Nanotechnology Perceptions
ISSN 1660-6795
www.nano-ntp.com

Enhancing Marine Biological Observations With The Resilience Of National Coastal Communities (Emborncc) To Climate Change With Essential Fisherman Aid And A Nautical Border Alert System

T M Bhraguram[1], Prashanth Kumar Bolisetty[2], Akhila K. R[3], Anu Krishna[4]

[1]Lecturer, Information Technology, Software engineering, University of Technology and applied Sciences-Shinas, Sultanate of Oman.
[2] Lecturer, Information Technology, Software engineering, University of Technology and applied Sciences-Shinas, Sultanate of Oman
[3] Lecturer, Information Technology, Networking, University of Technology and applied Sciences-Shinas, Sultanate of Oman.
[4] Lecturer, Information Technology, Software engineering, University of Technology and applied Sciences-Shinas, Sultanate of Oman
Corresponding author: [1]T M Bhraguram

Technology in today's world become more sensitive and productive with various aspects of socialization. Internet of Things (IoT) platform used to excavate and solve many of the sophisticated problems with limited resources and less infrastructure. The real life problems can be considered under IoT technology by the help of various sensors and technical binds including RFID, Artificial Intelligence, device connectivity and communication etc. This article provides a good framework for increasing the fisherman productivity used in Sultanate of Oman, the part of Arabian Peninsula. This AI based proposal can provide a good alert system for fishermen during 24/7-time frame. This may use various sensor-based setup and artificial intelligence mechanism to detect the availability of various fishes while fishing. Adverse climate conditions, unawareness of sea border always creates problems to the fishermen. The problems of fishermen including accidents met with obstacles and other yachts, yachts stuck due to insufficient fuels, crucial leakage etc. These cases happened while searching for quality fishes in various marine plots. The suggested framework can initiate solution of the said issues and saves the life of fishermen. Here the system uses IoT Patrolling robot along with Black box. This system has Ultrasonic sensors and GPS which may alert the fisherman about marine boundaries. Though the framework handles the rain alert system by the help of temperature sensors and it helps to locate quality fish by evaluating the ph values and other water monitoring measurements. Fuel tank measures and boat leakage might be recorded and the same can be reported to both patrolling robot and fishermen yacht. The system has Twilio messaging system to enable all the communication states. The framework provides sensor values updated to the cloud using ThingSpeak.com platform.

Key words: IoT, RFID, Artificial Intelligence, Ultrasonic sensors, GPS, pH values, GoPiGo Robot.

I. INTRODUCTION

This observation and alert system produce a systematic method of sea monitoring where the authorized government officials or even citizens can make deep system control during the emergency situations. Various technological aspects merged and the development anticipated its quality level might not be degraded as the system communication progresses. In spite of high quality sensor devices, a deep excavated learning mechanism polishing the system into an error free observation status. The framework proposed in this article regulates the mechanism of normal human based sea monitoring and the precautions needed during emergency. It articulated a number of various technological methods including IoT based sensors and its measurements, Black box implementation, Twilio GPS alternative messaging platform and cloud based systems. Decision making ThingSpeak platform gives sufficient communication flexibility during the analysis phase and faster response makes a good sense as the framework proposed in a sensitive network and expected number of responses within the time frame. The framework aiming mainly fishermen in Sultanate of Oman and the ministry level actions of sea monitoring. It includes various sensor categories to meet more accurate analysis system. IoT based framework introduces a clinching model of RFID, Ultrasonic sensors, GPS, materialistic measurements and diagnostics, GoPiGo robotic models etc. Number of marine problems including fishermen accident mainly due the obstacles hit, yachts stuck due to insufficient fuels, deep search for quality fishes etc. Adverse climate condition and unaware of sea borders are some crucial situation where most of the fishing yachts faced during the search for quality fishes. Ultrasonic sensors and GPS system of the framework is capable of handling the alert mechanism for fishermen about the sea borders. This framework is capable of making an alert of rain by the use of various sensors including temperature and moisture.

Fuel tank measures and leakage occurred in yachts may handle effectively with the help of IoT patrolling robot along with black box. The said measurements may have recorded in every limited time frequency and can disseminate the same to the nearest patrolling robot. This communication is more sensitive as the communication delay may lead to the system failure. All the fishing boats are looking for quality fish availing places, thus the framework proposes a new quality pH value diagnostic test of specific sea areas where the fishermen can directly move and take their actions. This helps the fishermen to take quality fish available places and thus the crucial climate such condition s can avoid. This system scopes the area covered mainly the Gulf of Oman and Arabian sea shores of Sultanate of Oman. This framework suggests the working of 24/7 during full-fledged communication channel. It can be considered an alert system which clears many of the sophisticated problems of fishermen during their fishing time. Most of the fishermen not taking necessary precautions in their domain as it directs and causes many accidents and thus affects the industry also. A cloud based communication and recorded system adapted in this framework for the better replacement of data loss. ThingSpeak.com cloud [6][8] associated with this system can effectively record and monitor the communication channel and its delivery.

Figure 1: Model of Communication strategy

The communication established based on the Twilio messaging platform where it gives an alternate solution to GPS mechanism and makes the communication through the virtual numbers. The alert may prompt to the patrolling robots, Royal Oman Police (ROP) and fishermen family. A bunch of sensor combinations including the device package used here may change the sequential alert results into an intermediate resultant message and can generate the cloud integrity module. 18 carrier sensors give a strong communication benchmark where the sensor failure can handle through the alternate options. Thingspeak and Twilio platforms [6][8] makes strong communication background once the framework implementation carries with high end modules. CISCO PL-APP IOS Image manages the code carrying facility and the platform continues to the integration of data analysis and learning modules. CISCO packet tracer makes the communication standard in a systematic model and ensures the delivery of messages without packet drops.

All the devices connected through the high speed ports are integrated with Thingspeak [6][8] platform and the module analysis performed within the time frame. A Tangible alert system attached here may recover any undelivered communications and the same can be re iterated with cloud platform. High end modules consist various hardware and software integrations which may interconnected through the fast response model and can be processed within the time frame and cost. Power usage detection may interchange within the framework and limits the sensor working and message passing during the non-measuring time. Raspberry Pi required to provide the sensor data transmission through the interconnected sensor channel. Once the measurements from the sensors are detected without false models, the data can be transmitted over the communication channel and the necessary decision can be carried out. The decision can be transmitted through the messaging platforms and the necessary communications reached the destination. This article formulates the entire sequence of operational part with the help of integrated circuits and the system can be fully adaptable to the patrolling boats. The system scope mentioned here in this article can be deviated to various sea monitoring purposes with the help of necessary device setup. The main advantage of this framework includes scalability and score enlargements. The device setup cost is less and the performance measurements indicates the communication system used in this framework may prompt with accurate delivery of messages. The action in an emergency situation depend on the nearest patrolling boats but the system can rule out the best for each criteria evaluation.

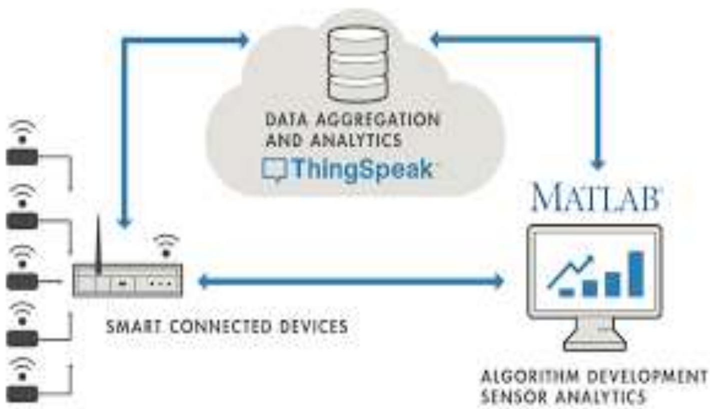


Figure 2: Thingspeak cloud platform sequence

The cloud system module actively participating in this framework is based on Thingspeak platform and it can provide sufficient communication storage and forwarding facilities without any drastic delay. This system has its own data aggregation and analysis part and an algorithmic module which may responsible to handle all sensor based analysis. The algorithmic module established on the top of Matlab development [11][13] environment and the measurements collection through a series of connected devices. Rest the communications are established and implemented on python based shell and integrated under the roof of CICSCO packet tracer. Every communication happened in terms of CISCO PL-APP IOS image. The Pl-App software platform running on Raspberry Pi which may raise one web interface based on the concept of a notebook.

