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IMPLEMENTATION OF BOAT SINKING ALERT SYSTEM

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Abstract: The boat sinking alert system is designed using IOT. It is mainly developed to save lives of people in critical situations. Despite of rapid growth in technology, people cannot survive his/her life immediately after a boat accident because of unavailability of emergency facilities in our country. Boat Sinking Alert System (BSAS), designed to monitor the structural condition of boats and provide early alerts in case of sinking or deformation.Sensors continuously collect data, which is processed in real-time by an onboard computer system using advanced algorithms to detect any deviations from the expected structural integrity. Upon detection of abnormal sinking or deformation patterns, the BSAS triggers alerts through various communication channels, including onboard displays, mobile applications, and remote monitoring systems. This system aims to alert the control room and to facilitate communication between control room and disaster management department in such havoc to avoid maximum loss. It comprises of MEMS sensor to detect unusual orientation, Water sensors to detect if there is any presence of water, GPS module for tracking the live location and four types of keys which have different functionalities of each.

Index Terms - ESP 32, GPS, Blynk Mobile GUI Application, Water Sensor, MEMS Sensor.

I. INTRODUCTION

Boat sinking alert system is critical components of maritime safety, offering early detection and notification of potential sinking incidents. This system typically incorporate water sensors strategically positioned within the vessel's hull to detect any ingress of water beyond safe levels. Upon detection, an integrated alarm system promptly alerts occupants with audible sirens, flashing lights, or notifications to connected devices.

And also it has feature monitoring capabilities, including real-time location tracking via GPS or satellite networks, enhancing the effectiveness of emergency responses. By providing early warnings, this system afford boat owners and crew valuable time to assess the situation and implement necessary measures to prevent further damage or sinking.

Additionally, the integration of sinking alert systems with other onboard systems ensures a coordinated and swift response in emergencies, ultimately enhancing the safety and security of maritime operations.

II. LITERATURE REVIEW

In a span of just 14 years from 2000 to 2014, more than 16,000 lives had been lost to ferry accidents around the world. While ferries and accidents associated with them are a pressing concern in many different developing countries. The captains of these vessels usually have little regard for much else besides profit and dangerously overburden their vehicles, which often leads to sinking and loss of hundreds of lives at a time. Other problems such as collisions with smaller vessels in the fog also occur. There were small individual work done on different aspects of the project like GPS tracking, water level sensing, etc. but all of these were not made into a complete system.

Individual papers were found related to PID control of underwater remotely controlled vehicles but this control was not tried or tested on ships for obstacle avoidance [1]. In this system the weight sensors for overweight detection may introduce inaccuracies due to variations in sensor calibration or environmental factors, potentially leading to false alarms or overlooked overweight conditions.

To overcome this drawback of this "GSM and GPS controlled autonomous boat with overweight detection and obstacle avoidance" another system is deigned with a conceptual innovation overload sensor that can be used to detect and reduce the overload problem of passenger ships. Such an innovation technology incorporates the elevator concept using the load sensor (HCC-High Capacity Compression).

But the HCC sensors might not provide precise measurements, leading to inaccuracies in detecting overload situations. External magnetic fields or electrical noise can interfere with HCC sensor readings, affecting their reliability. Calibration of HCC sensors may be required to ensure accurate readings, which can be time and consuming and costly [2].

The sensor will be installed at the entry point on the passenger ship and the minimum and maximum weights of passenger ships will be detected by the HCC sensor when passengers enter the ship. If the minimum of capacity is detected, the first alarm warning will be appeared by a green light at the system. The alarm sound will active when the HCC sensor detects the overload burden at the maximum capacity. The alarm sound will only can stop if the load burden is removed [2]

To overcome this problem we should use the modern technology to save lives and reduce accidents and injuries on the water. For this another system was implemented called "Crash detection system " .This system offers several features including a smart radar system, a crash detection system, and an application connected to the Coast Guard. The proposed system would help reduce or at least minimize boat accidents and save lives.

This crash detection system for boats utilizes various sensors to monitor the vessel's surroundings and potential collisions. Sensors like ultrasonics and infrared detectors scan for obstacles, while a water level sensor checks for water ingress, a possible sign of impact.

