Received: 15 APR 2026 | Accepted: 18 JUN 2026 | Published Online: OCT 2026
UCLM Journal of Computer Science, Engineering and Information Technology Vol. 1 Issue 1 (October 2026)

iSWAI: An Intelligent Shore-Based Wind Speed and Direction Monitoring System Using Random Forest and XGBoost

S. Bonganciso, E. L. Lacubtan, A. K. Ruiz, J.C. Engkong, D. T. Seroje, R. Fernandez, D.Abad
Bachelor of Science in Computer Engineering
University of Cebu - Lapu-Lapu and Mandaue
A. C. Cortes Avenue, Looc, Mandaue City

***Abstract*—Fishing communities are increasingly exposed to unpredictable winds and rough sea conditions caused by climate change. In Talisay, Daanbantayan, the lack of localized weather monitoring and sudden wind shifts place fishermen at greater risk during fishing activities. To address this issue, this study developed iSWAI, an intelligent shore-based wind speed and direction monitoring system that integrates Internet of Things (IoT) technology and machine learning for real-time localized wind monitoring and prediction. The system utilized an anemometer and wind vane connected to a microcontroller to collect and transmit wind data through a web-based interface. Random Forest and Extreme Gradient Boosting (XGBoost) algorithms were implemented to generate predictive wind analytics. Using a developmental research design with an Agile approach, the system was evaluated in terms of accuracy, reliability, responsiveness, and user acceptance among 20 fishermen participants. Results showed that the system achieved high performance, with 100% success rates in wind direction accuracy, prediction accuracy, reliability, and alert responsiveness, while wind speed accuracy and prediction update responsiveness achieved 90%. The wind speed prediction model achieved an R^2 of 0.9460, while the wind direction model achieved an R^2 of 0.9713. User evaluations indicated high acceptance in usefulness (3.59), ease of use (3.63), and behavioral intention to use (3.70). The findings demonstrate that iSWAI can support safer decision-making among fishermen and has strong potential as an adaptable coastal safety solution for local fishing communities.**

***Keywords*—Internet of Things (IoT), machine learning, wind monitoring, predictive analytics, coastal safety**

I. INTRODUCTION

Extreme weather events and environmental changes continue to threaten vulnerable communities worldwide. In particular, fishing communities face growing challenges as shifts in wind patterns, sudden storms, and limited access to timely forecasts increase uncertainty and safety risks. Climate change has further intensified these threats by increasing the frequency and severity of extreme events and reducing the reliability of traditional forecasting methods for small-scale fishers.

Globally, studies have reported significant changes in wind behavior and weather predictability affecting fishing activities. Observational datasets from more than 4,700 meteorological stations show a 10% decline in seasonal wind speed ranges since 1980, indicating reduced predictability [1]. Empirical studies further demonstrate that these changes directly affect fisheries. In Iskenderun Bay, stronger winds significantly reduced fishing duration [2], while fishers in Nosy Barren, Madagascar, experienced fewer fishing hours because of adverse weather conditions [3]. These findings show how climate variability affects not only marine ecosystems but also the safety, income, and resilience of fishing communities.

The Philippines is among the most disaster-prone countries in the world, ranking first in the 2022 World Risk Index due to high exposure to natural hazards and limited adaptive capacity [4]. Fisherfolk are among the most climate-vulnerable sectors, as their livelihoods depend heavily on stable weather and sea conditions [5]. Events such as Typhoon Haiyan in 2013 and Typhoon Odette (Rai) in 2021 highlight the consequences of limited localized weather information and preparedness, resulting in significant fisheries losses [6]–[7]. Even outside major disasters, small-scale fishers frequently lose income and fishing days due to sudden weather shifts and rough seas.

Although the Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA) provides essential weather advisories, these are often too broad to capture rapidly changing coastal conditions. Because of microclimatic variations, localized forecasts are necessary [8]. As a result, many fisherfolk still rely on traditional indicators such as clouds, wind patterns, moon phases, and animal behavior alongside official forecasts [9]. This reflects two key issues: increasing risks from climate variability and the lack of localized weather information.

In Cebu, coastal municipalities reflect these risks at a more localized scale. Vulnerability assessments in areas such as Moalboal confirm significant exposure to climate and ocean hazards affecting livelihoods [10]–[11]. These findings reinforce the need for community-focused forecasting systems tailored to coastal environments.

Within this context, Talisay in Daanbantayan, Cebu serves as a critical case study due to its dependence on small-scale fishing and frequent exposure to strong winds and rough seas. Fisherfolk primarily use small non-motorized boats with

Copyright: ©2026 The Authors. UCLM Journal of Computer Science, Engineering and Information Technology is published by University of Cebu Lapu-Lapu & Mandaue
This is an open-access journal licensed under the Creative Commons Attribution-NonCommercial 4.0 International (**CC BY-NC 4.0**) License.

limited safety equipment, making them highly vulnerable to sudden environmental changes. Traditional forecasting methods and national advisories are often insufficient due to climate change and rapidly changing conditions in the Visayan Sea. This highlights the need for a localized system that transforms real-time environmental data into actionable information for fishermen.

Recent advancements in Internet of Things (IoT) and machine learning provide viable solutions to this problem. IoT enables real-time environmental data collection through sensor networks, while machine learning analyzes historical and real-time data to generate predictive insights. These technologies have shown strong potential in climate-sensitive applications, including agriculture and disaster preparedness.

Motivated by these developments, this study proposes the Intelligent Shore-Based Wind Speed and Direction Monitoring System Using Artificial Intelligence (iSWAI). The system integrates IoT-based sensors, a web-based interface, and machine learning algorithms, specifically Random Forest and XGBoost, to provide real-time wind monitoring and localized prediction. Although Talisay serves as the pilot site, the system presents a scalable model for localized forecasting that bridges the gap between national advisories and community-level needs, contributing to safer decision-making and improved resilience among fishing communities in the Philippines.