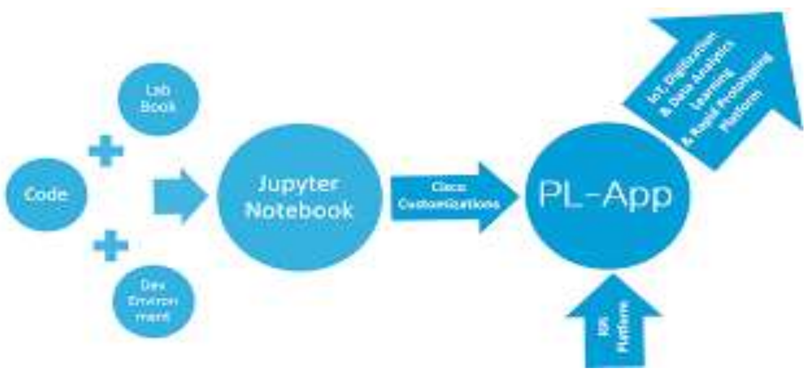


Figure 3: CISCO PL-APP IOS Image

It provides an interactive web page where the contents distributed on cells based formulation. A new app sequence generation is possible and the output can be viewed from the board using various virtualization models. The platform used here is CISCO PL App Image and it is capable of handling sufficient functionalities for integration purposes. Studies shows that, the error detection level is satisfied compare to other models used for the same purposes. The image loading time is negligible and the app developed under this image provides most optimized versions with less error rate and with good stability. CISCO packet tracer provides the effective message delivery without any packet drop and with good error handling modules. The device setup formulated under Packet tracer is most configurable and modular based. The python shell programming interface is active during the development and a good optimizable coding can be generated with this.

II. RELATED WORKS

Most fishermen don't use the Internet of Things, which may lead to a number of problems when they're out fishing. These problems include an increase in mishaps, border crossings with neighboring countries, leaks, and other problems. The research indicates that there are several approaches to addressing these problems.

Fishermen border security alert systemusing IoT: Jayaram , Durkka Devi , Jayaprabha [1]
Dr. Saravana Kumar R*4, Dr. John Clement Sunder A*5 , 2021 [1],The "Fishermen border security alert system" is the subject of this article. Nowadays, border violations frequently result in the capture of fishermen by other nations. This is primarily because sea borders cannot be identified. The microcontroller Arduino Uno and the ATmega328p microchip are used to collect and manipulate sensor data in this study. The NEO-6M GPS receiver module is used to determine where the boat is. Using an ESP8266 Wi-Fi module, the collected GPS location is uploaded to the IOT cloud. The navy can monitor the data there. The boat's speed, or motor speed, is reduced by 50% if the GPS location is within the warning zone. The buzzer will help identify the alert message. The main idea is to notify fishermen while sailing with the help of an Arduino Uno microcontroller and a NEO-6M GPS receiver module.

Alex Alcocer, Paulo Oliveira, and Antonio Pascoal. Underwater acoustic positioning systems based on buoys with gps. 8th ECUA, 2006. Provide a solution to improve the general safety of fishermen's life. We created an embedded system that uses the Internet of Things and an RF transmitter receiver to alert our country's maritime boundaries in order to do this. The system's overall performance is managed by the embedded unit. Additionally, it determines the fisherman's current location and whether they are in a restricted or safe zone by comparing the pre-defined and present values of their position. IOT and RF communication components supply the provider location for every maritime zone. The integrated equipment talks to fisherman through an LCD display. [2]

A Maulidi1, T Irmiyana1, A F Ilman1, Annafiyah1 and Kuzzairi1 (2022), The development of internet-of-things (IoT)-based safety monitoring system in North Sea Madura, IOP Conf. Series: Earth and Environmental Science 972 (2022) 012013 IOP Publishing doi:10.1088/1755-1315/972/1/0120: Suggested a simple, low-maintenance temperature alerting system for fishermen. In the unlikely event that any fisherman has issues such as unexpected weather changes or crises, this method may be utilized to keep an eye on the relatives, friends, and other fishermen. The climate in the fishing zone and whether or not fisherman pass the outskirts will be monitored by this project utilizing sensors such as stickiness and temperature, wind speed sensor, and rain sensor. When a fisherman needs help, this sensor will use a Zigbee module to transmit information to the server and continually advise them on the fishing zone. When they hit the crisis button, a GPS location and an alert will be transmitted to the designated principal server, allowing them to take protective measures. [3]

Pathmapriya.K1 , Sasikala.J2 , Suriyakala.M3 , Thejeswari.H4(2020), IOT BASED SMART BLACK BOX SYSTEM, IJARIIE-ISSN(O)-2395-4396, Vol-6 Issue-2 2020 Chaitra H.V 1 , Ashika HR 2, Kavitha KS 2 Kavya AS 2 Keerthika A 2(2021), Smart Ship, 2021 IJCRT | Volume 9, Issue 1 January 2021 | ISSN: 2320-2882: The work described in this article attempts to offer a financially viable solution for the design and development of an event data recorder, which has mostly been taken up by the aviation industry due to the associated advantages and requirement. Technologies have the potential to prevent ship mishaps, collisions, ship-to-ship contact, and wreckage. Problem: Automotive electronics is a big part of the car business. It offers opulent amenities, but it also takes care of security and safety issues. The article presents an integrated design of the black box with the fundamental data recorder features, which could be very helpful for domestic vehicles. In addition, it has several other features that could help reduce the number of accidents or, at the very least, act as an analysis tool to stop accidents by looking at past accidents. [4]

Surya Darmawan; Budhi Irawan; Casi Setianingsih; Muhammad Ary Murty (2020), Design of Detection Device for Sea Water Waves with Fuzzy Algorithm Based on Internet of Things, 2020 IEEE International Conference on Industry 4.0, Artificial Intelligence, and Communications Technology (IAICT), Date Added to IEEE Xplore: 20 August 2020 ISBN Information: INSPEC Accession Number: 19915759 DOI: 10.1109/IAICT50021.2020.9172018: The accelerator meter principle governs how the gyroscope sensor functions. Bots, drones, and other advanced technologies often employ this strategy. In addition, it makes use of the sensor and serves as a tool for early sea wave detection. This tool's benefits go beyond its lower cost; it may benefit society by informing locals about what occurs at sea, especially in coastal or near-coastal locations. Not only can it forecast calamities, but it can also tell people about the state of the water, especially beachgoers and fisherman. [5]

D. Mythily1, R. Helan Renila2, T. Keerthana3, S. Hamaravathi4, P. Preethi5(2020), IoT based Fisherman Border Alert and WeatherAlert Security System, International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181: This article obtaining fixed data, such IDs and ship names. Subsequently, it has the ability to transmit and receive dynamic data, such as ship locations, in order to get more insight into the marine activity within the area. This system can be developed in that way in the future. They follow the data in addition to gathering it in order to evaluate the state of the boats. When on the same VHF channel, an AIS receiver will automatically and instantaneously receive data from other ships. In order for all ships in the AIS range zone that are equipped with AIS transmitters to be able to view AIS data, the information received from ships to ships is provided to the AIS Operator as a code. [6]

III. METHODS OF SYSTEM PREPARATION

A detailed descriptions of various functionalities and the system requirements include both software based and hardware based specifications. The device requirements fulfill the common module functionalities with various level testing. Most of the IoT based devices are non-sophisticated categories and easily interchangeable and also with easy migrating facilities. The framework proposed here includes bunch of IoT based sensors [4][7][9]10] and integration mechanisms. Looking forward these specifications may change the configuration part once the suitable and sustainable integration mechanism found. The device quality expected with standard specifications as the system not ensured any environment safety. Below specifications adopted in this system with required combinations of circuits and necessary changes during the implementation. The hardware and software components used in this framework ensures the minimum output quality with combinational changes.

Hardware specification models

Raspberry Pi model 4 used here to control the sensor integration and measurement collection. This ensures the IoT systems provide a single board computer (SBC) [2][16][18]which can connect sensor modules and act as a web server for uploading and transmitting sensor data. Raspberry Pi model 4 is powered with cloud network. To use this as a webserver the requirements needed like custom code, specific platform, python library and a cloud network.

