PROJECT PROPOSAL

SeaEagle

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2017 Intake – 2018/2019 Academic Year

CS2972 – Automation Challenge I

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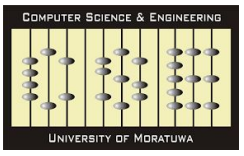

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ACKNOWLEDGEMENT

The team would like to thank the following persons for their assistance with the project.

1. Dr. Chandana Gamage (Project Advisor)
2. Dr. Chathura de Silva
3. Mr. Dharshana Muthtettugoda
4. EWIS R&D Centre
5. Batchmates of CSE Department

ABSTRACT

This proposal is focused on solving a problem related to embedded systems. It includes details about the embedded software module and related components, suitable algorithms and embedded system development tools and technologies.

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INTRODUCTION

Automation Challenge I Module (CS2972) of Semester 3 is about designing embedded system development project as a group. The project should contain a solution for a specific automation problem.Students are required to design an embedded system using suitable algorithms to fulfil a given task.

We have come up with a method to connect Navy ships, boats and control base using wireless communication methods. We have proposed to use Wifi to make the connection and GPS to track the respective ships and boats.

Navy ships are continuously checking whether boats in the sea are suspicious or not when they are offshore. This is done manually by the crew of the navy ships by entering the suspicious boats. There they get headcount of the boat and ask about the projected path of the boat. There is an issue of being prone to damage for the navy ship when the navy ship is coming closer to the other boats as it is much larger than the other boats. Our project idea is to create a system where navy ship will be able to obtain the details of the boat when it is within a certain range of distance from the boats.

PROGRESS TIMELINE

1. Finalizing the Project Idea - 2019.01.22
2. First Draft Submission of the Project Proposal - 2019.01.22
3. Finalizing the Project Proposal - 2019.02.04
4. Completion of Papyrus Diagrams - 2019.02.14
5. Testing the Connectivity Using NodeMCU - 2019.02.19
6. Analyzing Papers of Similar Project - 2019.02.21
7. Consideration of ZigBee Module - 2019.02.26
8. Testing Limitations of NodeMCU - 2019.02.28
9. Meeting Dr. Chathura to Finalize the Module - 2019.02.28
10. Meeting Dr. Chathura for Theoretical Approach - 2019.02.28
11. Informing Requirements of Devices - 2019.02.28
12. Having NodeMCU Connectivity Tests - 2019.03.05

LIST OF MODULES AND DEVICES USED

1. NodeMCU - 5
2. USB Cables - 4
3. SD Cards - -

USING DESIGN PATTERNS

- Three main objects are detected regarding development of the design

    a. Admin
    b. Navy Ships
    c. Fishing Boats

- Creational design patterns can be used with regard to connections between objects.

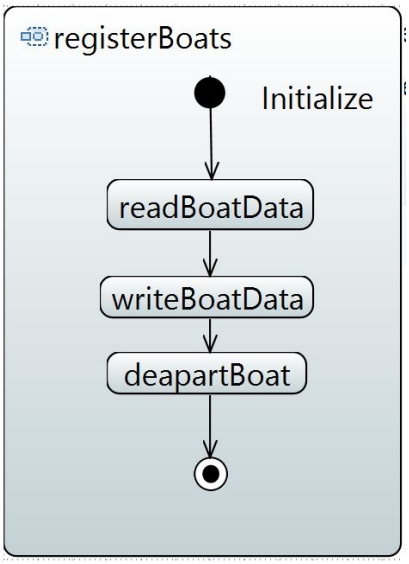
    1. Singleton for Admin
    2. Multiton for Navy Ships and Fishing Boats

