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Development of Life-Saving Buoy Ring With Remote Control System

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Abstract

This research focuses on the development of life-saving life saving rings equipped with remote control systems, with the aim of improving efficiency and effectiveness in emergency rescue in waters. The urgency of this research lies in the creation of a remotely operable buoy, thereby reducing reliance on physical strength and human accuracy during the rescue process. This research follows the ADDIE development model, which includes five phases: analysis, design, development, implementation, and evaluation. The design of the buoy and the accompanying remote control system are designed with user-friendliness and operational effectiveness in mind. The system is then tested by maritime professionals to assess its practicality and functionality. The test results showed a positive response from users, who gave a high assessment of the design and performance of the buoy. However, there are suggestions to increase the battery life of the remote control to support longer operations. Overall, the development of this life-saving buoy with a remote control system has made a significant contribution to maritime safety. By offering a more reliable and efficient solution, it can improve the quality of rescue operations, reduce the risk of accidents, and improve response in emergency situations in waters.

Keywords: *ADDIE model, emergency rescue, Life-saving buoy, remote control, maritime safety*

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1. Introduction

Transportation has a significant impact on individuals, society, economic development, and the socio-political landscape of a country. In its development, maritime transportation is one of the means of fostering cooperative relationships between countries in the exchange of technology and economy. Maritime transport can also serve as an identity for a country that is considered advanced in its economy if the country has a good maritime transport system. In 2024, the National Transportation Safety Committee (KNKT) recorded several maritime accidents that occurred in Indonesian waters. Statistical data shows that although there was a decrease in the number of maritime accidents compared to previous years, efforts to improve the maritime safety system remain a top priority. KNKT is committed to conducting thorough investigations to enhance maritime transportation safety, not just to punish offenders, but to prevent similar incidents in the future. (KNKT, 2024).

Shuen & Wahab (Rollah et al., 2019) found that 80 to 90% of workplace accidents are caused by human error. The causes of work accidents on ships can include the crew's negligence in maintaining the ship, excessive cargo loading permissions, overly high levels of self-confidence, lack of experience, and the crew's non-compliance with established safety

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procedures. The technology of safety equipment is currently advancing rapidly, one of which is the very important safety device known as the life jacket or buoyancy aid. According to (Smith 2022, p. 45), a life jacket is a safety device designed to keep the wearer afloat in water, generally used in water activities to prevent drowning. This device is usually made from materials containing flotation foam or inflatable gas. Initially, life jackets were made from natural materials such as leather or cork, but over time, the materials used have evolved into lighter and waterproof synthetic materials. Modern life jackets are also equipped with additional features such as marker lights and emergency whistles to facilitate rescue.

Besides life jackets, lifebuoys or circular floats are also important safety equipment on board a ship. According to (Jones, 2021, p. 58), a life buoy is a ring-shaped safety device used to help someone stay afloat in water, usually thrown to a drowning person. Meanwhile, according to (Brown, 2020, p. 74), life buoys are often found on ships and docks as emergency rescue devices to prevent drowning. In line with that opinion, White (2021, p. 89) states that a lifebuoy is one of the mandatory safety equipment that must be present on ships and other water facilities. Based on several opinions, it can be concluded that a lifebuoy, in addition to a life jacket, is an important safety device on board. This ring-shaped device functions to help someone stay afloat in the water, usually thrown to a drowning person. Lifebuoys are often found on ships and docks as emergency rescue devices to prevent drowning. Therefore, a lifebuoy is one of the mandatory safety equipment on ships and other water facilities.

Initially, a lifebuoy was just a ring made of wood or other natural materials. However, with the development of technology, modern lifebuoys are made from lightweight and waterproof materials. Some lifebuoys are even equipped with marker lights to facilitate their discovery when used in dark conditions. The basic material of a life buoy is usually made from polyethylene, a type of lightweight and durable plastic. Polyethylene is chosen for its resistance to harsh environmental conditions, including exposure to UV rays and seawater. (Johnson, 2019, p. 102). Another material that is often used is polyurethane foam, which provides high buoyancy and stability. Polyurethane foam also has waterproof properties, helping the life buoy to stay afloat for a long time. (Clark, 2020, p. 87). Life buoys are often coated with a layer of vinyl to enhance their resistance to abrasion and harsh impacts. Vinyl provides additional protection to the foam inside, ensuring the life buoy remains functional and sturdy in various conditions. (Evans, 2021, p. 45).

