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REAL-TIME FISHING VESSEL MOTION MONITORING UNIT FOR FISHERMEN SAFETY

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Abstract - *Coastal Ocean weather is highly dynamic in nature due to the rapid change in the wind patterns from time to time. Mostly wind-generated waves are seen in the coastal region. Wind-generated waves in the shallow water can pile up suddenly which is a threat to coastal fishing activity. Coastal fishing activities take place in the coastal region by small motorized fishing vessels and local country-made FRP (Fibre Reinforced Plastic) boats. These local fishing vessel operations are unusual during high wind-wave conditions, resulting in overtopping and capsizing of fishing vessels. These capsizing events end with injuries and even lead to deaths in fisherman communities. A dedicated real-time fishing vessel motion monitoring unit has been designed to track the fishing vessel motion continuously through IMU sensor and gives the warning about vessels experiencing high wind waves and capsizing information with live location through GSM and GPS based technology to the shore-based base station or coast guard for recovery and quick rescue operations. In particular, we are also focusing to control the navigation by placing the geofence so that the fishermen are directed to a safe region.*

Key Words: GSM, GPS, IMU, Fishing boat, Capsizing, Geofence

1. INTRODUCTION

Fishing is one of the most dangerous vocations, and many of the occurrences have been ascribed to a lack of stability awareness and having little to no equipment on their boat to call for aid in an emergency. The coastline region is extremely exposed to short period waves with larger wave heights, hence small vessel fishing takes place there. One of the most important occurrences in the marine environment is the movement of wind across the sea's surface. This flow causes the development of wind-generated waves that can travel long distances, as well as surface waves, which are caused by induced surface stress and friction caused by high winds. The creation of a wave is the result of interactions between individual waves. Individual wave interactions lead to the production of complex irregular wave movements. When deep sea waves travel into shallow water, their properties shift from a long wavelength to a short wavelength, and from a low wave height to a greater wave height. These waves may be dangerous to anglers, and several boat capsizing incidents have been reported.

Every year, hundreds of fishermen perish at sea due to a lack of a system onboard that can convey distress signals. Large boats, such as container ships, employ vessel stability monitoring systems, which typically include an accelerometer, a gyroscope, and a magnetometer. However, these systems are designed for larger operators, making them prohibitively expensive for fishermen. A solution to this problem is to equip them with an affordable system that allows them to send distress warnings and track boat location while also sending a distress message to the rescue party with all relevant location details during an emergency.

2. MOTIVATION

Fishing is one of the most dangerous jobs in the world, with over 24,000 fatalities per year; it is believed that capsizing of fishing vessels accounts for more than half of all fatalities in some nations. Commercial fishing is a dangerous profession. Hundreds of fishermen are hurt every day, and more than 80 fishermen die while participating in fishing activities. Fishermen sometimes labour long hours in inclement weather, which raises the risk of accidents or injury. As the number and intensity of extreme weather events increases, and natural catastrophes become more often and catastrophic, climate change has exacerbated the dangerous circumstances in which most fishermen operate. Most of the fishermen in India came from a middle and poor financial background in which the family man who is the fisherman was the only bread maker of the family, if any unexpected incident takes place there will huge loss for the family members as well as the fisherman community. And there was much recent news's on the boat capsizing events in India mainly from South India in which people are losing their lives and getting injured so, it is important to have a safety system for monitoring the fishing vessel for the fisherman and their family's welfare.

3. LITERATURE SURVEY

The Design of a Boat Safety and Accident Prevention System, developed in Kuwait by A. Al-Ramadhan, B. Al-Sahen, M. Ayesh, and S. E. Esmaeili, includes a radar that acts as an obstacle detector placed in front of the boat, which will help sailors avoid an underwater obstacle, reducing collision and preventing boat accidents. Their technology is capable of triggering an SOS in addition to avoiding an undesired

impediment. In the event of an emergency, send a message to the coast guard with your GPS position. One of the most important features of this system is that if the obstacle sensor detects an obstacle,it will issue a warning to the sailor to change the boat's direction, and if the sailor does not change the direction within three warnings, the system will automatically change the boat's direction. This is excellent work on boat safety, but it is too expensive for Indian fisherman. For example, a radar and obstacle detector system built in Kuwait costs over 540 dollars, which is far too expensive for our fishermen. Furthermore, this system was designed for much bigger boats, not for Indian fishermen. As a result, we can state that our gadget is far less expensive for Indian fisherman.

Leigh McCue's article "Putting vessel motion research into the hands of operators" The Small Craft Motion Program (SCraMP) for the iPhone Operating System was published in 2011. (iOS). This software is designed to provide low-budget operators, particularly fishermen, with essential information about the condition of their fishing vessels. The accelerometer, gyroscope, location capabilities, and CPU of the iPhone are all used. This programme allows you to measure the motion of a ship. Despite the fact that the programme is available for free in Apple's app store, using it needs the purchase of an iPhone, which is fairly costly for an Indian fisherman. Measuring movements at many locations on the vessel at the same time would necessitate the use of multiple iPhones, as well as some effort to make the iPhone waterproof to prevent damage during operation, which would keep the cost quite high.

