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Design of a Light Intensity Reducing System as a Light Aid Device for Purse Seine Fisheries Based on a Microcontroller

Taufiq[1], Mulyono S Baskoro[2], Wazir Mawardi[3], Mochammad Riyanto[4]
[1]Marine Fisheries Technology Study Program, IPB Postgraduate School, IPB University, Bogor, Indonesia
[2,3,4]Department of Fisheries Resources Utilization, Faculty of Fisheries and Marine Science, IPB University, Bogor, Indonesia.

ABSTRACT: Technology is vastly growing nowadays, and it can be used in many aspects of life, such as fisheries. The use of a control system to assistive devices in the capture fisheries is one example of how technology has significantly aided fishing operations recently. By deploying portable underwater lamps, this control system can let fishermen conduct fishing operations more quickly and easily while reducing operating expenses. Using the Arduino UNO device as a microcontroller, the NodeMCU ESP8266 module as a liaison, and the blynk application as a monitoring command for turning on and off from Android, this control system is built on the Internet of Things (IoT). The design technique and block diagram of the system, which comprises a remote-control system for lights such as on/off, reducing light intensity, and a buoy construction drive system, were employed as the study methodology. The test's findings demonstrate that the construction of the lamp is completely controllable, water resistant, and capable of 180-degree illumination based on the vertical axis of the light. Moreover, the lighting settings are straightforward to operate. The distribution of the light is affected by the design of the lamp and the brightness levels of the light have an impact on the light intensity.

KEYWORDS: Arduino, Fisheries, Internet of things, Microcontroller

I. INTRODUCTION

Currently, technological advancement is growing quite quickly, hence it must be used and researched therefore can be used in daily life (Gaol *et al.*, 2021). Control is one of the areas where improvements may be felt. It alleviates the issue of distance and time barriers, for instance, the usage of smartphones in daily life is one such technological solution (Mitul *et al.*, 2012).

The internet offered several features that can be used as sophisticated information and communication media. Accessing electronic devices, such as room lighting, that can be controlled online via smartphones is one of the technological advancements that may be made via the internet connection (Jayaprakash *et al.*, 2005; James and Deng, 2016). As a result, it will be easier for users to go over any challenges and implement them with notes in the area where remote control technology will be used. Using the internet or the Internet of Things (IoT), the remote-control system makes it simpler for users to manage house lights located relatively far away. The IoT strives to increase the advantages of continuous internet access through a device or module Arduino (Getu and Attia, 2015; Rahmad *et al.*, 2020; Sadi dan Mulyati, 2021; Thumsi and Jain, 2014).

Fishing with lights is one of the activities that relate to lighting frequently. Current fishing practices need lights, which are also highly beneficial for fishing operations (Sofijanto *et al.*, 2019). Fishermen use the lamp to attract fish and the lights used by fishermen are becoming more advanced as time goes on thanks to the usage of various types of lighting, including LED lights. Compared to traditional electric lamps, LED lamps provide several benefits, such as energy savings, long lifespan, safety, the absence of mercury, low pricing, and ease of maintenance (Baumgartner *et al.*, 2019; Chepurna *et al.*, 2019; Huan and Xing, 2013; Lee, 2013; Shen and Huang, 2012; Shen *et al.*, 2013; Zain and Patta, 2018).

LED lights have been developed as lighting accessories for purse seine fishing gear. The study's findings have led to the creation of different light designs. However, there are still flaws, such as the manual operation of the lamps, the hazardous nature of the structure, the continued use of the generator as the source of power, the inadequacy of the light in the water, and the price, which may range from IDR. 60 million to 70 million. Generally, floating lights are those that fishermen have developed. Earlier researchers used operating methods directly touching the water's surface, such as taillights, floating lights, and floating led light buoys (Hartaty *et al.*, 2012; Sofijanto *et al.*, 2019).

Based on the aforementioned issues, research is required to develop a floating lamp technology, namely the portable underwater lamp (PUL), which can be operated in water and controlled remotely. The major goal of the research is to develop floating light technology that can be used in water and has the benefit of coming with a remote-control system.

The primary goal of putting this study into practice is to create technologies for lighting assistance in purse seine fisheries. Feasibly with PUL technology it can gather and entice fish to congregate in the fishing area, assisting fishermen in getting the best results with the least amount of operational expense.

II. MATERIALS AND METHOD

A. Time and Place

The system block diagram approach by utilizing PUL technology was applied in this study. As a tool for luring and catching fish on purse seine fishing gear, the design of a remote-control system on pool technology is an invention and development of the most recent technology in the field of capture fisheries.