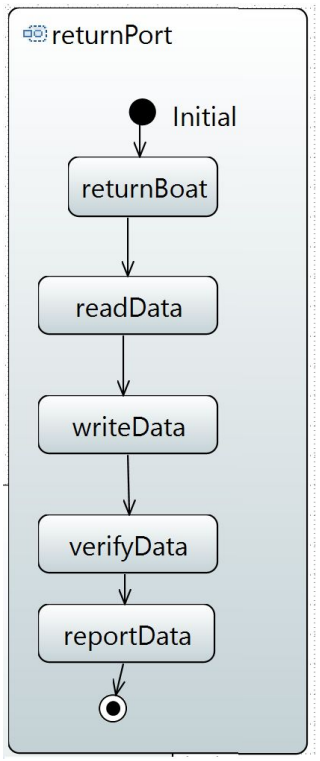
- Template pattern can be used for Ship classes
- Decorator pattern can be used to represent Special Ships.
- Strategy pattern is used for the method calls from the admin.
- Command pattern can be used for the method calls from Navy ship.

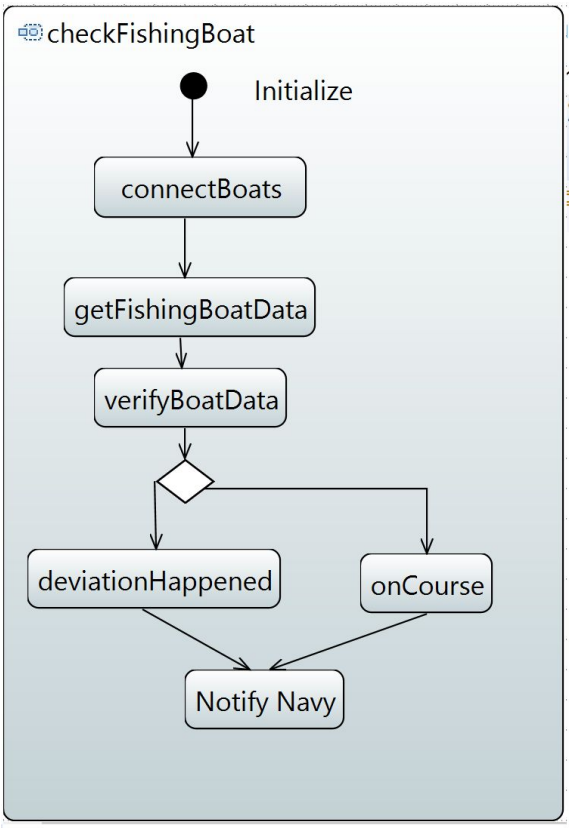
PAPYRUS TOOL DIAGRAMS

1. Activity Diagrams

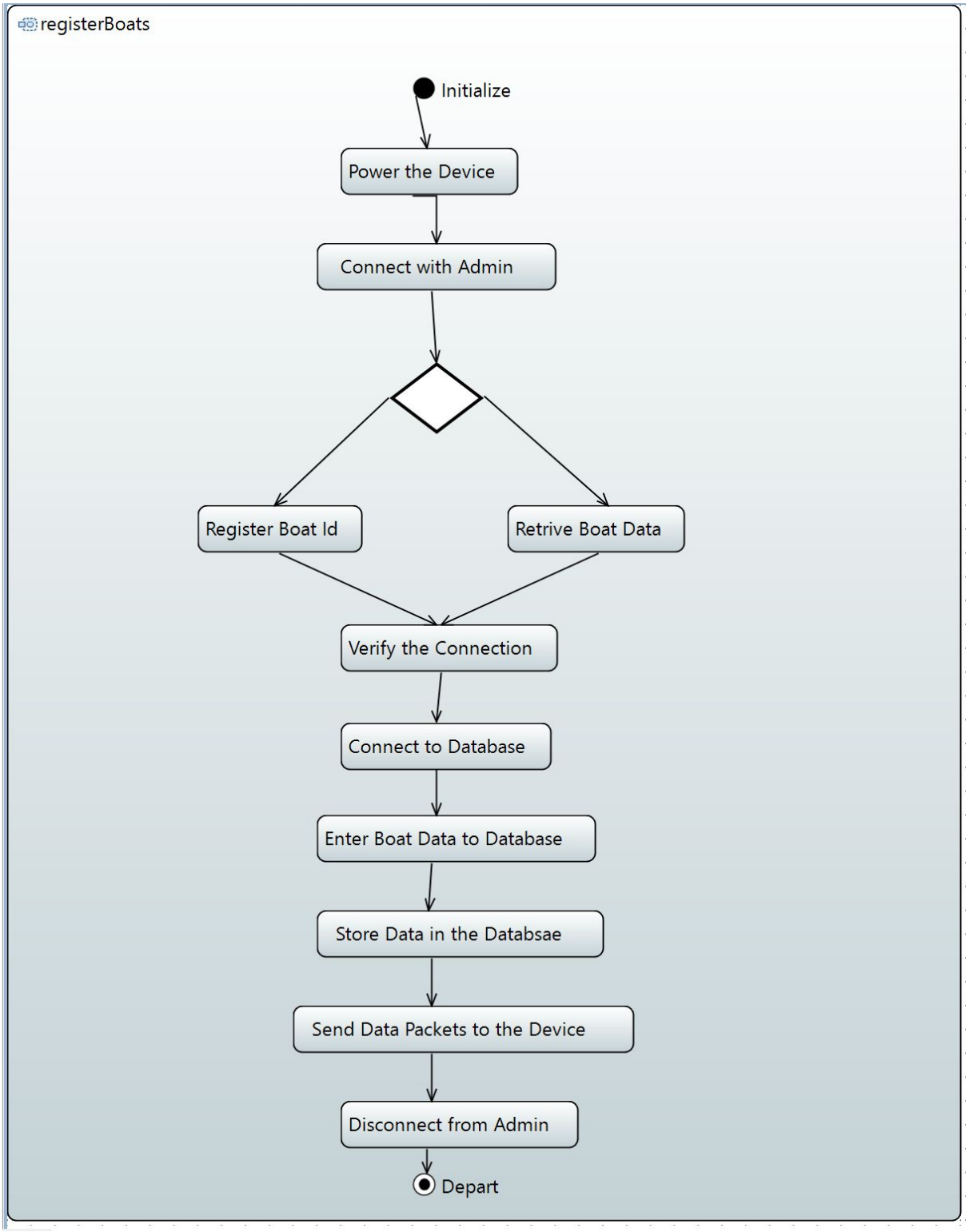
