POLITEKNIK BANTING SELANGOR

LIFESYNC TECH

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DEPARTMENT OF AIRCRAFT MAINTENANCE

NOVEMBER 2024

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

SUPERVISOR:

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CERTIFICATION OF PROJECT ORIGINALITY & OWNERSHIP

LIFESYNC TECH

SESSION: I 2024/2025

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

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ABSTRACT

LifeSync Tech is a new generation of life jacket that enhance safety and survival during emergencies on water. LifeSync Tech uses GPS technology, heating pad, beacon light and buzzer to help victim at sea. The GPS system provides real-time location tracking within a 1-2 km range, providing rescuers with accurate data to expedite search and rescue (SAR) operations. The heating pad, activated through an efficient and compact nanotechnology-based mechanism, mitigates hypothermia risks, offering warmth in cold oceanic conditions. LED lights and a buzzer improve visibility and alertness, especially in low-light scenarios, ensuring quicker detection during emergencies. LifeSync Tech is a life jacket that combines functionality, high safety and durability. Targeted towards the aviation sector, this product caters to both recreational and professional seafarers, filling a crucial gap in the market where multifunctional safety equipment is limited. By leveraging sustainable and innovative technologies, LifeSync Tech aligns with Sustainable Development Goals (SDGs), promoting safer oceans and enhanced maritime resilience.

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CO_2	-	Carbon Dioxide
N	-	Newton

LIST OF ABBREVIATIONS

GPS	-	Global Positioning System
CO_2	-	Carbon Dioxide

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

The history of the aircraft life jacket begins in the early days of aviation, when adventurers were willing to take on new challenges but were aware of the risks that came with flying over water. Early versions of the aeroplane life jacket, which were essentially simple inflated devices or improvised flotation aids, set the stage for later design and technological advances. The simple life jacket noticed a transformation throughout time as aviation advanced and safety regulations tightened, becoming an advanced piece of gear designed to satisfy the demands of modern flight operations. We embarked on an investigation to find out how these new features are changing the face of aviation safety. Through an exploration of the specifics of GPS tracking and heating pad components integrated into aircraft life jackets, we aim to clarify the challenges associated with their use, evaluate their effectiveness in reducing hazards, and consider their potential impact on aviation safety regulations going forward.

1.2 PROBLEM STATEMENT

Aircraft life jackets lack GPS monitoring and heating pad capability, which poses serious safety risks and restricts its use in emergency scenarios. Locating people in crisis becomes difficult without GPS, especially in large wide spaces or isolated areas. This complicates search

and rescue operations and may cause vital aid to be delayed. In a similar vein, incidents involving aircraft ditched in cold water environments, such as the 2009 crash landing of US Airways Flight 1549 on the Hudson River, have brought attention to the passenger risk of hypothermia brought on by the lack of heating pads in life jackets, which may worsen injuries and lower survivability. These occurrences highlight how crucial it is to include heating pad and GPS tracking features into aviation life jackets in order to increase survival rates and speed up rescue efforts in an emergency.

1.3 PROJECT OBJECTIVES

1.3.1 General Projective Objectives

The project's primary goal is to put in place a reliable GPS system that will allow for real-time position tracking of the wearer. SAR teams can obtain accurate and current position data by incorporating cutting-edge GPS technology into life jacket designs, greatly expediting the process of finding people in emergency circumstances. The capacity to act quickly might mean the difference between life and death in situations involving maritime or aviation crises, where time is of the essence. In addition, the initiative highlights how crucial it is to maintain the victim's condition by including a heating pad component in the life jacket. By giving the wearer vital warmth, especially in cold water situations, this heating pad lowers the risk of hypothermia and other cold related injuries.

The project increases the chances of a successful rescue by tackling this crucial component of survival and improving the life-saving equipment's overall effectiveness. In addition, the project adds elements like an LED light and buzzer to improve the life jacket's functionality. These components act as essential signalling tools, assisting SAR crews in quickly identifying victims even in limited visibility or at night. The buzzer's audio alert and the LED light's visible illumination greatly improve the effectiveness and precision of search operations, guaranteeing that no time is lost in finding and saving people in need.

1.3.2 Specific Individual Project Objectives

1.3.2.1 Product Structure

Material

The life jacket is made of a strong and waterproof material, allowing it to survive the severe circumstances seen in nautical and aviation situations. This material provides the initial line of defence against the elements, such as seawater exposure, severe temperatures, and mechanical wear and tear. Its strong design guarantees that the internal components of the life jacket are protected even under extreme stress. Furthermore, the shell's waterproof nature prevents water from invading the jacket, ensuring that the gadget retains its buoyancy and effectiveness even after prolonged exposure to water.

Heating Pad

Recognising the life-threatening risk of hypothermia in cold water conditions, the life jacket has a separate pocket for a heating pad. This chamber is carefully engineered to keep the heating mechanism safe while guaranteeing even heat dispersion throughout the victim’s body. This heating pad delivers warmth, helping to stabilise the victim’s core temperature and reduce the risk of cold-related injuries. The heating pad's design prioritises both comfort and safety, ensuring that it does not interfere with the jacket's buoyancy or movement while providing a life-saving function.

LED Light & Buzzer Housing

To improve visibility and signalling capabilities, the life jacket has strategically positioned housings for an LED light and a buzzer. These components are critical for aiding SAR teams in identifying humans, particularly in low-light circumstances or in places with restricted visibility. The LED light offers a strong and steady lighting that may be seen from a distance, allowing rescuers to better identify the victim's location. Similarly, the buzzer provides a loud audible alarm that may be heard over noise and

other surrounding disturbances. The positioning of these components provides optimal efficacy, allowing them to perform flawlessly while without impeding the wearer's movement or comfort.

1.3.2.2 Product Mechanisms

The GPS-enabled life jacket has advanced survival functions. Its GPS tracking device offers real-time position data to SAR teams, allowing for precise and speedy victim identification even in severe situations. The heating pad, supplied by sodium acetate, a salt hydrate that can be supercooled and then crystallized to release heat. The garment has an LED light for visibility in low light and a buzzer for auditory alarms, which help rescuers find victims. These systems work together to facilitate efficient rescue operations and increase the wearer's chances of survival in crises.

1.3.2.3 Software/Programming

LifeSync Tech’s functionality relies on robust and efficient software systems. The GPS tracking software supports real-time location transmission, accurate within a 1–2 km range, ensuring SAR teams can quickly pinpoint victims. A temperature regulation program governs the heating pad, maintaining optimal warmth and preventing overheating. The signal synchronization software ensures the LED light and buzzer activate simultaneously for effective visibility and alerting.

1.3.2.4 Accessories & Finishing

Lifesync Tech offers a very good finishing which GPS is put in a very secure pocket to ensure there is no leaking. Other than that, heating pad is embedded in a space which we glue it using same material with our lifejacket. So that, it will water resistance.

1.4 PURPOSE OF PRODUCT

The primary purpose of LifeSync Tech is to revolutionize safety and survival standards in maritime and aviation emergencies. By integrating advanced features like GPS tracking, heating pads, and signaling tools, it significantly improves the chances of timely rescue and survival in harsh oceanic conditions. The product is aimed at bridging the gap in the market for durable, multifunctional safety equipment, catering to both recreational users and professional sectors. Additionally, LifeSync Tech promotes sustainable innovation, aligning with global efforts to enhance maritime resilience and meet Sustainable Development Goals (SDGs) related to safe and sustainable oceans.

1.5 SCOPE OF PROJECT

1.5.1 General Project Scopes

The project focuses on designing, developing, and deploying a next-generation life jacket that integrates cutting-edge technologies. It targets aviation and maritime industries, addressing critical safety concerns through innovative features. The scope includes engineering the product's hardware and software, conducting rigorous testing, and ensuring compliance with international safety standards. The project also emphasizes sustainability in materials and manufacturing processes.

1.5.2 Specific Individual Scopes

1.5.2.1 Product Structure

Develop a durable and ergonomic design that integrates core components such as the waterproof materials, GPS module, heating pad compartment, LED light, and buzzer.

1.5.2.2 Product Mechanisms

Incorporate GPS tracking and synchronized signaling systems to enhance survival during emergencies. Ensure each mechanism operates reliably under challenging conditions.

1.5.2.3 Software/Programming

Develop software for GPS location tracking, signal synchronization, and power management. Optionally integrate with a user-friendly mobile application for SAR coordination.

1.5.2.4 Accessories & Finishing

Design and include essential ergonomic accessories such as adjustable straps. Prioritize a sleek, lightweight finish to maximize usability and aesthetics.

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL LITERATURE REVIEW

Advancing far beyond the lifesaving function of a traditional life jacket, the Lifesync Tech ushers in the new era of water safety by incorporating a comprehensive suite of features designed to streamline the Search and Rescue (SAR) team operations and demonstrably improve survivor well-being. Unlike its simpler counterparts that solely provide buoyancy, the Lifesync Tech boasts an integrated Global Positioning System (GPS) module. This critical feature enables real-time location tracking, proving invaluable in scenarios where survivors are scattered across vast distances following an incident. SAR teams can pinpoint their exact location swiftly, initiating rescue efforts with minimal delay.

The innovation of the Lifesync Tech doesn't stop at enhanced floatation. It delves into the realm of comfort and survival time extension by incorporating an integrated heating pad. This heating pad provides much-needed warmth to the wearer, helping to combat the effects of hypothermia in cold water environments. By maintaining core body temperature, the Lifesync Tech can significantly increase a survivor's chances of survival until rescue arrives. This critical data is then relayed in real-time using multiple channels, such as satellite connection, cellular network (if in range), or even short-range radio for communication with nearby rescue vessels. By combining the advantages of faster rescue times with improved medical care coordination, the Lifesync Tech has the potential to revolutionise water safety and significantly increase the likelihood of a successful rescue.

Moreover, the Lifesync Tech is meticulously designed with durability in mind. It can withstand the harsh conditions of marine environments, guaranteeing its functionality precisely when it's needed most. This ensures that even in the face of challenging circumstances, the Lifesync Tech remains a reliable lifeline for those in danger.

The unique features of the LifeSync Tech jacket as per following:

1. GPS device to detect by the SAR team of the victim’s location.
2. Heating pad to ensure slow heat loss and extend the amount of time a person can survive in cold water (hypothermia).
3. LED on the life jacket to locate the survivor during night time.
4. Buzzer to locate the victim easier.
5. Flexible solar panel to generate energy for the battery, to supply LED and buzzer.

This Lifesync Tech also has common accessories, for instance:

1. Harness to secure on the victim's body.
2. Oral inflation system for the victim to secure their buoyancy.
3. Whistle for the victim to draw the SAR team’s attention.

2.1.1 The Evolution of Life Vest

19th Century

Back in the 1840's, the first documented life jackets were made from cork and were used by lifeboat crews. Cork, being buoyant, was an effective material for flotation. In 1854, Captain John Ross Ward invented a cork life jacket for the Royal National Lifeboat Institution in the UK, marking one of the earliest official uses of life vests.

***Figure 2.1**: Captain John Ross Ward*

1950s-1970s

The Kapok Life Vests was introduced, Kapok, a natural fibre from the kapok tree, was introduced as a buoyant material. It was lighter than cork and became widely used in life vests.

***Figure 2.2**: Vintage 1956 Kapok Life Preserver - Model No. 2 - Adult Coast Guard Approved*

1980s-Present:

Advanced materials were used, modern life vests are made from advanced synthetic materials like neoprene and nylon, which offer better buoyancy, comfort, and durability. Next, design with improvements, ergonomic designs have improved, making life vests more comfortable and less restrictive. Automatic inflation mechanisms, such as CO_2 cartridges activated by water have been incorporated.

***Figure 2.3**: Life Vest with a double chamber (EASA approved)*

2.1.2 Comparison of Old design & New design of the Life Vest

Old Design the Life Vest	Aspects	New Design of the Life Vest
Bulky and less Ergonomic	**Design and Comfort**	Streamlined and ergonomic
Manual inflation (Blow into tube)	**Inflation System**	Automatic inflation (water-activated) with manual backup
Heavy and less flexible	**Material**	Lightweight, durable synthetic materials
Degrades faster, less resistant to wear and tear	**Durability**	Enhanced durability, resistant to punctures and tears
Basic buoyancy	**Buoyancy**	Enhanced buoyancy
Minimal visibility aids, less reflective materials	**Visibility Aids**	High-visibility colours, reflective materials
Basic functionality	**Additional Features**	May include GPS, heating pad and buzzer.

Table 2.1: *Comparison of Old design & New design of the Life Vest*

2.1.3 Aviation Life Vest

Aeroplanes flying over bodies of water are required to wear life jackets or vests, which are made up of two air cells, or bladders, that can be filled by causing carbon dioxide gas to be released from a canister one for each cell. A flexible tube with a one-way valve to seal the air inside the cell can also be used to orally inflate the cells. Commercial seafaring vessels must also have life jackets available for all crew members and passengers to wear in an emergency.

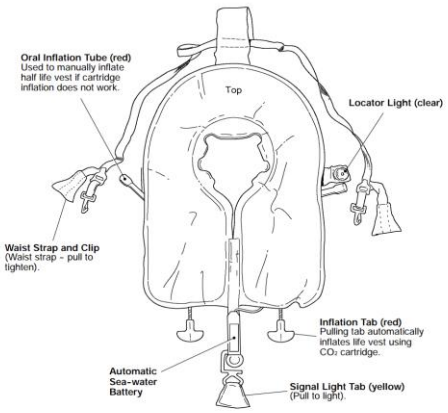


***Figure 2.4**: The anatomy of a Life Vest*

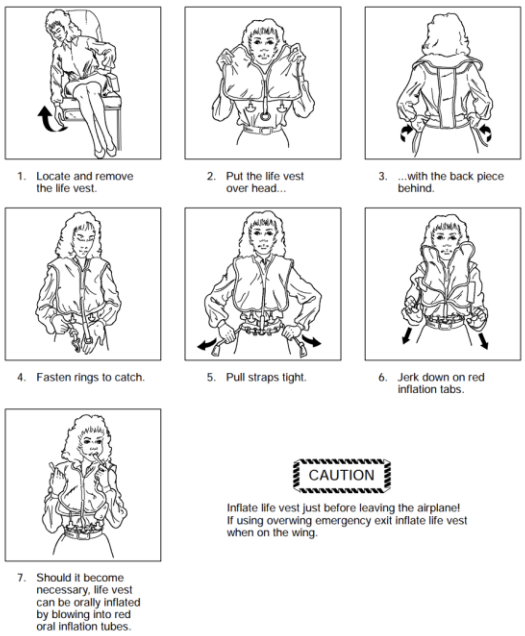


***Figure 2.5:** Steps to wear the life vest*

2.2 SPECIFIC LITERATURE REVIEW

2.2.1 Product Structure

A life jacket's main function is to provide buoyancy in water. It keeps you afloat, with your head above the water's surface even if unconscious. This prevents drowning by allowing the user to breathe. Some life jackets also offer additional features like increased visibility or turning the user face-up in the water.