Figure 3: Raspberry Pi-Model 4

Figure 4: GoPiGo Robotic kit

GoPiGo robotic starter kit [2][3][4][8][12][14] includes a car model and the system can take a start from its scratch. The base kit of GoPiGo and Raspberry Pi 3 included in this model kit and it enhance the functionalities of communicating devices effectively and the integration technique is highly adaptable for the environment. The sea monitoring ability of these communication devices makes it modular communication base and the communication channel is always active based on the sensor measurements. It includes Mini Wi-Fi dongle and servo package which takes the core functional specification roots. Ultrasonic sensors and the software modules contained Micro SD card provides the through mechanism to modulate the sensors and other active chips. Power supply chain is active and separate Ethernet cable also provided to maintain the proper adaptability of the system. The other sensor based setup takes a deep scanning and system mitigation in a proper channel with scalable capacity.

A GrovePi board together with 12 carefully selective grove sensors makes the system prototype with hassle free environment. These porotypes tell the system board to place the sensor nodes over the Raspberry Pi and how this sensor connectivity established in a cyclic manner. 10 pieces of cable connection over the Raspberry Pi model makes it run and produce the analysis output quickly. A powerful platform like Grovepi sensor module gets running on the top of Raspberry Pi is the standard hassle free environment with accurate results. As a result, the board connection device configuration tightly bonded on the system and more stable results anticipated. The PieCamera module tests the streams or video feeds effectively by the help of a video camera and the images extracted in real time can be streamed over a computer network. A piezo buzzer included in the buzzer part make the tone for connected digital output once the output is high. To generate various tone and effects, an analog pulse width modulation output can also be connected. The distance measured to an object by using ultrasonic sound waves established by the help of ultrasonic sensors and it uses a transducer to send and receive ultrasonic pulses that carry information about an object's proximity.

Figure 5: GrovePi sensor board streaming components

The streaming components can handle various measurement evaluation like sound, video and other proximity components. The enhancement of these component specification and configurations managed through the plugging facilities.

The other sensor modules like R1 temperature sensor [[5][9][11] model integrated to the circuit to detect the ambient temperature. A thermistor is capable of measuring this and once the temperature drops, the thermistor resistance increases. This resistant property is sensitive and variant might be recorded according to the time frame. The recorded measures can be used to calculate the ambient temperature based on demand requirement from the board. LCD display [5][9][11] used here is 2 x16 characters with backlight in any color palette RGB. The communication of this LCD established through two wire 12C bus and it is supplied with the voltage from 3.3 V to 5 V.

Materialistic and Sensor based criterion to be considered in the framework

Cloud services
ThingSpeak is a cloud-based IoT analytics platform service that lets you collect, view, and examine real-time data streams. You may send alerts, instantly see live data, and transmit data to ThingSpeak from your devices. The sensor data is uploaded as a variable to the cloud platform, where it may be analyzed for processing in the future.

Messaging Service
A program called Twilio allows users to send texts to mobile phones. As an alternative to GSM communications, consider this. You may use your virtual mobile number, which you will receive after registering on Twilio.com, to send messages to other phones. As part of our initiative, we will notify the Patrolling Robot, ROP, and fishermen's family members by mobile device.

Marine Border detection and Alert system
This module has a GPS system to determine the boat's present location. Additionally, it contains an ultrasonic sensor that can gauge how far a boat is from a neighboring marine boundary. Fishermen will receive an alarm if it gets close to the boundary. The Patrolling Robot and Police personnel will get an SMS message if the fishermen disregard these notifications. The Cloud platform will receive an update of the details.

Detecting Quality marine species
The fisherman can find the best place to catch fish with the aid of this module. He'll save time and gasoline by doing this. We're using the sea's temperature, pH, CO2 [11][13][16] and dissolved oxygen levels to determine this. When the data from the aforementioned sensors reach a certain point, we will employ an advanced GPS system known as USBL—ultra-short baseline, commonly referred to as SSBL for "Super Short Base Line"—to indicate the location in the deep sea. Underwater acoustic positioning is done via USBL. The fisherman shares this site with others so he may focus more on finding high-quality fish there.

Detect and Alert on Adverse weather conditions
The weather conditions are one thing that this module allows fishermen to know. This module will determine the likelihood and intensity of rain before, during, and after a fishing trip. For this, we employ temperature and rain sensors. We shall notify the fishermen in case of rain or potential rain.

Collision detection to avoid accidents

By using this module, maritime mishaps are prevented. We miss things like a large item on the way or another boat. The collision sensor will identify any item in your path or nearby and notify you if it does.

Detecting leak in the boat.

This module will identify the boat's leak. The module uses a water sensor to determine how much extra water is in the boat. A leak in the boat is identified if the water level exceeds a certain threshold. Thus, fishers should be made aware of it.

GoPiGo Robot for Patrolling

The Patrolling Robot receives all notifications related to the border, rain, fuel level, nearby objects, and leaks in the boat. Because if the Fisherman ignores these warnings, the Patrolling Robot will take the appropriate action in accordance with ROP after receiving the alert.

Software specification models

1. The Cisco PL-APP iOS [7][11][12][17]image and launcher

A Raspberry Pi software package called PL-App provides a web interface based on the notebook idea. A notebook is an interactive web page with cells—distributed content—on it. You may create your own applications using PL-App, run them, and use different visualizations to see the results from the board. The Cisco PLAPP image operating system is employed in this scenario.

2. Software for modeling real-world networks prior to installation is called Cisco Packet Tracer Network Simulation.

3.Twilio.com: A program called Twilio allows users to send texts to mobile phones. As an alternative to GSM communications, consider this.

4. A Python application

Python is a high-level, interpreted, dynamically semantic programming language. Python's short, simple-to-learn syntax puts readability first, resulting in less expensive program maintenance. Python supports modules and packages, which encourages code reuse and software modularity.

5. The cloud platform ThingSpeak[6][8]

ThingSpeak is a cloud-based IoT analytics platform service that lets you collect, view, and examine real-time data streams.

IV. SYSTEM OVERVIEW

This article presents a new framework approach to facilitate the marine acoustic positioning nautical border alert system for Arabian Peninsula and its root variations are based on the climate change. The system can act as a module for the various boats and ships positing which may lead to an effective monitoring mechanism to handle various misbehaving situations of marine electric equipment and its software malfunction. EMBORNCC Positioning framework consists various sensitive modules including materialized sensor pack, Raspberry Pi 4 model, Robotic kit, Deterministic positioning module, Thinspeak platform [6][8] etc. The algorithmic module implemented in this framework is based on the Instantaneous positioning form with various trilateration process. Quadratic convergence plays the role to determine the positon of the various objects on its face according to the materialistic sensor board.

Sensor data control log is responsible to handle the sensor measurements received from various sensors and record it with the corresponding time frame. A sensor log data processing module attached to the system may collect and process the log based on the deterministic rule and may communicate with Thinkspeak [6][8] to control the GoPiGo robotic system [2][3][4][6][12][15].

3 various trilateration process had been enabled in the system to measure the accuracy of the object and its deviated distance.

The possibility of object distance deviation and its accuracy to manipulate the acceleration or rest level of an obstacle can calculate the flexible movement and thus concentrates on maximum likelihood ratio. This ratio estimation can directly communicate with the cloud platform to enable an effective system accuracy in a dangerous situation like collision. The system enables proper alert mechanism in all system processing steps and can display this with necessary equipment.

