BACHELOR THESIS – ME184841

DESIGN OF INTERACTIVE SIMULATION MODEL SOFTWARE OF BRIDGE NAVIGATIONAL WATCH ALARM SYSTEM USING UNREAL ENGINE

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TUGAS AKHIR – ME 184841

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2022

VALIDITY SHEET

DESIGN OF INTERACTIVE SIMULATION MODEL SOFTWARE OF BRIDGE NAVIGATIONAL WATCH ALARM SYSTEM USING UNREAL ENGINE

BACHELOR THESIS

Submitted to meet one the conditions

Obtained a Bachelor of Enginering degree on

S-1 Marine Engineering study Program

Department of Marine Engineering

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Institut Teknologi Sepuluh Nopember

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Hereby declares that the Final Project with the title" DESIGN OF INTERACTIVE SIMULATION MODEL SOFTWARE OF BRIDGE NAVIGATIONAL WATCH ALARM SYSTEM USING UNREAL ENGINE " is his own work, original, and written following the rules of scientific writing.

If in the future a discrepancy is found with this statement, then I am willing to accept sanctions in accordance with the provisions in force at the Sepuluh Nopember Institute of Technology..

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ABSTRACT

DESIGN OF INTERACTIVE SIMULATION MODEL SOFTWARE OF BRIDGE NAVIGATIONAL WATCH ALARM SYSTEM USING UNREAL ENGINE

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Abstract

In today's world of shipping, the sophistication of communication and navigation tools from ships has far grown compared to previous eras and has made almost all activities in the ship's wheelhouse able to be done automatically. However, the presence of a guard or Officer On Watch (OOW) is still needed to ensure that nothing goes wrong in the ship's navigation while sailing. Therefore the presence of OOW is still required to maintain the ship's bridge deck while sailing. One of the navigation and communication equipment that ensures this happens is the Bridge Navigational Watch Alarm System (BNWAS). BNWAS will detect the presence of OOW and will alert officers if OOW is absent for too long from their duties. So the existence of BNWAS has become mandatory equipment as stated in Safety Of Life At Sea (SOLAS) Chapter V Regulation 19. This makes seafarers have to understand how to operate the BNWAS. however, BNWAS equipment is equipment that will be activated when the ship is sailing, so to learn firsthand how it works, you must be on the ship first. So to make it easier to learn how to learn how the BNWAS system works, the author designed a software for BNWAS simulation that can be played from a computer so that sailors or shipping students will be able to learn how the BNWAS system works even though they don't try the tool directly on the ship. In order for the simulation software from BNWAS to run properly, the end result of the software product must be close to how the original BNWAS equipment is operated. BNWAS equipment has performance standards listed in resolution 128 of the 75th session of the Maritime Safety Committee (MSC) in 2002, this is the author's reference standard in making simulation software from BNWAS. Author use Unreal Engine Software as the base software to design and create The BNWAS Simulator software. After testing the BNWAS simulation software, it was concluded that the simulation scheme designed by the author actually met the BNWAS performance standard criteria listed in resolution 128 of the 75th session of the Maritime Safety Committee (MSC) in 2002, such as regarding operational modes & sequences. reset function, as well as alarm output per stage and presentation of information, so that the software designed by the author can be used as a learning tool about BNWAS system simulation on ships.

Keywords: ***BNWAS, Officer on Watch, MSC Resolution, Simulator Software, Unreal Engine***

ABSTRAK

DESIGN OF INTERACTIVE SIMULATION MODEL SOFTWARE OF BRIDGE NAVIGATIONAL WATCH ALARM SYSTEM USING UNREAL ENGINE

Nama Mahasiswa / NRP	**:**	**Naufal Allam Gani Atmojo / 04211741000018**
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Abstrak

Dalam dunia Perkapalan di masa kini, kecanggihan alat alat komunikasi dan navigasi dari kapal telah berkembang dan membuat hampir seluruh kegiatan di ruang kemudi kapal bisa dilakukan secara otomatis. Namun, keberadaan petugas jaga atau Officer On Watch (OOW) tetap diperlukan kehadirannya untuk memastikan tidak ada yang salah di navigasi kapal selama berlayar. Maka dari itu keberadaan OOW tetap diwajibkan untuk menjaga dek anjungan kapal selama berlayar. Salah satu peralatan navigasi dan komunikasi yang memastikan hal tersebut terjadi adalah perangkat *Bridge Navigational Watch Alarm System* (BNWAS). BNWAS akan mendeteksi keberadaan OOW dan akan mengingatkan petugas apabila OOW absen terlalu lama dari tugasnya. Maka keberadaan BNWAS telah menjadi perlatan Wajib sesuai yang tercantum dalam *Safety OF Life At Sea* (SOLAS) Chapter V Regulation 19. Hal ini membuat para pelaut harus mengerti bagaimana mengoperasikan BNWAS tersebut. untuk mempelajari secara langsung cara kerjanya harus berada di kapal terlebih dahulu. Untuk mempermudah bagaimana mempelajari cara kerja dari sistem BNWAS, penulis mendesain perangkat lunak simulasi BNWAS yang bisa dimainkan dari komputer agar para pelaut ataupun siswa pelayaran akan dapat mempelajari cara kerja sistem BNWAS. Maka hasil akhir dari produk perangkat lunak harus mendekati dari bagaimana perlatan BNWAS yang asli dioperasikan. Peralatan BNWAS memiliki standar kinerja yang tercantum pada resolusi 128 dari sidang ke 75 *Maritime Safety Committee* (MSC) pada tahun 2002, inilah yang menjadi standar acuan penulis dalam membuat perangkat lunak simulasi dari BNWAS. Penulis menggunakan *Software Unreal Engine* sebagai basis perangkat lunak dalam membuat perangkat lunak simulasi BNWAS tersebut. Setelah perangkat lunak simulasi BNWAS dicoba didapatkan kesimpulan bahwa skema simulasi yang dirancang oleh penulis ternyata memenuhi kriteria standar kinerja BNWAS yang tercantum dalam pada tesolusi 128 dari sidang ke 75 *Maritime Safety Committee* (MSC) pada tahun 2002 seperti mengenai *operational mode & sequences.* fungsi *reset,* serta *output alarm per stage* dan *presentation of information,* sehingga perangkat lunak yang dirancang oleh penulis dapat digunakan sebagai sarana pembelajaran mengenai simulasi sistem BNWAS pada kapal.

Keywords: *BNWAS, Officer on Watch,* Perangkat Lunak Simulasi, Resolusi *MSC, Unreal Engine*

PREFACE

Alhamdulillah all praise and gratitude author prays to God Almighty Allah Subhanahu wa ta'ala because of His blessing and grace that Author could complete this bachelor thesis entitled "DESIGN OF INTERACTIVE SIMULATION MODEL SOFTWARE OF BRIDGE NAVIGATIONAL WATCH ALARM SYSTEM USING UNREAL ENGINE". This thesis written by author to complete and achieve Bachelor Degree on Marine Engineering Department, Faculty of Marine Technology, Sepuluh Nopember Institute of Technology, Surabaya. Furthermore author would like to express gratitude for many parties that gives author really meaningful helps in the process of completing this bachelor thesis. Those are:

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6. All of my friends, relatives, and related parties that helps author all this time and cannot author mention one by one, prayers and thanks are conveyed to you all

Author realizes that this bachelor thesis is far from any perfection whether it is about the concern of data, analysis method, simulator design and/or the report writing and author truly grateful for any criticizm and suggestion regarding this. However author hopes that this bachelor thesis could help others to learn more in scope of understanding about the Bridge Navigational Watch Alarm System and also others to be interested in developing many kind of simulation software of the operated systems in the ship.

Surabaya, 1 July 2022

Author

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LIST OF ABBREVIATIONS

BNWAS : Bridge Navigational Watch Alarm System

OOW : Officer On the Watch

IMO : International Maritime Organization

SOLAS : Safety Of Life At Sea

MSC : Maritime Safety Comittee

POV : Point of View

LIST OF SYMBOL

Td	-	Selected Dormant Period

CHAPTER 1

INTRODUCTION

1.1 Research Background

The use of navigational equipment on board the ship is very important in order to optimize the voyage of a ship from the point of departure to the place of destination. On the other hand, the world of navigation is getting more advanced and new equipment is added. Equipment such as BNWAS (Bridge Navigational Watch and Alarm System) which is one of the important navigational equipment on board the ship.

The Bridge Navigational Watch Alarm System or commonly abbreviated as BNWAS was introduced through amendments to SOLAS 1974 CHAPTER V Rule 19, which was approved by members of the IMO (International Maritime Organization) at the 86th Maritime Safety Committee (MSC 86) session as outlined in MSC Resolution No. 282 (86) on 5 June 2009. SOLAS Chapter V Regulation 19 states that all passenger ships and cargo ships 150 GT and above must install BNWAS on or after 1 July 2011 with some gradually in terms of installation period for older ships. Bridge Navigational Watch Alarm System or commonly abbreviated as BNWAS, is equipment that is installed on the bridge and is an alarm system for the navigational watch service on the bridge to monitor bridge activity and detect operator errors that can cause accidents at sea.

The Importance of BNWAS make all the crew of ship should understand how to operate the BNWAS especially the deck officer, but to understand the system better, the officer needs to operate the system. Sampurno, G.P., et al. (2021) stated that the lack of familiarization to the officer on the watch regarding the importance of using these device on ships because there are still many officers who do not know the function of the BNWAS, so that the officers on duty tend to ignore this device. This is becoming problem for sailing school student where are they not always can implement the theory by practical in the ship. So the solutions needed to give them similar experience of operating real BNWAS system. One of solutions that can be provide to solve the problem above is by creating or designing a simulator to give the similar experience of using the real BNWAS device. The BNWAS device itself have standard performance to make sure every BNWAS Device are in same standard. The standard of BNWAS device is Regulate in 75th Maritime Safety Committee (MSC 75) MSC Resolution 128(75). By simulator the student can implement the theory about BNWAS and help them gain better understanding. To create the simulator there are many software engine that can be the base software to design the simulator, one of them are Unreal Engine. Originally created as game architecture software in 1998, Unreal engine develop as one leading software engine that used to various purpose, with many features that support the purpose of creating simulation. The BNWAS Simulator are possible to create with Unreal Engine and expected to be the solution that can provide the students good simulator that helps them understand the BNWAS System better.

1.2 Problem Statement

Based on the research background, the problems statement can be concluded of this final project are:

a.How to design the BNWAS (Bridge Navigational Watch Alarm System) into interactive simulation model software using Unreal Engine as the base software?

b. How to use the designed BNWAS interactive simulation software as learning media to understand the system if BNWAS on the ship?

1.3 Research Objectives

Based on the problem statement in point 1.2, the research objectives of this final project are:

a.To design the BNWAS (Bridge Navigational Watch Alarm System) into interactive simulation model software using Unreal Engine as the base software.

b. To use the designed BNWAS interactive simulation software as learning media to understand the system of BNWAS on the ship.

1.4 Scope of Research

To ensure this final project organized and focused, the scope or limitations of this research will limited to:

a.This research use Unreal Engine as the base software to develop the BNWAS interactive simulation model software.

b. Only designed the simulation of BNWAS (Bridge Navigational Watch Alarm System).

1.5 Research Benefit

The benefit of this research will expected to receive by various parties. This research can give benefit of:

a.Provide the visualization of BNWAS system of the ship as interactive simulation model software.

b. Provide the learning media of how to operate the BNWAS equipment on the ship

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The study literature in this research covers the basic information that will be used in this final project. The contents of information that can be used in this project such as about component of BNWAS (Bridge Navigational Watch Alarm System), working principle of BNWAS, Explanation about Unreal Engine and the eminence of Unreal Engine.

2.2 Bridge Navigational Watch Alarm System (BNWAS)

Bridge Navigational Watch Alarm System (BNWAS) is one of many component that mandatory to be existed in any vessel built from 1st July 2011 and after, this rules stated in IMO (International Maritime Organization) MSC (Maritime Safety Committee)86 since July 2009 for any vessel 150 GT and above based on the categorized Gross tonnage and the date of constructed and/or first surveyed,.

Table 2.1 Ship Mandatory to have BNWAS Installed (MSC.282(86), 2009)

Gross Tonage (GT)	Constructed Before /After	First Survey After
≥150	After 1 July 2011	-
150 < 500	Before 1 July 2011	After 1 July 2014
500 < 3000	Before 1 July 2011	After 1 July 2013
≥3000	Before 1 July 2011	After 1 July 2012

The function of BNWAS device are to monitor the presence of on duty officer in the navigation room with time based alarm and motion sensor. With the BNWAS Device Installed on the Ship It will constantly detect the activity of the OOW and preventing that the wheelhouse from absence of officer in long period that have possibility to lead to marine accidents. Dang, Xuan-Kien., et al. (2020) stated that the BNWAS warnings also can used as the reminder to the captain and other crews about the OOW situation such in case of incapacity of the watchkeeping due to several situations like sicknes or accident and even security breaching.

2.2.1 Working principle of BNWAS

The working principle of BNWAS can be explained with a simple PD (Problem Diagram) below:

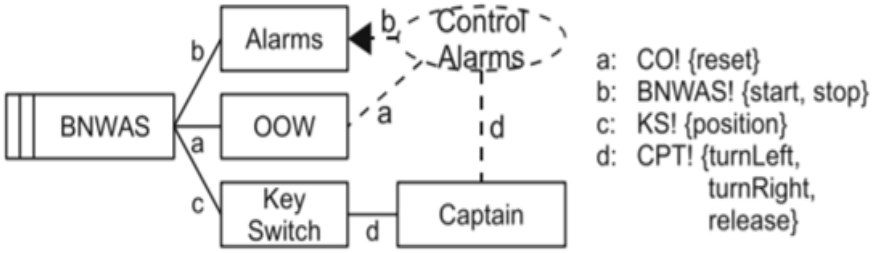

Figure 2.1 BNWAS Working Principle Problem Diagram (Lassen KB, & Tjell, 2008)

Lassen, K.B., Tjell, S. (2008) Explained the working principle of BNWAS system with the diagram in Figure 2.1 where the boxes are the domain and lines interface as shared phenomenon that build th construction of the BNWAS working System. The BNWAS device need to be started by captain using Key Switch, then the captain set the certain time called dormant period that will trigger the alarm if the timer count ends or the motion detector don't recognize any movement by OOW (Officer on the Watch). In case of the OOW movement detected by the detector, the count will not started and it keep on the start of dormant period. In case of the motion detector don't recognize any movement from the OOW, the countdown of dormant period started. The duration of dormant period can be set to 3, 6, 9, or 12 Minutes depend on the captain decision. When the dormant period ends and there are no Officer that press timer reset button, the Alarm will be activated. The Alarm Consist of four different stages depend on how long the period that the timer reset button not pressed by the OOW. Stages 1 the flash alarm in navigation room will start to activated, if after 15 second the OOW not acknowledge the reset button, the alarm enter the stage two that the audio alarm 1 in navigation room will be activated. If after 15 seconds the reset button still not acknowledged, the alarm unit in captain room start to activated, this is considered as stage 3. If 90 seconds after stage 3 alarm the button still not pressed, the stage 4 alarm will be activated, this stage alarm will activate all audio alarm unit in the all accommodation room where the alarm unit installed.