- AC-2000

Figure 2.6: *Life Jacket AC-2000*

The AC-2000 boasts a lightweight design, ensuring ease of use and comfort during extended periods. It offers the highest available buoyancy at 37.5 lbs, providing exceptional support and safety in the water. Additionally, the AC-2000 features single waist strap donning with an easy quick-fit buckle, allowing for quick and secure fastening.

- TYPE I OFFSHORE LIFE JACKET

Figure 2.7: *Type I Offshore Life Jacket*

The Type 1 Offshore Life Jacket is designed for maximum safety and durability in demanding marine environments. It provides a minimum buoyancy of 24 lbs, ensuring reliable flotation and support in rough waters. The jacket is equipped with 63 square inches of SOLAS-grade reflective tape, enhancing visibility in low light conditions and increasing the chances of rescue. Constructed from weather and fade resistant polyester, this life jacket is built to withstand harsh weather conditions and maintain its integrity over time.

- RFD 102 MK3

Figure 2.8: *RFD 102 MK3 Life Jacket*

The RFD 102 MK3 is a robust and reliable life jacket, fully approved for use in Australia. Designed for durability, it features automatic inflation for immediate buoyancy upon water immersion. It also comes equipped with a water-activated light to enhance visibility, a whistle for signalling, and an oral inflation tube for manual inflation as needed. The RFD 102 MK3 offers a 10-year service interval, ensuring long-term reliability and safety for its users in demanding marine environments.

- AIC - 35

Figure 2.9: *AIC-35 Life Jacket*

The AIC - 35 stands out as the world's lightest weight aviation life jacket, tipping the scales at a mere 0.9 lbs (410 grams). This translates to maximum comfort for flyers who need to wear the life jacket for extended periods.

Designed with a single inflatable chamber, the AIC - 35 prioritises buoyancy while maintaining a minimalist profile. To ensure ongoing safety, the life jacket requires inspection every 5 years. However, for those seeking a longer inspection interval, a 10-year version is also available.

It's important to note that due to its focus on aviation use, the AIC - 35 might not be suitable for all water activities. Features commonly found in traditional life jackets, such as whistles for signalling for help, reflective tape for night time visibility, or signal mirrors for attracting rescuers, might be absent from this design. If you plan on using a life jacket for general boating or recreational water activities, it's advisable to consider options with a wider range of features.

2.2.3 Software/ Programming

2.2.3.1 Global Positioning System (GPS)

The GPS type utilized was *NEO-6M GPS MODULES*, It is a family of standalone devices in a positioning engine. The module size is 23mm x 30mm and the update rate is 1Hz to 5Hz maximum. The tiny design and memory choices make it appropriate for battery-powered mobile devices with limited cost and space. It includes a receiver's exceptional navigation ability even in the most demanding settings. The GPS on the life jacket allows the search and rescue teams to shorten the rescue time and locate the latitude and longitude of the survivor.

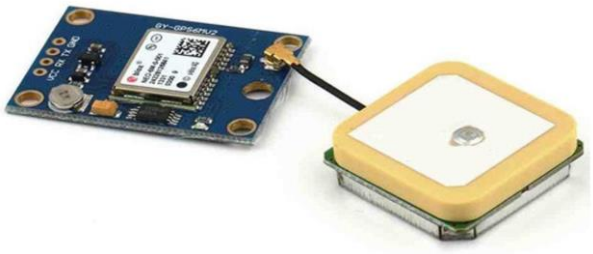


Figure 2.10: *NEO-6M GPS*

MVTAG GPS TRACKER

With the MVTAG Tag, it can easily track and locate the passengers using the Find My app. Instant Notifications: Receive instant notifications if your tag disconnects from your Apple device's Bluetooth connection.

Figure 2.11*: MVTAG GPS Tracker*

SP01 GPS TRACKER

SP01 is a GPS tracker designed for personal and asset tracking. Equipped with alerts such as geo-fence, low battery, and many other advanced reporting features. With a compact design and 900mAh battery that can work for up to 6 days makes SP01 easy to carry anywhere without worrying about charging the battery frequently.

Figure 2.12: SP01 GPS Tracker

2.2.4 Accessories & Finishing

We employed a tiny piezo buzzer, it produces sound by the piezoelectric action. When an alternating current is supplied, it causes a piezoelectric material to quickly expand and contract, resulting in sound waves. These buzzers are compact and lightweight, with a strong sound output for their size. The frequency it could produce is low which is 3.5 kHz, due to that low frequency, it travels at further distance.

Figure 2.13: *Mini piezo buzzer*

2.3 SELECTION OF IDEA, CONCEPT AND THEORY

2.3.1 Concept Generation of Aviation Life Jacket: Concept 1

CRITERION	CONCEPT 1	JUSTIFICATION
LIFE JACKET TYPE	**Ac-2000**	Lightweight design. Highest available buoyancy - 37.5 lbs. Single waist strap donning with easy quick fit buckle.
MATERIAL (TYPE)	**Nylon**	Silky smooth, strong, tough, durable Lighter weight compared to polyester.
SIZE	**40 × 40 × 10 Cm**	Bigger than standard size of aviation life jacket
COMPONENT	**GPS Device**	Can locate passenger easily
	Buzzer	To backup LED light
	Hbody Heating Pad	Can cover and heat up overall upper body
WEIGHT	**550 Gram**	Second lightweight

2.3.2 Concept Generation of Aviation Life Jacket: Concept 2

CRITERION	CONCEPT 2	JUSTIFICATION
LIFE JACKET TYPE	**Type I Offshore Lifejacket**	24 lbs. of minimum buoyancy 63 Sq. inches of SOLAS-grade reflective tape Weather and fade-resistant polyester
MATERIAL (TYPE)	**500 Denier Cordura Nylon**	Made with high tenacity air jet textured nylon 6,6 filament yarns.It is excellent resistance to abrasion and strong enough to anti-tear.
SIZE	**53.34cm X 43.18cm X 8.89cm**	Adult universal , child
COMPONENT	**MVtag GPS Tracker**	Real-Time Location Tracking Waterproof and Long-Lasting
	DC12 Piezo Buzzer	Lightweight, thin thickness, consumption, good reliability, cost,multi vibrator.
	Snap It! Heating Pad	Reusable,click and heat
WEIGHT	**810 Gram**	Heavier than others

2.3.3 Concept Generation of Aviation Life Jacket: Concept 3

CRITERION	CONCEPT 3	JUSTIFICATION
LIFE JACKET TYPE	**RFD 102 MK3**	Durability and is fully approved in Australia and features automatic inflation, water activated light, whistle and oral inflation tube. 10 year service interval.
MATERIAL (TYPE)	**Polyurethane Coated Nylon Fabric**	Offers a combination of unique benefits including durability, suppleness, breath ability, and an attractive appearance.
SIZE	**23cm X 45cm X 10cm**	Bigger from standard size of aviation life jacket
COMPONENT	**Sp01 GPS Tracker**	Portable Bluetooth connect Long lasting battery
	Piezo Buzzer (Alarm)	Sound output at 30cm Frequency 3500
	Self heating Air Activated Body Warmers	Disposable & Safe Easy to Activate Heats up in 20-30 minutes having up to 1+ hours of warmth
WEIGHT	**735**	Third lightweight

2.3.4 Concept Generation of Aviation Life Jacket: Concept 4

CRITERION	CONCEPT 4	JUSTIFICATION
LIFE JACKET TYPE	**AIC - 35**	This single cell vest is the lightest weight aviation vest in the world that only weighing 410 grams
MATERIAL	**Urethane Coated Nylon Fabric**	Strength and abrasion resistance UV resistance Easy to clean and maintain
SIZE	**27.94 x 20.32 x 5.72 cm**	Standard size of aviation life jacket
COMPONENT	**Neo-6M GPS modules**	Capable of receiving signals from multiple satellites to determine the module's precise position, time and velocity
	Mini piezo buzzer	Sound can be heard at further distance Small size and portable
	Heating pad	Easy to active and heat up Provide longest heat
WEIGHT	**410 gram**	Lightweight

2.4 COMPARISON BETWEEN RECENT RESEARCH AND CURRENT PROJECT

2.4.1 RFD 102 MK3 VS LIFESYNC TECH

PRODUCT	RFD 102 MK3	LifeSync Tech
DESIGN		
SAFETY FEATURES	• Buckle clip • Oral tube for inflation • Beacon light • CO_2 Tank	• GPS • Heating pad • Buckle clip • Oral tube • Beacon light • Buzzer
OPERATION	• Help survivor to float above water • Auto inflation	• Auto activated for GPS, buzzer and beacon light • Manual operation for heating pad

2.4.2 SP01 GPS Tracker VS NEO-6M

GPS MODULE	SP01 GPS Tracker	NEO-6M
DESIGN		
SIZE	52 mm x 38 mm x 21 mm	23mm x 30mm
BAUD RATE	9600 bps (Adjustable)	9600-230400 bps
ACCURACY	5m GPS Horizontal Position Accuracy	2.5m GPS Horizontal Position Accuracy

2.4.3 SELF HEATING AIR ACTIVATED BODY WARMERS VS CLICK HEAT REUSABLE HEAT PACK

PRODUCT	Self heating air activated body warmers	Click heat reusable heat pack
DESIGN		
SAFETY FEATURES	• Disposable & Safe • Easy to Activate • Heats up in 20-30 minutes having up to 1+ hours of warmth	• Easy to active and heat up • Provide longest heat
OPERATION	Activated by supplying current	Manually activated by click the metal clip

2.4.4 DUO PIEZO BUZZER VS PIEZO BUZZER

BUZZER MODEL	Duo Piezo Buzzer	Piezo Buzzer
DESIGN		
VOLTAGE	12V	12V
ADVANTAGES	• Light • Can withstand severe damage	• Sound can be heard at further distance • Small size and portable
OPERATION	Activate manually	Water activated

Our current project is concept 4 where we use it as our final product because it cheap and offer the most lightest material among others. Other than that, concept 4 has most durable material of life jacket since we emphasize the important of durability towards our project. We do not choose concept 1 due to its price where it become our main limitation even it gives lightweight to our project. Furthermore, concept 2 is the most durable but bare in mind it is the most expensive life jacket and the most heaviest. Concept 3 offers the most cheapest product among others but the durability will affect our project. Thus, Concept is the most suitable with our plan and budget.

CRITERION	CONCEPT 1	CONCEPT 2	CONCEPT 3	CONCEPT 4
Price	Expensive	Most expensive	Cheapest	Cheap
buzzer (frequency)	6900Hz	8000Hz	9000Hz	3500Hz
Life jacket (durability)	Durable	More durable	Less durable	Most durable
Life jacket (Weight)	Light	Heaviest	Heavy	Lightest
Heating pad (longetivity)	Last longer	Does not last long	Last long	Most long lasting

CHAPTER 3

RESEARCH METHODOLOGY

3.1 PROJECT BRIEFING AND RISK ASSESSMENT

The Lifesync Tech project intends to upgrade the ordinary life jacket to a multifunctional one with GPS and a heating function benefiting those who use it. This invention is primarily intended for passenger aircraft, but it may also be used by search and rescue teams. We proposed using GPS on life jackets to save time for search and rescue crews as well as saving more people's lives. Furthermore, this invention may be utilised to determine the victims' specific position. Moreover, due to the cold temperature of the ocean which is approximately around -2 to 16°C, the victims could die due to hypothermia. In order to counter that problem, a heating pad is attached to the back inner side of the life jacket to warm the victims as well as maintaining the condition of the victims. For this project, we planned to enhance the life jacket by adding features such as a Global Positioning System (GPS), heating pad, buzzer, and solar panel.

The life jacket we utilised for the project is the *AIC - 35*, which initially had an inflator, harness pull tab, CO_2 inflating system, RFID tag, Oral tube system, whistle, and light. Plus, the life jacket is notable for its small weight of about 410 grams. Furthermore, the dimension of this life jacket is (27.94 x 20.32 x 5.72) cm, which is suitable for a regular human size. Additionally, the material for this life jacket is urethane-coated nylon, it can sustain harsh weather due to the strength of the material itself.

3.1.1 Utilisation of Polytechnic Facility

For the development and testing of the GPS system for our prototype, it requires access to specific technical equipment to support its functionality especially on its electrical components. We have utilised our polytechnic facility for the essential resources to continue our progress.

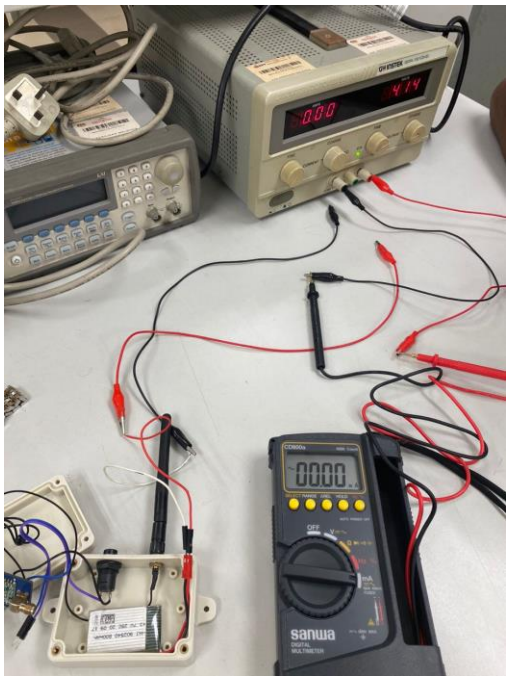


***Figure 3.1**: Utilisation of DC Power Supply*

The key facilities that we utilised is the laboratory DC power supply which is located in the Avionic lab. This is primarily used for:

- ***Testing and calibration***

  To power up the GPS receiver device and related electronic components during the development phase to ensure proper functionality.

- ***Simulating Real World Condition***

  To provide a stable voltage and current that can sustain according to the real world situation.

By using the laboratory DC power supply,We have ensured that our project is adhered to the electrical safety standards as well as maintaining the consistent performance during the testing. Last but not least, the availability of these resources contributes to project's successful development.