There are two phases in this study, laboratory and field scale. An experimental remote-control mechanism for PUL lights is being developed. Performance trials or technical testing are conducted as part of field research (Deno *et al.*, 2013; Jaedun, 2011).

All the laboratory activities were done in the Ship Design and Transportation Workshop, Department of Fisheries Resources Utilization, Faculty of Fisheries and Marine Sciences, Bogor Agricultural Institute. This study was conducted between March and November of 2021, and the fieldwork was conducted at Palabuhanratu in October 2022.

B. Tools and Materials

The list of the equipment and supplies used in the remote-control design for the portable underwater lamp is shown in table 1.

Table 1. The tools and materials used during the design of the portable underwater lamp

No.	Name	Function
1	Multitester	Measuring connections, Current, and Voltage
2	Solder	Connect components and cable jumpers
3	Tinol	Component Adhesives
4	Arpush	Tinol cleaner on solder
5	*Cutter Plier*	Cut component legs and cable jumpers
6	*Long Plier*	Install components on the breadboard
7	Laptop	Make a C language program
8	Arduino Ide	Creating programs and program transfers
9	ILT5000	Measure the brightness of a dark LED HPL
10	Android	Command to run the program
11	NodeMCU ESP8266	Wi-Fi module
12	Wi-Fi modem	Internet network provider
13	Step-up	Voltage regulator
14	Power bank	A current source of NodeMCU
15	LED HPL White 50 Watt	Indicator of Pulse Output
16	Jumper Cable	Connection between components
17	Battery Accu	A current source of lamp
18	Relay 8 channel	Electricity switch or voltage distributor
19	Heatsink	Cooling lamp
20	Cabel	Parallel circuit
21	Arduino IDE	Creating programs and program transfers
22	Blynk	*Flatform* control ESP8266

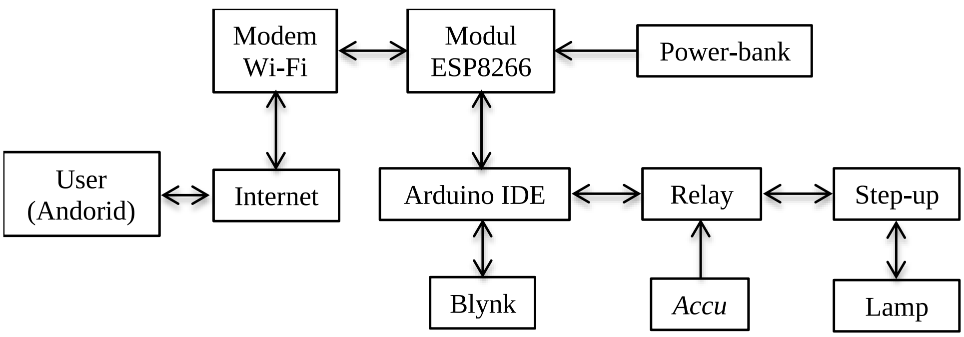
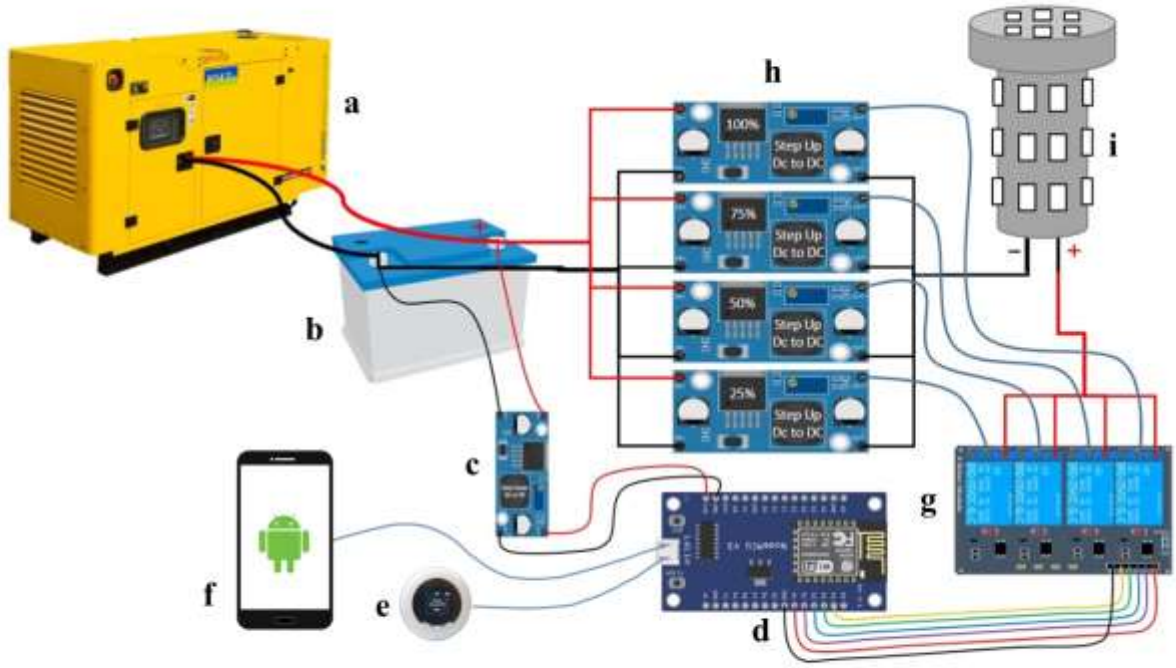


