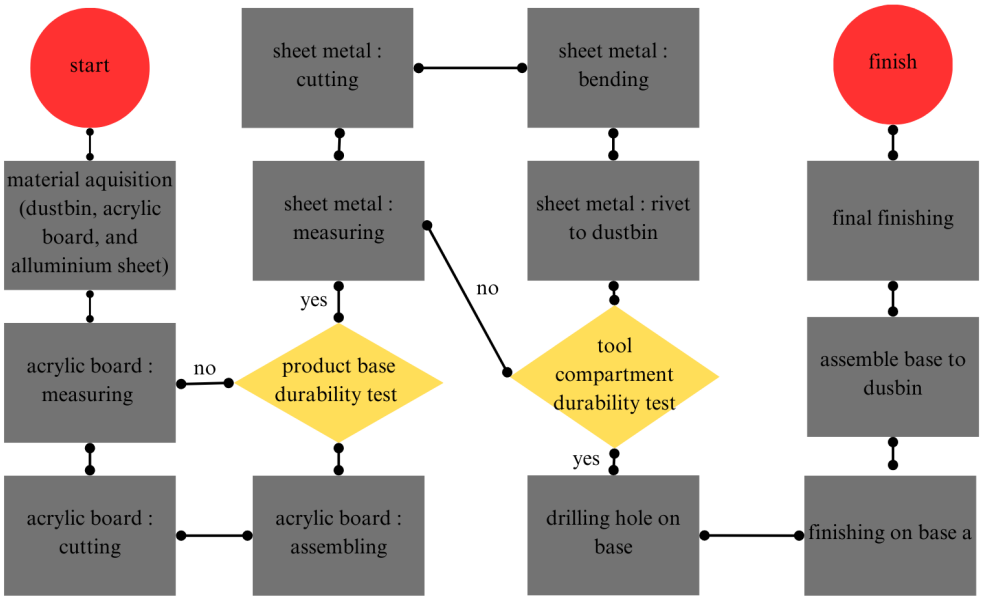


Figure 3.6 Product Structure

3.4.2.2 Product Mechanisms

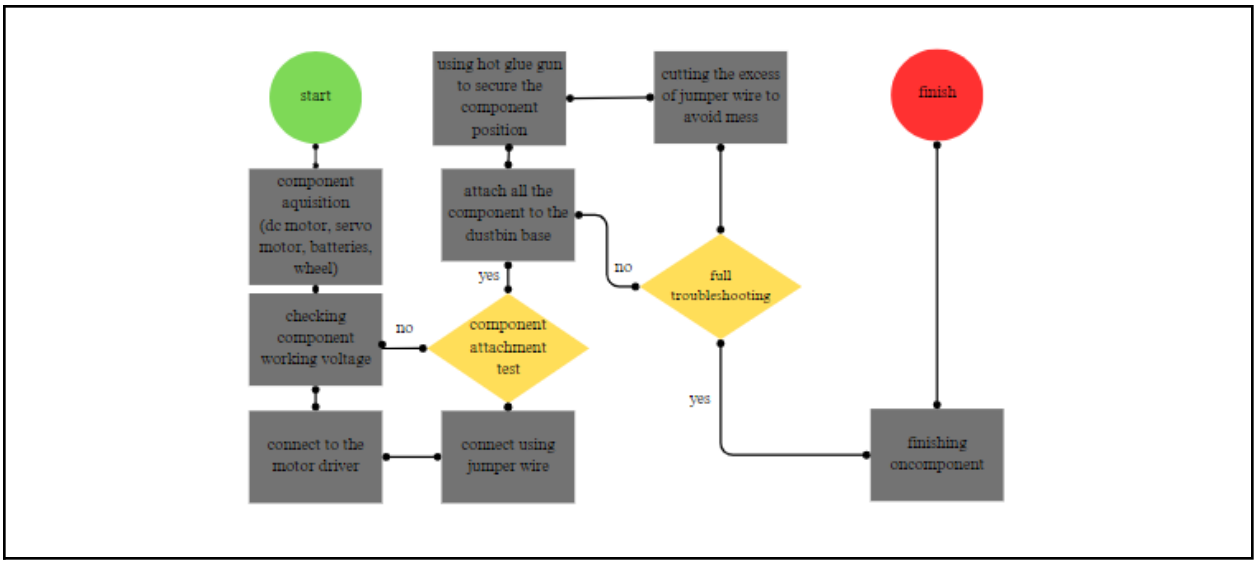


Figure 3.7 Product Mechanisms

3.4.2.3 Electronic/ Programming

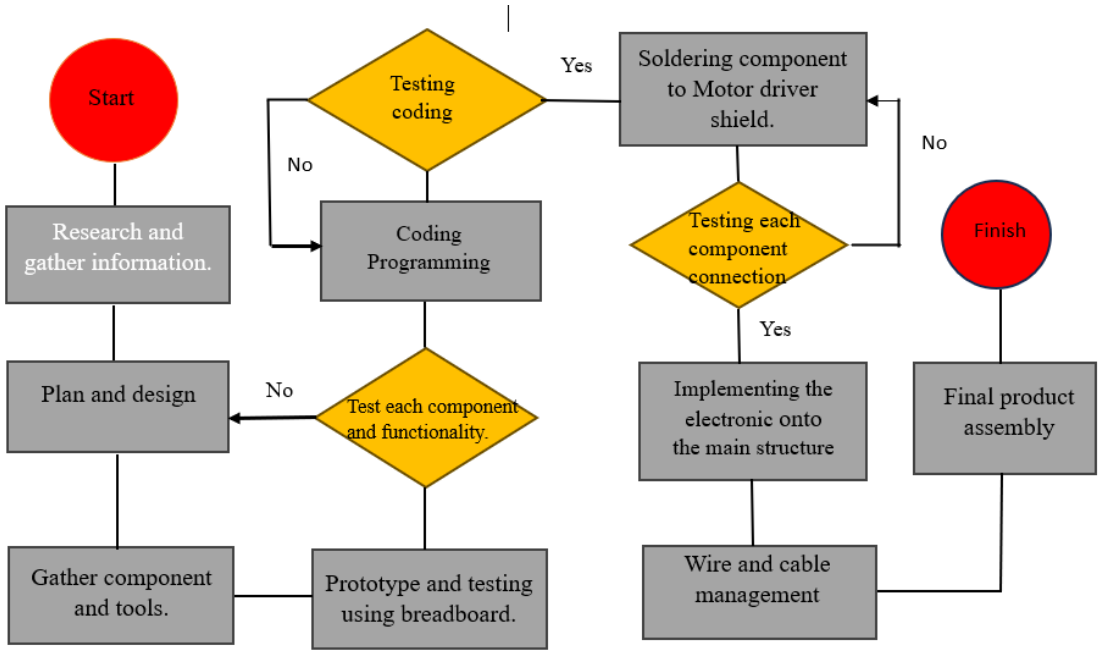


Figure 3.8 Software / Programming

3.4.2.4 Accessories & Finishing

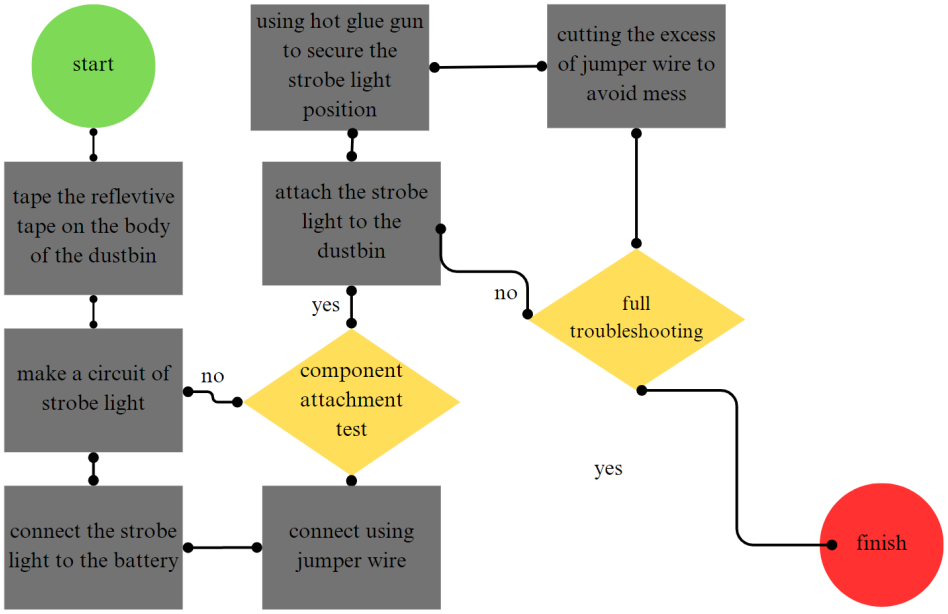


Figure 3.9 Accessories & Finishing

3.5 LIST OF MATERIALS & EXPENDITURES

3.5.1 Product structure				
No.	**Item Details**	**Unit**	**Price/Unit (RM)**	**Total (RM)**
1.	dustbin	1	RM44.20	RM44.20

Table 3.8 List and Expenditures of Product Structure

3.5.2 Product Mechanisms				
No.	**Item Details**	**Unit**	**Price/Unit (RM)**	**Total (RM)**
1.	Servo Motor	1	7.00	7.00
2.	DC Motor (include with wheel)	4	3.88	15.52

Table 3.9 List and Expenditures of Product Mechanism

3.5.3 Product Electronic / Programming				
No.	**Item Details**	**Unit**	**Price/Unit (RM)**	**Total (RM)**
1.	L293D Motor Driver Shield	2	18	36
2.	Infrared Sensor	2	2.90	5.80

Table 3.10 List and Expenditures of Electronic/Programming

3.5.4 Product Accessories & Finishing				
No.	**Item Details**	**Unit**	**Price/Unit (RM)**	**Total (RM)**
1.	Reflective Tape	1	10.12	10.12