3.2 OVERALL GANTT CHART

PROJECT ACTIVITIES		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15
Discuss the Programmed Learning Outcome (PLO) and Course Learning Outcome (CLO)	P															
	E															
Assign first assignment about questionnaire	P															
	E															
Distribute questionnaire to the respondent	P															
	E															
Submission of Assignment 1	P															
	E															
Assign assignment 2 and 3	P															
	E															
Submission Assignment 2 and 3	P															
	E															
SV distribute pre proposal presentation assignment slide	P															
	E															
Presentation of our pre proposal to pane	P															
	E															
Assign of final proposal slide presentation	P															
	E															
Submission and presentation of final proposal to panel	P															
	E															

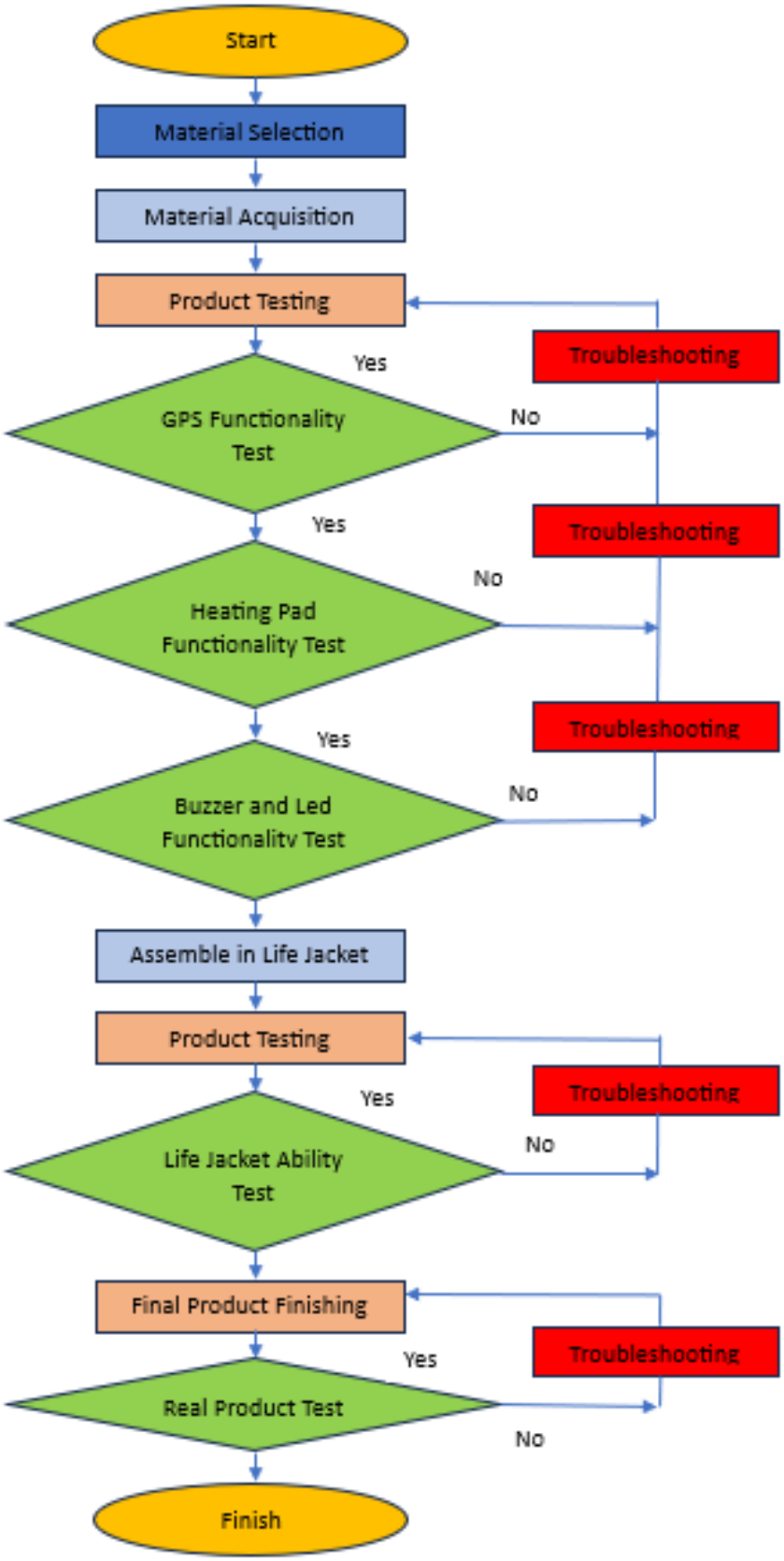
PLANNING

EXECUTED

Table 3.1: Gantt Chart Project

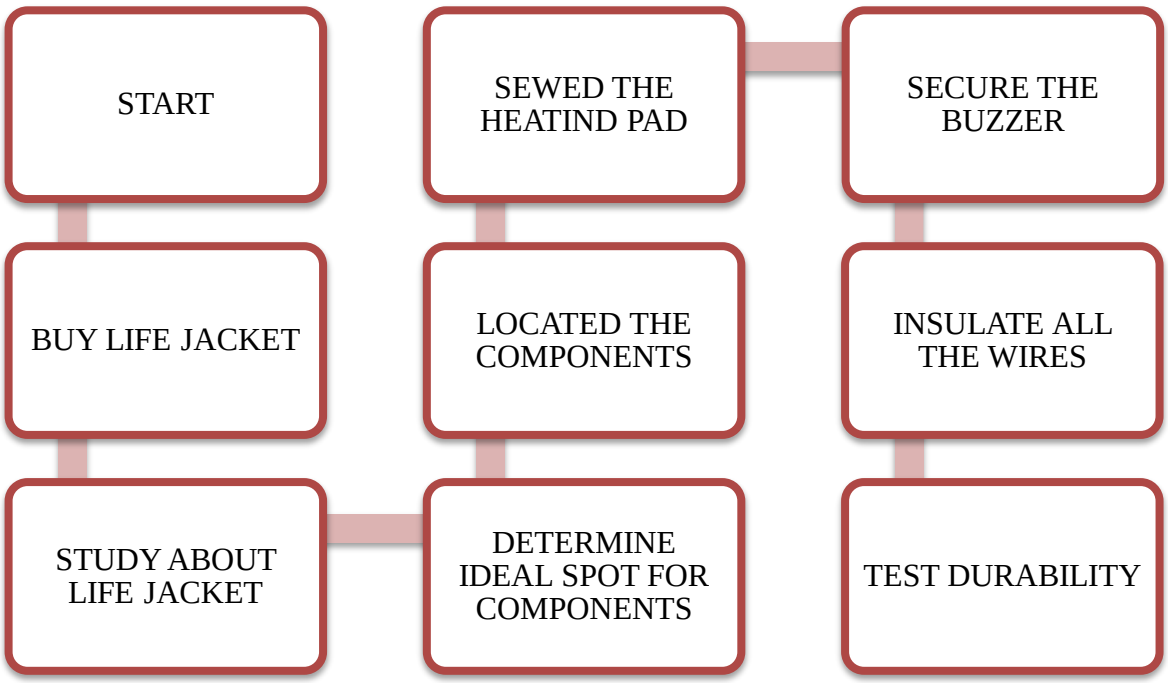
3.3 PROJECT FLOW CHART

3.3.1 Overall Project Flow Chart

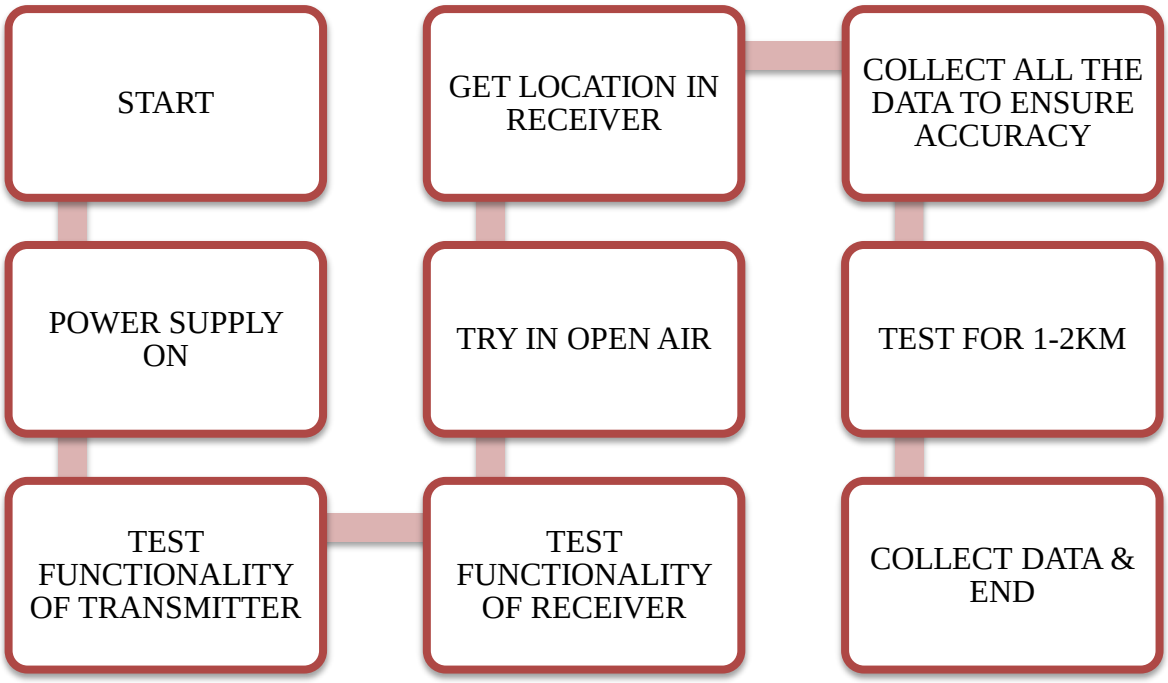


3.3.2 Specific Project Design Flow/Framework

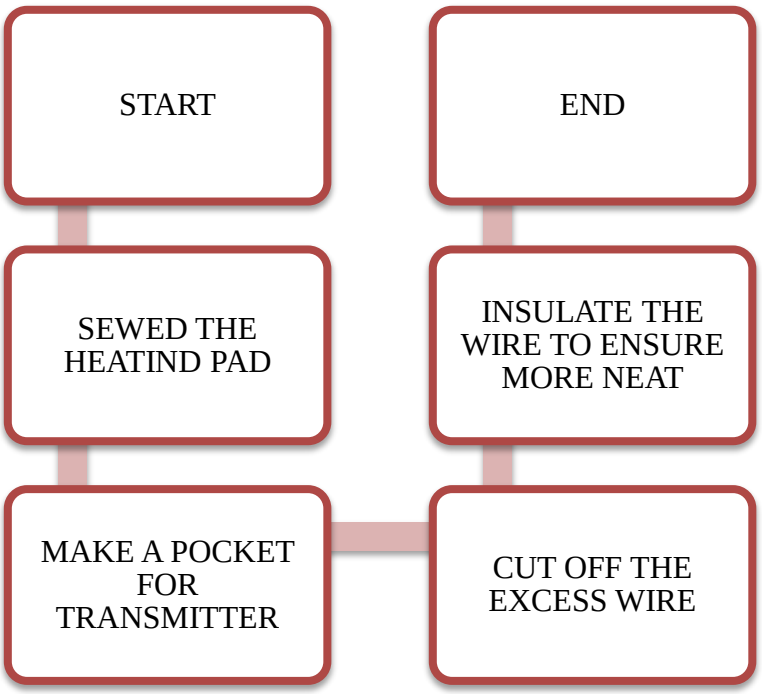
3.3.2.1 Product Structure



3.3.2.2 Product Mechanism



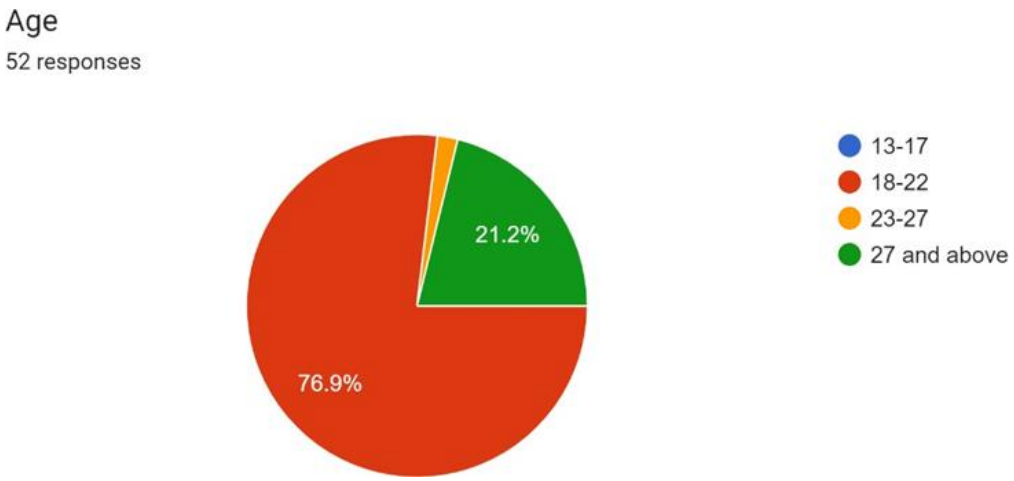
3.3.2.4 Accessories & Finishing



3.4 DESIGN ENGINEERING TOOLS

3.4.1 Design Requirement Analysis

3.4.1.1 Questionnaire survey



Figured 3.2: *Age of respondent*

According to the survey, most respondents are from 18-22 years old followed by the age of 27 and above with 21.2% and others are from 23-27 years old.

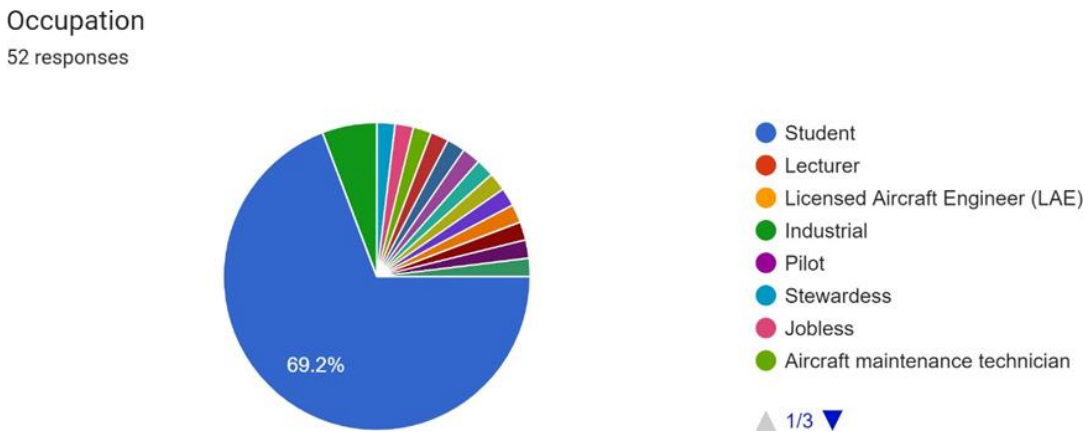


Figure 3.3: Occupation of respondent

From the survey, it shown that 69.2% from the respondents are students while others are from industrial, stewardess, pilot and more.

