IMD Signaling-Based Automated Safety Aid System for Fishermen

R. Avudaiammal, K. Jasmine Mystica, K. P. Raveendran, and Renjith George

Abstract Fishing industry is one of the most dangerous industries to work. Though fishing is a dangerous profession, many fishermen staunchly defend their independence. Indian Meteorological Department (IMD) periodically sends information regarding the weather conditions to ports through signals, ranging from 1 to 11. When the weather conditions are not normal, the flags will be raised by the port authorities to indicate various signal levels to alert the fishermen and public. Most of the fishermen ignore these signaling flags and take life risk to do fishing. It leads to motivation of the project "IMD Signaling-Based Automated Safety Aid System for Fishermen." The main objective of this work is to ensure safety for fishermen by monitoring the warning flags issued by IMD. The warning flags are monitored by the Raspberry Pi which acts as the decision maker in the proposed system to take the necessary actions like sending warning notifications and locking of boat's motor. The proposed system works in three modes, namely lock mode, notification mode, and rescue mode. If the warning flags are from signal 3 to signal 12 and if the ship is in the port, then the motor of the ship will be locked. If the warning flag is signal 1 or signal 2, the motor will be allowed to start and automatically a notification of the weather conditions will be sent to the registered fishermen using the cloud server with protocols like HTTP, MQTT, WebSocket, and SMTP.

Keywords Raspberry Pi · Color sensor · Proximity sensor · Cloud server

1 Introduction

One of the most dangerous industries to work is the fishing industry. Though fishing is a dangerous profession, many fishermen staunchly defend their independence. The main reasons behind the disasters occurring in fishing are poor emergency facilities, bad vessel maintenance, improper safety equipment, lack of awareness, and ignoring

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stability issues. Indian Meteorological Department (IMD) is a part of the Ministry of Earth Sciences of the Government of India. It collaborated with the Indian Space Research Organization and uses the IRS series and the Indian National Satellite System (INSAT) for weather monitoring of the Indian subcontinent by maintaining its own satellite system. IMD observes many ports across India. In 1864, Kolkata suffered from back to back storms and the government agreed to establish a cyclone alert system. The next year, a storm warning system was set up in Kolkata. India uses a signaling system ranging from Signal 1 to Signal 11, which is raised at the ports to alert vessels of a probable cyclonic storm. The IMD periodically delivers data to ports generally four moments a day and once in every three hours if there is a cyclone [1, 2].

Signal 1: There is a low-pressure zone developed far away in the sea. The expected wind speed is 33 knots (about 60 kmph).

Signal 2: There is a depression formed far in the sea, and wind speeds may reach between 34 and 47 knots (60–90 kmph).

Signal 3: There is a depression formed, and it can affect the port. Surface wind speed will be in the range of 22 knots to 27 knots (40–50 kmph).

Signal 4: There is a deep depression developed in the sea, which may affect the port later with wind speeds in the range of 28 knots to 33 knots (50–60 kmph).

Signal 5: There is a cyclonic storm which will cross the coast with the port to the left. Surface wind speed can be in the range of 34 knots to 47 knots (about 60–80 kmph).

Signal 6: Similar to Signal 5, but the cyclonic storm will cross the coast with the port to its right.

Signal 7: This means that the cyclone will cross very close to the port. Signal 5, Signal 6, and Signal 7 show and warn a potential risk to the port.

Signal 8: This is a "very danger" acute cyclone warning, and the cyclone will make landfall with port to its left. Wind speed will range from 48 to 63 knots (90–120 kmph).

Signal 9: Similar to Signal 8, but the cyclone will make landfall with port to its right.

Signal 10: This is a "very danger" warning, with wind speed 64–119 knots (120–220 kmph), and we call it a super-cyclone if wind speed is above 120 knots.

Signal 11: This means that there is no communication intact between the port and the warning office.

