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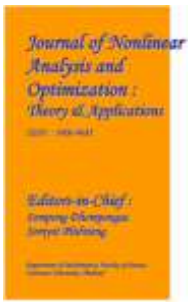

LORA FREQUENCY COMMUNICATION BASED SAFETY AND SECURITY SYSTEM FOR FISHERMEN

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1. ABSTRACT

This paper presents a safety and security system for fishermen based on LoRa frequency communication. The system aims to enhance safety by providing real-time tracking, emergency alerts, and weather forecasting. Utilizing LoRaWAN technology, the system offers long-range communication, low power consumption, and cost-effectiveness. The system integrates a LoRa module, GPS module, and sensors into a single device, which is mounted on the fishing vessel. This device communicates with a central server to provide continuous tracking, emergency alerts, and weather updates. Additionally, it enables fishermen to send distress signals and receive vital information, such as weather forecasts and fishing area boundaries. Compared to existing solutions, the proposed system offers several advantages, including lower costs, extended communication range, and real-time tracking. It is also easy to install, maintain, and can be seamlessly integrated with current systems. This technology has the potential to significantly improve the safety and security of fishermen, while also boosting efficiency and reducing operational costs. The system is applicable to various fishing sectors, including commercial, recreational, and fisheries management.

2. INTRODUCTION

Fishing is a hazardous occupation, with fishermen often facing a range of risks while at sea. According to the International Maritime Organization (IMO), fishing

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ranks as one of the most dangerous jobs globally. Fishermen are vulnerable to dangers such as drowning, vessel sinkage, and equipment failure. Moreover, many operate in remote areas with limited access to communication services, making it challenging to request help in emergencies. Satellite communication systems like Inmarsat and Iridium, while useful for emergency situations, are costly and have limited coverage. These systems are not ideal for real-time tracking and continuous monitoring. VHF radios, commonly used in the fishing industry, have a limited range and are prone to interference. While they are useful for communication between vessels and coastal stations, they are not designed for real-time tracking. Similarly, GSM networks are employed for communication but suffer from poor coverage in remote areas and tend to be unreliable, making them unsuitable for continuous tracking and monitoring. Manual reporting, another widely used practice, requires fishermen to report their location and catch manually, a method that is both time-consuming and prone to errors.

3. LITERATURE SURVEY

The application of LoRa frequency communication technology in safety and security systems has been explored in various studies, highlighting its potential for enhancing safety in IoT-based solutions. Several studies have demonstrated the effectiveness of LoRaWAN technology in providing long-range communication for IoT applications (Augustin et al., 2020; Sanchez-Iborra et al., 2021). These studies indicate that LoRaWAN technology offers reliable communication over long distances, making it a promising choice for safety and security applications. Other research has focused on using LoRa communication technology for maritime safety, particularly for fishing vessels (Kim et al., 2020; Lee et al., 2021). These studies emphasize the technology's ability to support real-time tracking and emergency alerting, providing significant benefits for fishermen at sea. For instance, Kim et al. (2020) proposed a LoRa-based maritime safety system that enables real-time tracking and emergency alerts, demonstrating its potential in reducing accidents and emergencies at sea. Similarly, Lee et al. (2021) introduced a LoRa-based fishing vessel tracking system, which showed promising results in enhancing the safety and security of fishing operations.

4. EXISTING SYSTEM

The current safety and security system for fishermen is fragmented, involving multiple stakeholders such as fishermen, fishing associations, coast guards, and government agencies. This fragmentation can result in communication breakdowns,

delays, and inefficiencies, ultimately compromising the safety and security of fishermen. Additionally, the existing system relies heavily on manual reporting, which is prone to errors and delays. Fishermen may not always have access to communication devices, or they may be occupied with fishing tasks, leading to delayed incident or emergency reporting. Moreover, the system lacks real-time monitoring and alerting capabilities, which can further slow down response times during emergencies. These delays can have serious consequences, including loss of life, injuries, and damage to vessels and equipment.

