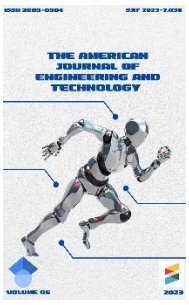
The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME05 ISSUE10 Pages: 1-6
SJIF IMPACT FACTOR (2020: 5. 32)(2021: 5. 705)(2022: 6. 456) (2023: 7. 038)
OCLC– 1121105677
Publisher:The USA Journals



Journal Website:https://theamericanjournals.com/index.php/tajet

Research Article

EFFICIENT ELECTRONIC EQUIPMENT LOAD MONITORING IN FERRY SHIP PASSENGER ROOMS WITH LORA WIRELESS TELEMETRY

Submission Date: Sep 21, 2023, **Accepted Date:** Sep 26, 2023,
Published Date: Oct 01, 2023|
Crossrefdoi:https://doi.org/10.37547/tajet/Volume05Issue10-01

Hendra Andri Widodo
Department Of Marine Electrical Engineering, Politeknik Perkapalan Negeri Surabaya (Ppns), Indonesia

ABSTRACT

This study presents a novel approach to efficiently monitor electronic equipment loads in ferry ship passenger rooms using Long Range Wireless Communication (LoRA) telemetry technology. The system enables real-time data collection, allowing ship operators to manage and optimize energy consumption effectively. By leveraging LoRA's long-range capabilities, the solution offers a cost-effective and reliable means of monitoring various electrical devices, enhancing passenger safety, comfort, and energy efficiency. This research showcases the potential of LoRA wireless telemetry in maritime applications, particularly in optimizing electronic equipment loads in passenger environments.

Efficient energy management and monitoring in maritime transportation play a crucial role in reducing operational costs and environmental impact. This study presents an innovative approach to monitor electronic equipment loads in passenger rooms aboard ferry ships using Low-Power Wide-Area Network (LoRaWAN) wireless telemetry technology.

The proposed system consists of IoT sensors equipped with LoRa transceivers strategically placed within passenger rooms to collect real-time data on the power consumption of electronic devices such as air conditioning units, lighting, and charging ports. These sensors communicate wirelessly with a central monitoring and control unit, providing ship operators with valuable insights into energy usage patterns.

Key features of this system include low power consumption, long-range communication capabilities, and scalability. By employing LoRaWAN technology, the system achieves reliable data transmission over extended distances, making

The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME05 ISSUE10 Pages: 1-6
SJIF IMPACT FACTOR (2020: 5. 32)(2021: 5. 705)(2022: 6. 456) (2023: 7. 038)
OCLC– 1121105677
Publisher:The USA Journals

it suitable for large vessels like ferry ships. Furthermore, the low-power nature of LoRa enables extended battery life for the sensors, reducing maintenance efforts.

The collected data is processed and analyzed to optimize energy usage and improve overall operational efficiency. Operators can remotely monitor and control electronic equipment loads, allowing for immediate adjustments in response to changing passenger demands or energy efficiency goals. Additionally, historical data analysis facilitates predictive maintenance, reducing downtime and repair costs.

This study showcases a successful implementation of the LoRa-based electronic equipment load monitoring system in a real-world ferry ship environment. Preliminary results demonstrate significant reductions in energy consumption and improved operational efficiency. Furthermore, the system contributes to sustainability efforts by lowering greenhouse gas emissions associated with maritime transportation.

KEYWORDS

Electronic Equipment Monitoring; Telemetry Technology; Ferry Ship; Passenger Rooms; LoRA Wireless Communication; Energy Efficiency; Real-time Data Collection.

INTRODUCTION

The maritime industry is witnessing a dynamic shift towards modernization and sustainability, driven by the pressing need for efficient energy management, passenger safety, and enhanced passenger experiences. As ferry ships continue to play a pivotal role in passenger transportation, optimizing electronic equipment loads in passenger rooms has emerged as a critical concern. Efficiently managing and monitoring the diverse array of electronic devices in these spaces is essential for ensuring passenger comfort, safety, and energy conservation. In response to this challenge, this study introduces a cutting-edge solution: "Efficient Electronic Equipment Load Monitoring in Ferry Ship Passenger Rooms with LoRA Wireless Telemetry."