Table 3.11 List and Expenditures of Accessories & Finishing

3.6 PRODUCT DRAWING / SCHEMATIC DIAGRAM

3.6.1: General Product Drawing

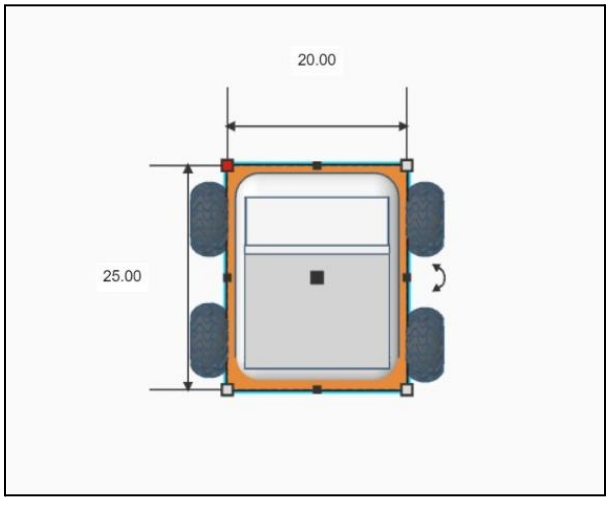


Figure 3.10 Top view of AFD

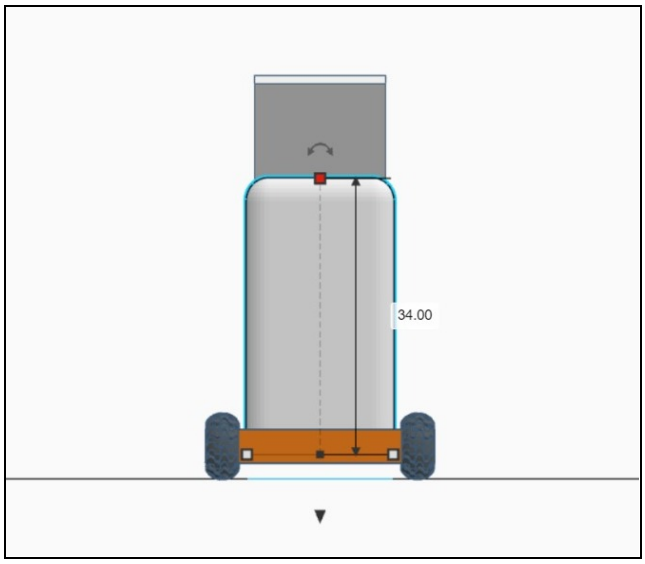


Figure 3.11 Front view of AFD

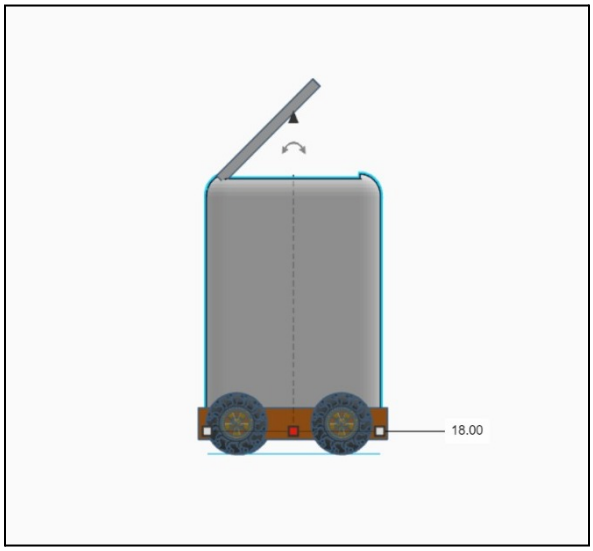


Figure 3.12 Side view of AFD

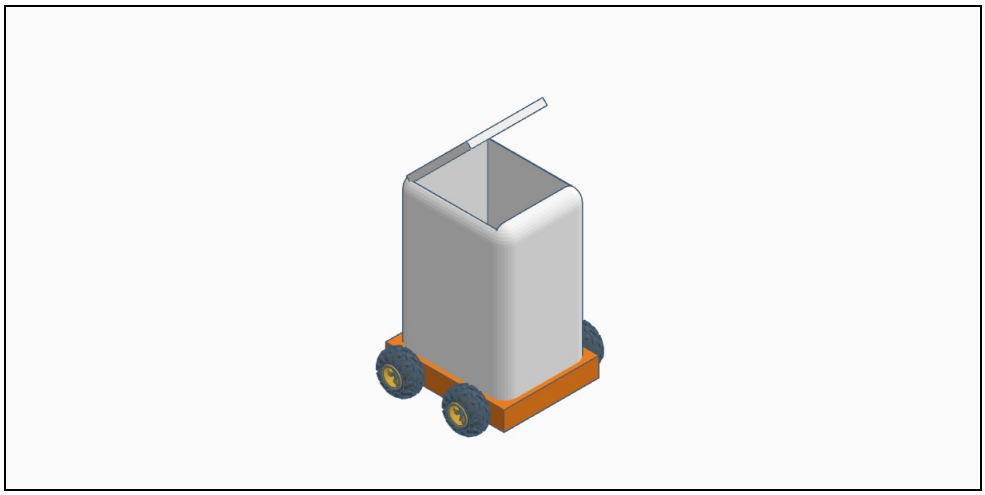


Figure 3.13 Isometric view of AFD

3.6.2: Specific Part Drawing

3.6.2.1 Product Structure

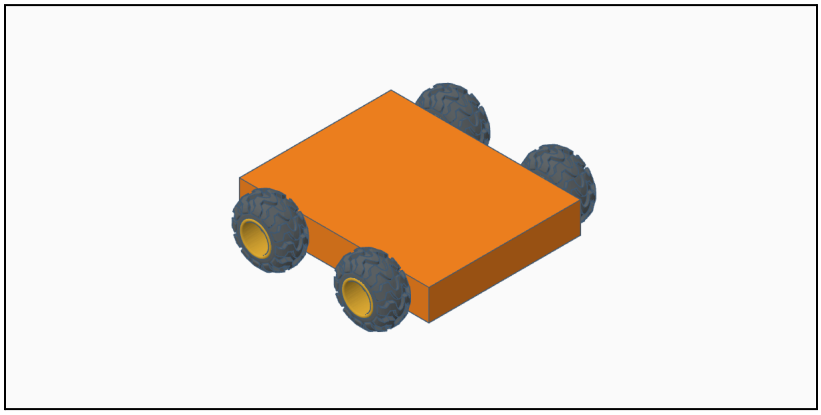


Figure 3.14 Isometric view of product base

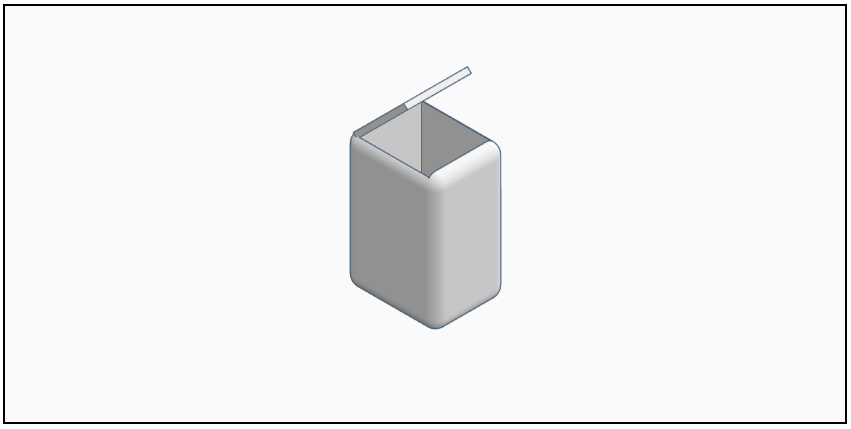


Figure 3.15 Isometric view of product main structure

3.6.2.2 Product Mechanisms

- **DC motor schematic diagram**

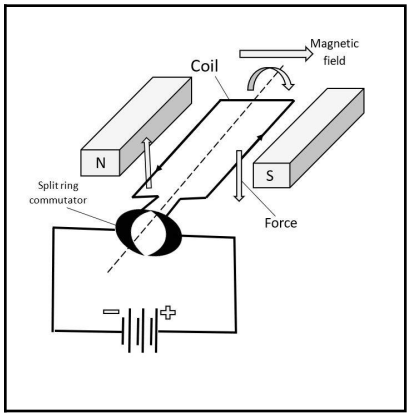


Figure 3.16 Diagram of DC motor (Vendatu.com, 2 December 2023)

- **Servo motor schematic diagram**

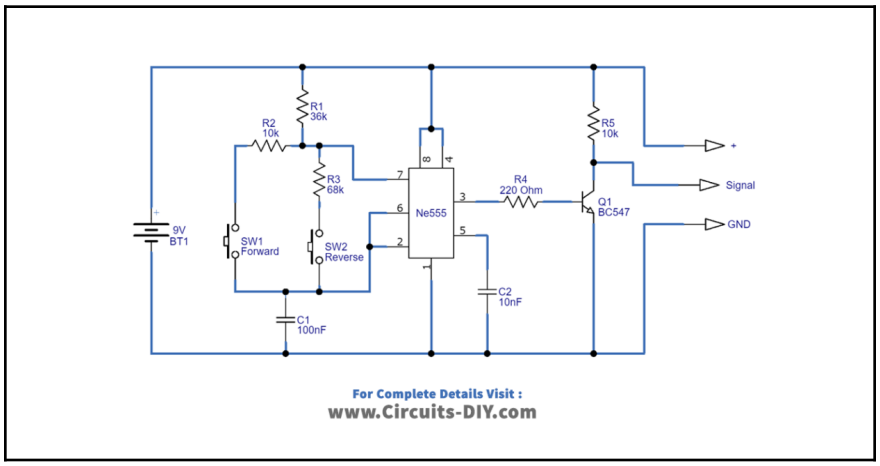


Figure 3.17 Servo Motor Driver Circuit (circuits-diy.com, January 2023)