2.3 Components of BNWAS Device

There are several component of BNWAS device with different function of each other, every device will connected to the main units to make sure the BNWAS system works properly, those components are :

a.BNWAS Main unit

BNWAS Main unit is the main panel of the system, in Figure 2.2 we can see that it contains several function such as the on/off switch with key hole, power supply indicator, timer setting panel, watch alarm indicator, and emergency call button.

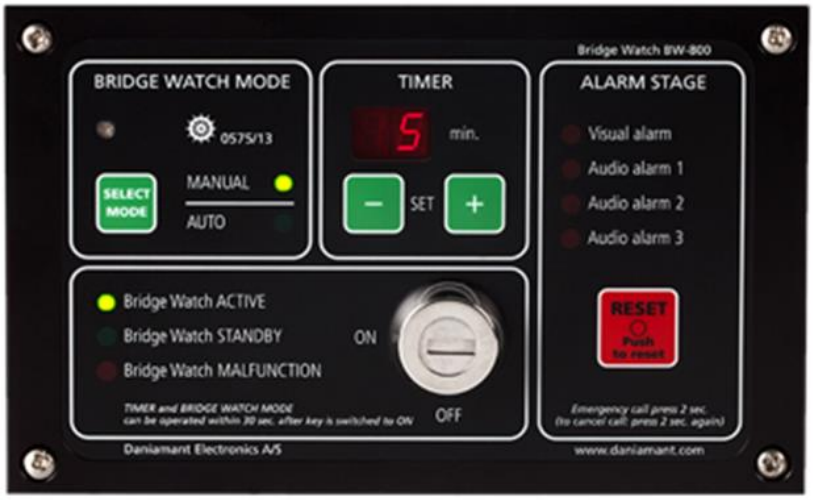

Figure 2.2 BNWAS Main Unit (daniamant.com)

The BNWAS Main unit comonly located in the wheelhouse near other navigation & communication devices. It can be in form of a digital sceen or analog panel. The captain / master interact with this main unit to settings the BNWAS Alarm

b. Timer Reset Panel

Timer Reset Panel contains the button to press by the officer on the watch (OOW) in navigation room when the dormant period of the timer ends and reset the timer count, in Figure 2.3 we can see that the shape of the reset button is simple bix with push button to reset the alarm..

Figure 2.3 Timer reset Panel (furuno.com

The timer reset reset panel also located in the wheel house and its function is to stop the emerging alarm and restart the dormant period. To do it function the officer on watch should press this button.

c. Motion Detector

Motion detector are the sensor that placed in navigation room to detect of there are sign of movement by the OOW to detect the officer awake and do the duty properly in Figure 2.4 is shows the motion detector that will be placed to detect the OOW.

Figure 2.4 BNWAS Motion Detector (furuno.com)

The motion detector will be located in the wheelhouse in the area that will be able to detect the presence of the officer on watch because of its function. The information emitted from the motion sensor will determined the whole process of the BNWAS alarm, it its detect the OOW, it will be maintain the dormant period, if not, it will make the dormant priod starts to countdown.

d. BNWAS Alarm Unit

The flash and alarm beacon in BNWAS Alarm Unit will be activate of the dormant period of the timers ends but the OOW didnt press the button on timer reset panel or the motion sensor didnt recognize any sign of movement by the officer. The alarm unit divided to several stage depends on where the alarm located.

Figure 2.5 BNWAS Alarm Unit (ishamarine.com)

There are several location of where the alar unit installed, the alarm unit with both buzzer and flash indicator are installed in wheelhouse for stage 1 and 2 alarm, and the alarm unit with only sound buzzer are locatd in deck for stage 3 and 4 alarm the Figure 2.5 shows the shape of the BNWAS Alarm Unit.

2.4 Regulation of Standard Performance for BNWAS

As one of mandatory devices in navigation deck. BNWAS device installed in the ship must be adopted the standard performance as stated in International Maritime organization MSC.128 (75) (2002). Moreover, in MSC 282(86) which stated that "a bridge navigational watch alarm system (BNWAS) installed prior to 1 July 2011 may subsequently be exempted from full compliance with the standards adopted by the Organization, at the discretion of the Administration". The standard performance agreed on MSC resolution 128 on 75th session (2002). Shoul be implemented in all BNWAS device after 1 July 2011. The standard performance itself have several operational requirements such as operational modes, operational sequence, reset function, alarm output per stage and presentation of information.

2.4.1 Operational Modes and Sequence of BNWAS Alarm

the operational modes sequenes of based on standard performance agreed on International Maritime organization MSC resolution.128 (75) (2002) are explained in Figure 2.6 Below :

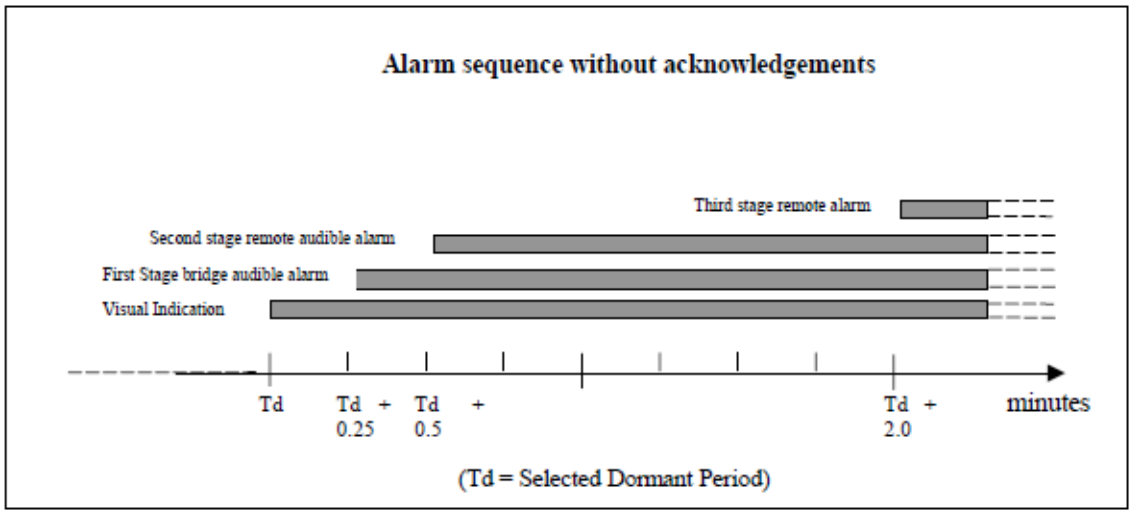

Figure 2.6 : BNWAS performance standard of Alarm Sequence (MSC 128(75), (2002))

1. Once operational, the alarm system should remain dormant for a dormant period of between 3 and12 min (Td) and at the end of this dormant period, the alarm system should initiate a visual indication on the bridge.
2. If not reset, the BNWAS should additionally sound a first stage audible alarm on the bridge 15 s after the visual indication is initiated.
3. If not reset, the BNWAS should additionally sound a second stage remote audible alarm in the other officers and/or captain location 15 s after the first stage audible alarm is initiated.

4. If not reset, the BNWAS should additionally sound a third stage remote audible alarm at the locations of further crew members capable of taking corrective actions 90 s after the second stage remote audible alarm is initiated.
5. In vessels other than passenger vessels, the second or third stage remote audible alarms may sound in all the above locations at the same time. If the second stage audible alarm is sounded in this way, the third stage alarm may be omitted.

In larger vessels, the delay between the second and third stage alarms may be set to a longer value on installation, up to a maximum of 3 min, to allow sufficient time for the other officer and/or Master to reach the bridge.

2.4.2 Reset Function

the reset function based on standard performance agreed on International Maritime organization MSC resolution.128 (75) (2002) are:

1. It should not be possible to initiate the reset function or cancel any audible alarm from any device, equipment or system not physically located in areas of the bridge providing proper look out.

2. The reset function should, by a single operator action, cancel the visual indication and all audible alarms and initiate a further dormant period. If the reset function is activated before the end of the dormant period, the period should be re-initiated to run for its full duration from the time of the reset.

3. To initiate the reset function, an input representing a single operator action by the OOW is required. This input may be generated by reset devices forming an integral part of the BNWAS or by external inputs from other equipment capable of registering physical activity and mental alertness of the OOW.

A continuous activation of any reset device should not prolong the dormant period or cause a suppression of the sequence of indications and alarms.

2.4.3 Alarm Output per stage and Presentation of Information

the alarm output per stage and presentation of information based on standard performance agreed on International Maritime organization MSC resolution.128 (75) (2002) are:

1. Visual Indications, The visual indication initiated at the end of the dormant period should take the form of a flashing indication. Flashing indications should be visible from all operational positions on the bridge where the OOW may reasonably be expected to be stationed. The colour of the indication(s) should be chosen so as not to impair night vision and dimming facilities (although not to extinction) should be incorporated.
2. Frist stage bridge audible alarm, The first stage audible alarm which sounds on the bridge at the end of the visual indication period should have its own characteristic tone or modulation intended to alert, but not to startle, the OOW. This alarm should be audible from all

operational positions on the bridge where the OOW may reasonably be expected to be stationed. This function may be engineered using one or more sounding devices. Tone/modulation characteristics and volume level should be selectable during commissioning of the system.

3. Second and Third stage remote audible alarm, The remote audible alarm which sounds in the locations of the Master, officers and further crew members capable of taking corrective action at the end of the bridge audible alarm period should be easily identifiable by its sound and should indicate urgency. The volume of this alarm should be sufficient for it to be heard throughout the locations above and to wake sleeping persons.

Every stage of alarm sequence will not cancel each other and will activated together with the previous stage of alarm if the alarm not acknowledged in each stage until the last stage of alarm.

2.5 Unreal Engine

The base software that will be author use to design and create the BNWAS Simulator software is Unreal Engine.

Figure 2.7 Unreal Engine Software (unrealengine.com)

Figure 2.7 show the Unreal Engine Software. Unreal Engine is a Game Engine developed by Epic Game, Unreal Engine first appeared in 1998 with its FPS game entitled Unreal. At the beginning of its appearance, Unreal Engine used the C++ programming language, this application has high-level features and tools that are easy to use by game creators to date. Then in March 2014, Epic Games launched Unreal Engine 4 with complete tools, C++ Source Code writing features for the development process through a new subscription model. Unreal Engine 4 has advantages in features such as Real-Time Global Illumination using Voxel Cone Tracing, and Pre-computed Lighting. However, today the function and feature of Unreal Engine not only for creating game, but also for various purposes such as Film making, Interactive Simulator, and VR and AR program.

2.5.1 Advantage of Unreal Engine

Unreal Engine has advantage for developing the software compared to other Engine software to develop the project of BNWAS Simulator system. Unreal Engine Software are

free to download and use and has high degree of portability and support multiple platform, and provide better 3d rendering compared to other Engine. Commonly Unreal Engine use C++ Programming language that commonly used in various purpose of programming, and also suitable to create simulation, but Unreal Engine also have special feature that helps user with less experience of coding with the “Blueprint Visual Scripting” that works similar like packed source code that can used to create or build the program.

2.5.2 Advantage of Unreal Engine

Blueprint Visual Scripting is a feature in Unreal Engine that help the user to scripting gameplay with complete system without using programming language. Figure 2.8 Shows the Blueprint Visul Scripting of Unreal Engine The Blueprint works with a concept of node-based interface to create gameplay elements in the Unreal Engine. Blueprints work as additonal visual script in the project and can create complex system in project by connecting the nodes, function, variable, and event in the script by wires.

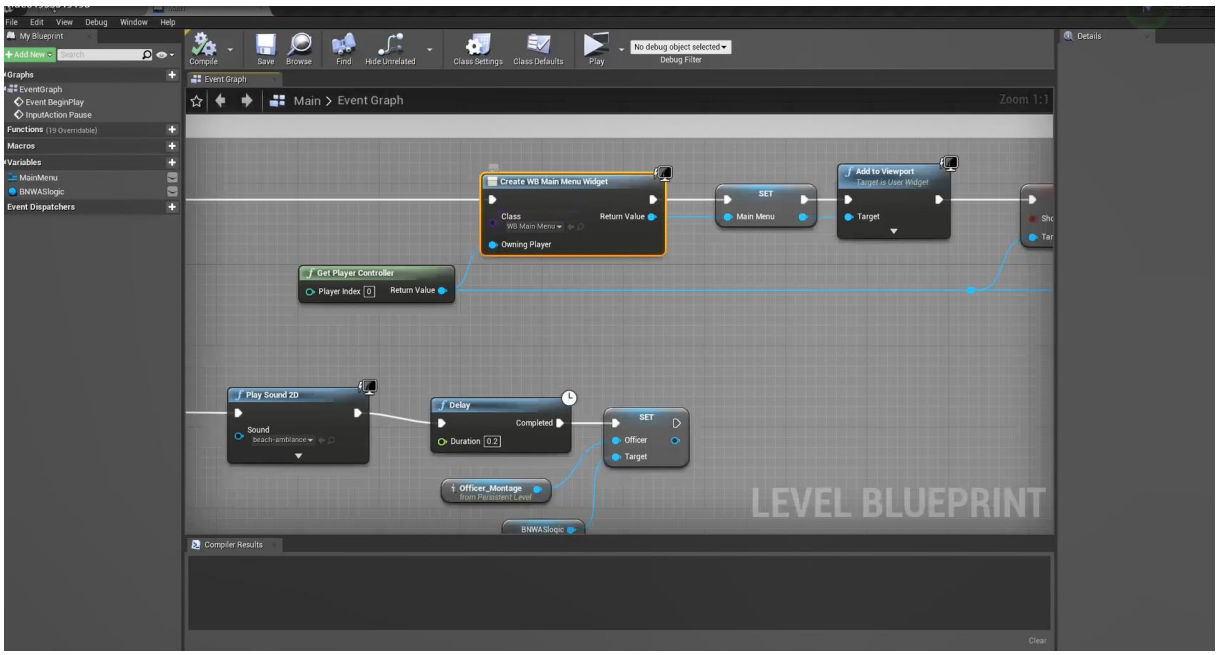

Figure 2.8: Unreal Engine Blueprint Visual Scripting (Author, 2022)

There are many functions of blueprint, without blueprint the system designing will be much more difficult because the system designed must be created in C++ programming language, so the presence of Blueprint visual Scripting Feature is will help the BNWAS System design process in the simulator.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This Chapter will be explain the research methodology and step that author will be used in this project. As the outline of the methodology used by author is starting from the problem identification, literature study, data collecting, software development, software trial, until the conclusion. Author will use those step to create the BNWAS simulation software to achieve the research objectives.