A central control unit analyzes the sensor data for sudden changes that could indicate a crash, such as rapid deceleration or tilting. If a crash is detected, the system triggers an emergency signal sent wirelessly and relays the boat's location via GPS, enabling emergency services to locate and assist those onboard [3] [4]. But This system primarily relies on ultrasonic and infrared sensors, which have a restricted detection range: This can be a disadvantage in open waters or when obstacles are farther away. To overcome these type of problems we designed a system called Boat Sinking Alert system.

III. PROPOSED SYSTEM

We propose a system which identifies and detects the sinking of boat. It checks if there is any presence of water and sends information to the substation if the water sensor detects the water. MEMS sensors is used to calculate the tilt of the boat. The tilt of the boat is fixed to a certain threshold value and if the tilt of the boat is above certain threshold value then our system will send notification along with the exact location of a boat to the substation regarding the drowning of the boat.

It is designed using ESP32 that is acquainted with sensors to detect sinking of boat immediately. when the accident happen the boat alert system detects immediately and finds the sinking of the boat. That will immediately inform that to the authorities. GPS system will be used to find the boat location during a sinking of a boat.

IV. SYSTEM DESIGN

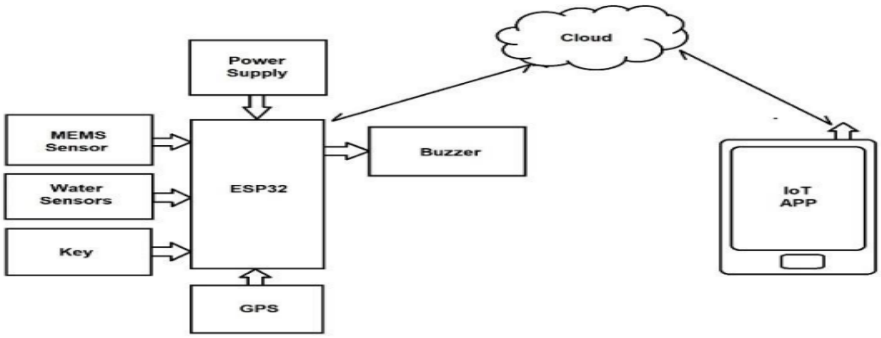

Figure 1. Proposed System Block Diagram.

The Block diagram of the proposed system consists of following hardware components detailed explanation is given below :

A. Power Supply :

The power supply block consists of a step-down transformer, a bridge rectifier, capacitor, voltage regulator and rechargeable battery. By using bridge rectifier, the power supply from the main source will be step down to lower voltage range and it is rectified to get the direct or DC current. This rectified direct current is filtered and regulated to the whole circuit operating range with a capacitor filter and voltage regulator IC. The current from the IC regulator is used to recharge the battery.

The power supply consists of a transformer, which will step down the input voltage 230 volts to the required operating voltage of 9 volts, thereby diodes will convert the AC current into DC and this process of conversion is called as rectification.

B. ESP32 Microcontroller :

ESP32 is a low-cost System on Chip (SoC) Microcontroller from Espressif Systems, the developers of the famous ESP8266 SoC. It is a successor to ESP8266 SoC and comes in both single.core and dual-core variations of the Tensilica's 32-bit Xtensa LX6 Microprocessor with integrated Wi-Fi and Bluetooth.

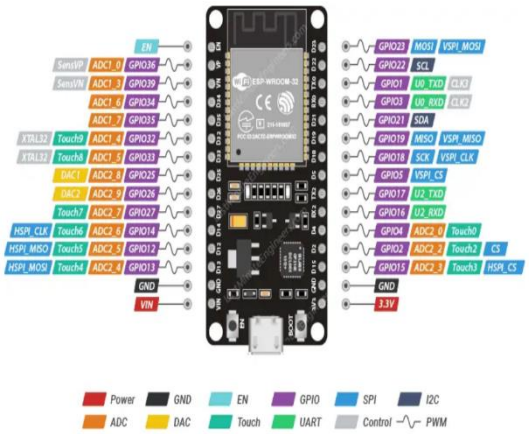

Figure 2. ESP32 Microcontroller

The ESP32 supports multiple programming environments. Some of the commonly used programming environments are Arduino IDE, Platform IO IDE (VS Code), LUA, MicroPython Espressif IDF (IoT Development Framework), JavaScript.

C. Water Level Sensor

The Marine Water Sensor detects the presence of high water in boat. Water sensors are installed in areas prone to leaks, such as near plumbing connections, through-hull fittings, or around the engine compartment. These sensors detect the presence of water due to leaks or ingress and trigger alarms or alerts to notify the boat owner or operator of potential issues..