At present, the systems used for fishermen safety include the portable life protection system, border alert system, and the marine wireless networks for communication. The work presented in [3] focused on helping the fishermen by providing them with the details of their location in the sea with the help of GPS. The work also focused on establishing communication between the fishermen boat and the nearby ships. The work [4] focused on ensuring safety of fishermen by alerting them on the border area, thus preventing them from crossing the border of the country. The author made use of GPS and GSM techniques for border monitoring. The work [5] helped in providing a solution to the hardships faced by fishermen due to lack of communication. The author made use of GPS for real-time location and Zigbee for

wireless communication. It is inferred from the literature that the existing systems to safeguard the fishermen make use of GSM technology and GPS technology. Moreover, there is no strict mechanism to restrict the movement of boats under critical climatic conditions.

The proposed **IMD Signaling-Based Automated Safety Aid System for Fishermen** focuses on replacing the GSM technology and Zigbee, with IOT and cloud services for saving the fishermen and by monitoring the flag raised by the Indian Meteorological Department (IMD) to take the necessary safety measures like locking the boat motor and sending notifications to authorities.

The outline of the paper is as follows: Sect. 2 gives the objective and explains the methodology of the proposed **IMD Signaling-Based Automated Safety Aid System for Fishermen**. Section 3 describes working prototype model with screenshots, and finally, Sect. 4 concludes the proposed work and future scope related to it.

2 IMD Signaling-Based Automated Safety Aid System

Indian Meteorological Department (IMD) periodically sends information to ports through signals ranging from 1 to 11 ports will raise warning flags according to signal levels. Most of the fishermen ignore those signaling flags and take life risk to do fishing. It leads to motivation of the work IMD Signaling-Based Automated Safety Aid for Fishermen. The objectives of our proposed **IMD Signaling-Based Automated Safety Aid System for Fishermen** are:

- To ensure safety for fishermen by monitoring the flag raised by the Indian Meteorological Department (IMD) and allow to access data to take the necessary safety measures like locking the boat motor and sending notifications to authorities.
- To use the cloud platform for establishing communication between the transmitter and receiver.

The proposed **"IMD Signaling-Based Automated Safety Aid System for Fishermen"** consists of transmitter module and receiver module. The transmitter module monitors flags and the proximity [6] and stores the information in the cloud. The receiver module monitors the stored information in the cloud and takes the necessary actions like locking the motor [7] and sending notifications. These modules are interfaced using a cloud server. There are several cloud providers who provide a pay-as-you-use model where customers pay for the specific resources used. In our system, we have used Heroku [8] as our cloud platform. Heroku is a service based on a managed container system with integrated data services, and it is a powerful ecosystem, for deploying and running modern apps. Nginx a free Web server of the platform is used. The information from the Raspberry Pi using the onboard Wi-Fi is stored in the Web server. GitLab is used to access the Heroku platform. The program in GitLab is written using Node.js. The cloud server is used to store the information from the transmitter module and to establish communication between the transmitter module and receiver module. The data is transferred using the protocols like HTTP

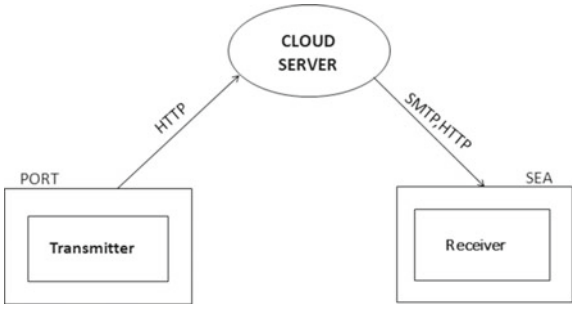

Fig. 1 Modules of the Proposed System

[9], MQTT [10], WebSocket [11], and SMTP [12] between the modules and the cloud (Fig. 1).