3.2 Research Flowchart

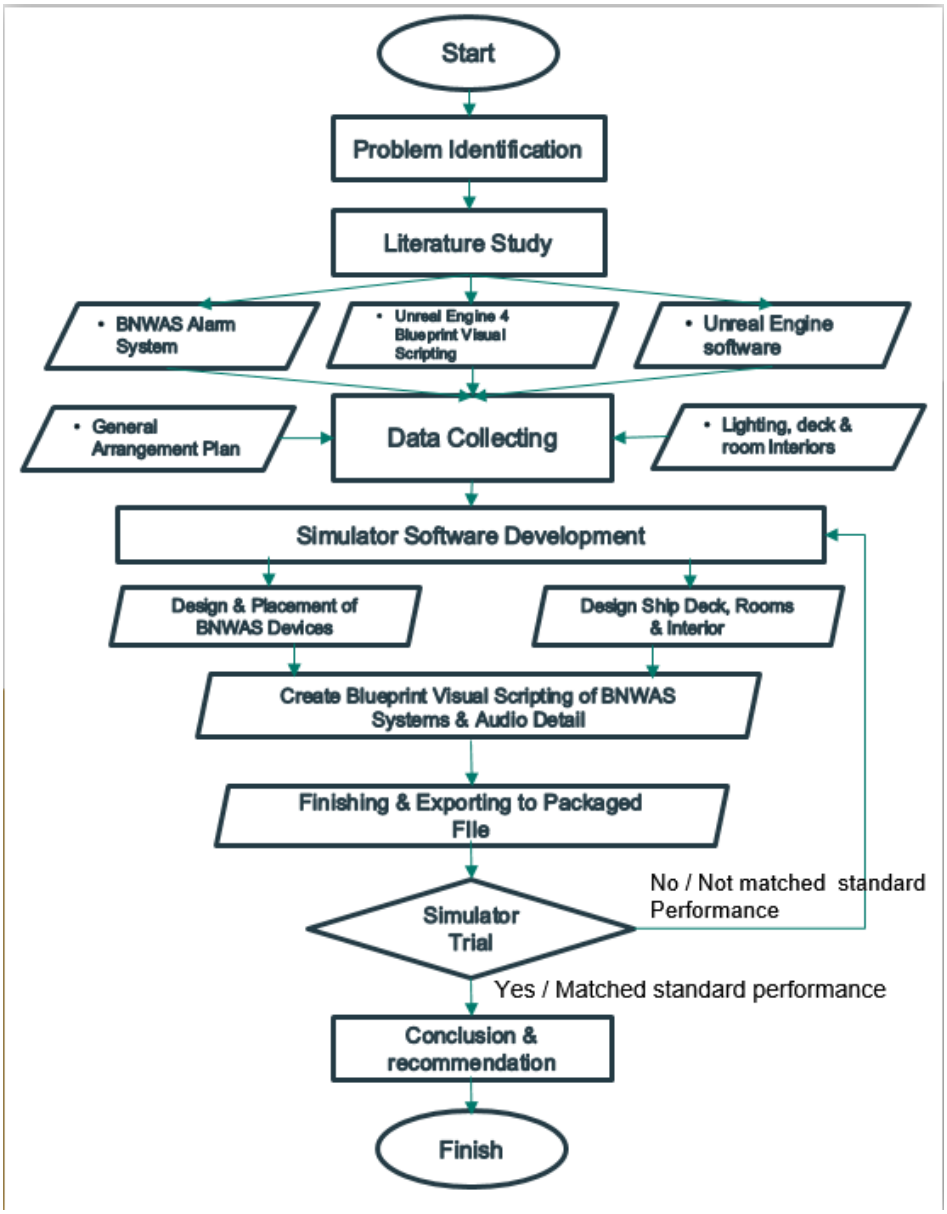

Figure 3.1 Research Flowchart (Author, 2022)

Figure 3.1 Explain the flowchart of the research conducted by author, in this research, author use Qualitative approachment, with the result is yes or no statement. In the flowchart Author use several steps from the start to the end of the research.

3.3 Problem Identification

The problem identification stage is the stage that taken by author to formulate such as the problem statement, objective, and scope of this research as well as the benefit of this research. The problem identification Also identify the problem regarding the difficulty to the sailor and salinig school studendt to practice the BNWAS system because of limitationthat the devices only operated while the ships is sailing so author design the Simulator software to solve the problem. This stage also to analyze the obstacle that might happened during the process of the research of this project.

3.4 Literature Study

In this Stage, Author's objective is to obtain the basic theory and information needed from resources to ensure the project of this research will be able to perform. The author obtain the information from various resources such as related studies, books, and websites that provide the information that support the research. As show in Figure 3.1, There are 3 key material that must be obtained in the literature Study, which is consisted of :

1. BNWAS Alarm System
2. Unreal Engine Software
3. Unreal Engine 4 Blueprint Visual Scripting

Information obtained from BNWAS alarm system is about what is ist, the background and origin of the BNWAS system and device, the function, and the standard performance, while about the unreal egine itself is how to operate the Unreal engine, and the lueprint visual scripting are about the designing the simulation system in the software using Blueprint to programming the BNWAS simulation system.

3.5 Data Collecting

In this stage, Author collect the data that will be used to create the product ot this research. Basedn on the Figure 3.1, the data that will be collected by authors are the BNWAS system works principle, the model of the BNWAS device, Unreal Engine tools, Blueprint visual scripting that will be used to Create the Software and the model of room environment that will be used as model in the simulator software.

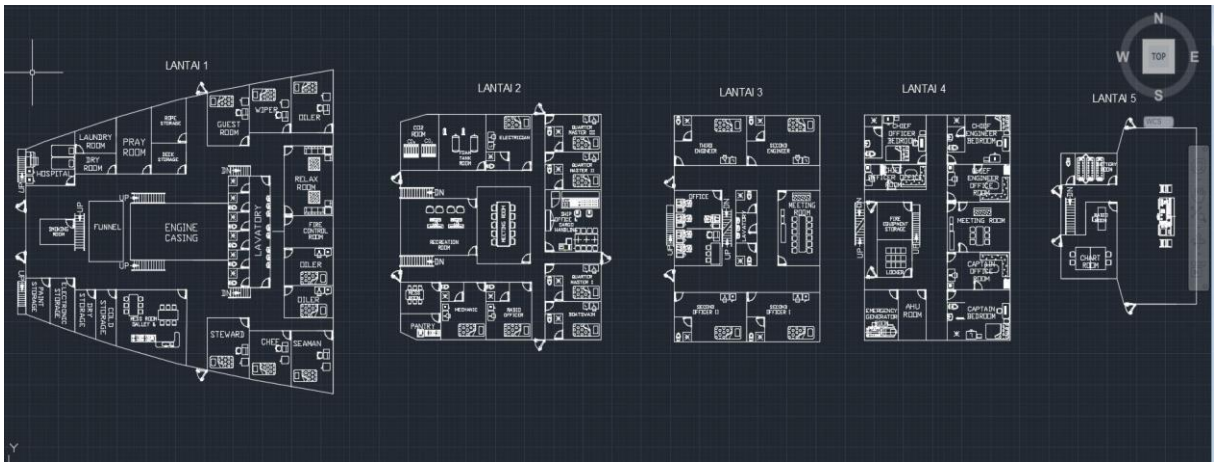

Figure 3.2 General Arrangement plan as the simulator environtment reference (Author, 2022)

The Figure 3.2 shows teh general Arrangement of the ship as the data that should be obtained is the General Arrangement plan so author can designed the area/environtment of the simulator. Each decks designed based on the general arrangement plan and then the next step is collecting the lighting, deck & rooms interior to make the map of the simulator resembles the actual interior of the ship.

3.6 Software Development

After the data collecting stage finished, author start the software development process as the stage of creating the BNWAS simulator such as create and rendering the model of room and equipment, audio and visual effect, and interaction from the user with the simulator, the outline of the software development process as shown in Figure 3.1 are consist of several substep such as design the ship decks, design & placement of BNWAS devices, create blueprint of te system and finishing.

1. The first step of developing the simulator software is to design of the ship deck, rooms, and interior that will be used as the maps / environtment in the simulator. It consisted of decks, from main deck, poop deck, boat deck, bridge deck, and navigation deck. The design of the environtment use the collected ship general arrangement data in data collecting process that shown in Figure 3.2 .
2. Next step is the design and placement of BNWAS devices, the design of bnwas devices should be standout from other interiors in the decks/rooms, so the user can recognize clearly the devices in simulator. The placement is also important because it regulated in the standard of BNWAS performance in MSC regulation 128 (75), so it important to not place the BNWAS devices component in wrong area, the compnent must be placed correct and properly, it will be explained later in chapter 4.
3. After the environtment and the devices is designed and placed correctly, then the next step is to create the blueprint of the system. the blueprint works as programming code for the BNWAS simulation. it will make the user can have interaction with the simulator and do the simulation. the blueprint is the critical element of how the Simulator works. Correct blueprint creating will make the Simualtor works as desired to match the standard performance, but if there's an error or wrong in creating the blueprint, the simulation will not occured as correctly. After the blueprint created and finished, then

the simulator software are exported into packaged files that can be used in computer normally without open the Unreal Engine editor itself.

3.7 Software Trial

After the application creating process finished, then the application will be tested and the result will be evaluated for knowing whether the simulation can fulfill the standard of BNWAS and feasible to use or not. As shown in flowchart in Figure 3.1, if the result of trial is yes and matched the standard performance then the simulator product is accepted and can move to the last steps, if not then the bug or incorrect part of the simulation will be repaired in further development of the software. The process of software trial will be explained later in chapter 4.

3.8 Conclusion and Recommendation

After the application tested by users than the last stage is conclusion. After the software created considered feasible to use than the development of the software will be made to a report that the software can be used to learn of how the BNWAS system works on ship also recommendation for future development.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This Chapter will Explaining about the Process of Simulator designing & trial and the conformity of the simulator with the standard of BNWAS performance. The first stage is the design and creation of a simulator using the Unreal Engine starting from making a ship model, then making a BNWAS alarm simulation work system and then testing it to find out whether the simulator made can work according to how the BNWAS alarm system installed on the ship according to standards the required BNWAS performance.

4.2 Simulator Design Concept

The design concept of the simulator is aimed to match wiht the standard performance of the BNWAS device as explained in Chapter 2.4 following the International Maritime Organization MSC Resolution .128(75),(2002). The concept of the design is consist of the location of placement of the BNWAS components device and the operational stages of the BNWAS system.

a. Concept design of the simulator in term of the Placement of Components are :

    1. BNWAS Main Unit located in Wheel House with other navigation communication equipment to activated by the captain.
    2. Placement of the motion sensor units on the wheelhouse ceiling to detect the presence of the officer on the watch (OOW) it located 3 units in the wheelhouse over the area of navigation communication table to reach all the area that where the OOW will do the duty.
    3. Placment of the alarm unit will be divided into severa place, for the Visual and buzzer alarm unit it will be located in the wheelhouse, and then for the buzzer only alarm unit will be located in the captain room and the commons room in th ships such as office, meeting room, recreation room, and dining room.
    4. Placement of the alarm reset button will be in the wheelhouse under the visual and buzzer alarm unit

b. Concept design of the simulator in term of scheme operational stages of the BNWAS system are :

    1. After the BNWAS activated
        a. After the BNWAS activated, the motion sensor will detect the presence of the OOW in he wheelhouse area that covered by the sensor.
        b. If the presence of the OOW not detected by the motion sensor because OOW leave the wheelhouse, then the dormant period countdown will staerted
        c. If the dormant period end, then the stage 1 alarm (Visual Bridge Alarm) will be triggered.

2. First 15 seconds after stage 1 alarm activated
    a. After stage 1 alarm activated, the visual and buzzer alarm unit located in the wheelhouse will giving visual indicator as flashing lamp for 15 seconds, in this duration the OOW should walk from where he located to the reset button to pres the reset button and reset the alarm
    b. If after 15 second since stage 1 alarm triggered the reset button not pressed, then the alarm will enterthe next phase, stage 2 alarm (Visual and Audible Bridge alarm)

3. 15 seconds after stage 2 alarm activated
    a. After stage 2 alarm activated, the visual and buzzer alarm unit in the wheelhouse will not only emitted the visual indicator, but also emitted audible alarm sound warning, to reset the alarm, the OOW also should walk to reset button to resetthe alarm
    b. If after 15 seconds the alarm still not reset, then the alarm will enter next phase, the stage 3 alarm will be activated.

4. 90 Seconds after stage 3 alarm activated.
    a. After stage 3 alarm activated, the buzzer alarm unit in captain room will be emit the audible alarm sound for 90 seconds.
    b. The alarm sound in the captain room is to alert or awake the captain and informed the captain that the OOW is missing from duty and the captain should walk from his room in bridge deck to wheel house in navigation deck to press the reset button to reset the alarm.
    c. If after 90 seconds since the stage 3 alarm activated the reset button still not pressed, then the alarm will enter the last phase, stage 4 alarm.

5. After the alarm enter the stage 4 alarm
    a. The stage 4 alarm is the final stage of the alarm, in this phase, all the alarm units from stage 1, stage 2, and stage 3 together activated wiht the stage 4 alarm buzze runit that located in the common room such as meeting room, office room, recreation room , and dining room.
    b. The alarm will be emit the warning alarm sound to reach other officer and ship crew , this will give the other officer and crew informations that the OOW is missing from duty as well as the captain since he captain not giving any reacton to teh stage 3 alarm. In this situation the crew should walk to the wheelhouse and press the reset alarm button to reset the alarm. The stage 4 alarm not have limit duration and will always continuing to emit the warning sound until the reset button is pressed.

4.3 Simulator Designing process

The simulator design process using the Unreal Engine Editor starts from making ship models starting from the main deck to the navigation deck to get the deck that will be used as a map/area of the simulator. In this process the ship's deck is made to meet the needs of using a simulator which requires a place to place the BNWAS alarm unit according to its standards. The making of this deck model includes making models of BNWAS device units which will later interact with users.

4.3.1 Design of the Decks, Rooms, and Interiors

The first step is to design the decks and rooms in the ship as well as the common furniture, then coloring the the interior and the objects in the rooms and decks such as doors, chairs, desks, beds.