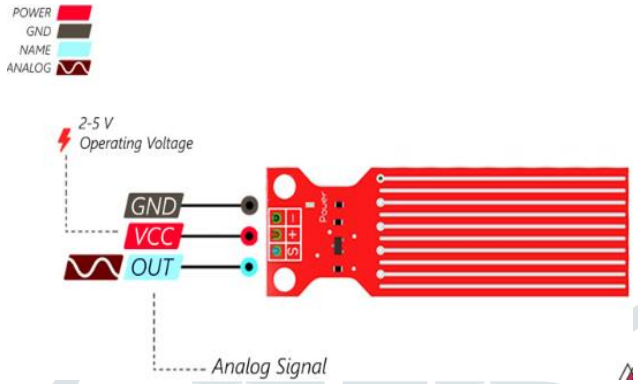

Figure 3. Water level Sensor

D. Buzzer :

When the boat or ship is in emergency or in overload conditions the information can be output via buzzer which produces sound based on the piezoelectric effect. Here the buzzer produces sound output or alert based on the information obtained from the sensors or control signals, and finally these are used in alarming circuits.

Figure 4. Buzzer

E. MEMS Sensor (ADXL345)

MEMS are low-cost, and high accuracy inertial sensors and these are used to serve an extensive range of industrial applications. This sensor uses a chip-based technology namely micro-electro-mechanical-system.

Whenever the tilt is applied to the MEMS sensor, then a balanced mass makes a difference within the electric potential. This can be measured like a change within capacitance

MEMS sensors are miniature devices used to measure physical quantities such as pressure, temperature, acceleration and magnetic fields. The ADXL345 can measure acceleration along three axes (X, Y, and Z) with high resolution and accuracy. It communicates with microcontrollers or other devices via digital interfaces such as I2C or SPI, making it easy to integrate into various electronic systems.

The ADXL345 is designed for low power operation, making it suitable for battery-powered applications such as wearable devices, motion-activated sensors, and portable electronics.

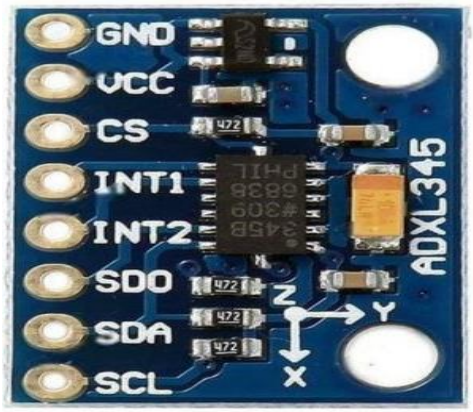

Figure 5. MEMS sensor

F. GPS Module

To sense locations with NEO-6M GPS Module that can track up to 22 satellites and identifies locations anywhere in the world. It may serve as a great launch pad for anyone looking to get into the world of GPS. GPS receivers actually work by figuring out how far they are from a number of satellites. They are pre-programmed to know where the GPS satellites are at any given time.

The satellites transmit information about their position and the current time in the form of radio signals towards the Earth. These signals identify the satellites and tell the receiver where they are located. GPS enables boat operators to track the movements of other vessels in the vicinity, helping to avoid collisions and maintain safe distances, especially in busy waterways or during adverse weather conditions.

Figure 6. Global Positioning System (GPS)

V. WORKING

We proposed a system which identifies and detects the sinking of boat. It checks if there is any presence of water and sends information to the substation if the water sensor detects the water. MEMS sensors is used to calculate the tilt of the boat. The tilt of the boat is fixed to a certain threshold value and if the tilt of the boat is above certain threshold value then our system will send notification along with the exact location of a boat to the substation regarding the drowning of the boat. All these can be done by GPS.

The system continuously monitors key parameters such as water level in bilge compartments, hull integrity, engine performance, battery voltage, fuel levels, and environmental conditions (e.g., temperature, humidity). Any deviations from normal operating conditions are promptly detected to alert the crew before they escalate into emergencies. It is designed using ESP32 that is acquainted with sensors to detect sinking of boat immediately. when the accident happen the boat alert system detects immediately and finds the sinking of the boat.