The development of the use of life buoys as safety equipment on ships has not progressed. In this case, the life buoy is still thrown towards the person in need of help. By ensuring an accurate throw, the life buoy can be easily reached by the person in need, and the throw is usually done at a maximum distance of 8 meters, depending on the strength of the crew. If the life buoy is equipped with a lifebuoy line (rope), carefully pull the life buoy back to help the person in the water to be lifted onto the ship. According to research conducted by Dijkstra et al. (2018), the main factors affecting throwing distance include the angle of the throw and the speed of the throw. The optimization of the launch angle is usually between 30 to 45 degrees to achieve maximum distance. In more realistic conditions, such as strong winds or the rescuer's physical condition not being optimal, the distance may decrease. Throwing a life buoy or float is a crucial action in an emergency situation, especially in water. The maximum distance of a life buoy throw depends on several factors, including the execution technique, the physical strength of the recipient, and environmental conditions such as wind and waves. the increase in back and arm muscle strength also contributes to the improvement in throwing effectiveness (Sari & Rahman, 2023). According to recent research, the average throwing distance for a standard buoy ranges from 15 to 30 meters (Purnama, 2023). On the other hand, innovations in life buoy design, such as the addition of aerodynamic systems or the use of lighter materials, have the potential to improve the distance and accuracy of life buoys.

Based on the use of the life buoy by ensuring an accurate throw and the throwing distance depending on the strength of the crew. Researchers feel the need for innovation in the use of life buoys. Innovation can begin with the application of appropriate technology to life buoy safety equipment, thereby influencing the usage and efficiency of the rescue process. This is also supported by the achievements of the strategic plan and research roadmap of the

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Makassar Politeknik Ilmu Pelayaran, where one of the flagship research themes in the Nautical Studies program is "Operate Life-Saving Appliances." Researchers assume that the innovation made on life buoy safety equipment can have a wide impact on maritime science, especially at the Makassar Politeknik Ilmu Pelayaran, in terms of rescue processes and providing innovative products for the development of safety equipment on board. This research aims to develop a life-saving device based on an autonomous remote system. The urgency is to develop a maritime safety device in the form of a life buoy that can be remotely controlled or a life-saving buoy ring with a remote control system.

2. Methods

The method applied in this research is development research or research and development (R&D). The model used by the researchers is ADDIE, which stands for analysis, design, development, implementation, and evaluation. This model was developed alongside the development of the learning system. The development process interacts with one another, so the assessment results from each stage can be used to proceed to the next stage. In other words, the final result of one stage is the initial product of the next stage. Throughout the entire process of planning and implementing learning, the achieved cycle process will develop over time and be continuous. (Hamzah, 2021).

The model in development research has a procedural and descriptive nature that serves as a reference in the development steps. In research and development to produce a specific product, needs analysis research is used, and to test the effectiveness of the product so that it can function in the wider community, research is needed to test the effectiveness of the product. (Sugiyono, 2021). The research and development procedures for the software planned by the researcher use the ADDIE model, which is a development model consisting of: 1) analysis, 2) design, 3) development, 4) implementation, 5) evaluation. (Anggraeni et al., 2019).

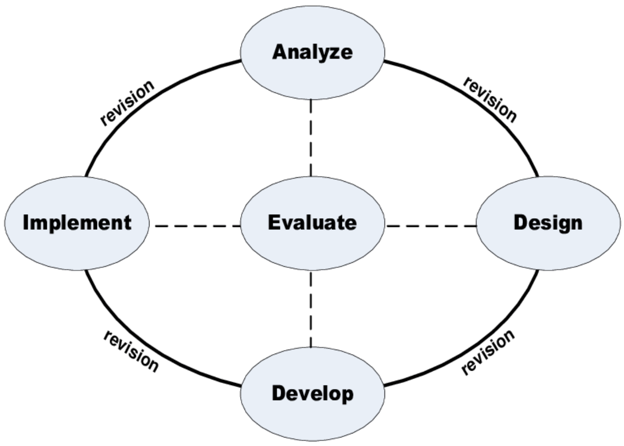

Figure 1. Stages of the ADDIE Research Model
Source: Data Research

The data collection techniques used to generate data and information in this research are observation, interviews, black box testing, and the distribution of questionnaires to media experts and subject matter experts. In this study, the researcher used the open observation method.