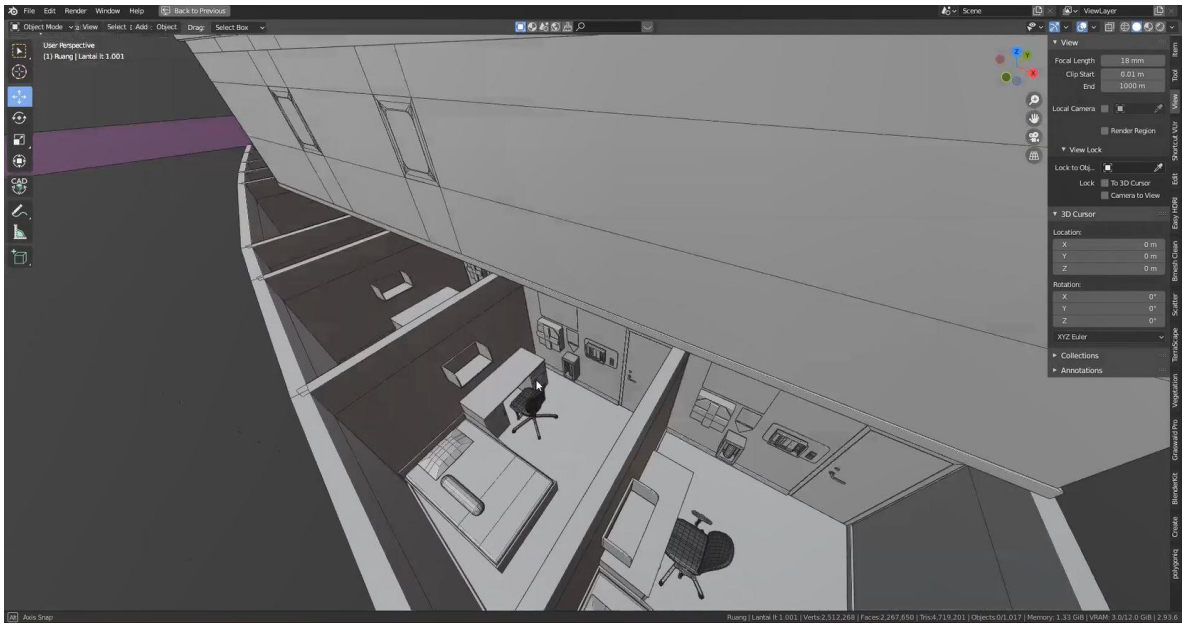

Figure 4.1 : Design of the decks and room interior (Author,2022)

We can see in the Figure 4.1 ther is the example of how the rooms designed. It shows design of some crew room in the main deck, so after obtained the reference of the general arrangement plan author made the model of the decks and rooms in Blender 3d, and after it done author will export the model to unreal engine, and complete the design process such as coloring and giving detail like lighting and texture. The result of designed decks and room interior looks like shown in the Figure 4.2.

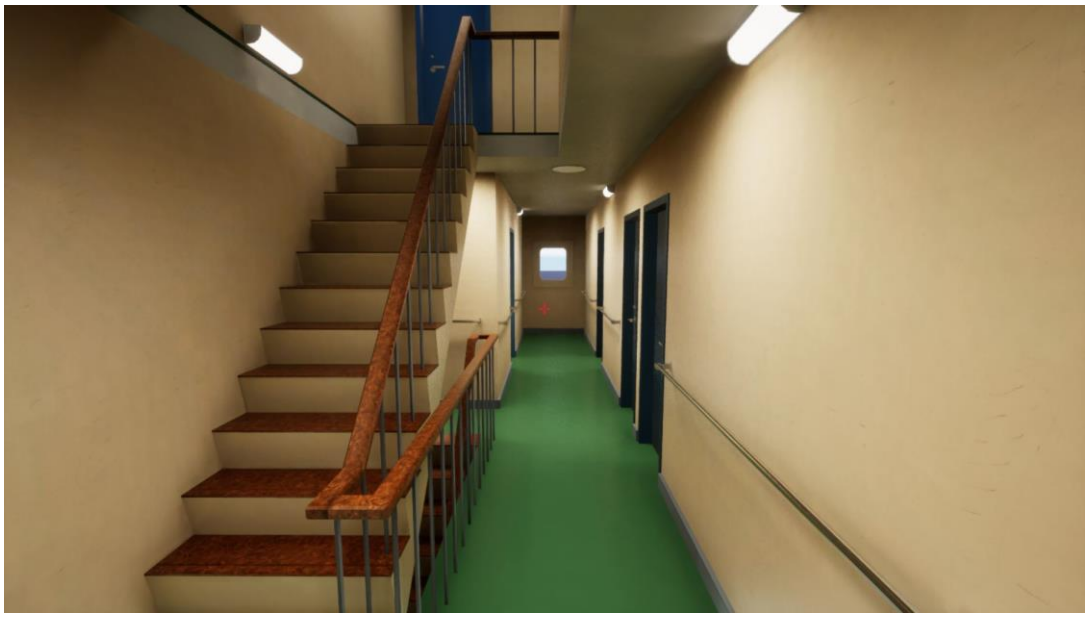

Figure 4.2 : Finished design of bridge deck gangway (Author,2022)

The Picture above is the example of completed design of the decks. It shows the gangway after the imported model from Blender 3D to Unreal Engine and given details like lighting, coloring and textures, so the user of the simulator can get a resembles experience of ships decks and rooms interiors..

4.3.2 Design of the BNWAS Device Components

After finishing the design of the rooms and decks, next step is to design the BNWAS device units. Based on the explanation in the simulator designing concept in chapter 4.1, The BNWAS device is consist of :

a. BNWAS Main Unit
b. Motion Sensor
c. Visual & Buzzer alarm Unit
d. Buzzer Alarm Unit
e. Reset Button

The BNWAS components designed to be similar with the actual looks of the devices as explained to give the user familiarization to the devices in the simulator.

1. BNWAS Main unit

BNWAS Main Unit Located in the Wheelhouse with other navigation and communication equipment, the form of the BNWAS main unit in the simlator shown in Figure 4.3.

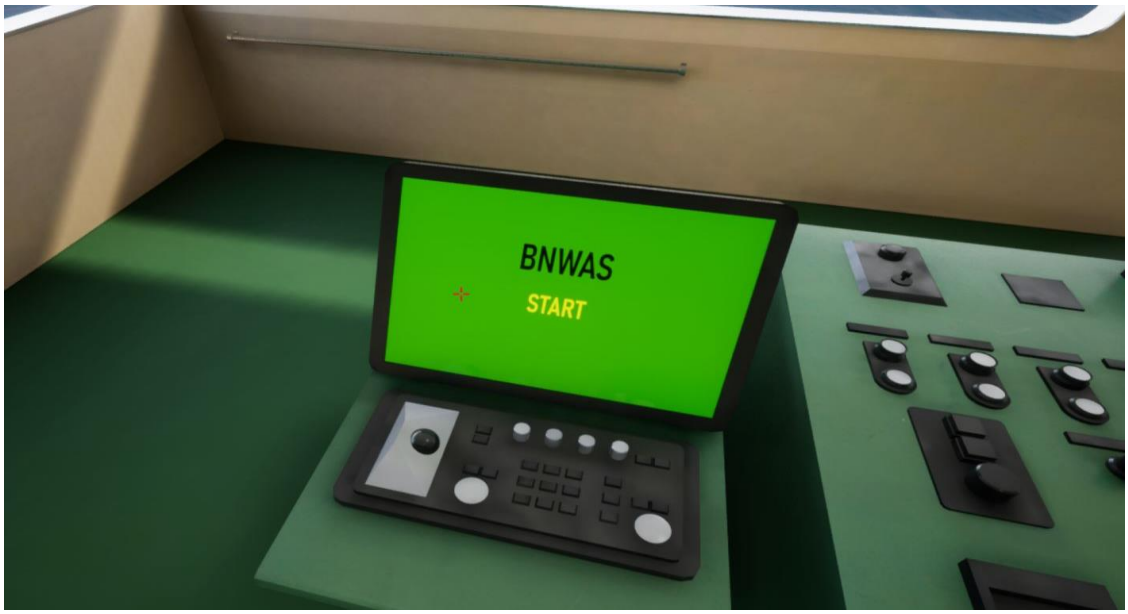

Figure 4.3 BNWAS Main Unit (Author, 2022)

The function of the main unit is to turn on and turn off the devices and setting the alarm. The user of the simulator will interact with this unit to activate and deactivate the simulation, and seting the dormant period. Auhor places the BNWAS main unit inthe left side of Wheel house near the other navcom equipment as well as the reset button and the navigation deck alarm unit alarm unit

2. Motion Sensor

Motion sensor functioned to detect the presence of the OOW in the wheelhoouse so its located in the ceiling of the wheelhouse.

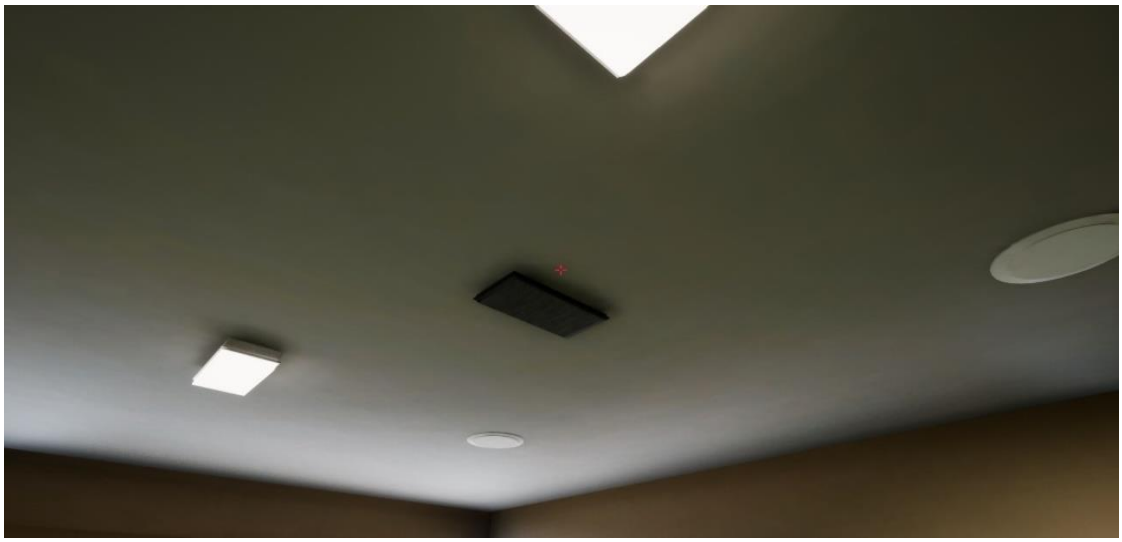

Figure 4.4 Motion sensor (Author, 2022)

The location of the motion sensor in the ceiling as shown in Figure 4.4 with the consideration of author put or located the motion sensor in thr ceiling of wheelhouse is purposedly to make the motion detector can catch any movement from the OOW in charge and

detect if there are absence or preence of the OOW accurately and also the scope are detected by the motion sensor is in the area of navigation and communication device table in the wheelhouse.

3. Visual and Buzzer Alarm unit

The visual and Buzzer alarm unit, is the component of the BNWAS system that will be active when the Stage 1 and Stage 2 of the Alarm triggered. The shape of the visual and buzzer alarm unit are shown in the Figure 4.5.

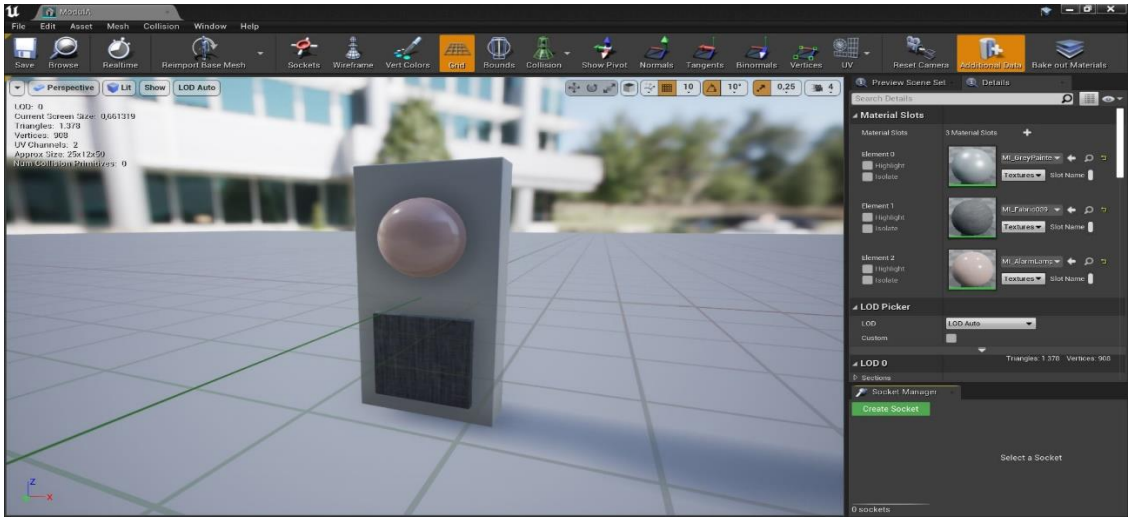

Figure 4.5 Visual and buzzer alarm unit (Author, 2022)

The function of this unit is to give output of visual indicator by flashing it lamp in the wheelhouse when the dormant period ends, and then also emitting alarm sounds after 15 seconds of stage 1 alarm passed by. This is the reason why this unit have 2 output, the visual flash indication and audio buzzer, because this unit will use for 2 first stages of alarm. However it will keep active if the alarm enters the stage 3 and 4.

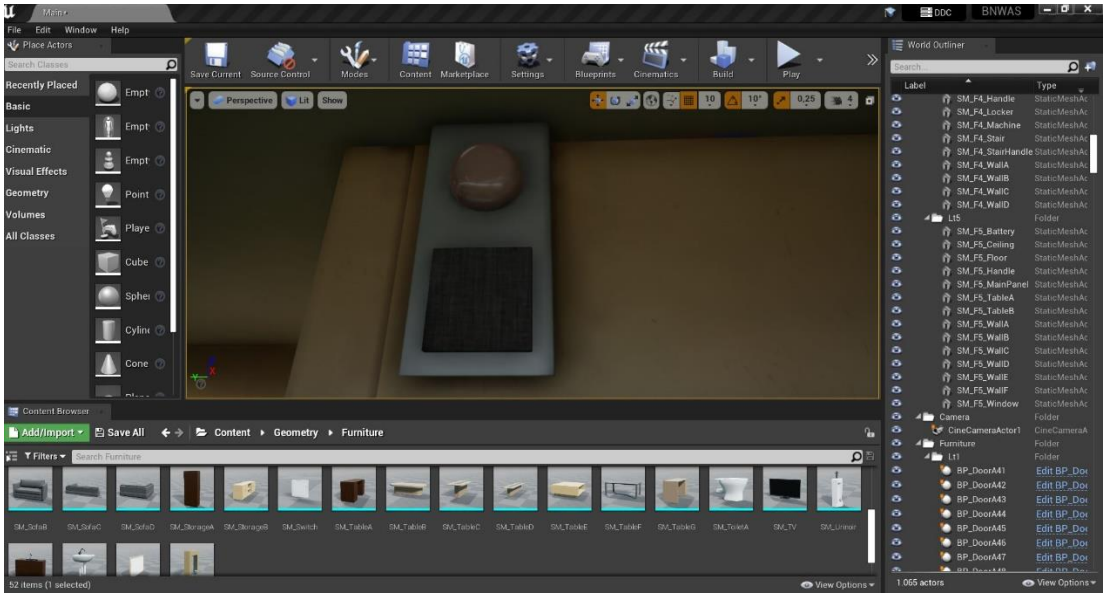

Figure 4.6 Location of Visual and buzzer alarm unit (Author, 2022)

The visual and Buzzer alarm unit are located in the wheelhouse accurately in the wall of wheelhouse like shown in figure 4.6 is based on where the output of stage 1 and 2 alarm should be. Author located the unit in the left area of the wheelhouse, near the BNWAS main unit and reset button.

