Application of Navigation Light Monitoring and Control in Ship’s KRI Sampari 628 Based on Android

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Abstract. The current BCC (Bridge Control Console) system is still controlled manually mainly on the ship’s navigation lights, which requires the crew to come to the BCC room, so it will be difficult if the crew is far from the BCC room. From that problem the author wants to create a digital system, in this case an android-based control and monitoring system for navigation lights which is expected to be practical and efficient to operate both in the BCC room and outside the room. In facing the industrial revolution 4.0, the author uses the scientific field of Internet of Things (IoT) with the main electronic device, namely Arduino UNO with a MEGA 2560 microcontroller as the system control center, as well as the ESP8266 wifi module for controller communication. LDR is used to detect light, relay is used to switch lights, Interface is made based on applications installed on Android and the hardware is a series of systems and prototypes.

1. Introduction
PT. PAL Indonesia (Persero) as one of the strategic industries that produces the main tools of the Indonesian defense system, especially for the marine dimension, certainly has an important and strategic role in supporting the development of the national marine industry. Currently the capability and design quality of PT. PAL Indonesia (Persero) has been recognized by the international market. As a shipbuilding company with more than three decades of experience, PT. PAL Indonesia (Persero) together with 1,300 employees, have mastered the construction of various quality products as follows: Commercial Ship Products, Warship Products, 60 m Fast Missile Ship (KCR) (KRI Tombak 629, KRI Halasan 630 and KRI Sampari 628). [1]

On KRI Sampari 628 there is a navigation room in the form of a console that functions to regulate the navigation system, communication system, steering system, propulsion system, alarm system, engine control system, payload control system, ballast water control system and other systems. One of these consoles is the BCC (Bridge Control Console), which is a steering panel mounted on the ship’s bridge to control the navigation system, communication system, steering system, propulsion system, alarm system, and other systems. However, this console can only be operated/controlled from the inside, it cannot be controlled outside the room, so when the crew is away from the BCC room it...
will be difficult to control. From these problems the author wants to create an integrated application on the KRI Sampari 628 model to control and monitor android-based navigation lights. So that it can help the crew practically and efficiently both inside and outside the BCC. Internet of Things (IoT) which requires several main electronics such as Arduino Mega 2560 as system control, ESP8266 wifi module for controller communication and LDR module for detecting lamps, as well as relays for lamp switching. The interface is made based on an Android-based install application. and hardware of the KRI Sampari 628 system and model series.

Furthermore, if the control and monitor system is successful, in the future it will be integrated with the hybrid propulsion system control system that the author has made on other peppers. The hope is to control and control using only one device, namely a mobile phone or android.

2. Theoretical Background

2.1. Navigation Lamp

The most important piece of equipment in the navigation room is the navigation light. In Figure 1. Navigation lights function as signs or signs indicating the position of a ship if it is seen by other ships. These navigation lights must be installed in accordance with existing safety regulations. Planning for navigation lights can be seen from the IMO - COLREG regulations (Convention on the International Regulations for Preventing Collisions at Sea, 1972). [2]

![Figure 1. Navigation light of various Layouts](image)

2.2. Internet of Things (IoT)

The Internet of Things (IoT), also called the Internet of Everything or the Industrial Internet, is a new technology paradigm envisioned as a global network of machines and devices capable of interacting with each other. The IoT is recognized as one of the most important areas of future technology and is gaining vast attention from a wide range of industries. The true value of the IoT for enterprises can be fully realized when connected devices are able to communicate with each other and integrate with
vendor-managed inventory systems, customer support systems, business intelligence applications, and business analytics. [3]

2.3. Microcontroller MEGA 2560
Arduino is an electronic device consisting of hardware and software, small in size, easy to carry and very practical to use. Arduino is commonly used in the world of engineering, design, or for hobbies. [12]

In Figure 3. Arduino Mega 2560 is a microcontroller development board based on Arduino using the ATmega2560 chip. This board has quite a lot of I/O pins, a total of 54 digital I/O pins (15 of which are PWM), 16 analog input pins, 4 UART pins (hardware serial port). Arduino Mega 2560 is equipped with a 16 Mhz oscillator, a USB port, DC power jack, ICSP header, and reset button. This board is very complete, already has everything that is needed for a microcontroller. With a fairly simple use, you just need to connect the power from USB to your PC or via AC/DC adapter to DC jack. [12]

2.4. Module Wifi ESP 8266
The ESP 8266 is a complete chip which includes processor, memory and access to GPIO. This causes the ESP8266 to directly replace the Arduino and coupled with its ability to support direct wifi connections.