The transmitter section as shown in Fig. 2 comprises a color sensor, proximity sensor, and a Raspberry Pi. The Raspberry Pi functions as a decision maker. The color sensor is used to identify the color of the warning flag based on the signal level received from IMD ranging from 1 to 12. A proximity sensor is used to identify the location of the ship, whether the ship is at port or in the sea based on the proximity range. The information such as warning signal level and proximity range which are gathered from these color sensors and proximity sensors is analyzed by the Raspberry Pi to find out the modes of operation, and then, the identified mode is sent to the cloud server. When the weather conditions are not normal, the flags will indicate high signal levels. In our system, we represent the bad weather conditions with a red flag and the intermediate conditions with a green flag. The monitoring system monitors the warning flags, and it takes the necessary actions. If the warning flag is red in color, the motor of the ship will be locked. If the warning flag is green in color, the motor will be allowed to start and automatically a notification of the weather conditions will be sent to the fishermen using the cloud server [13, 14].

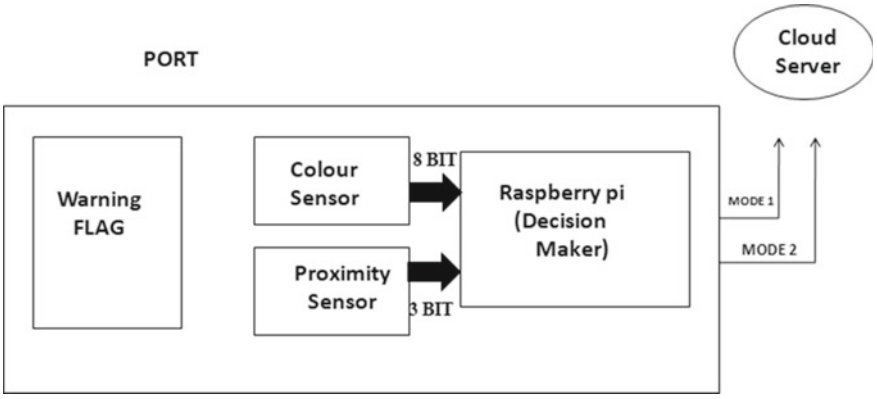

Fig. 2 Transmitter module

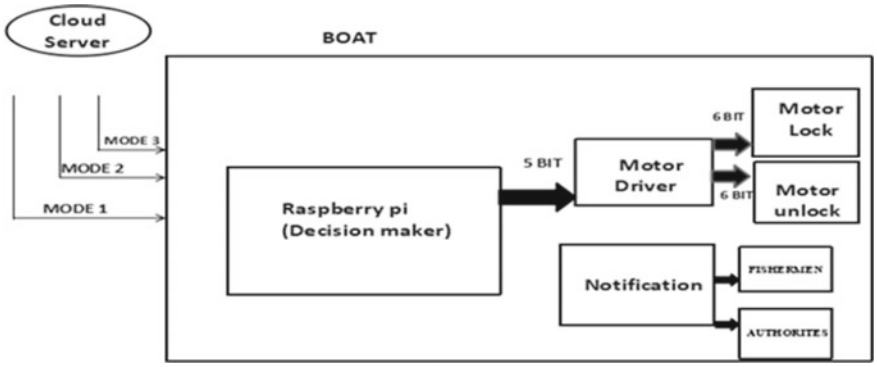

Fig. 3 Receiver module

Receiver section as shown in Fig. 3 includes a Raspberry Pi, a DC motor, and a motor driver [14, 14]. The Raspberry Pi with a LTE interface at the receiver is used to monitor the data in the cloud at regular time intervals and takes the necessary actions according to the respective modes. The proposed system works in three modes, namely lock mode, notification mode, and rescue mode.

1. **Lock mode**: If the proximity sensor indicates that the ship is at the port and if the warning flag level is above signal level 3 (red in color), then the proposed system automatically locks the engine. Thus, it aids fishermen to save their lives even if they ignore the warning flags.
2. **Notification mode**: If the proximity sensor indicates that the ship is at the port and if the warning flag lies between signal levels 1 and 2 (green in color), the proposed system sends a notification "This is a gentle warning that the weather conditions are risky for fishing" to the fishermen and the motor is allowed to start. The notification is sent via the cloud server.
3. **Rescue mode**: If the proximity sensor indicates that the ship is in the sea and if the warning flag level is above signal level 3 (red in color), the system sends a notification "The fishermen are stranded in the sea due to bad weather conditions" to the Fishermen Rescue Team and other authorities.