4. Buzzer Alarm unit

The Buzzer Alarm Unit is the alarm unit that only emitting sounds of the alarm when the BNWAS alarm enter the stage 3 and 4. The buzzer alarm unit shown in the Figure 4.7 and The function of this unit is to reach the other decks than navigation deck if after 15 seconds of the stage 2 alarm is passed by but still no one acknowledge the alarm and press the reset button.

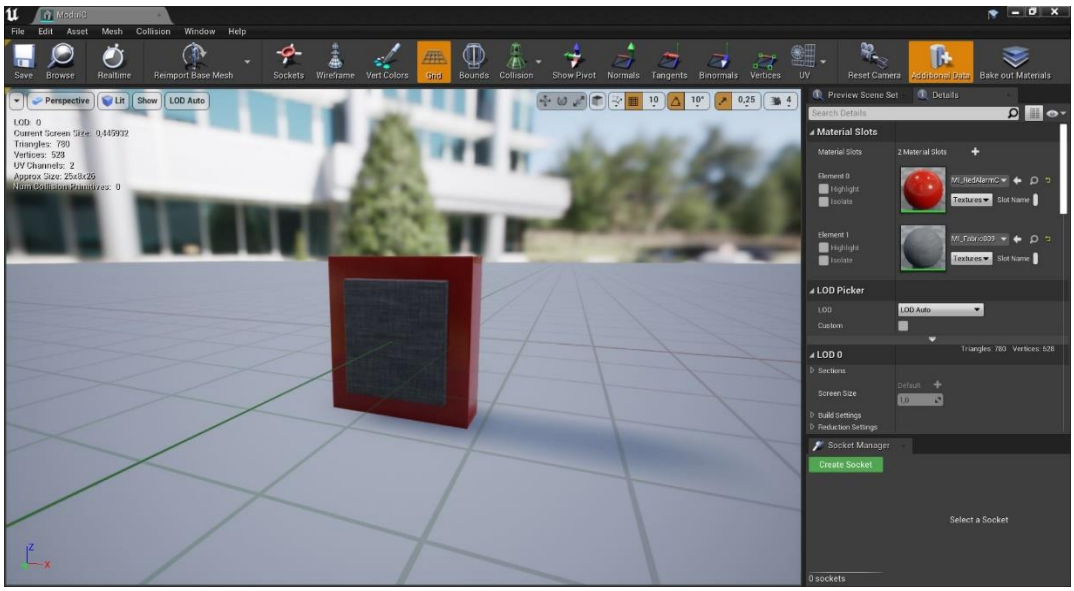

Figure 4.7 Buzzer alarm unit (Author,2022)

The Buzzer only alarm unit are located in the ship according by the needs of the alarm sound when the alarm enters stage 3 and 4 that regulated by the standard performance. For the step 3 the buzzer unit located in the captain room as shown in the Figure 4.8 and for the stage 4 alarm, it spread in the common room in the ship such as meeting room, office, recreation room, and dining room.

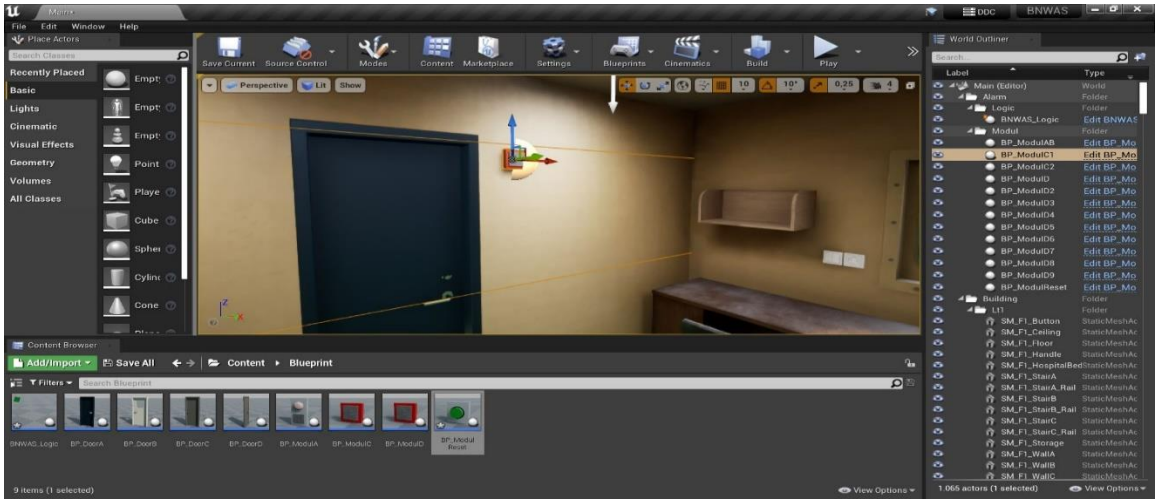

Figure 4.8 Buzzer Alarm Unit located in captain room (Author,2022)

The buzzer unit located spread in many common/public rooms in the ships, as for in the bridge deck, it located in bridge deck's meeting room. In the boat deck, the buzzer unit located in meeting room and office. In the poop deck, the buzzer unit located in meeting room, recreation room. Mess room, and cargo handling room. In the main deck, the buzzer unit located in the relax/recreation room and mess room.

5. Reset Button

The reset button is the component to reset the alarm in any stage if the dormant period ends and the alarm are triggered, the reset button shown in Figure 4.9, it located in the wheelhouse and located near the Visual and buzzer alarm unit to make sure to press the button will need physical activities by the OOW.

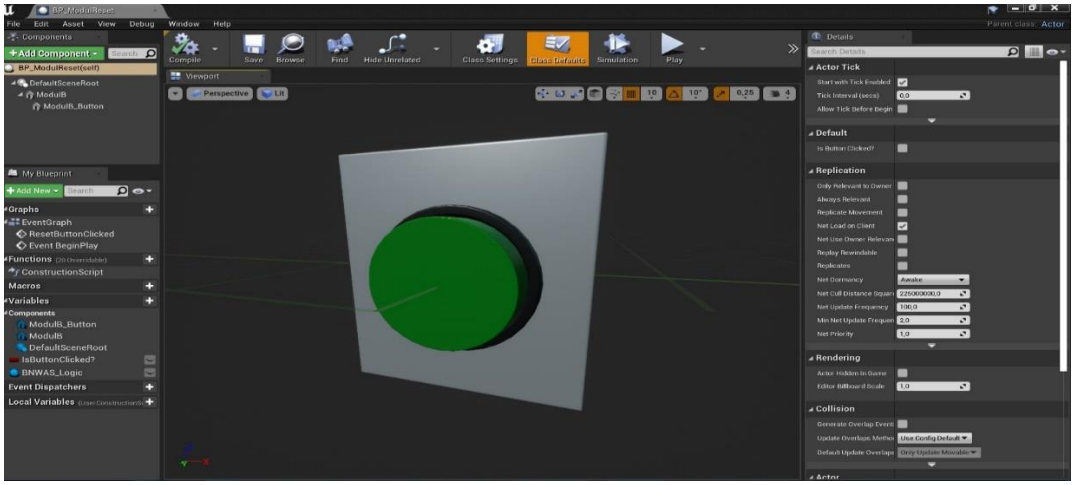

Figure 4.9 Reset button (Author, 2022)

Author located the reset button in the left side of the wheelhouse, more acurately in the wall under the visual and buzzer alarm unit to fulfill the requirement of location of the reset button as explained in chapter 2.4 that it needs physical action and awareness of the OOW to press the button, so author not located it near the working area of OOW, so if the alarm started OOW needs to walk towards the reset button.

4.3.3 Blueprint of the System

After all the design process of the simulator maps complete wiht the components such as the rooms, decks, furniture, and BNWAS devices itself, than the process of designing simulator are moved to the next step which is creating the program of the BNWAS system itself using the Blueprint visual scripting feature in the unreal engine.

To making the BNWAS alarm system works author Blueprint using visual scripting in the Unreal engine. At this stage, the author makes an interactive system that is on the BNWAS equipment that is made so that later it can be run properly. this includes the work system, sensor area, dormnt period settings, duration of each alarm stage, options for placing OOW officers on the wheelhouse navigation deck, to the alarm reset button and turn on turn off bnwas and create an opening screen on the simulator software which provides a start menu and instructions on how to use the simulator.

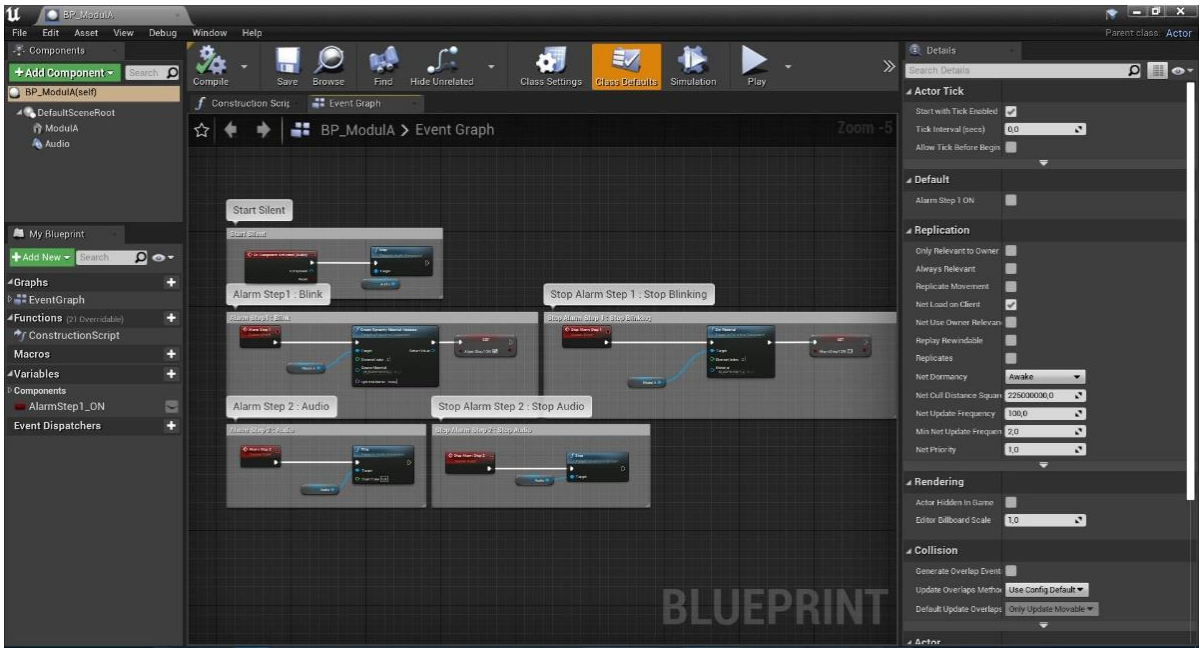

Figure 4.10 Blueprint for stage 1 and 2 alarm (Author, 2022)

In the Figure 4.10 is the one example of blueprint in the BNWAS simulator, it is the blueprint of the Stage 1 and Stage 2 Alarm. The blueprint consist of multiple command and input that will give the output based on the command that written on it, the devices that related with the system will have a blueprint and for every steps of simulation will have the blueprint for it start from the beginning of the simulation for example like switch on/of the BNWAS, input password, set the dormant period, Acknowledge the alarm, and place the OOW.

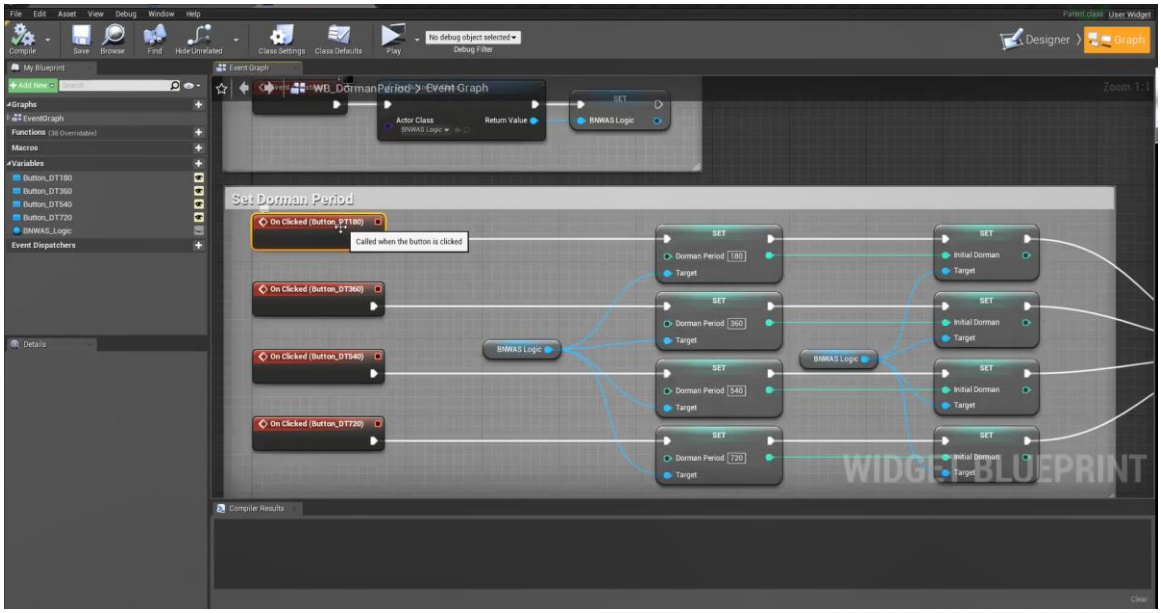

Figure 4.11 Blueprint for set dormant period (Author,2022)

The Figure 4.11 shown the blueprint for set dormant period in the simulator. Author set the command on clicked button for each variable of dormant period, and when the player clicked the chosen dormant period, the blueprint will execute command that from the “on clicked button” node and run the order to the “set” node by the line. And the “set” node will activate the target

BNWAS Logic Blueprint that consist from constructed order that will set the whole alarm system started. The set node will determine the duration of dormant period and the BNWAS logic is the same for all variable of the dormant period so the BNWAS Logic connected to all variale of the dormant period and whe the period ends,the order will execute the command of BNWAS logic blueprint and the alarm started to activate.