Figure 1. System block diagram on portable underwater lamp technology

C. System Block Diagram

There are several components in tool design. The phases involved in creating a lamp controller and several parts, including a controller/microcontroller system, relays, remote controls, and lights, enable the system's functionality., components that serve as the system's input, controller, and output are needed. Block diagrams may also describe how a tool design's performance flow works quickly (Artono and Susanto, 2016; Benediktsson, 2009; Jayaprakash *et al.*, 2005). This can be useful as a planning tool since the block diagram (Figure 1) allows the designer to comprehend the system's flow quickly.

In the procedure above, the user can be seen controlling the lights by utilizing an internet-connected Android smartphone to switch them on and off. The NodeMCU ESP8266 microcontroller is an internet-connected data processing brain that can accept instructions from an Android device (Blynk). In contrast, the step-up and relay serve as voltage regulators. The lights may be turned on with varying intensities (100%, 75%, 50%, and 25%) due to the regulation of each step-up voltage. The battery provides the lamp's current source. The process of creating the hardware design circuit is then carried out, along with selecting and compiling hardware design algorithms. In Figure 2, the assortment of manufacturing instruments is shown.



Note: a= Accu-charger; b= Battery accu; c= Step-down; d= NodeMCU ESP8266; e= Wi-Fi modem; f= Android; g= Relay; h= Step-up; i= Lamp.

Figure 2. **The instruments used in the manufacture of the circuit of remote control**