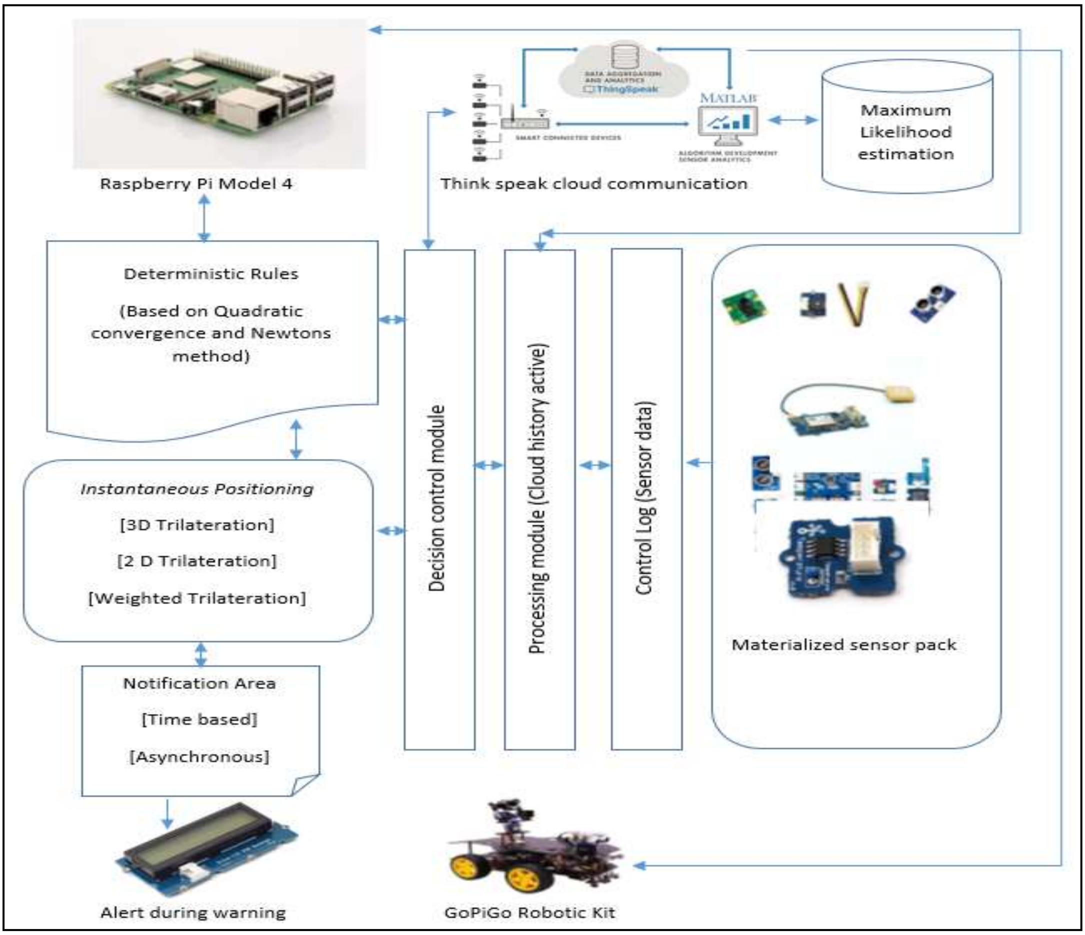


Figure 6: EMBORNCC Positioning topology

This positioning framework contains various rule based allocation formats and its convergence mechanism to facilitate and provide maximum accuracy in sensitive situations like collision or drowns. Every time frame is categorized for its notification in various categorical labels. Both time bound oriented and asynchronous category labels are enabled while a new notification process is initiating. A rich set of materialized sensor pack is sufficient in its ranges and measurements and may change its measurement accuracy according to climate change. A location based artificial intelligence module is enabled to handle the automatic movement of the objects and any detected obstacles on the path. An AI based remote robotic controls strengthen the positioning accuracy and this process completely depends on the categorical decision control module and its result stored in the cloud platform. EMBORNCC framework developed for the marine department of Sultanate of Oman and the department may take a serious responsibility of their fishermen citizens especially for their life threatening incidents during their daily routine workplace. A less cost but effective framework for the ministry of marine environment and research studies stipulates a high quality sensitive system to be adopted by the department and may take more enhancements in the future.

V. ALGORITHMIC IMPLEMENTATION

This marine positioning framework handles a bunch of collected sensor measurements where a proper channel integration takes place with various algorithmic modules. It handles deterministic rules to facilitates the positioning accuracy. A direct convergence based on quadratic modulation and Newtons method [5][9][17] had been adopted to integrate and formulates the rules to manipulate many object criteria.

Constraints to be evaluated

1. Quality fish

If (CO_2 < 20 ppm) && PH between 6.5 and 9 && Dissolved oxygen > 4.5 ppm
There is a chance of getting good quality fish

2. Possibility of Rain

Code	Output Sensor						
	Humidity Sensor		Temperature		Rain Sensor		Output Response
	Output Sensor %	Thermometer °C	Output Sensor °C	Thermometer °C	% Dry	% Water	
1.	18	41	35	43	88.2	95	Sunny
2.	35	32	29	33	79	81	Cloudy
3.	57	28	25	28	55	35	Drizzle
4.	61	25	22	25	25	25	Wet
5.	76.5	22	19	21	5	15	Heavy Rain

Table 1: Sample Sensor pack output ranges measured in various environment

3. Detecting Border: If distance shown by ultrasonic sensor is greater than 100 meter "you are approaching border"
4. Detecting Collision: If Collison sensor value is more than 5, collision detected.
5. Detecting Leak in the boat: If the water level shown using water sensor is more than 10, leak is detected in the boat.

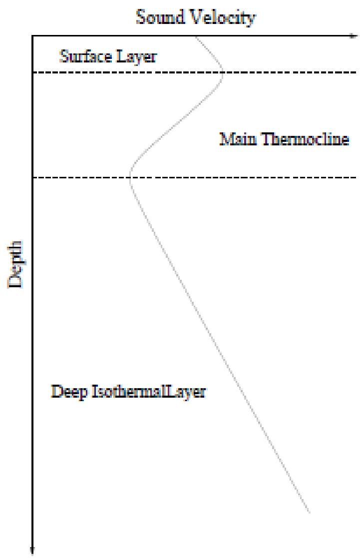


Figure 7: Sound velocity profile

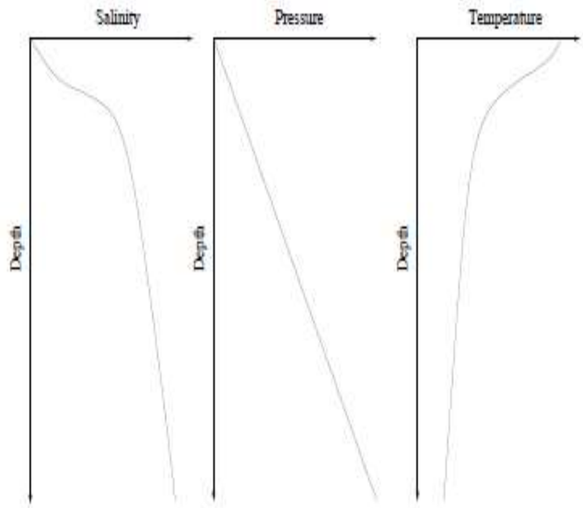
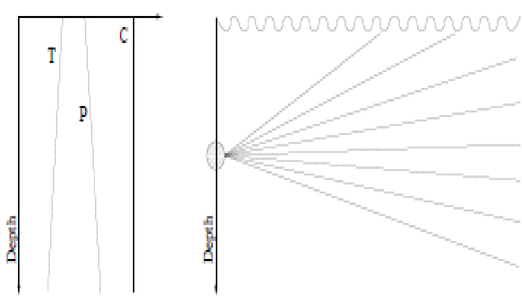


Figure 8: Sample characteristics profile

A number of variables, like as salinity, pressure, and water temperature, affect sound velocity. Figure 7 displays each variable's effect. A disposable bathythermograph probe is typically used to measure the Speed Velocity Profile (SVP); [5][9][17] an example of a typical SVP is seen in figure 8.



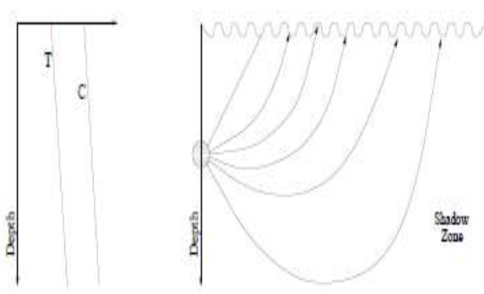
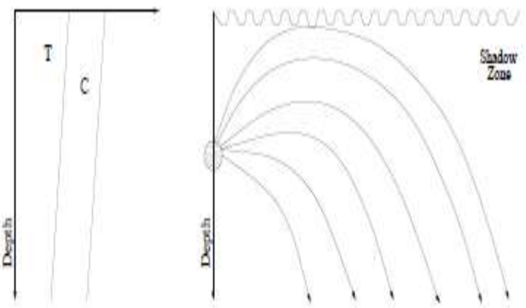


Figure 9: Sound propagation in isovelocity water

Figure 10: Sound propagation in positive gradient water



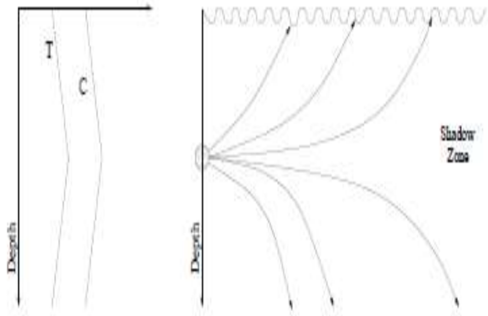


Figure 11: Sound propagation in negative gradient water

Figure 12: Layer depth phenomenon

Isovelcity: [5][9][17] a place where sound travels in a long, straight line, temperature drops with depth, and sound speed remains constant. Positive gradient prevents sound from reaching the seabed by bending it in the direction of the surface. Surface Duct is the term for this phenomena. Warm water over chilly water is a characteristic of a positive gradient. It depicted in figure 9.