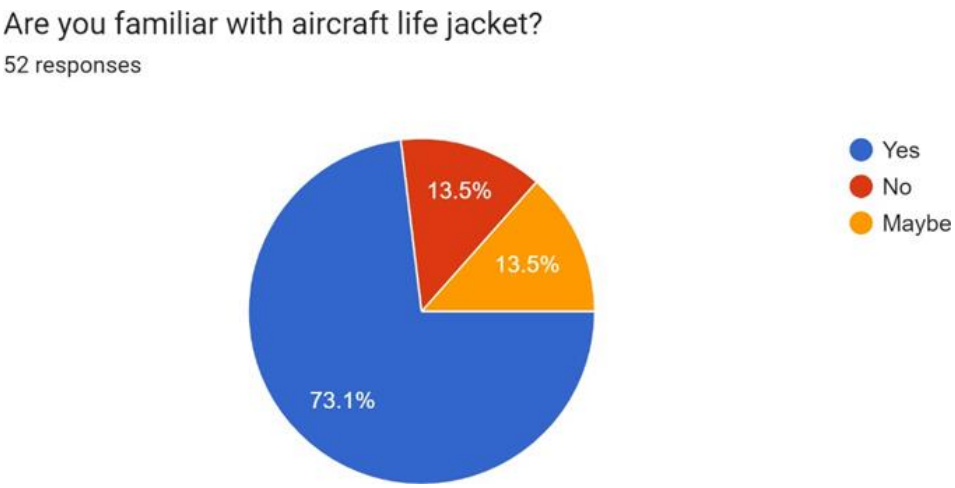


Figure 3.4: Familiar with aircraft life jacket

The survey revealed that a majority of individuals (73.1%) are acquainted with the aircraft life jacket, while 13.5% are not, and an additional 13.5% are uncertain.

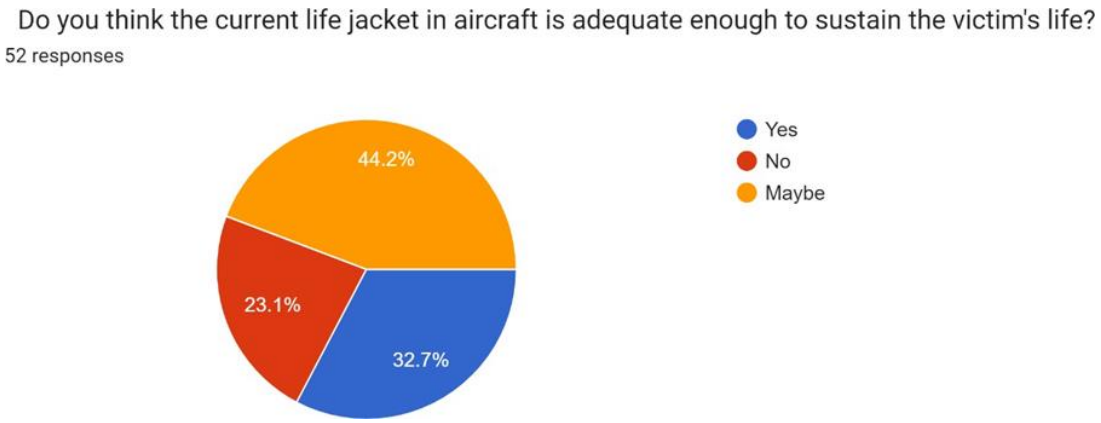


Figure 3.5: Life jacket adequately sustain victim's life

Based on the survey findings, it appears that the current aircraft life jacket might not adequately sustain the victim's life. This is supported by the fact that 44.2% of respondents expressed doubt about its sufficiency, while 32.7% stated that it is insufficient.

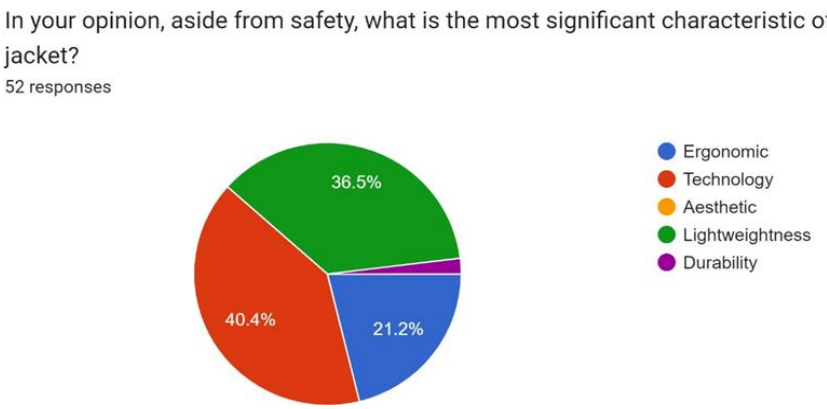


Figure 3.6: Significant characteristic of aviation life jacket

From the survey, the data shown a significant portion of respondents (40.4%) value technological features in aviation life jackets, an indicating for preference to have advanced materials or functionalities life jacket while 36.5% from the respondent's emphasis on lightweightness and attention to ergonomic design.

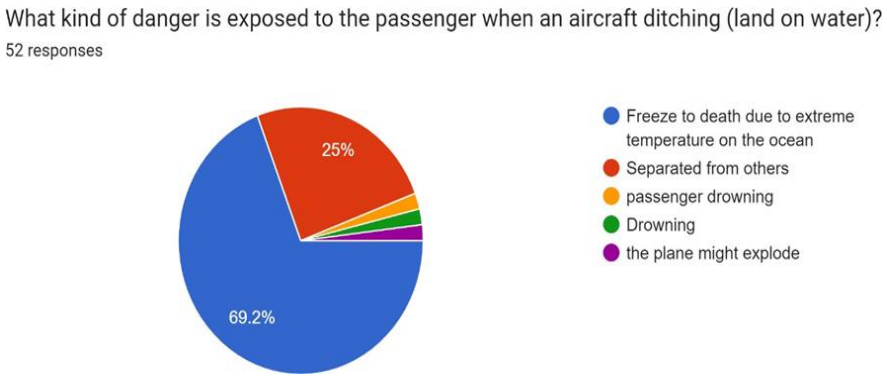


Figure 3.7: Kind of danger exposed

Based on the respondent's answers, the data highlights a significant fear among respondents regarding freeze to death due to exposure to extreme temperatures in the ocean after ditching. These findings underscore the critical importance of addressing cold exposure risks to enhance passenger safety and survival outcomes.

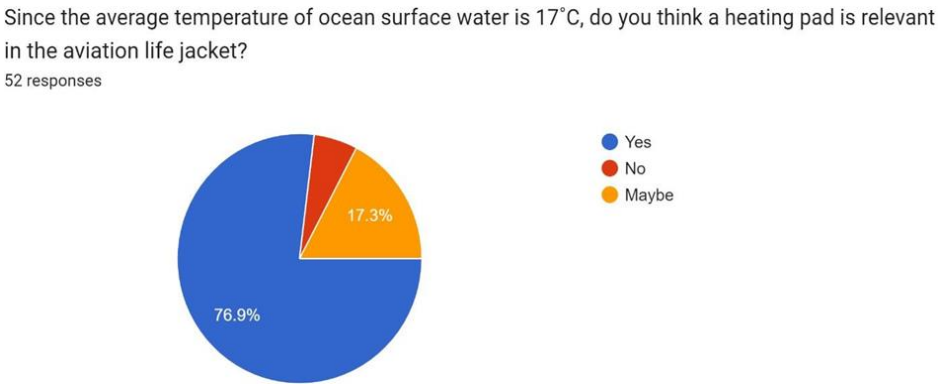


Figure 3.8: Average temperature of ocean

Results indicate that 76.9% of respondents answered affirmatively, suggesting strong support for adding the heating pad. Furthermore, 17.3% responded with 'maybe,' This data shows a significant consensus among respondents regarding the potential benefits of integrating heating elements into life jackets, likely driven by concerns about cold exposure in emergency situations

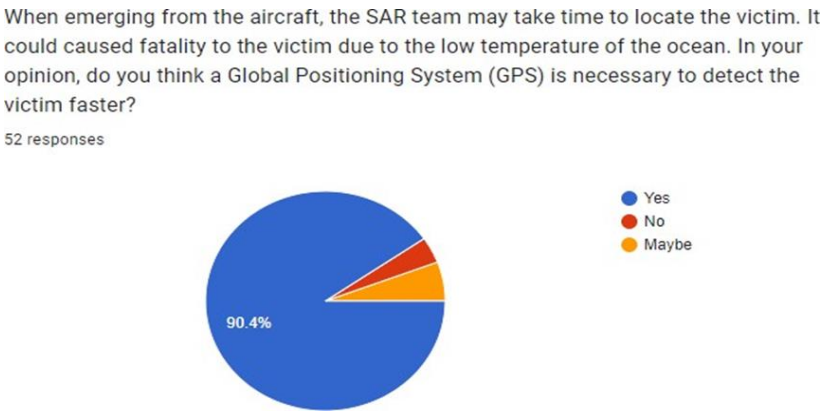


Figure 3.9: GPS essential in life jacket

From the chart, 90.4% of respondents agreed that a Global Positioning System (GPS) is essential in the life jacket to detect the victim faster. The other 9.6% respondents answered “no” and “maybe”. This shows that this benefits such technology of GPS could offer in expediting the detection and rescue of victims in emergency situations.

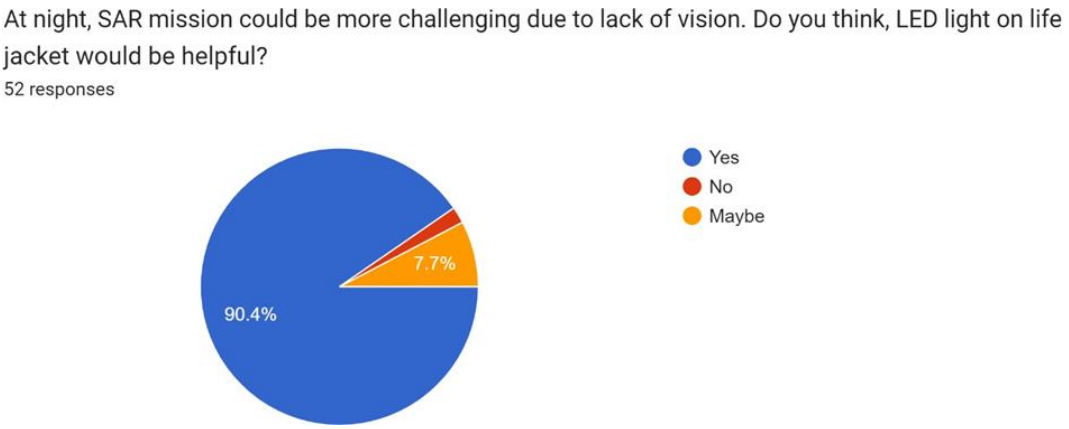


Figure 3.10: LED light could help SAR team

Based on the chart, 90.4% of respondents agreed that LED lights could help the SAR mission at midnight. LED lights provide bright illumination, making it easier for SAR team to spot victims since it increases the visibility of the victims.

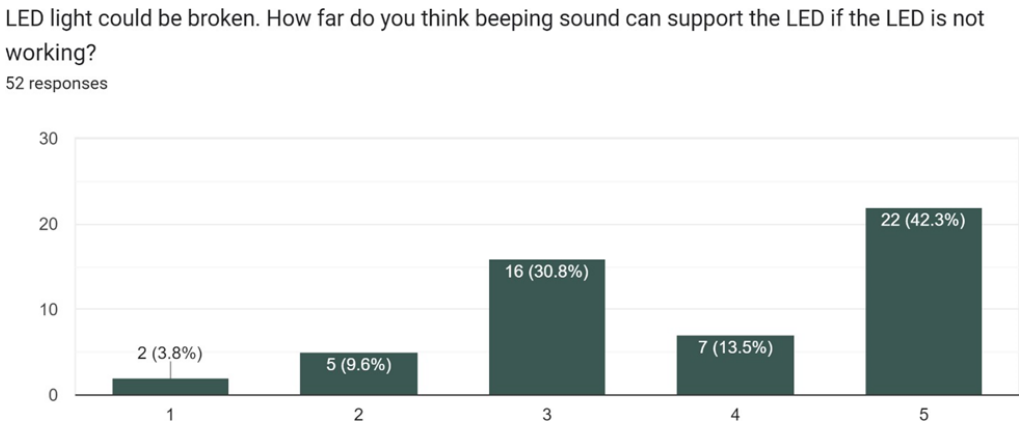


Figure 3.11: Adding beeping sound to aircraft life jacket

In answer to the survey, a total of 22 respondents indicated that they were in favour of the idea of adding a beeping sound to aircraft life jackets. As a backup plan in cases where the LEDs aren't working properly because of a variety of issues like malfunctioning devices or low power supplies, this suggested beeping sound is meant to increase the chances of finding victims

3.4.1.2 Pareto Diagram

Aircraft Life Jacket	Frequency	Percentage	Cumulative Percentage	Pareto Baseline
GPS Relevance	47	25%	25%	80%
Led Light Relevance	47	25%	50%	80%
Heating Pad Relevance	40	21%	71%	80%
Familiarity	38	20%	91%	80%
Suitability	17	9%	100%	80%
Grand Total	189			

Table 3.2: Pareto diagram

3.4.2 Design concept Generation

3.4.2.2 Morphological Matrix

CRITERION	CONCEPT 1	CONCEPT 2	CONCEPT 3	CONCEPT 4
Life Jacket type	 AC-2000	 Type I : Off shore life jacket	 RFD 102 mk3	 UXF - 35
Material (Type)	 Nylon	 500 Denier Cordura Nylon	 Polyurethane coated nylon fabric	 Urethane Coated Nylon fabric
size	40 × 40 × 10 cm	53.34 cm x 43.18 cm x 8.89 cm	23 x 45 x 10 cm	27.94 x 20.32 x 5.72 cm
Component	 GPS Device  Buzzer  HBody heating pad  Mini solar panel	 Solar Generated Power bank  Snap It ! Heating Pad  MVTAG GPS Tracker  DC12 Piezo Buzzer Continuous Buzzer Waterproof	 SP01 GPS Tracker  PIEZO BUZZER (ALARM)  Self Heating Air Activated Body Warmers  Mini Solar Panel	 NEO-6M GPS MODULES  Heating pad  Mini Piezo Buzzer  Flexible Solar Panel
Weight	550 gram	810 gram	735 gram	410 gram

Table 3.3: Morphological Matrix

3.4.2.3 Proposed Design Concept 1

CRITERION	CONCEPT 1	JUSTIFICATION
LIFE JACKET TYPE	AC-2000	Lightweight design. Highest available buoyancy - 37.5 lbs. Single waist strap donning with easy quick fit buckle.
MATERIAL (TYPE)	NYLON	Silky smooth, strong, tough, durable Lighter weight compared to polyester.
SIZE	40 × 40 × 10 cm	Bigger than standard size of aviation life jacket
COMPONENT	GPS DEVICE	Can locate passenger easily
	BUZZER	To backup LED light
	BODY HEATING PAD	Can cover and heat up overall upper body
WEIGHT	550 GRAM	Second lightweight