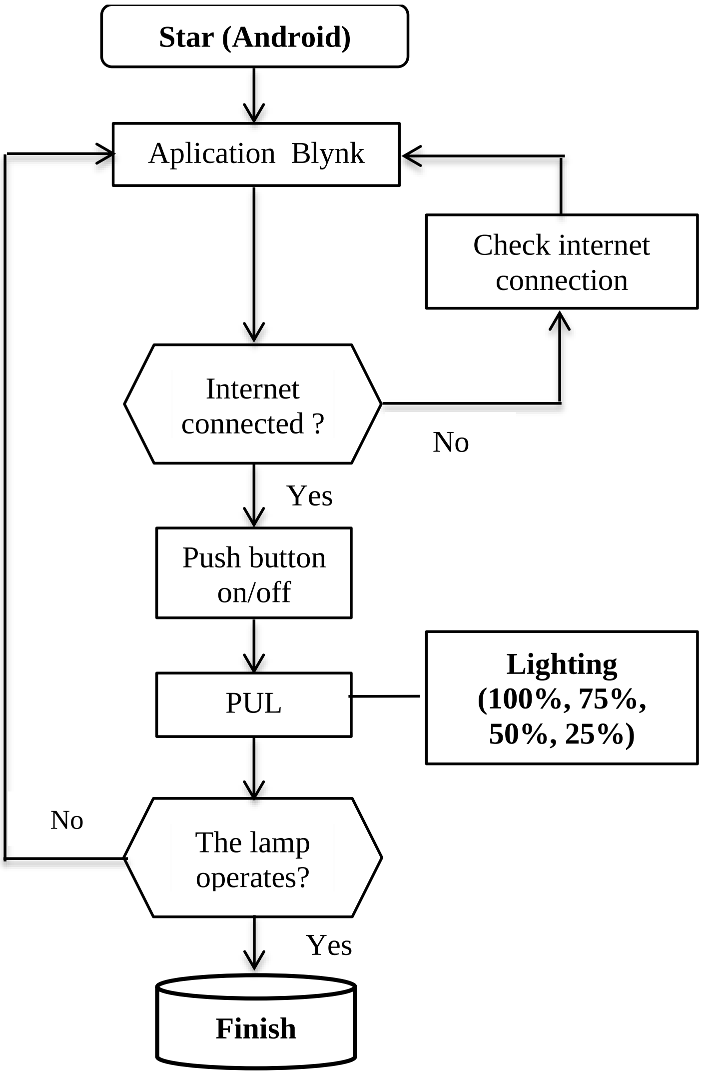


Figure 3. Flowchart the Blynk applications

D. Software Design

The IoT-based remote control system for lighting is constructed using a control application (Blynk) to operate the hardware. Designing a remote-control system for a light using software created by the Blynk app (Artiyasa *et al*., 2020). Figure 3 displays the software diagram utilizing the Blynk application.

The device is connected, then the application is open (star), and Android is running (blynk) (internet). When the on/off button is pressed, the light will turn on or off by what is specified on the button if the device is linked to the blynk application and if it is not attached to the pin of the widget and the Arduino program is valid. Ascertain the lamp's functionality and lighting levels (100%, 75%, 50%, and 25% percent). It is regarded as finished if it functions adequately.

E. Arduino IDE Software Design

The lamp's remote control system design uses an Arduino IDE programming language. This part's software identifies the inputs and outputs connected to the NodeMCU ESP8266/microcontroller pins. This software aims to issue the commands to turn on or off the lights. The lights may be switched on and off using this work application at various lighting (100%, 75%, 50%, 25%, and 0%).

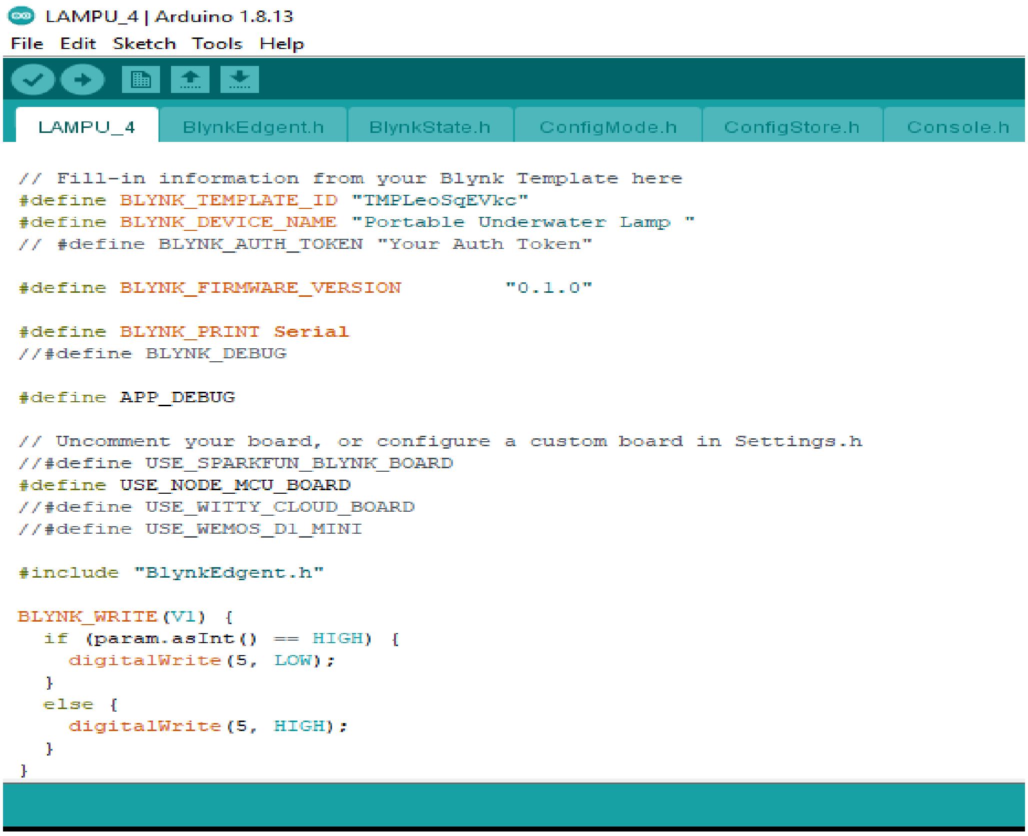
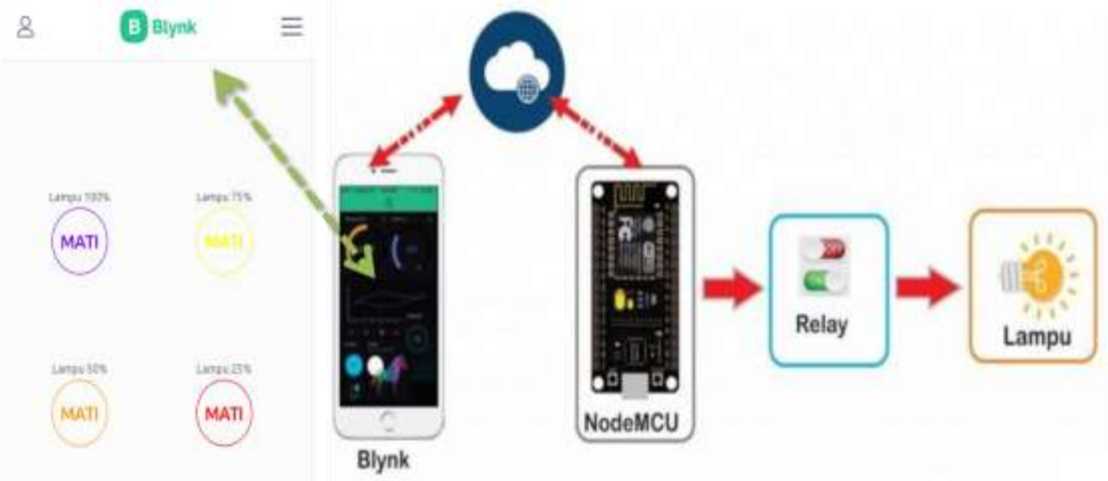


