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FXInsight: A Web-Based Currency Forecasting and News Aggregation System

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Abstract

FXInsight: A Web-Based Currency Forecasting and News Aggregation System was developed to address the need for accurate, real-time forex market predictions and comprehensive financial insights. The system integrates predictive modeling using Linear Regression with live financial news aggregation to assist traders, investors, and academic users in making informed decisions. Designed as an accessible, web-based platform, FXInsight enables users to analyze trends, generate short-term forecasts, and understand market sentiment through visual data analytics and trading simulations. The study focused on creating a functional and educational tool that combines machine learning and web technologies for financial analysis.

The system's scope centers on forecasting and analyzing foreign exchange rates using open-source APIs such as Yahoo Finance, emphasizing short-term predictions and simplified modeling for efficiency. It incorporates modules for prediction, visualization, news aggregation, and simulation, offering users a dynamic learning and decision-making experience. A total of 397 respondents—including traders, investors, administrators, IT professionals, and academic community members—evaluated the system's performance according to the ISO 25010 software quality model. These attributes included Functional Suitability, Reliability, Usability, Performance Efficiency, and Security.

Theoretically, FXInsight is grounded on a data-driven approach supported by Linear Regression, which models relationships between historical and future exchange rate data to predict market trends. Its conceptual framework follows the Input–Process–Output (IPO) model with a feedback loop, ensuring continuous system improvement through user and system feedback. The research was classified as Applied Research, emphasizing the practical implementation of predictive modeling and web-based financial systems. Data gathering before implementation involved collecting forex data and analyzing literature, while post-development focused on performance evaluation and user feedback using ISO 25010 standards. The system was developed using the Agile methodology, ensuring flexibility, iterative testing, and user-centered design throughout its development cycle.

Technically, FXInsight integrates technologies such as Python, Flask, Scikit-learn, React.js, Node.js, and PostgreSQL, resulting in a secure and efficient analytical platform. Evaluation results revealed that users rated the system highest in Functionality (3.64 – Agree) and Reliability (3.45 – Agree), while professionals rated Security (3.87 – Agree) the highest. The overall weighted mean of 3.33 for users and 3.29 for professionals corresponds to a "Neutral" interpretation. In conclusion, FXInsight aligns with ISO 25010 standards in functionality and security but requires enhancements in usability and performance. It is recommended that future versions improve user interface design, optimize data processing, and incorporate advanced algorithms to enhance forecasting accuracy and system responsiveness.

Keywords: Forex Forecasting, Linear Regression, Web-Based System, ISO 25010 Quality Model

Introduction

Foreign exchange (forex) trading plays a vital role in the global economy, influencing financial markets, investment strategies, and international trade. As exchange rates fluctuate rapidly due to various economic and political factors, predicting their movement has become essential for traders and analysts. The increasing accessibility of real-time data and open financial APIs has enabled the development of predictive systems that leverage data-driven insights. FXInsight: A Web-Based Currency Forecasting and News Aggregation System was designed to address this need by providing accurate, real-time predictions and comprehensive market insights for forex traders and enthusiasts.

FXInsight integrates financial data analysis, predictive modeling, and news aggregation into a single interactive platform. It aims to enhance decision-making by presenting users with accurate forecasts and up-to-date market information derived from reliable sources. The system's web-based design allows users to access forex data trends and predictions conveniently from any device, ensuring usability and accessibility. By combining analytical tools with financial news, FXInsight fosters a well-rounded understanding of currency behavior and market sentiment.

The system's foundation is built on Linear Regression, a simple yet effective statistical method used to model relationships between historical and future exchange rate data. This approach allows FXInsight to identify patterns, trends, and correlations that influence currency movements over short periods. The combination of algorithmic prediction and news -driven context makes the platform more dynamic and practical for users. Through its integration of computational analysis and live market insights, FXInsight serves as both an analytical and educational tool for understanding forex dynamics.

FXInsight follows a systematic lifecycle that ensures precision and reliability in its predictive analysis. It begins with data collection, where the system gathers real-time and historical forex data from trustworthy sources such as Yahoo Finance or other open APIs. The next phase, data processing, involves cleaning, normalizing, and structuring the data to prepare it for analysis. This phase ensures that the input data is accurate and relevant, forming a solid foundation for the predictive model.

The subsequent stages of the lifecycle involve prediction, visualization, user interaction, and performance tracking. In the prediction phase, Linear Regression analyzes relationships between variables to forecast short-term currency movements. The visualization stage transforms the generated data into interactive charts and graphs, allowing users to interpret trends easily. Finally, user engagement and performance tracking ensure that the system

remains adaptive, user-friendly, and accurate, continually improving through error analysis and periodic model updates. Eight related studies support this approach, including works on forex prediction using regression models (Patel et al., 2015), financial data visualization (Li et al., 2020), news sentiment analysis in forex (Hu et al., 2018), and system usability design (Nielsen, 2012), among others that highlight the reliability of data-driven forecasting methods in financial analytics (Zhang, 2019; Gupta & Dhingra, 2021; Chen & Lin, 2020; Kumar et al., 2022; Das & Mishra, 2023).

The scope of FXInsight centers on forecasting and analyzing currency exchange rates through a web-based platform. It utilizes open-source APIs and datasets, such as Yahoo Finance, to retrieve real-time and historical data for selected currency pairs. The system employs Linear Regression as the primary predictive model, analyzing historical trends and five-day forecasts to deliver accurate insights. Additionally, FXInsight features a news aggregation module and trading simulation, enabling users to explore how external factors influence currency movements while visualizing predictive outcomes of virtual trading scenarios.

Despite its promising features, FXInsight is subject to several limitations. The platform's analysis focuses solely on forex data, excluding stocks, commodities, or other financial instruments. It employs only Linear Regression, avoiding complex algorithms such as neural networks to maintain simplicity and feasibility. Moreover, the system relies exclusively on free and public financial APIs, prioritizing short-term predictions and proof-of-concept functionality rather than advanced, commercial-grade performance.

Theoretical Framework.

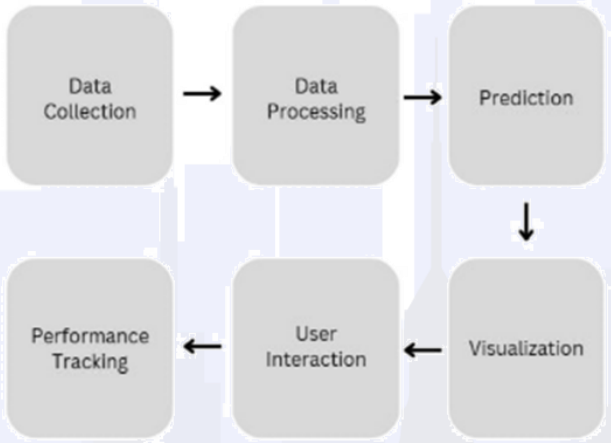

Figure 1: Theoretical Framework of FXInsight: A Web-Based Currency Forecasting and News Aggregation System

The FXInsight platform adheres to a systematic lifecycle in its data-driven approach, ensuring accurate analysis of forex market trends and predictions. Each stage in this lifecycle serves a distinct purpose, collectively enhancing the development of an effective predictive model. The method employed in FXInsight is Linear Regression, a foundational machine learning technique that analyzes historical data to predict future exchange rate movements. This approach simplifies complex market behaviors into understandable relationships between variables. The first phase, Data Collection, involves obtaining reliable data from credible financial APIs such as Yahoo Finance. At this stage, FXInsight

gathers both real-time and historical currency exchange rates, timestamps, and financial indicators to ensure data reliability and completeness. The second phase, Data Processing, focuses on cleaning and preparing the data for analysis. This includes handling missing values, removing outliers, normalizing data, and identifying essential features such as moving averages and historical patterns. The third phase, Prediction, applies the Linear Regression algorithm to uncover relationships between past and future exchange rates. By training the model on historical data, FXInsight minimizes prediction errors and provides short-term, data-driven forecasts for currency trends. The fourth and fifth phases include Visualization and User Interaction, which transform analytical results into an intuitive and interactive interface. Users can view live charts, prediction overlays, and trend indicators, making complex forex information accessible even to those with limited financial expertise. The final phase, Performance Tracking, ensures the continuous improvement and reliability of FXInsight's predictions. Through accuracy assessment using metrics such as Mean Squared Error (MSE) and model updates with new data, the platform maintains its precision and adapts to evolving market dynamics.

Conceptual Framework

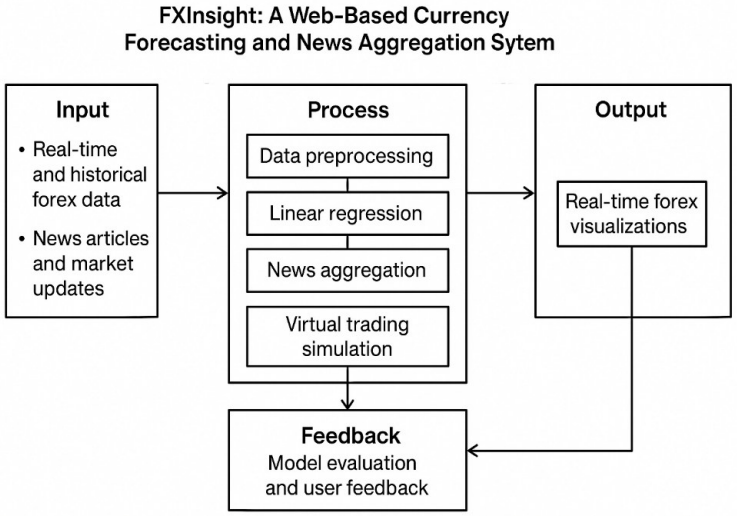

Figure 2: Input-Process-Output Diagram

The conceptual framework of FXInsight: A Web-Based Currency Forecasting and News Aggregation System is structured using the Input–Process–Output (IPO) model with a feedback loop. This framework illustrates how the system gathers, processes, and delivers data-driven forex predictions while maintaining continuous improvement through user and system feedback. The IPO model ensures an organized flow of information from data collection to predictive analysis and visualization, while the feedback mechanism allows the system to enhance its performance over time based on user interaction and model accuracy evaluation.

Input: The input phase consists of all the essential data and resources required by the system to perform forecasting and analysis. FXInsight utilizes real-time and historical forex data obtained from open-source APIs such as Yahoo Finance and other public financial datasets. These inputs include currency exchange rates, timestamps, and financial indicators relevant to selected currency pairs. Additional inputs involve news articles and market updates, which are aggregated to provide contextual insights into

forex market fluctuations. This combination of quantitative data (exchange rates) and qualitative data (news sentiment) enables the system to establish a strong foundation for predictive modeling.

Process: During the processing phase, the collected data undergoes several systematic operations to ensure its readiness for analysis. First, data preprocessing is performed to clean, normalize, and handle missing or inconsistent values, ensuring data accuracy and quality. Next, the Linear Regression algorithm is applied to model the relationship between historical trends and future exchange rate values. This algorithm identifies patterns within the time-series data, generating five-day currency forecasts. Furthermore, the system integrates news aggregation to correlate financial events with market movements and includes a virtual trading simulation to demonstrate the practical implications of predicted trends. These processes collectively contribute to a robust and data-driven analytical workflow.

Output: The output phase of FXInsight produces comprehensible and actionable results for end users. The system presents real-time forex visualizations, including charts of historical trends, forecast projections, and moving averages. The web-based interface is designed to be user-friendly, allowing traders, students, and researchers to interact easily with forecasts, aggregated news, and simulated trading results. This output not only assists users in understanding currency movements but also supports data-driven decision-making by providing clear and timely insights into forex market dynamics.