Researchers will directly participate to conduct direct observations of the actual conditions in the field in accordance with the objectives to be achieved. Next, the purpose of conducting the interview is to gather information related to the issues raised by the researcher. The informants in this interview are the captain and the crew. Meanwhile, Blackbox testing is a type of testing used to evaluate the performance or functionality of software applications. In this testing, the following errors will be sought: 1) incorrect or missing

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functions, 2) interface errors, 3) errors in data structure or external database access, 4) performance errors, 5) initialization and termination errors. Then, a questionnaire is a data collection technique that includes providing respondents with a series of written statements or questions to answer. Data collected using questionnaires will be more objective because the data comes from the respondents' complete knowledge and opinions. The instrument used is a Likert scale questionnaire with 5 scales, namely, very good, good, fair, poor, very poor. The answers to each instrument have a gradient from very positive to very negative. For the purposes of quantitative analysis, the answers can be scored as follows.

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Table 3.1. Instrument Grading Values

No	Answer	Score
1	Very Good	4
2	Good	3
3	Not Good	2
4	Very Not Good	1

Source: Data Research

Data analysis techniques are activities conducted after data from all respondents or other data sources have been collected. The activities in data analysis include grouping data based on variables and types of respondents, tabulating data based on variables from all respondents, presenting data from each variable being studied, and performing calculations to answer the problem formulation.

Based on the data to be obtained from information system experts, material experts, and crew members in the form of questionnaires, it will be analyzed using descriptive analysis techniques. Descriptive analysis techniques are conducted using descriptive statistics. Descriptive statistics are statistics used to analyze data through the depiction of collected data without making general conclusions. To calculate the percentage of results using the following formula:

$$p = \frac{Score\ of\ Data\ Collection\ Results}{Ideal\ Score} \text{x } 100\%$$

Explanation:
P = Percentage
Ideal Score = Highest Score x Number of Respondents x Number of Items.

The ideal score is the score set under the assumption that each question receives the highest score. (Widoyoko, 2012). Next, all the collected data is presented in the form of narrative sentences, images, and also percentage distribution. The development research stage involves analysis techniques in accordance with the purpose and objectives of that stage. Because the analysis used in this research is descriptive analysis, which describes the development results, validator responses, and trial results.

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3. Results And Discussion

The results and discussion of the research based on questionnaire responses using the ADDIE Model approach, which includes the stages of Analysis, Design, Development, Implementation, and Evaluation:

1. Analysis

In the analysis stage, the main focus is on identifying the needs of users who are ship crews or rescue operators in emergency environments. Users need safety equipment that is easy to operate and effective in rescue situations. Based on interviews with primary users, it was found that a remote control system allowing the operation of buoys from a distance is very

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important for improving rescue efficiency. In this context, the developed autonomous remote-controlled buoy ring system aims to meet this need, both in terms of functionality and operational safety.

2. Design

The design phase includes creating the aesthetic and functional design of the buoy and remote control. Based on the survey responses, the buoy design was rated very well by the respondents, with an average score of 96% for aesthetics. The color and shape of the buoy are easily recognizable from a distance, which is an important feature in rescue situations. Respondents also rated the remote control design as ergonomic and comfortable to use for extended periods, with an average score of 86%-88%. This indicates that the design process successfully developed a device that is easy to use and can be operated efficiently.