Figure 4. Design software

F. Blynk Application Program Design

The Blynk application is an IOS or ANDROID platform used to operate Wemos, Arduino, and other similar modules remotely.The ESP8266 module and Microcontroller/Arduino Uno have the blynk application built into them to enable remote control applications on IoT-based portable underwater lighting. When the smartphone (Android) and device (light) are online, Blynk can function. The email address and Auth Token code that the Blynk application gave to the Arduino IDE software must be used to log into the Blynk application. Figure 4 presents the Blynk application's appearance.

The Blynk app is intended to function as both an on/off switch and a method for lowering light levels. Since just four relays are used, the blynk application design features four on/off buttons and four gauges for monitoring. Additionally, the remote control is available for the light intensity and on/off the system. When linked to the ESP8266 module, the lamp may be turned on remotely. The android can control the light intensity with orders, gradually lowering the light while responding to commands (Bahri and Sudrajat, 2015; Mahardika *et al.*, 2016).



Note: *MATI*: OFF; and *Lampu*: Lamp.

Figure 5. The Blynk application display

Figure 6. Hardware on the lamp

G. Hardware Implementation

The ESP8266 wifi module, the relay module, the step-up, and the hardware preparation stage are connected via cables by the circuit and the outcome of the hardware implementation, utilizing a lamp load with a power range of 300 to 900 watts. The Blynk app shows ON/OFF control of lamps in various brightness states, including 100%, 75%, 50%, and 25%. The equipment of the lamp is shown in Figure 6.