II. Statement of the Problem

This study aimed to design and develop iSWAI: An Intelligent Shore-Based Wind Speed and Direction Monitoring System Using Random Forest and XGBoost, to provide safe, accessible, and real-time wind information to fishermen in Talisay, Daanbantayan, Cebu.

Specifically, the study seeks to:

1. Identify related studies and technologies on wind monitoring and alert systems, and gather user requirements from local fishermen to guide the prototype design.
2. Develop a shore-based system that monitors wind speed and direction in real time, with data collection, a display interface, automated alerts, and a machine learning-based wind prediction feature.
3. Evaluate the system in the coastal setting of Talisay and its technical performance in terms of:

   3.1. Accuracy of wind speed and direction measurement.

   3.2. Reliability of real-time data transmission.

   3.3. Responsiveness of the alert mechanism.

4. Determine the system's usability and acceptability among local fishermen in terms of:

   4.1. Perceived usefulness.

   4.2. Perceived ease of use.

   4.3. Behavioral intention to use.

III. Methodology

This section discusses the methods used to conduct the study to meet its objectives. It includes the research environment, the respondents involved, the instruments used, and the procedures and data-gathering techniques applied throughout the study.

A. Research Design

The study used a developmental research design, which emphasizes the systematic process of designing, developing, and evaluating products or systems to enhance their effectiveness, efficiency, and applicability [12]. This approach aligns to create iSWAI as a functional and practical prototype for monitoring wind speed and direction, tailored to the needs of local fishermen. To ensure the system meets its intended purpose, quantitative methods were employed to assess its performance in terms of accuracy, reliability, and responsiveness. This evaluation provided measurable data to guide improvements and confirm that the final prototype is both efficient and user-friendly, offering practical support for fishing activities and community decision-making.

B. Research Method

The study adopted the Agile development approach, an iterative and flexible methodology that divides the project into short, manageable phases. Each phase involved planning, designing, developing, and testing specific components of iSWAI, enabling continuous evaluation and timely adjustments based on user and stakeholder feedback [13]. This approach ensures that the system evolves progressively, addressing potential issues as they arise and improving overall functionality. By incorporating regular testing and feedback loops, the researchers can enhance the system's performance, usability, and relevance for local fishermen. Ultimately, the Agile method supports the development of a practical, user-centered, and efficient prototype for wind speed and direction monitoring.

C. Research Environment

This study was conducted in Barangay Talisay, a coastal community in Daanbantayan, Cebu, located at the northern tip of the province. The area was chosen because its fishermen are highly vulnerable to sudden weather changes, as most use small boats with minimal safety equipment. National forecasts often do not capture the specific conditions they face, so many still rely on traditional signs like clouds and currents, which are now less reliable due to climate change. These problems highlight the need for a more accurate, community-based monitoring tool, making Barangay Talisay a suitable place to develop an AI-powered system that can help fishermen make safer decisions and protect their livelihoods.

D. Research Subjects or Respondents

The respondents of this study are 20 selected fishermen from Barangay Talisay, Daanbantayan, Cebu. They are selected based on their direct experience with sudden changes in weather and sea conditions, which affect their daily fishing activities and primary livelihood. Focusing on this group ensures that the feedback reflects the real challenges faced by local fishermen. The respondents participate in the user-acceptance evaluation of the iSWAI system, where they

Copyright: ©2026 The Authors. UCLM Journal of Computer Science, Engineering and Technology

assess its usefulness, ease of use, and overall effectiveness. Their responses provide valuable insights into how well the system meets the needs of fishermen and its potential benefits to their safety, livelihood, and decision-making in real-world fishing activities.

E. Research Instrument

This study used a researcher-developed survey questionnaire to collect data from the respondents as part of the user-acceptance evaluation. The questionnaire focuses on assessing the system's perceived usefulness, ease of use, and behavioral intention to use. To ensure the validity and clarity of the instrument, it is reviewed and validated by three engineering instructors. Their feedback and suggestions are incorporated to improve the questionnaire before it is administered to the respondents. The collected responses are then analyzed to evaluate the system's acceptability and effectiveness among the intended users.

F. Research Procedure

The respondents in the study were first identified based on their exposure as fishermen and their availability during the data-gathering period. Once identified, the survey questionnaires were personally administered to them, accompanied by a brief explanation of the study's purpose and the instructions for answering. They were also invited to participate in short face-to-face interviews to clarify or expand on their survey responses.

After collecting the completed questionnaires, the data were organized, encoded, tabulated, and analyzed using statistical tools, including frequency counts, percentages, and means. The results served as the basis for determining user needs, identifying common challenges related to wind monitoring, and evaluating the potential usefulness of the proposed system.

G. Gathering of Data

The data for this study were gathered personally by the researchers through survey questionnaires and short interviews. The respondents were given sufficient time to answer the questions carefully, and the researchers were present to provide clarifications as needed to avoid misunderstandings. All completed questionnaires were collected on the same day to ensure uniformity in data handling and to prevent missing or altered responses. Before answering, respondents were informed of the study's purpose to encourage honest and accurate feedback.

The face-to-face interviews were conducted immediately before or after the survey to capture additional insights and experiences. All information gathered were treated with strict confidentiality, stored securely, and used only for academic purposes to protect the respondents' privacy.

IV. Results and Discussion

This section presents the results of the evaluation and testing of the iSWAI system in terms of accuracy, reliability, responsiveness, and user acceptance. The accuracy of the prediction models is assessed using Mean Absolute Error (MAE), Mean Squared Error (MSE), and the coefficient of determination (R^2). The findings provide insights into the system's capability to monitor wind speed and direction, transmit real-time data, generate alerts, and support fishermen in decision-making.

