
GTBMS: GPS-BASED TRACKING AND MONITORING SYSTEM FOR SMALL CRAFT SAFETY WITH SMS NOTIFICATIONS

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Abstract

Maritime safety is a vital concern, particularly for small crafts operating in regions like the Philippines, where accidents are common due to unpredictable weather and limited navigation tools. This study introduces the Global Positioning System-Based Tracking and Monitoring System (GT-BMS), a real-time tracking solution enhanced with SMS notifications to improve the safety and efficiency of small boat operations. By aligning with the United Nations Sustainable Development Goals, specifically SDG 3 (Good Health and Well-being), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 14 (Life Below Water), the system supports safer navigation, fosters technological innovation, and promotes sustainable marine practices. The GT-BMS was developed using a prototyping approach and evaluated against ISO 25010 standards for functionality, security, compatibility, and maintainability. Feedback from 30 respondents, including boat operators and maritime authorities, highlighted its effectiveness in providing real-time tracking, timely alerts, and improved emergency response capabilities. While the system proved highly functional and secure, areas like compatibility and maintainability require further refinement. Future enhancements aim to expand its adaptability, integrate advanced analytics, and strengthen its usability for a broader audience. This study underscores the potential of GT-BMS as an innovative tool for enhancing maritime safety, reducing risks, and supporting sustainable development in the maritime sector.

Keywords: GPS tracking, Real-time monitoring, SDG, Small craft safety, SMS notifications.

INTRODUCTION

In a country like the Philippines, where maritime travel is a way of life, small boats are key for transportation, fishing, and tourism. However, these vessels often face challenges such as unpredictable weather, insufficient navigation tools, and slow emergency responses, putting both operators and passengers at risk. These challenges emphasize the importance of finding practical solutions to improve their safety and reliability.

Existing safety measures for small boats are often outdated or lack essential features like real-time tracking and communication. A review of related studies reveals that while there are systems designed for larger vessels, small boats are frequently overlooked. This gap leaves small craft operators without the tools they need to navigate safely or respond quickly in emergencies.

This study introduces the Global Positioning System-Based Tracking and Monitoring System (GT-BMS), designed specifically for small craft. The system combines GPS technology with real-time monitoring and SMS notifications to provide operators and authorities with timely updates, helping to prevent accidents and improve response times during emergencies. Unlike previous approaches, GT-BMS focuses on the unique needs of small boats, providing an innovative and practical solution.

The goal of this research is to showcase how GT-BMS can improve safety for small boats while contributing to the United Nations Sustainable Development Goals, particularly in promoting innovation, health, and sustainable use of marine resources. By addressing the gaps in current systems, this study offers a significant step forward in ensuring safer and more efficient maritime operations.

LITERATURE REVIEW

The integration of Global Positioning System (GPS) technology in maritime safety has been extensively studied, but its application to small craft operations remains underexplored. This section reviews key theories, concepts, and technologies relevant to GPS-based tracking and monitoring systems, providing the foundation for analyzing and developing the Global Positioning System-Based Tracking and Monitoring System (GT-BMS).