3.6.2.3 Electronic / Programming

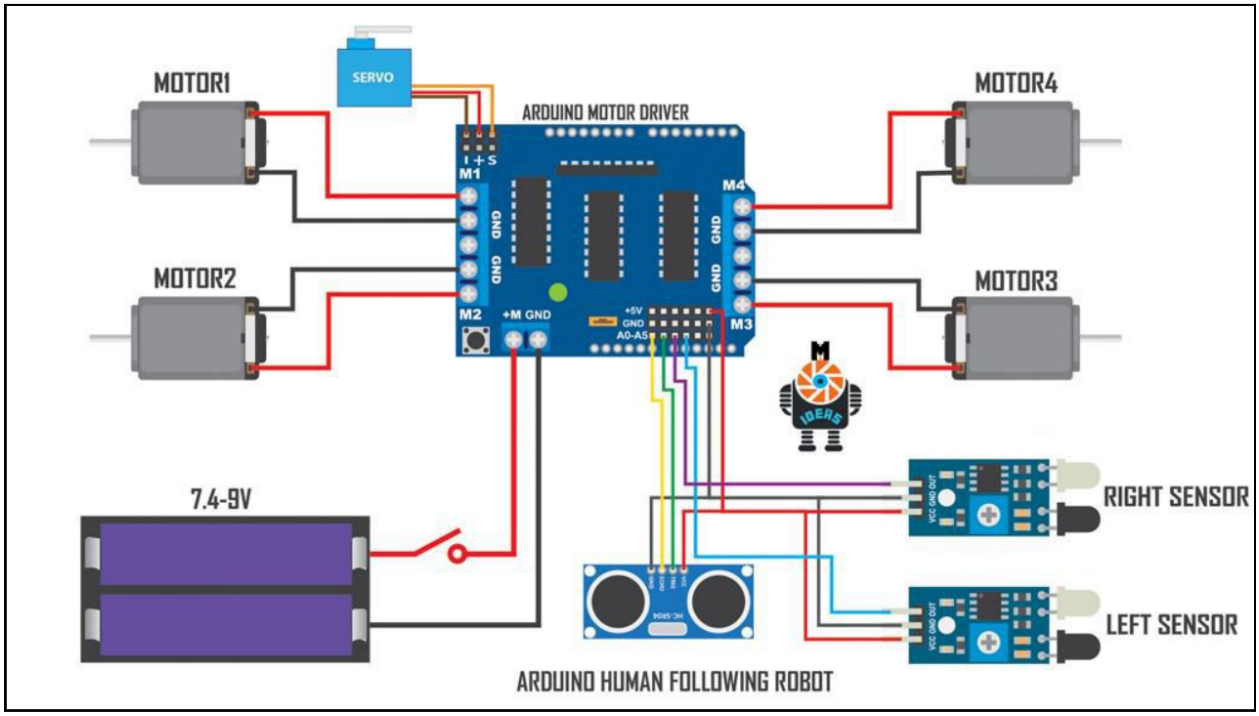


Figure 3.18 Circuit Diagram for AFD

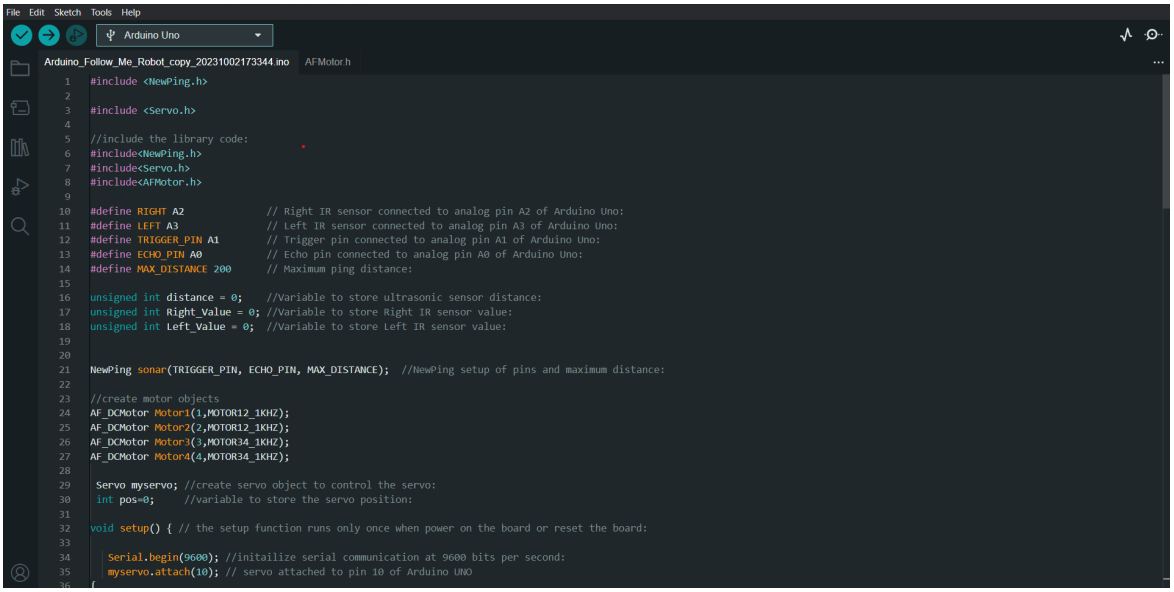
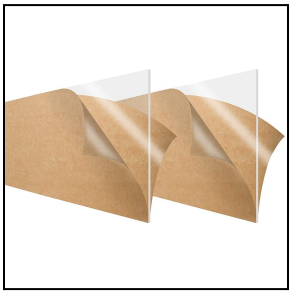


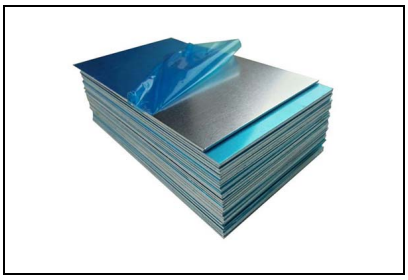
Figure 3.19 Arduino coding for sensors, dc motors and servo motor

3.7 DEVELOPMENT OF PRODUCT

3.7.1 Material Acquisition

3.7.1.1 Base structure of AFD

Material	Description
 Acrylic board	Acrylic board was used for the base of the product and it is also function as place to keep most electronic parts to make sure the electronic parts is safe from any hazard that can make them faulty

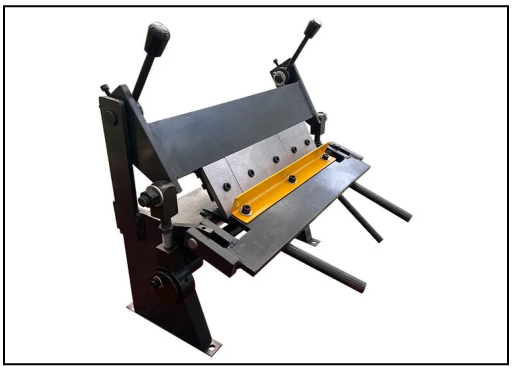
 3003 Aluminum sheet	Aluminium sheet were used for the tools compartment by cutting, bending, and riveting it inside the dustbin
 Blind rivet	Blind rivet or pop rivet were used to rivet the tools compartment which is the aluminium sheet to the dustbin
	The dustbin is the main structure of the product

Dustbin	
 Hinge	Hinge were used to attach the top part of the acrylic board base so that it can be open for easy access to the electronic parts

Table 3.12 List of Base Structure of AFD

3.7.2 Machines and Tools

Material	Description
	Used to cut some of the material which is acrylic board, turn it into the base of the dustbin.

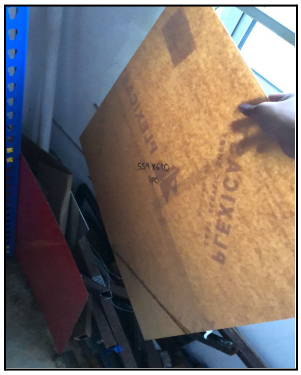
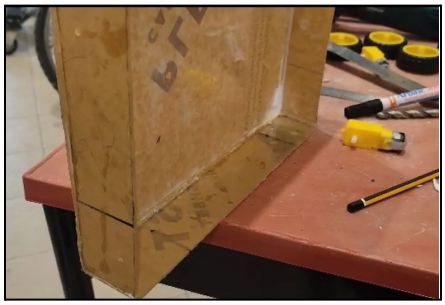
	Being used to rivet the pop rivet in the making of the tool compartment, it is pneumatically powered.
	Used to drill holes at the dustbin and the base of the dustbin.
	Used to shape the tool compartment sheet metal after done cutting.

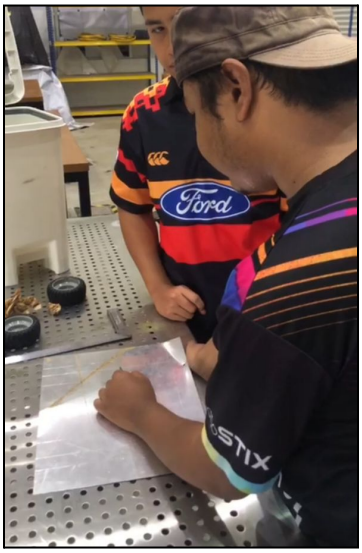
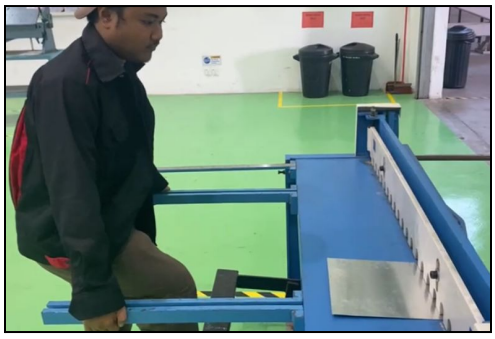
	Have been used to cut sheet metal in the making of the tool compartment that has been attached inside the dustbin.
	Soldering set was used to solder some of the electronics components.

Table 3.13 List of Machines and Tools

3.7.3 SPECIFIC PROJECT FABRICATION

3.7.3.1 Phase 1 (Base Structure):

No	Process	Description
1.	 Material acquisition	The acrylic board is salvage from the project workshop.
2.	 Material cutting	The acrylic board is cutted according to the measurement that have been made. The measurement were marked using masking tape.
3.	 board assembling	The acrylic board was assemble and attach to each other using acrylic sealant.

4.	 Drilling hole for wheels	Cordless drill was used to drill hole on the acrylic for the wheels hole.
5.	 Aluminum sheet measuring and marking	L square ruler was used to measure the needed measurement and marked using marker pen to make the marking more visible.
6.	 Aluminum sheet cutting	The process of cutting the aluminum sheet is done by using cutting machine after completion of measuring and marking.

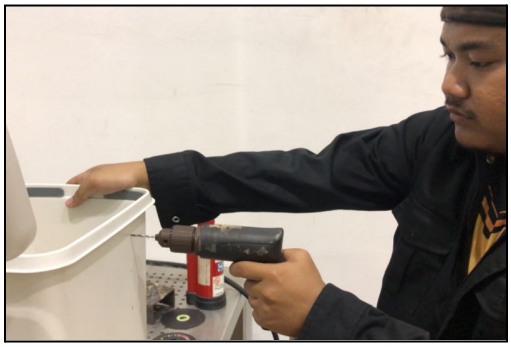
7.	 Aluminum sheet bending	Bending machine was used to bend the cutted aluminum sheet according to the 90 degree angle.
8.	 Drilling hole on structure	Structure was drilled using pneumatic powered drill to make hole for riveting the aluminum sheet to the dustbin.
9.	 Riveting aluminum sheet	The aluminum sheet that has been cutted and bent was riveted to the dustbin using pop rivet and pneumatic powered rivet gun.