A. Accuracy Testing

This section presents the test scenarios and cases developed to evaluate the system's accuracy in predicting wind conditions and recording real-time data.

Results of the System's Accuracy of Wind Speed and Direction Measurement

This section presents the results of the accuracy testing conducted to evaluate the system's wind speed, wind direction, and prediction accuracy.

Table 1. Results of the System's Wind Speed Accuracy Testing

Trial	Reference	iSWAI Speed	Difference	Status
1	11 km/h	11.5 km/h	0.5	Passed
2	11 km/h	9.4 km/h	1.6	Passed
3	11 km/h	9.0 km/h	2	Passed
4	11 km/h	11.5 km/h	0.5	Passed
5	11 km/h	8.3 km/h	2.7	Passed
6	11 km/h	9.0 km/h	2	Passed
7	11 km/h	6.5 km/h	4.5	Failed
8	11 km/h	10.8 km/h	0.2	Passed
9	11 km/h	8.3 km/h	2.7	Passed
10	11 km/h	8.6 km/h	2.4	Passed
Average Wind Speed Difference			**1.91 km/h**	**Passed**
Overall Result of Wind Speed Accuracy				

Table 1 shows the system's wind speed accuracy results. Most trials were close to the reference values, with 9 out of 10 (90%) meeting the acceptable threshold. One trial exceeded the limit, likely due to fluctuating wind conditions and sensor limitations. Overall, the system demonstrated accurate and reliable wind speed measurement.

Table 2. Results of the System's Wind Direction Accuracy Testing

Trial	Reference	iSWAI	Difference	Status
1	0° N	0° N	0°	Passed
2	90° E	90° E	0°	Passed
3	180° S	180° S	0°	Passed
4	270° W	270° W	0°	Passed
5	250° SW	247° SW	3°	Passed
6	133° SE	135° SE	2°	Passed
7	66° NE	67.5° NE	1.5°	Passed
8	315° NW	315° NW	0°	Passed
9	225° SW	225° SW	0°	Passed
10	134° SE	135° SE	1°	Passed
Average Wind Direction Difference			**0.75°**	**Passed**
Overall Result of Wind Direction Accuracy				

Table 2 displays the system's wind direction accuracy results. All trials recorded values that are identical or very close to the reference direction, with all differences falling within the acceptable threshold. Out of ten trials, all met the

Copyright: ©2026 The Authors. UCLM Journal of Computer Science, Engineering and Technology

defined threshold, resulting in 100% of trials meeting the acceptable range. The minimal variations observed in some trials may be due to slight sensor sensitivity and environmental factors. Overall, the system demonstrated highly accurate wind direction measurement across all trials, indicating that it can provide reliable directional data for monitoring wind conditions.

Table 3. Results of the System's Wind Prediction Accuracy Testing

Trial	Actual	Predicted	Difference	Status
1	5.2 km/h	7.4 km/h	2.2	Passed
2	4.4 km/h	5.4 km/h	1.0	Passed
3	5.4 km/h	4.1 km/h	1.3	Passed
4	4.6 km/h	4.0 km/h	0.6	Passed
5	3.9 km/h	4.3 km/h	0.4	Passed
6	3.9 km/h	4.8 km/h	0.9	Passed
7	3.2 km/h	5.2 km/h	2.0	Passed
8	2.7 km/h	4.6 km/h	1.9	Passed
9	2.9 km/h	4.6 km/h	1.7	Passed
10	4.1 km/h	4.9 km/h	0.8	Passed
Average Wind Speed Difference			**1.28km/h**	**Passed**
Overall Result of Wind Prediction Accuracy				

Table 3 shows the system's prediction accuracy results. The predicted wind speed values were compared with the actual recorded wind speed values to evaluate the performance of the machine learning model. Results show a 100% compliance within the acceptable threshold, indicating that all trials produced differences within the acceptable range. Minor variations between actual and predicted values may be due to changing environmental conditions and limitations in prediction modeling. Overall, the results demonstrate that the system can provide reliable wind speed predictions for monitoring purposes.

B. Reliability Testing

This section presents the test scenarios and cases developed to evaluate the system's ability to transmit, store, and display real-time wind data.

Results of the System's Reliability of Real-Time Data Transmission

This section presents the results of the reliability testing conducted to evaluate the system's ability to transmit, store, and display wind data in real time.

Table 4. Results of the System's Reliability Testing

RELIABILITY TESTING											
TEST CASES	**TRIALS**										**%**
	1	2	3	4	5	6	7	8	9	10	
Verify that all hardware components power on and initialize without errors.	P	P	P	P	P	P	P	P	P	P	100%
Verify that the microcontroller connects to the Wi-Fi network after booting.	P	P	P	P	P	P	P	P	P	P	100%
Verify that the microcontroller transmits wind data at the set interval.	P	P	P	P	P	P	P	P	P	P	100%
Verify that newly sent sensor data appears on the dashboard without noticeable delay.	P	P	P	P	P	P	P	P	P	P	100%
Verify that transmitted wind speed and direction values are saved accurately in the database.	P	P	P	P	P	P	P	P	P	P	100%
Verify that the system correctly displays wind speed and direction from the database.	P	P	P	P	P	P	P	P	P	P	100%
Verify that multiple users can access wind data without performance degradation.	P	P	P	P	P	P	P	P	P	P	100%
System's Overall Reliability											**100%**

Table 4 shows the system's reliability testing results. Across 10 trials, the prototype consistently powered on correctly and the microcontroller successfully connected to the Wi-Fi network without issues. The system reliably transmitted wind data at the configured intervals, which appeared promptly on the dashboard. The transmitted sensor data was also accurately stored in the database and could be retrieved without issues. Additionally, multiple users were able to access wind data simultaneously without performance degradation. Overall, the system achieved 100% reliability, indicating stable and dependable performance throughout all testing trials.