Positive gradient prevents sound from reaching the seabed by bending it in the direction of the surface. Surface Duct is the term for this phenomena. Warm water over chilly water is a characteristic of a positive gradient. It depicted in figure 10.

Temperature and sound speed decrease with depth under a negative gradient when sound is bent toward the bottom and creates shadow zones. It depicted in figure 11.

The most typical sea arrangement in real-world applications is represented by a first layer with a positive gradient on top of a second layer with a negative gradient. The Layer Depth phenomenon, which is the depth at which the sound velocity reaches its maximum, happens under certain circumstances. As seen in figure 12, layer depth causes a crucial ray (sound propagation path) split that results in the creation of a shadow zone.

Relative position modes

Relative position mode is a technique that uses the measured distances between a collection of reference sites with known positions and the target to calculate the relative position. In order to identify a unique relative fix in a 2D environment, this method requires at least three (non-collinear) reference points.

Maximum Likelihood Estimator (MLE) [5][9][17] and the Least Square Estimator (LSE) [5][9][17] are frequently used algorithms to solve problems. The MLE maximizes a specific density probability function, while the former relied on squaring the ranges and linearizing the results to estimate fixes.

3D position modes

An overview of the LSE implementation of the trilateration method is given in this section. The measured times of arrival (TOA) τi can be converted to distances by using the formula ri = vsτi = di + wi, where wi is assumed to be Gaussian, zero mean, disturbance, and di is a vector containing the actual ranges. This formula requires that the target be synchronized with the positioning system and that the sound velocity (vs) be constant and known. The elements that make up di are defined as follows:

$$di = \left|\left|p - pBi\right|\right| = \sqrt{(Px - pBxi)^2 + (Py - pByi)^2 + (Pz - pBzi)^2} \quad (5.1)$$

where p = [x y z]T ∈ R3 denotes the position of the target with respect to some inertial reference frame.

Let pBi = [pBxi pByi pBzi]T ; i = 1, . . . ,m (where m is the number of available measurements). Using the vector notation, the equations can be written in compact form

r = d + w, E{wwT} = R ∈ Rm×m
(5.2)

The square of r_is, a nonlinear equation in the unknown vector p is obtained.

ri2 = di2 + wi2 + 2widi
= (p − pBi)2 + wi2 + 2widi

= kpk2 + kpBik2 − 2pTBip + εi,
(5.3)

where the new disturbance is defined as

εi = ωi2 + 2ωidi,
(5.4)

under the assumption $d_i \gg \omega_i$, ε_i is Gaussian zero mean:

$\varepsilon_i \approx 2\omega_i d_i$,
(5.5)

and the vector $\varepsilon = [\varepsilon_1..\varepsilon_m]$ has covariance:

$$E\{(p - \hat{p})(p - \hat{p})^T\} \approx E\{W\varepsilon\varepsilon^T W^T\}$$
$$= WE\{\varepsilon\varepsilon^T\}W^T$$
$$= 4WDRDW^T \quad (5.6)$$

2D position mode

It is a fair approximation in certain operating conditions to assume that the pz coordinate of each sensing communication medium is the same. This presumption causes the plane where the devices are deployed to become symmetrical. Let pzi = Z, i ∈ {1,...,m}, be the number of buoy measurements that are available. Observe that the square range equation contains:

di2 = (px − pBxi)2 + (py − pByi)2 + (pz − Z)2

(5.7)

the third term is constant

$$K = (p_z - Z).$$

(5.8)

Define

$$p'_{Bi} = \begin{bmatrix} p_{Bx_i} \\ p_{By_i} \end{bmatrix}, \; p' \begin{bmatrix} p_x \\ p_y \end{bmatrix} \quad (5.9)$$

By stacking each and every m squared range observation that we get

$$\underbrace{\begin{bmatrix} 2p'^T_{B_1} \\ \vdots \\ 2p'^T_{B_m} \end{bmatrix}}_{A} p' = \underbrace{\begin{bmatrix} \|p'_{B_1}\|^2 - r_1^2 \\ \vdots \\ \|p'_{B_m}\|^2 - r_m^2 \end{bmatrix}}_{b} + K^2 \underbrace{\begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix}}_{1_m} + \underbrace{\begin{bmatrix} \varepsilon_1 \\ \vdots \\ \varepsilon_m \end{bmatrix}}_{\varepsilon} + \|p'\|^2 \underbrace{\begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix}}_{1_m}$$

(5.10)

In this case the solution is a 2D fix calculated utilizing 3D measurements.

Weighted position mode

Each data point gives equally exact information regarding the process variation, according to one of the basic assumptions underlying the majority of process modeling techniques, such as LSE. Stated differently, the error term's standard deviation remains constant across all variable values. Since each variable has its own informative information in a real application, it is evident that this assumption is false. In this case, the Weighted Least Square Estimator (WLSE) can provide a solution. Similar to LSE, this method reduces residuals while additionally taking into account a distinct weight for every point. The requirement for precise weight knowledge is likely the primary drawback of WLSE.

In the weighted case the linear system is multiply on the left by a symmetric positive definite matrix which take in account the covariance of the error.
Let's define;

$R^{-}, E\{M\varepsilon\varepsilon^T M^T\}$

$= ME\{\varepsilon\varepsilon^T\}M^T$

$$= 4MDRDM^T, \quad (5.11)$$

then the resulting linear is

$$WMAp = WMb + WM\varepsilon,$$

where the optimal solution in sense of Least Square is

$$\hat{p} = (WMA)^{\dagger}WMb. \quad (5.12)$$

Define $(\cdot)^{\dagger}$ as Pseoudoinversion operator

$$(WMA)^{\dagger} = ((WMA)^T WMA)^{-1}(WMA)^T \quad (3.22)$$

$$= (A^T M^T \bar{R}^{-1} MA)^{-1} A^T M^T \bar{R}^{\frac{1}{2}} \quad (5.13)$$

Maximum Likelihood Estimation

An additional approach to the Trilateration problem is based on Maximum Likelihood (ML) [5][9][17]. The basis for this is the maximization of the Likelihood function, a conditional probability. Remembering that r represents the measured ranges and p is the AUV position, the likelihood function l(r|p) can be understood as a function of its second input, p. Put another way, the likelihood function works backward from probability to determine the optimal set of estimating parameters given a distribution of probability and a collection of gathered data. Thus, the values of p that maximize l(r|p) form the Maximum Likelihood Estimator (MLE).

$$l(r|p) = \frac{1}{(2\pi)^{\frac{m}{2}}|R|^{\frac{1}{2}}} exp\{-\frac{1}{2}(r-d)^T R^{-1}(r-d)\} \quad (5.14)$$

where p represents the AUV position, r the measured range, and d the actual range

VI. SYSTEM FRAMEWORK

Each of the five modules that the framework suggests—Marine Border Detection and Alert System, Collision Detection to Prevent Accidents, Boat Leak Detection, Quality Marine Species Identification, and Detect and Alert on Adverse Weather Conditions—has a distinct purpose. To connect or attach each sensor to the Raspberry Pi, we utilized Grove Pi.GPS [2][4][12] and ultrasonic sensors were employed by the marine border detection and alarm system to identify the boundary. Collision detection, which uses collision to identify a collision before it occurs, helps prevent accidents. Using a water sensor to measure the water level, the boat's leak was found. Using sensors for temperature, dissolved oxygen, carbon dioxide, and pH, quality marine species may be identified. These data are then utilized to determine the location of high-quality fish. Identify and notify about unfavorable weather conditions used sensors for temperature, humidity, wind speed, and rain to determine the weather. If anything went wrong, these sensors were used to notify the fishermen by displaying an LCD message. If something else went wrong, the sensors were also used to send a message to the patrolling robot, which used twillio.com to notify the police and any family members. To update all the info to the cloud, we'll make use of ThingSpeak.com. [2][4][5][6][7]

An electrical safety gadget called a collision sensor uses vibration to identify impact. A collision sensor is also known as an impact or crash sensor. Collision sensors are utilized everywhere these days, however they were originally designed to "sense" a true collision between a car and any object. This module will be utilized in our project to prevent maritime mishaps. We miss things like a large item on the way or another boat. The collision sensor will identify any item in your path or nearby and notify you if it does. To alert fishing boats to impending ships or other objects, we have developed a collision avoidance system and an accident detection system in this module. Twilio, a GPS receiver [5][8], an ultrasonic sensor, a collision sensor, and a Raspberry Pi make up the recommended setup. The ultrasonic sensor alerts the occupants of the fishing boat to any approaching ships or objects.