That will immediately inform that to the authorities. GPS system will be used to find the boat location during a sinking of a boat. Also there are four keys in this system in which each key functionality is different from one another.

- Key 1 represents the medical emergency
- Key 2 represents the need of food & water
- Key 3 represents power outrageous
- Key 4 represents Disaster or dangerous

The above represented keys are operated like pulled up by the captain of the ship himself to notify the control station if there is any need. And Buzzer alarms installed in boat substations can also be integrated with remote monitoring and control systems, allowing boat owners or operators to receive real-time alerts and notifications about critical events or system malfunctions, even when they are not on-board the vessel.

VI. ALGORITH

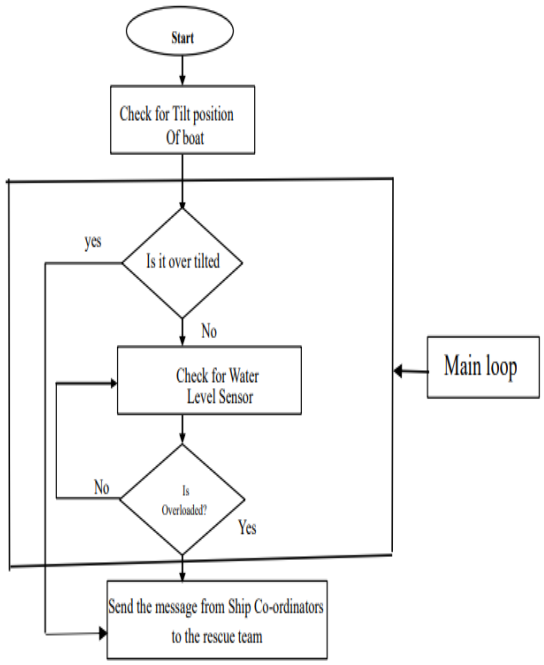

Figure 7. Algorithm of Boat sinking alert system

1. **System Initialization:** The system starts by initializing communication channels and configuring the sensor pins for operation
2. **Checks the Conditions:**

   Condition case – 1:

   It checks the tilting position of the Boat and Measures value of the tilt. If the Tilt position value is Greater than Threshold value then it gives the Alert message to rescue team along with location.

   Condition case -2:

   If the boat gets breaks then the water level sensor gets activated and sense the level of water present in the Boat. And gives the information to the rescue team along with location.
3. **Loop Continuation:** It checks the conditions continuously and measures the values of tilt position and level of the water.
4. **System Termination:** The system continues to operate in a loop until manually terminated or when specific conditions are met.

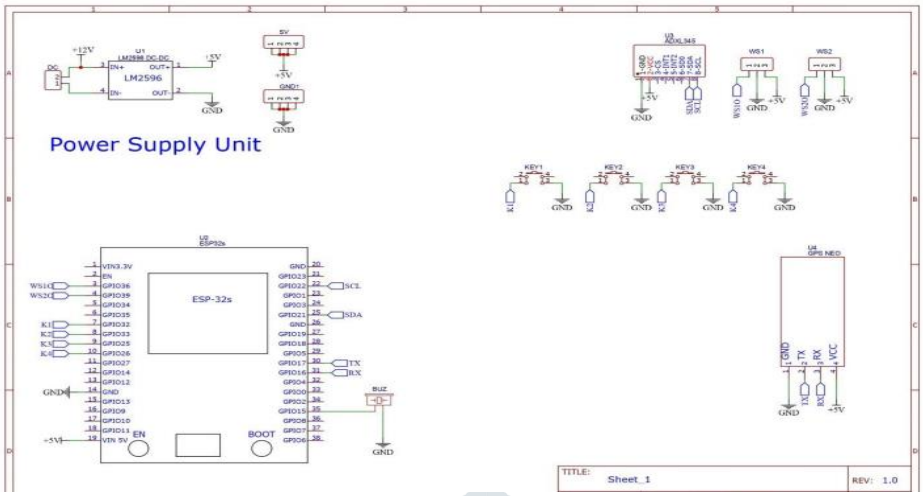

Figure 8. Schematic diagram of Bot sinking alert system

VII. ANALYSIS AND RESULT

The Boat sinking alert system after connection and dumping the code to ESP32 Microcontroller. The resultant circuit become real world project. The structure of the project id showed in below diagram.

Figure 9. Prototype of the proposed System.