Copyright: ©2026 The Authors. UCLM Journal of Computer Science, Engineering and Technology

C. *Responsiveness Testing*

This section presents the test scenarios and cases developed to evaluate how the system responds to changing wind conditions through alerts and indicators.

Results of the System's Responsiveness of the Alert Mechanism

This section presents the results of the alert responsiveness testing conducted to evaluate how effectively the system reacts to changing wind conditions.

Table 5. Results of the System's Safety Indicator Responsiveness Testing

Trial	Event	Response Time	Status
1	Safe	1 sec	Passed
2	Moderate	1 sec	Passed
3	Moderate	1 sec	Passed
4	Unsafe	1 sec	Passed
5	Safe	1 sec	Passed
6	Safe	1 sec	Passed
7	Moderate	1 sec	Passed
8	Safe	1 sec	Passed
9	Safe	1 sec	Passed
10	Safe	1 sec	Passed
Average Response Time		**1 sec**	**Passed**
Overall Result of Safety Indicator Responsiveness			

Table 5 presents the results of the safety indicator responsiveness testing. The system consistently updated the safety indicators based on changes in wind conditions within an average response time of 1 second. All trials were successfully executed, indicating that the system can quickly reflect changes in wind status through visual indicators on the interface. This demonstrates that the safety indicator feature responds effectively and in near real-time. Overall, the system achieved 100% responsiveness, confirming that all trials successfully triggered timely safety indicator updates.

Table 6. Results of the System's Alert Activation Responsiveness Testing

Trial	Event	Response Time	Status
1	Wind Speed Increase	1 sec	Passed
2	Wind Speed Increase	1 sec	Passed
3	Wind Speed Increase	1 sec	Passed
4	Wind Speed Increase	1 sec	Passed
5	Wind Speed Decrease	1 sec	Passed
6	Wind Speed Increase	1 sec	Passed
7	Wind Speed Increase	1 sec	Passed
8	Wind Speed Decrease	1 sec	Passed
9	Wind Speed Increase	1 sec	Passed
10	Wind Speed Decrease	1 sec	Passed
Average Response Time		**1 sec**	**Passed**
Overall Result of Alert Activation Responsiveness			

Table 6 presents the results of the alert activation responsiveness testing. The system successfully triggered alerts in response to changes in wind conditions, with all recorded response times averaging around 1 second. This indicates that the alert mechanism is capable of immediate activation once unsafe or changing wind conditions are detected. Overall, the system achieved 100% responsiveness, demonstrating reliable and timely alert generation for user warning purposes across all testing trials.

Table 7. Results of the System's Prediction Update Responsiveness Testing

Trial	Event	Response Time	Status
1	Wind Speed Increase	23 sec	Passed
2	Wind Speed Decrease	26.30 sec	Passed
3	Wind Speed Increase	18.80 sec	Passed
4	Wind Speed Decrease	8 sec	Passed
5	Wind Speed Increase	28.30 sec	Passed
6	Wind Speed Increase	14.15 sec	Passed
7	No prediction generated	N/A	Failed
8	Wind Speed Increase	24.50 sec	Passed
9	Wind Speed Increase	28.10 sec	Passed
10	Wind Speed Increase	26.75 sec	Passed
Average Response Time		**21.99sec**	**Passed**
Overall Result of Prediction Update Responsiveness			

Table 7 presents the results of the prediction update responsiveness testing. The system generally updated predicted wind data on the web interface within an acceptable response time, with most trials successfully completed. However, one trial failed due to no prediction being generated, indicating a temporary issue in system processing. Despite this, the overall results show that the system is capable of updating prediction outputs in near real-time under normal conditions. Overall, the system achieved 90% responsiveness, indicating generally reliable prediction updates with minor inconsistencies during testing.

D. *Model Accuracy and Evaluation: MSE, MAE, and R² Analysis*

This section presents the evaluation results of the model's predictive accuracy using three key performance metrics: Mean Squared Error (MSE), Mean Absolute Error (MAE), and R² score, providing a comprehensive assessment of the model's ability to predict wind speed and wind direction accurately.

Wind Speed Model Accuracy and Evaluation

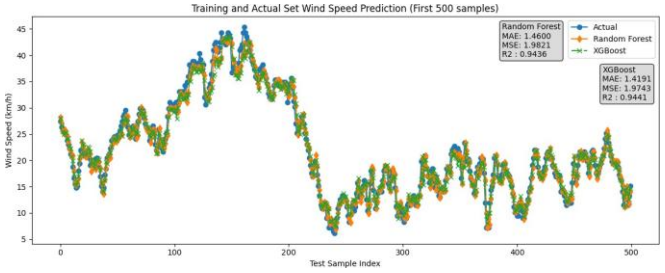

Fig. 1. Training and Actual Set Wind Speed Prediction (First 500 samples)

Copyright: ©2026 The Authors. UCLM Journal of Computer Science, Engineering and Technology

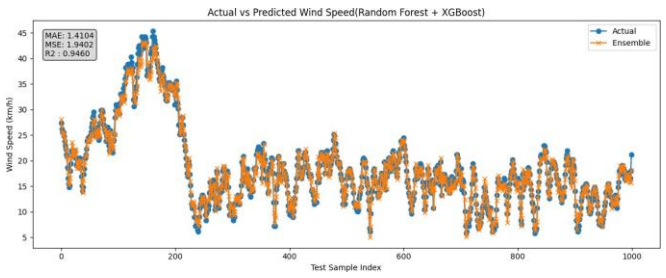

Fig. 2. Wind Speed Prediction Graph of the Combined Random Forest and XGBoost Models

The wind speed prediction model for Talisay, Daanbantayan, Cebu demonstrates strong performance based on standard evaluation metrics. It achieved a Mean Absolute Error (MAE) of 1.4104, indicating a small average difference between predicted and actual wind speeds. The Mean Squared Error (MSE) of 1.9402 shows that large prediction errors are minimal, reflecting consistent model performance. Additionally, the R^2 score of 0.9460 indicates that about 95% of the variation in wind speed is accurately explained by the model, confirming its reliability and effectiveness in predicting real-world wind conditions.