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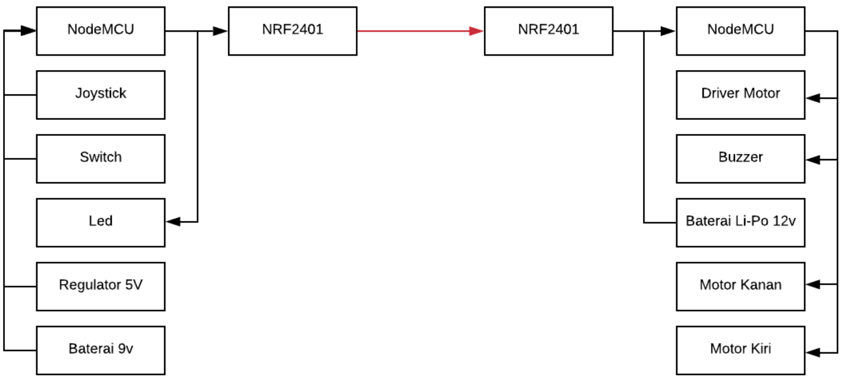

Figure 1. System Flow Diagram
Source: Data Reasearch

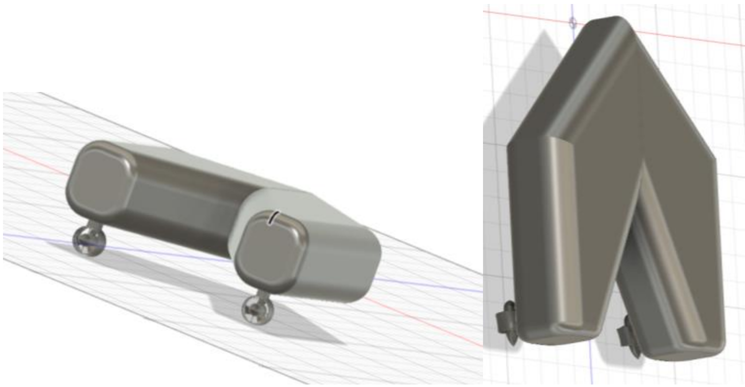

Figure 2. Buoy Design
Source: Data Research

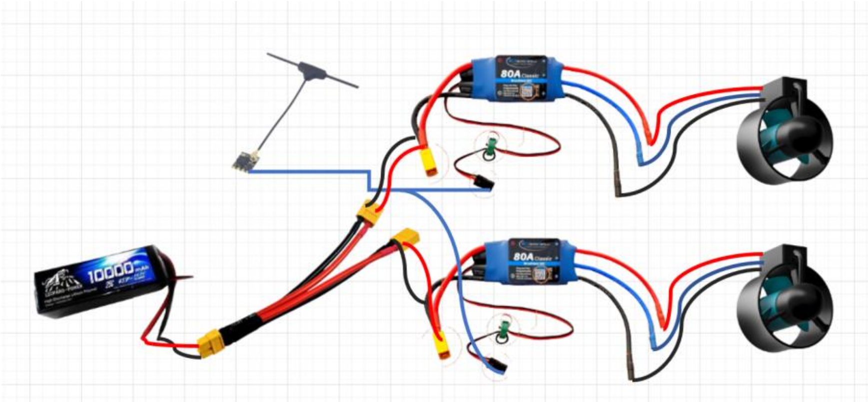

Figure 3. Electronic Circuit on the Buoy
Source: Data Research

3. Development

At the development stage, the buoy and remote control were developed based on the planned design. The integration of electronic systems and remote control components was also carried out to ensure the buoy can be controlled automatically. Initial testing was conducted to ensure that the product functions according to the designed specifications, including the motor's ability to direct the buoy in various directions according to the joystick commands connected via NodeMCU and the NRF24l01 signal. The development results show that the buoy functions well, with 90% of users reporting satisfaction in terms of performance.

Figure 4. Integration of Power and Electronic Systems
Source: Data Research

4. Implementation

the implementation stage, the buoy was tested by the ship's crew at PIP Makassar to obtain direct feedback on the functionality and comfort of the device. From the test results, the product received very good ratings in terms of ease of use and safety. This buoy is considered easy to use and remove, and it can function well even in less than ideal conditions. Remote control is also considered capable of functioning well from a distance, with a quick response to commands. The average score obtained at this stage is 90.759%, indicating that the product implementation meets user expectations.