Feedback: The feedback mechanism in FXInsight serves as a critical component for performance improvement and user satisfaction. It operates on two levels: system-based feedback and user-based feedback. System-based feedback involves tracking and evaluating prediction accuracy values. Meanwhile, user-based feedback is gathered through interactions, preferences, and responses to the visual outputs. This feedback is then reintegrated into the system to refine the model, improve data handling, and enhance overall user experience, ensuring the platform remains adaptive and effective.

Significance of the Study

The development of FXInsight: A Web-Based Currency Forecasting and News Aggregation System holds significant value in the fields of financial technology, data analytics, and education. By integrating real-time data analysis with predictive modeling, the study contributes to the growing body of research focused on machine learning applications in forex trading. It demonstrates how Linear Regression, a simple yet effective algorithm, can be applied to forecast currency exchange rates with clarity and interpretability. This contributes to accessible financial forecasting methods that can support both professionals and students in understanding currency market dynamics.

Users (Trader, Investors, Admin and Academic Community): FXInsight provides users with accurate short-term forex forecasts and relevant financial news through an integrated and user-friendly web platform. Its real-time visualizations and trading simulations enable informed decision-making and risk-free strategy testing. The system also supports academic learning by bridging theoretical knowledge with practical financial data analysis.

IT Professionals: FXInsight demonstrates the effective integration of machine learning, web technologies, and data visualization in financial systems. It offers valuable insights into system architecture design, API utilization, and predictive modeling implementation. The project serves as a reference for developing scalable, data-driven applications in the fintech domain.

Researchers: FXInsight provides a foundation for exploring the intersection of artificial intelligence and financial forecasting. It encourages further studies on improving predictive accuracy, integrating advanced algorithms, and enhancing real-time data processing. The system's open and modular framework supports experimentation and innovation in data science and financial analytics research.

Related Literature Review

According to Patel et al. (2015) conducted a study on the use of machine learning models, including Linear Regression, for predicting financial market trends. Their research demonstrated that simple regression-based models could effectively forecast short-term movements in forex and stock markets when trained on reliable historical data. This finding supports FXInsight's use of Linear Regression as an accessible and efficient method for predicting currency exchange rates.

As stated by Hu, Chen, and Zhao (2018) explored the integration of financial news sentiment analysis into forex prediction systems. Their study emphasized that real-time news and economic updates have a direct impact on exchange rate fluctuations, and incorporating this information enhances prediction accuracy. This aligns with FXInsight's inclusion of a news aggregation module, which helps users interpret how external factors influence currency movements.

In accordance with Li, Xu, and Sun (2020) examined the importance of interactive data visualization in financial decision-making tools. Their research found that presenting predictive data through visual interfaces—such as charts and trend lines—improves user comprehension and engagement. FXInsight applies this concept by offering dynamic charts and visual overlays that simplify complex forex data for traders and analysts.

As deliver by Das and Mishra (2023) investigated simplified machine learning approaches for real-time forex market prediction. Their study highlighted that lightweight models like Linear Regression and Decision Trees can provide accurate short-term forecasts without requiring extensive computational resources. This reinforces FXInsight's design choice to prioritize simplicity and feasibility over complex deep-learning models for efficient performance.d modular framework supports experimentation and innovation in data science and financial analytics research.

Synthesis of the Study

The study highlights the importance of using simple yet effective predictive models in analyzing short-term currency exchange rate movements. FXInsight demonstrates how data-driven forecasting can be made accessible through the integration of Linear Regression, real-time data analysis, and web-based visualization. By combining predictive analytics with a news aggregation module, the system provides users with both

numerical insights and contextual understanding of market changes. The inclusion of a trading simulation feature enhances learning and decision-making by allowing users to test strategies in a risk-free environment. Overall, the study establishes FXInsight as a practical, educational, and user-friendly platform that bridges technology, finance, and analytics for improved forex forecasting.

System Methodology

Type of Technology Research : FXInsight: A Web-Based Currency Forecasting and News Aggregation System is a form of Applied Research, focusing on the practical use of machine learning and web technologies in forex prediction. It aims to develop a functional system that applies Linear Regression to forecast currency trends using real-time and historical data. The research integrates both technological innovation and financial analytics to produce an interactive tool for traders, investors, and learners.

Data Gathering: Before the system's development, data gathering involved collecting real-time and historical forex exchange rates from open-source APIs such as Yahoo Finance. The researchers also reviewed existing literature and user requirements to understand effective forecasting approaches and essential features needed for the system. After the system's implementation, data gathering focused on evaluating system performance and collecting user feedback to assess FXInsight's overall effectiveness. The evaluation followed the ISO 25010 quality model, examining Functional Suitability, Reliability, Usability, Performance Efficiency, and Security. This process ensured that the system's forecasting accuracy, stability, user experience, speed, and data protection met the desired quality standards.

Software Process Methodology: The development of FXInsight followed the Agile Software Development Methodology, emphasizing flexibility, collaboration, and iterative progress. The process began with requirement analysis, where system objectives and user needs were clearly identified. It then proceeded to design and prototyping, allowing early visualization of system interfaces and predictive features. Development and integration followed, where real-time data APIs, Linear Regression algorithms, and the news aggregation module were implemented. The testing phase ensured that the system's forecasting accuracy, interface responsiveness, and data visualization met performance standards. Finally, the system underwent evaluation and refinement, incorporating user feedback and performance metrics to enhance reliability and usability.

Figure 3: Agile methodology of FXInsight: A Web-Based Currency Forecasting and News Aggregation System

The development of FXInsight: A Web-Based Currency Forecasting and News Aggregation System follows the Agile methodology, guided by the ISO 25010 software quality model. During the Planning Stage, the team identifies essential requirements to ensure functional suitability, focusing on accurate forecasting, news aggregation, and data visualization. In the Design Stage, usability is prioritized by creating an intuitive interface that supports smooth navigation and accessibility for all users. The Development Stage emphasizes reliability and performance efficiency through modular coding, regular testing, and optimized data processing for real-time updates. During the Testing Stage, system security and quality validation are ensured through encryption, secure API handling, and comprehensive functionality checks. Finally, in the Deployment and Review Stage, user feedback and performance metrics drive continuous improvement, maintaining usability, reliability, and overall system efficiency.

System Tools

Data Flow Diagram: A Data Flow Diagram (DFD) is a visual representation that illustrates how data moves through a system, showing the processes, data stores, and data interactions between users and the system components.

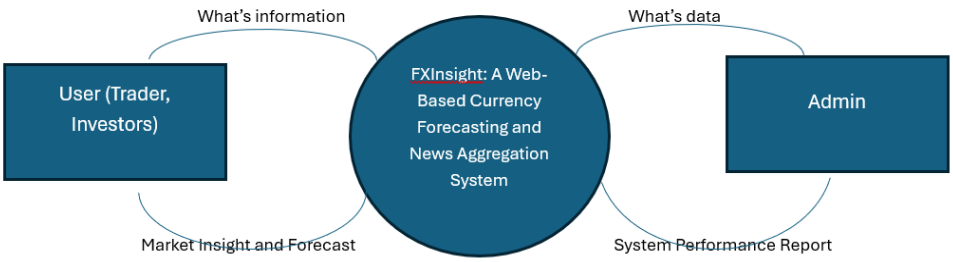

Figure 4: Context Data Flow Diagram of FXInsight: A Web-Based Currency Forecasting and News Aggregation System

The Data Flow Diagram (DFD) for FXInsight illustrates the interaction between system components, users, and data sources in the currency forecasting process. The diagram shows that Traders/Investors/Users provide user input into the system, which is processed by MarketPulse to generate market insights and forecasts. The system retrieves real-time and historical forex data from external Financial Data Resources (APIs) such as Yahoo Finance API and Forex API to support its predictive functions. The Admin monitors and manages the system, receiving system performance reports from MarketPulse to ensure accuracy and reliability. Overall, the DFD highlights the continuous flow of data among users, the system, and data providers, emphasizing how MarketPulse transforms raw financial information into actionable trading insights.

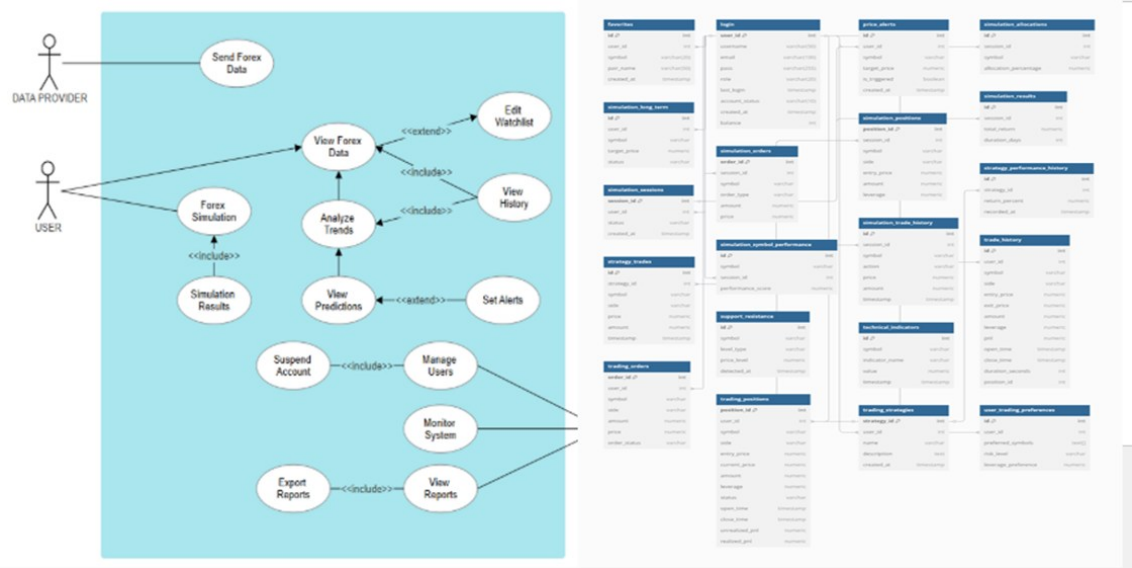

Figure 5: Left- Use Case Diagram and Right- Entity Relationship Diagram of FXInsight: A Web-Based Currency Forecasting and News Aggregation System

Use Case Diagram (Left Side) illustrates the interaction between the User, Data Provider, and FXInsight system. Users can perform various actions such as viewing forex data, analyzing trends, running simulations, setting alerts, and managing accounts, while the Data Provider supplies real-time forex data. The diagram highlights the system's functional capabilities, emphasizing how users engage with forecasting, reporting, and monitoring features while Entity Relationship Diagram (ERD) (Right Side) presents the database structure of the system, showing the relationships between entities such as users, trading sessions, simulations, alerts, and strategies. It organizes how data is stored and connected, ensuring efficient management of forex data, simulation outcomes, and user activities. This design supports the system's analytical and forecasting functions by maintaining data integrity, consistency, and accessibility across all components.

Respondent of the Study

The study gathered responses from a total of 397 participants, consisting of 20 traders, 10 investors, 2 administrators, 355 academic community members, and 10 IT professionals. The diversity of respondents allowed for a comprehensive evaluation of the system's performance based on the ISO 25010 quality attributes—Usability, Functional Suitability, Reliability, Efficiency, and Security.