Wind Direction Model Accuracy and Evaluation

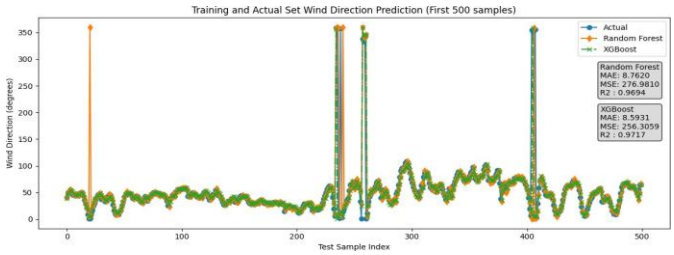

Fig. 3. Training and Actual Set Wind Direction Prediction (First 500 samples)

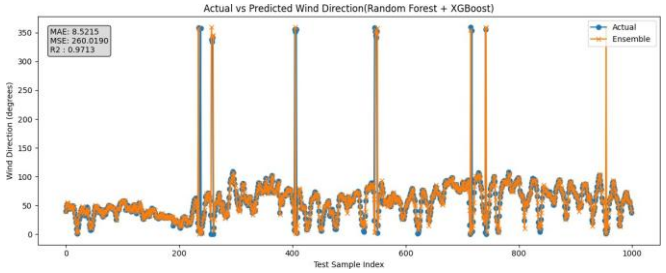

Fig. 4. Wind Direction Prediction Graph of the Combined Random Forest and XGBoost Models

The wind direction prediction model for Talisay, Daanbantayan, Cebu shows strong and reliable performance. It achieved a Mean Absolute Error (MAE) of 8.5215 degrees, indicating a small average deviation between predicted and actual directions. The Mean Squared Error (MSE) of 260.0190 suggests only occasional larger errors, while overall consistency is maintained. The model also obtained a high R^2 score of 0.9713, meaning about 97% of wind direction variability is accurately explained by the model. Despite minor limitations due to the circular nature of wind direction data, the results confirm that the combined Random Forest and XGBoost model effectively captures wind direction patterns and provides dependable predictions.

E. User Satisfaction and Evaluation

This section presents the analysis of the user acceptance evaluation survey results, providing insights into users' satisfaction with the system.

Respondent's Profile

This section presents the demographic profile of the respondents involved in the study.

Table 8. Type of fishing vessel

Variables	Frequency	Percentage
Small motorized	14	70%
Largely motorized	6	30%

As shown in Table 8, most respondents (70%) use small motorized boats, indicating that fishing in Barangay Talisay is primarily small-scale, while 30% use largely motorized boats. The result highlights the need for reliable wind and weather monitoring tools to ensure the safety of fishermen at sea. Small-scale fishers are highly vulnerable to changing weather and climate conditions [14]. Therefore, reliable wind and weather information is essential to support safer and more informed fishing decisions.

Table 9. Fishing distance from shore

Variables	Frequency	Percentage
Nearshore	8	40%
Midshore	6	30%
Offshore	6	30%

Table 9 shows that 40% of the fishermen operate near the shore, while 30% work in midshore areas and another 30% operate offshore. This indicates that although many fishermen stay close to shore, a considerable number still travel farther, making real-time weather and wind alerts important for safety

Copyright: ©2026 The Authors. UCLM Journal of Computer Science, Engineering and Technology

and decision-making. It also suggests that fishermen experience different levels of exposure to sudden wind changes, highlighting the need for a reliable alert system for both short- and long-distance fishing trips. This is supported by studies showing that weather variability significantly affects fishing safety and available fishing time among small-scale fishers [3].

Table 10. Frequency of fishing activities

Variables	Frequency	Percentage
Daily	6	30%
Several times a week	9	45%
Weekly	5	25%

The frequency of fishing activities among the respondents is presented in Table 10. The results show that 9 fishermen (45%) go fishing several times a week, while 6 (30%) go fishing daily and 5 (25%) fish on a weekly basis. None of the respondents reported fishing only occasionally. These findings suggest that most fishermen engage in regular fishing activities, highlighting the importance of reliable and timely wind monitoring information to support fishing activities and safety at sea. Small-scale fishers are highly affected by changing weather conditions due to their frequent dependence on fishing for livelihood [15].

Table 11. Years of fishing experience

Variables	Frequency	Percentage
1-5 years	4	20%
6-10 years	9	45%
More than 10 years	7	35%

Table 11 presents the years of fishing experience among the respondents. The results show that 45% of the fishermen have 6–10 years of fishing experience, while 35% have more than 10 years of experience. Meanwhile, 20% have been fishing for 1–5 years, and none reported having less than a year of experience. These findings indicate that most respondents have considerable fishing experience, suggesting that their feedback and evaluation of the system are based on practical knowledge and real fishing conditions. This strengthens the reliability of their responses, as they are grounded in long-term exposure to sea and weather conditions. Experience plays a key role in how fishers understand and respond to environmental and climate-related risks in fishing activities [16].

Table 12. Access to a smartphone

Variables	Frequency	Percentage
Yes	14	70%
No	6	30%

Of 20 respondents, 14 (70%) reported having access to smartphones, while 6 (30%) did not. This indicates that most fishermen can use mobile-based systems with app features, although a significant portion may require alternative methods for receiving alerts. Smartphones can enhance small-scale fisheries by improving access to real-time information and communication, supporting safer and more informed fishing decisions [17].