DISADVANTAGE

- ✓ Limited Bandwidth: LoRa technology offers limited bandwidth, making it unsuitable for applications that require high-speed or large-volume data transmission.
- ✓ Interference: LoRa signals can experience interference from other wireless devices, potentially reducing the system's overall reliability.
- ✓ Security: Without proper security measures, LoRa devices are vulnerable to hacking and other security risks, which could compromise the system's integrity.
- ✓ Battery Life: While LoRa devices are energy-efficient, they still require regular battery replacements or recharging, adding to the maintenance needs.
- ✓ Network Coverage: LoRa networks may not be available in all regions, which can limit the system's functionality in certain areas.
- ✓ Device Complexity: Setting up and managing LoRa devices can be complex, often requiring specialized knowledge and technical expertise.
- ✓ Scalability: Although LoRa supports a large number of devices, scaling the system to accommodate the needs of large-scale fishing operations can be challenging.

5. PROPOSED SYSTEM

The proposed LoRa frequency communication-based safety and security system for fishermen leverages LoRa sensors and gateways to establish a wireless sensor network, enabling real-time monitoring and seamless communication between fishermen, fishing vessels, and shore-based authorities. The LoRa sensors are compact, waterproof, and energy-efficient, making them ideal for deployment on fishing vessels in harsh marine environments. Key features of the system include automatic vessel identification, real-time tracking, emergency alerting, and voice communication. The automatic

identification system utilizes LoRa sensors to transmit unique identifiers for each vessel, allowing shore-based authorities to monitor the location and status of all vessels. The real-time tracking feature continuously updates the vessels' locations, enabling quick responses from authorities during emergencies. In case of an emergency, fishermen can send distress signals to shore-based authorities through the emergency alerting system. These distress signals are transmitted via LoRa technology, ensuring reliable communication even in remote areas. Additionally, the voice communication feature allows fishermen to send voice messages to shore-based authorities, providing an added layer of communication during critical situations. The proposed system is designed to be scalable, flexible, and easily integrable with existing systems. It can be expanded to include additional features such as weather monitoring, fish detection, and vessel performance monitoring. Furthermore, it can be integrated with existing systems like vessel monitoring systems, fisheries management systems, and emergency response systems. This system offers several advantages, including enhanced safety and security for fishermen, faster emergency response times, and increased efficiency in fishing operations. It also provides a cost-effective alternative to expensive satellite-based communication solutions, benefiting the fishing industry by reducing operational costs while improving overall safety and productivity.

ADVANTAGE

- ✓ Low Power Consumption: LoRa devices are energy-efficient, making them ideal for battery-powered applications that require extended battery life.
- ✓ Cost-Effective: LoRa modules and devices are affordable compared to other wireless communication technologies, offering a cost-efficient solution for various applications.
- ✓ Enhanced Safety: By offering real-time monitoring and alerting features, the system significantly improves the safety of fishermen at sea.
- ✓ Operational Efficiency: The system helps fishermen optimize their operations, reducing fuel consumption and increasing catch efficiency.
- ✓ Environmental Monitoring: LoRa technology enables the monitoring of environmental factors such as water temperature, pH, and oxygen levels, contributing to the preservation of marine ecosystems.