Table 3.4: Design Concept 1

3.4.2.4 Proposed Design Concept 2

CRITERION	CONCEPT 2	JUSTIFICATION
LIFE JACKET TYPE	**Type I Offshore Lifejacket**	24 lbs. of minimum buoyancy 63 Sq. inches of SOLAS-grade reflective tape Weather and fade-resistant polyester
MATERIAL (TYPE)	**500 Denier Cordura Nylon**	Made with high tenacity air jet textured nylon 6,6 filament yarns.It is excellent resistance to abrasion and strong enough to anti-tear.
SIZE	**53.34cm X 43.18cm X 8.89cm**	Adult universal , child
COMPONENT	**MVtag GPS Tracker**	Real-Time Location Tracking Waterproof and Long-Lasting
	DC12 Piezo Buzzer	Lightweight, thin thickness, consumption, good reliability, cost,multi vibrator.
	Snap It! Heating Pad	Reusable,click and heat
WEIGHT	**810 Gram**	Heavier than others

Table 3.5: Design Concept 2

3.4.2.5 Proposed Design Concept 3

CRITERION	CONCEPT 3	JUSTIFICATION
LIFE JACKET TYPE	**RFD 102 MK3**	Durability and is fully approved in Australia and features automatic inflation, water activated light, whistle and oral inflation tube. 10 year service interval.
MATERIAL (TYPE)	**Polyurethane Coated Nylon Fabric**	Offers a combination of unique benefits including durability, suppleness, breath ability, and an attractive appearance.
SIZE	**23cm X 45cm X 10cm**	Bigger from standard size of aviation life jacket
COMPONENT	**Sp01 GPS Tracker**	Portable Bluetooth connect Long lasting battery
	Piezo Buzzer (Alarm)	Sound output at 30cm Frequency 3500
	Self heating Air Activated Body Warmers	Disposable & Safe Easy to Activate Heats up in 20-30 minutes having up to 1+ hours of warmth
WEIGHT	**735**	Third lightweight

Table 3.6: Design Concept 3

3.4.2.6 Proposed Design Concept 4

CRITERION	CONCEPT 4	JUSTIFICATION
LIFE JACKET TYPE	**AIC - 35**	This single cell vest is the lightest weight aviation vest in the world that only weighing 410 grams
MATERIAL	**Urethane Coated Nylon Fabric**	Strength and abrasion resistance UV resistance Easy to clean and maintain
SIZE	**27.94 x 20.32 x 5.72 cm**	Standard size of aviation life jacket
COMPONENT	**Neo-6M GPS modules**	Capable of receiving signals from multiple satellites to determine the module's precise position, time and velocity
	Mini piezo buzzer	Sound can be heard at further distance Small size and portable
	Heating pad	Easy to active and heat up Provide longest heat
WEIGHT	**410 gram**	Lightweight

Table 3.7: Design Concept 4

3.4.3 Evaluation & Selection of Conceptual Design

CRITERION	CONCEPT 1	CONCEPT 2	CONCEPT 3	CONCEPT 4
Price	Expensive	Most expensive	Cheapest	Cheap
buzzer (frequency)	6900Hz	8000Hz	9000Hz	3500Hz
Life jacket (durability)	Durable	More durable	Less durable	Most durable
Life jacket (Weight)	Light	Heaviest	Heavy	Lightest
Heating pad (longetivity)	Last longer	Does not last long	Last long	Most long lasting

Table 3.8: Evaluation & Selection of Conceptual Design

3.4.3.1 Pugh Matrix

Features	Factor	Concept 1	Concept 2	Concept 3	Concept 4
Aesthetic (Type of life jacket)	**3**	**3**	**1**	**2**	**D A T U M**
Comfortability	**2**	**2**	**2**	**2**	
Weight	**3**	**3**	**1**	**2**	
Longetivity	**3**	**2**	**1**	**2**	
Total score	**11**	**10**	**5**	**8**	

Table 3.9: Pugh Matrix Concept 4 As A Datum

Legend:

1 = Least important

3 = Most important

3.5 PRODUCT DRAWING / SCHEMATIC DIAGRAM

3.5.1 General Product Drawing

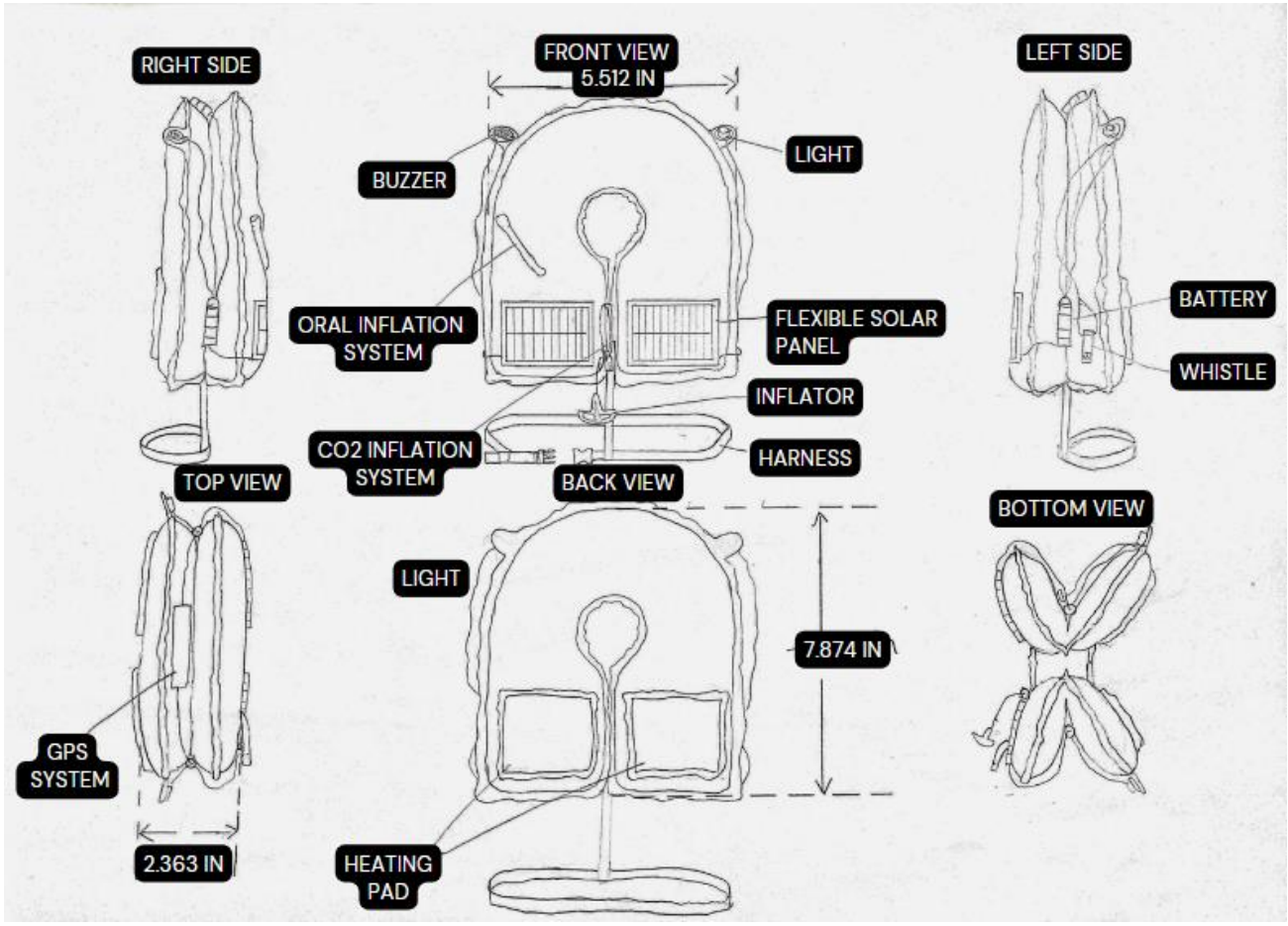


Figure 3.12: *General Product Drawing*

3.5.2 Specific Part Drawing / Diagram

3.5.2.1 Product Structure

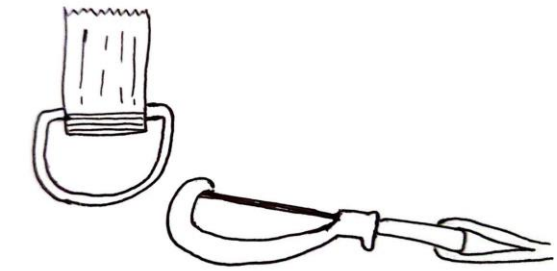


Figure 3.13: *Buckle Clip*

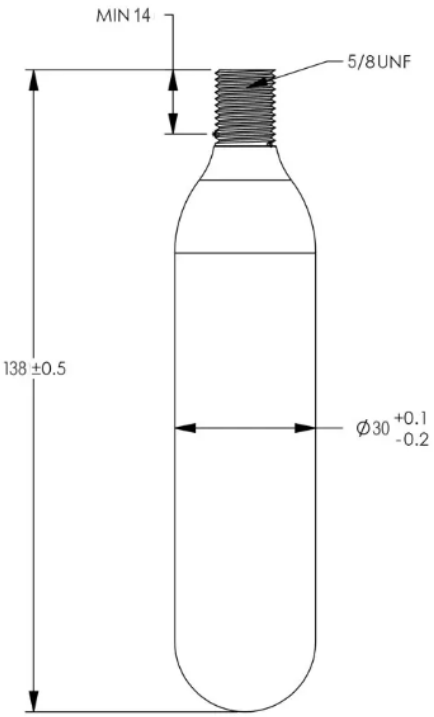


Figure 3.14: CO_2 Cylinder

Figure 3.15: *Neo-6m GPS*

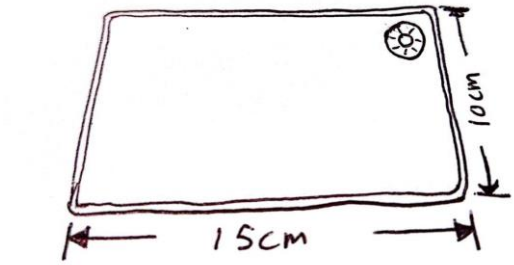


Figure 3.16: *Heating pad*

3.5.2.2 Product Mechanisms

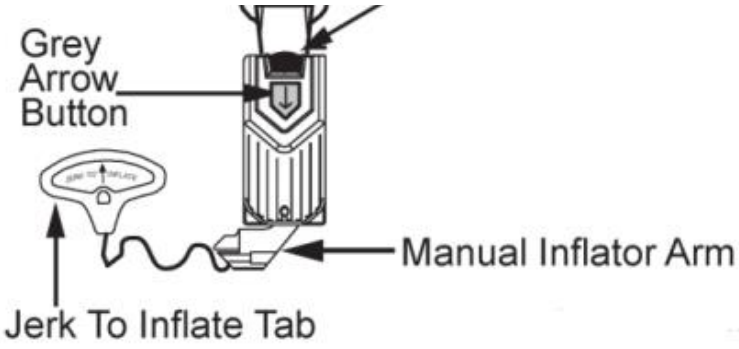


Figure 3.17: *CO_2 inflator mechanism*

3.5.2.3 Software / Programming

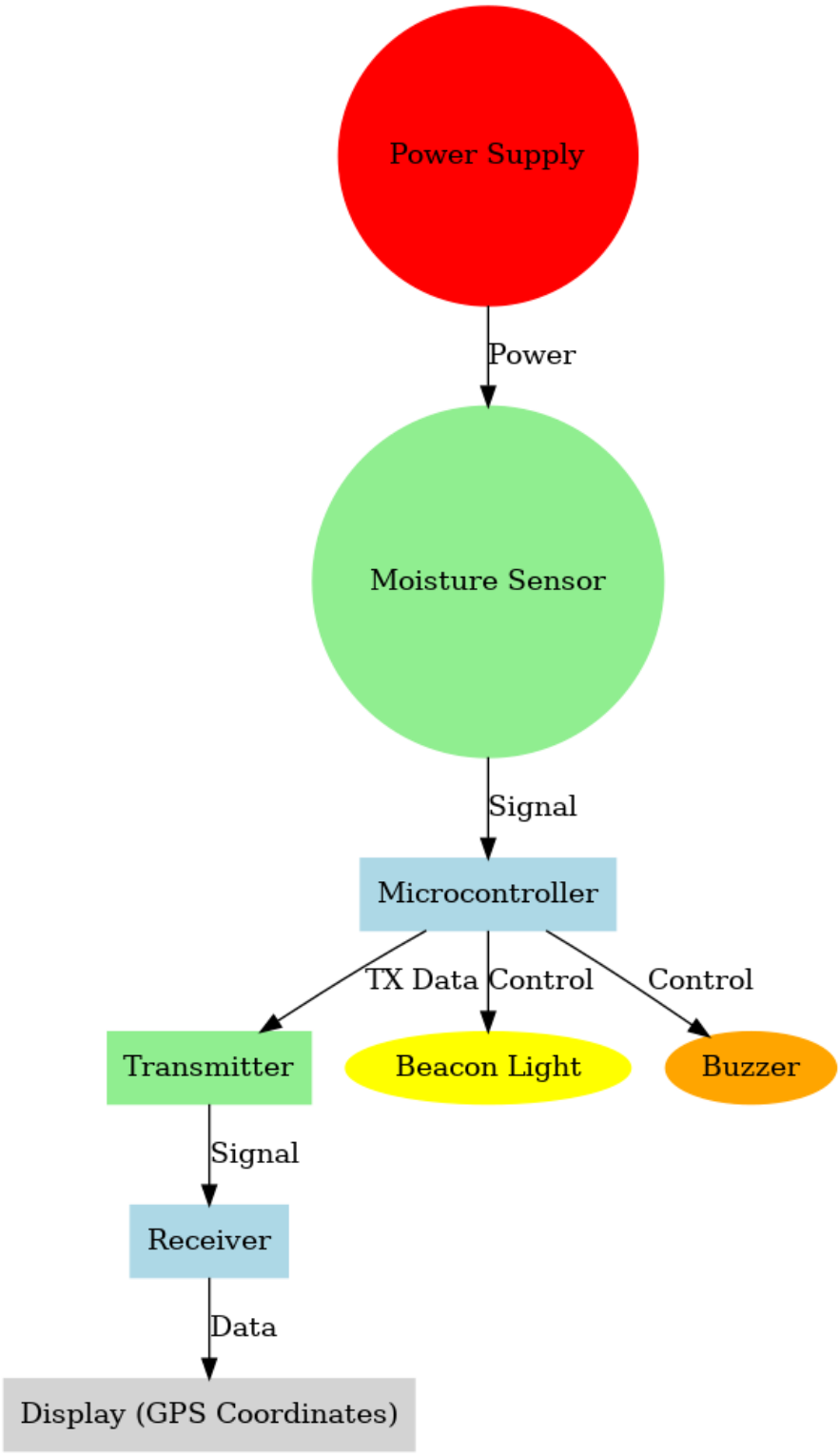


Figure 3.18: *System schematic diagram*

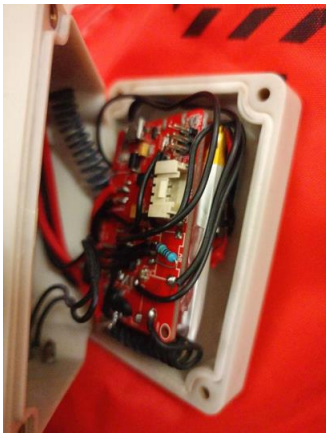
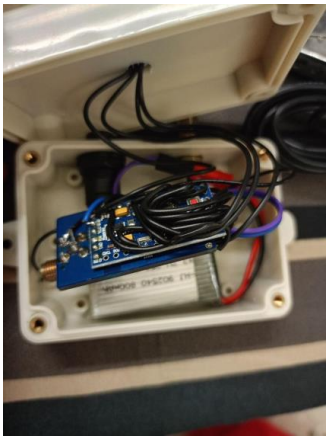
3.5.2.4 Accessories & Finishing