Table 13. Mobile network availability

Variables	Frequency	Percentage
Always available	8	40%
Sometimes available	8	40%
Rarely/ Not available	4	20%

Table 13 shows that 8 respondents (40%) always have mobile network availability, while another 8 respondents (40%) reported that it is sometimes available, and 4 respondents (20%) indicated that the network is rarely or not available. While some fishermen have stable network coverage, others still experience connectivity issues, underscoring the importance of features that can function even with weak or limited internet access. These results highlight the need for the alert system to remain dependable in low-signal conditions so that fishermen can still receive warnings during critical situations. Fishing communities often face challenges in accessing timely information due to limited and unstable connectivity [18].

Table 14. Source of weather information

Variables	Frequency	Percentage
PAGASA	17	85%
Fellow fishers	4	20%
Traditional signs	17	85%
Mobile app/SMS	2	10%

Table 14 shows that the majority of fishermen rely on PAGASA reports (17 respondents, 85%) and traditional signs (17 respondents, 85%) for weather and wind updates, while a smaller number consult fellow fishers (4 respondents, 20%). Only a few respondents use mobile apps or SMS (2 respondents, 10%). This indicates that while formal and traditional weather sources are widely trusted, digital tools are still not commonly used. Fisherfolk commonly depend on both

Copyright: ©2026 The Authors. UCLM Journal of Computer Science, Engineering and Technology

traditional forecasting practices and official weather advisories [9]. The result highlights the potential benefit of introducing an accessible, AI-powered wind alert system that can complement both modern and traditional knowledge sources, improving safety and decision-making through timely and localized wind updates. It also suggests the importance of making weather information more accessible and user-friendly to support fishermen in adapting to changing sea conditions.

Perceived Usefulness (PU)

This section presents the perceived usefulness based on the user acceptance survey.

Table 15. User-Acceptance Results Assessing the Perceived Usefulness

Statement	Mean	Verbal Interpretation
1. The iSWAI system provides useful real-time wind information for my fishing activities.	3.70	Strongly Agree
2. The system helps me make safer decisions before going out to sea.	3.60	Strongly Agree
3. The wind speed and direction data are helpful in planning my fishing trips.	3.75	Strongly Agree
4. The system's alerts help me avoid dangerous wind and sea conditions.	3.65	Strongly Agree
5. The system's wind predictions help me anticipate sudden changes in weather.	3.60	Strongly Agree
6. The system improves my confidence in deciding whether to go fishing or not.	3.40	Strongly Agree
7. The system can help reduce risks while fishing.	3.50	Strongly Agree
8. The recorded wind data/history helps me understand wind patterns in my area.	3.50	Strongly Agree
Average Weighted Mean	**3.59**	**Strongly Agree**

The user-acceptance results assessing perceived usefulness of the iSWAI system are shown in Table 15. Respondents strongly agree that the system provides useful real-time wind information (3.70) and helps them make safer decisions before going to sea (3.60). They also find wind data helpful for planning trips (3.75), with alerts aiding in avoiding dangerous conditions (3.65) and predictions supporting anticipation of sudden weather changes (3.60).

In addition, respondents strongly agree that the system improves their confidence in deciding whether to go fishing (3.40), helps reduce risks while fishing (3.50), and that recorded wind data helps them understand local wind patterns (3.50). Overall, the system obtained an average weighted mean of 3.59, interpreted as Strongly Agree, indicating high perceived usefulness, supported by findings that fisheries-based digital systems are widely accepted when they provide practical and relevant information for safety and decision-making [19].

Perceived Ease of Use (PEOU)

This section presents the perceived ease of use based on the user acceptance survey.

Table 16. User-Acceptance Results Assessing the Perceived Ease of Use

Statement	Mean	Verbal Interpretation
1. The iSWAI system is easy to understand.	3.70	Strongly Agree
2. The display of wind speed and direction is clear and readable.	3.65	Strongly Agree
3. I can easily interpret the information shown by the system.	3.50	Strongly Agree
4. The system is easy to access when needed.	3.55	Strongly Agree
5. Learning how to use the system was easy for me.	3.50	Strongly Agree
6. The alerts are easy to understand.	3.55	Strongly Agree
7. I can use the system without assistance.	3.75	Strongly Agree
8. The layout of the system is simple and easy to understand.	3.80	Strongly Agree
Average Weighted Mean	**3.63**	**Strongly Agree**

The perceived ease of use results of the iSWAI system are presented in Table 16. Respondents strongly agree that the system is easy to understand (3.70) and has a clear wind data display (3.65). They also find it easy to interpret information (3.50), access when needed (3.55), and learn to use (3.50), with alerts that are easy to understand (3.55).

Additionally, they strongly agree that they can use the system without assistance (3.75) and that the layout is simple and easy to understand (3.80). Overall, the system is perceived as user-friendly, as technology applications are more likely to be accepted when they are simple and easy to use [20].

Behavioral Intention to Use (BIU)

This section presents the behavioral intention to use based on the user acceptance survey.

Table 17. User-Acceptance Results Assessing the Behavioral Intention to Use

Statement	Mean	Verbal Interpretation
1. I intend to use the iSWAI system regularly.	3.70	Strongly Agree
2. I will rely on this system when deciding whether it is safe to go out to sea.	3.75	Strongly Agree
3. I would recommend this system to other fishermen.	3.65	Strongly Agree
4. I am willing to continue using the system in the future.	3.65	Strongly Agree
5. I would use this system if it is available in other fishing areas.	3.75	Strongly Agree
Average Weighted Mean	**3.70**	**Strongly Agree**

The behavioral intention results in Table 17 show that respondents strongly agree they intend to use the iSWAI system regularly (3.70) and rely on it when deciding whether

Copyright: ©2026 The Authors. UCLM Journal of Computer Science, Engineering and Technology

it is safe to go fishing (3.75). They also strongly agree that they would recommend it to other fishermen (3.65) and continue using it in the future (3.65).