Table 3.14 Process of Product Stucture AFD

3.7.3.2 Phase 2 (Accessories & Mechanisms):

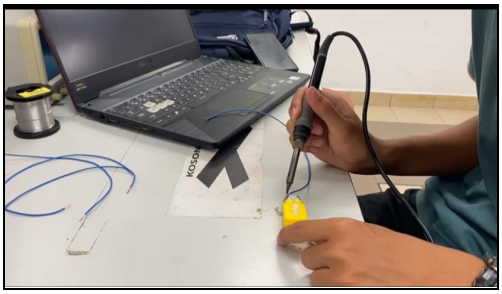
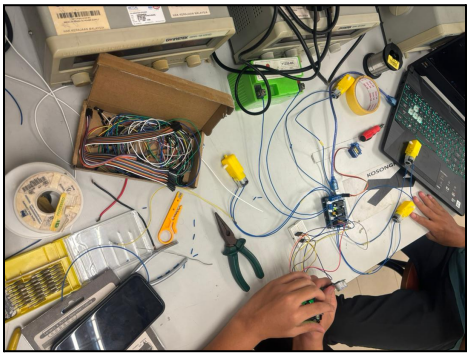
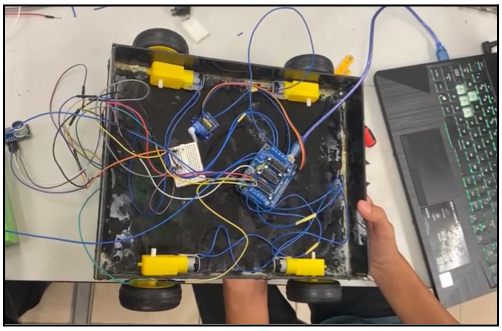
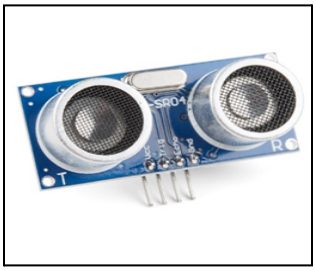
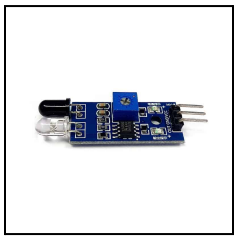
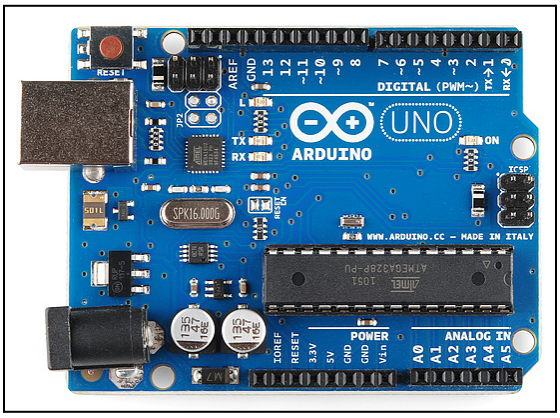
No	Process	Description
1.		Process to solder the jumper wire to the DC motor, there are 4 of it. After done soldering, went to testing one by one either it function or not.
2.		Performing the process to attach all the component to the motor driver and arduino. This process include DC motor, Servo motor, Ultra-sonic sensor and IR sensor.
3.		For the last task, all the components were being attach to the base structure of the AFD. Troubleshooting was also done after everything in a good condition.

Table 3.15 Process of Mechanism of AFD

3.7.3.3 Phase 3 (Electronic / Programming):

Material	Description
 HC-SR04 Ultrasonic Sensor	Use ultrasonic waves to measure distance. An ultrasonic wave is emitted by the sensor head, which then receives the wave reflected back from the target.
 Infrared Sensor	Generates an electric signal after detecting infrared radiation in its surroundings. In addition to measuring an object's heat, an infrared sensor may detect movement.
 Arduino UNO R3	Use so that it can program the coding that has been uploaded.

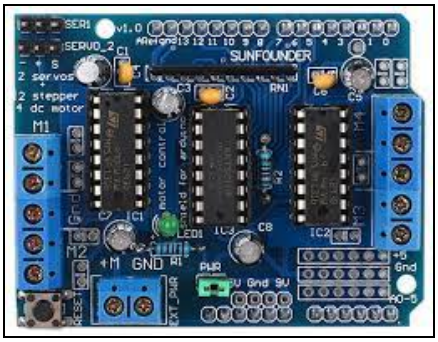
 L293D Motor Driver Shield	Use to run 4 dc motor and servo motor
 Jumper Wire	Use to jump the circuit to the electrical circuit by attaching a jumper wire to it.
 Arduino IDE	Use to upload coding to Arduino Uno R3 Board

Table 3.16 Process of Electronic/Programming of AFD

3.7.3.4 Phase 4 (Finishing):

Product	Description
	Cleaning the surface area where the reflective tape was to be applied was the first step in installing it on the AFD. To get rid of all the dust, the area was carefully cleaned. After that, scissors were used to measure and cut the reflective tape to the proper size. I made sure the tape was applied smoothly and firmly by carefully peeling off the backing and placing it on the indicated parts of the dustbin's surface. After the reflective tape was firmly attached, I smoothed down any wrinkles or air bubbles to ensure a consistent look.After installation, the reflective tape boosted the AFD's visibility and made it easier to see in high-traffic or low-light situations, improving both safety and recognition.
	Once the best placement had been established, the area needed to be cleaned and the required instruments acquired in order to guarantee a secure attachment. A stable electrical connection was ensured by connecting the wires in accordance with the light's specifications. The strobe light fixture was firmly installed in the designated location on the dustbin after the wiring was installed. Testing was done. The strobe light underwent satisfactory testing and was then set to go.
	The surface had to be prepared before the acrylic board could be finished or sprayed. After that, the board was set up on a level surface in an area with enough ventilation to reduce fumes.Next, I moved the paint can side to side to create even coverage while holding it 6 to 8 inches away from the board and spraying the paint with even, smooth strokes. I applied the first layer and let it fully dry before adding further coats as needed to achieve the desired opacity. The acrylic board had a smooth and vibrant finish when the paint had completely dried, ready for use

Table 3.17 Process of Finishing of AFD

3.8 PRODUCT TESTING / FUNCTIONALITY TEST

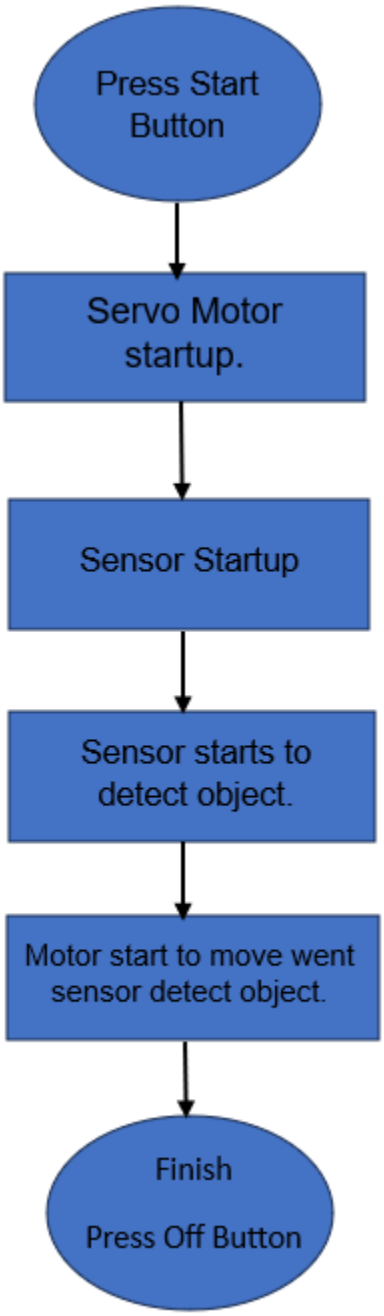


Figure 3.18 Flow chart of AFD functionality

CHAPTER 4

RESULT & DISCUSSION

4.1 PRODUCT DESCRIPTION

4.1.1 General Product Features & Functionalities

Aviation Friendly Dustbin also known as AFD is a smart dustbin that is capable of moving by itself by using sensors to detect its user in front of it. AFD also has its own tool compartment for small to medium size tools.

The purpose of AFD is to ease maintenance personnel work to dispose FOD when working on aircraft maintenance. Compared to dustbins, which are used on a daily basis to dispose of odd objects and trash, this device is an upgrade. The primary objective of this device is to facilitate cleaning by eliminating the need to transport waste to a stationary trash can and instead allowing it to be moved directly to the area that needs cleaning. Moving the dustbin closer to the disposal site might make emptying it more convenient.

Finally, the product has a container for the tools. This AFD's added function allows it to easily hold a certain amount of tools that will help workers who are doing base maintenance.

4.1.2 Specific Part Features

4.1.2.1 Product Structure

The structure of the AFD is made from various functions. Some of it consist of a tools compartment, acrylic board for the base and a place to keep the electronic parts.

The tools compartment which is made from aluminium sheet are made to be strong enough to withstand the weight of the tools needed for the specific task.

Lastly is the acrylic board that is made into a cuboid shape to be the base of the AFD. This acrylic board is also used as a place to keep an electronic compartment because it is safe from any FOD or any hazard that can damage the electronic parts.

4.1.2.2 Product Mechanisms

The crucial part in this product mechanism is the DC motor and the Servo motor. Energy-Consumptive DC Motors variable speed DC motors with high performance and energy efficiency. This feature could optimise energy consumption for sustainable and economical use, and facilitates efficient and controlled waste disposal operations.

4.1.2.3 Electronic / Programming

The electronics in AFD are made up of a number of sensors , arduino board and a motor driver shield that are crucial for the AFD to function.

These sensors include HC-SR04 Ultrasonic sensor so that it can detect the distance the object and AFD and Infrared sensor can both detect motion and measure the object's heat.

Lastly, the dustbin's electrical system is provided by an Arduino UNO R3 board. This is because it is capable of performing a wide range of tasks and duties with ease. It also acts as the primary nervous system of the system, instructing the different components and sensors to do their designated tasks.

4.1.2.4 Accessories & Finishing

The functioning of the AFD is improved in a number of ways by the addition of accessories like strobe lights and reflective tape. The dustbin's visibility is improved by the reflective tape, particularly in low-light conditions and regions with heavy traffic. It makes sure the AFD is conspicuous, which facilitates easy detection and location for both people and

vehicles. However, the strobe light functions as a visual alert system that turns on when the trash fills up or needs maintenance. This light's sporadic flashing acts as a clear indicator, alerting users and maintenance staff to take immediate action.By supplying instantly identifiable signs for necessary care, these accessories not only increase the smart dustbin's visibility and safety but also simplify maintenance operations.