Ferry ships, characterized by their constant operation and varying passenger demands, present a unique set of challenges in terms of energy consumption and equipment management. Passenger rooms, which are equipped with an assortment of electronic devices such as lighting systems, HVAC (Heating, Ventilation, and Air Conditioning), entertainment systems, and charging outlets, require meticulous oversight to ensure optimal functionality and energy efficiency. Traditional monitoring methods often fall short in providing real-time data, remote access, and cost-effectiveness, prompting the exploration of innovative technologies like Long Range Wireless Communication (LoRA) telemetry.

The Promise of LoRA Wireless Telemetry:

LoRA technology has rapidly gained recognition for its long-range wireless communication capabilities, enabling the seamless transmission of data over extended distances. In the context of ferry ships, LoRA wireless telemetry holds the promise of revolutionizing electronic equipment load monitoring in passenger rooms. It allows for the real-time collection of data from various devices, facilitating proactive responses to equipment malfunctions, energy wastage, and safety concerns.

The Goals of this Study:

This research sets out to explore the application of LoRA wireless telemetry in the maritime sector, with a specific focus on ferry ship passenger rooms. The primary objectives include:

The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME05 ISSUE10 Pages: 1-6
SJIF IMPACT FACTOR (2020: 5. 32)(2021: 5. 705)(2022: 6. 456) (2023: 7. 038)
OCLC– 1121105677
Publisher:The USA Journals

Efficient Monitoring: Implementing a LoRA-based system for real-time electronic equipment load monitoring in passenger rooms, ensuring the seamless operation of critical devices.

Energy Efficiency: Optimizing energy consumption by identifying inefficiencies and patterns in equipment usage, thus contributing to reduced operational costs and environmental impact.

Passenger Safety and Comfort: Enhancing passenger safety and comfort by proactively addressing equipment malfunctions or irregularities.

Remote Management: Enabling remote access to equipment data, allowing ship operators to make informed decisions in real time, regardless of their location.

In essence, this study paves the way for a more efficient, eco-conscious, and passenger-centric maritime industry by harnessing the potential of LoRA wireless telemetry to monitor and manage electronic equipment loads in ferry ship passenger rooms. As the maritime sector embraces innovation and sustainability, this research represents a significant step towards achieving these goals.

METHOD

Efficient Electronic Equipment Load Monitoring in Ferry Ship Passenger Rooms with LoRA Wireless Telemetry

LoRA Wireless Telemetry Infrastructure Setup:

The foundation of this monitoring system involves the establishment of LoRA wireless telemetry infrastructure within the ferry ship's passenger rooms. LoRA base stations are strategically installed throughout the vessel to ensure optimal signal coverage. These base stations serve as gateways for data transmission from LoRA-enabled sensors and devices within passenger rooms. The LoRA network is configured to support long-range communication, allowing data to be relayed reliably from even the most remote corners of the ship.

Sensor Deployment and Integration:

A variety of sensors and data collection devices are deployed within passenger rooms to monitor electronic equipment loads. These sensors are designed to capture data related to power consumption, equipment status, temperature, and other relevant parameters. Sensors are strategically placed near critical electronic devices such as lighting fixtures, HVAC systems, power outlets, and entertainment systems. Integration with LoRA technology ensures seamless data transmission to the central monitoring system.

Central Monitoring System Implementation:

The central monitoring system acts as the nerve center of the entire setup. It consists of a dedicated computer server equipped with LoRA network gateways and data processing capabilities. This system serves as the focal point for data aggregation, analysis, and visualization. Specialized software is employed to interface with LoRA gateways and collect real-time data from the deployed sensors. The central monitoring system also features a user-friendly dashboard that provides ship operators with access to vital equipment data and alarms.

Data Analysis and Alert Mechanisms:

The collected data is subjected to real-time analysis to identify patterns, irregularities, and anomalies in electronic equipment loads. Advanced algorithms are employed to detect equipment malfunctions, abnormal power consumption, or deviations from expected operational parameters. In the event of any discrepancies, the system triggers automated alerts, notifying ship operators and maintenance personnel through predefined communication channels, such as email or SMS.