Moreover, respondents strongly agree that they would adopt the system even if it is implemented in other fishing areas (3.75). The overall average weighted mean of 3.70 indicates a strong behavioral intention to adopt and sustain the system. Fishers show strong willingness to adopt decision-support technologies when these systems improve safety, reliability, and decision-making efficiency [21].

V. CONCLUSION

This study successfully developed iSWAI, an intelligent shore-based wind monitoring and prediction system that integrates real-time data collection, machine learning, and a user-friendly interface to provide reliable wind information. Based on the results of system testing, the prototype achieved 90% accuracy in wind speed measurement, while wind direction and prediction accuracy testing both achieved 100%. Reliability testing also achieved 100% in real-time data transmission. In terms of responsiveness, the safety indicators and alert activation tests achieved 100%, while the prediction update responsiveness experienced one failed trial due to no prediction being generated. These results confirm that the system is capable of providing generally accurate, reliable, and responsive performance, making it suitable for real-world deployment in coastal environments.

The effectiveness of the system is further supported by the implementation of Random Forest and XGBoost algorithms, which demonstrated strong predictive capability. The wind speed model achieved an R^2 score of 0.9460, while the wind direction model reached 0.9713, indicating that the models were able to accurately capture and explain variations in wind behavior. These findings confirm that machine learning is effective in handling complex and dynamic environmental conditions, and the combined use of both models improved prediction performance by capturing both stable patterns and sudden changes in wind conditions.

Moreover, the integration of hardware and software components enabled the system to deliver real-time data, predictions, and alerts effectively. Although minor issues were encountered during the initial testing phase, the system demonstrated stable performance in succeeding trials. The user-acceptance results further revealed that respondents strongly agreed on the system's usefulness, ease of use, and intention to adopt, indicating that it meets the practical needs of fishermen. In conclusion, the iSWAI system is proven to be accurate, reliable, and user-friendly, and it serves as a practical tool for improving safety, preparedness, and decision-making in fishing communities through accessible and data-driven wind information.

AUTHOR CONTRIBUTIONS

Author 1: Conceptualization, Methodology; Author 2: Writing-Original draft preparation; Author 3: Validation, Visualization, Writing- Reviewing; Author 4: Conceptualization, Writing-Original draft preparation; Author 5: Data curation, Investigation; Author 6: Writing- Reviewing; Author 7: Data curation, Investigation.

FUNDING

This research received no external funding.

GENERATIVE AI STATEMENT

The authors used ChatGPT solely as a language-support tool to improve the clarity, coherence, and grammatical accuracy of the manuscript. All AI-assisted outputs were critically reviewed, revised, and validated by the authors to ensure the accuracy, integrity, and originality of the content. The authors accept full responsibility for the final version of the manuscript and its published content.

ETHICAL CONSIDERATIONS

Prior to the data gathering, ethical approval was obtained from the University of Cebu Academic Research Ethics Committee (UCAREC). The approved protocol ensured adherence to the principles of respect for persons, beneficence, justice, voluntary participation, informed consent, confidentiality, and anonymity, and compliance with the Data Privacy Act throughout the research process.

DECLARATION OF INTEREST

The authors declare that they have no competing financial, professional, or personal interests that could have influenced the conduct, findings, or publication of this study.

DATA AVAILABILITY

Data will be made available by the corresponding author on request.

ACKNOWLEDGMENT

The completion of this study was made possible through the support and encouragement of many individuals. The researchers wish to express their sincere gratitude to the following:

To the Almighty Father, for giving the researchers the courage, determination, and motivation needed to complete this study. With His guidance, they overcame challenges and now look back with pride.

Engr. Dave Theodore Seroje, Research Adviser, for assisting us in identifying a relevant and valuable topic and for giving continuous direction that ensured the solid development of this study;

Miss Catherine Rivera, Former Research Instructor, is sincerely appreciated for her continued guidance and for sharing essential guidelines on university research standards despite her busy schedule. She consistently made time to review the work and provided helpful remarks that strengthened the paper.

Dr. Roland Fernandez, Dean of the College of Engineering and Research Instructor, is sincerely acknowledged for his constructive feedback, thorough review of the manuscript, and valuable recommendations, which significantly strengthened the study.

To the respondents, for generously giving their time, sharing their experiences, and actively participating in the

Copyright: ©2026 The Authors. UCLM Journal of Computer Science, Engineering and Technology

survey, which provided essential insights for this study.

The researchers acknowledge with gratitude their parents and friends for their consistent trust, financial help, and ongoing support, which gave them hope and perseverance during this study.

REFERENCES

[1] L. Zhou, Z. Zeng, C. Azorin-Molina, Y. Liu, J. Wu, D. Wang, D. Li, A. D. Ziegler, and L. Dong, "A continuous decline of global seasonal wind speed range over land since 1980," *Journal of Climate*, vol. 34, no. 23, pp. 9443–9461, 2021, doi: 10.1175/JCLI-D-21-0112.1.

[2] S. Demirci, "Impact of regional wind changes on trawl fishing effort under the pressure of overfishing in the Iskenderun Bay," *Sustainability*, vol. 17, no. 5, p. 2055, 2025, doi: 10.3390/su17052055.

[3] S. Farquhar, A. F. Nirindrainy, N. Heck, M. Gomez Saldarriaga, and Y. Xu, "The impacts of long-term changes in weather on small-scale fishers' available fishing hours in Nosy Barren, Madagascar," *Frontiers in Marine Science*, vol. 9, p. 841048, 2022, doi: 10.3389/fmars.2022.841048.