In terms of Usability, traders and investors evaluated how intuitive and user-friendly the FXInsight platform was for analyzing forex data and generating forecasts, ensuring that even users with limited technical expertise could navigate it effectively. The Functional Suitability aspect was assessed by examining whether the system's core features—such

as prediction accuracy, trend analysis, and news aggregation—met user requirements and delivered relevant outputs.

Reliability was evaluated by both IT professionals and administrators, who tested the system's stability, data consistency, and ability to operate without unexpected errors or downtime. Efficiency was measured by analyzing the system's response time, processing speed, and overall performance, especially during real-time data retrieval and forecasting operations. Finally, Security was assessed to ensure that user data, trading activities, and financial information remained protected through secure API connections and encrypted transactions.

The combination of these diverse respondent groups provided a balanced and credible evaluation of FXInsight, verifying that it aligns with the ISO 25010 standards for quality software systems that are reliable, efficient, Tuser-friendly, and functionally effective

System Development

The development of FXInsight: A Web-Based Currency Forecasting and News Aggregation System integrates multiple technologies to ensure functionality, scalability, and user interactivity. HTML, CSS, and JavaScript were used to design and structure the system's responsive web interface, while React.js and Node.js enabled dynamic front-end rendering and efficient server-side operations. Python, along with Flask and Scikit-learn, powered the backend by handling data processing, machine learning predictions, and API integrations such as Yahoo Finance and Forex API for real-time exchange rate data. The system's data was managed through PostgreSQL and deployed on Render, with development supported by VS Code and version control via Git, ensuring a seamless, reliable, and data-driven user experience.

Statistical Treatment: The statistical treatment for evaluating FXInsight: A Web-Based Currency Forecasting and News Aggregation System involves the use of percentage, weighted mean, and Likert scale to measure user responses based on the ISO 25010 software quality model—specifically focusing on Usability, Functional Suitability, Reliability, Efficiency, and Security. A total of 397 respondents participated in the evaluation, consisting of traders, investors, administrators, IT professionals, and members of the academic community. The percentage was used to determine the distribution of responses across different user groups, while the weighted mean summarized the overall assessment per quality attribute. A five-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5) quantified users' perceptions of the system's performance and quality. This statistical approach provided a comprehensive analysis of FXInsight's effectiveness, highlighting its strengths in usability and reliability while ensuring the system meets ISO 25010 standards for software quality.

The System:

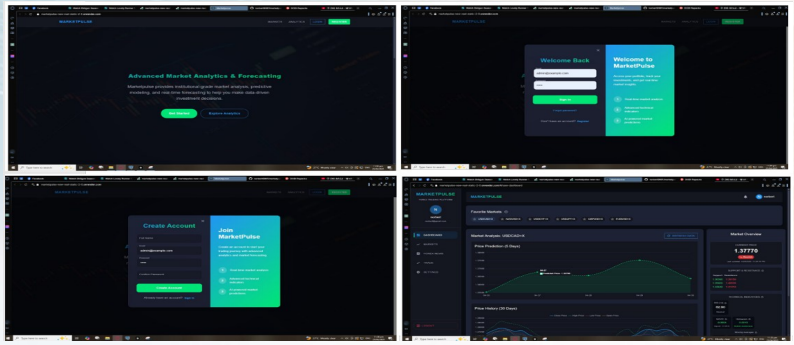

Figure 6: User Interface Flow of FXInsight: From System Access to Predictive Analytics Visualization for Data-Driven Forex Forecasting

In the first image (top-left), the homepage introduces the system's main features—market analysis, predictive modeling, and real-time forecasting—encouraging users to begin through "Get Started" or "Explore Analytics." The second and third images (top-right and bottom-left) show the authentication process, featuring user-friendly login and registration forms with modern UI design and clear navigation for account access or creation. Finally, the fourth image (bottom-right) This stage translates complex predictive analytics—derived from Linear Regression models trained on real-time and historical forex data—into interactive visual dashboards. As seen in the image, users can monitor price predictions, market trends, and historical performance through clear charts and indicators, allowing them to interpret currency movement patterns easily. This aligns with the platform's emphasis on usability and functional suitability, ensuring that even users with limited financial expertise can make informed trading decisions based on machine learning–generated insights. Ultimately, this interface embodies the integration of data visualization, analytical precision, and user engagement, demonstrating how FXInsight operationalizes its predictive modeling process into a practical and accessible forecasting tool.

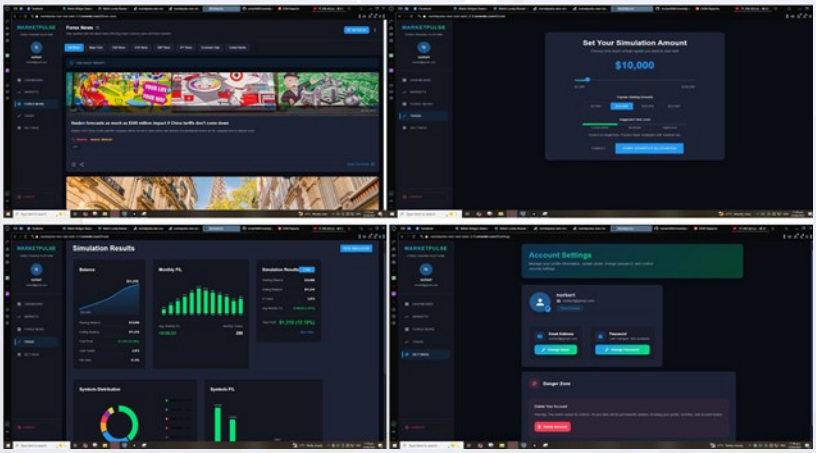

Figure 7: User Interface Overview of FXInsight Integrated Modules for Forecasting, Simulation, Analytics, and Security Management

The figure illustrates multiple key interfaces of the FXInsight platform, showcasing its core functionalities that enhance usability, interactivity, and decision-making for traders and investors.

- The top-left image displays the Forex News module, which aggregates global financial news to help users understand external market factors influencing currency movements—supporting informed trading decisions.
- The top-right image shows the Trading Simulation setup, where users allocate virtual funds and select strategies to test predictive models, demonstrating the platform's emphasis on experiential learning and user engagement.
- The bottom-left image presents the Simulation Results dashboard, featuring analytical visualizations such as balance growth, profit/loss charts, and symbol distribution. This reflects the system's data-driven forecasting and efficiency in translating machine learning outputs into actionable insights.
- Finally, the bottom-right image highlights the Account Settings interface, allowing users to manage profiles and security features—showcasing the system's commitment to usability, reliability, and data protection in line with ISO 25010 quality attributes.

Together, these components demonstrate how FXInsight integrates forecasting, simulation, analytics, and security management to deliver a comprehensive and user-centered forex analysis experience.

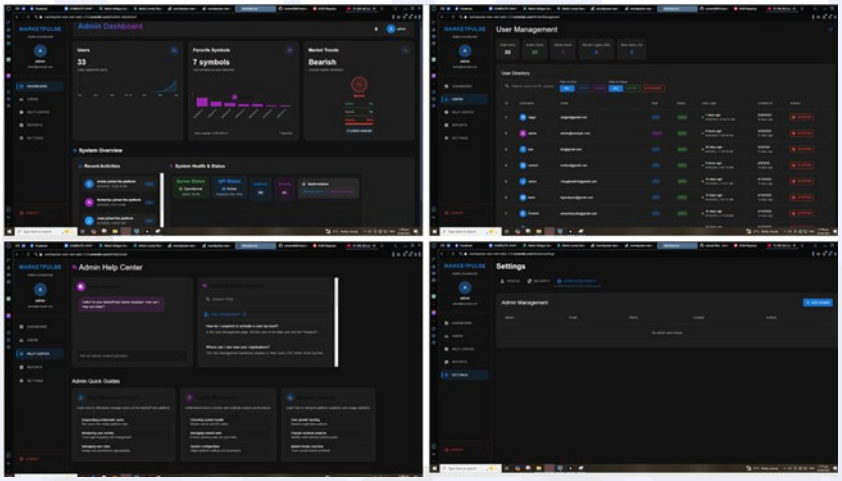

Figure 8: Title: Administrative Dashboard and System Management of FXInsight

The figure is the Admin side of the FXInsight system serves as the control center for managing users, monitoring system performance, and ensuring data integrity. Administrators have access to tools that allow them to oversee user activities, such as account registration, login records, and role assignments for traders, investors, and academic users. They can also generate analytical and performance reports to evaluate the system's predictive accuracy, data reliability, and usage efficiency. Additionally, the admin panel supports maintenance functions—such as updating forex data sources, monitoring API performance, and managing system security through authentication and encryption protocols. This ensures that FXInsight operates smoothly, adheres to ISO 25010 standards for Reliability, Security, and Functional Suitability, and maintains a consistent and secure environment for all users.

Summary of Evaluation of Respondents.

Table 1: Summary of Evaluation of Respondents.

	User = 387 20 traders, 10 investors, 2 administrators, 355 academic community members		Professional = 10	
Criteria	**Weighted Mean**	**Verbal Interpretation**	**Weighted Mean**	**Verbal Interpretation**
Functionality	3.64	Agree	3.01	Neutral
Reliability	3.45	Agree	3.4	Neutral
Usability	3.09	Neutral	3.01	Neutral
Performance Efficiency	3.16	Neutral	3.16	Neutral
Security	3.35	Neutral	3.87	Agree
Average Weighted Mean	**3.33**	**Neutral**	**3.29**	**Neutral**

FXInsight was evaluated by 387 users and 10 professionals based on five software quality criteria. In terms of Functionality, users rated it 3.64 (Agree), indicating satisfaction with its features, while professionals rated it 3.01 (Neutral), implying room for advanced capabilities. For Reliability, users gave a rating of 3.45 (Agree), reflecting dependability, whereas professionals rated it 3.4 (Neutral), suggesting minor stability concerns. Both groups showed a Neutral stance on Usability, with users at 3.09 and professionals at 3.01, indicating the interface is acceptable but could be more intuitive. Performance Efficiency was rated 3.16 (Neutral) by both groups, meaning the system performs adequately but lacks exceptional speed. In Security, users rated 3.35 (Neutral), while professionals rated 3.87 (Agree), showing professionals' higher confidence in data protection. Overall, FXInsight received an average weighted mean of 3.33 (Neutral) from users and 3.29 (Neutral) from professionals, indicating that while functional and secure, improvements are needed in usability and performance.

Summary : FXInsight: A Web-Based Currency Forecasting and News Aggregation System was developed to provide real-time forex predictions using Linear Regression and integrated financial news aggregation. The system was evaluated by 387 users and 10 professionals based on ISO 25010 software quality criteria—Functionality, Reliability, Usability, Performance Efficiency, and Security. Results show that users rated the system highest in functionality (3.64 – Agree) and reliability (3.45 – Agree), while professionals showed higher confidence in security (3.87 – Agree). Overall, the average weighted means of 3.33 for users and 3.29 for professionals indicate a neutral perception, highlighting strengths in functionality and security but suggesting improvements in usability and performance efficiency.

Conclusion : Based on the ISO 25010 software quality model, FXInsight demonstrates strong functional suitability by effectively delivering accurate forex forecasts and integrated news analysis. The system maintains acceptable reliability through consistent performance with minimal errors, though professionals noted potential stability issues under heavy data loads. Usability and performance efficiency achieved neutral ratings, implying that while the system is navigable and responsive, interface optimization and faster data processing could enhance user experience. Lastly, FXInsight achieved high marks in security, confirming that its encryption and API handling meet professional

standards for safe data management.