4.4 Simulator Trial Process

This section will explain the steps to use the simulator to do the simulation on how to operate BNWAS system.

1. Open the simulator software and the screen will appear like below :

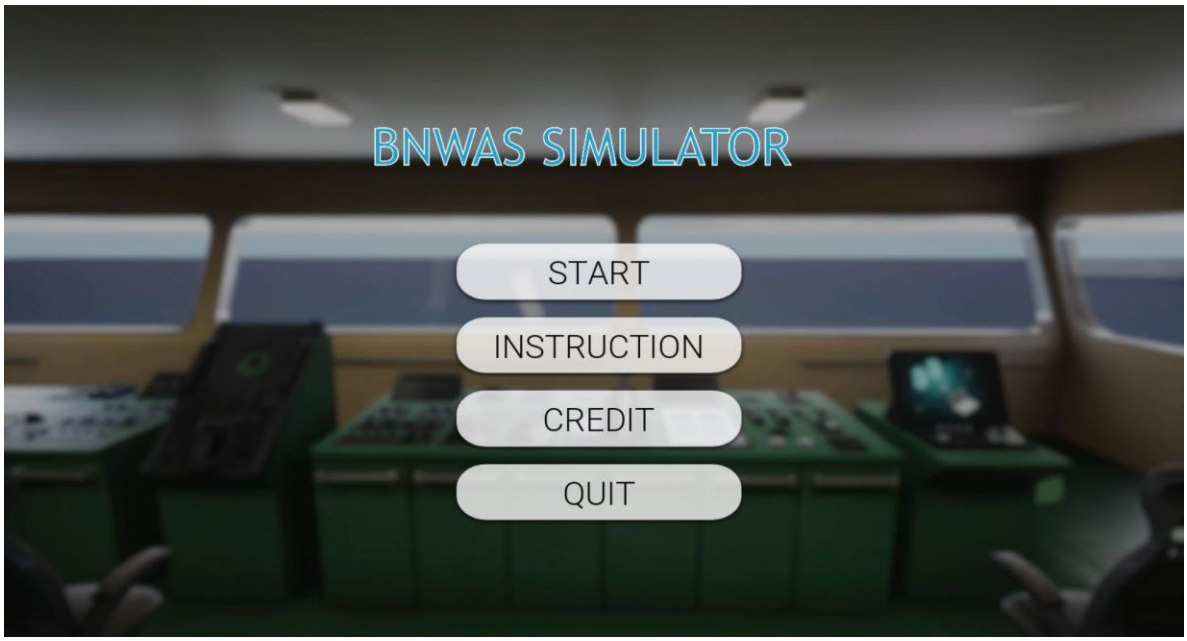

Figure 4.12 Main menu of the simulator (Author, 2022)

This screen will appear first when user start to play the simulator, it consist several menu like shown in Figure 4.12 such as start menu that will be start the simulation. Instruction menu contains the guide for the user on how to use the simulator. Credit menu contains the credit for Unreal Engine as the software used to create the simulator software. And quit menu for quitting the simulator.

2. Choose the “Instruction” to get the information on the control key and how to use the simulator, it will also provide the password for activate the BNWAS device

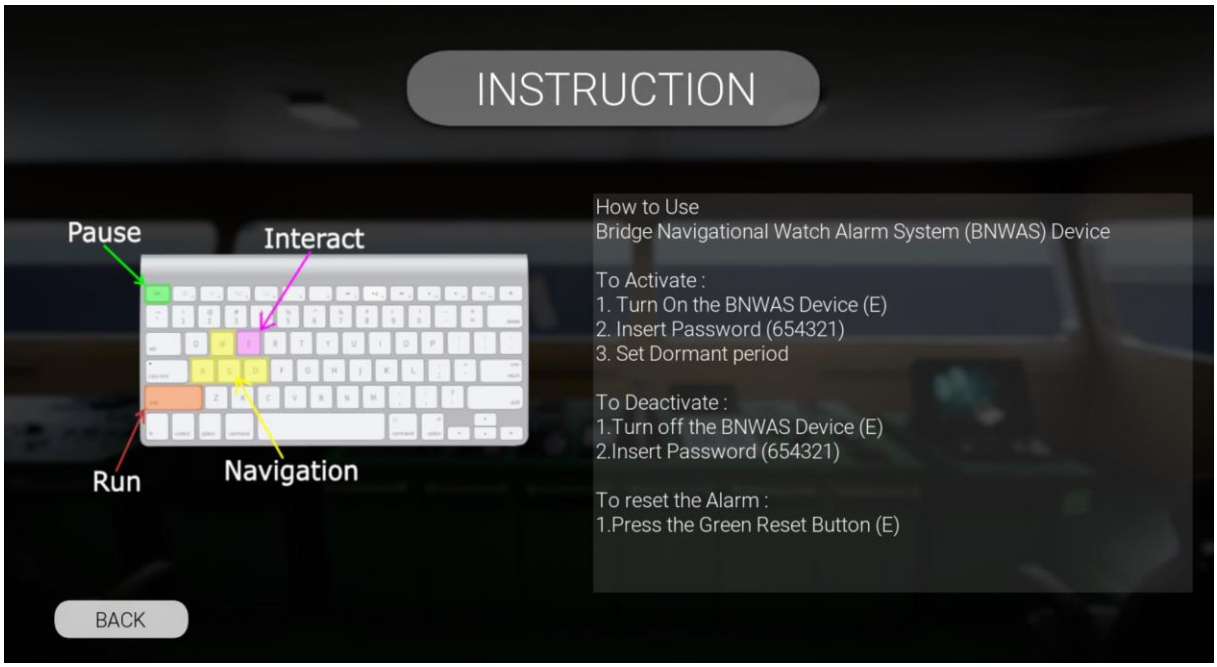

Figure 4.13 Instruction menu of the simulator (Author, 2022)

In This Instruction menu, the user will get information to operate the BNWAS Simulator, the user should read the explanation in the instruction menu that Shown in the Figure 4.13 and understand to able to do the simulation properly.it consist on how tu use the simulator, and the control key which must be pressed in keyboard while operating the simulator.

3. Click on back and choose Start to starting use the simulator, then it will change to the Point of View (POV) of the User

Figure 4.14 POV of the User (Author, 2022)

The figure 4.14 is the Point of View (POV) of the user after clicked the start menu on keyboard, the user will spawned in the wheelhouse.the user can see the interiors and the BNWAS device main unit, Motion sensor, visual and buzzer alarm, and the reset button. From this point user can walk towards the BNWAS main unit to activate the BNWAS system.

4. Now the user can go to the BNWAS main unit screen and start the simulation by pressing E, the BNWAS main unit will ask for password to turn on

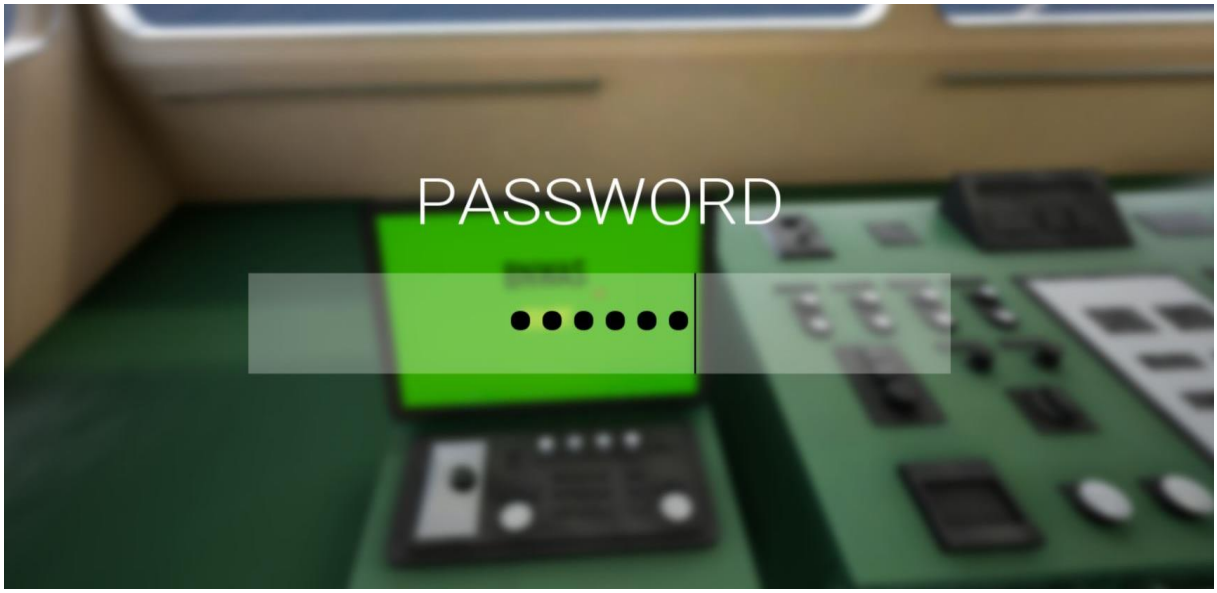

Figure 4.15 Interaction with BNWAS main unit to activation (Author, 2022)

After interact with BNWAS main unit and pres E, the screen shown in the Figure 4.15 will appear, this is to ask the password from the user. From this point, the user should click on the password box and type the password that already explained in instructor menu (654321). If the password typed incorrect, user should type again until it correct and access granted by the main unit.

5. Insert password correctly and then choose the duration of dormant period

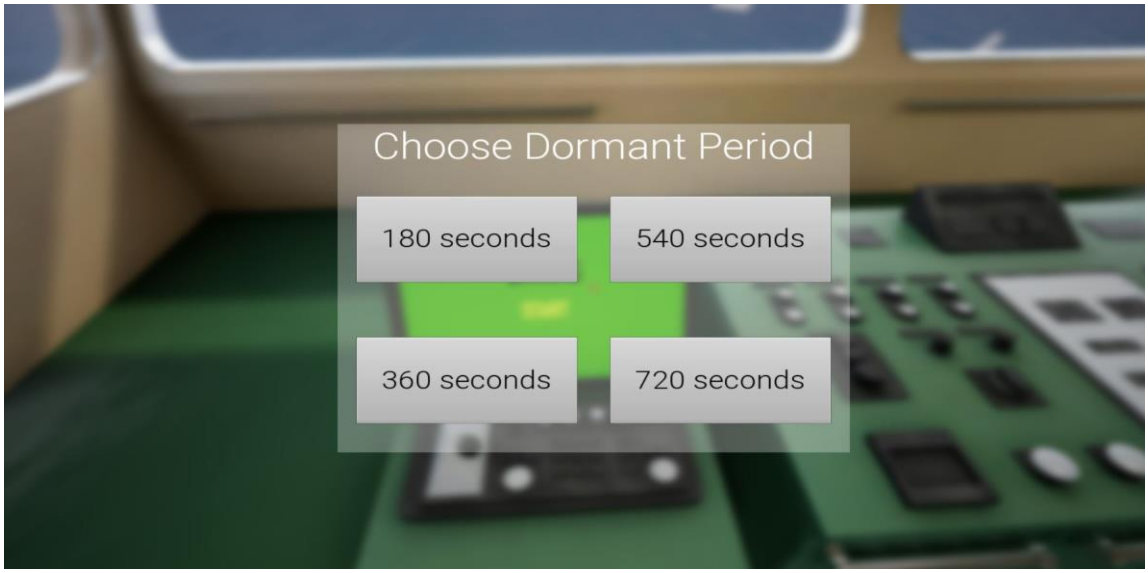

Figure 4.16 Dormant Period Option (Author, 2022)

The user can choose the dormant period provided by the BNWAS Main Unit. Figure 4.16 explain the available period option provided by the main unit. The period options are have 4 variant, 180, 360, 540, or 720 seconds.

6. After that the BNWAS system will be activated and the screen will back to user's POV.

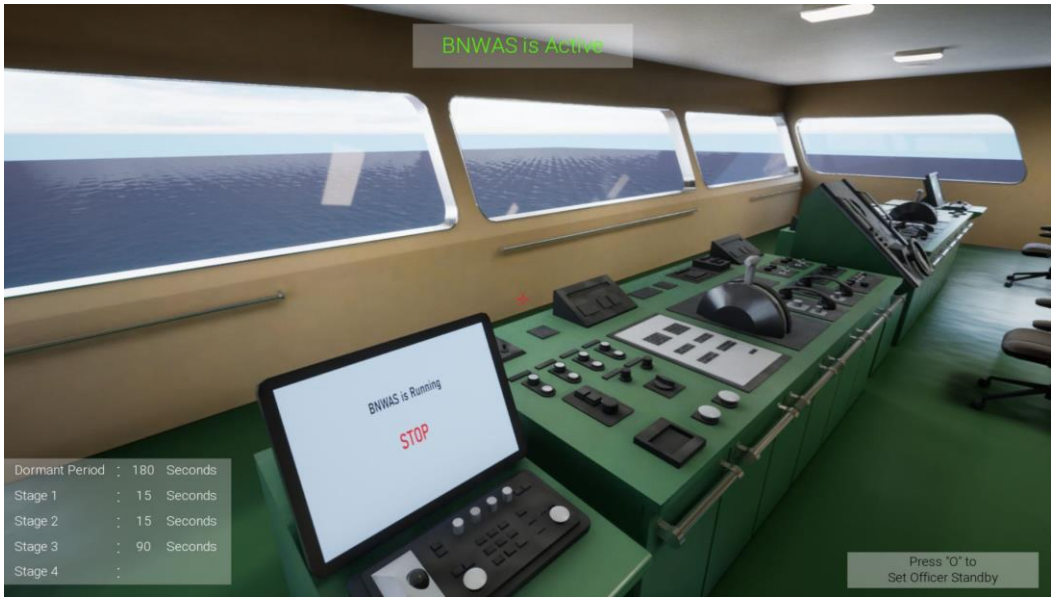

Figure 4.17 Actived BNWAS User's POV (Author, 2022)

The BNWAS system is now activated and the user can use the simulator as desired. in the Figure 4.17 shown that when the BNWAS Activated, in th euser screen will show information of he dormant period duration and the alarm duration. From this point, there are 2 scenarios hat might came out, scenario 1 if the alarm will not triggered at all, and scenario 2 if the alarm trigered through various stage.

4.4.1 Scenario 1 (Alarm not Triggered)

the first scenario is scenario 1 where the alarm never triggered until the user torn off the BNWAS system again.