[4] Bündnis Entwicklung Hilft and IFHV, *World Risk Report 2022* [PDF]. WeltRisikoBericht, 2022. [Online]. Available: https://weltrisikobericht.de/wp-content/uploads/2022/09/WorldRiskRepo rt-2022_Online.pdf

[5] G. K. Cabico, "Prioritizing artisanal fishers' conditions crucial to sustainable Philippine fisheries — report," *Philstar*, Mar. 5, 2023. [Online]. Availabl e: https://www.philstar.com/headlines/climate-and-environment/2023/03/05/2249497/prioritizing-artisanal-fishers-conditions-crucial-sustainable-philippine-fisheries-report.

[6] P. Lena, "Fishery sector incurs over P780-M losses from Odette," *Philippine News Agency*, Jan. 10, 2022. [Online]. Available: https://www.pna.gov.ph/articles/1165426.

[7] S. Meniano, "Odette destroys over 7K fishing boats in Leyte Island," *Philippine News Agency*, Jan. 10, 2022. [Online]. Available: https://www.pna.gov.ph/articles/1164960.

[8] Philippine Institute for Development Studies, "Localized weather and climate info, crucial for climate-resilient agri-fishery sector" [Press release], Oct. 29, 2020. [Online]. Available: https://pids.gov.ph/details/localized-weather-and-climate-info-crucial-for-climate-resilient-agri-fishery-sector.

[9] A. B. Tahiluddin, A. H. Ullang Jr., A. M. Jali, J. O. Ajik, J. H. Ebbah, and W. M. Jamil, "Traditional weather forecasting: Practices of fishers, sailors and old folks in Tawi-Tawi, Philippines," *Acta Natura et Scientia*, vol. 4, no. 1, pp. 10–16, 2023, doi: 10.29329/actanatsci.2023.353.02.

[10] C. Asis-Egar, P. J. L. Geraldino, and M. D. Santos, "Climate change vulnerability assessment of milkfish fry fishery in selected sites in Argao and Bantayan, Cebu, Philippines," *The Philippine Journal of Fisheries*, vol. 31, no. 2, pp. 11–25, 2024, doi: 10.31398/tpjf/31.2.2024-0002.

[11] A. G. Diola, W. P. Perpetcho, J. C. A. Graciosa, G. D. B. Pantanosas, R. H. Montecillo, S. M. M. Flores, et al., "Climate change vulnerability assessment of the coastal resources in Moalboal, Cebu, Central Philippines," *Annals of Tropical Research*, vol. 43, no. 1, pp. 35–54, 2021, doi: 10.32945/atr4313.2021.

[12] R. C. Richey, "Developmental research: The definition and scope," *Educational Technology Research and Development*, vol. 42, no. 1, pp. 3–13, 1994. Available: https://eric.ed.gov/?id=ED373753

[13] S. Laoyan, "What is Agile methodology? (A beginner's guide)," *Asana*, Feb. 20, 2025. Available: https://asana.com/resources/agile-methodology

[14] E. D. Macusi, D. O. Diampon, and E. S. Macusi, "Understanding vulnerability and building resilience in small-scale fisheries: The case of Davao Gulf, Philippines," *Climate Policy*, vol. 25, no. 1, pp. 1–14, 2023, doi: 10.1080/14693062.2023.2261889.

[15] E. D. Macusi, K. L. Camaso, A. Barboza, and E. S. Macusi, "Perceived vulnerability and climate change impacts on small-scale fisheries in Davao Gulf, Philippines," *Frontiers in Marine Science*, vol. 8, p. 597385, 2021, doi: 10.3389/fmars.2021.597385.

[16] A. K. Daudu, F. O. Oladipo, L. K. Olatinwo, and W. O. Kareem, "Analysis of factors influencing vulnerability of fishing systems to climate change among artisanal fisher-folks in coastal area of Lagos, Nigeria," *African Journal on Land Policy and Geospatial Sciences*, vol. 3, no. 1, 2020.

[17] V. F. Jeffers, F. Humber, T. Nohasiarivelo, R. Botosoamananto, and L. G. Anderson, "Trialling the use of smartphones as a tool to address gaps in small-scale fisheries catch data in southwest Madagascar," *Marine Policy*, vol. 99, pp. 267–274, 2019, doi: 10.1016/j.marpol.2018.10.040.

[18] M. K. Hossain, M. Anwar, G. Oliver, V. Frings-Hessami, T. Kanij, R. Alam, G. Saha, and U. Humayra, "Small-scale fishing community's information needs and access in Bangladesh: An information ecosystem perspective," *Journal of the Association for Information Science and Technology*, vol. 76, no. 1, pp. 1–18, 2025, doi: 10.1002/asi.70022.

[19] M. V. Ampo, J. A. D. Castro, J. P. Ramoso, M. Ilang-Ilang, V. Rodulfo, and A. del Rosario, "Technology acceptance model (TAM)-based assessment of user acceptance for a smart crop management system," *Philippine Journal of Agricultural and Biosystems Engineering*, vol. 20, no. 1, 2024, doi: 10.48196/020.01.2024.05.

[20] J. Astaño, "Development, validity, and acceptability of Android-based applications in ecology: A technology acceptance model (TAM) approach," *ASEAN Journal of Educational Research and Technology*, vol. 4, no. 1, pp. 91–106, 2024. Available: https://www.ejournal.bumipublikasinusantara.id/index.php/ajert/article/view/640

[21] I. Asante, J. Kassah, J. Ocran, and E. Badu, "Acceptance of global positioning system (GPS) technology among artisanal fishers in the Central Region, Ghana: An extended technology acceptance model," *Fisheries*, art. no. vuae016, pp. 1–16, 2025, doi: 10.1093/fshmag/vuae0

Copyright: ©2026 The Authors. UCLM Journal of Computer Science, Engineering and Technology

Copyright: ©2026 The Authors. UCLM Journal of Computer Science, Engineering and Technology