
Safe Vessels: Enhancing Security and Safety for Aparri, Cagayan Fishers through Web-Based GPS Vessel Tracking

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ABSTRACT

GPS tracking gadgets are essential for improving fisher's security and safety. On fishing boats, real-time GPS trackers enhances communication and guarantee compliance with fishing regulations. With these devices, managers and users may keep an eye on the whereabouts of boats and get notifications when they depart from specific areas. In addition to providing protection, this technology helps anglers plan and navigate to their favorite fishing locations. Monitoring of the fishing vessels of our local fishers, fishing activities is made safer and more secure overall when GPS tracking technologies are used to monitor and protect the boat and its crew. Additionally, these systems are essential for maintaining legal compliance and encouraging sustainable fishing methods, which helps improve the management of fishing resources. Controlling fish populations and stopping illegal fishing require vigilantly tracking and documenting boat movements. However, a few things need to be taken into account, such as setup expenses, continuing upkeep, and guaranteeing dependable connectivity in remote locations. Furthermore, to fully realize the benefits of the system, users must be educated, and data security measures are necessary to safeguard sensitive information. To sum up, GPS tracking devices are essential for enhancing the efficiency, security, and safety of fishing operations. When implemented appropriately, they promote adherence to the law, environmentally friendly fishing methods, and the management of fisheries resources as a whole. GPS tracking is a vital instrument, in contemporary fishing techniques despite several obstacles including installation costs, upkeep, and user training. The advantages of GPS tracking significantly outweigh the disadvantages.

Keywords: Fishers, GPS, Monitoring System, SDG14, Tracking Device.

INTRODUCTION

To address issues including poverty, inequality, environmental degradation, and other global concerns, the United Nations adopted the Sustainable Development Goals (SDGs) in 2015. The conservation and sustainable use of the oceans, seas, and marine resources is the subject of one of the objectives, SDG 14. The SDGs' overarching goals, which include fostering decent employment and economic growth (SDG 8) and guaranteeing healthy lives and well-being (SDG 3), are in line with protecting the safety and welfare of those employed in the fishing industry.

The distribution of fatalities in the fishing sector varies significantly by age, region, employment type, and type of fishing. It is crucial to examine who is most vulnerable to injuries or fatalities on commercial fishing vessels, especially since 96% of these incidents occur at sea or on rivers (Conde, 2020). These may be associated to weather conditions, boat-related parameters, and fishers-related parameters. As of 2013, a total of 1958 motorized and 2341 non-motorized commercial fishing boats were recorded in the key coastal towns of Cagayan (Calicdan, MA et al, 2018). The likelihood of fishing related incidents is seen in various forms. The risk increases during the winter, the most profitable season for fishing, as rough waters and climate change intensify storms and hurricanes, contributing to a higher likelihood of vessels sinking. Consequently, inclement weather is a factor in one out of every six fishing deaths. Studies show that over half of these fatalities result from workers being carried overboard by nets or gear, with the remaining incidents involving activities such as retrieving, checking, or repairing equipment. Drowning accounts for approximately 84% of these deaths, a stark contrast to the shipping industry, which has a significantly lower total mortality rate. The risk of going overboard is exacerbated in cold water or winter conditions, where survival time without a lifejacket is less than ten minutes, with hypothermia developing rapidly and potentially leading to cardiac failure.

Self-employed fishermen makeup about half of the commercial fishing workforce but only account for 40% of the fatalities. Most deaths occur among wage and salary employees, who

are more likely to be performing hazardous tasks on deck. This pattern also reflects the age distribution of fatalities, with younger men less likely to own vessels and older individuals less likely to be wage laborers. Despite the inherent risks, the high fatality rate in the fishing sector can be mitigated through improved regulations, methods, and equipment. Organizations, especially the largest ones, must implement these safety measures. When they fail, it becomes the responsibility of concerned citizens and researchers to advocate for and enact changes to reduce accidents and fatalities among fishermen. Comprehensive investigations and the use of advanced tools are essential steps toward achieving a safer fishing industry.