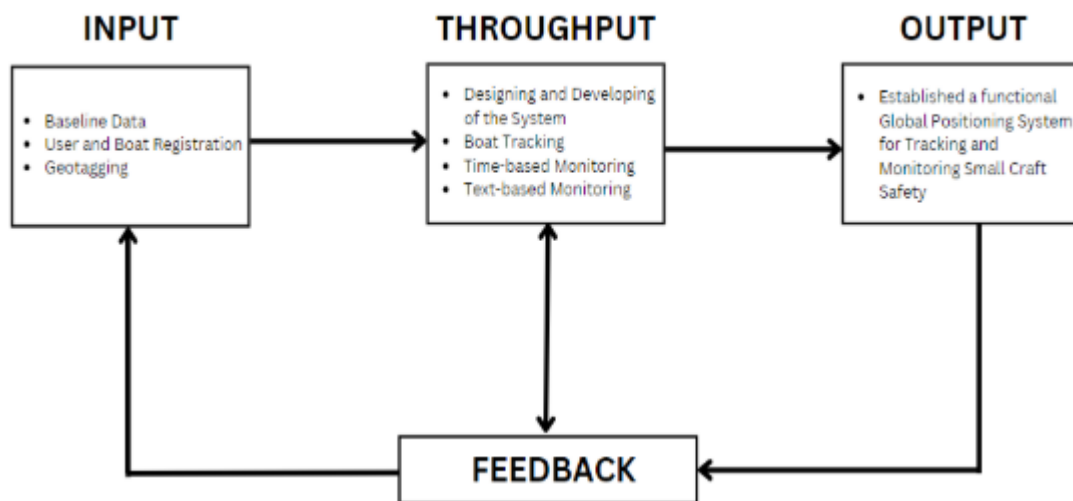


Figure 1. Conceptual framework

Figure 1 showed the flow of the data or concepts in the system, it presented the inputs, the methods applied to process these inputs, the established system after these data have been processed, and the feedback.

The Input phase involves gathering essential data and resources required to develop the Global Positioning System for tracking and monitoring small craft safety (GT-BMS). This includes baseline data on boat operations, user and boat registration information, and geotagging data that will enable accurate real-time location tracking. These inputs are for the design and functionality of the system, ensuring it can address the needs of small craft operators and maritime authorities.

In the Throughput phase, the inputs are processed through the development and implementation of the GT-BMS system. This phase focuses on designing the system architecture, building the GPS tracking mechanism, and integrating time-based and text-based monitoring features. These components work together to ensure continuous real-time monitoring and the ability to send alerts or notifications when necessary. The throughput phase ensures that the system is robust, efficient, and meets the safety objectives of the maritime sector.

The Output phase results in the establishment of a fully functional GT-BMS system. The developed system provides real-time tracking of small craft, enhancing safety, security, and

operational efficiency. This output demonstrates the successful implementation of the system, which can now be used by boat operators and maritime authorities to improve small craft safety.

The Feedback loop allows for the ongoing refinement and optimization of the GT-BMS system. Information gathered from the system's performance in real-world conditions is used to make improvements. This could include enhancing system accuracy, addressing operational challenges, or introducing new features based on user needs. The feedback process ensures that the system continues to evolve and meet the safety demands of small craft operations over time.

RESEARCH METHOD

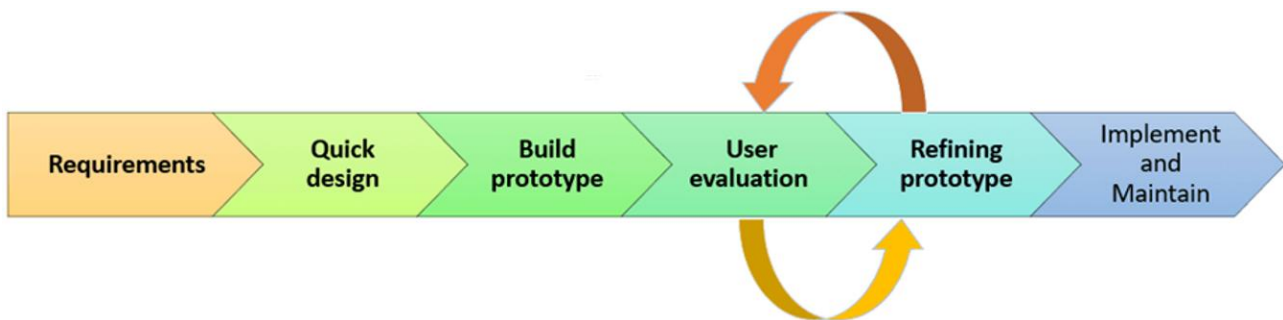


Figure 2. Prototyping model

This study utilized a prototyping methodology within the Software Development Life Cycle (SDLC) framework to successfully design, develop, and implement the Global Positioning System-Based Tracking and Monitoring System (GT-BMS). The methodology followed a structured and iterative process, ensuring the system met the needs of small craft operators and addressed safety gaps.

1. Requirements Gathering

The initial phase involved gathering requirements through surveys and interviews with 30 respondents, including boat operators, owners, and maritime authorities in the Region VI area. This process identified key requirements such as real-time GPS tracking, SMS notifications, and a user-friendly interface to enhance small craft safety.