Figure 4 shows the flow diagram of the proposed system.

3 Results and Discussion

In this section, the operating modes of the proposed system such as lock mode, notification mode, and rescue mode are explained with screenshots. Figure 5 shows the output sent to the cloud by the transmitter module which includes the color sensed by the color sensor, and Fig. 6 shows the output received from the cloud by the receiver module.

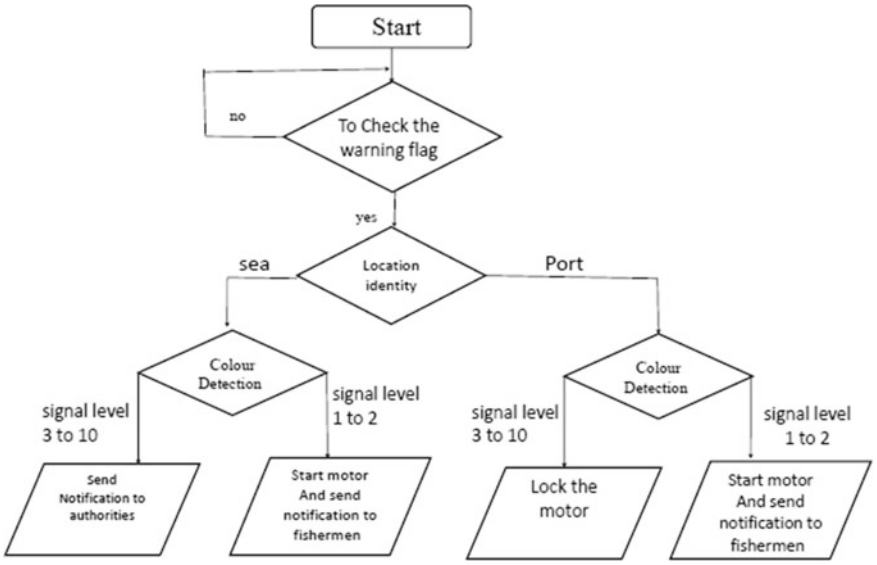

Fig. 4 Flow diagram

Fig. 5 Transmitter module output

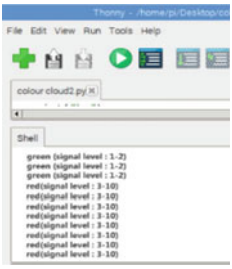

Fig. 6 Receiver module output

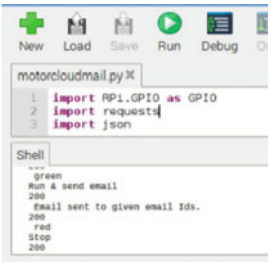

Figure 7 shows warning notification message sent by the fishermen safety system created in our work to give a gentle warning that the weather conditions are risky for fishing to the fishermen. When the proximity sensor indicates that the ship is at the port and if the warning flag lies between signal levels 1 and 2 (green in color), the

Fig. 7 Warning notification

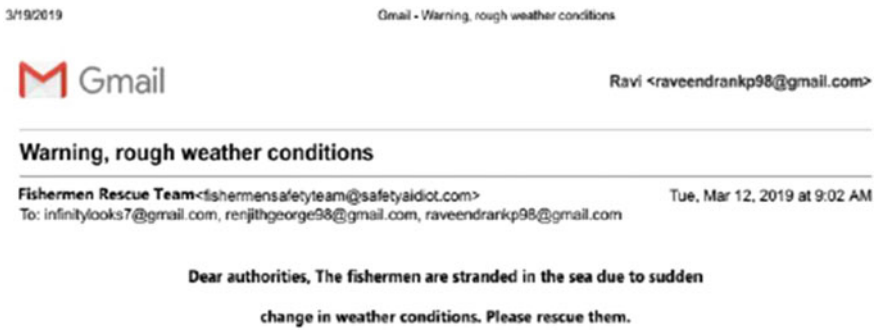

Fig. 8 Rescue notification

proposed system sends this notification message and allows the motor to start. The notification is sent via the cloud server.