The proposed system works on several operations with the main intention to prevent ships or boats from sinking into the water. So, here we are going to discuss about the test case result for the operations proposed in the system.

TEST CASE: 1

To make sure the system sends alerts at the time of disaster or danger:

- The words disaster and danger are used in many situations but when it comes to a boat or ship, the main danger is that tilting of boat due to heavy and uncontrollable waves. It can cause instability and imbalance.
- When the system detects the tilting of the ship, then the system sends alerts to the base station and gives a buzz to keep everyone inside the ship safe. The tilting of the ship is detected by using MEMS sensor that is Micro Electronics Mechanical System.
- The MEMS sensor used in this system is 8 pin ADXL345. The protocol used by MEMS sensor is I2C protocol which is also known as IIC – Inter Integrated Circuit protocol. MEMS sensors are composed of a suspended mass between a pair of capacitive plates.

- When tilt is applied to the sensor, the suspended mass creates a difference in electric potential. The difference is measured as a change in capacitance.
- When the system detects tilting, it gives alert to a mobile IOT application that is Blynk IOT through wi-fi.
- The system also sends the ships location based on latitude and longitude to the registered email. This helps in the rescue of the ship and people inside the ship.

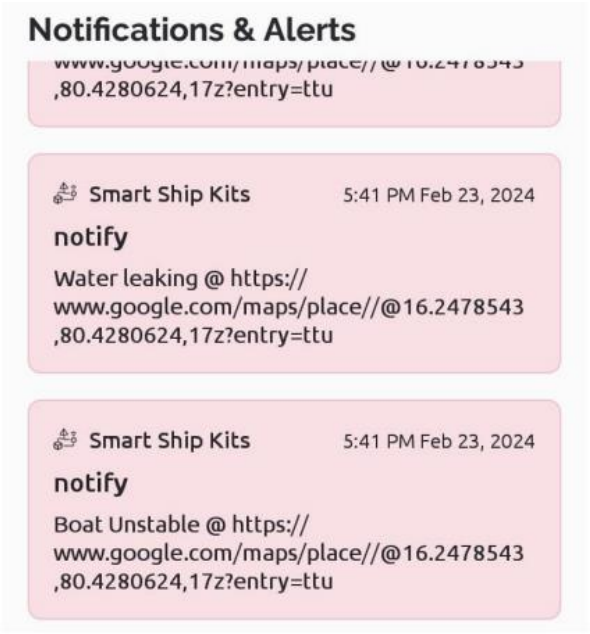

Figure 10. Blynk App output While Boat gets tilt

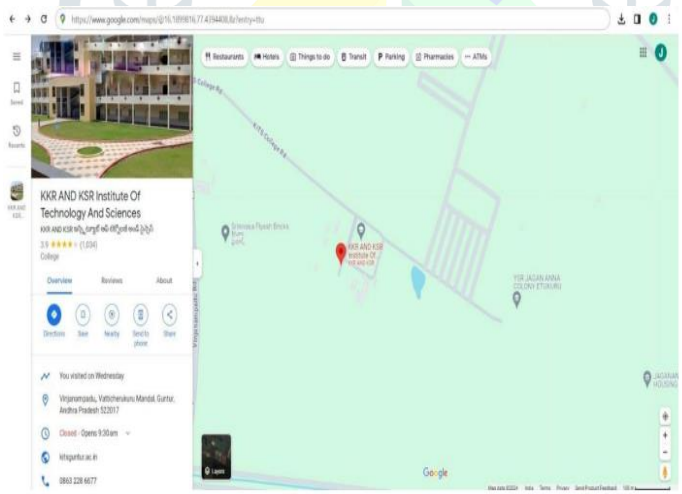

Figure 11. Location specified by Blynk app

TEST CASE: 2

To make sure the system sends alerts at the time of water leakage:

- The system also detects water leakage in the ship with the help of water sensors placed at different places of the ship.

- As soon as the water leaks into the ship the sensors placed in different places detects and send notification and alert to keep the ship safe.