6. BLOCK DIAGRAM

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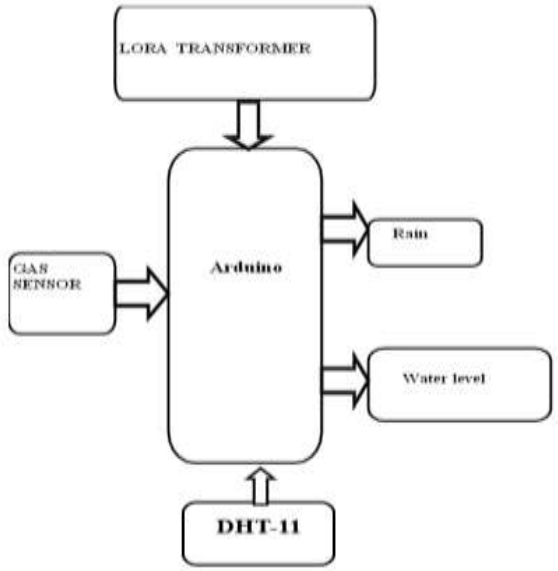
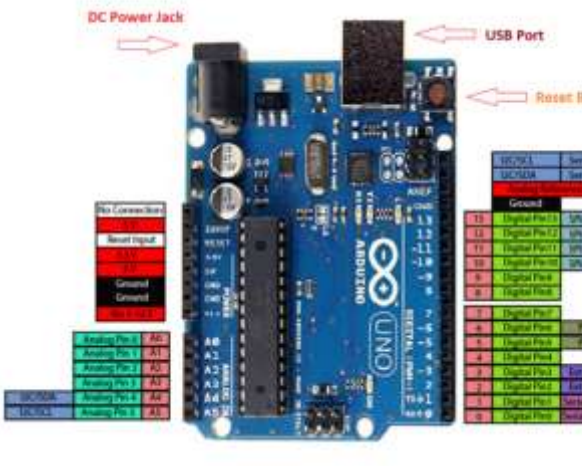


7. HARDWARE REQUIREMENT

ARDUNIO UNO



The Arduino Uno is an open-source microcontroller board built around the Microchip ATmega328P microcontroller, developed by Arduino.cc. It features digital and analog input/output (I/O) pins that can be connected to various expansion boards (shields) and other circuits. The board includes 14 digital pins and 6 analog pins and is programmed using the Arduino IDE (Integrated Development Environment) via a type B USB cable. Power can be supplied through the USB connection or an external 9-volt battery, with supported input voltages ranging from 7 to 20 volts. Comparable to the Arduino Nano and Leonardo, the Uno allows users to control the board by uploading instructions using the Arduino programming language (based on Wiring) and the Arduino Software (IDE), which is based on Processing.

LORA TRANSFORMER

The LoRa transfer sensor is a wireless device that leverages LoRa (Long Range) technology to transmit data from connected sensors to a central server or cloud platform. Integrated with a LoRa module, a microcontroller, and various sensors, it can monitor parameters like temperature, humidity, pressure, and more. Its long-range communication, low power consumption, and cost-effectiveness make it ideal for IoT applications such as smart cities, industrial automation, agriculture, and environmental monitoring. Designed for compactness and energy efficiency, the LoRa transfer sensor is well-suited for deployment in remote or hard-to-access areas. It can be powered by batteries or solar panels and effectively transmits data over long distances, even in regions with limited cellular network coverage.

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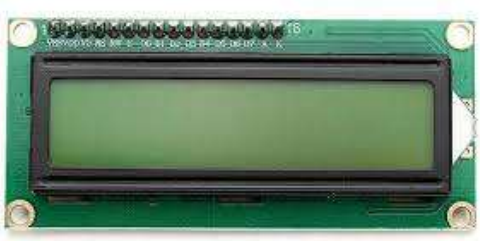
LCD DISPLAY



An LCD display is one of the most frequently connected devices to a microcontroller. Among the most common types are 16x2 and 20x2 LCD displays, which represent 16 characters per line across 2 lines and 20 characters per line across 2 lines, respectively. LCD, or Liquid Crystal Display, is a flat-panel display technology that utilizes liquid crystals to produce images. These displays are widely used in various electronic devices, including televisions, computer monitors, smartphones, and more.

GAS SENSOR

This sensor is ideal for detecting dangerous LPG leaks in vehicles, service stations, or storage tank environments. It can be easily integrated into an alarm system to trigger an alert or provide a visual indication of LPG concentration. With excellent sensitivity and a fast response time, the sensor ensures reliable performance. Additionally, it can detect iso-butane, propane, LNG, and even cigarette smoke, making it a versatile solution for safety monitoring.