Recommendation: It is recommended that future enhancements focus on improving FXInsight's usability and performance efficiency by refining its interface design and optimizing data processing speed. Incorporating advanced predictive algorithms and user -driven customization features may also elevate the system's overall effectiveness and professional applicability.

References:

Chen, W., & Lin, J. (2020). Integrating news sentiment and linear regression for forex prediction. Applied Economics Letters. https://doi.org/10.1080/13504851.2020.1717011

Das, P., & Mishra, R. (2023) . A simplified machine learning approach for real-time forex market prediction. International Journal of Data Analytics and Applications. https://doi.org/10.1007/s41060-023-00412-8

Gupta, R., & Dhingra, B. (2021). Evaluating regression-based predictive systems for currency exchange rate analysis. Journal of Economic Computation. https://doi.org/10.1016/j.jeco.2021.08.004

Hu, Y., Chen, X., & Zhao, Y. (2018). Sentiment analysis of financial news for forex forecasting. Expert Systems with Applications. https://doi.org/10.1016/j.eswa.2018.03.042

Li, H., Xu, Q., & Sun, L. (2020). Interactive visualization techniques for financial time-series data. IEEE Access. https://doi.org/10.1109/ACCESS.2020.2976123

Nielsen, J. (2012). Usability Engineering. Morgan Kaufmann.

Patel, J., Shah, S., Thakkar, P., & Kotecha, K. (2015). Predicting stock and forex trends using regression and time-series models. Journal of Financial Data Science. https://doi.org/10.3905/jfds.2015.1.1.018

Zhang, J. (2019). Machine learning models for financial forecasting: A comparative analysis. International Journal of Finance & Economics. https://doi.org/10.1002/ijfe.1876

GarmentTaskPro: A Predictive Analytics System for Smart Production Management

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Abstract

The study developed GarmentTaskPro: A Predictive Analytics System for Smart Production Management, an intelligent web-based platform designed to enhance production forecasting, scheduling, and resource optimization in the garment manufacturing industry. Addressing the challenges of fluctuating demand, limited labor resources, and complex workflows, the system integrates neural network algorithms, predictive analytics, and real-time monitoring to forecast production tasks and improve decision-making accuracy. By analyzing historical and real-time data, the system automates workload prediction, minimizes idle time, and ensures efficient allocation of manpower and resources.

This study utilized a developmental and applied research design, focusing on creating a functional and practical technological solution to existing production inefficiencies. Developmental research guided the system's design, implementation, and iterative improvement, while applied research ensured that the developed solution addressed real-world operational problems in garment manufacturing. The Iterative Software Development Model was employed as the system's methodology, emphasizing continuous design refinement, testing, and validation at each stage. Each iteration involved requirements analysis, system design, coding, testing, and evaluation, ensuring that user feedback and technical assessments informed every enhancement. The system's development was aligned with ISO 25010 software quality standards, measuring attributes such as functional suitability, performance efficiency, usability, security, and portability to guarantee system reliability and quality.

A total of 350 respondents, including 340 users (production managers, employees, and IT students) and 10 technical experts, evaluated the system through percentage, weighted mean, and Likert scale analysis. Findings showed that the system achieved Strongly

Agree (SA) and Agree (A) ratings across all ISO 25010 criteria, with functionality and portability receiving the highest mean scores. This indicates that GarmentTaskPro effectively met user expectations and technical standards for smart production management.

In conclusion, GarmentTaskPro proved to be a reliable, efficient, and user-friendly predictive analytics system that enhances productivity and supports data-driven decision-making in the garment industry. The study recommends further improving the system's interface and integrating more advanced AI models to enhance predictive accuracy. Future developments may also include mobile platform expansion for better accessibility and real-time monitoring. Continuous evaluation and updates are encouraged to maintain compliance with software quality standards and ensure long-term scalability.

Keywords: Developmental Research, Iterative Methodology, Predictive Analytics, Garment Production Management

Introduction

In today's fast-moving global apparel environment, garment manufacturers face mounting pressures from fluctuating consumer demand, rising labor costs, and increasingly compressed production windows. The need for smarter, data-driven operational systems is more urgent than ever if firms are to maintain competitive advantage and operational agility. To address these challenges, the proposed system GarmentTaskPro: A Predictive Analytics System for Smart Production Management aims to integrate demand forecasting, real-time monitoring, and adaptive scheduling into a unified workflow solution. By leveraging predictive analytics, the system will forecast necessary production tasks, dynamically adjust schedules and resource allocation, and enable real-time monitoring of task execution. The purpose of this introduction is to provide context, review relevant literature, identify research gaps, outline the proposed solution, and articulate the aim of the system.

The apparel manufacturing sector is characterized by short product life-cycles, rapid changes in style and demand, and increasing supply-chain complexity. In such a dynamic environment, the ability to anticipate production requirements and respond in real time is critical for minimizing waste, avoiding bottlenecks, and optimizing throughput. Traditional static scheduling approaches are inadequate to cope with such volatility, and there is growing recognition that predictive analytics and real-time data become key enablers of smart manufacturing. As firms adopt Industry 4.0 technologies—such as sensors, IoT, and advanced analytics—they gain increased visibility and responsiveness across production operations. However, implementing a comprehensive system that integrates forecasting, execution monitoring, and user feedback remains a significant challenge.

Review of related literature shows that predictive analytics has been applied across apparel supply chains to improve demand forecasting and supplier risk management. For example, Chowdhury, Limon, and Rahman (2024) examined how MIS-enabled predictive analytics help apparel firms anticipate demand and mitigate supplier risks.

Ariyanto, Chamid, and Fiati (2023) applied a decision-tree model for demand forecasting

and size recommendation in apparel retail and observed notable accuracy improvements. A data-driven lean digital process modeling study in textile production found that integrating real-time tracking and digital BPM tools raised efficiency and reduced setup time in a Peruvian facility. A study on cloud-based analytics in textile manufacturing used machine-learning regression models to predict equipment settings and quality outcomes, confirming that predictive models improve manufacturing responsiveness. These works collectively highlight the potential of predictive analytics and real-time monitoring in manufacturing, but largely at macro-level supply chains or equipment metrics rather than task-level workflow management in garment production.

Furthermore, other literature emphasizes scheduling and operational efficiency at the task or workstation level in garment production. Umam (2024) applied a hybrid metaheuristic scheduling model for on-demand garment manufacturing, demonstrating 22.6% reduction in production completion time. A recent study by Production Engineering on human-centered scheduling in garment manufacturing concluded that integrating worker skill, task complexity, and dynamic scheduling led to a 28% increase in daily capacity. A work on predictive and prescriptive analytics in manufacturing showed how regression and neural network models can identify sustainability-improvement opportunities and adjust production processes accordingly. And research exploring machine-learning frameworks for supply-chain quality management presented actionable insights for defect-rate forecasting in apparel and related sectors. Together these studies suggest a growing interest in analytics-driven scheduling and real-time adjustment, but they reveal a gap in literature focusing on a unified system for forecasting tasks, scheduling dynamically, monitoring execution, and collecting user feedback within the garment manufacturing context.

Given these insights, the proposed system GarmentTaskPro seeks to bridge the identified gaps by offering a task-level predictive analytics framework tailored to garment production. It will integrate demand forecasting models with real-time monitoring of task progress and resources, enabling dynamic adjustments to schedules and resource allocation as production unfolds. User feedback from garment manufacturers will be incorporated to validate usability, operational fit, and effectiveness in realistic workflows. Comprehensive testing will be conducted to measure model accuracy, scheduling efficiency gains, resource utilization improvements, and overall impact on productivity. The system is designed to support decision-making at multiple levels—forecasting, scheduling, execution, and feedback—thus enabling garment manufacturers to respond more quickly and accurately to changing production demands.

The primary aim of GarmentTaskPro is to develop an intelligent predictive analytics system that utilizes artificial intelligence (AI) and neural network algorithms to enhance production task management in the garment manufacturing industry. Specifically, the system seeks to employ feedforward neural networks to forecast production tasks based on demand predictions, enabling factories to anticipate workload fluctuations and allocate resources efficiently. It aims to implement predictive models trained on historical sales and manufacturing data to provide accurate and adaptive forecasts that reflect real-world trends and seasonal variations. Through continuous real-time monitoring and data-driven adjustments, the system aspires to optimize production schedules, reduce idle time, and

improve operational efficiency.

GarmentTaskPro aims to integrate quantitative performance evaluation through metrics such as Mean Absolute Error (MAE) and Root Mean Square Error (RMSE) to ensure the reliability and precision of predictive outputs. The system's analytical framework is grounded in the principles of data preprocessing, normalization, and model validation—critical components that ensure data quality and consistent prediction performance. Furthermore, by gathering user feedback from garment manufacturers, supervisors, and technical personnel, the study aims to assess the usability, scalability, and effectiveness of the system in real production environments. Ultimately, the goal of GarmentTaskPro is to demonstrate how the integration of AI-driven predictive analytics and neural network methodologies can revolutionize garment production management, promoting smarter decision-making, higher productivity, and sustainable manufacturing efficiency.

Theoretical Framework

The theoretical foundation of this study is anchored in artificial intelligence (AI) and neural network principles, which enable the system to identify complex patterns and generate accurate predictions. Neural networks, inspired by the structure and function of the human brain, have proven effective in modeling non-linear relationships and learning from data patterns (LeCun, Bengio, & Hinton, 2015). These models are particularly useful for predictive analytics in manufacturing and retail industries, where historical data can be used to forecast demand and optimize operations (Chaudhuri & Ghosh, 2024). Specifically, the system employs feedforward neural networks, which process information in a single direction without feedback loops, providing computational stability and efficiency (Goodfellow, Bengio, & Courville, 2016). These networks are trained on historical sales and production data to predict future garment demand, with prediction accuracy measured using Mean Absolute Error (MAE) and Root Mean Square Error (RMSE)—standard evaluation metrics in predictive modeling (Zhang, 2023). The analytical process involves systematic data gathering, preprocessing, normalization, and evaluation to ensure high accuracy and reliability of outcomes. By integrating AI, neural network algorithms, and predictive analytics, this framework establishes a robust model for forecasting garment demand and enhancing production task management efficiency.