a. Initial Set of Diagrams

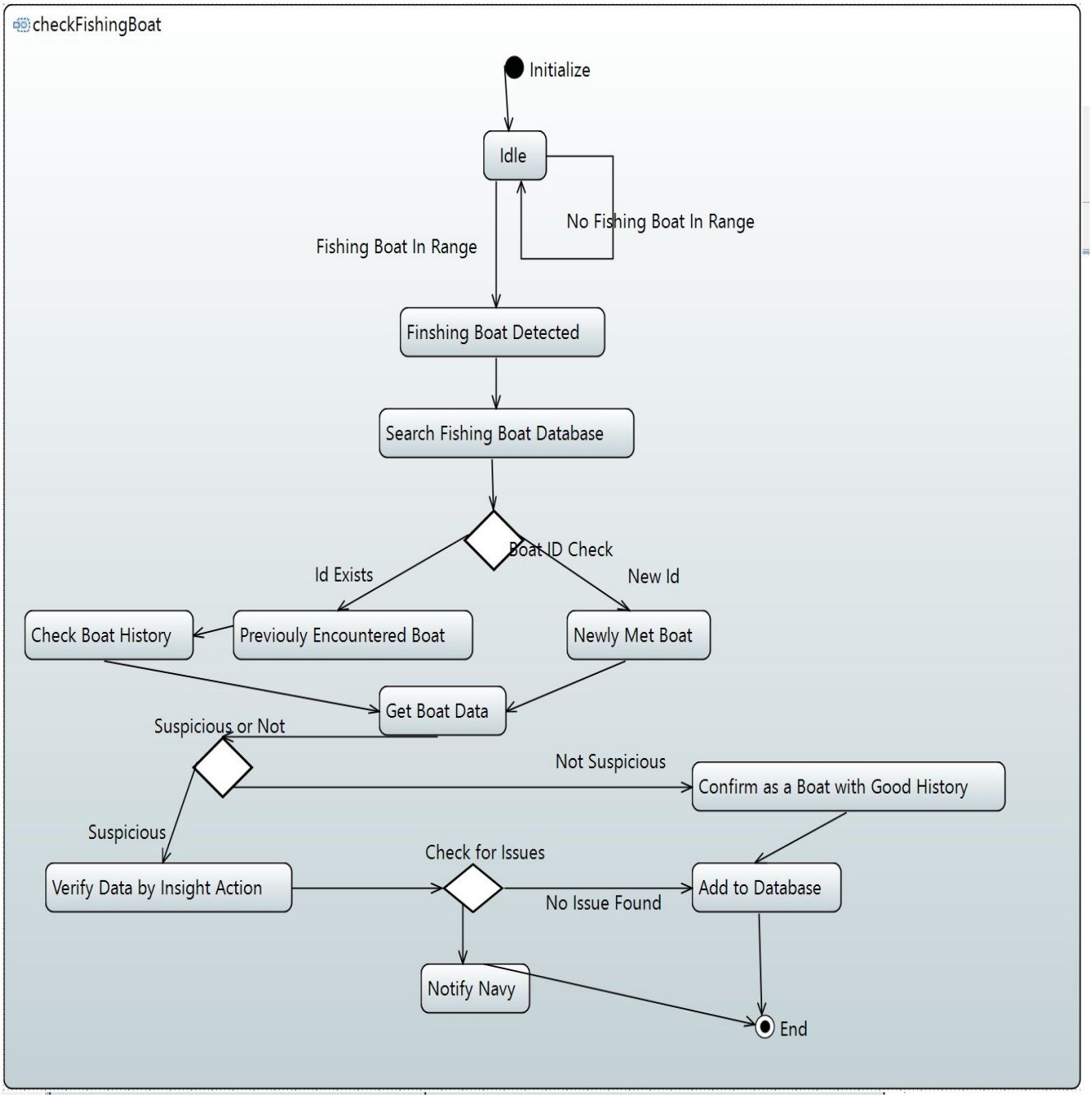


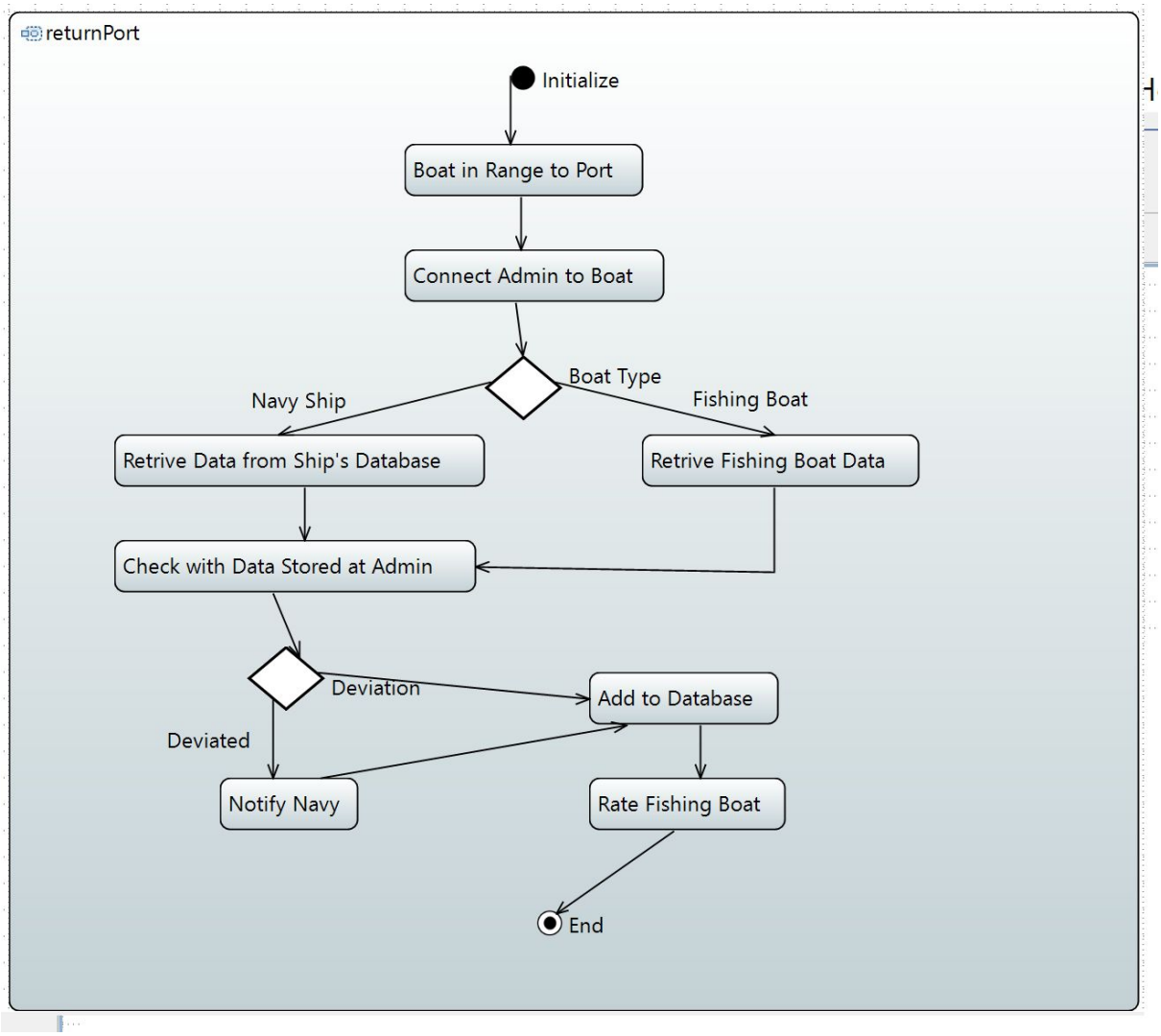




b. Improved Diagrams

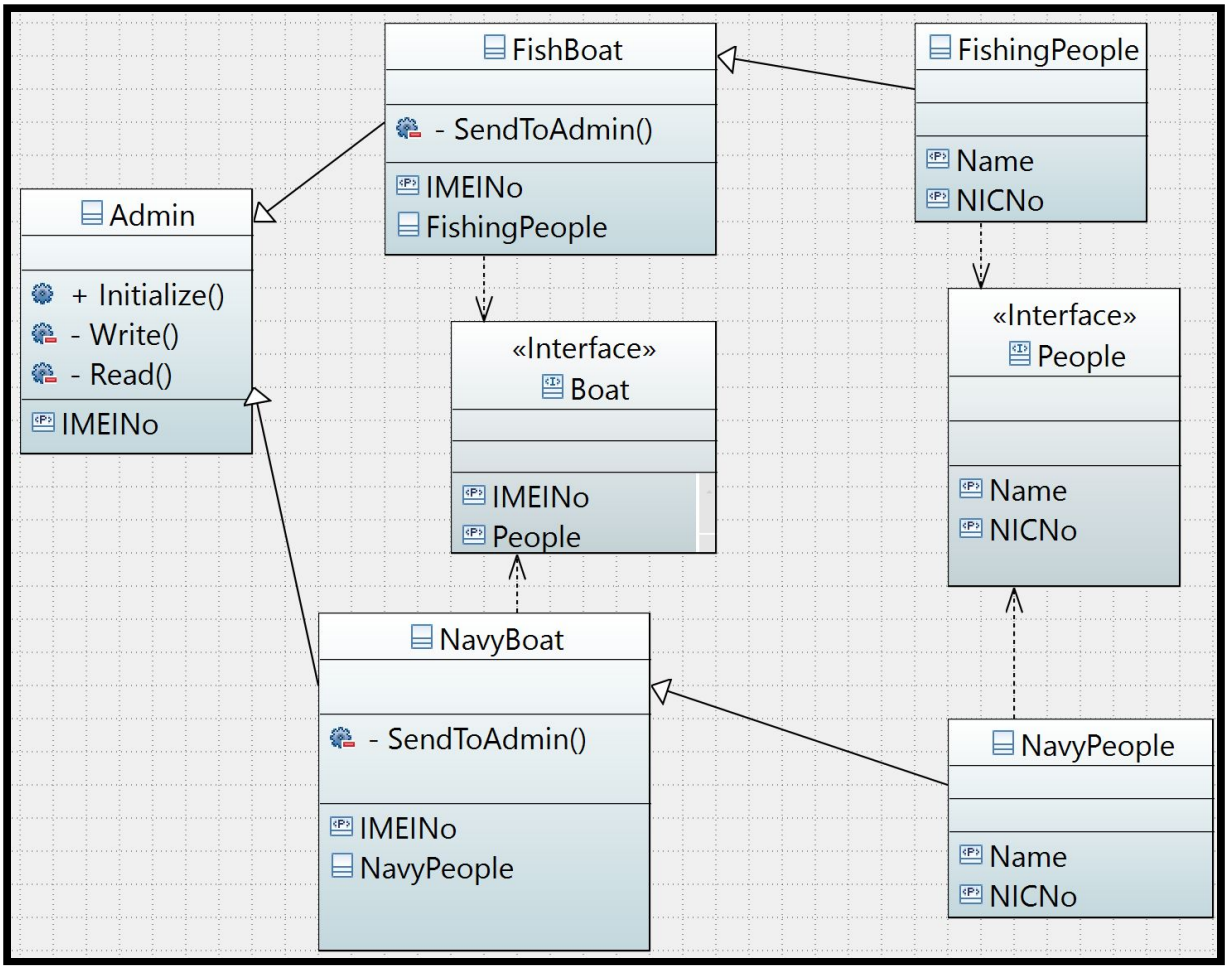



checkFishingBoat
Initialize
Idle
No Fishing Boat In Range
Fishing Boat In Range
Finshing Boat Detected
Search Fishing Boat Database
Boat ID Check
Id Exists
New Id
Check Boat History
Previouly Encountered Boat
Newly Met Boat
Get Boat Data
Suspicious or Not
Not Suspicious
Confirm as a Boat with Good History
Suspicious
Check for Issues
Verify Data by Insight Action
No Issue Found
Add to Database
Notify Navy
End