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Source: Data Research
Figure 4. Implementation of Lifesaving Buoy

5. Evaluation

Evaluation is conducted using a questionnaire to measure user satisfaction after using the product. From the evaluation results, the buoy and remote control received high scores for comfort, safety, and effectiveness. The overall score achieved is 90.759%, indicating that the product successfully meets user needs. However, there are several suggestions for improvement, particularly regarding the enhancement of battery life on the remote control and the refinement of ergonomics for long-term use. This point of improvement is important to ensure that the device can continue to deliver optimal performance in various situations.

Figure 5. Evaluation process
Source: Data Processing

Table 1. Survey Results

Questionnaire Number	Responden										Amount (S)	Skor Maks (N)	%	Average %
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10				
1	4	4	4	5	4	5	5	5	5	5	46	50	92	90,759
2	4	5	4	5	5	5	5	5	5	5	48	50	96	
3	4	4	4	5	4	5	5	5	5	5	46	50	92	
4	4	4	4	5	5	5	5	5	5	5	47	50	94	
5	4	4	4	5	4	5	5	5	5	5	46	50	92	
6	4	4	4	5	4	5	5	5	5	5	46	50	92	
7	4	4	4	5	4	5	5	5	5	5	46	50	92	
8	4	4	4	5	4	5	5	5	5	5	46	50	92	
9	5	5	5	5	4	5	5	5	5	5	49	50	98	
10	5	5	4	5	4	5	5	5	5	5	48	50	96	
11	5	5	4	5	4	5	5	5	5	4	47	50	94	
12	4	3	4	5	4	5	5	5	5	4	44	50	88	

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13	4	3	4	5	4	5	5	5	5	5	45	50	90
14	4	3	4	5	4	5	5	5	5	5	45	50	90
15	5	5	4	5	4	5	5	5	5	5	48	50	96
16	5	5	4	5	4	5	5	5	5	5	48	50	96
	Responden												
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10			
17	4	4	4	5	5	5	4	5	4	3	43	50	86
18	5	4	4	5	4	5	4	5	4	3	43	50	86
19	4	4	4	5	4	5	5	5	4	3	43	50	86
20	4	4	4	5	4	5	5	5	4	3	43	50	86
21	4	5	4	5	4	5	5	5	4	3	44	50	88
22	5	5	4	5	4	5	5	5	4	3	45	50	90
23	4	5	4	5	5	5	4	5	5	5	47	50	94
24	3	4	4	5	4	5	4	5	5	5	44	50	88
25	4	3	4	5	4	5	4	5	5	5	44	50	88
26	4	4	5	5	4	5	4	5	4	4	44	50	88
27	4	4	4	5	5	5	4	5	4	4	44	50	88
28	4	4	5	5	4	5	4	5	4	4	44	50	88
29	4	4	4	5	4	5	4	5	4	4	43	50	86
Amount	122	121	119	145	121	145	136	145	135	127			
Skor Maks	145	145	145	145	145	145	145	145	145	145			
%	84,13793	83,44828	82,06897	100	83,44828	100	93,7931	100	93,10345	87,58621			
% Average	90,759												

Source: Data Processing

4. Conclusion

Research on the Development of Lifesaver Buoy Rings with Remote Control Systems has successfully answered the main research question regarding the effectiveness and functionality of the tool in the context of emergency rescue. Based on the survey data collected from 10 respondents, consisting of the crew of the PIP Makassar ship, this life ring is rated very satisfactory in terms of design, comfort, and ease of use. The average score obtained from respondents reached 90.759%, indicating that this product is well-received and successfully meets the primary needs in life-saving situations in emergency environments. This buoy has a modern design and is easily recognizable from a distance, which is one of the important factors in rescue operations. In addition, the materials used do not cause skin irritation, and the buoyancy is considered not to interfere with the user's body movements, which adds to the comfort of use. The remote control system, which is the main innovation of this product, also works very well. Respondents rated the remote as easy to operate and effective even from a distance, making it a very useful tool in emergency situations where speed and precision are crucial. However, this research also identified several areas for improvement, particularly regarding the battery life of the remote control, which, although quite good, could be enhanced to be more durable for long-term use. Overall, this life ring is deemed suitable and effective for use in rescue operations, making a positive contribution to maritime and emergency safety.