4. METHODOLOGY

4.1. IMU (MPU 9250)

The Inertial Measurement Unit (IMU) is a device that produces motion data in a time-series format. It's utilised in a variety of applications, including Human Activity Recognition, Tracking and Navigation, and many more. The MPU9250 9-DOF (Degree of Freedom) module is a Micro-Electro-Mechanical System (MEMS) that combines an accelerometer, a gyroscope, and a magnetometer into a tiny package for this project. As a result, the MPU-9250 is a 9-axis motion tracking device with a 3-axis gyroscope, 3-axis accelerometer, 3-axis magnetometer, and a Digital Motion Processor. The MPU9250 module may interface with a microcontroller either through a serial port or a parallel port. The SPI protocol is known as i2c. SPI is preferred for faster speeds, whereas I2C has fewer pins but operates at slower speeds.

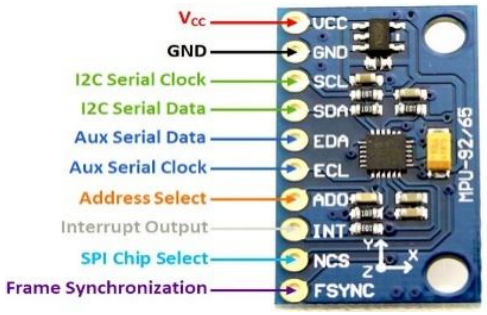

Fig. 1: IMU (MPU-9250)

4.2. NodeMCU [ESP8266]

The ESP8266 is a low-cost Wi-Fi microprocessor with a microcontroller and integrated TCP/IP networking software. Microcontrollers can connect to a Wi-Fi network and create primitive TCP/IP communications using Hayes-style instructions. TCP/IP stands for Transmission Control Protocol/Internet Protocol, and it is a set of communication protocols that are used to link network devices on the internet as well as in private computer networks. The ESP8285 is a similar chip with 1 MiB of built-in flash memory. This sends instructions to the peripheral devices attached to it, which act on them.

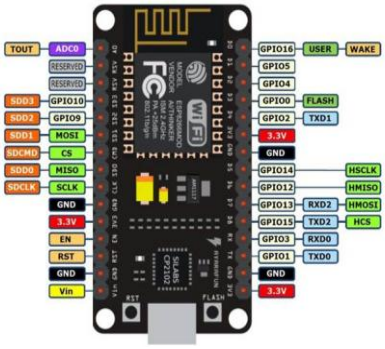

Fig. 2: NodeMCU (ESP8266)

4.3. GSM Module [SIM900A]

The SIM900A GSM Module is the tiniest and most affordable GPRS/GSM module on the market. The module communicates with a mobile sim card through GPRS/GSM technology. It can make and receive phone calls and SMS messages and operates on the 900 and 1800 MHz frequency bands. The ESP module processes the IMU data, and if distress occurs, it activates the GSM module, which sends the data in URL format to the SOS contact, along with a message that includes the position and an alarm call.

Fig. 3: GSM Module (SIM 900A)

4.4. GPS TRACKER(AKARI)

A GPS tracking unit, sometimes called a tracker, is a navigation device that utilises the Global Positioning System (GPS) to follow the movement and geographic position (latitudes and longitudes) of a vehicle, asset, person, or animal. GPS tracking systems transmit special satellite signals, which are analysed by a receiver. The Akari GPS Tracker is a tracker that uses the gsm/gprs network and the gps satellite positioning system to provide many security, location, monitoring, surveillance, emergency alerts, and tracking capabilities.

Fig. 4: GPS Tracker (AKARI)

5. WORKING MODEL

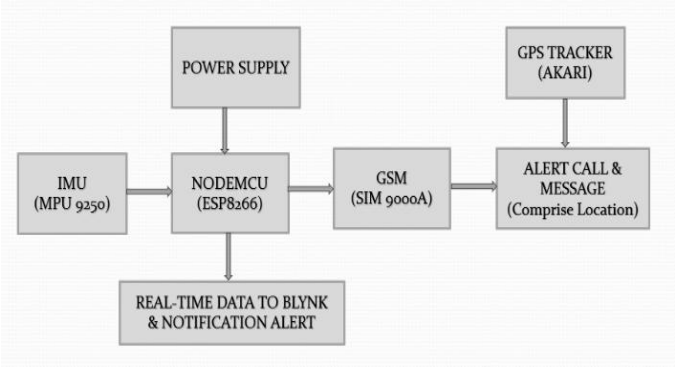

Fig. 5: BLOCK DIAGRAM

The IMU unit which is MPU 9250 is embedded with the features of three individual units which are the Accelerometer, Gyroscope, and Magnetometer. Here in this project we mainly utilize the Accelerometer and Gyroscope for the calculation of Roll, Pitch, and Yaw which are motions of the fishing vessel. That information is being evaluated by the NodeMCU microcontroller whether there is any boat capsizing or not and if there is any boat capsizing it will enable the GSM module (SIM 900A) which alerts the respective with a call and message, the message will contain a link which direct to the AKARI GPS maps page which shows the current location of the fishing vessel where the capsizing incident has occurred.