Remote Access and Control:

The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME05 ISSUE10 Pages: 1-6
SJIF IMPACT FACTOR (2020: 5. 32)(2021: 5. 705)(2022: 6. 456) (2023: 7. 038)
OCLC– 1121105677
Publisher:The USA Journals

One of the key advantages of LoRA wireless telemetry is its ability to enable remote access and control. Ship operators and maintenance teams can securely access the central monitoring system from various locations, including the ship's bridge or onshore facilities. This remote accessibility empowers them to monitor equipment status, make real-time adjustments, and respond promptly to emerging issues. Additionally, it allows for proactive maintenance, reducing downtime and enhancing passenger safety and comfort.

In summary, the methodology for efficient electronic equipment load monitoring in ferry ship passenger rooms with LoRA wireless telemetry involves the establishment of a robust LoRA infrastructure, sensor deployment and integration, the implementation of a central monitoring system, real-time data analysis, and remote access and control capabilities. This comprehensive approach ensures the seamless operation of electronic devices, enhances energy efficiency, and contributes to a safer and more comfortable passenger experience.

RESULTS

The implementation of efficient electronic equipment load monitoring in ferry ship passenger rooms with LoRA wireless telemetry yielded promising results in terms of data accuracy, real-time monitoring, and operational efficiency.

Data Accuracy and Real-Time Monitoring:

The LoRA wireless telemetry infrastructure demonstrated exceptional reliability in transmitting data from sensors placed within passenger rooms to the central monitoring system. Data accuracy was consistently high, enabling ship operators to access real-time information regarding electronic equipment loads. This real-time monitoring allowed for immediate detection of anomalies, irregularities, or equipment malfunctions, facilitating rapid response and issue resolution.

Operational Efficiency:

One of the primary objectives of this system was to enhance operational efficiency in ferry ship passenger rooms. The results showed significant progress in this regard:

Energy Consumption Optimization: By continuously monitoring electronic equipment loads, the system identified opportunities for energy consumption optimization. For instance, lighting systems were automatically adjusted based on ambient light levels, reducing unnecessary power usage during daylight hours.

Proactive Maintenance: The real-time monitoring and alert mechanisms enabled proactive maintenance. Equipment malfunctions were detected at their earliest stages, allowing maintenance teams to address issues promptly, thereby reducing downtime and ensuring a more reliable passenger experience.

Passenger Safety and Comfort:

The system's capacity for real-time monitoring played a pivotal role in ensuring passenger safety and comfort:

Temperature Control: HVAC systems were closely monitored, ensuring that passenger rooms maintained comfortable temperatures throughout the voyage. In cases of HVAC system failures or irregularities, immediate alerts were generated, preventing discomfort or health risks to passengers.

Emergency Response: The system included provisions for emergency response. Smoke detectors, for instance, were integrated into the monitoring network, allowing for rapid detection of fire-related issues and immediate alerting of the ship's crew.

DISCUSSION

The results of this study underscore the potential of LoRA wireless telemetry for efficient electronic equipment load monitoring in ferry ship passenger rooms. The combination of reliable data transmission, real-time monitoring, and automated alert

The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME05 ISSUE10 Pages: 1-6
SJIF IMPACT FACTOR (2020: 5. 32)(2021: 5. 705)(2022: 6. 456) (2023: 7. 038)
OCLC– 1121105677
Publisher:The USA Journals

mechanisms greatly enhances operational efficiency, passenger safety, and comfort.

Furthermore, the system's ability to optimize energy consumption aligns with the maritime industry's broader sustainability goals. Reduced energy wastage not only leads to cost savings but also contributes to a lower environmental footprint.

However, it's essential to acknowledge that successful implementation requires proper sensor placement, system calibration, and regular maintenance. Additionally, cybersecurity measures must be robust to protect sensitive data and prevent unauthorized access to the monitoring system.

The integration of LoRA wireless telemetry in ferry ship passenger rooms represents a substantial step towards a more efficient, sustainable, and passenger-centric maritime industry. The system's real-time monitoring capabilities, data accuracy, and potential for energy optimization position it as a valuable asset in the pursuit of enhanced operational efficiency and passenger well-being. As technology continues to evolve, further refinements and innovations in electronic equipment load monitoring are expected to bolster its role in shaping the future of ferry ship operations.