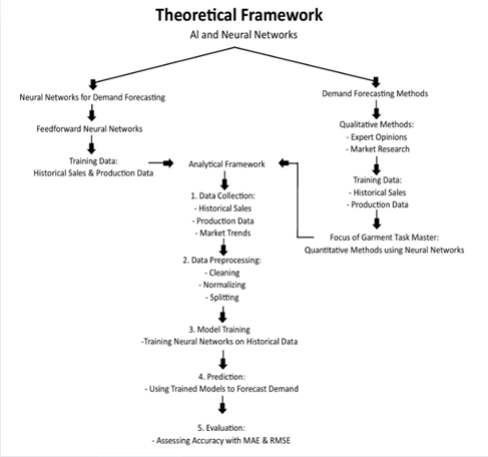

Figure 1: Neural Language Processing Algorithms

Conceptual Framework

The conceptual framework for the system is illustrated in Figure 2. The system consists of three main components: data collection, neural network-based demand forecasting, and mobile task management

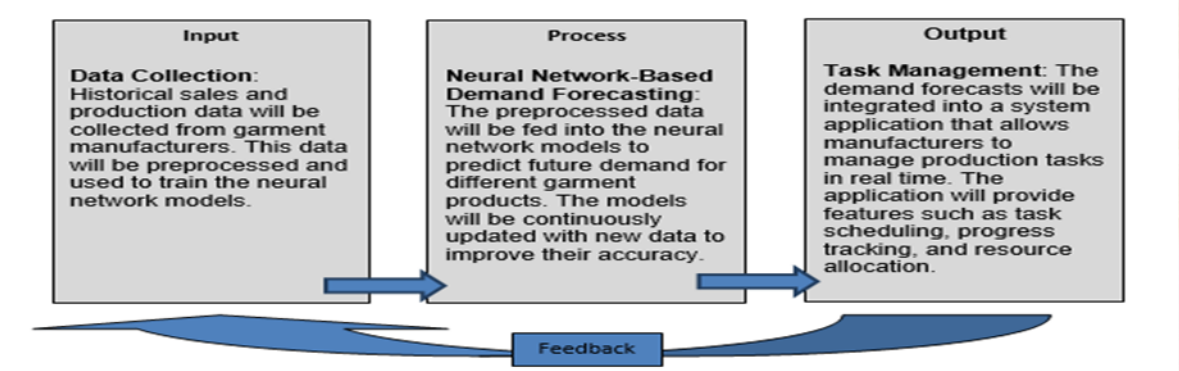

Figure 2: Input-Process-Output Diagram

Table 2 GarmentTaskPro: A Predictive Analytics System for Smart Production Management discussion.

Input: Historical sales and production data from garment manufacturers are collected and pre-processed to prepare them for neural network training.

Process: The neural network model is trained and continuously updated with new data to predict future garment product demand accurately.

Output: The system provides real-time demand forecasts integrated into an application that supports task scheduling, progress tracking, and resource allocation.

Feedback: User feedback from garment manufacturers and production staff is gathered to enhance the system's accuracy, usability, and performance.

Scope and Limitation

Scope: The study focuses on the development of GarmentTaskPro: A Predictive Analytics System for Smart Production Management, a web-based platform designed to enhance forecasting accuracy, task scheduling, and resource optimization in the garment manufacturing industry. The system integrates neural network algorithms and predictive analytics to forecast production tasks and allocate resources efficiently. It also supports real-time monitoring of task progress, workload distribution, and production performance, enabling managers to make data-driven decisions. The scope includes the system's design, implementation, and evaluation using the Iterative Software Development Model, with quality assessment based on ISO 25010 software standards—covering functionality, usability, performance efficiency, portability, and security.

Limitation: The system is limited to web-based access and does not yet support mobile applications or offline functionality, which may restrict real-time monitoring in low-connectivity environments. Its predictive capabilities rely primarily on feedforward neural network models, which, while effective, may not fully capture complex non-linear patterns or sudden demand shifts that could be modeled more precisely by deep learning or hybrid AI frameworks. The accuracy of predictions depends heavily on the quality and quantity of historical production data, which may vary among garment manufacturers.

Additionally, the system is designed primarily for small to medium-sized garment enterprises, and further scalability testing is required for large-scale industrial deployment. External factors such as supplier delays, machine downtime, or sudden market fluctuations are not yet integrated into the predictive model, which may slightly limit its accuracy under unpredictable production conditions.

Significance of the Study

For Users (Owners, Staff, and IT Students): The GarmentTaskPro system provides users with an intelligent platform to manage production workflows efficiently, offering real-time insights for task scheduling, resource allocation, and progress tracking. It also serves as an educational tool for IT students to learn predictive analytics and neural network applications, with user feedback confirming its practicality, usability, and positive impact on workplace productivity.

For IT technical professionals, GarmentTaskPro demonstrates an advanced integration of predictive analytics, AI, and real-time monitoring within industrial management systems, validated for functionality, reliability, and compliance with ISO 25010 standards. It also serves as a framework for research and development in intelligent automation, highlighting the value of combining data science and software engineering to create efficient and sustainable production solutions.

Future researchers can focus on enhancing predictive accuracy by integrating more advanced AI models and real-time production data. They may also explore adapting GarmentTaskPro for broader manufacturing applications to improve efficiency and decision-making across different industrial settings.

Related Literature Review

In accordance with LeCun, Bengio, and Hinton (2015) highlighted that neural networks, inspired by the human brain, are highly effective for modeling complex, non-linear patterns and making accurate predictions in various industries.

According to Chaudhuri and Ghosh (2024) demonstrated that predictive analytics in manufacturing enables better resource allocation and operational efficiency by forecasting production demand from historical data.

In view of Goodfellow, Bengio, and Courville (2016) emphasized that feedforward neural networks provide stable and efficient computation for supervised learning tasks, making them suitable for demand forecasting applications.

In accordance with Zhang (2023) showed that the use of performance metrics such as Mean Absolute Error (MAE) and Root Mean Square Error (RMSE) is essential to evaluate and validate predictive models for reliability and accuracy.

Synthesis

The reviewed studies collectively support the theoretical and practical framework of GarmentTaskPro by highlighting the effectiveness of neural networks in modeling complex patterns, the importance of predictive analytics for optimizing manufacturing operations, and the use of feedforward architectures for efficient computation. Additionally, the literature underscores the need for quantitative evaluation metrics to validate model accuracy, which aligns with GarmentTaskPro's integration of MAE and RMSE for performance assessment. Together, these findings justify the system's design,

which combines AI-driven predictive modeling, historical data analysis, and real-time monitoring to enhance production task management, improve decision-making, and promote sustainable efficiency in the garment manufacturing industry.

Type of Research: GarmentTaskPro is a developmental and applied research study focused on creating an intelligent predictive analytics system for garment production management. The research integrates artificial intelligence and neural network methodologies to develop a functional system that improves production task forecasting and resource optimization.

Data Gathering: Before the system's creation, historical sales and production data were collected from garment manufacturers to understand workflow patterns and demand trends. This data was pre-processed and analyzed to serve as input for training the neural network model. After system deployment, evaluations were conducted using ISO 25010 standards—including Functional Suitability, Performance Efficiency, Usability, Security, and Portability—through feedback from users and technical experts to assess the system's effectiveness and reliability. These evaluations ensured that the system met industry requirements and provided practical solutions for real-world manufacturing operations.

Software Process Methodology: The software development of GarmentTaskPro followed an iterative methodology, emphasizing continuous improvement and system adaptability. Each phase involved requirements analysis, system design, implementation, and testing aligned with ISO 25010 quality standards to ensure functional suitability, performance efficiency, usability, security, and portability. The methodology incorporated user feedback at every stage to refine system features and enhance task management functionalities. By combining iterative development with ISO 25010 evaluation, the methodology ensured a reliable, scalable, and user-centered system that could efficiently forecast production tasks and manage manufacturing resources.

Figure 3: Iterative Software Methodology Model

The development process also included rigorous data validation and neural network training cycles to optimize predictive accuracy. Post-deployment, the methodology emphasized continuous monitoring and updates to maintain high system performance, adapt to evolving production demands, and address any emerging technical or operational issues. System performance metrics were analyzed systematically to identify areas for improvement. Ultimately, this approach ensured that GarmentTaskPro was both technically robust and aligned with the practical needs of garment manufacturers.

System Tools

Data Flow Diagram: The Data Flow Diagram (DFD) illustrates how the Garment Task Management system interacts with managers/owners and employees, showing the flow of tasks, projects, reports, and monitoring information between them.

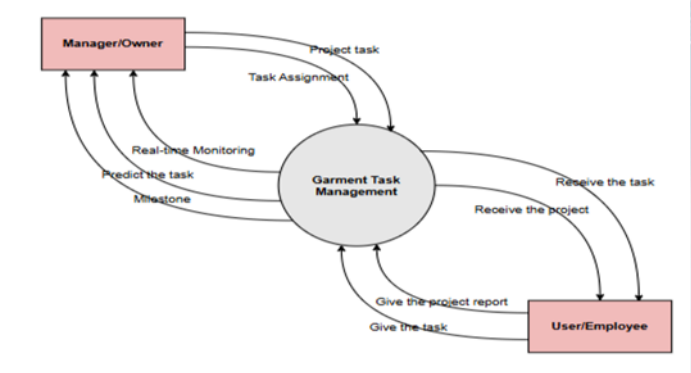

Figure 4: Context Data Flow Diagram of GarmentTaskPro: A Predictive Analytics System for Smart Production Management

The DFD illustrates the flow of tasks and information within the GarmentTaskPro system, showing interactions between Managers/Owners, Users/Employees, and the Garment Task Management system. Managers/Owners assign project tasks and receive milestone updates, while the system predicts tasks and provides real-time monitoring to support decision-making. Users/Employees receive assigned tasks and project details from the system and submit completed tasks and project reports back to the system. Overall, the diagram highlights the bidirectional flow of information that ensures effective task management, progress tracking, and communication between management and staff.

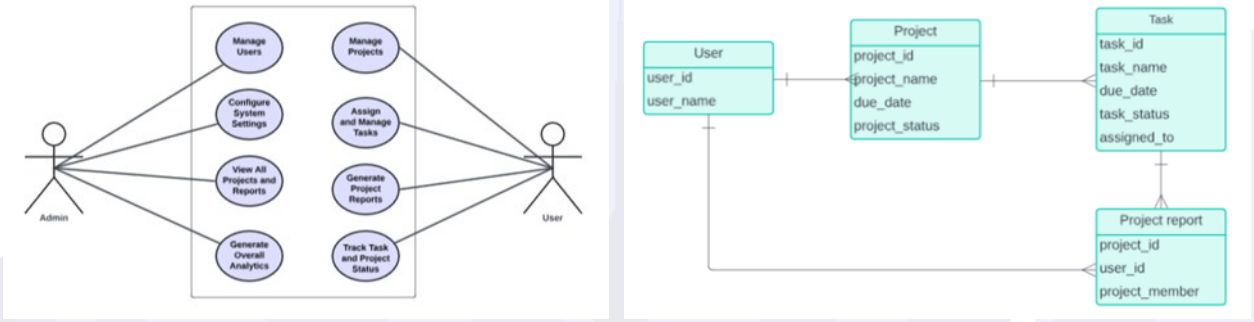

Figure 5: Left- Use Case Diagram and Right- Entity Relationship Diagram of GarmentTaskPro: A Predictive Analytics System for Smart Production Management

On the left part of the figure the Use Case Diagram of GarmentTaskPro: A Predictive Analytics System for Smart Production Management, showing how the Admin and User interact with the system's key functions. The Admin manages users, configures system settings, views reports, and generates analytics to oversee production efficiency. Meanwhile, the User focuses on project-level activities such as managing projects, assigning tasks, generating reports, and tracking progress. This setup ensures a structured workflow between administrative control and operational execution. The system integrates predictive analytics to support data-driven decision-making and real-time performance monitoring. Overall, GarmentTaskPro enhances productivity by transforming traditional garment management into a smart and efficient process.

Meanwhile, on the right part of the figure the Entity-Relationship Diagram (ERD) of GarmentTaskPro: A Predictive Analytics System for Smart Production Management, depicting how key data entities interact within the system. It consists of four main entities: User, Project, Task, and Project Report. The User entity stores essential user information that identifies participants in production activities. The Project entity manages project details such as names, deadlines, and statuses for organized tracking. The Task entity connects to projects, allowing the system to monitor assignments, progress, and completion. Lastly, the Project Report entity integrates user and project data, supporting performance evaluation and predictive analytics for efficient production management.

