ENHANCING MARITIME SAFETY USING UNDERWATER COMMUNICATION AND IOT

Mohammed Younus K, Sivaselvaraj M, Selvakumar M, Sivanesh K, Tamilselvan S
E-Mail Id: sivaselvarajmk@gmail.com; selvasivamuthusamy@gmail.com; sivaneshksamy@gmail.com; tamilselvan66709@gmail.com
Department of Electronics and Communication Engineering, V.S.B. Engineering College, Tamilnadu, India

Abstract- This project proposes an innovative approach utilizing underwater data transfer to enhance the safety and well-being of fishermen navigating through challenging marine environments. By testing various types of agents to precisely alter experimental water coefficients, the project aims to transmit real-time information about fishermen's organic conditions and interactions to a tracking station. This is achieved through separate transmitter and receiver modules deployed in the water. The fluctuating atmospheric conditions of the ocean pose significant challenges for marine navigators, often leading to health complications such as uncontrollable heart rate fluctuations, particularly during deep dives. To address these challenges, the proposed system integrates GPS coordinates, air pressure sensors, and air humidity sensors to monitor fishermen's health status while navigating. The system facilitates two-way communication between the ground station and sea navigators, enabling prompt response and assistance in case of emergencies. By leveraging this technology, the project aims to mitigate risks and potentially save the lives of numerous fishermen navigating hazardous waters.
Keywords: Underwater data communication, fishermen safety, boat to boat communication, air pressure sensor, air humidity sensor, GPS.

1. INTRODUCTION

Recently, there has been a growing presence of interconnected physical objects, giving rise to the Internet of Things (IoT) concept. The IoT has significantly transformed various aspects of our lives, including healthcare, energy management, industrial processes, agriculture, livestock, infrastructure, and technology. This interconnected network of devices has the potential to link objects across the globe, enhancing our ability to interact with our surrounding environment for a more enriched living experience [1]. The IoT has primarily focused on and undergone extensive research in terrestrial and urban network environments. This substantial groundwork has laid a robust foundation for the rapid growth of industrial IoT, which is progressing remarkably as of the present moment [2]. Nonetheless, 72% of the Earth's total surface area, which spans 509 million square kilometers, is occupied by water. Scientists grew interested in underwater exploration, which has driven technological advancements toward creating a "smart ocean" or the Internet of Underwater Things (IoUT). This concept extends the IoT designed explicitly for underwater environments [3].

The Internet of Things (IoT) has transformed how we engage with the physical world, impacting various sectors like agriculture, healthcare, transportation, and logistics. The fishing industry stands to benefit significantly from IoT solutions due to its importance in providing livelihoods globally. Despite its significance, fishing is inherently risky, with fishermen facing challenges like unpredictable weather, equipment malfunctions, and accidents at sea. Therefore, a reliable communication system is vital to track fishermen and offer timely assistance during emergencies [4]. This paper proposes an IoT-based fisherman tracking and communication system utilizing wire water communications. The system employs underwater sensors to gather data such as water temperature, pressure, and location, transmitting it via wire water communications technology to a central server [5]. This server then analyzes the data and disseminates real-time information to fishermen and stakeholders like fisheries managers and rescue teams. This approach enhances safety and efficiency in the fishing industry while leveraging IoT advancements for improved monitoring and response capabilities [6].

The fishing industry serves as a cornerstone for countless livelihoods globally, yet it is fraught with perilous conditions that jeopardize the safety of fishermen at sea. In response to these challenges, there is a pressing need for innovative solutions to enhance fisherman safety [7]. This paper proposes a pioneering approach leveraging underwater networks with IoT communication tailored specifically for fishermen safety, utilizing sea channels for communication [8]. Integrating state-of-the-art technologies including GPS, IoT, air pressure sensors, air humidity sensors, and LCD displays, this system aims to redefine safety protocols for fishermen navigating the open waters. The incorporation of GPS facilitates precise vessel tracking, enabling real-time monitoring of fishing fleets. IoT technology empowers the collection and transmission of critical data pertaining to environmental conditions and vessel status, enhancing situational awareness for both fishermen and rescue teams [9]. Furthermore, air pressure and humidity sensors furnish invaluable insights into atmospheric dynamics, pivotal for forecasting weather patterns and preempting potential hazards. A dedicated water communication channel transmitter and receiver ensure seamless communication between fishing vessels and onshore facilities, even in the face of adverse