Figure 3.19: *Fabric glue*

Figure 3.20: *Nylon Fabric*

3.7 DEVELOPMENT OF PRODUCT

3.7.1 Material Acquisition

Materials	**Pictures**
GPS data transmitter module	
GPS data receiver module	
Antenna	

Heating pad	
Piezo buzzer	
Beacon light	

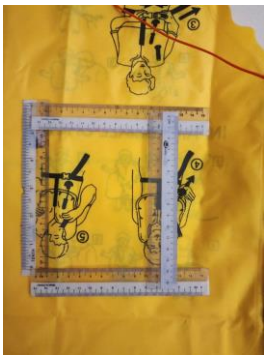
3.7.2 Machines and Tools

Tools & machines	Picture
Solder -used to melt the flux core at the soldering point.	
Flux core -used to solder the components at the PCB and wires with buzzer	
Measuring tape -use to measure the size of heating pad, transmitter and other components	

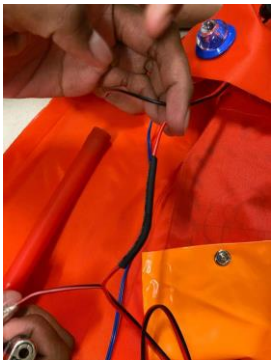
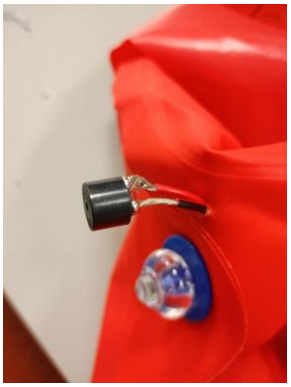
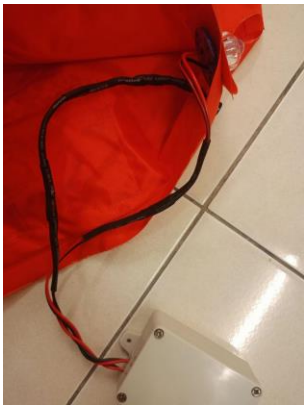
Heat shrink tube -used to insulated and waterproof wires	
Hot gun -used to shrink the heat shrink tube.	
Cutter -used to cut the wires.	
Multimeter -used to test the current flow in the wires	

3.7.3 Specific Project Fabrication

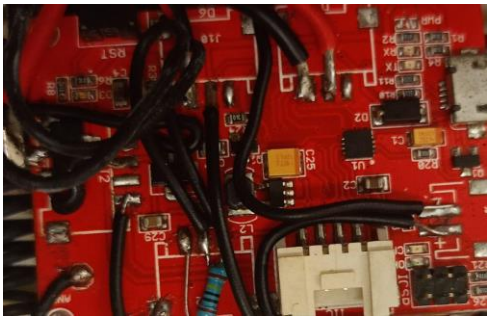
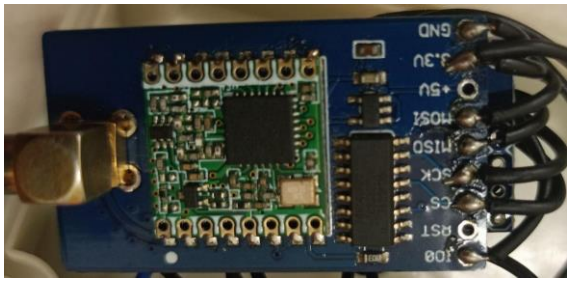
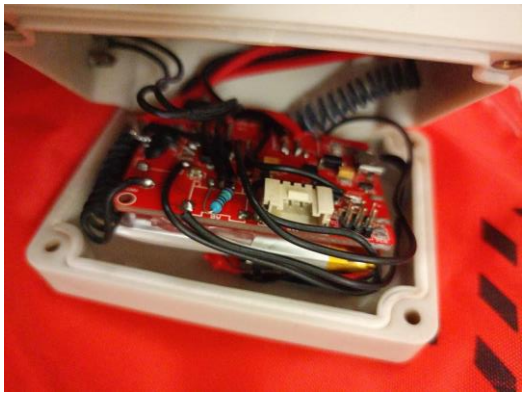
3.7.3.1 Base Structure (Phase 1)

Process	Picture
Identified the location of the heating pad	
Attached the heating pad to the life jacket	
Identified the place to locate transmitter	
Design a mini pocket that can fitted the transmitter	

3.7.3.2 Accessories & Mechanisms (Phase 2)

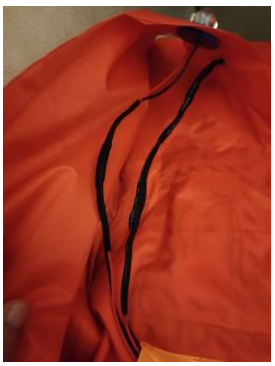
Process	Picture
Arrange the wiring of the buzzer and light	
Solder the buzzer and cover it by heat shrink tube	
Cover the wires with heat shrink tube	
Connect the buzzer and the light to the transmitter casing	

3.7.3.3 Programming & Electrical Circuit (Phase 3)

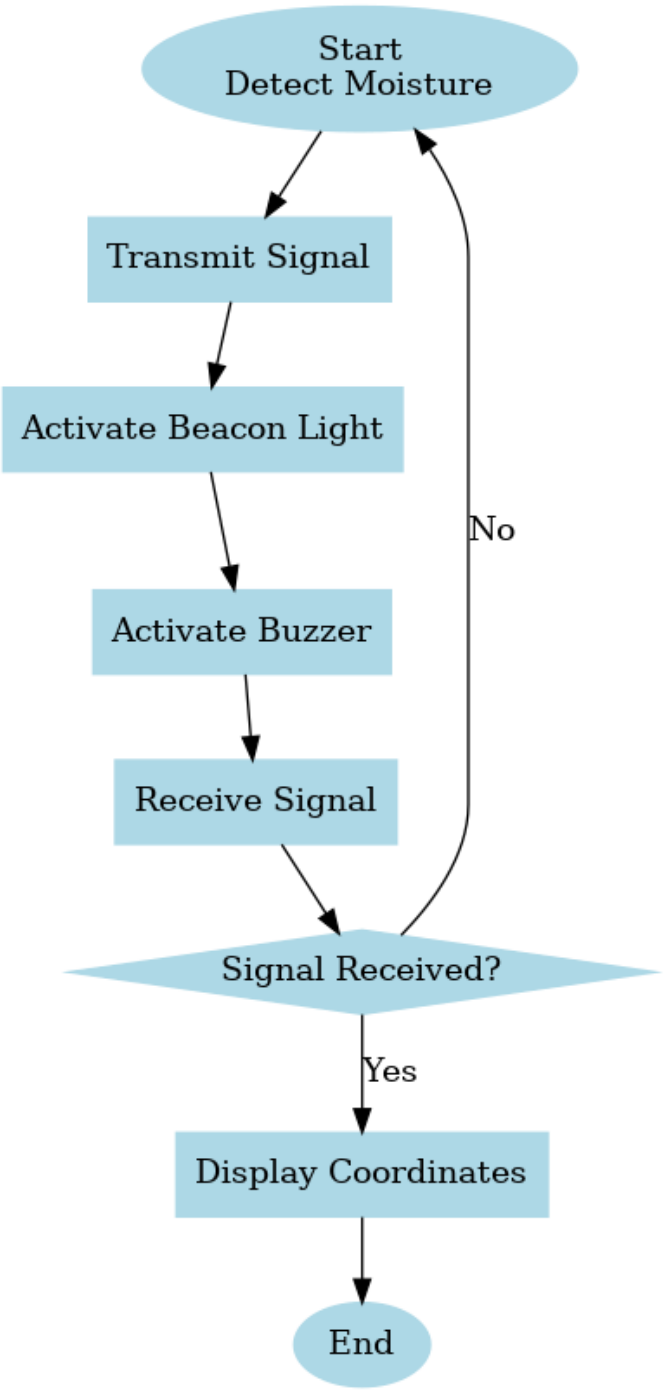
Process	Picture
Solder the wires to the transmitter PCB	
Solder the wires to the receiver PCB	
Place the transmitter PCB into the casing	
Place the receiver PCB into the casing	

Attach the antenna to the receiver	
Test run for the transmitter and receiver	

3.7.3.4 Finishing (Phase 4)

Process	Picture
Double check the wiring to make sure all secure and the water proof	
Functional test for all the components	

3.8 PRODUCT TESTING / FUNCTIONALITY TESTS



3.9 LIST OF MATERIALS & EXPENDITURES

LIFE JACKET AND ACCESSORIES				
NO.	**ITEMS DETAILS**	**UNIT**	**PRICE/UNIT (RM)**	**TOTAL (RM)**
1.	Life jacket (AIC-35)	1	500	500
2.	Life jacket (AV-35)	2	400	800
3.	Waterproof sealant	1	11.80	11.80
4	Waterproof tape	1	5.70	5.70
GLOBAL POSITIONING SYSTEM (GPS)				
1.	Neo-6m GPS	1	80	80
HEATING PAD				
1.	Chemical heating pad	2	14.90	29.80
BUZZER				
1.	Mini piezo buzzer	1	6.20	6.20
GRAND TOTAL				1433.50

CHAPTER 4

RESULT & DISCUSSION

4.1 PRODUCT DESCRIPTION

4.1.1 General Product Features & Functionalities

Lifesync tech is a game changing improvement for life saving devices, which is established to improve the survivability in a nautical or aerospace emergency scenario. This modern concept includes extreme features such as a GPS module, heating pad and a buzzer system that solve many severe problems concerning victims of the search and rescue operations. With the ultimate aim of Lifesync Tech to combine these technologies with the reliability and efficiency of the AIC-35 life jacket, the market was given a perfect option for individuals and rescue teams.

In the great multitude of functions performed by Lifesync Tech life jacket, its Global Positioning System (GPS) is one of the most sought- out features. With this integrated module, continuous positioning information is received, allowing search and rescue personnel to quickly and accurately determine the position of victims of the disaster. Given the ability to reduce response time tremendously, this feature has the potential of saving many lives during an emergency situation at sea or in a remote area. GPS also improves the efficiency of the detection system by reducing the time taken to locate a victim.

An additional critical improvement is the heating pad placed on the back of the life jacket, which is also one of the new features. The temperature of the ocean can be anywhere between minus 2 degree Celsius and 16 degree Celsius.

4.1.2 Specific Part Features

4.1.2.1 Product Structures

- CO_2 gas cylinder - Two 33 gram gas cylinders will be used. The approximate weight is 135 g and also has ½ inch threads. Most adults in 150N class can fit its design rather comfortably whether it is manual or automatic inflation.
- Strap buckle clip - As the term indicates, pressing in on the sides of this buckle ends up opening it for this particular model as opposed to other models that may have a centre or cam style release. Side release buckles are of different kinds, and each has its special application. Most side release buckles have two slots on them, one on either end, to attach a strap or cord. These slots are primary to the working of the buckle, however, it must be noted that every side buckle is not adjustable.

4.1.2.2 Products Mechanisms

The GPS type utilized was *NEO-6M GPS MODULES*, It is a family of standalone devices in a positioning engine. The module size is 23mm x 30mm and the update rate is 1Hz to 5Hz maximum. The tiny design and memory choices make it appropriate for battery-powered mobile devices with limited cost and space. It includes a receiver's exceptional navigation ability even in the most demanding settings. The GPS on the life jacket allows the search and rescue teams to shorten the rescue time and locate the latitude and longitude of the survivor.

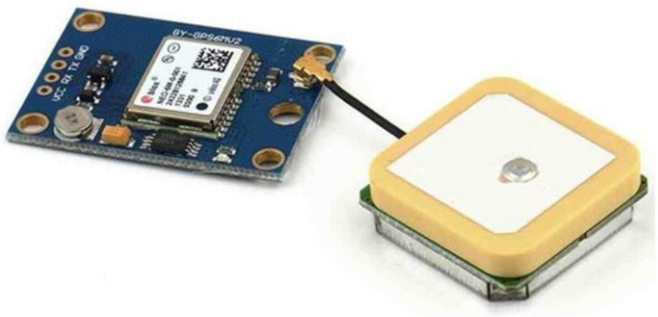


Figure 4.1: *NEO-6M GPS*

4.1.2.3 Software/Programming

We employed a tiny piezo buzzer, it produces sound by the piezoelectric action. When an alternating current is supplied, it causes a piezoelectric material to quickly expand and contract, resulting in sound waves. These buzzers are compact and lightweight, with a strong sound output for their size. The frequency it could produce is low which is 3.5 kHz, due to that low frequency, it travels at further distance.

Figure 4.2: Mini piezo buzzer

4.1.2.4 Accessories & Finishing

The heating pads can be used to help prevent hypothermia by aiding in the maintenance of body temperature. Hypothermia occurs when the body loses heat faster than it can produce heat, causing the body temperature to drop to dangerously low levels. The heating pad that we use comprises two pads, each of which may provide heat for up to 30 minutes. The heating pad is attached to the inner back of the life jacket, this is because it contacts most surface area with the human body.

Figure 4.3: Heating pad

4.1.3 General Operation of the Product

This product is operated as a standard life jacket except for the heating pad, GPS, and other components. Passengers should take out the life jacket from its compartment as soon as it faces any trouble. Then, wear it as instructed or follow the guidance.

As soon as the aircraft landed, passengers should inflate their life jackets. At the moment, all the electronic components will be water activated and turned on including GPS, buzzer and light. The transmitter will activate and send the coordinates of the passenger location to the receiver. The coordinates will display on the screen of the receiver and Search and Rescue (SAR) team will receive the location and take their action immediately. The buzzer and light will assists the SAR team to locate the passengers once they are nearby.

For the heating pad, the passengers should squeeze the heating pad to keep their body temperature warm to prevent hypothermia. The life jacket is attached with two heating pads, passengers can activate one by one and each heating pad can withstand 1 hour. Other basic components such as the oral tube can keep the life jacket inflated.

4.1.4 Operation of the Specific Part of the Product

4.1.4.1 Product Structure

Oral tube - All life jackets are designed to operate automatically when you fall into water. Single-chamber jackets can also be inflated manually by pulling on the lanyard attached to them. Both types of jackets are fitted with mouth tubes to enable you to inflate them orally. Many manufacturers have a C02 cylinder that does not fully inflate the air bladder, so the oral tube allows you to top up the bladder.