2. Quick Design

A preliminary design was created to outline the system's architecture. This included modules for real-time GPS tracking, alert notifications, and time-based monitoring. The design provided a clear structure and served as the foundation for prototype development.

3. Build Prototype

A functional prototype of the GT-BMS was developed based on the initial design. The prototype included all core features, such as location tracking, alert mechanisms, and historical data logging, to meet the identified requirements.

4. User Evaluation

The prototype was tested by the respondents in real-world scenarios. Feedback was gathered to assess its functional suitability, security, compatibility, and maintainability. Respondents noted that the system significantly improved safety and response time during emergencies, though some areas required enhancement.

5. Refining Prototype

Using the feedback from the user evaluation, the prototype was refined. Improvements included enhancing system compatibility with different devices, optimizing GPS accuracy, and streamlining the SMS notification system. These refinements ensured the system performed reliably under various conditions.

6. Implement and Maintain

The finalized GT-BMS was deployed and used effectively by small craft operators and maritime authorities. The system demonstrated robust performance in improving safety, real-time tracking, and emergency response. Maintenance protocols were established to ensure continued system functionality and adaptability to future needs.

RESULTS AND DISCUSSION

The overall performance of the Global Positioning System-Based Tracking and Monitoring System (GT-BMS) was evaluated using ISO 25010 standards. The system achieved consistently high scores across all criteria, reflecting its reliability, usability, and potential for improving small craft safety. The table below presents the total mean scores:

Table 1. Evaluation results of GT-BMS based on ISO 25010 standards		
Evaluation Criteria	Mean Score	Interpretation
Functional Suitability	4.8	Excellent
Security	4.5	Very Satisfactory
Compatibility	4.4	Very Satisfactory
Maintainability	4.3	Very Satisfactory
Overall Performance	4.5	Very Satisfactory

Functional Suitability

The GT-BMS excelled in meeting its functional requirements, achieving a total mean score of **4.8 (Excellent)**. Users commended the system for its accurate real-time GPS tracking and seamless SMS notification features, which significantly enhanced navigation and emergency response capabilities.

Security

Security was rated **4.5 (Very Satisfactory)**, with users noting the effectiveness of the system's encryption and data protection features. The system successfully ensured the confidentiality and integrity of user data, with minimal concerns regarding unauthorized access.

Compatibility

The system achieved a **4.4 (Very Satisfactory)** score for compatibility, successfully operating on a wide range of devices, including smartphones and computers. Minimal issues were encountered with legacy devices, reflecting a high level of adaptability.

Maintainability

Maintainability received a **4.3 (Very Satisfactory)** score, indicating that system updates and troubleshooting processes were straightforward for most users. Feedback highlighted the intuitive design of maintenance features and user guides.

Overall Discussion

The **overall performance score of 4.5 (Very Satisfactory)** reflects the GT-BMS's success in providing an innovative and effective solution for small craft safety. Its outstanding functionality, strong security measures, high compatibility, and ease of maintenance highlight its readiness for widespread adoption.

CONCLUSION

The development and implementation of the **Global Positioning System-Based Tracking and Monitoring System (GT-BMS)** successfully addressed the gaps in small craft safety. By combining real-time GPS tracking and SMS notifications, the system provided operators and maritime authorities with timely and accurate information, significantly enhancing navigation and emergency response capabilities.

The system achieved high performance across the evaluated criteria, as reflected in its **overall score of 4.5 (Very Satisfactory)**. It excelled in functional suitability, ensuring that all intended tasks were effectively addressed. The strong security measures demonstrated the system's ability to protect user data and maintain confidentiality. Additionally, its compatibility with various devices and ease of maintenance ensured broad accessibility and usability for small craft operators.

The GT-BMS also fulfilled its goal of contributing to the United Nations Sustainable Development Goals (SDGs), particularly **SDG 3 (Good Health and Well-being)**, **SDG 9 (Industry, Innovation, and Infrastructure)**, and **SDG 14 (Life Below Water)**. The system supports safer maritime practices, fosters technological innovation, and promotes sustainable use of marine resources.

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