4.1.3 General Operation of the AFD

An array of sensors and motors is included in the intelligent moveable dustbin to enable effective obstacle identification and navigation. When the system is powered on, the microcontroller is turned on and the infrared and ultrasonic sensors are set up. These sensors are moved by a servo motor, which looks for obstructions in their path. Whereas the infrared sensor looks for impediments within a specific range, the ultrasonic sensor gauges the distance between the trashcan and surrounding objects. When the microprocessor detects an obstruction, it interprets the sensor data and instructs the DC motor to move the dustbin in the appropriate direction.

Furthermore, The servo motor continuously modifies the sensor position to scan for obstacles during navigation, and the movement is decided by the obstacle's location. The system uses decision-making logic to determine the best route and avoid barriers. When the dustbin is idle, it waits for more orders or sensor events. It also has power management functions that save battery life by turning off or dimming components when not in use. This all-encompassing design guarantees the smart moveable dustbin's efficient and independent operation in a variety of settings.

4.1.4 Operation of the Specific Part of the Product

4.1.4.1 Product Structure

The dustbin has a convenient and unique structure that improves the user experience. Its automatic lid opens with a spring system, removing the need for manual effort. This feature not only makes it easier to access the bin, but it also eliminates the need for people to physically hold the lid open. Furthermore, the glass base is cleverly designed with a hinged top that allows simple access to the interior. This design is also important because it allows access to the electronic components hidden beneath the base, demonstrating a careful and practical approach to the dustbin's performance.

4.1.4.2 Product Mechanisms

This AFD use 4 DC motor that could drive it all the way through the operation period, and theres also a Servo motor that functions as a head of the AFD that should move within a distance of 180 degrees in front of the AFD. Both of this motor helps the AFD to operate efficiently as it should. The DC motors speed limit are 5km/h to 7km/h depending on the current weight it carry.

4.1.4.3 Electronic/ Programming

AFD is using sensors, motor driver shield and arduino uno to work properly. First is the sensor, AFD using an ultrasonic sensor which functions to utilise ultrasonic sound waves to calculate the distance to an item. An ultrasonic sensor transmits and receives ultrasonic pulses using a transducer to determine the proximity of an item. Furthermore, it is using 2 infrared sensors for each side. The function is the same for both sensors to detect motion and measure the object heat.

Motor driver shield that is used in AFD is named L293D motor driver shield; its function is intended to regulate the motion of stepper motors or DC motors. The L293D Motor Driver Shield increases the adaptability and simplicity of implementation in a range of electrical projects by providing an effective and small solution for motor control applications. It does this by controlling motor speed and directional also the motor driver shield is attached to Arduino UNO board

4.1.4.4 Accessories & Finishing

The AFD works by utilising a number of integrated features that maximise its efficiency. Initially, sensors are used to identify when the dustbin is getting close to its capacity level or to detect incoming waste. The system starts a recognition process to assess the filling level upon waste detection. High-visibility reflective tape is used to increase visibility, particularly in low-light or busy areas, so that both cars and pedestrians can clearly see the garbage.

The device sends out an alarm when the AFD gets close to filling up or needs repair. A strobe light is activated to visually represent this alert. It flashes periodically, giving forth a clear notice that something is full or that repair is required. This is a fast signal for users and maintenance staff to respond. The strobe light and reflective tape make it simple for users to determine the condition of the dustbin, alerting them when the dustbin is area them and avoid collision in busy or packed situations .

In addition to their primary function, the reflective tape and strobe light warn maintenance staff. These visual cues let maintenance crews identify which particular AFD needs maintenance. The mechanism resets itself after the required action, like emptying or maintenance, is completed. The dustbin returns to its regular operating mode, ready to detect and accept garbage, and the strobe light stops blinking.

The AFD remains vigilant throughout its working cycle by keeping an eye on its surroundings. In order to optimise the waste management process and raise overall operational efficiency, the reflective tape and strobe light continue to be essential elements that guarantee visibility and alert capabilities.

4.2 PRODUCT OUTPUT ANALYSIS

Table 4.1 PRODUCT OUTPUT ANALYSIS

NO	PARAMETERS	RESULTS	REMARKS/DESCRIPTION	ANALYSIS
1.0	SPEED LIMIT			
1.1	Speed limit (Unloaded)	5 Km/H	The fastest speed an AFD can go when unloading	When empty, the Aviation Friendly Dustbin (AFD) can travel up to 5 km/h in terms of speed limit. Nevertheless, under FULL load conditions, its speed capability will decrease by up to 67%.
1.2	Speed limit (Partially Load)	4 Km/H	A maximum speed an AFD can go during 50% load	
1.3	Speed limit (Fully Load)	2 Km/H	The fastest speed at which an AFD may operate while fully loaded	

NO	PARAMETERS	RESULTS	REMARKS/DESCRIPTION	ANALYSIS
2.0	OPERATION			
2.1	Max time	1 Hours 30 Minutes	The maximum time that AFD can operate	The AFD is rechargeable

2.2	Weight/Load	3.5 Kg	The weight of AFD	The weight of AFD is 3.5 Kg
2.3	Turning Radius	180 Degrees	This is the maximum turning radius of AFD	The maximum turning radius is 180 degrees of AFD
2.4	Capacity	10 Kg	The maximum capacity that AFD can carry.	The maximum capacity AFD can carry is 10 Kg

4.3 ANALYSIS OF PROBLEM ENCOUNTERED & SOLUTIONS

4.3.1 Product Structure

A few problems were encountered in the process of making the product structure. One of them is difficulties when cutting the acrylic board. The board is chipping from the cutting due to its brittleness. This problem causes us to cut another acrylic board because the chipped acrylic board is unused. The other problem is the acrylic board is melted a little when cutting it with a grinder due to the heat from the friction created. This problem was solved by just sanding the melted part so it looks perfect and good.

For the tools compartment, the problem is that the aluminium sheet is hard to be bent using the bending machine because of the design of it. We encountered this by bending it manually by hand. The other problem is springback. It was solved by overbending the aluminium sheet so that we can get the actual bent degree that we wanted.

When riveting, the problem that happened is deforming of the rivet head. Because of the deforming of the rivet head, we have to remove the rivet and rivet a new one so that the attachment of the aluminium sheet is perfect and not easy to break.

4.3.2 Product Mechanisms

There are a few problems that have been encountered wild doing this part. Firstly, Inconsistent performance of DC motors, variations in power supply, load circumstances, or mechanical wear can cause DC motors to function erratically. The solution is, to guarantee consistent functioning, put in place feedback systems, voltage regulating devices, and routine maintenance. Moreover, take into account using motor controllers to maximise torque and speed.

Moreover, DC motor overheating and efficiency, DC motor overheating is a typical problem that can reduce motor efficiency and perhaps cause the motor to fail. The solution that comes3 out is to use appropriate heat-dissipation techniques, including heat sinks or cooling fans. Make sure that the motor size is optimised to meet the needs of the application and to use power effectively.

In conclusion, a thorough grasp of potential problems relating to DC motors and servo motors in product mechanisms is provided by this analysis.

4.3.3 Electronic/Programming

A number of difficulties could come up during the building of AFD outfitted with an Arduino Uno, infrared and ultrasonic sensors, and a motor driver shield. Each of these problems would call for a different solution. By modifying the sensor settings and confirming their accuracy, calibration problems with the sensors that result in inaccurate readings can be resolved. It is possible to reduce interference between the sensors by putting in place physical barriers, changing time in the code, or synchronising readings.

Furthermore, it may be required to verify connections, wiring, and motor driver settings if motors are not responding correctly to control commands. Debugging tools and code reviews can help find logic problems in the code, which might cause unexpected behavior from robots. Circuitry faults, mislabeled pin definitions, or malfunctioning Arduino boards might cause communication problems between the Arduino Uno and sensors or a motor driver.

Finally, by incorporating obstacle avoidance logic based on sensor readings and optimising the navigation algorithm, physical barriers that interfere with robot navigation can be addressed. Resolving these problems and guaranteeing the robot's efficient operation need methodical troubleshooting and iterative testing.

4.3.4 Accessories & Finishing

Many difficulties developed when adding accessories to our Aviation Friendly Dustbin, such as reflective tape and a strobe light. Because of the dustbin's uneven surface, applying reflective tape was difficult since it was difficult to guarantee consistent adherence and good visibility from a variety of angles. The strobe light system integration also proved to be difficult, needing careful wiring and calibration to synchronise with the dustbin's sensors without disrupting its operation. It took meticulous preparation and creative thinking to overcome these obstacles and make sure that these accessories were successfully incorporated without sacrificing the smart dustbin's usefulness or visual attractiveness.

CHAPTER 5

CONCLUSION & RECOMMENDATIONS

5.1 ACHIEVEMENT OF AIM & OBJECTIVES OF THE RESEARCH

5.1.1 General Achievements of the Project

Upon the completion of final project testing, AFD is able to produce the output as expected.The AFD is able to move when the sensors detect an object in front of it and if the sensor cannot detect the object within 1 meter, AFD automatically stops.

Other than that, a post survey is conducted to gather user satisfaction. Based on the data collected, the majority of respondents agreed that it is efficient to use AFD when doing maintenance work so that it can reduce FOD in hangar and reduce maintenance personnel time use to dispose FOD.

5.1.2 SPECIFIC ACHIEVEMENT OF PROJECT OBJECTIVES

5.1.2.1 Product Structure

The goal of creating the AFD structure has been met. To achieve this goal, the suitable shape and dimension of the structure are identified, and AFD is developed in accordance with these aspects. The AFD structure was methodically created and built using TINKERCAD, a user-friendly 3D design and modelling application, once the ideal shape and dimensions were determined.

5.1.2.2 Product Mechanisms

The objective to achieve in the product mechanism section is to ensure that all the motors are functioning as it has to be, this helps the AFD to fully function. When all the motor are functioning its make the AFD to move around after being turn on,

5.1.2.3 Electronic / Programming

As the Aviation Friendly Dustbin (AFD)'s electronics were being built and the codes were being assembled, the objective was to make the dustbin move by using sensors to help ease maintenance personnel work. It is also a way to reduce time and energy use by maintenance personnel. Moreover, Use self-maintenance features for improved hygiene, such as easily replaceable liners and a self-cleaning mechanism. Use a rechargeable battery system and energy-efficient components to prioritise power efficiency. Make sure the dustbin's dimensions and appearance are ideal for blending in with a variety of settings. Include touch controls, LED indications, and security measures such as user authentication and locking mechanisms in a user-friendly interface.

Finally, Use recyclable materials and intelligent sorting technology to take the environment into consideration. In order to create a clever and sustainable trash disposal solution, lastly, make sure that continuous support is provided through remote diagnostics and customer support integration.