Figure 8 shows rescue notification message sent by the fishermen to the Fishermen Rescue Team and other authorities stating "The fishermen are stranded in the sea due to bad weather conditions." If the proximity sensor indicates that the ship is in the sea and if the warning flag level is above signal level 3 (red in color), the system sends this notification message.

The proposed IMD Signaling-Based Automated Safety Aid System for Fishermen is shown in Fig. 9.

4 Conclusion

Fishermen safety is becoming a very big concern in our day-to-day life. The proposed work is attempted to save lives of many fishermen who will not adhere to the IMD's protocol of entering the sea and alert message to save fishermen's vessels in the port

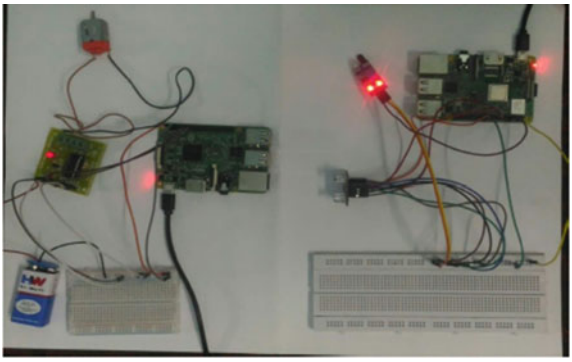

Fig. 9 Signaling system hardware

automatically according to the warning signal from Indian Meteorological Department (IMD). The proposed system "IMD Signaling-Based Automated Safety Aid System for Fishermen" chooses cloud technology to transmit and receive data which overcomes the existing problem. It also takes the necessary safety measures like locking the boat motor and sending notifications to authorities. In this work, the proximity sensor is used to monitor the distance. The proposed system overcomes limited range and connectivity problem of existing GSM and GPS-based methodology by making use of the cloud platform to establish communication between the transmitter and receiver and to access data from anywhere and anytime. The proposed system can be further enhanced by deploying multiple wireless sensor nodes having GPS modules to monitor the location of the boat and warn them of the anticipated weather condition.

References

1. https://www.thehindu.com/news/national/Cyclone-warning-signals-What-they mean/article16797019.ece
2. https://mausam.imd.gov.in/
3. Senthilkumar A (2013) Portable life protection system for fishermen using global positioning system. Int J Emerg Technol Adv Eng (2013)
4. Ranjith S (2017) Automatic border alert system for fishermen using GPS and GSM techniques. Indo J Electr Eng Comput Sci
5. Rajaparthiban M (2013) Multi-purpose marine wireless networks for fishermen aid and other applications. Int J Eng Res Technol (2013)
6. Kim YS (2014) Single chip dual plate capacitive proximity sensor with high noise immunity. IEEE Sens J 14(2)
7. Bubnov AV, Digital automatic control system of phase-lock motor drive. IEEE dynamics of systems, mechanisms and machines (Dynamics) (Omsk, Russia)
8. https://www.heroku.com/what
9. https://tools.ietf.org/html/rfc2616
10. https://tools.ietf.org/html/draft-sengul-ace-mqtt-tls-profile-00
11. https://tools.ietf.org/html/rfc6455
12. https://tools.ietf.org/html/rfc5321

13. Bellini P (2015) A knowledge base driven solution for smart cloud management. In: IEEE 8th international conference on cloud computing
14. Birgit S-W (2011) Cloud user roles establishing standards for describing core tasks of cloud creators, providers, and consumers. In: IEEE 4th international conference on cloud computing
15. Singh B (2014) A unity power factor NI-BIBRED converter fed brushless DC motor drive. In: IEEE conference
16. Lam Z-Y (2012) The design of DC motor driver for solar tracking applications. In: IEEE-ICSE2012 proceedings, Kuala Lumpur Malaysia