CO_2 gas cylinder- CO_2 is commonly used to inflate life rafts and inflatable life jackets because it is an inert, non-flammable, inexpensive gas which is easily obtained and cheap to manufacture worldwide. If you use your inflatable lifejacket, you will need to replace the CO_2 gas cylinder once it has been used.

Buckle clip - A harness will provide a secure tether point to your life jacket, allowing you to use a strap to attach a secure point and preventing a man overboard situation. Adjustable side buckle has a set of “teeth” inside these slots that grip the strap or cord. By pulling the material through the slot, you can determine the right length.

4.1.4.2 Product Mechanisms

When the transmitter is turned on by water, the receiver will receive the passenger coordinates and display them on the screen of the receiver. The transmitter will transmit the data once it reacts with water.

4.1.4.3 Software/Programming

The passengers are required to push the metal clip inside the heating pad themselves. Once they push the metal clip, the heating pad will activate and slowly heat up their body. There are two heating pads, passengers can choose to activate one by one or straight two at the same time. Each heating pad can withstand for 1 hour.

4.1.4.4 Accessories & Finishing

The buzzer will be activated together with the light and the transmitter. When activated, it will continue to produce 'beep' sound, the 'beep' sound will assist the SAR team to locate the passengers especially during night.

4.2 PRODUCT OUTPUT ANALYSIS

NO.	Criteria	Results	Remarks/ Descriptions	Analysis
1.0	**Range between transmitter & receiver to transmit and receive**			
1.1	500m	Able to transmit & receive	The data from the transmitter is transmit to the receiver and the receiver can receive the data faster	The range of the receiver to receive the data from the transmitter is around 500m-1500m
1.2	1000m	Able to transmit & receive	The data from the transmitter is transmit to the receiver and the receiver can receive the data fast	
1.3	2000m	Unable to transmit & receive	The data from the transmitter is transmit to the receiver and the receiver cannot receive the data	
2.0	**Time of Operation**			

2.1	Battery of the transmitter	90 minutes	The transmitter can power up 90 minutes continuously	The transmitter and receiver can work for 90 minutes while the heating pad can heat up for 60 minutes if active simultaneously and 120 minutes if active one by one
2.2	Battery of the receiver	90 minutes	The receiver can power up 90 minutes continuously	
2.3	Heating pad	60 minutes for each	Each heating pad can be active and heat up for 60 minutes continuously. If active one by one can withstand for 120 minutes.	

Table 4.1: *Product Output Analysis*

4.3 ANALYSIS OF PROBLEM ENCOUNTERED & SOLUTIONS

4.3.1 Product Structure (Design)

PROBLEM	SOLUTION
Circuit wire keeps disconnecting due to movement in the process of locating it in the life jacket	We arranged and separate each wires by heat shrink tube and secured each connector with tape to ensure there will be ni wire disconnecting
Transmitter unable to attached to the life jacket	We designed a pocket for the transmiiter to put inside.

Table 4.2: *Problem encountered and Solutions on Product Structure*

4.3.2 Global Positioning System (GPS)

PROBLEM	SOLUTION
The receiver cannot receive the data from the transmitter	Test run after do a proper reset on the transmitter and also receiver

Table 4.3: *Problem encountered and Solutions on GPS*

4.3.3 Piezo Buzzer

PROBLEM	SOLUTION
The wires keep disconnecting and also short circuit occur due to the two wire are contacted	We desoldering the wires and solder it back to avoid the wires contact together
The wires of the beacon light is not working and the wires of beacon light is connect together with the wires of the buzzer	We disconnect the wires of buzzer and beacon light and we do a current test with a multimeter. After identify the failure part, we change the wires that are not working with a new wires and do a test run for buzzer and beacon light

Table 4.4: *Problem encountered and Solutions on Buzzer*

4.3.4 Heating Pad

PROBLEM	SOLUTION
The heating pad is unable to attached to the life jacket by sewing	We find a better way which is gum the heating pad on the life jacket so it can avoid damage to the life jacket

Table 4.5: *Problem encountered and Solutions on Heating Pad*

CHAPTER 5

CONCLUSION & RECOMMENDATION

5.1 ACHIEVEMENT OF AIM & OBJECTIVES OF THE RESEARCH

5.1.1 General Achievement of the Project

As a final analysis, the aims and objectives which are listed during project planning were successfully accomplished. By integrating GPS tracking, a heating pad, LED lights, and an alert system into a single, innovative life jacket, LifeSync Tech directly addresses the critical needs of search and rescue operations and improves survival outcomes in challenging, high-risk environments.

A literature review of the study has been comprehensively developed throughout the project plan and this involves all the parts used to come out with our final product, Lifesync Tech. The differences between the Lifesync Tech and the current life jacket is the improvement and the efficiency of the product which is equipped with GPS for the location, heating pad to warm up the victim to avoid hypothermia and buzzer to alert SAR team at night. Lastly, we found that the common life jacket only uses the basic equipment such as whistle, oral tube and reflector while LifeSync Tech has more advanced safety features.

5.1.2 Specific Achievement of project objectives

5.1.2.1 Product Structure (Design)

In the part of designing, we had fully achieved the objective as we had chosen the high performing material that still maintain their durable and waterproof characteristic after going through multiple stages of modification and fabrication. Until now we still maintain the basic accessory such as oral tube, whistle and oxygen tank that need on a life jacket. Moreover, we had made addition that go along with our main objective of this project that is GPS and heating pad. At last, we always concern of user comfort to allow then feels better with the life jacket.

We had made a smooth clearance to the user to make them comfortable while using the life jacket.

5.1.2.2 GPS

The objective and aim of GPS stated at the beginning of the work are considered accomplished. The primary purpose of the GPS is to locate the location of the life jacket user by radio frequency between transmitter (on life jacket) to receiver (SAR team).

5.1.2.3 Heating Pad

In order to prevent victim from experiencing hypothermia, we embedded heating pad on both side. One heating pad can long lasting approximately 30 minutes. The victim need to push a metal clip inside to activate the heating pad.

5.1.2.4 Buzzer

A loud buzzer further assists in alerting nearby rescuers, adding an additional layer of safety by providing an audible signal that can help draw attention to the user's location. This buzzer can act as backup especially at night if LED light turn off. Approximately the buzzer can withstand up to 30-45 minutes with powered up by Lofi battery.

5.2 CONTRIBUTION OR IMPACT OF THE PROJECT

We hope the LifeSync Tech is a credible guide for further enhancement in safety for variety field. LifeSync Tech is an invented life jacket that has unique technology such as heating pad and GPS that locate victim location. Furthermore, in the methodology section, it is clearly demonstrated the features and functionality of LifeSync Tech that have safety features and designated for the use in increasing the safety of the user. In addition, the innovation of the heating pad that helps the victim from experiencing hypothermia (very low temperature) is the main cause of people dying on the ocean.

5.3 IMPROVEMENT & SUGGESTIONS FOR THE FUTURE RESEARCH

There are some drawbacks in the studies that lead to impacting the precision and quality of the study purpose and targets. However, in order to significantly increase the reliability of the experiments and test outcomes of the study, there is still a room for progress to take place. The enhancement can be classified into three distinct fields as follows:

5.3.1 Product structure

1. Find out a life jacket supplier that can customize the life jacket according to our needs so that we can easily access and located the component inside the life jacket without disturbing the life span of it.
2. Invest money in the highest quality base board to our component to fit properly
3. Use auto inflation life jacket system that can parallel with our LifeSync Tech. It will help a lot for users if facing any panic situation.

5.3.2 Product Mechanisms

1. Incorporating nanotechnology into LifeSync Tech’s design represents an innovative leap in personal flotation device engineering, significantly enhancing the life jacket’s weight efficiency and space-saving capabilities

5.3.3 Software

1. Find better way to make it more aesthetic look and reliable
2. Auto heated up victim when in contact with water

5.3.4 Accessories & Finishing

The improvement and suggestion for future research are we plan to put solar panel that will power up all the features. For example, If the solar panel expose to the sun for a particular amount of time, it will triggered the GPS, buzzer and LED. Additionally, It would be possible to attach flexible or thin-film solar panels to the life jacket's surface without significantly increasing its bulk or weight. The wearer's comfort and movement are preserved by these lightweight panels that fit the design of the life jacket.

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APPENDICES

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1.5.2.1	Specific Individual Scope: Product Structure
2.2.1	Specific Literature Review: Product Structure
2.3.1.1	Review of Recent Research / Related Products: Concept 1
2.3.2.1	Recent Market Products
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3.3.2.1	Specific Project Design Flow / Framework: Product Structure
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3.7.3.1	Specific Project Fabrication: Phase 1
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3.3.2.2	**Specific Project Design Flow / Framework: Product Mechanisms**
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3.5.2.2	**Specific Part Drawing / Diagram: Product Mechanisms**
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5.1.2.2	**Specific Achievement of Project Objectives: Product Mechanisms**
5.3.2	**Improvement & Suggestions For Future Research: Product Mechanisms**
	EDWIN NG SER YEE
1.3.2.3	**Specific Individual Project Aims: Software / Programming**
1.5.2.3	**Specific Individual Scope: Software / Programming**
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1.3.2.4	**Specific Individual Project Aims: Accessories & Finishing**
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3.4.2.6	**Design Concept Generation: Concept 4**
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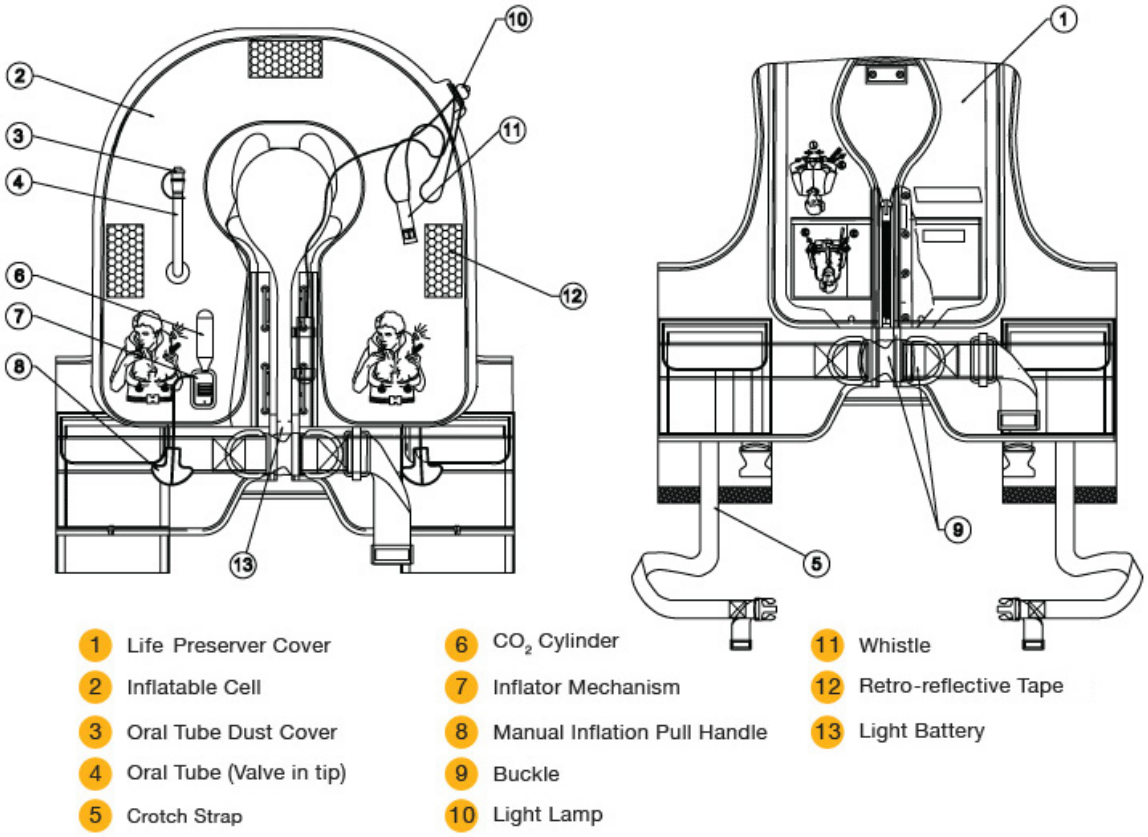
5.3.4	**Improvement & Suggestions For Future Research: Accessories & Finishing**

APPENDIX A: EXAMPLE OF AVIATION LIFE JACKET



APPENDIX B: HOW DO AVIATION LIFE JACKET WORKS?

How does a life vest work?

Assuming you don't intend to wear a bulky foam life jacket, you will be choosing an inflatable style. Our inflatable life vests are manually activated.

Manual vests work by the wearer pulling a cord to puncture a compressed carbon dioxide gas canister and release the gas which inflates the vest.

Redundancies keep us alive and the life vest manufacturers have built in a backup system. If for some reason your vest fails to inflate when you pull the tab, don't worry. Your vest is also equipped with a blow tube. Simply blow into the tube to inflate the vest.

If you're worried about accidental inflation in the cockpit, know that it's not very likely with a manually inflating vest.

For the vest to inflate accidentally, you would have to catch the pull tab on something. Since the tab has a very low-profile design and hangs flat against the vest, the odds of this happening are negligible.

APPENDIX C: THE IMPORTANCE OF LIFE JACKET ON AIRCRAFT

It's Called a **'Life' Jacket** for a Reason

A ditching in 2013 illustrated how important life jacket wearing is, even if passing over water for a little while. And a could-have-ditched incident last year echoed that.

In August 2015, when the engine of ZK-RTE broke down five nautical miles off the Canterbury coast, the pilots executed a pretty flawless return to Christchurch International Airport.

Their emergency training kicked in, and while they were fully aware of the danger they were in, the atmosphere in the Piper Arrow cockpit was calm and measured.

The only hiccup in their studied calm was having to hastily don life jackets. While stowed in the aircraft, they had not been put on before the flight took off, despite the fact it was, for some time, over water.

Tension rose when the pilot-in-command, Craig Vause, had trouble getting his life jacket on, because it twisted as he tried to do so. He was, however, successful on a second attempt.

Steven Perreau, in the right seat, told *Vector* in November 2015 that not having those life jackets already on was a real mistake.

"It was a curious decision, given my practice of always doing so if I'm flying over water," Steven told us. "It was definitely not the right decision to make!"

A 2003 report for Transport Canada, *Survival in Cold Water*, says that operating close to shore or in a group, or with an emergency beacon, are not reasons to go without wearing a life jacket.

Death from cold shock could occur within 3 to 5 minutes, the report said.

A quality life jacket will keep its wearer buoyant for as long as needed. American research indicates that general aviation ditching survival rates could be as high as 90 per cent *if* the aircraft occupants are wearing life jackets.

Modern inflatable aviation life jackets are more comfortable and fit for purpose than the old, bulky ones. And the cost, relative to the cost of flying, is not high.

So there are two fewer reasons to resist wearing one.

Remember, however, that the life jacket must meet certain requirements. They can be found in Part 91, Appendix A14.