6. TESTING, DISTRESS IDENTIFICATION AND GEO-FENCE SETUP

The model is tested in the different water bodies which gives us the following conclusions

- Mostly the pitch value is varying among the three values when the system is installed in the respective arena as shown in fig 6.

- We created the capsizing event so that we can observe the variation in the pitch, yaw, and roll values at the time of distress, we observed there is a change in axis when there is a turnover of the fishing vessel and there is also a change in values of fishing vessel motion. When we compare the change in the values among the three motions pitch, yaw, and roll, there we observed there is a wide variation in the roll motion as shown in fig 7 So, we took roll motion as a primary value to determine the capsizing event of the fishing vessel.

Fig. 6: Change in Values of Pitch, Yaw, and Roll when the system is placed in a water body

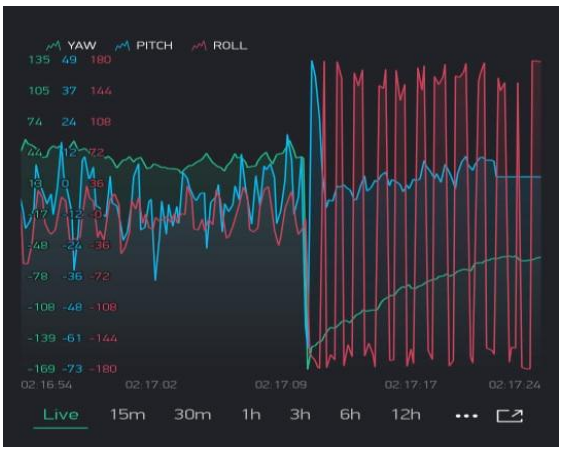

Fig. 7: Change in parameters when turnover is applied

- The main advantage of using the AKARI GPS Tracker is to create the geo-fences. The geofences can be created in any kind of shape circular, rectangular with the help of lines and also with an area of coverage with respect to our requirement as shown in fig 8.

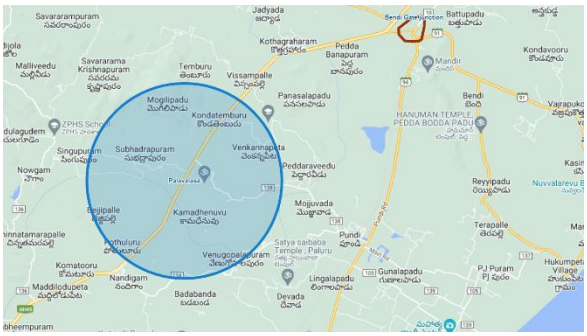

Fig. 8: Setup of Geo-fence

7. RESULTS

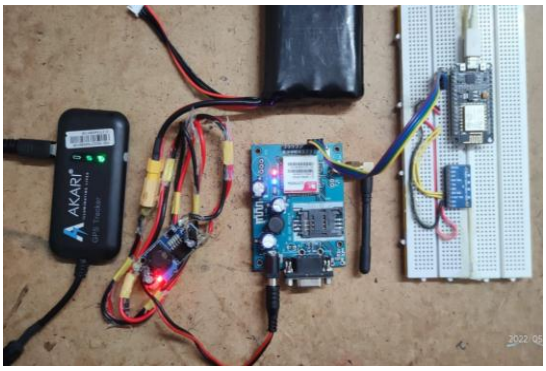

Fig. 9

Fig.9 shows the assembly of all the components i.e., the final prototype which is placed in a waterproof enclosure. In Blynk application, there is continuous monitoring of the data and real-time data collection as shown in fig 10.

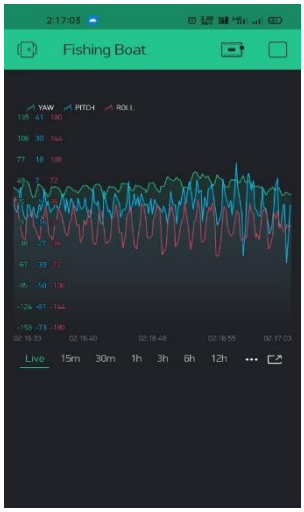

Fig. 10: Real-Time Data in Blynk

Here the capsized event is intimated in two ways one is through BLYNK and the other is through GSM.