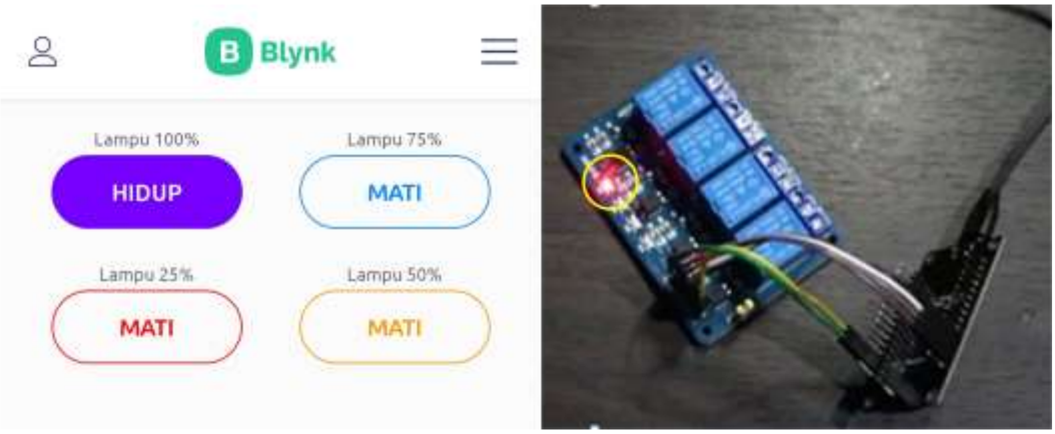
H. Implementation of Lamp Lighting

The lights were examined at this point, and the brightness levels of the lamps at 100%, 75%, 50%, and 25% lighted situations were observed to differ in the proportion and shape of the light distribution. To establish the pattern of light distribution and the distance of the manufactured LED lights, measurements of light illumination in the air are done. Utilize the ILT (International Light Technologies) 5000 research radiometer to gauge the dispersion of light in the atmosphere. Wisudo *et al.* (2002) and Susanto (2019) are cited in the approach to assessing light dispersion. Concerning the lamp's direction and the light's intensity, measurements were made in both horizontal and vertical locations at intervals of 10°. A 1.5 meters support pole is used to hang the LED lights. Multiple 10° angles were measured at 100 cm, 75 cm, 50 cm, and 25 cm in both the horizontal and vertical directions in the air medium. Each intensity data point is gathered in the form of notes, which are subsequently tabulated and analyzed. Furthermore, descriptive approaches were used to examine the data.

III. RESULTS AND DISCUSSION

A. Lamp Control Test with Relay

The test results show that touching the on/off button widget on the blynk application turns on or controls the lights while using a smartphone. This is carried out when the system is turned on and linked to Wi-Fi. A unique Wi-Fi modem must be placed close to other components to decrease the internet connection being in poor condition. If the internet connection is lost or the signal is poor, system performance (lamp) may be compromised. Because each circuit delivers a distinct voltage with the appropriate programming configuration, testing relays and bulbs is done to ascertain if they are functioning properly and optimally. The relay is put in the closed area for installation, and the lights are in the open section. According to the test findings, as long as the lights are linked to the internet network, they may be controlled forever with various brightness levels (ON (100%, 75%, 50%, 25%, and OFF (0%)).



Note: *HIDUP*: ON; and *MATI*: OFF.

Figure 7. Testing of relays and lamps

Table 3. Testing of relays and lamps

Pin Relay	Relay Indicator Light	Lamp Lighting
IN1	ON	100%
IN2	OFF	75%
IN3	OFF	50%
IN4	OFF	25%

The outcomes of the testing on the relay module are shown in Figure 7 and Table 2. The Blynk's button is pressed, and the IN1 indicator light turns on with 100% brightness. If the IN2 indication light is on, the bulb is 75% on, and the lamp is 100% off (OFF). The treatment at 50% and 25% brightness is the same. The Relay Module appears to be operating properly based on the test findings.

Figure 8 demonstrates how a 5VDC voltage will be sent to the relay and turned NC when the digital pin is instructed to do so. Step-up voltages of 32V, 27.5V, 25V, and 22.5V flow into the bulb under these circumstances, illuminating it. On the other hand, if the digital pin is instructed to be OFF, it will produce a voltage of 0VDC and cause the relay to C. The lamp shuts off because the electricity cannot reach it in this situation. The commands are sent progressively in this circuit. The light must be turned on at full brightness in the first stage, then at 75%, 100%, and so on.

B. Lighting Test

Based on the percentages of 100%, 75%, 50%, and 25% while the lamp is ON, proof of the light intensity is obtained. It can be seen from the form of the resulting light distribution that the portable underwater lamp's design can equally illuminate the region in a horizontal direction of 360 degrees. The light's vertical axis also suggests that the lamp is capable of 180-degree illumination. The lamp's design demonstrates that it passed the dispersion test for usage as a tool to aid in catching fish for purse seine fisheries. The design of the lamp has an impact on how the light is distributed (Figure 9).