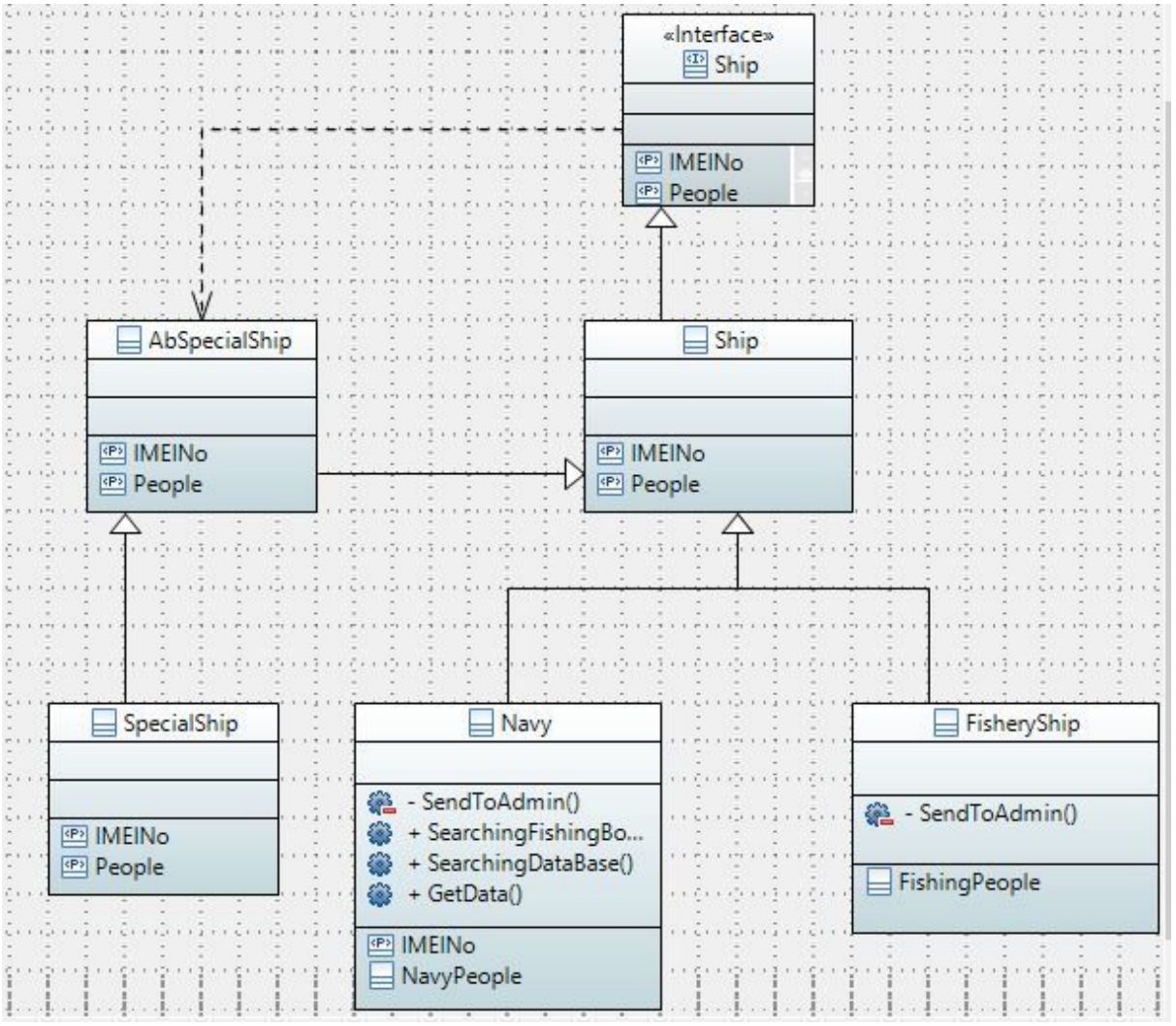

returnPort
Initialize
Boat in Range to Port
Connect Admin to Boat
Boat Type
Navy Ship
Fishing Boat
Retrive Data from Ship's Database
Retrive Fishing Boat Data
Check with Data Stored at Admin
Deviation
Add to Database
Deviated
Notify Navy
Rate Fishing Boat
End

2. Class Diagrams

a. Initial Class Diagrams



b. Class Diagrams with Design Patterns



RESEARCH PAPER ANALYSIS

1. A Hybrid Network for Maritime On-Board Communications

   Current maritime on-board communications have to be enhanced for safety and security, where ubiquitous technologies can help, together with providing comfort and convenience to the crew and passengers. Employing wireless sensor networks on board is one recent practice of implementing ubiquitous technology for ships, where further study is needed because of the connectivity challenges.

2. Detection and Tracking of Ships in Open Sea with Rapidly Moving Buoy-mounted Camera System

   Visual surveillance in the maritime domain has been explored for more than a decade. Although it has produced a number of working systems and resulted in a mature technology, surveillance has been restricted to the port facilities or areas close to the coastline assuming a fixed-camera scenario.

3. Closed Loop Tracking Systems for Naval Applications

   Naval Weapon Closed Loop Tracking systems require adequate sensor availability, suitable algorithms to provide appropriate system response and a modelling capability that allows evaluation of candidate designs and algorithmic techniques under representative conditions.