Objectives of the Study

This capstone project entitled "Safe Vessels: Enhancing Security and Safety for Aparri, Cagayan Fishers through Web- Based GPS Vessel Tracking" seeks to

1. determine the current practices, policies, problems, and issues encountered by the fishers in the current navigations and tracking of vessels.
2. design, develop, and test a system solution needs to be developed to address the problems and issues encountered in the current system of tracking navigations of fishing boats.
3. determine the extent of compliance of the web-based application using ISO 25010:2011 Software Quality Standards in terms of:
 - a) Functionality Suitability
 - b) Performance Stability
 - c) Compatibility
 - d) Usability
 - e) Reliability
 - f) Security
 - g) Maintainability
 - h) Portability
4. determine the usability and acceptability of the developed application using the technology acceptance model.

MATERIALS AND METHODS

Research Design

The project used a descriptive- developmental design. The descriptive aspects focused on analyzing the assessments of the users and IT experts along compliance to ISO 25010:2011 and the indicators of the Technology Acceptance Model. The developmental aspect leverage on the adoption of the agile software development model.

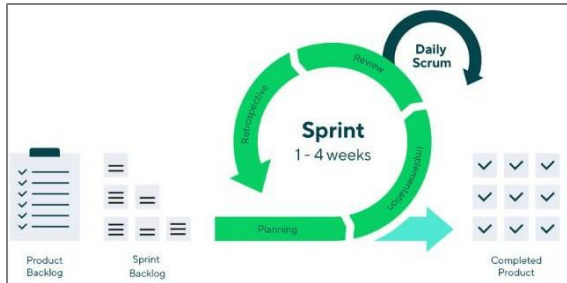


Figure 1. Agile Software Development Model

Agile Software Development Model

The Agile Method shows the researcher's way of implementing the system in Cagayan State University-Aparri Campus, "Safe Vessels: Enhancing Security and Safety for Aparri, Cagayan Fishers through Web-Based GPS Vessel Tracking", the Cycle covers the process of making the study. Software development and maintenance are the major goals of the agile software development life cycle approach or methodology. It is a scope that describes all software modifications, upgrades, and maintenance from start to finish.

Concept Phase

The idea stage comes first, prioritizing the most crucial initiatives, where the product owner collaborates with the client to document essential requirements, outline supported features and intended outcomes, start small with the possibility of expansion, estimate time and cost, and assess project feasibility through thorough research before commencement.

Inception Phase

After outlining the concept, the software development team is assembled by the product owner, who selects qualified members, confirms their availability, and initiates the design phase with project architecture and user interface mock-ups, ensuring stakeholder input and frequent check-ins to incorporate all requirements.

Iteration Phase

During the iteration phase, developers work closely to code the design, ensuring all specifications and user feedback are incorporated, aiming to achieve basic functionality by the first sprint and iterating further to add features and adjustments, showcasing agile software development's ability to swiftly adapt to client needs.

Release Phase

As the product approaches launch, the Agile quality assurance team conducts essential tests to ensure functionality, promptly addressing any defects found, while also preparing user training and documentation to finalize the product for production.

Maintenance Phase

Users can now access the fully deployed software, marking the start of the maintenance phase where the development team ensures ongoing functionality, addresses new defects, provides user training, and continues to update and enhance the product through subsequent iterations.

Retirement Phase

A product enters the retirement phase when replaced by new software or deemed incompatible or outdated by the company. Users are notified in advance, transferred to a new system if available, and developers complete final tasks before ceasing support.

Locale of the study

The study took place at the Cagayan State University at Aparri. Data and related information were requested and consented through the Philippine Coast Guard – CGS Aparri, Barangay 9, Minanga, Aparri, Cagayan. Additionally, other sources of data were obtained from the fishers in key coastal barangays of Aparri, Cagayan.