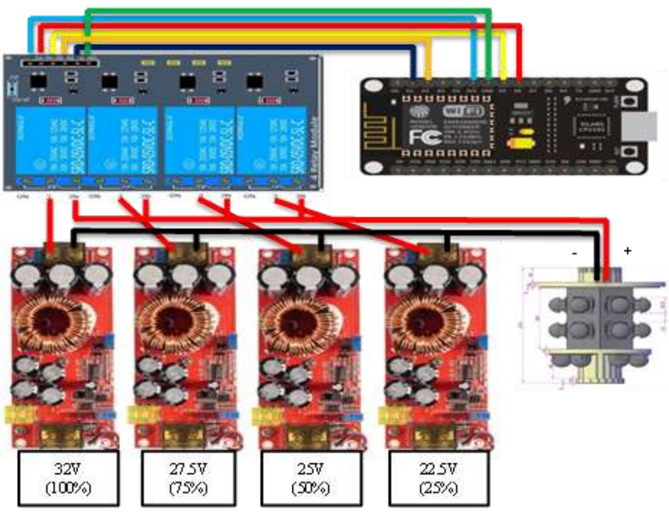


Figure 8. The components and set-up of the relay circuit for illuminating the lamp

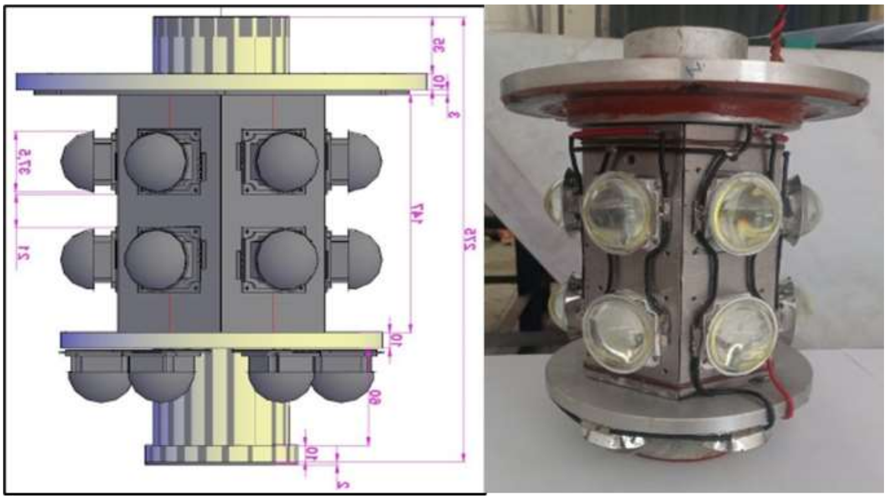


Figure 9. Construction of a portable underwater lamp

To establish the pattern of light dispersion and the light distance of LED lights created using ILT5000, measurements of light illumination in the air were done. At a distance of 100 cm, measurements were taken both horizontally and vertically at successive intervals of 10°. When light is dimmed from 100% to 75%, 75% to 50%, and 50% to 25% brightness, the intensity of the light also decreases. An exponential equation is used to examine measurements. According to Barger's law, illumination declines exponentially (Nikonorov, 1975). Figure 10 shows the form of the resultant light dispersion.

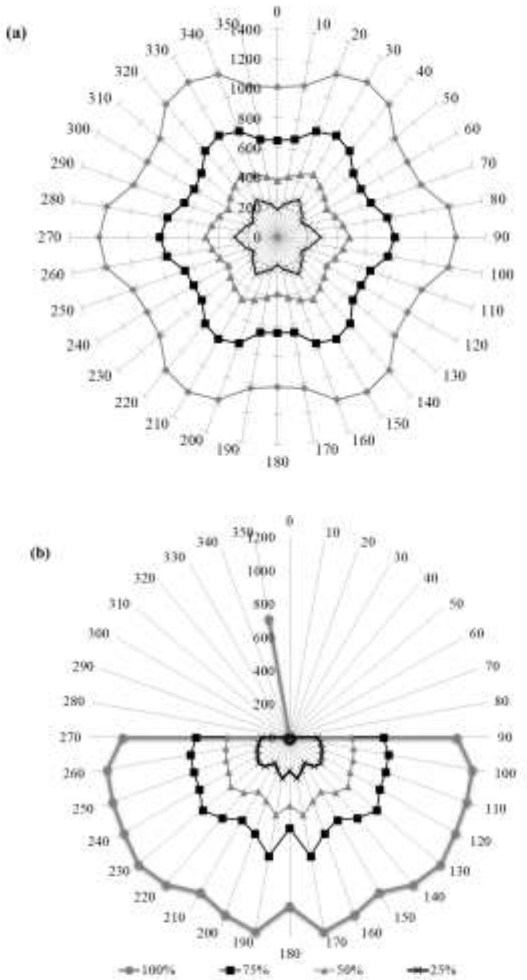


Figure 10. Distribution of light based on brightness level (a) Horizontal position and (b) Vertical position.