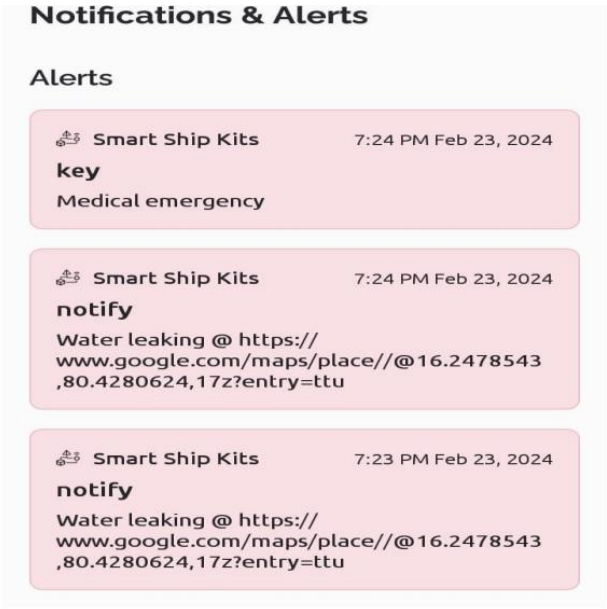

Figure 12. Alert message in Blynk App when Water Leakage occurs

- The sensors work by continuously monitoring the presence of water. They can detect even small amounts of water and trigger an alert system when water is detected. These alerts can be sent to the ship's crew through a centralized monitoring system or directly to their handheld devices.
- Once an alert is received, the crew can quickly investigate the source of the leak and take appropriate action to mitigate the problem. This can include activating pumps to remove the water, sealing off affected areas, or implementing temporary repairs until permanent solutions can be implemented.

TEST CASE: 3

To verify the working of keys placed for different emergencies of ship:

- Adding different types of emergency switches that connect with a base station can indeed enhance the safety and rescue operations for a ship. These switches can be part of an integrated emergency communication system that allows the crew to quickly alert the base station or rescue authorities in case of an emergency.
- When activated, these switches can send distress signals or emergency notifications to the base station, providing crucial information about the ship's location, situation, and the nature of the emergency.
- This helps the rescue team to respond promptly and efficiently. By having these emergency switches, ships can enhance their safety measures and improve the chances of a successful rescue operation if the need arises. Safety should always be a top priority at sea.

As shown in below figure represents the notifications ok keys when they pressed

Figure 13. Blynk App outputs for keys used in boat sinking alert system

VIII. CONCLUSION

The boat health monitoring and sinking alert system is a vital tool for ensuring maritime safety. By continuously monitoring various parameters such as water level, hull integrity, and engine performance, it provides real-time insights into the condition of the vessel. In the event of any anomaly or potential threat to the boat's safety, the system promptly alerts the crew, enabling them to take proactive measures to prevent disasters such as sinking.

With its ability to enhance operational efficiency and safety at sea, the implementation of such a system is essential for maritime industries and boat owners alike. To mitigate these risks, it's crucial to prioritize safety measures such as proper training, adherence to regulations, and the use of advanced technology like collision avoidance systems and boat health monitoring.

REFERENCES

[1] Shadman Sakib Arnob, Adiba Sumaiya Khan, Rashed Shelim, Mahmood Chowdhury, "GSM and GPS controlled autonomous boat with overweight detection and obstacle avoidance", Published in Indonesian Journal of Electrical Engineering and Computer Science, 2019..

[2] N. S. F. Abdul Rahman, H. Z. Rosli.: "An Innovation Approach for Improving Passenger Vessels Safety Level: Overload Problem." Published in International Journal of Business Tourism and Applied Sciences, Vol.2 No.2, 2014

[3] A. Al-Ramadhan, B. Al-Sahen, M. Ayesh, S. E. Esmaeili, The Design of A Boat Safety and Accident Prevention System, Department of Electrical and Computer Engineering American University of Kuwait Salmiya, Kuwait, 2017 9th IEEE-GCC Conference and Exhibition (GCCCE)

[4] Friedrich Samuel, R. Gomathi Bhavani, "GPS Based System for Detection and Control of Maritime Boundary Intruding Boats", IEEE 59th International Midwest Symposium on Circuits and Systems (MWSCAS), 16-19 October 2016

[5] C. Clark, and M. Morgan. "Capsize Alerting Apparatus and Method." U.S. Patent Application 11/991,675, filed December 3, 2009.

[6] L Kobylinski. "Capsizing scenarios and hazard identification." 8th International STAB Conference, Madrid 2003.

[7] R. Gatti, Aishwarya, Harika, R. B. Nandini and C. Gagana, "Boat Navigation and Safeguard of Passenger's Over Flood Disaster," 2018 3rd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), 2018