Figure 4.18 Scenario 1 illustration (Author, 2022)

The Scenario 1 like shown in the Figure 4.18 will happened if the user always present in the navigation and communcation equipment area in the wheelhouse or if the user leaving the area but always come back before the dormant period ended or the user always placing the OOW in there.

4.4.2 Scenario 2 (Alarm Triggered in Various Stage)

the Second scenario is scenario 2 where the alarm Triggered through in various stage.

Figure 4.19 Scenario 2 illustration (Author, 2022)

The Scenario 2 will happened if the user leave the navcom equipment are in wheelhouse and there are no OOW present there until the dirmant period ends, then the alarm will start triggered. In the Figure 4.19 show that the information for remaining seconds before entering nex alarm stage will shown in the bottom left of the user's screen over time. To acknowledge and reset the alarm, the user should walk to the reset button and pressed it like shown in the Figure 4.20.

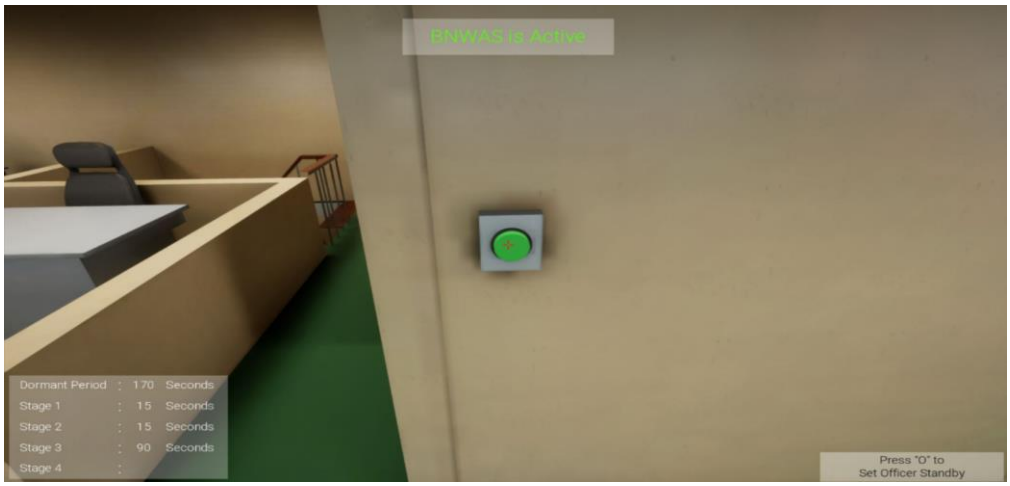

Figure 4.20 resetted dormant period after alarm acknowledged (Author, 2022)

After the reset button pressed , the BNWAS system will reset the alarm and going to start a new dormant period with the same period as before.

4.5 Analysis of the Simulator Trial

This sub-chapter will discuss whether the results of the simulation carried out by the simulator are in accordance with the way the Bnwas works which should be in accordance with the performance standards listed in MSC resolution 128 on 75th session (2002) the result for each category will shown in Table 4.1-4.3 and the overall result will shown in Table 4.4 to conclude that the BNWAS simulator are match the performanc standard or not.

4.5.1 Standards from Reset Function

After testing the simulator and get the result, the table 4.1 shows the comparison between what happened in simulator compared with how the standard requirements in terms of reset function, the Simulator condition should be fulfill the requirements and matched the standard.

Table 4.1 Table of Trial Result in terms of Reset Function

Requirement in real condition	Simulator Condition	Matched the standard
Reset Function should not be possible to initiate the reset function or cancel any audible alarm from any device, equipment or system not physically located in areas of the bridge providing proper look out.	In accordance	Yes
Reset Function could cancel all the visual and all audible alarms and initiate a further dormant period	In accordance	Yes
Reset function Should be initiated by single operator action by the OOW and capable to registering physical activity and mental alertness of the OOW	In Accordance	Yes
A continuous activation of any reset device should not prolong the dormant period or cause a suppression of the sequence of indications and alarms	In Accordance	Yes

Based on the simlator trial, we can see that the location of the reset function buton are fulfill the standards, and functioned properly that cancel al the alarm when it pressed, initiated by single operation action, which is the buton pressed by OOW, and not prolong the dormant period or supress of the sequence of indications and alarms.

4.5.2 Standard from Operational Modes and Sequence

After testing the simulator and get the result, This is the comparation between what happened in simulator compared with how the standard requirements in terms of Operational modes and sequences, the Simulator condition should be fulfill the requirements and matched the standard

1. Result on Dormant period (Td) 3 minutes / 180 Seconds

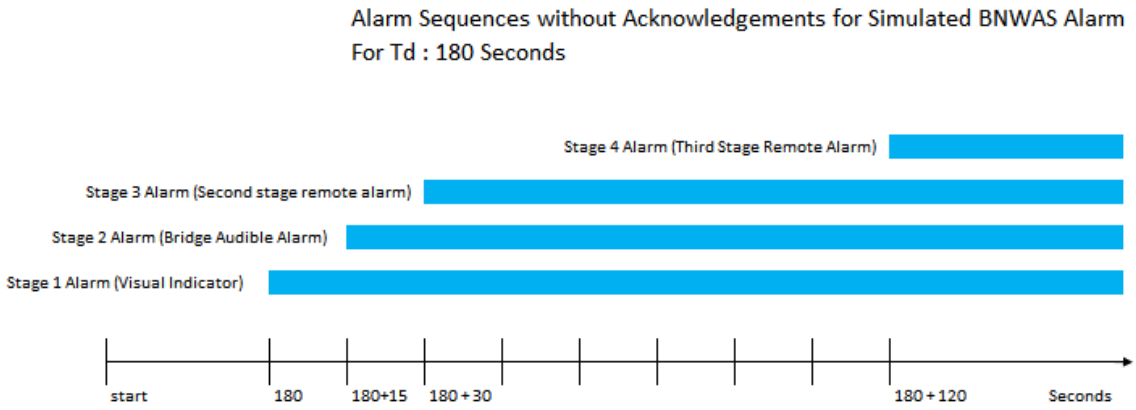

Figure 4.21: Alarm Sequence for Td 180 s (Author, 2022)

From the Figur 4.21 Above it can be seen that the graphic result of trial are matched with the standard that explained in MSC resolution.128(75), (2002). And the complete result for the teset with othr dormant period option shown in the table 4.2.

Table 4.2 Table of dormant period variant and time of staged alarm start triggered

Dormant Period (s)	Stage 1 Alarm	Stage 2 Alarm	Stage 3 Alarm	Stage 4 Alarm	Matched the Standard
180	180 s	180 + 15 s	180 + 30 s	180 + 120 s	Yes
360	360 s	360 + 15 s	360 +30 s	360 + 120 s	Yes
540	540 s	540 + 15 s	540 + 30 s	540 + 120 s	Yes
720	720 s	720 + 15 s	720 + 30 s	720 + 120 s	Yes

By this Result, it can be stated and concluded that all the operational modes and sequence of the alarms and its respective duration are meeting the requirements.

4.5.3 Standards from Alarm Output per Stage and Presentation of Information

After testing the simulator and get the result, This is the comparation between what happened in simulator compared with how the standard requirements in terms of Output per Stage and Presentation of Information, the Simulator condition should be fulfill the requirements and matched the standard

1. Stage 1 / Visual Indications

Figure 4.22: Stage 1 Alarm (Author,2022)

Based on chapter 2, the visual indication should be visible flashing indication in wheelhouse in navigation room, in the simulator the visual indication are matching the criteria that shown by Figure 4.22 above that the visual indicator are flashing when the alarm entered stage 1 of the alarm.

2. Stage 2 / First Stage Bridge Audible Alarm

Figure 4.23: Stage 2 Alarm (Author,2022)

Based on chapter 2, Bridge Audible Alarm which sounds at the end of the visual indication period will be activated to alert but not startle the OOW, and it should be audible from OOW expected to benstationed and all over location in the bridge. In the simulation, the stage 2 alarm are matching this criteria, the user will hear the buzzer sounds al over the navigation deck when the stage 2 alarm is triggered as shown in the Figure 4.23 that the user can hear the sound while the user are located in the wheelhouse in the simulator .

3. Stage 3 / Second Stage Remote Audible Alarm

Figure 4.24: Stage 3 Alarm (Author,2022)

Based on chapter 2, The remote audible alarm will activated in the locations of the Master/Captain at the end of the bridge audible alarm. The volume of this alarm should be sufficient for it to be heard throughout the locations above and to wake sleeping persons. In the simulator trial it shown in Figure 4.23 that the user can hear the sound while the user are located in captain bedroom when the stage 3 alarm is triggered.

4. Stage 4 / Third Stage Remote Audible Alarm

Figure 4.25: Stage 4 Alarm in Bridge deck (Author,2022)

Based on chapter 2 the remote audible alarm will activated in the locations of the common room in the ship like meeting room, office, recreation room, and dining room to reach the further crew member. In the Figure 4.25 shown that the user will hear the alarm sound of stage 4 in one of the common room which is the meeting room in the bridge deck. The condition in simulator are matched with this criteria.

Soo the result of Simulator trial for Output per Stage and Presentation of Information can be concluded as in the table 4.3, the result is the simulator condition is in Accordance and matched with the standard.

Table 4.3 Table of Trial Result for Output per Stage and Presentation of Information

Alarm Stage	Output/Presentation of Information	Simulator Condition	Matched the standard
Stage 1	Bridge Visual indicator	In Accordance	Yes
Stage 2	Bridge Audible Alarm	In Accordance	Yes
Stage 3	Remote Audible Alarm (Master/Officer)	In Accordance	Yes
Stage 4	Remote Audible Alarm (Further Crew member)	In Accordance	Yes

After doing the Analysis of the simulator Trial, than the Result of the simulator are obtained. The result of the Simulator trial shown in the Table 4.4 that explain the overall result of the simulator testing and it concluded that the BNWAS Simulator Software created by author follows the performance standard criteria and suitable as the learning media to understand and use BNWAS Device in the ship.

Table 4.4 Result of The Simulator Compliance with the BNWAS Standard Performance

Category of Standard Performance	BNWAS Simulator Trial Result	Compliance Between Standard Performance and Smulator
Reset Function category	Matched the standard	Yes
Operational Modes and Sequence	Matched the standard	Yes
Alarm Output per Stage and Presentation of Information	Matched the standard	Yes

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusions

Bridge Navigational Watch Alarm System (BNWAS) is one of the mandatory devices to installed and operated for ships starts from 150 gross tonnage upwards as stated by the SOLAS chapter V Regulation 19. That means every seafararer should be understand how to operate the system itself. The presence of a simulator will be an help/assistance to try how to operate BNWAS system without doing it directly in the ship.

1. In this final project author design and create the BNWAS simulation software on the ship to help the users understand on how to operate the BNWAS system Correctly. To Create this simulator, Author use Unreal Engine as the Base software to develop the BNWAS simulator software. This simulator give the user very close experience of using BNWAS device on the ship. The simulator designed to adjust with the standard performance of the BNWAS that required by MSC Resolution 128 (75).
2. Based on the simulator trial result, the finished product of the Simulator meet and matched with the standard Performance requirements that agreed by the MSC resolution 128 on 75th session (2002) as shown in the Table 4.4 that all the performance criteria is fulfilled. This is means that the simulator can be used as learning media to understand the system of BNWAS on the ship because the result of the trial is fullfilled the standard.

With this designed Bridge Navigational Watch Alarm System simulation Software, author aims that the user of this simulator could understand how the BNWAS device system works in the ship, in this simulator, the user will experienced how to turn on/turn off the system, how to set alarm, and where and when the alarm will be triggered if the dormant period end, and how to reset the alarm with the same performance standard of the actual BNWAS device on the ship.

5.2 Recommendations

Based on the Simulator trial analysis result, there are some suggestions regarding to this BNWAS simulation Software:

1. The devices / system created by author in this simulator is still limited to only BNWAS system. in the future it will be expected comes simulation software for other systems and can even be integrated each other
2. The interface of BNWAS main unit still can be improved to be closer than an actual product of BNWAS device.
3. The simulator will be better if it can be operated as multiplayer type of simulator.

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ATTACHMENT

ATTACHMENT I : USER MANUAL OF BNWAS SIMULATOR

Bridge Navigational Watch Alarm System (BNWAS) is one of many component that mandatory to be existed in any vessel more than 150 Gross Tonnage (GT) built from 1st July 2011 and after. The function of BNWAS device are to monitor the presence of Officer On The Watch (OOW) in the navigation room with time based alarm and motion sensor.

Welcome to the Bridge Navigational Watch Alarm System (BNWAS) Simulator. in this Simulator, you will practice on how to use the BNWAS device o the ship via this simulator.

A. Working Principle

The BNWAS device needs to be started by the captain using a Key Switch or password, then the captain sets a certain time called the dormant period which will trigger an alarm if the timer count ends or the motion detector does not recognize any movement by the OOW (Officer of the Watch). If OOW motion is detected by the detector, the count will not start and remain at the beginning of the inactivity period. If the motion detector does not recognize any movement from the OOW, the inactivity period countdown begins. Perion dormant duration can be set to 3, 6, 9, or 12 Minutes depending on the captain's decision.

When the dormant period ends and no officer presses the timer reset button, the alarm will activate. Alarm Consists of four distinct stages depending on how long the timer reset button is not pressed by the OOW. Stage 1 flash alarm in navigation room will start to activate, if after 15 seconds OOW does not recognize reset button, alarm goes to stage two that audio alarm 1 in navigation room will be activated. If after 15 seconds the reset button is still not recognized, the alarm unit in the captain's room starts to activate, this is considered stage 3. If 90 seconds after the stage 3 alarm the button is still not pressed, the stage 4 alarm will be activated, this stage alarm will activate all alarm units audio in all accommodation rooms where the alarm unit is installed.