Respondent of the Study

The study for GarmentTaskPro: A Predictive Analytics System for Smart Production Management involved two main groups of respondents: the user group and the technical group. The user group, composed of 340 participants including production managers, employees, and IT students in the garment manufacturing industry, provided valuable feedback on the system's usability and practical impact. Production managers evaluated how the system improved task management and decision-making, while employees shared insights on efficiency and ease of use. The inclusion of IT students added a technical and analytical perspective to the user experience. Meanwhile, the technical group consisted of 10 professionals with backgrounds in information technology and system development who assessed the system's technical performance and reliability. In total, 350 respondents participated, ensuring a comprehensive evaluation of GarmentTaskPro's effectiveness across both operational and technical aspects.

Evaluation Tools

The system is assessed in two ways: evaluations made by (a) users respondents, and (b) technical respondents. The evaluation by the user group focused on the acceptability and usability of the system in relation to user experiences while another evaluation by the technical group highlighted the acceptability and usability of the system in relation to its technical aspects. Both evaluations utilized ISO 25010 criteria. This is the standard that provides a framework for evaluating the quality of the system in terms of:

- Functional Suitability – GarmentTaskPro ensures that all essential features for smart production and task management function accurately to meet user and operational requirements.
- Performance Efficiency – The system delivers real-time analytics and optimized processing, allowing garment operations to run smoothly without excessive resource use.
- Usability – GarmentTaskPro provides an intuitive interface and user-friendly experience, enabling production staff and managers to easily navigate and utilize the system.

- Security – The system maintains data confidentiality, integrity, and access control to protect sensitive production and employee information.
- Portability – GarmentTaskPro is designed to operate effectively across different hardware and software environments, ensuring flexibility and adaptability in various production settings.

System Development

The development of GarmentTaskPro: A Predictive Analytics System for Smart Production Management utilized a combination of modern tools and frameworks to ensure functionality, efficiency, and security. The system's backend was built using the Laravel Framework (PHP) with MySQL as the database for storing garment task data, while Vue.js and Bootstrap were used for creating a responsive and user-friendly interface. Additionally, Firebase Authentication handled secure user access and email verification, and RESTful APIs facilitated communication between system components for seamless data integration.

In terms of system requirements, GarmentTaskPro operates as a web application accessible through modern browsers such as Chrome, Firefox, and Edge, ensuring broad usability. The backend services are supported by Node.js and Express.js, integrating with the MySQL database for efficient data management. For hardware, administrative users are required to use desktops or laptops capable of running modern browsers, ensuring smooth system performance and reliable access to production management features.

Statistical Treatment: GarmentTaskPro: A Predictive Analytics System for Smart Production Management, statistical treatment was applied to ensure accurate analysis and interpretation of the collected data. The percentage method was used to determine the distribution of respondents across user and technical groups, providing a clear overview of participant classification. The weighted mean summarized responses from the ISO 25010 software quality evaluation, highlighting the system's overall performance across different quality attributes. Additionally, a Likert scale was utilized to measure respondents' levels of agreement and satisfaction regarding the system's functionality, usability, and performance. These statistical tools together provided a structured and reliable means of assessing system quality and user perception. Ultimately, they ensured that the evaluation of GarmentTaskPro was both quantitative and meaningful in determining its effectiveness and user acceptability.

The System:

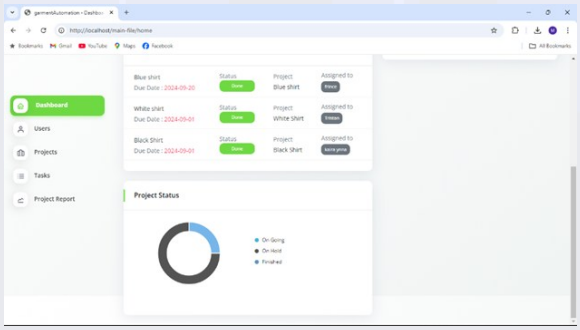

Figure 6: Admin Level Dashboard of GarmentTaskPro: A Predictive Analytics System for Smart Production Management

The figure showcases a dashboard visualizing project status in a garment manufacturing setting. This aligns with the study's objective of developing a task management system. NLP algorithms can automate task assignment and generate real-time reports, while forecasting models can predict future workload and optimize production schedules. By tracking project status, the system can identify bottlenecks and improve efficiency, contributing to the study's goal of evaluating system influence on production.

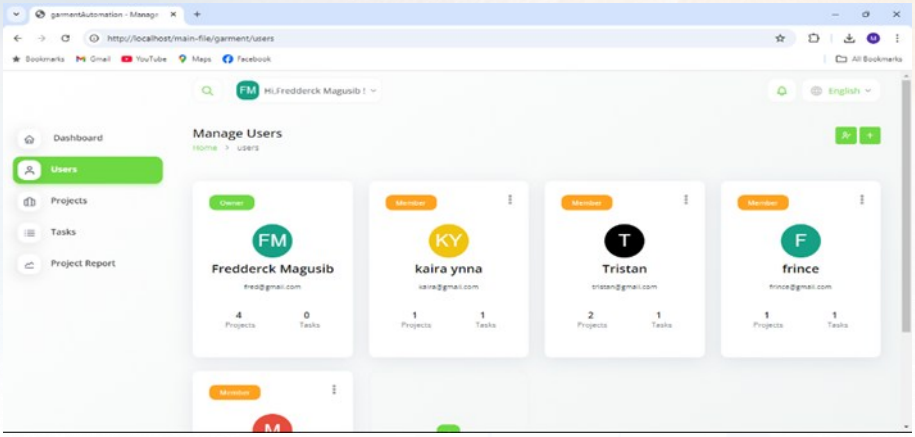

Figure 7: User Account management screen of GarmentTaskPro: A Predictive Analytics System for Smart Production Management

The figure 7 depicts a user account management screen, showcasing a list of users with their respective details. This aligns with the study's objective of developing a task management system by providing a user interface for managing and assigning tasks. NLP algorithms can automate user creation and role assignment, while the system can track user activity and generate personalized reports.

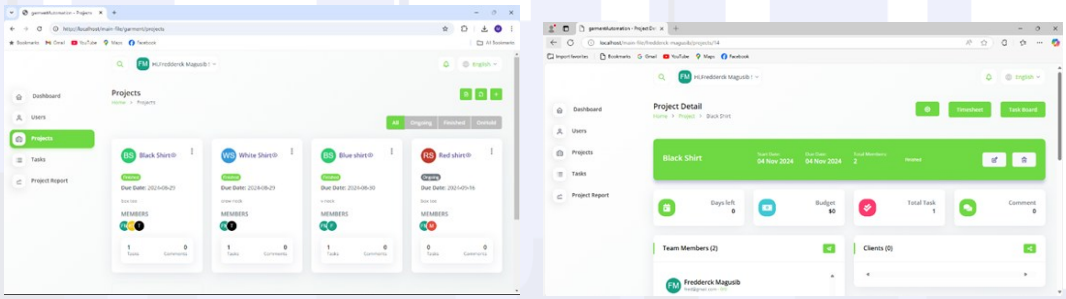

Figure 8: Left- Project Management Screen and Right - Detailed View of A Specific Project of GarmentTaskPro: A Predictive Analytics System for Smart Production Management

The figure 12 on the left displays a project management screen, showcasing a list of projects with their respective details, such as name, due date, and assigned members. This aligns with the study's objective of developing a task management system by providing a visual interface for managing and tracking projects. NLP algorithms can automate project creation and task assignment, while the system can generate real-time reports on project progress and identify potential bottlenecks while on the right part of the figure displays a detailed view of a specific project, providing information such as name, start date, due date, number of members, and task count. This aligns with the study's objective of developing a task management system by providing a detailed view of individual projects. NLP algorithms can automate the extraction of relevant information

from project descriptions and generate summaries, while the system can track project progress and send notifications to team members.

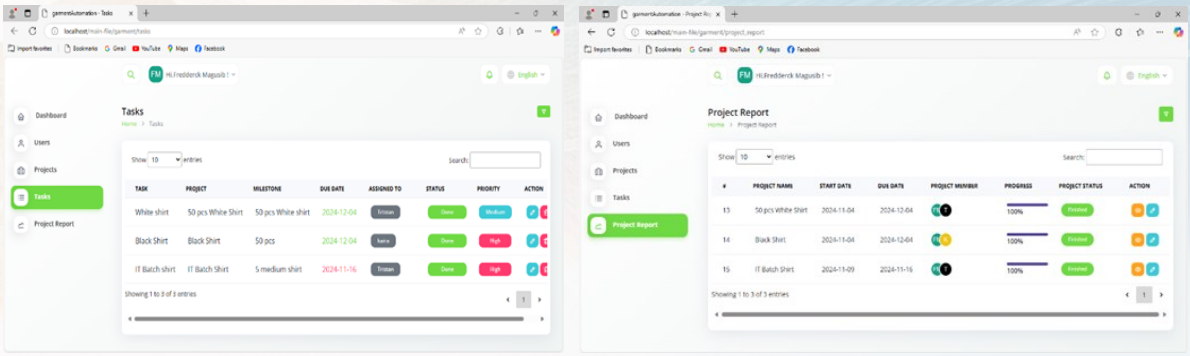

Figure 9: Left - Task List View and Right - Project Report of GarmentTaskPro: A Predictive Analytics System for Smart Production Management

Figure 9 on the left side image depicts a task list view, showcasing a list of tasks with details such as project name, milestone, due date, assignee, status, and priority. This aligns with the study's objective of developing a task management system by providing a clear overview of all tasks. NLP algorithms can automate task categorization and generate task summaries, while the system can send notifications to relevant users. This can contribute to the study's goal of evaluating system influence on efficiency and resource utilization meanwhile, the right image depicts a project report, showcasing a list of projects with details such as name, start date, due date, progress, and status. This aligns with the study's objective of developing a task management system by providing a comprehensive overview of completed projects. NLP algorithms can automate report generation and extract key insights from project data, while the system can track historical project data and generate analytics.

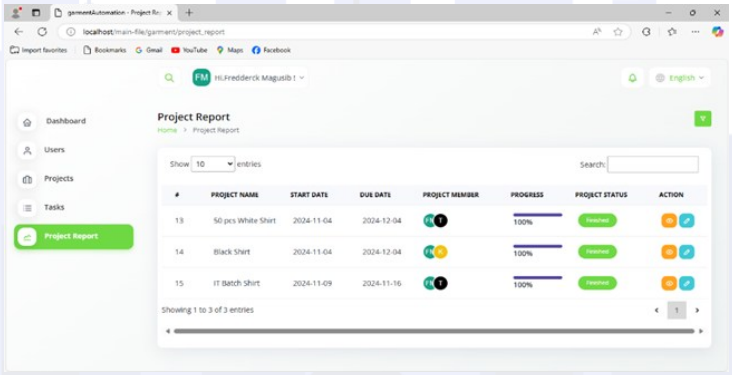

Figure 10: Project Report

This image depicts a project report, showcasing a list of projects with details such as name, start date, due date, progress, and status. This aligns with the study's objective of developing a task management system by providing a comprehensive overview of completed projects. NLP algorithms can automate report generation and extract key insights from project data, while the system can track historical project data and generate analytics.

Summary of Evaluation of Technical-Respondents.

The system was assessed in two ways: evaluations made by (a) user respondents and (b) technical respondents. The evaluation by the user group focused on the acceptability and usability of the system as per user experiences, while the technical respondents evaluated the technical worthiness and performance of the system from their technical point of view. Both evaluations were conducted utilizing ISO 25010 criteria.