IoT (Internet Of Things) is growing along with the development of microcontrollers, more and more and more various modules based on Ethernet and wifi, starting from Wiznet, Ethernet shield to the newest Wifi module known as ESP8266. In Figure 4. There are several types of ESP8266 that can be found in the market, but the easiest to find in Indonesia are the ESP-01,07, and 12 types with the same function, the difference lies in the GPIO pin provided. Here are some types of ESP8266. [4]
The working voltage of the ESP-8266 is 3.3V, so for the use of an additional microcontroller, you can use an Arduino board that has a 3.3V source voltage facility, but it would be better if you make a level shifter separately for communication and a voltage source for this wifi module. [7]

Because this wifi module is equipped with a microcontroller and GPIO so many people are developing firmware to be able to use this module without additional microcontroller devices. The firmware used so that this wifi module can work standalone.

2.5. Fritzing
In Figure 5, Fritzing is a free software used by designers, artists, and electronics hobbyists to design various electronic equipment. Usually before using the fritzing program they will make a prototype using actual electronic components.

This prototype is made on a breadboard so that if something goes wrong it is easy to fix. In addition, it is also usually connected to Arduino if the prototype requires additional programs. After the prototype is finished and there are no errors, a program design is made.

How to use the fritzing program is also very easy. We just have to imitate the prototype that has been made in the fritzing software. Drag and drop components provided in the fritzing software on the work area. The components provided are also quite complete, from basic components such as resistors and capacitors to more complex components such as ICs and various microcontrollers.

2.6. RemoteXY
In Figure 6, RemoteXY is an apk maker application (android application) that we can do independently through access to the remotexy.com site. The interface editor is an online development editor. This editor is designed to be able to develop a GUI or user interface and generate source code for Arduino microcontrollers. This editor interface can be seen at http://remotexy.com/en/editor/.
3. Methodology

In Figure 7, the flowchart of the research stage is explained starting with the design and manufacture of hardware, followed by the design and manufacture of software, and testing of tools after that Analysis and conclusions.

![Flowchart](https://via.placeholder.com/150)

**Figure 7. Research Flowchart**

3.1. Schematic of Control and Monitoring System Circuit

The software design includes the design of the GUI display on the smartphone screen through the panel component settings on the remotexy.com site. In addition, the development of the Arduino Mega 2560 microcontroller program code is also the result of the translation of panel components from the remotexy.com site as well as additional data processing program code from the light sensor.
4. Result and Discussion

As shown in figure 9, the display of the application in portrait or landscape position. By default, when the application is opened on a smartphone, the display will be directed as shown in Figure 9. In the application display, the number of lights that can be controlled and monitored is displayed. The work of this application is that the smartphone is first connected to the local wifi, this local wifi is obtained from turning on the wifi module installed on the ship model. When connected means the application is ready to control the navigation lights on the ship model. On the application display,
there is a description of the name of the lamp on each number, then there are 3 light color indicators to monitor, namely red means the light is off, green means the light is on and yellow means there is a problem with the installation of the lamp or on the lamp itself.

From testing to communication between software and applications using a smartphone is 100% successful. Indicators of successful data transmission, from the lights and the Arduino serial features indicate that the program data, the installation of electronic circuits on ship models and applications on smartphones no problems.