Water flow is monitored via leak detection systems. Leak detection systems track the patterns of water flow. Leak detectors alert fishermen when they detect too much water. If the leak detection sensors in the boat detect water approaching the flooring, the fisherman will receive a warning. Leak detectors perform effectively in offshore point-of-use applications. On whole boats, systems for detecting any leaks often keep an eye on the water level. You may check the water level in your boat using the Wi-Fi connection that most leak detection systems include. When a leak happens, leak detectors will inform you via a water sensor, warning fishermen to the water flow before a little leak becomes a catastrophe. They will also tell the Patrolling Robot and Rescue system of the leak.

Figure 13: EMBORNCC Positioning framework

Detect and Alert on Adverse weather conditions

Fishermen depend heavily on area-based alert services because of the hazardous conditions in the area.
Situations and a lack of inventiveness in salvage assist our fishermen in resolving a genuine issue with neighboring nations. To address this issue, we suggested a simple and easy-to-use weather warning system for fisherman that enables them to stay in touch with friends, family, and other fishermen. Fishermen would benefit from this paradigm in the event that they face issues such as unexpected climate change or a catastrophe. Right now, we're going to use sensors for temperature, humidity, wind speed, and rain to keep an eye on the weather in the fishing area.

A recent trend known as the "Internet of Things" (IoT) involves connecting a sizable number of embedded devices, or "things," to the Internet. These networked devices share information with one another and with people. They also regularly transfer sensor data to cloud computing and storage services for processing, analysis, and production of important insights. Better device connections and more reasonably priced cloud computing capability enable this development.
ThingSpeak is a cloud-based IoT analytics platform service that lets you collect, view, and examine real-time data streams. You may send alerts, instantly see live data, and transmit data to ThingSpeak from your devices.

Configure Settings at ThingSpeak

After Successful registration in ThingSpeak.com we configured the following settings in the ThingSpeak.com platform

1. Name of the Channel
2. Description of channel
3. Create 3 fields (Distance Sensor, Water and Motion Sensor)
4. Note down Write API Key and Read API key
5. Make the channel as Public

Install Httplib2 package

A feature-rich HTTP client library, the httplib2 module manages caching, keep-alive, compression, redirection, and many forms of authentication.
Upload the Output sensors to ThingSpeak.com Cloud

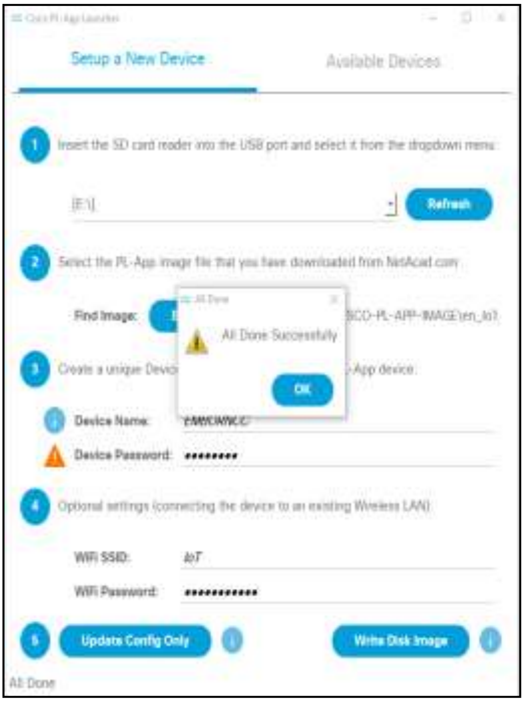
Revise the Python software. Examine the sensor's readings. Upload the sensor outputs to the appropriate variables on the ThingSpeak platform. Additionally, show the cloud platform widgets.

Register in Twillio message service
A free Twilio service called Messaging Services was created to make it simpler to transmit messages at scale and across many nations. A Messaging Service, in essence, is a container for several Twilio message senders (e.g. phone numbers). When you give your Messaging Service information in your API queries rather than a particular from number, it provides you with extra message sending intelligence and content capabilities like automated number selection.
Register student details in to ThingSpeak platform by giving Email address, password and Mobile phone number.

Configure Twilio.com's Settings
Following a successful Twilio.com signup, we set up the following settings on the ThingSpeak.com platform.

1. Product Type as SMS
2. Plan Type for Alerts and Notifications
3. Create Twilio using zero code; 4. Obtain a Twilio number to deliver SMS
5. Write down the Auth Token number and Account SID.

Install the package for Twilio.
Installing the Twilio package using a Python editor is required in order to use Twilio coding on a Raspberry Pi. Inform the registered phone number of the sensors' status by sending SMS messages. Revise the Python software. Send SMS messages to a mobile device to display the sensor status.



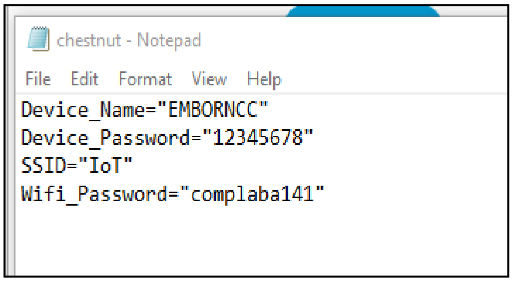


Figure 14: EMBORNCC Connection parameters (CISCO PL App)

Figure 15: EMBORNCC Connection parameters
(CISCO PL App) ChestNut return

Figure 16: EMBORNCC channel settings

VII. SYSTEM IMPLEMENTATION

To personalize the PL-App installation on the µSD card, navigate to the settings area of the PLApp Launcher application and make the following changes: "Device Name - This is the name of the PL-App Raspberry Pi instance on the local area network (LAN)." If the chosen device name is not the only one on the local area network, naming conflicts could happen. You can use your initials, your username, or your name with a number (myname-myRPi1). The Device Name may also include dashes (-), letters (a–z) (–), and numbers 0–9. A letter must be the first character.

Device Password: You need to input this password in order to access PL-App on the Raspberry Pi. On the SD card, the password is kept in plain text.

For security purposes, you should always use a different password (never use the same password for netacad.com, email, social media, etc.).To connect your Raspberry Pi to the network via Wi-Fi, navigate to the optional settings section and configure the following: The WiFi SSID of the network you want to connect to, such Classroom WiFi, is its name.[5][6][9][11]

The fourth option is the WiFi password, or WPA2 Pre-Shared Key.

If all the configurations are correct, click the Write Disk Image button to flash the PL app image into the selected removable SD card disk and remove all of its contents. This process also writes the configuration settings to his Chestnut.txt file on the SD card. Depending on how quickly your SD card reads, it could take five to 10 minutes. Once the µSD card has been configured, use File Explorer to view its contents. The drive letter for the SD card has changed to CISCO-PLAPP.

Figure 17: Raspberry Pi Board setup

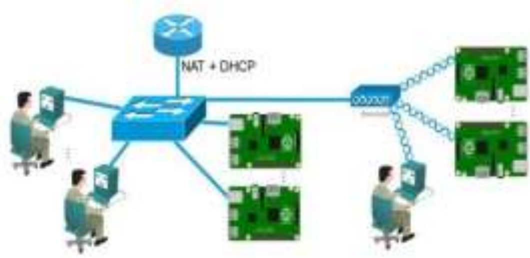


Figure 18: Device topology

Insert your Raspberry Pi's µSD card. The rear side of the board has the µSD card slot. Join your LAN using the Raspberry Pi. Attach the Ethernet wire to your Raspberry Pi if you're using one. Make sure your access point's signal is strong enough if you're utilizing Wi-Fi. For the PL App Launcher detection to function, your computer and the Raspberry Pi need to be connected to the same network.
After a successful login, the PL-App directory browser opens the root directory of the notebooks