5.1.2.4 Accessories & Finishing

The goals of AFD's incorporation of accessories like reflective tape and a strobe light have been effectively met. The dustbin is now much more visible thanks to the addition of high-visibility reflective tape, which makes it stand out in busy locations and under different lighting circumstances. By making the AFD clearly visible to vehicles and pedestrians, this achievement has significantly increased safety by lowering the risk of accidents. Furthermore, the strobe light alarm mechanism has effectively shown when the dustbin is full or needs

maintenance. This success has improved the effectiveness of waste management procedures by streamlining operations and encouraging rapid action from maintenance personnel as well as users. Overall, the functionality, safety, and operational effectiveness have been greatly improved by the successful integration of these accessories.The overall functionality, safety, and operating efficiency of the smart AFD have been greatly improved by the successful integration of various accessories.

5.2 CONTRIBUTION OR IMPACT OF THE PROJECT

Aircraft hangar environments benefit greatly from AFD that is equipped with infrared and ultrasonic sensors. By offering obstacle avoidance capabilities, the combination of these sensors improves efficiency and safety by enabling the trashcan to manoeuvre in crowded areas without running into any accidents and By enabling hands-free operation and minimising the requirement for manual handling, ultrasonic proximity sensors are included. Additionally, by measuring the fill level and guaranteeing prompt trash removal, these sensors support environmental monitoring.

Moreover, The AFD moves precisely in tight areas and around aircraft thanks to infrared sensors' precision navigation, which helps to organise the gathering of rubbish. The AFDintegrates with the hangar's management system to optimise waste management plans by providing vital data on garbage generation patterns.

5.3 IMPROVEMENT & SUGGESTIONS FOR FUTURE RESEARCH

5.3.1 Product Structure

In the future, there is a lot of improvement that can be made to the structure of the product. One of them included using carbon fiber or glass fiber for the base to replace the acrylic board. This can make the product lighter and more strong. The other improvement that can be made is to create a separate section within the trash can to aid in the separation of recyclable materials. By providing a specific location for recyclables within the same unit, this feature

improves environmental sustainability and user convenience. Next structure improvement that can be made is to use sleek and modern design elements to boost the visual attractiveness of the trashcan, making it a natural fit in a variety of settings such as homes, offices, and public locations.

5.3.2 Product Mechanisms

For the next idea in upgrading this project which is to improve efficiency and be easier to use, there are few ideas in terms of upgrading for this part. Firstly, the enhancement is to enhance motor efficiency, to improve the smart dustbin's overall operational efficiency, install energy-efficient DC motors and servo motors. For the future research is to maximise energy recovery during motor operation and support environmentally friendly and sustainable practices, investigate sophisticated motor control algorithms and regenerative braking systems.

Therefore, the next idea will be monitoring and reporting in real-time. The enhancement is to incorporate instantaneous monitoring features to furnish prompt insights into waste quantities, system conditions, and possible problems. In terms of research, it will examine how IoT (Internet of Things) technology might be used to facilitate optimal operations and predictive maintenance by enabling smooth communication between smart dustbins, central monitoring systems, and maintenance staff.

The Aviation Friendly Dustbin can develop into a more complex and versatile solution that meets the changing needs of waste management in aviation environments and promotes sustainability and operational efficiency by concentrating on these enhancements and recommendations for further study.

5.3.3 Software / Programming

The improvement that will be considered in the future is that AFD can add cutting-edge sensor technologies, like motion and proximity sensors, to enable hands-free operation. Create a smart lid that has safety features like automatic opening and closing and obstruction detection. Establish Wi-Fi or Bluetooth connectivity to enable monitoring and remote control through a dedicated mobile app or integration with well-known smart home platforms**.**

Furthermore, Use self-maintenance features for improved hygiene, such as easily replaceable liners and a self-cleaning mechanism. Use a rechargeable battery system and energy-efficient components to prioritise power efficiency. Make sure the dustbin's dimensions and appearance are ideal for blending in with a variety of settings. Include touch controls, LED indications, and security elements such as user identification and locking mechanisms in an intuitive interface. Use recyclable materials and intelligent sorting technology to take the environment into consideration. In order to create a clever and sustainable trash disposal solution, lastly, make sure that continuous support is provided through remote diagnostics and customer support integration.

5.3.4 Accessories & Finishing

Beyond the addition of reflective tapes and strobe lights, research and development in smart dustbin technology offers bright opportunities for improving trash management systems. Adding solar-powered elements, including solar panels set into the dustbin's exterior to power LED lights for better night time vision, lessening dependence on outside power sources, and supporting environmental initiatives, is one way to make improvements. The use of smart identification tags, or QR codes, for effective trash sorting is an additional topic that merits investigation. These tags enable users to scan and identify suitable disposal categories, supporting improved recycling practices. Furthermore, studies into self-cleaning coatings or automated cleaning systems could reduce the need for manual maintenance, guaranteeing the dustbin's performance and beauty with the least amount of assistance from humans.Studying odour-neutralising filters or air circulation systems within the dustbin also significantly enhance user experience in high-traffic areas. The study of IoT-based remote monitoring capabilities, interactive user interfaces, anti-vandalism features, and the combination of AI and machine

learning has the potential to transform waste management, optimise processes, encourage responsible disposal of waste, and promote sustainability objectives in urban settings.

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APPENDIX A : LIST OF SEGGERATION TASK

SUB CHAPTER	DESCRIPTION
MUHAMMAD DANIAL ISKANDAR BIN NOORAINI	
1.3.2.1	Specific Individual Project Objective : Product Structure
1.5.2.1	Specific Individual Scope : Product Structure
2.2.1	Specific Literature Review : Product Structure
2.2.1.1	Basic Design of dustbin
2.2.1.2	Minimum Safety Requirements
2.2.1.3.1	Type of Material for Product Structure : HDPE dustbin
2.2.1.3.2	Type of Material for Product Structure : Clear Acrylic Perspex
2.2.1.3.3	Type of Material for Product Structure : Aluminium Sheet
2.3.1.1	Related Patented Products : Trash can by Eko Development Ltd.
2.3.2.1	Recent Market Products : TORI HOME Small Dustbin
2.4.1	2COMPARISON BETWEEN RECENT RESEARCH AND CURRENT PROJECT : Patent A vs. Product A vs. Your Product
3.2	PROJECT BRIEFING & RISK ASSESSMENT
3.2.1	Utilisation of Polytechnic's Facilities
3.4.2.1	Specific Project Design Flow / Framework : Product Structure
3.5.1	LIST OF MATERIALS & EXPENDITURES : Product structure
3.6.1	PRODUCT DRAWING / SCHEMATIC DIAGRAM : General Product Drawing
3.6.2.1	Specific Part Drawing : Product Structure
3.7.1.1	Material Acquisition : Base structure of AFD

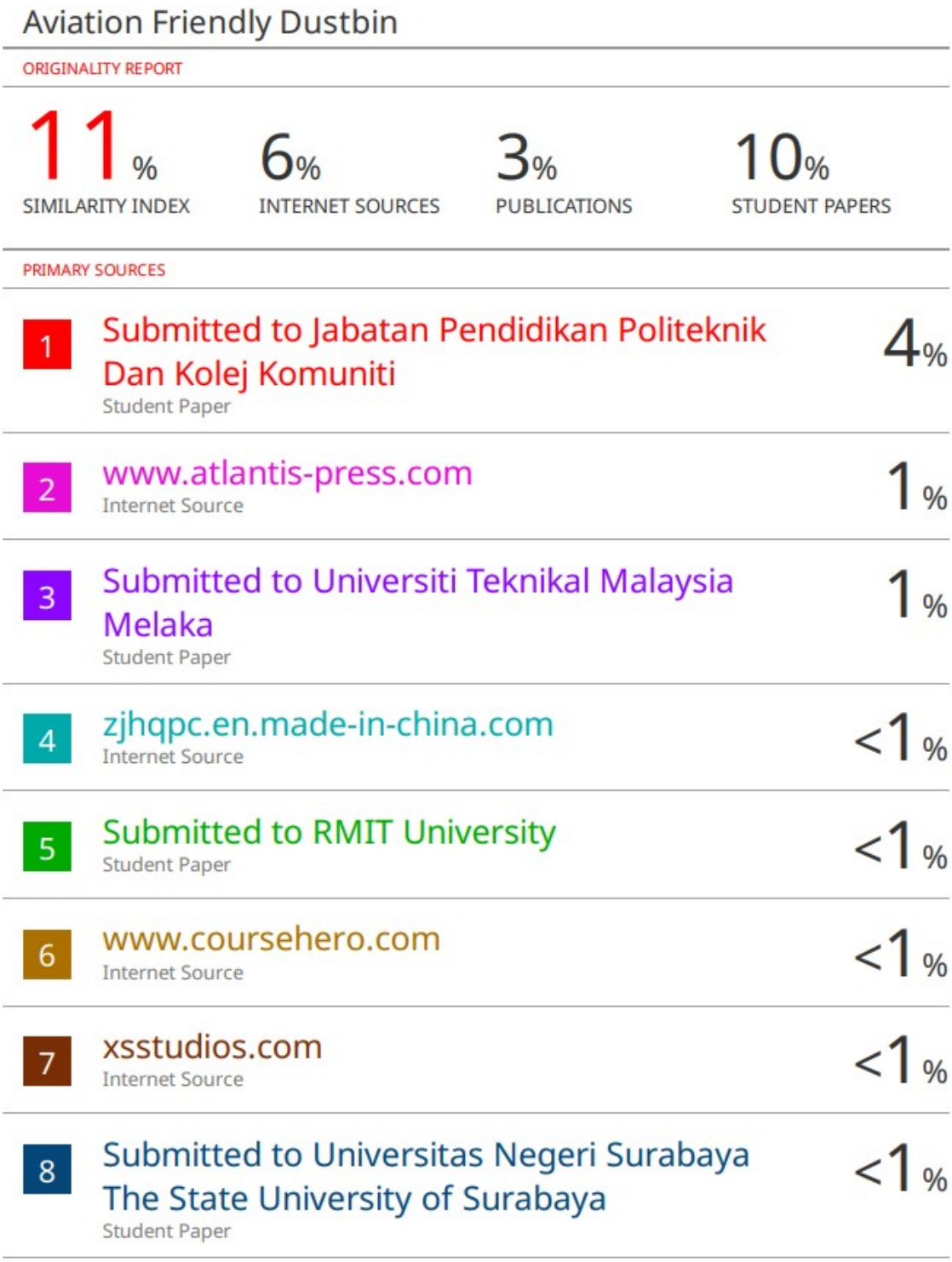
3.7.3.1	Specific Project Fabrication : Phase 1 (Base Structure):
4.1.2.1	Specific Part Features : Product Structure
4.1.4.1	Operation of the Specific Part of the Product : Product Structure
4.3.1	ANALYSIS OF PROBLEM ENCOUNTERED & SOLUTIONS : Product Structure
5.1.2.1	Specific Achievement of Project Objectives : Product Structure
5.3.1	IMPROVEMENT & SUGGESTIONS FOR FUTURE RESEARCH : 5.3.1 Product Structure
MUHAMMAD MUSYRIF AQIL BIN RAZLISHAM	
1.3.2.2	Specific Individual Project Objective : Mechanical Mechanism
1.5.2.2	Specific Individual Scope : Mechanical Mechanism
2.2.2	Specific Literature Review : Product Mechanisms
2.3.1.2	Related Patented Product : Sulo MGB Bin
2.3.2.2	Recent Market Product : Plastic Waste Bin
2.4.2	Comparison Between Recent Research and Current Project : Sulo MGB Bin vs. Plastic Waste Bin vs. AFD
3.1.1.2	Pareto Diagram
3.3	Overall Poject Gantt Chart
3.4.2.2	Specific Project Design Flow : Product Mechanisms
3.5.2	List of Materials & Expenditure : Product Mechanisms
3.6.2.2	Specific Part Drawing : Product Mechanisms
3.7.2	Machines and Tools
3.7.3.2	Specific Project Fabrication : Phase 2 (Accessories & Mechanisms)
4.1.2.2	Specific Part Feature : Product Mechanisms
4.1.4.2	Operation of the Specific Part of the Product : Product Mechanisms
5.1.2.2	Specific Achievement of Project Objective : Product Mechanisms

