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Machine Learning-Based Disease Monitoring and Forecasting System for Barangay Adlay Level Health Analytics

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ABSTRACT: This study developed and evaluated a Machine Learning-Based Disease Monitoring and Forecasting System for Barangay Adlay Level Health Analytics. The system was designed to improve community-level disease monitoring through real-time data organization, trend analysis, and predictive forecasting using the ARIMA algorithm. The study adopted a descriptive-developmental research design and Agile Software Development Life Cycle methodology. Evaluation based on ISO/IEC 25010 revealed that the system achieved “Very Great Extent” ratings in functionality, usability, reliability, efficiency, maintainability, and security. The findings confirmed that the system effectively supports disease surveillance, early outbreak detection, and public health decision-making in Barangay Adlay.



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KEYWORDS: Machine Learning, Disease Forecasting, Health Analytics, ARIMA, ISO/IEC 25010

I. INTRODUCTION

Disease monitoring in rural communities remains a challenge due to manual health record management, delayed reporting, and limited forecasting capabilities. In Barangay Adlay, traditional methods of disease surveillance make it difficult for local health workers to identify trends and respond quickly to possible outbreaks. The lack of automated monitoring tools reduces the efficiency of public health services and limits data-driven decision-making.

Several studies emphasized the importance of machine learning in improving healthcare monitoring and predictive analytics. Rahman et al. (2023) explained that machine learning algorithms can analyze epidemiological data and predict disease outbreaks more effectively. Rodrigues et al. (2023) highlighted that data-driven health systems support timely interventions and better public health planning. Igwama et al. (2024) also noted that machine learning and big data analytics are valuable in rural healthcare environments with limited resources.

Despite the growing use of machine learning in healthcare, most existing systems are designed for urban or highly developed healthcare infrastructures. Few systems are specifically tailored for barangay-level health analytics in rural communities. Existing solutions often lack localized disease forecasting, simplified dashboards, and practical deployment for barangay health workers.

To address these challenges, the researchers developed a Machine Learning-Based Disease Monitoring and Forecasting System for Barangay Adlay. The system integrates disease record management, real-time analytics, and forecasting capabilities using the ARIMA model. Through this platform, barangay health workers can monitor disease trends, generate predictive forecasts, and support proactive public health responses.

The study is significant because it introduces a practical and data-driven solution for community health monitoring. The system benefits barangay health workers, local officials, and community residents by improving disease surveillance, forecasting outbreaks, and supporting timely healthcare interventions. Furthermore, the study contributes to future research involving machine learning applications in public health systems.

II. LITERATURE SURVEY

Machine learning and predictive analytics continue to transform healthcare monitoring and disease surveillance systems worldwide. Several researchers emphasized the role of machine learning in forecasting disease outbreaks, improving diagnosis, and enhancing public health decision-making.

Janani et al. (2023) developed a machine learning-based healthcare monitoring system that predicts cardiovascular disease risks using fuzzy logic and random forest algorithms. Kute et al. (2022) explained that IoT and machine learning technologies improve disease diagnosis through automated analysis of symptoms and patient data. Nerkar et al. (2023) proposed a predictive analytics framework for heart healthcare systems that supports data-driven diagnosis and monitoring.

Local studies in the Philippines also support the use of machine learning in healthcare. Omadlao et al. (2022) developed a dengue forecasting system in Baguio City using predictive models and health data analytics. Parreño (2024) analyzed disease underreporting during the COVID-19 pandemic using forecasting techniques such as SARIMA and NNAR models. Talirongan et al. (2021) utilized ARIMA to forecast national health trends in the Philippines.

The reviewed literature demonstrates that machine learning improves healthcare analytics, disease prediction, and early outbreak detection. These studies collectively support the development of the proposed Machine Learning-Based Disease Monitoring and Forecasting System for Barangay Adlay.



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Table 1. Summary of Related Literature

No.	Paper Title	Author/s	Key Points	Remarks
1	Predicting Infectious Disease Outbreaks with Machine Learning	Rahman et al., 2023	Machine learning improves disease outbreak prediction and epidemiological analysis.	Supports predictive analytics integration.
2	Machine Learning-Based Dengue Forecasting System	Omadlao et al., 2022	Forecasting models improve dengue monitoring and outbreak prevention.	Supports disease forecasting implementation.
3	Modeling National Trends on Health Using ARIMA	Talirongan et al., 2021	ARIMA effectively predicts disease trends using time-series data.	Supports ARIMA forecasting model.
4	AI and Big Data Analytics for Public Health Surveillance	Igwama et al., 2024	Big data analytics improves healthcare monitoring in rural communities.	Supports rural health analytics deployment.
5	Healthcare Predictive Analytics Using ML and DL	Badawy et al., 2023	Predictive analytics improves disease diagnosis and healthcare efficiency.	Supports machine learning integration.