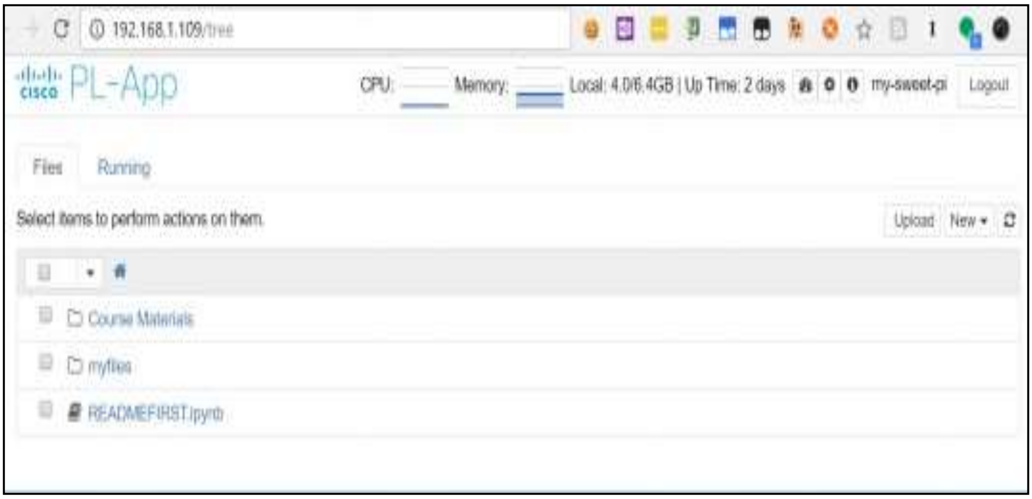


Figure 19: µSD card PL App Root directory structure

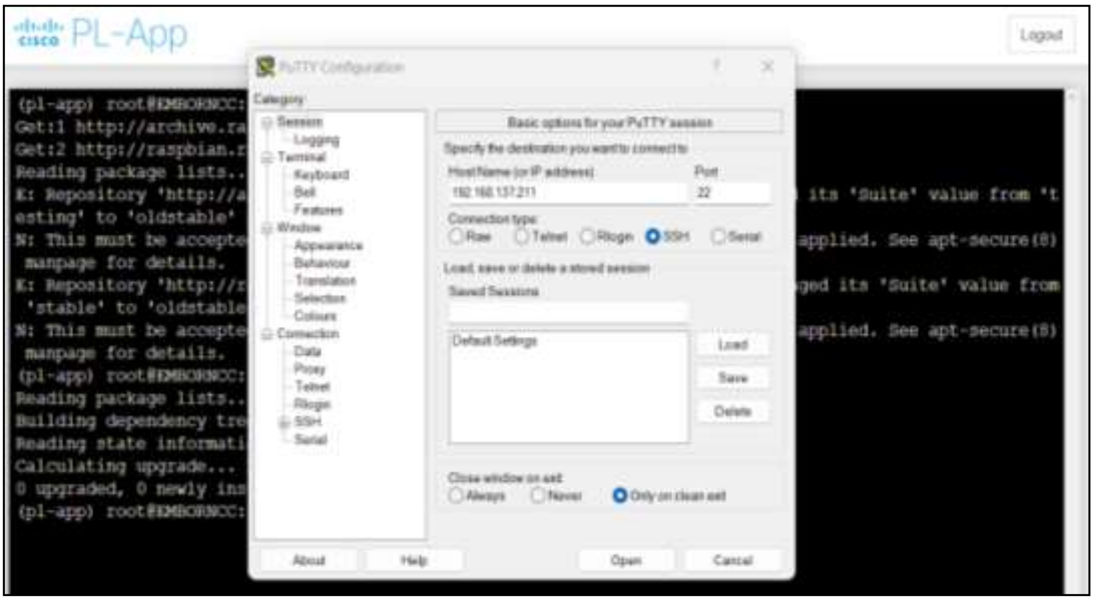


Figure 20: PL-App Session variable configuration

The port number assigned must be equipped with the PL-App image server settings and the configuration modules must be initialized while forecasting the measurements. SSH connection type is initiated with host name to be accessible remotely. Once the rot directory structure is initiated successfully the generated root shares can be configured according to the session variables. The pseudo code may bind with various sensor inputs and can be structured with authentication tokens generated by python script. Grovepi [7][8][10][11]modules initiated accordingly with necessary parameters and categorical values once the ultrasonic modulation is illuminated.

In GrovePi modulation, the sensor needs to omit the measurements while initializing the module category, thus the ultrasonic ranger might be occupied with the object to find whether the distance proximity is measurable or close to look. The objects near to the ship might be identified with digital write sensor part and is based on the trilateration extension already leveled up with GrovePi. The below pseudocode extends its proximity closer calculation based on trilateration and with necessary error handling mechanisms.

```
grovepi.pinMode(pir_sensor,"INPUT")
while True:
    try:
        # Read distance value from Ultrasonic
        u=grovepi.ultrasonicRead(ultrasonic_ranger)
        if(u<10):
print("objects arecloser")
            setRGB(255,0,0)
            setText_norefresh("Objects near by the ship")
            grovepi.digitalWrite(buzzer,1)
            account_sid = "AC594fe96de3e2239a71a82d13747a46ce"
            auth_token = "cf1ee52d29f5ba21f41f61e86dd1d53c"
            client = Client(account_sid, auth_token)

message=client.api.account.messages.create(to="+96896530590",from_="+15074686793",body="
Objects are enar by the ship")

message=client.api.account.messages.create(to="+96896530590",from_="+15074686793",body="
Attention Motion detected")
            grovepi.digitalWrite(buzzer,1)
        else:
            print("No Motion")
            setRGB(0,255,0)
            setText_norefresh("No Motion")
            grovepi.digitalWrite(buzzer,0)
        time.sleep(0.5)
        URL='https://api.thingspeak.com/update?api_key='
        KEY='HFZ0AQOOV1JAHYOX'
        HEADER='&field1={}&field2={}&field3={}'.format(u,water,motion)
        new_URL = URL + KEY + HEADER
        v = urllib.request.urlopen(new_URL)
        print(v)
    except Exception as e:
        print ("Error:{}".format(e))
    time.sleep(0.1) # don't overload the i2c bus
grovepi.digitalWrite(buzzer,0)
setText_norefresh(" ")
```

Table 2: GrovePi Sample Implementation pseudocode of Trilateration

The API key binding is necessary to coordinate the module and integrate the high speed network proximity level.

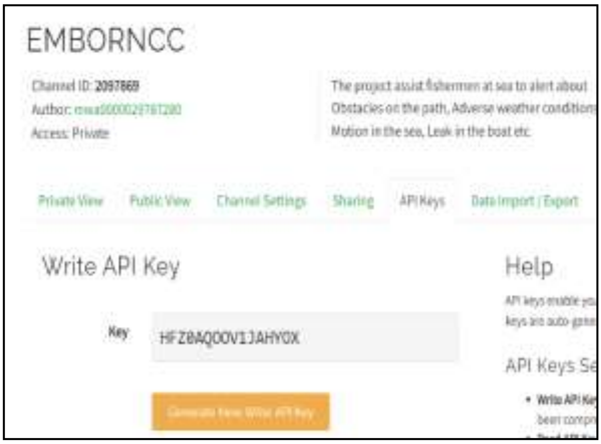


Figure 21: API Key binding for EMBORNCC

Figure 22: API Key Request status of EMBORNCC

VIII. RESULTS AND DISCUSSION

Because the cost function declines more quickly than it do in the case of the pure ranges likelihood function, solutions based on the squared ranges likelihood function need a precise design of the step size method and a stop condition. When compared to the Gradient approach, both implementations demonstrate that the Newton method converges to the best solution with less iterations. Therefore, the Newton technique and the MLE version based on pure ranges likelihood function may be implemented in real-time.