maritime conditions. By harnessing these cutting-edge technologies, this integrated solution endeavors to mitigate risks, streamline response efforts, and ultimately safeguard the lives of fishermen navigating the unpredictable seas [10].

2. RELATED WORK

This paper introduces a GPS-based system designed to detect and manage maritime boundary intrusions, addressing a persistent issue arising from the constraints of maritime boundary conditions and the limited literacy among impoverished fishermen who rely on hazardous waters for their livelihoods. [12] Each year, thousands of lives are lost to natural disasters. Fishermen, particularly vulnerable during events like cyclones, lack adequate communication equipment onboard to signal their location in emergency situations. The proposed system seeks to safeguard fishermen by utilizing GPS and GSM technology to enhance their safety and improve communication capabilities. [13] The performance evaluation demonstrates the effectiveness and suitability of the proposed system, showcasing its potential and applicability. While the performance analysis focused on Bangladesh, the system exhibits capabilities that can be deployed in marine fisheries across developing countries. It has been observed that the system can successfully forward messages to 98% of users when at least 50% of boats are at sea. Furthermore, even in low-density network scenarios, the system is capable of reaching over 90% of users, attributed to the inclusion of a missing message retrieval procedure in the broadcasting protocol. These findings underscore the system's reliability and effectiveness in enhancing communication and safety measures for fishermen operating in challenging maritime environments [14].Yearly, numerous lives are claimed by natural disasters. Fishermen are particularly vulnerable during such events, like cyclones, as they often lack communication equipment onboard to signal their location during emergencies. The proposed system seeks to safeguard fishermen by leveraging GPS and GSM technology, thereby enhancing their safety and enabling effective communication in critical situations [15]. The assessment of system performance underscores its potential and suitability for deployment in marine fisheries, particularly in developing countries. Although the evaluation was conducted specifically for Bangladesh, the system exhibits promising capabilities that can benefit similar environments worldwide. Notably, the system demonstrates the ability to transmit messages to 98% of users when at least 50% of boats are at sea. Moreover, even in low-density network scenarios, the system achieves communication with over 90% of users, facilitated by the implementation of a missing message retrieval procedure within the broadcasting protocol [16]. These findings highlight the system's effectiveness in enhancing communication reliability and coverage for fishermen, contributing to their safety and well-being in challenging maritime conditions. [17]. The proposed system focuses on enhancing fishermen safety through a trizonal implementation strategy, aimed at preventing them from inadvertently crossing the International Maritime boundary at sea. Additionally, the system facilitates the identification of boats categorized into safe, intermediate, and danger zones from a centralized location. This centralized control enables the control room to monitor and manage all boats within a specified region, thereby improving oversight and safety measures for fishermen operating in maritime areas. [18]. The paper introduces a GPS-based system designed to detect and control intrusions of maritime boundary by boats, addressing a persistent issue arising from the constraints of maritime boundary conditions and the limited literacy among impoverished fishermen who rely on hazardous waters for their livelihoods. A dynamic system is proposed, well-suited for both communication and localization of fishing boats, aiming to enhance safety measures and operational efficiency in maritime environments [19].

3. EXISTING SYATEM

The system is originally designed as a training platform for radio frequency (RF) signals, has undergone significant enhancements to incorporate a sea channel for communication, GPS integration, and IoT integration. This modification aims to augment the training capabilities of the system, providing users with a more immersive and comprehensive understanding of RF signal transmission and reception in diverse environments [20]. With these updates, users can now engage in practical training exercises for RF signal transmission and reception in real-world scenarios, accounting for the intricacies and challenges posed by different communication channels. The inclusion of GPS integration facilitates precise location tracking, enabling users to simulate and analyze RF signal behavior across varying geographical contexts. Additionally, IoT integration empowers users to connect and interact with a multitude of devices and sensors, further enriching the training experience. Overall, these enhancements elevate the system's utility by offering a holistic approach to RF signal training, bridging the gap between theoretical knowledge and practical application in complex communication environments.