III. METHODOLOGY

Research Design

The study utilized a descriptive-developmental research design to develop and evaluate the Machine Learning-Based Disease Monitoring and Forecasting System for Barangay Adlay Level Health Analytics. The developmental aspect focused on designing and implementing the forecasting system, while the descriptive aspect evaluated the quality and effectiveness of the system using ISO/IEC 25010 standards.

Development Methodology

The Agile Software Development Life Cycle (SDLC) was adopted in developing the system. Agile methodology allowed continuous testing, iterative improvements, and integration of user feedback throughout the development process.

System Features

The developed system includes the following features:

- Disease record management
- Real-time disease trend visualization
- Forecast generation using ARIMA algorithm
- Analytics dashboard
- CSV health data upload
- Report generation
- User authentication and access control

Respondents of the Study

The study involved 170 respondents composed of residents, barangay health workers, and IT experts. Respondents were selected using purposive sampling to ensure direct interaction and evaluation of the developed system.

Data Gathering Procedure

The researchers conducted interviews, observations, consultations, and survey questionnaires to gather system requirements and evaluate the developed platform. Respondents performed actual system tasks such as encoding disease records, generating forecasts, and viewing analytics dashboards.

Statistical Treatment

The following statistical tools were used:

1. Weighted Mean
2. Frequency and Percentage Distribution



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3. Mean Absolute Error (MAE)
4. Root Mean Square Error (RMSE)

The ISO/IEC 25010 Software Quality Model was used to evaluate functionality, reliability, usability, efficiency, maintainability, and security.

IV. RESULTS & DISCUSSION

The developed Machine Learning-Based Disease Monitoring and Forecasting System successfully implemented its intended functionalities for disease surveillance and predictive analytics in Barangay Adlay.

Disease Monitoring Dashboard

The system provided a centralized dashboard that organizes health records, visualizes disease trends, and displays real-time analytics. Barangay health workers were able to monitor disease occurrences efficiently through graphical charts and summarized reports.

Forecasting Feature

The forecasting module utilized the ARIMA time-series algorithm to generate short-term disease predictions based on historical health data. The generated forecasts allowed users to identify possible increases in disease cases and prepare appropriate interventions.

Performance Evaluation

The system was evaluated using ISO/IEC 25010 software quality standards. Results revealed that the system achieved “Very Great Extent” ratings across all quality characteristics.

Table 2. Performance Evaluation of the System

Quality Characteristics	Mean	Verbal Interpretation
Functionality	4.72	Very Great Extent
Reliability	4.69	Very Great Extent
Usability	4.71	Very Great Extent
Performance Efficiency	4.72	Very Great Extent
Maintainability	4.74	Very Great Extent
Security	4.76	Very Great Extent
Overall Mean	4.72	Very Great Extent

The results indicate that the system is highly functional, reliable, secure, and user-friendly for barangay-level disease monitoring. The forecasting outputs also demonstrated acceptable predictive performance based on MAE and RMSE validation metrics.

The findings support previous studies which emphasized that machine learning systems improve healthcare analytics, outbreak detection, and public health decision-making. The developed system demonstrates that predictive analytics can be effectively implemented in rural healthcare environments.

V. CONCLUSION

The study successfully developed and evaluated a Machine Learning-Based Disease Monitoring and Forecasting System for Barangay Adlay Level Health Analytics. The system effectively addressed challenges in manual disease monitoring by providing organized health record management, real-time trend visualization, and predictive forecasting capabilities.

The implementation of the ARIMA forecasting model enabled the system to generate reliable short-term disease predictions that support early outbreak detection and proactive health interventions. Evaluation results based on ISO/IEC 25010 confirmed that the system achieved “Very Great Extent” ratings in functionality, reliability, usability, efficiency, maintainability, and security.



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The findings demonstrate that machine learning-based health analytics systems can significantly improve community-level disease surveillance and public health decision-making in rural areas such as Barangay Adlay.

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