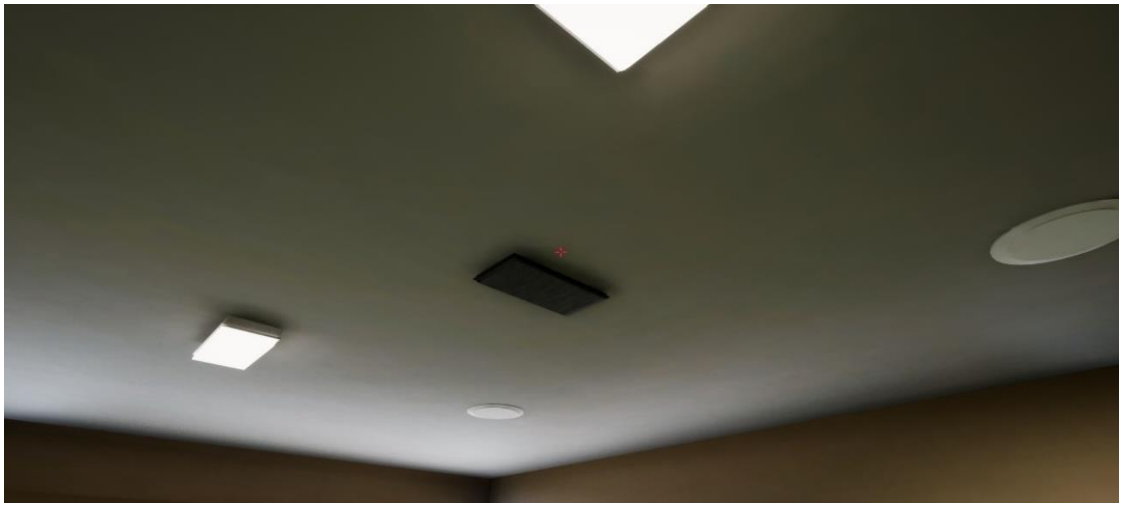
B. Component of BNWAS Device in Simulator

1. BNWAS Main Unit

BNWAS Main Unit Located in the Wheelhouse with other navigation and communication equipment, the function of the main unit is to turn on and turn off the devices and setting the alarm.

2. Motion Sensor

Motion sensor functioned to detect the presence of the OOW in the wheelhoouse so its located in the ceiling of the wheelhouse.

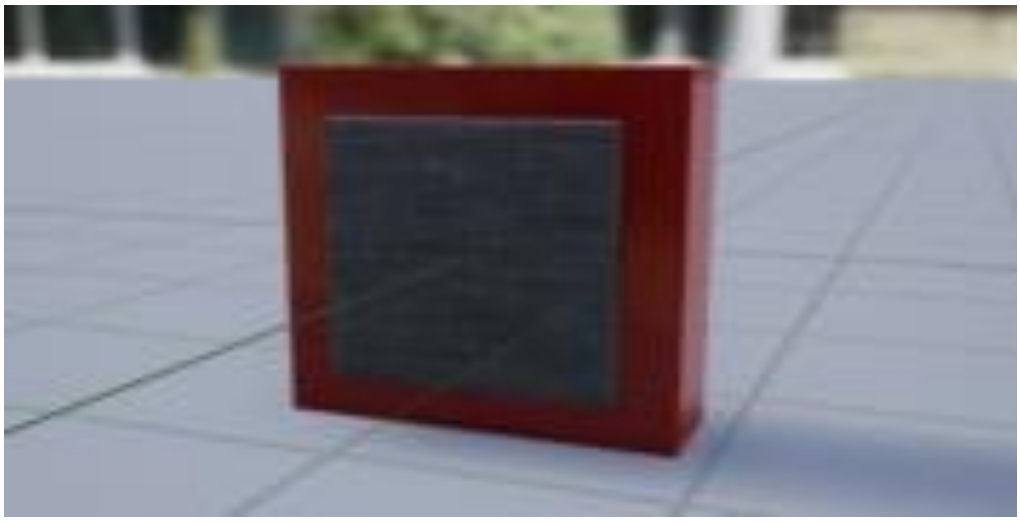


3. Visual and Buzzer Alarm unit

The visual and Buzzer alarm unit, is the component of the BNWAS system that will be active when the Stage 1 and Stage 2 of the Alarm triggered.

4. Buzzer Alarm unit

The Buzzer Alarm Unit is the alarm unit that only emitting sounds of the alarm when the BNWAS alarm enter the stage 3 and 4.



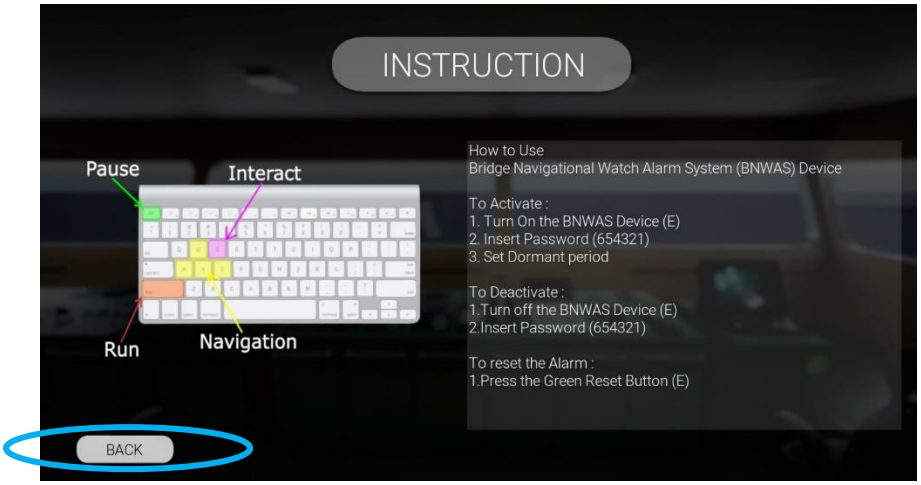
5. Reset Button

The reset button is the component to reset the alarm in any stage if the dormant period ends and the alarm are triggered

C. How to Operate the Simulator

1. Open The BNWAS Simulator, and the Opening screen Will Appear like Below, choose the instruction first

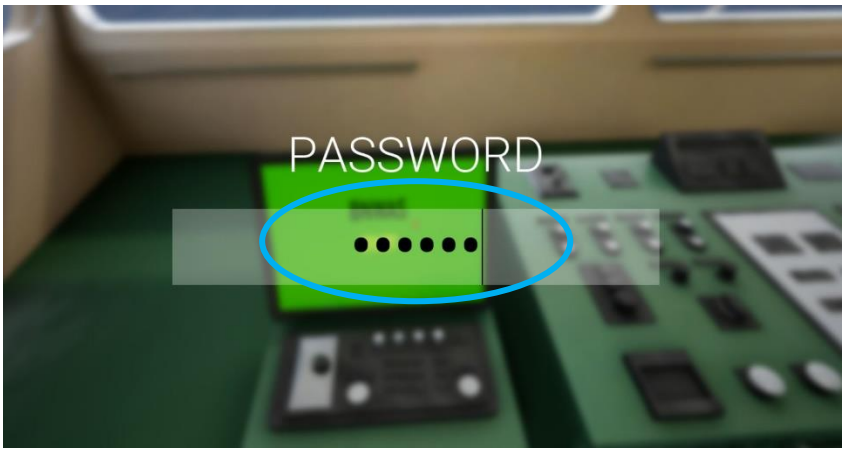
2. Choose the “Instruction” to get the information on the control key and how to use the simulator



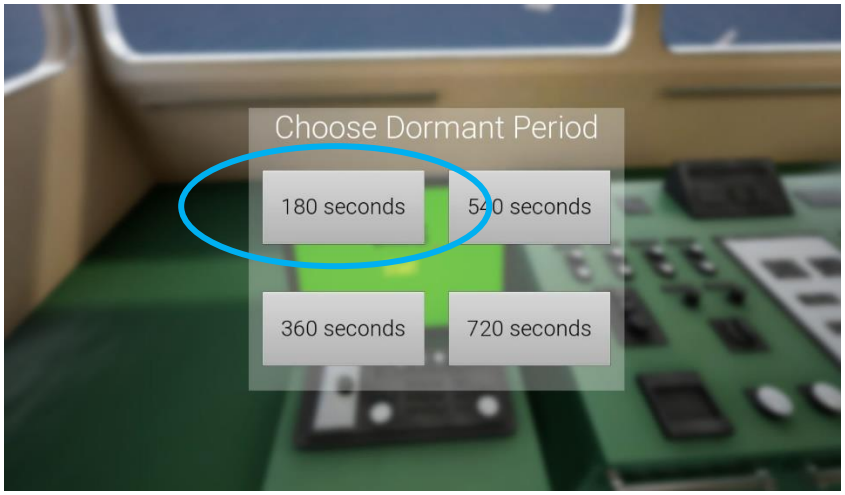
3. Click Start

4. Click on back and choose Start to starting use the simulator, then it will change to your Point of View, then you should recognize the Components of BNWAS

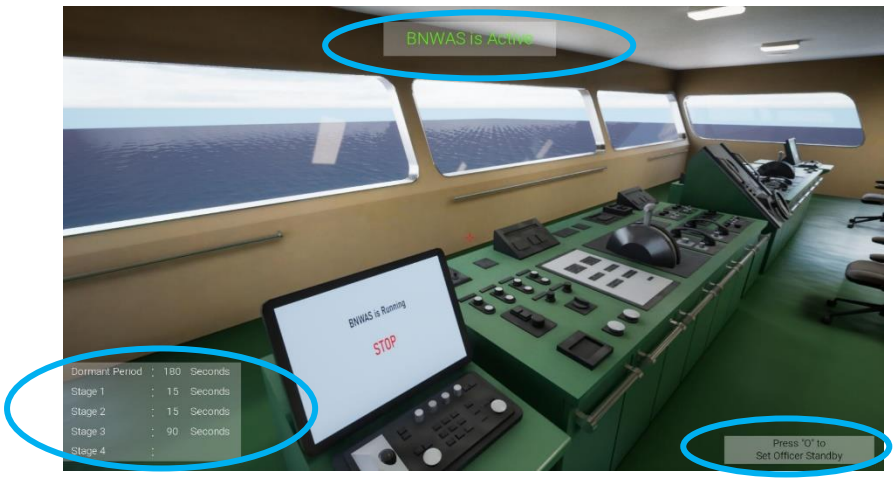
5. Now the user can go to the BNWAS main unit screen and start the simulation by pressing E, the BNWAS main unit will ask for password to turn on, insert 654321 (this will also explained in instruction menu)



6. After access granted, choose your preferable dormant period, for example 180 Seconds

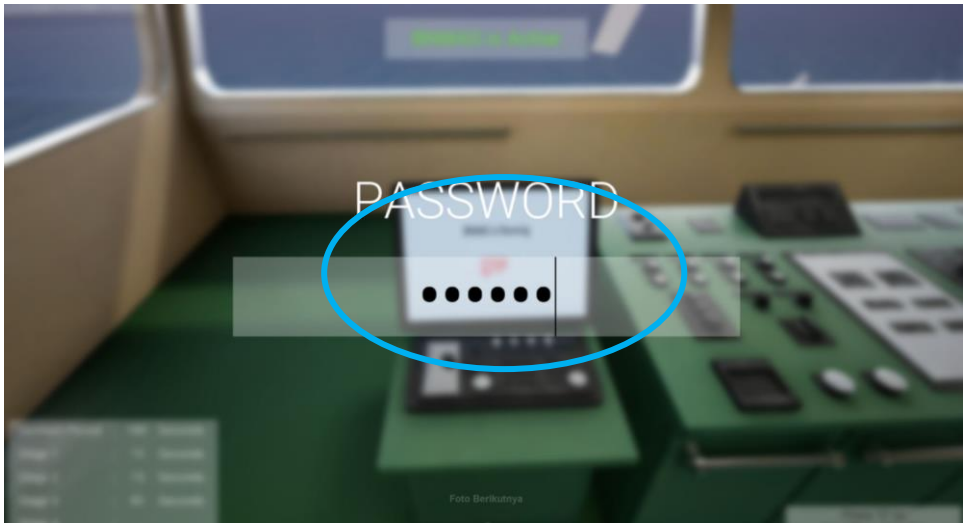


7. After that the BNWAS system will be activated and the screen will back to your POV. Now you will as the captain and explore decks and rooms in the simulator, the bottom left indicator will inform you about the remainig duration of dromant period and alarm, bottom right note will inform you whether you put OOW or not, and top center indicator tell you that the BNWAS is active. You can learn onhow to use the BNWAS simulator and how the system itself works.



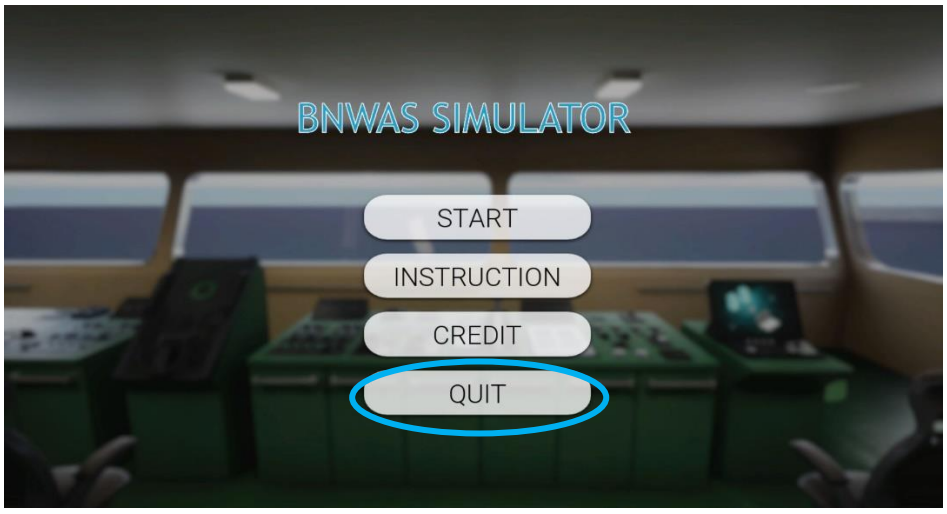
8. If the Dormant period ends, the alarm will be triggered, to stop and reset your alarm, press the reset button, it will stop the alarm and restart another dormant period

9. If you want to turn off the simulator, just come to the BNWAS main Unit again, press E, and insert the password again.



10. After that, the BNWAS system will deactivated again.

11. After that, to quit the Simulator, press ESC key, and then click “quit” menu



AUTHOR'S BIODATA

The Author was born in Pringsewu, 2nd March 2000, as the first of 2 children from Mr.Triyoga Pramukyanto and Mrs.Erwin Suciarni. Author has studied formal education at TK ABA II Pringsewu, SD Muhammadiyah Pringsewu, SMPN 1 Pringsewu, and SMAN 1 Gadingrejo. After graduate from SMAN 1 Gadingrejo at 2017, Author continue study for Bachelor Degree on Marine Engineering Joint Degree program study at Department of Marine Engineering FTK-ITS from SBMPTN at 2017 and registered with Student Number 04211741000018

During the Study in Department of Marine Engineering, Author also active in several student activities such as UKM Penalaran ITS in 2018 as staff and vice president in 2019, and Lembaga Minat Bakat ITS as vice president in 2020, and also contributed as presenter contributor at orientation week (o-week) for international student of ITS in 2020. Author Also joined in several competition and Achieved Bronze Medal award in InIIC Series 2/2019 Competition in Selangor, Malaysia in 2019. During the Study period, Author already completed his on-the-job training twice at PT. Yasa Wahana Tirta Samudera and Marine Electrical and Automation System (MEAS) Laboratory, FTK-ITS. Author also active as member and practice Assistant of Marine Electrical and Automation System (MEAS) Laboratory in 2020-2021.