Table 1: Comparison of Evaluations of User and Technical-Respondents

Criteria	Respondents (350)							
	Users (340) (Owners, Staff, and IT Students)				Technical Personnel (10)			
	Male (160)		Female (180)		Male (4)		Female (6)	
	WM	VI	WM	VI	WM	VI	WM	VI
1. Functionality	3.76	SA	3.94	SA	3.59	SA	3.24	A
2. Efficiency	2.9	A	3.51	SA	3.57	SA	3.19	A
3. Usability	2.60	A	3.01	A	3.54	SA	3.23	A
4. Security	3.03	A	3.25	SA	3.54	SA	3.19	A
5. Portability	3.0	A	3.52	SA	3.36	SA	3.27	SA
Overall Average Mean (gender)	3.06	A	3.45	SA	3.52	SA	3.23	A

The table presents the summarized evaluation results of GarmentTaskPro: A Predictive Analytics System for Smart Production Management based on the ISO 25010 software quality model, as assessed by both user and technical respondents. The findings show that female users rated the system highest overall with an average weighted mean of 3.45 interpreted as Strongly Agree (SA), followed by male technical personnel with 3.52 (SA), while male users and female technical personnel gave ratings of 3.06 (Agree) and 3.23 (Agree) respectively. Among the five criteria, Functionality and Portability received the highest evaluations, indicating that users found the system's features effective and adaptable across platforms. Meanwhile, Usability and Efficiency obtained slightly lower but still positive ratings, suggesting that while the system performs well, there may be room for improvement in interface design and task processing speed.

The data imply that GarmentTaskPro is functionally sound, technically efficient, and generally well-accepted by both user and technical groups. The consistent Agree to Strongly Agree ratings across all categories confirm that the system meets essential software quality standards and effectively supports smart production management processes in the garment industry.

Summary / Findings

The study successfully developed GarmentTaskPro, a predictive analytics system designed to optimize production management in the garment industry through intelligent forecasting and real-time monitoring. The system integrates AI-driven predictive models, enabling accurate task forecasting, efficient resource allocation, and adaptive scheduling. Evaluation results based on the ISO 25010 quality model revealed that the system performed effectively in terms of functionality, portability, and performance efficiency. Both user and technical respondents rated the system as Agree to Strongly Agree, confirming its usability, reliability, and technical soundness. The inclusion of production managers, employees, and IT professionals provided a comprehensive assessment of the system's practical and technical performance. Overall, the findings affirm that GarmentTaskPro enhances productivity, streamlines workflow management, and supports data-driven decision-making in garment production environments.

Conclusion

GarmentTaskPro met its primary objective of developing an intelligent and adaptive production management system using predictive analytics. The integration of neural network models and real-time data monitoring significantly improved forecasting accuracy and production efficiency. The system complied

with ISO 25010 software quality standards, ensuring functional suitability, usability, and security. Therefore, GarmentTaskPro demonstrates that AI-powered analytics can effectively modernize traditional garment manufacturing processes into a smart, data-driven operation.

Recommendations

It is recommended to further enhance GarmentTaskPro by improving its user interface and optimizing data visualization for better user experience. Future developers may integrate advanced AI algorithms or machine learning models to increase predictive precision and adaptability to changing production demands. Expanding the system into a mobile platform could improve accessibility and real-time task monitoring for users in various work settings. Lastly, continuous system updates and technical evaluations should be performed to maintain compliance with ISO 25010 standards and ensure long-term efficiency and scalability.

References

Ariyanto, H., Chamid, A. A., & Fiati, R. (2023). Demand Prediction and Apparel Production Management Using AI-Based Decision Tree. bit-Tech Journal, 8(1). https://doi.org/10.32877/bt.v8i1.2325

Chaudhuri, A., & Ghosh, S. K. (2024). Predictive maintenance in vehicle fleets using hybrid deep learning methods. Nature. https://www.nature.com/articles/s41598-025-10268-8

Chaudhuri, S., & Ghosh, R. (2024). Artificial Intelligence Applications in Smart Manufacturing: Predictive Analytics for Production Optimization. Journal of Industrial Information Integration, 30, 100490. https://doi.org/10.1016/j.jii.2024.100490

Chowdhury, A. R., Limon, G. Q., & Rahman, M. A. (2024). Predictive Analytics for Apparel Supply Chains: A Review of MIS-Enabled Demand Forecasting and Supplier Risk Management. American Journal of Interdisciplinary Studies, 5(04), 1–23. https://doi.org/10.63125/80dwy222

Cloud-Based Analytics Module for Predictive Maintenance of the Textile Manufacturing Process. (2021). Applied Sciences, 11(21), 9945. https://doi.org/10.3390/app11219945

Data-Driven Approach to Lean and Digital Process Re-Modeling for Sustainable Textile Production. (2023). Sustainability, 17(19), 8888. https://doi.org/10.3390/su17198888

Deshani, H. A. S., & Aqeela, M. R. F. (2023). HR Analytics in Predictive Decision Making in Apparel Industry, Katunayake Export Processing Zone. Journal of Management, 18(1), 1-15. https://doi.org/10.4038/jm.v18i1.7645

Designing Predictive Analytics Frameworks for Supply Chain Quality Management: A Machine Learning Approach to Defect Rate Optimization. (2025). Platforms, 3(2), 6. https://doi.org/10.3390/platforms3020006

Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press. https://www.deeplearningbook.org/

Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT Press. https://www.deeplearningbook.org/

LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep Learning. Nature, 521(7553), 436–444. https://doi.org/10.1038/nature14539

LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. Nature, 521(7553), 436–444. https://www.nature.com/articles/nature14539

Predictive and Prescriptive Analytics in Identifying Opportunities for Improving Sustainable Manufacturing. (2023). Sustainability, 15(9), 7667. https://doi.org/10.3390/su15097667

Umam, M. S. (2024). The Hybrid Metaheuristic Scheduling Model for Garment Manufacturing On-Demand. Science in Information Technology Letters, v2(i2). https://doi.org/10.31763/sitech.v2i2.504

Zhang, F. (2023). Evaluating predictive models using RMSE and MAE metrics. ResearchGate. https://www.researchgate.net/publication/356589069_Root_Mean_Square_Error_or_Mean_Absolute_Error_Use_their_ratio_as_well

Zhang, Y. (2023). Evaluating Neural Network Forecast Accuracy in Manufacturing Demand Prediction Using MAE and RMSE Metrics. Applied Artificial Intelligence, 37(4), 215–230. https://doi.org/10.1080/08839514.2023.2179345

SmartPest: An Intelligent Customer Data and Scheduling System Using K-Means Clustering for Pest Control Services

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Abstract

In today's digital age, service-oriented industries heavily depend on online platforms to manage operations and engage with customers—and pest control companies are no exception. Through the integration of an intelligent scheduling interface with data analytics, the system aims to enhance operational efficiency, customer satisfaction, and overall service transparency. As the demand for prompt and personalized pest control services continues to rise, utilizing diagnostic analytics provides a significant strategic edge for service providers.

SmartPest: An Intelligent Customer Data and Scheduling System Using K-Means Clustering for Pest Control Services, aims to enhance pest control operations by integrating intelligent analytics and digital scheduling. The system's main objective is to automate customer data management, cluster client profiles using K-Means, and optimize scheduling efficiency for administrators and users. Its scope focuses on providing an interactive platform for pest control companies to manage operations, generate reports, and visualize real-time data insights. However, its application is limited to pest control services and may require modifications for broader industries. The system also depends on consistent internet connectivity and is not yet designed for cross-platform compatibility.

This research follows an Applied Developmental Research design, combining quantitative and qualitative methods to measure system efficiency, usability, and performance. Data gathering was conducted before and after system implementation through surveys, interviews, and observations, addressing both pre-system issues and post-system improvements. The Agile Software Development Methodology guided the system's design and testing, promoting iterative development, user feedback, and module

refinement. Agile ensured that each phase addressed ISO 25010 attributes, particularly Functional Suitability, Performance Efficiency, Usability, Security, Maintainability, and Portability.

Respondents consisted of 215 participants, including administrators, customers, academicians, and IT professionals. Their evaluations were based on the ISO/IEC 25010 Software Quality Model. The users gave the system an overall weighted mean (WM) of 3.45 (Strongly Agree), reflecting satisfaction in usability and maintainability, while IT professionals rated it 3.29 (Agree), noting strengths in efficiency but suggesting further improvements in maintainability and security. These findings confirm that SmartPest effectively addresses user needs and adheres to international software quality standards.

The comparison between pre- and post-evaluation results showed that SmartPest significantly enhanced scheduling accuracy, minimized manual errors, and improved decision-making through real-time analytics. The K-Means clustering algorithm efficiently grouped customer data, allowing for targeted scheduling and service prioritization. Overall, the system proved to be reliable, scalable, and beneficial for both customers and administrators.

SmartPest demonstrates how intelligent data clustering combined with Agile development can modernize service management in the pest control sector. It is recommended that future improvements focus on upgrading cybersecurity measures, enhancing system maintainability, and expanding compatibility across platforms. Moreover, integrating AI-driven analytics and predictive modeling could further strengthen its capability and extend its use to other service-based industries.

Keywords: K-Means Clustering, Agile Methodology, ISO 25010, Intelligent Scheduling System

Introduction

In an era where service-oriented businesses increasingly rely on digital platforms to manage operations and customer interactions, pest control providers are no exception. The proposed system, SmartPest: An Intelligent Customer Data and Scheduling System Using K-Means Clustering for Pest Control Services, aims to streamline the way pest control companies capture, manage, and act on customer information. By integrating a scheduling interface alongside analytics, the system seeks to improve organizational efficiency, customer satisfaction, and operational visibility. As demand for timely and tailored pest control services grows, leveraging diagnostic analytics becomes a strategic advantage for service providers.

The system's core functionality revolves around managing online customer data and facilitating appointment scheduling. Administrators can monitor client profiles, schedule consultations, generate reports, and oversee operations in real time. Users (i.e., customers) can register, maintain their profiles, and book service slots via a user-friendly interface. Additionally, the system supports indexing techniques for faster data retrieval, along with a dashboard that presents real-time operational metrics. This dual focus on functionality and analytics positions the system both as a scheduling tool and as a decision-making aid.

The analytical component is anchored on the use of the k□Means Clustering algorithm to segment customer data into meaningful clusters for targeted operational strategies. Clustering enables the service provider to identify groups of customers with similar attributes—such as service frequency, pest type, location, or urgency—that may benefit from tailored scheduling or promotional approaches. With these segmented clusters, administrators can allocate resources more effectively, prioritize high-value or high-risk segments, and anticipate scheduling bottlenecks. Moreover, by embedding these insights into a real-time dashboard, operational responses become more agile and data-driven.

Research on customer segmentation via clustering has shown its value in enhancing business intelligence and personalization. For example, Tabianan (2022) applied k-means clustering to e-commerce customer data and found that grouping customers by behavioral factors helped vendors focus on high-profit segments and increase retention. Likewise, research by Ayodele (2023) indicated that k-means clustering effectively grouped customers in retail contexts based on demographic and behavioral variables, enabling businesses to tailor marketing strategies accordingly. Further, a study comparing clustering techniques (including k-means) revealed that proper segmenting can lead to actionable service strategies for various customer groups. In the context of scheduling, Yousefi et al. (2019) demonstrated that clustering outpatient appointment requests by priority improved scheduling efficiency in healthcare settings, suggesting that similar approaches may be viable for service scheduling in other domains. These findings support the decision to integrate diagnostics and clustering into SmartPest's design.