Table 1. Testing Navigation Lights on the Model Sampari 628

| No. | Pressed command | Status Lamp | Which expected | Observation | Color Display On/Off on the Applications | Conclusion |
|-----|----------------|-------------|----------------|-------------|----------------------------------------|------------|
| 1   | ON             | 1 lamp on   | Lamp 1 can turn off | 1 light off | Red [√] accepted                      |            |
|     | OFF            | 1 lamp off  | Lamp 1 can turn on | 1 lamp on   | Green [ ] rejected                     |            |
| 2   | ON             | 2 lamp on   | Lamp 2 can turn off | 2 light off | Red [√] accepted                      |            |
|     | OFF            | 2 lamp off  | Lamp 2 can turn on | 2 lamp on   | Green [√] accepted                     |            |
| 3   | ON             | 3 lamp on   | Lamp 3 can turn off | 3 light off | Red [√] accepted                      |            |
|     | OFF            | 3 lamp off  | Lamp 3 can turn on | 3 lamp on   | Green [ ] rejected                     |            |
| 4   | ON             | 4 lamp on   | Lamp 4 can turn off | 4 light off | Red [√] accepted                      |            |
|     | OFF            | 4 lamp off  | Lamp 4 can turn on | 4 lamp on   | Green [ ] rejected                     |            |
| 5   | ON             | 5 lamp on   | Lamp 5 can turn off | 5 light off | Red [√] accepted                      |            |
|     | OFF            | 5 lamp off  | Lamp 5 can turn on | 5 lamp on   | Green [ ] rejected                     |            |
| 6   | ON             | 6 lamp on   | Lamp 6 can turn off | 6 light off | Red [√] accepted                      |            |
|     | OFF            | 6 lamp off  | Lamp 6 can turn on | 6 lamp on   | Green [ ] rejected                     |            |
| 7   | ON             | 7 lamp on   | Lamp 7 can turn off | 7 light off | Red [√] accepted                      |            |
|     | OFF            | 7 lamp off  | Lamp 7 can turn on | 7 lamp on   | Green [ ] rejected                     |            |
| 8   | ON             | 8 lamp on   | Lamp 8 can turn off | 8 light off | Red [√] accepted                      |            |
|     | OFF            | 8 lamp off  | Lamp 8 can turn on | 8 lamp on   | Green [ ] rejected                     |            |
| 9   | ON             | 9 lamp on   | Lamp 9 can turn off | 9 light off | Red [√] accepted                      |            |
|     | OFF            | 9 lamp off  | Lamp 9 can turn on | 9 lamp on   | Green [ ] rejected                     |            |
In testing the Wi-Fi range of Table 2, between smartphones and ship models at a distance of 1 to 40 meters it can still be reached. But at a distance of 40 to 42 meters is already unreachable.

| No. | Reach   | Room Condition | Conclusion          |
|-----|---------|----------------|---------------------|
| 1   | 1-20 M  | No barrier     | [] accepted         |
|     |         | barrier        | [√] accepted        |
| 2   | 20-35 M | No barrier     | [] accepted         |
|     |         | barrier        | [√] accepted        |
| 3   | 35-40 M | No barrier     | [] accepted         |
|     |         | barrier        | [√] accepted        |
| 4   | 40-42 M | No barrier     | [] accepted         |
|     |         | barrier        | [√] accepted        |

In the picture is the final result of assembling a model ship with electronic components.

**Figure 10. Portside and Starboard Side Ship Model View**
5. Conclusion

Based on system design, making tools and from the tests that have been carried out, several conclusions can be made that answer the problem objectives and suggestions for the development of further research as follows:

1. The series of devices consist of 12V 5 A and 5V 6A adapters, Arduino MEGA 5260, wifi module, LDR module as monitoring lights when on or off and relay module instead of a switch to disconnect and connect electricity to the navigation lights.

2. Android applications are made using remoteXY and writing programs for Arduino MEGA 5260 using Arduino IDE (Integrated Development Environment) software.

3. The simulation tool is a ship model from Nasdec ITS. Each place is given an LED by adjusting the color according to the existing rules and is given a voltage of 3V with a 1A diode and a 56K resistor connected to the electrical circuit and main equipment.

4. Based on the results of the tests carried out, the tool can work well to control navigation lights with a maximum distance of 40 m without any obstacles and 35 m when there are obstacles. And can monitor all navigation lights when the lights are off (problem) when the on/off button is on.

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