5.3.2	Improvement & Suggestion for Future Research : Product Mechanisms
MUHAMMAD SYAFI BIN MOHD SHAHFRIZAN	
1.3.2.3	Specific Individual Task: Electronic / Programming
1.5.2.3	Specific Individual Scopes : Electronic / Programming
2.2.3	Specific Literature Review : Electronic / Programming
2.3.1.3	Related Patented Product : Smart Garbage Bin
2.3.2.3	Recent Market Product : Swing Top Garbage with Swing Lid
2.4.3	Comparison Between Recent Research and Current Project : Smart Garbage Bin vs Swing Top Garbage Bin with Swing lid
3.1.1.1	Questionnaire Survey
3.1.2.1	Function Tree
3.1.2.2	Morphological Matrix
3.1.2.7	Accepted vs Discarded Solution
3.1.3.1	Pugh Matrix
3.4.1	Overall Project Flow Chart
3.4.2.3	Specific Project Design Flow : Electronic / Programming
3.5.3	List of Materials & Expenditure : Product E;ectronic / Programming
3.6.2.3	Specific Part Drawing : Electronic / Programming
3.7.3.3	Specific Project Fabrication : Phase 3 (Electronic / Programming)
3.8	Product Testing / Functionality Test
4.1.2.3	Specific Part Feature : Electronic / Programming
4.1.3	General Operation of the AFD
4.1.4.3	Operation of the Specific Part of the Product : Electronic / Programming

4.2	Project Impact / Purpose of Product
4.3.3	Analysis of Problem Encountered & Solution : Electronic / Programming
4.4	Product Output Analysis
5.1.1	General Achievements of the Project
5.1.2.3	Specific Achievement of Project Objective : Electronic / Programming
5.2	Contribution or Impact of the Project
5.3.3	Improvement & Suggestion for Future Research : Electronic / Programming
AIZANATASHA QISTINA BINTI ROSLI	
1.1	BACKGROUND OF STUDY
1.2	PROBLEM STATEMENT
1.3.1	PROJECT AIM : General Project Objectives
1.4	PURPOSE OF PRODUCT
1.5	SCOPE OF PROJECT
1.5.1	General Project Scopes
1.3.2.4	Specific Individual Project Objective: Accessories & Finishing
1.5.2.4	Specific Individual Scope: Accessories & Finishing
2.2.4	Specific Literature Review: Accessories & Finishing
2.2.4.1	Reflective Tape
2.2.4.2	Strobe Light
2.3.1.4	Garbage Bin with Cover
2.3.2.4	Nakada Smart Dustbin
2.4.4	Garbage Bin with Cover vs Nakada Smart Dustbin vs AFD
3.1.2.3	Proposed Design Concept 1
3.1.2.4	Proposed Design Concept 2

3.1.2.5	Proposed Design Concept 3
3.4.2.4	Specific Project Design Flow Chart/Framework : Accessories & Finishing
3.5.4	LIST OF MATERIALS & EXPENDITURES: Product Accessories & Finishing
3.7.3.4	Specific Project Fabrication : Phase 4 (Finishing)
4.1.2.4	Specific Part Features : Accessories & Finishing
4.1.4.4	Operation of the Specific Part of the Product : Accessories & Finishing
4.3.4	Analysis of Problem Encountered & Solutions : Accessories & Finishing
5.1.2.4	Specific Achievement of Project Objectives : Accessories & Finishing
5.3.4	Improvement & Suggestion For the Future Research : Accessories & Finishing

APPENDIX B : TURNITIN SIMILARITY REPORT



Aviation Friendly Dustbin

ORIGINALITY REPORT

11%	6%	3%	10%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

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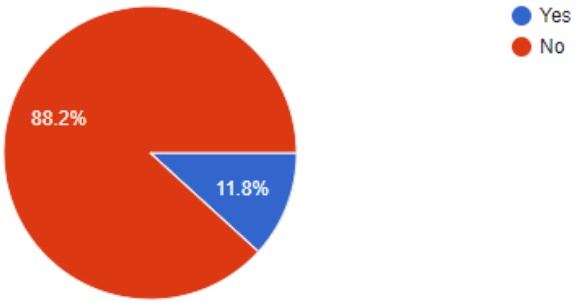
APPENDIX C : POST SURVEY

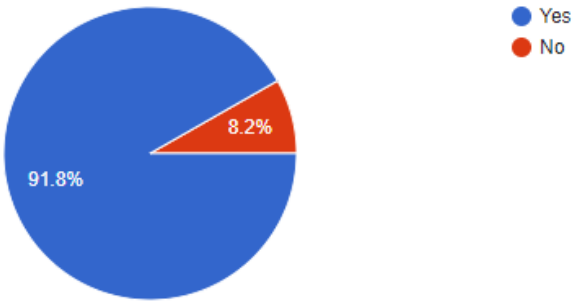
1. Have you ever used a smart movable dustbin at hangar for base maintenance? Copy

85 responses



2. Do you think smart movable dustbins are more convenient than traditional dustbins? Copy

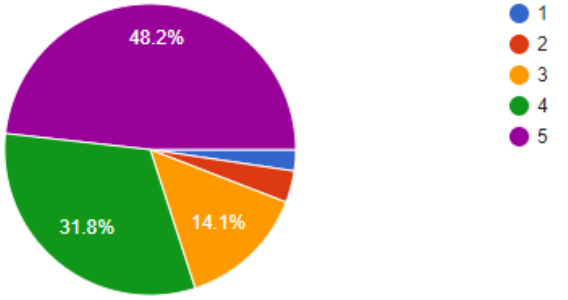
85 responses



3. On a scale of 1-5, how likely are you to use a smart movable dustbin with a built-in tool compartment?

Copy

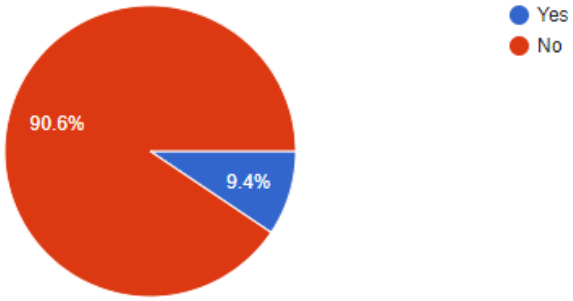
85 responses



4. Have you ever used a smart movable dustbin in an aircraft hangar bay?

Copy

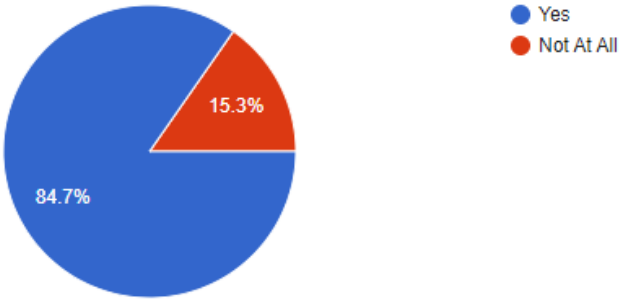
85 responses



5. Do you think the use of smart movable dustbins in the aircraft hangar bay promotes safety and improves overall efficiency?