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Bibliography

Anggraeni, D., Elmunsyah, H., Handayani, A., Modul Pembelajaran Fuzzy Pada Mata Kuliah Sistem Cerdas, P., Rosita Anggraeni, D., Elmunsyah, H., & Nur Handayani, A. (2019). *Pengembangan modul pembelajaran fuzzy pada mata kuliah Sistem Cerdas untuk mahasiswa S1 Pendidikan Teknik Elektro Universitas Negeri Malang* (Vol. 29). http://journal2.um.ac.id/index.php/tekno

Fernando, A., Kusuma, A. C., Suganjar, S., & Astriawati, A. (2022). Optimalisasi Fungsi Alat Keselamatan Di Kapal Mt. Patra Tanker 2. Dalam *Politeknik Bumi Akpelni Semarang* (Vol. 24, Nomor 1). www.e-journal.akpelni.ac.id,

Grandinetti. (2015). *(12) United States Patent45) Date of Patent: (54) (76) (*) (21) (22) (65) (60) (51) (52) (58) Life Ring Buoy And Flotation Cushon*. https://patents.google.com/patent/US8951081B2/en

Hamzah, A. (2021). *Metode penelitian & pengembangan (research & development) uji produk kuantitatif dan kualitatif proses dan hasil dilengkapi contoh proposal pengembangan desain uji kualitatif dan kuantitatif*. CV Literasi Nusantara Abadi.

Imran, A., Pusaka, A., Buwono, A., Clinton, A., Oloan, P., Arifin, M. D., Teknik, M. J., Perkapalan, S., Teknologi, F., Universitas, K., Persada, D., Jurusan, D., Perkapalan, T., & Teknik, D. J. (2022). *Pemodelan Varian Desain Life Buoy Dengan Menggunakan Software Berbasis Energi Terbarukan*.

Pahlevi, R. (2021). *Sempat turun, jumlah kasus kecelakaan pelayaran kembali meningkat pada 2021*. https://databoks.katadata.co.id/datapublish/2021/12/29/ sempat-turun-jumlah-kasus-kecelakaan-pelayaran-kembali-meningkat-pada-2021.

Pemerintah Indonesia. (1970). *Undang-Undang (UU) Nomor 1 Tahun 1970 tentang Keselamatan Kerja*. Sekretariat Negara.

Roepajadi, J., Nurmaya, I., Wahyudi, H., & Irawan, R. J. (2024). Manipulation Analysis Sport Massage On Decreased Heart Rate After Swimming 100-Meter Freestyle. *MSJ: Majority Science Journal,* 2(2), 112-119.

Rollah, S., Wahab, A., & Shuen, Y. S. (2019). The Relationship Between Safety Communication And Human Factor Accident At The Workplace-A Conceptual Framework. www.jurnal-kemanusiaan.utm.my

Sitepu, F. (2017). *Optimalisasi Perawatan Alat-Alat Keselamatan Sebagai Penunjang Keselamatan Awak Kapal Di Kn. Bima Sakti*. https://ejurnal.pip-semarang.ac.id/index.php/jdb/article/download/46/12

SOLAS-International Convention for the Safety of Life at Sea. (2009).

Sugiyono. (2021). *Metode Penelitian dan Pengembangan Research and Development* (5 ed.). Alfabeta.

Tahir, A. (2024). Exploring New Paradigms in Auditing: Challenges and Opportunities in the Digital Era. *MSJ: Majority Science Journal*, 2(2), 83-90.

Thanakodi, S., Talib, M. L., Ali, S. A. S., Wahab, N. A., Ahmad, A. F., Noor, N. M., Zahari, M. I. B. A., & Ahmad, M. A. (2021). A study into the development of a light weight smart life buoy prototype (LWSLB). *Transactions on Maritime Science*, *10*(2), 383–389. https://doi.org/10.7225/toms.v10.n02.008

Widoyoko, S. E. P. (2012). *Teknik Penyusunan Instrumen Penelitian* (W. S Eko Putro, Ed.). Pustaka Belajar.

Wulandari, S., Rapi, N. L., & Putra, D. P. (2022). Analysis of Completeness of Safety Equipment on Fishing Vessels in Beba Fishing Port. *Lutjanus*, *27*(2), 71–83. https://ppnp.e-journal.id/lutjanus_PPNP