1. In BLYNK, the intimation is given through the alert notification which is generated through the Blynk application and it also sends a notification if the device is disconnected from the server

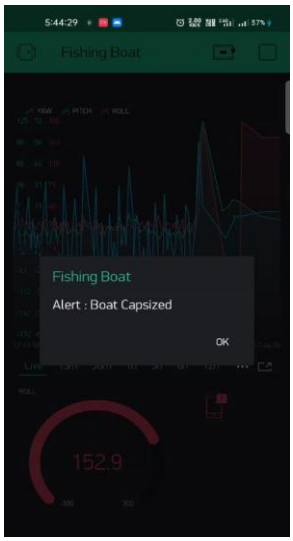

Fig. 11: Alert Notification through Blynk Application

2. In GSM, the intimation is given through the alert call and alert message which is embedded with web location link by clicking over the link it will direct to the akari website so that we can observe the live location the boat.

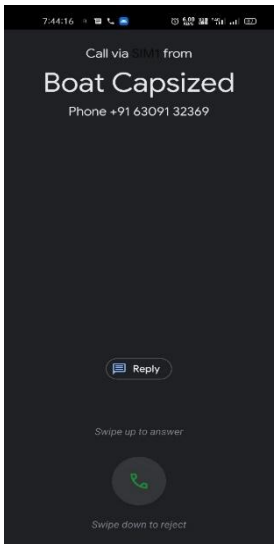

Fig. 12: Alert Call

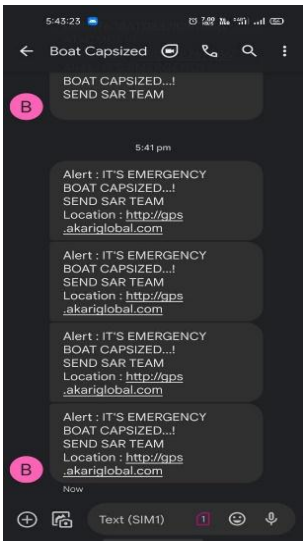

Fig. 13: Alert Message

AKARI GPS Tracker tracks the movement of the fishing vessel and there is the availability of live location and it also has a facility that stores the previous trace history as shown in fig 15 and also helps to create the geo-fences. The live location and tracking of the data can be accessed from a phone or laptop. We get the alert message when there is in and out of the fishing vessel in the respective geofence as shown in fig 14.

Fig. 14: Alert Notification for crossing geo-fence

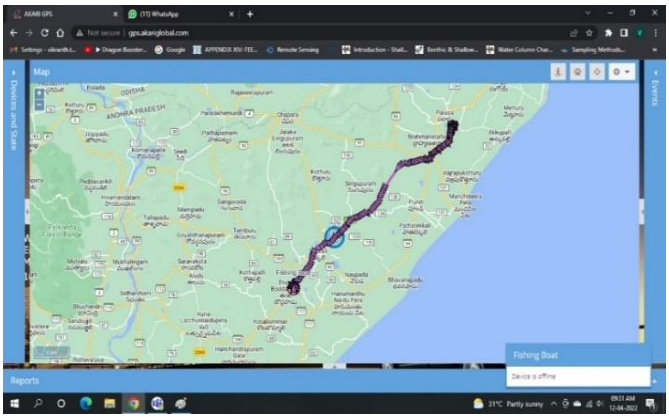

Fig. 15: Live Tracking of the System

8. FUTURE SCOPE

- The system with Satellite communication improves long-range fishing activities and works out of cellular coverage and will give a wide range of coverage.
- A further prediction of wave activity with two-way voice communication which shares the voice message from the shore to the vessel and vessel to shore makes faster recuse of fisherman if any incident happens.
- This will help in introducing the latest technologies to the fishers and make safer coastal fishing activities for the local fisherman communities and improvement in surveillance.
- Villages in India called Lanka villages which are completely surrounded by water have only the water transportation for even children to go to school, so in this scenario, the vessel motion monitoring unit would play a vital role.

9. CONCLUSION

Local fishermen can afford to have the device installed in their boats. Fishermen are the most susceptible during a crisis since they have absolutely no communication technology onboard that can bring them aid on their location during an emergency. The suggested solution intends to protect fishermen's safety by employing GPS and GSM technologies in conjunction with the Internet of Things to keep a constant eye on the fishing vessel. According to our evaluation, our system identifies location with high precision and provides data in a matter of seconds, so in the event of a crisis, it will be able to rapidly send a distress signal to the search and rescue team with their position. The suggested system would allow the turnover to be automatically detected, and it will be able to connect with the coast guard or SAR team in the event of an emergency. As a result, the proposed system will help save the lives of many fishermen in India.

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