Data Gathering Tools and Instruments

The study made use of survey- questionnaire, observation guide, and document and interview checklist. The evaluation questionnaire is composed of the indicator statements of (1) the ISO 25010:2011 for the IT Experts and (2) User Acceptance and Use of Technology for User.

RESULTS AND DISCUSSION

The current practices, policies, problems, and issues encountered by the fishers in the current system.

1. Safety Practices:

- Basic Gear: Life jackets, ropes, and first aid kits are commonly carried on fishing boats to enhance safety.
- Signaling Devices: Traditional fishermen may carry signaling devices such as flares or whistles to attract attention in emergencies.

2. Difficulties Faced by Fishers:

- Lack of Existing Monitoring Systems:
- Fishermen often operate without access to dedicated vessel monitoring systems (VMS) or similar technologies for tracking their activities.
- Without such systems, fishermen may face challenges in ensuring their security and safety while at sea.

3. Policies and Regulations:

- There are specific policies in place governing the use of GPS tracking devices to ensure they are used

responsibly and ethically. These policies include obtaining necessary permissions from local authorities and ensuring data security and confidentiality.

- Compliance with environmental regulations is also a priority, ensuring that the devices do not negatively impact marine ecosystems.

The Developed System: Safe Vessels: Enhancing Security and Safety for Aparri, Cagayan Fishers through Web-Based GPS Vessel Tracking



Figure 2. Landing/Welcome Page

The accompanying figure displays the landing page for the developed system. You can enter the fisherman's details using the navigation to Join Now and the navigation to About Us.

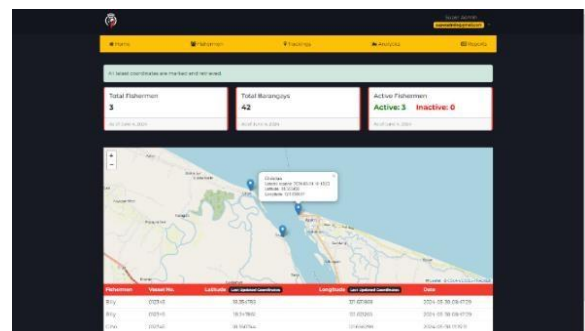


Figure 3. Dashboard (Admin)

The primary dashboard, which displays the most recent locations associated with each fisherman and highlights the website analytics, is depicted in the above figure while the administrator is logged in.

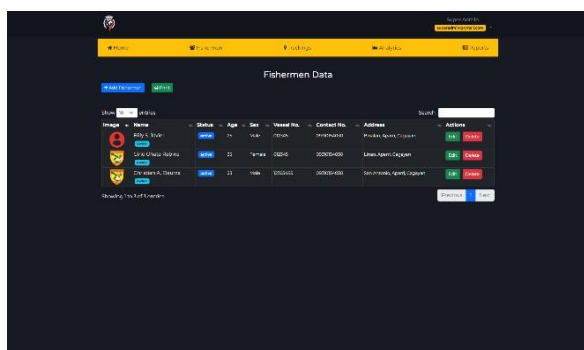


Figure 4. Fisherman Records

The fishermen's records are displayed in the above graphic together with the pertinent, significant details that go with them.

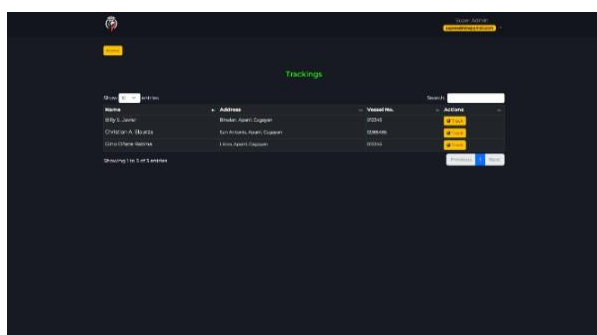


Figure 5. Fishermen's records that are locatable

Obtaining the Fisherman Table records will enable them to be located in this location.