4. PROPOSED SYSTEM

The proposed system for underwater communication leveraging IoT technology is designed to elevate fisherman safety through real-time communication and monitoring functionalities. Comprising underwater communication devices, IoT sensors, and a central control unit, this system is engineered to gather and transmit crucial data including fisherman location, weather conditions, and potential hazards. The central control unit assumes responsibility for data processing, issuing alerts or notifications to both fishermen and relevant authorities as needed. IoT communication ensures uninterrupted connectivity between the underwater devices and the central

control unit, even in the most challenging underwater environments. Moreover, the system integrates a sea channel for communication, facilitating information exchange between different vessels and the central control unit. This feature proves invaluable in coordinating rescue operations and disseminating vital safety-related information among fishermen. In summary, the proposed system for underwater communication, bolstered by IoT technology, stands poised to significantly enhance fisherman safety by furnishing real-time communication and monitoring capabilities. Through seamless integration of IoT devices, underwater communication equipment, and centralized control, the system promises to enhance the safety and operational efficiency of fishing endeavors.

5. MATERIALS AND METHODS

5.1 Air Pressure Sensor

The air pressure sensor integrated into the underwater network with IoT communication for fisherman safety serves as a critical component for monitoring atmospheric conditions in the vicinity of fishing vessels. the sensor detects changes in air pressure, providing valuable insights into weather patterns and atmospheric disturbances that may impact fishing operations.

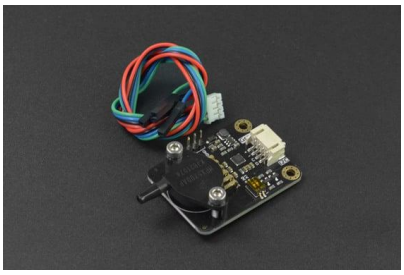

Fig. 5.1 Air Pressure Sensor

5.2 Air Humidity Sensor

The air humidity sensor deployed within the underwater network with IoT communication for fisherman safety plays a crucial role in monitoring humidity levels in the surrounding atmosphere. Positioned strategically within the network, this sensor continuously measures air humidity levels, providing essential data to the central control unit via IoT communication.

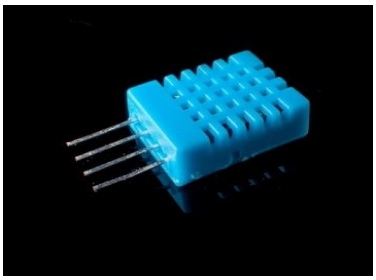

Fig. 5.2 Air humidity Sensor

5.3 GPS

The GPS (Global Positioning System) device integrated into the underwater network with IoT communication for fisherman safety serves as a critical component for accurately tracking the location of fishing vessels. Positioned within the network, the GPS device continuously receives signals from satellites to determine the precise geographic coordinates of the vessel's location. Through IoT communication, this data is transmitted to the central control unit in real-time.

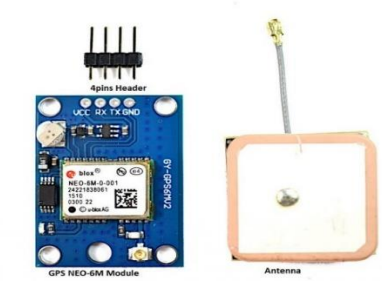

Fig. 5.3 GPS

5.4 LCD

The LCD (Liquid Crystal Display) screen incorporated into the underwater network with IoT communication for fisherman safety serves as a crucial interface for displaying essential information to fishermen and authorities. Positioned within the network, the LCD screen receives data from the central control unit via IoT communication

and presents it in a user-friendly format. This information may include real-time updates on weather conditions, vessel location, safety alerts, and navigational instructions.