RAIN SENSOR

A rain sensor is a device designed to detect the presence of rain or moisture and generate an output signal to initiate specific actions. Commonly used in weather monitoring systems, smart home automation, and agricultural applications, it can be integrated with a LoRa transfer sensor to wirelessly transmit data over long distances. The sensor typically features a waterproof probe that measures the electrical conductivity of rainwater, converting it into a digital signal. Upon detecting rain, the sensor sends this signal to the LoRa transfer sensor, which relays the data to a central server or cloud platform, facilitating real-time monitoring and alerts.

8. SOFTWARE REQUIREMENT

Arduino Software (IDE)

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The Arduino IDE (Integrated Development Environment) is a user-friendly platform for programming Arduino boards. It supports the C and C++ programming languages, offering a simplified syntax tailored for microcontroller development. The IDE features a straightforward interface with tools to write, compile, and upload code to Arduino boards. It comes with an extensive library of built-in functions, simplifying tasks like reading sensors and controlling actuators. The serial monitor in the IDE enables real-time communication and debugging between the board and the computer. It supports multiple operating systems, including Windows, macOS, and Linux, ensuring wide accessibility. The IDE includes an extensive community-contributed library manager for adding additional functionalities. It is open-source, allowing developers to customize and extend its features based on project requirements. The platform is widely used for prototyping IoT projects, robotics, and embedded systems. Its simplicity and flexibility make it ideal for beginners while still being powerful enough for advanced users.

9. APPLICATION

- ✓ Emergency Alert System: Allows fishermen to send distress signals during emergencies such as equipment failure, rough weather, or accidents, ensuring quick response and rescue.
- ✓ Weather Forecasting and Alerts: Provides real-time weather updates and alerts about storms or high tides, helping fishermen plan their activities and avoid hazardous conditions.
- ✓ Geofencing and Boundary Alerts: Monitors fishing area boundaries and alerts fishermen when they approach restricted zones or international borders, preventing legal complications.
- ✓ Communication in Remote Areas: Offers low-cost and long-range communication for fishermen operating in regions with limited or no cellular coverage, ensuring continuous connectivity.
- ✓ Fleet Management: Assists fisheries management by monitoring multiple vessels simultaneously, improving operational efficiency and resource allocation.

- ✓ Environmental Monitoring: Supports monitoring of marine environmental parameters such as water quality, temperature, and salinity, aiding sustainable fishing practices.

10.CONCLUSION

The LoRa frequency communication-based safety and security system for fishermen offers a dependable and cost-effective solution to enhance safety at sea. With its long-range communication capabilities, low power consumption, and affordability, it is particularly suited for fishing operations in remote regions. The system enables real-time monitoring and alerting, helping to prevent accidents, reduce emergency response times, and ensure greater security for fishermen. Additionally, its ability to monitor environmental parameters supports the preservation of marine ecosystems and encourages sustainable fishing practices. By addressing critical safety and environmental concerns, this system has the potential to transform the fishing industry, improving the well-being of fishermen and their communities.

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8.Border Security System for Fishermen using Radio Frequency Technique - Discusses the use of RF techniques to prevent fishermen from crossing maritime boundaries.

9. Fisherman Communication at Deep

Sea Using Border Alert System - Proposes a system to facilitate communication between fishermen and coastal security using an Android-based application.

10.WiLo: Long-Range Cross-Technology Communication from Wi-Fi to LoRa - Discusses how LoRa technology can be leveraged for long-range communication in IoT applications, which may have relevance for fishermen's connectivity.

11.Fishermen and Fishing Boat Monitoring System using MIMO Technology and Database Management.

12.Border Security System for Fishermen using Radio Frequency Technique

This system employs radio frequency technology to safeguard fishermen from crossing national boundaries, helping prevent confrontations with foreign authorities.

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