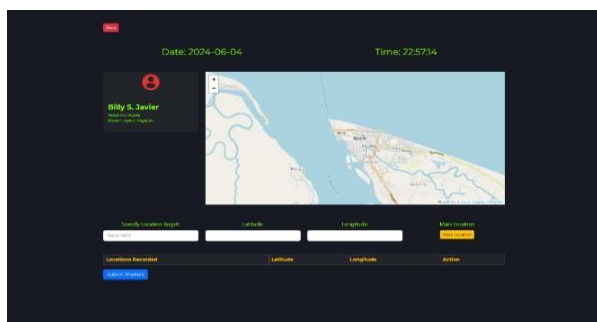


Figure 6. Dashboard (Track Vessel)

The dashboard shown in the above figure allows the administrator to find a specific fishing vessel and to update the vessel's most recent location when new locations are supplied.

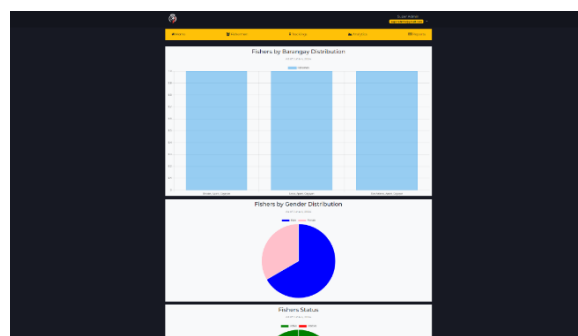


Figure 7. Analytics of Reports

The system's analytics data is displayed in the above graphic, which also includes a graph of active fishermen and information on fishermen by gender and barangay.

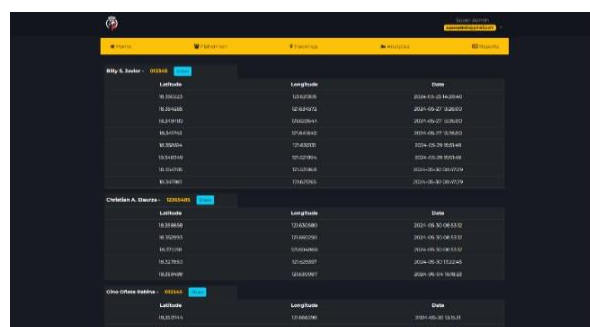


Figure 8. Reports regarding a vessel's indexed location

The reports that are produced based on the indexed position of a vessel are shown in Figure 8. These reports offer comprehensive tracking data, displaying the vessel's exact location in real-time.

Comparative Assessment of the Safe Vessels - Prototype and Common GPS Trackers VMS (Vessel Monitoring System)

Table 1. Comparative Assessment of the Safe Vessels

	Safe Vessels - Prototype	VMS – GPS Trackers
Cost	\$35-\$65 (cost-effective, especially for educational purposes)	\$20-\$200+

Functionality	Customizable to specific needs, can add unique features (e.g., environmental sensors, custom alerts)	Advanced features (geo-fencing, real-time tracking, apps)
Ease of Use	Learning experience, educational value, satisfaction of building your device	Plug-and-play, user-friendly, customer support
Scalability and Flexibility	Highly customizable, suitable for innovative projects, expandable with additional sensors	Limited to manufacturer specifications, the range of models available
Reliability and Accuracy	Depends on component quality and assembly, potential for high reliability with careful design	More reliable, robust testing, better accuracy
Market Demand and Use Cases	Ideal for hobbyists, educational purposes, custom applications (e.g., research projects, DIY enthusiasts)	Wide range of applications (personal safety, fleet management, etc.)
Overall Suitability	Excellent for learning, innovation, and custom applications; significant cost savings for tailored solutions	Practical and reliable for general consumers and businesses

The extent of compliance to ISO Standards as assessed by the IT Experts.