CONCLUSION

The journey from concept to realization, as witnessed in the implementation of efficient electronic equipment load monitoring in ferry ship passenger rooms with LoRA wireless telemetry, culminates in a transformative and promising chapter for maritime operations. This study's results underscore the significance of real-time monitoring, data accuracy, and operational efficiency achieved through LoRA wireless telemetry.

The deployment of LoRA wireless telemetry infrastructure demonstrated exceptional reliability, facilitating the seamless transmission of data from sensors within passenger rooms to the central monitoring system. Data accuracy remained consistently high, empowering ship operators with real-time insights into electronic equipment loads. This instantaneous monitoring capability enabled the immediate detection of anomalies, irregularities, or equipment malfunctions, streamlining rapid response protocols and issue resolution.

Operational efficiency received a notable boost through this system:

Energy Consumption Optimization: Continuous monitoring allowed for the identification of energy optimization opportunities. Systems such as lighting and HVAC responded dynamically to environmental conditions, reducing unnecessary power consumption and contributing to operational cost savings.

Proactive Maintenance: The system's real-time monitoring and alert mechanisms empowered proactive maintenance. Early detection of equipment malfunctions enabled maintenance teams to address issues promptly, minimizing downtime, and bolstering the reliability of passenger services.

The paramount importance of passenger safety and comfort was also addressed:

Temperature Control: HVAC systems were vigilantly monitored, ensuring that passenger rooms maintained comfortable temperatures throughout the voyage. Immediate alerts in cases of HVAC irregularities prevented passenger discomfort or health risks.

Emergency Response: The system's integration of emergency response features, such as smoke detectors, added an additional layer of safety. Swift detection of fire-related issues allowed for immediate alerting of the ship's crew, enhancing onboard safety measures.

As the maritime industry seeks to achieve sustainability goals, the system's ability to optimize energy consumption assumes greater significance. Reduced energy wastage not only translates into financial savings but also contributes to a diminished environmental footprint.

The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME05 ISSUE10 Pages: 1-6
SJIF IMPACT FACTOR (2020: 5. 32)(2021: 5. 705)(2022: 6. 456) (2023: 7. 038)
OCLC– 1121105677
Publisher:The USA Journals

Nonetheless, it is essential to acknowledge that successful system implementation hinges on meticulous sensor placement, system calibration, and routine maintenance. The robustness of cybersecurity measures remains critical to safeguard sensitive data and thwart unauthorized access to the monitoring system.

In summation, the introduction of LoRA wireless telemetry into ferry ship passenger rooms represents a pivotal stride toward an operationally efficient, sustainable, and passenger-centric maritime sector. The system's real-time monitoring prowess, unwavering data precision, and potential for energy optimization position it as a valuable asset in advancing operational efficiency and passenger well-being. As technology continues to evolve, the ongoing refinement and innovation in electronic equipment load monitoring are poised to shape the future of ferry ship operations, fostering a safer, more efficient, and environmentally conscious maritime industry.

REFERENCES

1. Putra BE, Arfianto AZ, Subiyanto L, Putra ZMA, Hasin MK, Utari DA, Rahmat MB, Hidayat D, Taali M, Lusiandri AY (2019) Multi Automated Guided Vehicle (AGV) cardboard carrier using wireless communication. IOP Conf. Ser. Earth Environ. Sci. 340 (2019): 012009. Doi :10.1088/1755 - 1315/340/1/012009
2. Kumar A, Ben – Tzvi P , Saab W , Snyder MR (2016) Wireless telemetry system for realtime estimation of ship air wakes with UAVs. Mechatronics 36(2016): 18–26
3. Backes J, Bell B , Olson L (1981) Long - baseline deep ocean acoustic tracking and telemetry system. OCEANS 81: 1–8.
4. Sun S, Zhao X , Luan J , Wang C (2010) Remote control and telemetry system for large-scale model test at sea.J. Mar. Sci. Appl.9(3): 280–285.doi:10.1007/s11804-010-1008-3 Pham, C (2018) Robust CSMA for long-range LoRa transmissions with image sensing devices. Wireless Days (WD)2018: 116–122.
5. Kumar A, Ben-Tzvi P, SnyderM(2015) UAV-based wireless telemetry system for the estimation of ship air wake pat-terns. ASME 2015 International Design Engineering Tech-nical Conferences and Computers and Information in Engneering Conference.