On 24 February 2013, a Robinson R44 helicopter ditched, fortunately, in only waist-deep water, about 80 metres off the shore of Lake Rotorua.

The subsequent Transport Accident Investigation Commission report said, "The helicopter was fitted with life jackets for everyone on board, and these were stored underneath the seats. The life jackets were not used during the emergency as there was not enough time for the occupants to locate and don them."[1]

Rule 91.525 *Flights over water* states there should be one life jacket for each person on board a variety of aircraft in a variety of situations, and that those life jackets should be stowed in a "position that is readily accessible from the seat or berth occupied by the person". The pilot-in-command should brief passengers on the place the life jackets are stowed, as part of the standard passenger safety briefing.

But, as *Vector* reported exactly 13 years ago, "If the ditching preparations begin at a low altitude, the chances of the aircraft's occupants being able to get into a conventional airline-style life jacket in time are almost nil".

If the intention is to fly over water during any part of the journey, the CAA strongly recommends a pre-flight procedure should include all occupants donning a life jacket.

It could save lives. At the very least, it will save unnecessary angst.

Just ask Craig and Steven. ■

If the intention is to fly over water, even if briefly, the pre-flight procedure should include all occupants donning a life jacket.

Inquiry AO-2013-002: Robinson R44, ZK-HAD, engine power loss and ditching, Lake Rotorua, 24 February 2013.

APPENDIX D: DESIGN OF GPS SYSTEM FOR TRACKING A LIFE VEST

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Design of GPS System for Tracking a Life Vest

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***Abstract*—Global Positioning System (GPS) is a satellite navigation system used to determine the ground position of an object. Nowadays, the GPS equips in many commercial products such as smartphones, sport watches, car dash camera and hiking. It apparently has unforeseen benefits to society that go well beyond military and civil aviation applications. In time of emergency crisis (for instance, aircraft crash at sea or ship sinking), survivors need to be found and rescued in a short time. Therefore, this paper proposed a life vest with GPS tracking capabilities. The system consists of Radio Frequency (RF) transceiver, life vest, GPS Module and GPS cockpit tracking program. The GPS module attached to the life jacket. The design of GPS tracking life jacket comprises two segments, one is GPS life jacket tracking system and another one is receiver system. The GPS module works with the RF transmitter to convey series NMEA 0183 format messages to receiver system. These messages possess longitude, latitude, time, date and other satellite information. Based on the GPS data received, the cockpit GPS tracing program would extract the latitude and longitude. Then, the coordinate position of the survivor pinpoints on the Google Map. The proposed system has been tested in a field and displayed good performance compared to a standard GPS device.**

Keywords- Longitude; Latitude; Google Map; NMEA 0183 messages; RF transceiver; GPS

I. INTRODUCTION

Drowning can happen in an instant. Life jackets/vests are designed to keep you from drowning in the water even you are not excellent swimmers. Wearing the life jacket surly will help us stay afloat over the water's surface. In addition, it keeps us warm if we are stuck in cold water awaiting rescue team. In case you lose consciousness, it developed to turn your face up for better breathing even if you are not awake. The rescue team often takes from several hours to several days to rescue a victim when an aircraft or ship accident happens. It has been noticed that the death of victims could happen even though they have wearing the life jacket. The main reason that causes the death of a victim is usually from hunger, exhaustion, thirsty and taking long time to rescue the victim. Therefore, it is necessary to shorten the rescue time as much as possible and precisely identify the coordinate position of the survivors. The GPS tracking system provides a unique opportunity to overcome these difficulties.

Design of GPS tracking life jacket is mainly applicable in salvage system where the rescue teams could immediately find out the coordinate position of the survivor in time of emergency. This work may cause a significant reduction in the number of deaths when the rescue teams carry out suitable action for rescuing the survivors. In the past years, various tracking/monitoring systems had been proposed and designed using GPS modules. In 2015, Isha and Dilip proposed a wearable smart locator band [1]. This electronic device can be worn on the wrist of the children to monitor and keep an eye on them. The system is very useful in case the children suffer from diseases like autism or dementia. Pankaj and Bhatia have designed GPS/GSM based vehicle tracking system and track the vehicle on Google Map. Moreover, this thought provides the shortest route to reach vehicle easily in negligible time [2]. The authors in this paper [3] proposed a GPS tracking system called Goo-Tracking using a client-server model. Client is an embedded device with a GPS/GPRS module to recognize device location information that is periodically transmitted to a server. On the other hand, server is a personal computer with a web server program to receive the location information that is then converted into the format that can be displayed by using Google Earth software or Google Map technology.

The rest of paper is organized as follows: Section 2 introduces system overview, and then Section 3 describes the design consideration. The result and discuss is conducted in Section 4. Finally, the conclusion is drawn in Section 5.

II. SYSTEM OVERVIEW

The proposed system is divided into two parts: GPS life jacket tracking system and receiver system as shown in Fig. 1 and

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APPENDIX E: HOW GLOBAL POSITIONING SYSTEM (GPS) WORKS

HOW GPS WORKS

GPS satellites circle the Earth twice a day in a precise orbit. Each satellite transmits a unique signal and orbital parameters that allow GPS devices to decode and compute the precise location of the satellite. GPS receivers use this information and trilateration to calculate a user's exact location. Essentially, the GPS receiver measures the distance to each satellite by the amount of time it takes to receive a transmitted signal. With distance measurements from a few more satellites, the receiver can determine a user's position and display it electronically to measure your running route, map a golf course, find a way home or adventure anywhere.

Today, GPS is built in to all types of devices, such as smartwatches, satellite communicators, automobiles, boats and more. To calculate your 2D position (latitude and longitude) and track movement, a GPS receiver must be locked onto the signal of at least three satellites. With four or more satellites in view, the receiver can determine your 3D position (latitude, longitude and altitude). Generally, a GPS receiver will track eight or more satellites, but that depends on the time of day and where you are on the Earth. Some devices can do all of that from your wrist.

Once your position has been determined, the GPS unit can calculate other information, such as:

- Speed
- Bearing
- Track
- Trip distance
- Distance to destination
- Sunrise and sunset times
- And more

APPENDIX F: SEARCH AND RESCUE

Search and Rescue (SAR)

Definitions

Search and rescue service. The performance of distress monitoring, communication, coordination and search and rescue functions, initial medical assistance or medical evacuation, through the use of public and private resources, including cooperating aircraft, vessels and other craft and installations.

Search. An operation normally coordinated by a rescue coordination centre or rescue subcentre using available personnel and facilities to locate persons in distress.

Rescue. An operation to retrieve persons in distress, provide for their initial medical or other needs, and deliver them to a place of safety.

Source: ICAO Annex 12

Description

Search and rescue (SAR) service is provided to the survivors of aircraft accidents as well as aircraft in distress (and their occupants) regardless of their nationality. The basic elements include a legal framework, a responsible authority, organized available resources, communication facilities and a workforce skilled in coordination and operational functions.

The SAR service, while related to the alerting service, is not part of the air traffic services (ATS), as it does not fulfill any of the ATS objectives, as defined in Annex 11, Chapter 2. It is therefore often performed by agencies other than ANSPs (although close cooperation with the ATS units is ensured by the establishment of relevant procedures).

The states define the regions within which SAR service is provided. These regions do not overlap and normally coincide with the corresponding flight information regions (FIRs). Nevertheless, neighbouring states are advised to develop common SAR plans and procedures to facilitate coordination of these operations. Based on such coordination (and subject to relevant national law), a state would permit immediate entry into its territory of search and rescue units of other states for the purpose of searching for the site of aircraft accidents and rescuing survivors. Also, arrangements are made so that aircraft, vessels and local services (which are not part of the SAR organization) cooperate in search and rescue effort and assist the survivors of aircraft accidents.

The provision of SAR is organized by rescue coordination centres (RCCs). They are staffed 24 hours a day by trained personnel proficient in the use of the language used for radiotelephony communications and have means of rapid and reliable two way communication with appropriate units and facilities (e.g. ATS units, SAR units, the regional Cospas Sarsat Mission Control Centre, etc.).

SAR operations are conducted by SAR units. They are elements of public or private services designated by the states and are composed of trained personnel and provided with appropriate equipment (including appropriate communication eqiupment). They may be complemented by other units that do not qualify as SAR units but are nevertheless able to participate in such operations.

Pilots of other aircraft in the vicinity assist the SAR operation by obtaining and providing useful information to RCCs or ATS units, e.g. type and position (coordinates) of the aircraft in distress, information about survivors, weather, etc. Also, any distress transmission must be acknowledged and forwarded to the appropriate RCC or ATS unit.

SAR operations continue until all survivors are delivered to a place of safety or until all reasonable hope of rescuing survivors has passed. The decision to discontinue the SAR operation is made by the responsible RCC.

APPENDIX G: WARMING LIFE JACKET

A warming life jacket

New liner contains a substance that helps fight heat loss in chilly water

By **Sid Perkins**

May 28, 2013 at 7:04 am

New life saver
A 17-year-old from South Africa has invented a warming liner (blue cloth liner, shown on table) for life jackets. Patrick Thornton, SSP

Sometimes the biggest threat from a boat sinking isn't the accident itself. It's not even the sharks that might be swimming nearby. It's a life-threatening loss of body heat from remaining too long in cold water. Now, a South African teen has invented a heat-producing liner for life jackets. It could help delay injuries — or death — until a rescue is possible.

Normal body temperature for people is around 37° Celsius (98.6° Fahrenheit). But when the core body temperature falls below 35° C (95° F), people suffer from something called hypothermia. When this occurs, the body doesn't function quite the way it should, says Danielle Mallabone. She is a 17-year-old junior at St. Teresa's High School in Johannesburg, South Africa.

With mild hypothermia, blood vessels just beneath the skin shrink. This restricts blood flow to help cut the loss of heat from blood. (As blood cools, it speeds the cooling of internal tissues.) Hypothermia also triggers shivering. Those muscle contractions help generate heat to somewhat boost the body's internal temperature, she notes.

During severe hypothermia, things get much worse. People become confused and uncoordinated. They also have difficulty speaking. Eventually, major organ systems such as the heart will fail. This can lead to death.

APPENDIX H: COPSAS-SARSAT

MEOLUT NEXT: A BREAKTHROUGH TECHNOLOGY DEDICATED TO SATELLITE SEARCH & RESCUE

Thales Alenia Space is offering a breakthrough technology for satellite Search & Rescue, called MEOLUT Next. The solution will be deployed within the scope of the global COSPAS-SARSAT system.

What is COSPAS-SARSAT?

COSPAS-SARSAT is an intergovernmental organization founded in 1985, providing a free global Search and Rescue (SAR) service, using the infrastructures from 47 countries worldwide. As a participating nation, the Australian Maritime Safety Authority manage search and rescue responses across our region.

Today, nearly 1 million ships and 300,000 aircraft are equipped with COSPAS-SARSAT distress beacons, allowing them to use this service. The service has saved more than 57,000 lives since its inception in the early 1980s, and in recent years has saved an average of seven lives every day.

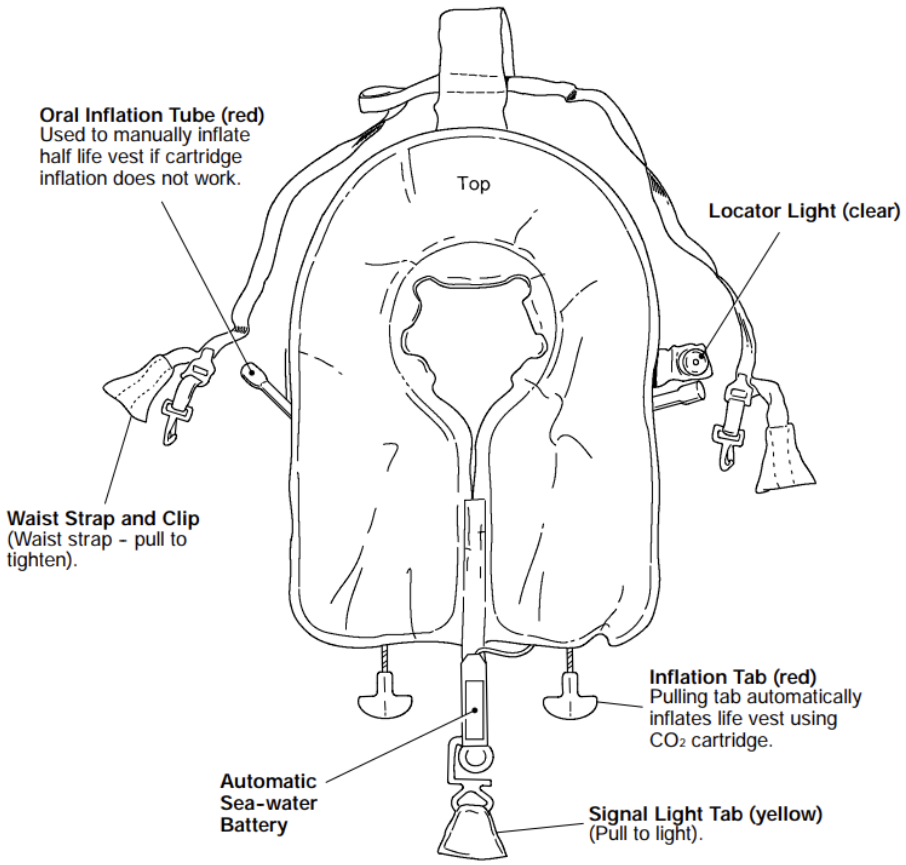
How COSPAS-SARSAT works?

The beacon on a plane or ship is triggered manually or automatically, and transmits a distress signal at a frequency of 406 MHz. This signal is picked up by surveillance satellites, which retransmit it to a Local User Terminal (LUT). This terminal processes the signal, calculates the position of the transmitting beacon, and sends this information to the Mission Control Center (MCC).

The MCC is in charge of filtering out false alerts, and contacting the most appropriate Rescue Coordination Center (RCC) to dispatch rescue teams to the scene.

Until the end of 2020, this system relied on secondary payloads on Earth-observation satellites in both low Earth orbit (LEOSAR) and geostationary Earth orbit (GEOSAR). The new service, assured by satellites in medium Earth orbit (MEOSAR), with secondary payloads on GPS, Galileo, Beidou, and Glonass positioning system satellites in MEO, improves performance, precision and responsiveness.

APPENDIX I: THE CHARACTERISTICS OF A STANDARD LIFE JACKET



Life Vest
Figure 09–50–1

APPENDIX J: HOW TO USE THE LIFE JACKET

1. Locate and remove the life vest.

2. Put the life vest over head...

3. ...with the back piece behind.

4. Fasten rings to catch.

5. Pull straps tight.

6. Jerk down on red inflation tabs.

7. Should it become necessary, life vest can be orally inflated by blowing into red oral inflation tubes.

CAUTION

Inflate life vest just before leaving the airplane! If using overwing emergency exit inflate life vest when on the wing.

Life Vest Operation
Figure 09-50-2

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by Danial Iman

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