Table 2. Summary of Assessments of the IT Experts

Category	Mean	DV
Functionality Suitability	4.800	Very High Extent
Performance Stability	4.667	Very High Extent

Compatibility	4.767	Very High Extent
Usability	4.667	Very High Extent
Reliability	4.833	Very High Extent
Security	4.767	Very High Extent
Maintainability	4.733	Very High Extent
Portability	4.700	Very High Extent
Overall Mean	4.741	Very High Extent

The software system performed quite well, according to the IT professionals' evaluations, with mean scores ranging from 4.667 to 4.833 in all assessed categories. Particularly, an overall mean score of 4.741 was achieved by rating extremely highly on functionality appropriateness, performance stability, compatibility, usability, dependability, security, maintainability, and portability. These high scores indicate that the system not only meets but exceeds the standard requirements across multiple dimensions of software quality. All things considered, these high ratings imply that the system is prepared to proceed into the development stage, guaranteeing that it satisfies user requirements and operates dependably in practical situations.

User Acceptance of the Developed System using the Unified Theory of Acceptance and Use of Technology

Table 3. Summary of Assessments of the Users

Statements	Mean	Interpretation
Performance Expectancy	4.175	Agree
Effort Expectancy	4.142	Agree
Social Influence	4.142	Agree
Facilitating Conditions	4.192	Agree
Behavioral intention	4.225	Agree

Perceived Ease of Use	4.050	Agree
Perceived Usefulness	4.225	Strongly Agree
Self-Efficacy	4.225	Strongly Agree
Response		
Efficacy	4.225	Strongly
Agree		
Adoption Intentions	4.200	Agree
Overall Mean	4.180	Agree

The software system appears to be well-received by users, as seen by the mean scores obtained in most areas. Notably, the highest ratings—interpreted as strongly agree—were given to perceived usefulness, self-efficacy, and response efficacy. The system's overall mean score, which is 4.180, indicates that users are generally in accord with its functionality and performance.

CONCLUSIONS

After logical analysis and interpretation of data, these are the conclusions that can be drawn from the findings of the study:

The developed application features a real-time location of the fishing boats, maximizing the use of Arduino technology and GPS technology, as well as aspects of geofencing within the Aparri waters. The provision of a customizable dashboard for the key government offices offers statistical values on geo-locations, vessel-related track points, and real-time data that heeds to the decision-making efforts of the authorities upon ensuring safety and monitoring of fishers. The developed application conforms to the indicators of the ISO 25010:2011 software quality characteristics and the Technology Acceptance Model.

RECOMMENDATIONS

The researchers recommended the following:

- Forging partnership with Philippine Coast Guard and the Local Government of Aparri for the adoption and use of the developed application and device for fishers in the locality.
- Enhancing training programs for fishers to improve their understanding and operation of GPS tracking devices may be initiated by the local fishing authorities. This could include the development of multilingual training materials and interactive workshops.
- Developers and designers may focus on improving the reliability and accuracy of GPS tracking devices through technological advancements and regular maintenance checks.
- Establishing a robust support system for technical issues, ensuring that fishers and researchers have access to timely assistance when needed

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ACKNOWLEDGEMENT

First and foremost, the researchers extend their profound gratitude to God for His unwavering presence in their lives. His love, grace, and mercy have been a constant source of comfort and strength, guiding them through the challenges and uncertainties of this academic endeavor.

The researchers would like to express their sincere appreciation to their advisor, Dr. Billy S. Javier, for his invaluable contributions to their academic and research pursuits. His expertise, guidance, support, and insightful feedback have greatly enriched the quality and depth of this thesis. They are grateful for his mentorship and the knowledge he has imparted, which has been instrumental in shaping their scholarly development.

They also wish to thank the esteemed Dean, Dr. Julieta B. Babas, for her leadership and support. It is through God’s grace that they have had the opportunity to learn and grow under her guidance.

To their dear friends, the researchers express their gratitude to God for placing them in their lives. Their friendship, encouragement, and shared experiences have been a true blessing, providing joy and strength throughout this academic journey.

Lastly, the researchers wish to convey their deepest gratitude to their families, whom God has blessed them with. Their love, prayers, and unwavering faith have been crucial to their achievements. The researchers are forever thankful for their support and the profound connection they share.