Copy

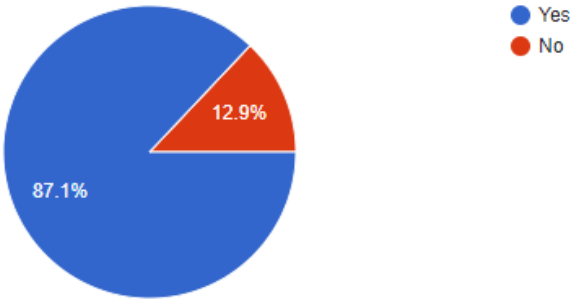
85 responses



6. Would you prefer using Aviation Friendly Dustbin (AFD) over a traditional dustbin in the aircraft hangar bay?

Copy

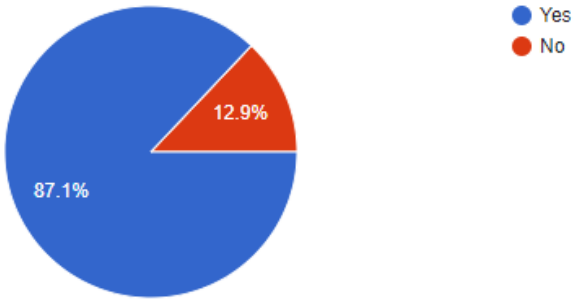
85 responses



7. Have you ever experienced overflowing trash in your current dustbin?

Copy

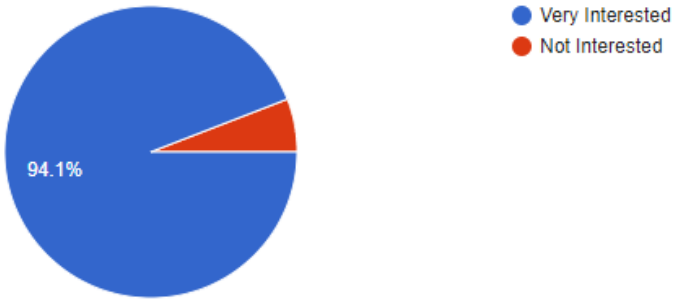
85 responses



8. How interested are you in a smart dustbin that can be controlled through a mobile app or human follow sensor?

Copy

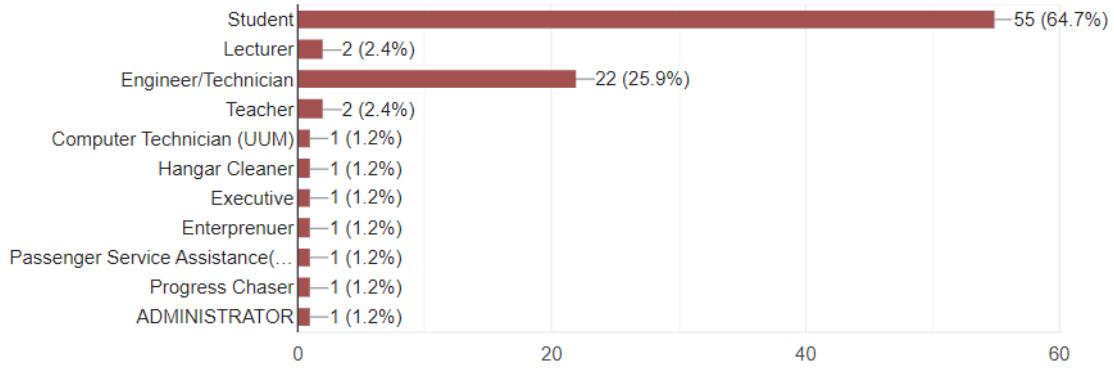
85 responses



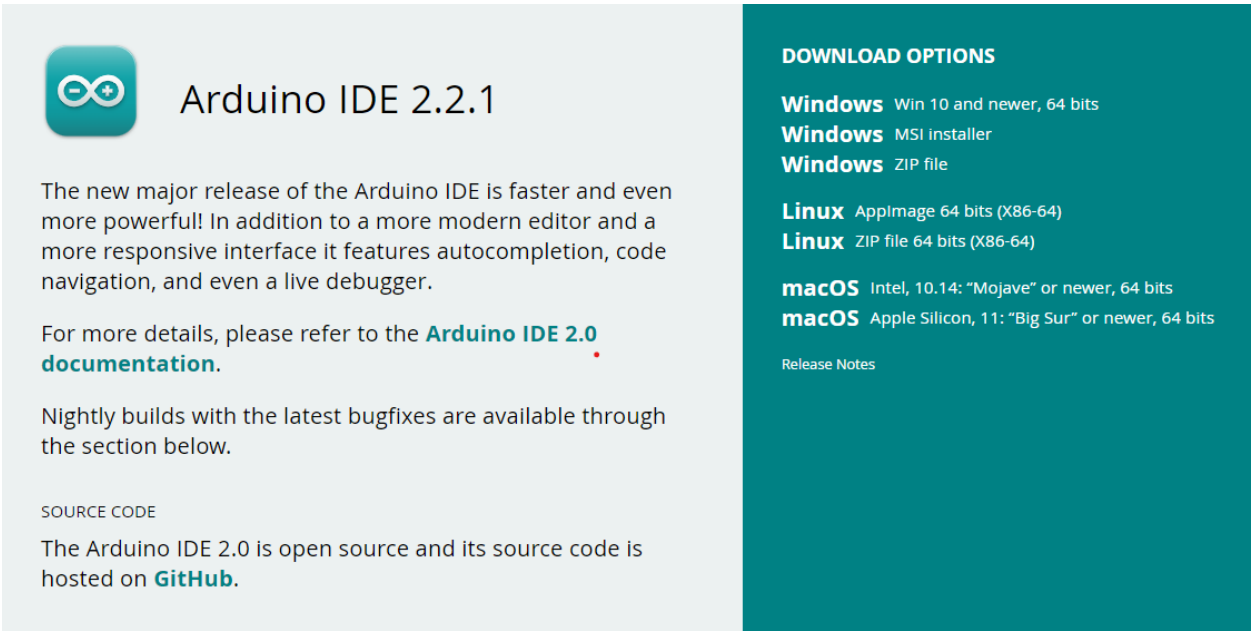
Position/Profession

Copy

85 responses



APPENDIX D : ARDUINO IDE



APPENDIX E : CODING FOR SENSORS AND MOTOR IN ARDUINO IDE SOFTWARE

```
#include <NewPing.h>

//include the library code:
#include <NewPing.h>
#include <Servo.h>
#include <AFMotor.h>

#define RIGHT A2          // Right IR sensor connected to analog pin A2 of Arduino Uno:
#define LEFT A3           // Left IR sensor connected to analog pin A3 of Arduino Uno:
#define TRIGGER_PIN A1    // Trigger pin connected to analog pin A1 of Arduino Uno:
#define ECHO_PIN A0       // Echo pin connected to analog pin A0 of Arduino Uno:
#define MAX_DISTANCE 200  // Maximum ping distance:

unsigned int distance = 30;    //Variable to store ultrasonic sensor distance:
unsigned int Right_Value = 0;  //Variable to store Right IR sensor value:
unsigned int Left_Value = 0;   //Variable to store Left IR sensor value:


NewPing sonar(TRIGGER_PIN, ECHO_PIN, MAX_DISTANCE);  //NewPing setup of pins and maximum distance:

//create motor objects
AF_DCMotor Motor1(1, MOTOR12_1KHZ);
AF_DCMotor Motor2(2, MOTOR12_1KHZ);
AF_DCMotor Motor3(3, MOTOR34_1KHZ);
AF_DCMotor Motor4(4, MOTOR34_1KHZ);

Servo myservo;  //create servo object to control the servo:
int pos = 0;    //variable to store the servo position:

void setup() {  // the setup function runs only once when power on the board or reset the board:

  Serial.begin(9600);  //initailize serial communication at 9600 bits per second:
  myservo.attach(10);  // servo attached to pin 10 of Arduino UNO
  {
    for (pos = 90; pos <= 180; pos += 1) {  // goes from 90 degrees to 180 degrees:
      myservo.write(pos);                   //tell servo to move according to the value of 'pos' variable:
```

```
  {
    for (pos = 90; pos <= 180; pos += 1) {  // goes from 90 degrees to 180 degrees:
      myservo.write(pos);                   //tell servo to move according to the value of 'pos' variable:
      delay(15);                            //wait 15ms for the servo to reach the position:
    }
    for (pos = 180; pos >= 0; pos -= 1) {  // goes from 180 degrees to 0 degrees:
      myservo.write(pos);                  //tell servo to move according to the value of 'pos' variable:
      delay(15);                           //wait 15ms for the servo to reach the position:
    }
    for (pos = 0; pos <= 90; pos += 1) {  //goes from 180 degrees to 0 degrees:
      myservo.write(pos);                //tell servo to move according to the value of 'pos' variable:
      delay(15);                         //wait 15ms for the servo to reach the position:
    }
  }
  pinMode(RIGHT, INPUT);  //set analog pin RIGHT as an input:
  pinMode(LEFT, INPUT);   //set analog pin RIGHT as an input:
}

// the lope function runs forever
void loop() {

  delay(50);                     //wait 50ms between pings:
  distance = sonar.ping_cm(30);  //send ping, get distance in cm and store it in 'distance' variable:
  Serial.print("distance");
  Serial.println(distance);  // print the distance in serial monitor:


  Right_Value = digitalRead(RIGHT);  // read the value from Right IR sensor:
  Left_Value = digitalRead(LEFT);    // read the value from Left IR sensor:

  Serial.print("RIGHT");
  Serial.println(Right_Value);  // print the right IR sensor value in serial monitor:
  Serial.print("LEFT");
  Serial.println(Left_Value);  //print the left IR sensor value in serial monitor:

  if ((distance > 1) && (distance < 30)) {  //check wheather the ultrasonic sensor's value stays between 1 to 15.
```

```
                                        //If the condition is 'true' then the statement below will execute:
    //Move Forward:
    Motor1.setSpeed(130);  //define motor1 speed:
    Motor1.run(FORWARD);   //rotate motor1 clockwise:
    Motor2.setSpeed(130);  //define motor2 speed:
    Motor2.run(FORWARD);   //rotate motor2 clockwise:
    Motor3.setSpeed(130);  //define motor3 speed:
    Motor3.run(FORWARD);   //rotate motor3 clockwise:
    Motor4.setSpeed(130);  //define motor4 speed:
    Motor4.run(FORWARD);   //rotate motor4 clockwise:

  } else if ((Right_Value == 0) && (Left_Value == 1)) {  //If the condition is 'true' then the statement below will execute:

    //Turn Left
    Motor1.setSpeed(150);  //define motor1 speed:
    Motor1.run(FORWARD);   //rotate motor1 cloclwise:
    Motor2.setSpeed(150);  //define motor2 speed:
    Motor2.run(FORWARD);   //rotate motor2 clockwise:
    Motor3.setSpeed(150);  //define motor3 speed:
    Motor3.run(BACKWARD);  //rotate motor3 anticlockwise:
    Motor4.setSpeed(150);  //define motor4 speed:
    Motor4.run(BACKWARD);  //rotate motor4 anticlockwise:
    delay(150);

  } else if ((Right_Value == 1) && (Left_Value == 0)) {  //If the condition is 'true' then the statement below will execute:

    //Turn Right
    Motor1.setSpeed(150);  //define motor1 speed:
    Motor1.run(BACKWARD);  //rotate motor1 anticlockwise:
    Motor2.setSpeed(150);  //define motor2 speed:
    Motor2.run(BACKWARD);  //rotate motor2 anticlockwise:
    Motor3.setSpeed(150);  //define motor3 speed:
    Motor3.run(FORWARD);   //rotate motor3 clockwise:
    Motor4.setSpeed(150);  //define motor4 speed:
    Motor4.run(FORWARD);   //rotate motor4 clockwise:
```

```
    delay(150);

  } else if (distance > 30) {  //If the condition is 'true' then the statement below will execute:

    //Stop
    Motor1.setSpeed(0);   //define motor1 speed:
    Motor1.run(RELEASE);  //stop motor1:
    Motor2.setSpeed(0);   //define motor2 speed:
    Motor2.run(RELEASE);  //stop motor2:
    Motor3.setSpeed(0);   //define motor3 speed:
    Motor3.run(RELEASE);  //stop motor3:
    Motor4.setSpeed(0);   //define motor4 speed:
    Motor4.run(RELEASE);  //stop motor4:
  }
}
```