4. A Comparative Study among Possible Wireless Technologies for Smart Grid Communication Networks

   The worlds of power grids technologies are converging towards a new concept that is smart grid (SG) technology. The basic objective of smart grid technology is to design an autonomous network in which all types of energy resources, consumers and any other entity related to electricity or energy are linked up together to enhance the energy conservation.

5. A WiFi Based Smart Wireless Sensor Network for Monitoring an Agricultural Environment

   The ability to document and detail changes in parameters of interest has become increasingly valuable. Investigations were performed for a remote monitoring system using WiFi, where the wireless sensor nodes are based on WSN802G modules. These nodes send data wirelessly to a central server, which collects the data, stores it and allows it to be analyzed and displayed as needed.

NODEMCU TESTING

NodeMCU uses ESP-8266 Module to communicate using wifi. We use NodeMCU modules to establish access point and client communication process. It allows us to connect and share information.

We choose NodeMCU because of it is an open source platform and low cost developing board. The most important reason is it can be directly programmed through USB port using Arduino IDE, which is quite easy for implementation for testing purposes. As well it can be easily programmed with C++ for the final product.

Basically we established a soft access point on NodeMCU and we tried to connect it using mobile phones and computers. It was successful. After connecting to access points we tested how far long it can be held without disconnecting. It was a difficult task because we are having the module in the middle of the sea at the real situation but we tested it on a building where there are lots of disturbances due to concrete. But approximately it can hold 50m without disconnecting. That range is enough to continue our project for testing purposes.

WRITTEN CODE SEGMENTS

```
#include <ESP8266WiFi.h>
#include <WiFiClient.h>

const char *ssid = "FisheryBoat";
const char *password = "Boat123";

void setup() {
  delay(1000);
  Serial.begin(115200);
  Serial.println();
  Serial.println("Configuring access point...");
  WiFi.softAP(ssid, password);

  IPAddress myIP = WiFi.softAPIP();
  Serial.print("Fishery Boat IP address is ");
  Serial.println(myIP);

}

void loop() {

}
```

MEETING DR.CHATHURA

We were advised to continue our project with NodeMCU and if there is any signal issue we are able to fix it with having an antenna along with the module. Upon completion of data transfer process we were told that we will be given the opportunity to test the connectivity in a real life situation with collaboration with Navy.

MEETING PROF.GIHAN

We were advised to look similar projects done in papers as well to consider the distances that we are considering to choose our communication mode. We were asked to finish our testing purposes soon and check this with a navy ship and a boat because there will be issues that are needed to be addressed which would take a considerable amount of time.

CHALLENGES

1. Connectivity issues of NodeMCU due to the effect of concrete. It has reduced the wifi range of the module. NodeMCU server connection lost within the wifi range.
2. Frequencies of water and wifi are the same. So the component has to be fixed with a maximum range from the water level. Wifi signals are being absorbed into the water.
3. Keeping the signal strength of the wifi module actively within 100m.
4. The security of the data transfer process should be encrypted with security exceptions.
5. Always keeping the module online.

REFERENCES

1. https://www.youtube.com/watch?v=dsmMzS3Qvg
2. https://www.youtube.com/watch?v=ZTnTKGdwzMs
3. https://www.researchgate.net/publication/315510876_A_Comparative_Study_among_Possible_Wireless_Technologies_for_Smart_Grid_Communication_Networks
4. https://ieeexplore.ieee.org/document/6379161/
5. https://ieeexplore.ieee.org/document/6137009
6. https://ieeexplore.ieee.org/document/1631038/
7. https://www.google.com/patents/US6933884
8. https://patents.google.com/patent/US6249241B1/en
9. https://www.sciencedirect.com/science/article/pii/S0029801812002326
10. https://ieeexplore.ieee.org/document/4392408/
11. https://trello.com/b/wR6jtEnQ/seaeagle