Table 3: MLE: Simulation parameters

ε_1	$1e-9$
ε_2	$1e-9$
$\alpha^0 = \beta^0 s$	2
β	$5e-1$
γ	$1e-1$

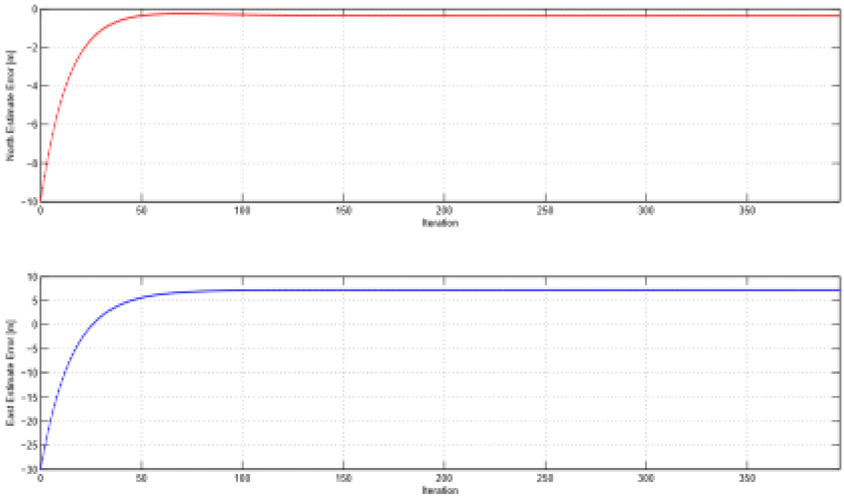
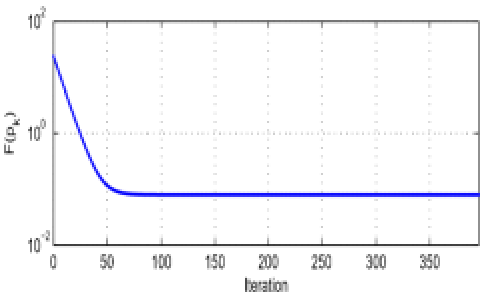


Figure: 23: Trilateration variants during limited Iteration

The local minimum of the cost functions is strongly influenced by the quantity and location of buoys as well as the strength of the measurement noise. This is a significant issue that hinders the approaches' worldwide applicability on several optimization situations. The cost function value inside the region is represented by the values on the contour lines.



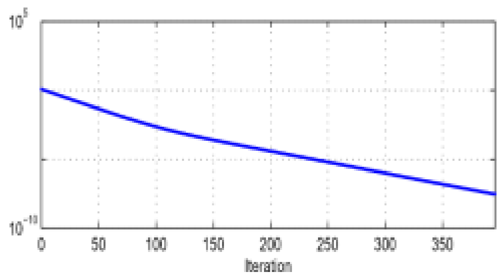
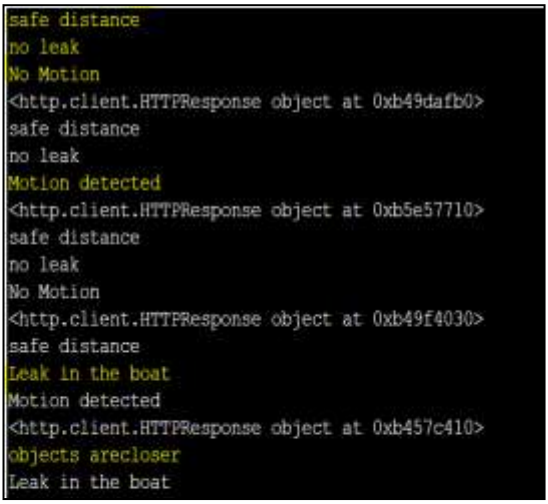


Figure 24: Step 1 iteration of trilateration during iteration

Figure 25: Proximity distance variant



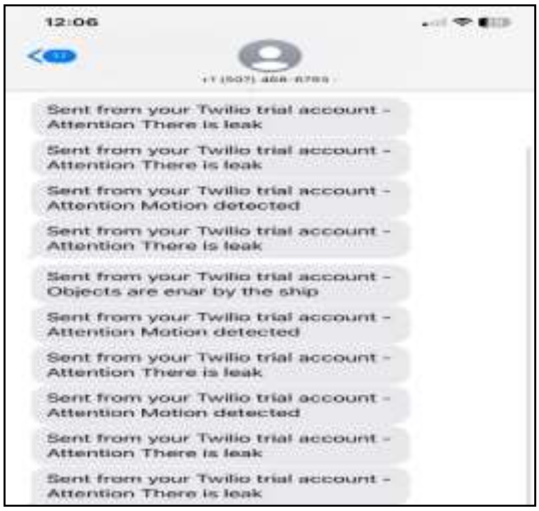


Figure 26: Trilateration sample output

Figure 27: Twilio Trilateration proximity status

Once the execution of 3d trilateration illuminated, each sensor may initiate with necessary measurements during the execution process. The GrovePi [5][6][9]board may take the measurements process initiation and the magnitude calculates accurately to fall into the respective category label. Any motion variation or leaks found could be measured and processed with necessary atmospheric incidents. The twilio proximity calculation might be prompted to the status area of robotic control and also to the message alert system.

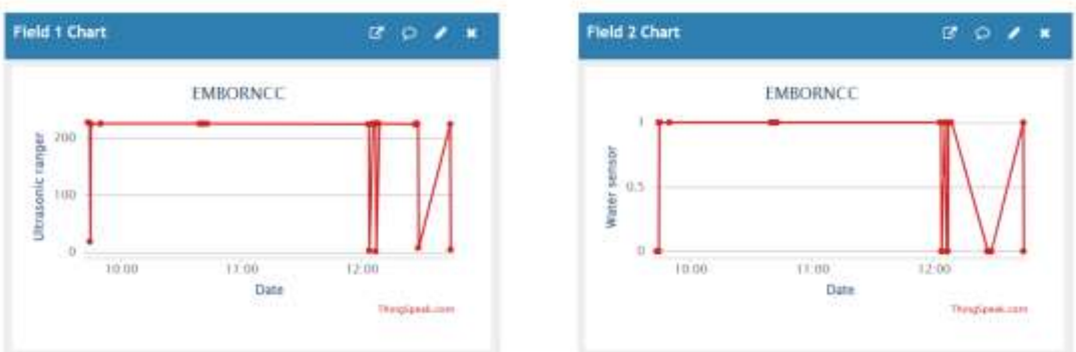


Figure 28: EMBORNCC object detection chart

Figure 29: EMBORNCC motion sensor detection chart

Object detection chart represents the motion characterization of various objects and its magnitude. The detection recorded based on the dates of the motions in timely manner.

IX. Conclusion

The system proposed here is a combinational strategy of IoT (Internet of Things) with artificial intelligence module attached with GrovePi board configuration. The system produced an effective soulatuo0n as per the execution result for a better navigation purpose of fishermen and another marine engineering people. The social setup of this system provides a standard framework model for government organization where it responsible for monitoring the people moving and driving across marine environment. The article proposes an effective marine motion detection framework which can handle various obstacles and its variations during fishing time or any other marine engineering works. This framework contains a variety of sensors modeled along with Grovepi Board and the trilateration implementation scheme with IoT devices to be formulates a most modern system for marine monitoring and engineering. The proposed system Enhancing Marine Biological Observations with the resilience of National Coastal Communities (EMBORNCC) is accurate according to the execution result and it gives an effective movement chart and messaging system with communication parameters according to the climate change. The 3D trilateration model experienced in this system can accommodate 2D trilateration and weighted trilateration module also as part of the future enhancements.

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Author Profile

Dr. Bhraguram T M received his Doctorate degree from Kanpur University, India and M.Sc. degree in Computer Science and Engineering (CSE) from Bharathidasan University, India. He has completed M.E degree in Computer Science and Engineering (CSE) from VMKV Engineering college Tamilnadu, India and Cyber security specialization from Govt. Law college, Mumbai. He is a Master of Business degree holder in E business. His distinguished career spanning 15 years of academic and one year of corporate experience. He has published more than 19 plus articles which include Scopus & Web of Science (WoS). He holds multifarious memberships from the prominent professional bodies specifically from IEEE, ACM, ISTE, IACSIT, CSTA, IAENGG, IAHFP and IARCP. He holds 3 patent registrations under various fields and his research interest and areas are Data mining, Cloud based services, Digital forensics, Metaverse and Block chaining.

Prashanth Kumar Bolisetty. He received M. Tech (CSE) degree from Department of Computer Science and Engineering, Jawaharlal Nehru Technological University Hyderabad, India and also received M.Sc., degree from Department of Computer Science, Osmania University, India. He is an ISTQB certified software test engineer. His distinguished career spanning 21 years of academic and Industry experience. He worked as a Software Testing Consultant for number of MNC's in India. His research interest includes various fields of Computer Science and Pedagogy.

Akhila K. R received her M.Tech degree in Computer and Information Technology from Manonmaiam Sunderanar University, Tamilnadu in the year 2011 and B.E degree in computer science and engineering from Anna University in 2007 and She is currently pursuing her PhD from Anna University. She has published 3 papers which include Scopus journals. Her major research interests are image processing machine learning and data mining.

Anu Krishna received her Masters and Bachelor's degree from Mahatma Gandhi University, India. She is a Master of Business degree holder in Artificial Intelligence from Amrita University, India. Her distinguished career spanning 15 years of academic experience. She holds multifarious memberships from the prominent professional bodies specifically from IEEE and IAENGG. She has published around 4 articles. Her research interest areas are Artificial Intelligence, Data Science, and Machine Learning.