Fig. 5.4 LCD

5.5 Water Communication Channel Transmitter

The water communication channel transmitter, an integral component of the underwater network with IoT communication for fisherman safety, plays a pivotal role in facilitating seamless communication between underwater devices and the central control unit. Strategically positioned within the network, the transmitter utilizes specialized technology to transmit data signals through the water medium.

Fig. 5.5 Water Communication Channel Transmitter

5.6 Water Communication Channel Receiver

The water communication channel receiver, an essential component of the underwater network with IoT communication for fisherman safety, serves as the counterpart to the transmitter, facilitating bidirectional communication within the network. Positioned strategically underwater, the receiver is responsible for receiving data signals transmitted by other devices and sensors deployed in the vicinity. These signals contain critical information such as environmental data, vessel status, and safety alerts, which are transmitted through the water medium.

Fig. 5.6 Water Communication Channel Receiver

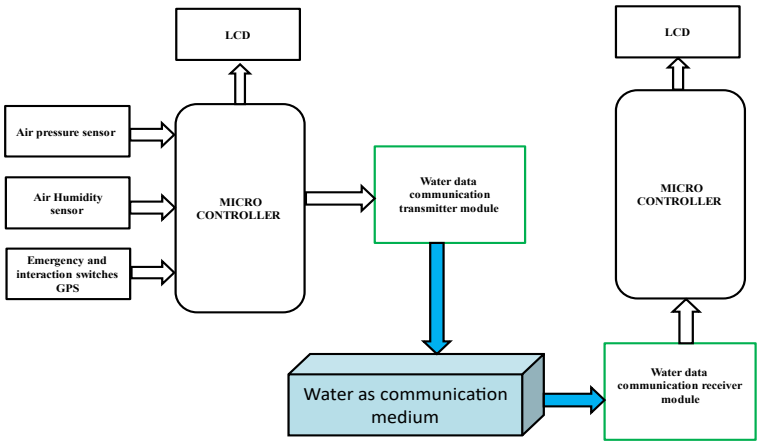

Fig. 5.7 Proposed Block Diagram

6. RESULTS AND CONCLUSION

the project presents a novel approach to data transmission in underwater environments by leveraging transmitter sources. Additionally, the system incorporates GPS tracking functionality to safeguard fishermen and prevent inadvertent crossing of maritime boundaries.

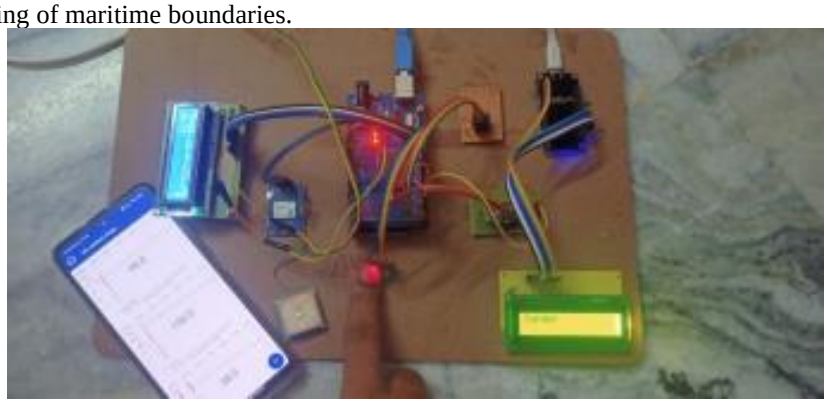

Fig. 6.1 Prototype Model

By enabling the transmission and reception of emergency messages through water in critical situations, the proposed system is poised to enhance the effectiveness and dependability of communication in underwater settings. Through these advancements, the project aims to bolster safety measures and streamline communication protocols for fishermen, ultimately improving operational efficiency and ensuring their well-being at sea.

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