According to the findings of measuring light intensity at various brightness levels (100%, 75%, 50%, and 25%), there has been a noticeable decline. The findings of measuring light intensity horizontally are as follows: brightness level 100% (maximum intensity value 1205 lux, lowest intensity value 1011 lux, and average 1074 lux), brightness level 75% (highest intensity value 795 lux, lowest intensity value 648 lux, and average 714 lux), 50% brightness the average intensity is 432 lux, with a maximum value of 485 lux and a minimum value of 380 lux. The average intensity value is 236 lux, with 293 lux being the highest value and 184 lux being the lowest. Meanwhile, the findings of measuring light intensity vertically are as follows: brightness level 100% (maximum intensity value 1182 lux, lowest intensity value 1003 lux, and average 590 lux), brightness level 75% with highest intensity value 724, and brightness level 25% is a very effective way to concentrate on the fish schooling in the fishing ground. According to the lamp's perceptual threshold for brightness that is set in Figures 11 and 12, the intensity of the lamp's light is calculated.

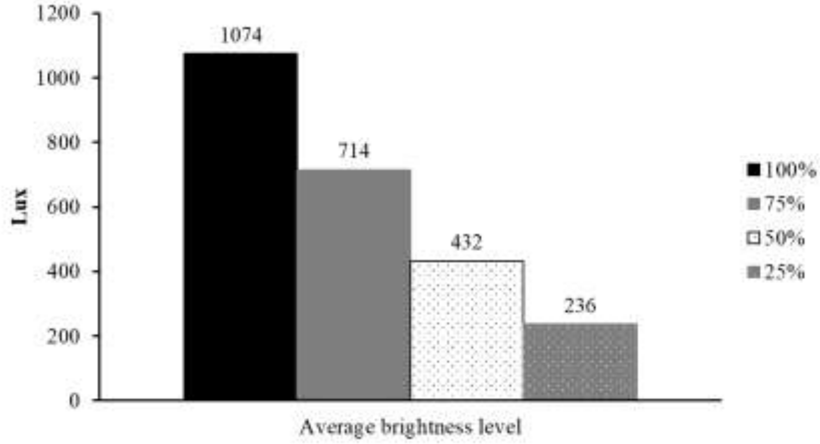


Figure 11. The average light intensity of lamps in a horizontal position

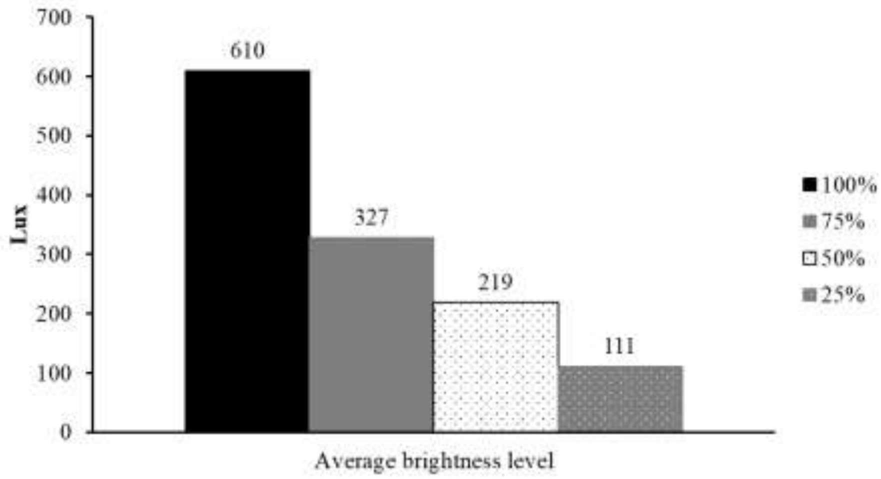


Figure 12. The average light intensity of lamps in a vertical position

CONCLUSIONS

Based on the study's findings, it can be said that the portable underwater lamp is made of 18 white, 900-watt, 27-amp, 32-volt LED HPL lamps arranged in a vertical cylinder utilizing a parallel electrical circuit. According to the findings of a light distribution test, portable underwater lamps are capable of equally illuminating a fishing area at an angle of 180° toward the vertical and 360° to the horizontal with a visible distance of 0.357 w/cm2 to 0.455 w/cm2 and 0.347 w/cm2 to 0.447 w/cm2, respectively. Additionally, remote control and underwater operation are both possible with portable underwater lamp technology.

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