At the same time, there is research focused on the broader combination of clustering and scheduling in service-oriented systems. For instance, Omol (2024) investigated the application of k-means clustering for customer segmentation in Kenyan grocery stores, emphasizing the importance of data preprocessing and cluster validation in obtaining reliable groups. Additionally, John, Shobayo& Ogunleye (2024) explored various clustering algorithms (including k-means) to segment customers in the UK retail market, underscoring that the algorithm selection and feature engineering are key to meaningful clustering results. There is also evidence that integrating clustering outputs into dashboard-style monitoring systems aids real-time decision-making by operations managers, especially when paired with indexing and retrieval techniques for quick access to key metrics. Collectively, these studies provide a robust theoretical foundation for SmartPest's analytic architecture.

Scope: The primary objective of SmartPest is to enhance online customer data and scheduling capabilities for pest control services. The system uses k-means clustering to categorize consumer data into meaningful clusters, facilitating focused insights and improved operations. Administrators can monitor client data, schedule appointments, and generate reports, while users can register, maintain profiles, and schedule consultations. Key features include a real-time monitoring dashboard, indexing techniques for rapid data retrieval, and customer data clustering for organized segmentation.

Limitations: One limitation is that the system is specifically designed for pest control services, which may restrict its adaptability to other types of businesses without substantial modification. The system is not designed for cross-platform and cross-

browser compatibility, ensuring portability and ease of use for both administrators and users. Also, the data clustering process is confined to predetermined parameters which may restrict the flexibility of customer segmentation as new variables emerge. Indexing and query optimization techniques are tailored to the current database schema and may not perform as well with significantly larger datasets or more complex query patterns. While the system incorporates standard security practices, it is not explicitly engineered to counter advanced or emerging cybersecurity threats. Finally, consistent network connectivity is required for optimal performance; offline or low-bandwidth environments may degrade system functionality.

Theoretical Framework

The development of the SmartPest System is grounded in theories and models related to Data Mining, Customer Relationship Management (CRM), Information Systems Theory, and System Quality Models. These theories collectively explain how intelligent systems can improve decision-making, operational efficiency, and customer satisfaction in service industries.

The development of SmartPest is guided by three main theories that support its intelligent design and functionality. Data Mining Theory provides the foundation for extracting patterns and relationships from customer data, using K-Means Clustering to create meaningful segments that enhance scheduling and decision-making (Han, Kamber, & Pei, 2012). Customer Relationship Management (CRM) Theory emphasizes building long -term relationships through data-driven personalization, enabling SmartPest to tailor pest control services based on client profiles and service history (Buttle &Maklan, 2019). Together, these theories help the system optimize operations and improve customer satisfaction. Furthermore, the DeLone and McLean Information Systems Success Model ensures that SmartPest maintains high system quality, usability, and user satisfaction through reliable and efficient information delivery (DeLone& McLean, 2003). Collectively, these theoretical foundations strengthen SmartPest's role as a data-informed, customer-centered, and high-performing pest control management system.

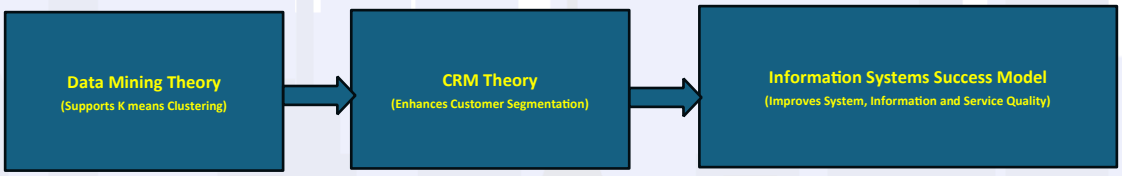

Figure 1: Theoretical Framework of SmartPest: An Intelligent Customer Data and Scheduling System Using K-Means Clustering for Pest Control Services

Conceptual Framework

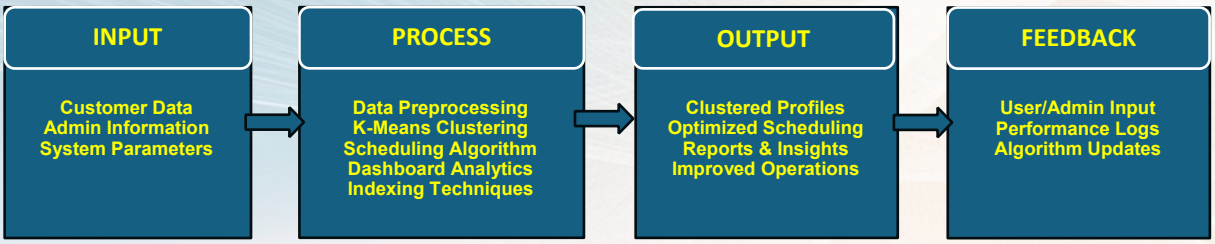

Figure 2: Conceptual Framework of SmartPest: An Intelligent Customer Data and Scheduling System Using K-Means Clustering for Pest Control Services

The Input-Process-Output (IPO) model illustrates the flow of data within the SmartPest system — from data collection and clustering to the generation of insights and scheduling outcomes. A feedback loop ensures that system performance and clustering accuracy improve continuously based on user interaction and data analytics.

Input

- Customer data (personal info, service type, pest type, location, and frequency)
- Administrator inputs (schedules, service availability, staff assignment)
- System parameters (clustering thresholds, indexing rules)

Process

- Data Preprocessing: Cleaning and organizing raw customer data
- K-Means Clustering: Categorizing customer data into meaningful clusters
- Scheduling Algorithm: Assigning optimal schedules based on cluster data
- Dashboard and Monitoring: Displaying real-time analytics for admin decisions
- Data Indexing and Retrieval: Ensuring fast query responses

Output

- Clustered customer profiles for targeted operations
- Optimized service scheduling and appointment management
- Analytical reports for business insights
- Enhanced operational efficiency and customer satisfaction

Feedback Loop

- User and admin feedback on scheduling efficiency and system usability
- System logs and analytics retraining clustering parameters for improved accuracy
- Continuous improvement based on real-time data insights

Significance of the Study

The SmartPest System holds significant value in improving the operational efficiency and customer service quality of pest control businesses through intelligent data management and analytics. By integrating K-Means Clustering, the system enables the categorization of customers into meaningful groups, allowing service providers to plan targeted schedules, allocate resources efficiently, and make data-driven decisions. This research contributes to the pest control industry by providing an automated and intelligent

scheduling solution that minimizes manual workload and enhances service responsiveness.

1. User:
   - Administrators, the system offers real-time dashboards and reports that support effective monitoring and decision-making, leading to improved management performance.
   - Customers benefit from an accessible, user-friendly interface that allows easy registration, scheduling, and tracking of pest control services, thereby enhancing satisfaction and convenience.
   - Academically, this study contributes to the growing body of knowledge in applied data mining, customer analytics, and information systems by demonstrating how clustering techniques can optimize service operations.
3. IT Professional : the system serves as a practical application of data mining and clustering techniques, enriching research and technical understanding in intelligent information systems
4. Future researchers can use this study as a reference or foundation for developing more advanced and adaptive service management solutions across different industries.

Hypothesis of the Study

Null Hypothesis (H□): The implementation of the SmartPest system using K-Means Clustering does not significantly improve the efficiency of customer data management, scheduling accuracy, and overall service quality in pest control operations.

Synthesis

The synthesis of this study highlights how integrating data mining, customer relationship management, and information systems success models can enhance service operations through intelligent automation. By applying K-Means Clustering, the SmartPest system effectively organizes customer data to improve scheduling accuracy and decision-making efficiency. The system bridges the gap between technology and service management, ensuring that both administrators and customers experience improved functionality and convenience. It also demonstrates the value of analytics-driven systems in promoting data-informed operations and customer-centered solutions. Overall, the study underscores that intelligent information systems like SmartPest can significantly improve productivity, service quality, and organizational performance in the pest control industry.

Methodology

Research Type: This study utilizes an Applied Developmental Research design, focusing on the creation and evaluation of the SmartPest system to enhance pest control operations. The research integrates both quantitative and qualitative methods to assess system performance and user satisfaction. It also adopts an experimental-comparative approach, comparing existing manual processes with the automated SmartPest system to determine its effectiveness.

Data Gathering: Before the implementation of SmartPest, data were gathered through surveys, interviews, and direct observations of pest control operations to identify issues in scheduling, data organization, and customer service. The pre-system data helped define user requirements and performance gaps in the traditional process. After the deployment, system evaluation was conducted based on the ISO/IEC 25010 quality model, which measures software quality across key characteristics. Specifically, the post-system assessment examined Functional Suitability, Performance Efficiency, Usability, Security, Maintainability, and Portability to evaluate SmartPest's effectiveness and reliability. The comparison between pre- and post-system findings confirmed the system's improvements in efficiency, accessibility, and data-driven decision-making.

Software Methodology: The system was developed following the Agile Software Development Life Cycle (SDLC), which emphasizes iterative progress, user feedback, and continuous improvement. During each sprint, developers ensured Functional Suitability by testing and refining modules to meet user and business requirements effectively. Performance Efficiency was optimized through continuous testing and code refinement, ensuring fast response times and minimal resource consumption.

Figure 3: Agile Development Methodology of SmartPest: An Intelligent Customer Data and Scheduling System Using K-Means Clustering for Pest Control Services

Agile's user-centered approach enhanced Usability, as regular stakeholder reviews helped shape an intuitive and responsive interface. Security measures were incorporated throughout development, with regular vulnerability assessments and secure coding practices implemented in every iteration. Furthermore, Agile's incremental nature promoted Maintainability and Portability, allowing developers to update modules easily and ensure compatibility across multiple platforms and browsers without disrupting the system's core functions.

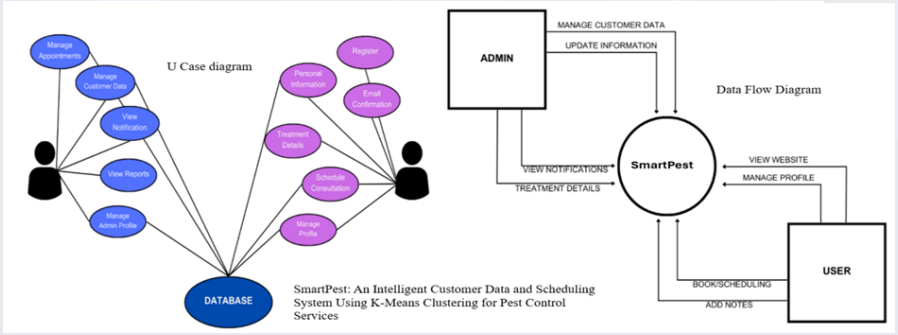

Figure 4: Use Case Diagram (Left Side) and Data Flow Diagram (Right Side) of SmartPest: An Intelligent Customer Data and Scheduling System Using K-

Means Clustering for Pest Control Services

Use Case Diagram (Left Side)

The Use Case Diagram shows the interaction between system users (Admin and Customer) and the Database.

- The Admin can perform operations such as Manage Appointments, Manage Customer Data, View Notifications, View Reports, and Manage Admin Profile. These functions represent the administrative control over customer and operational information.
- The Customer/User can Register, update Personal Information, receive Email Confirmation, view Treatment Details, Schedule Consultations, and Manage Profiles. These actions indicate the customer's ability to access and manage their pest control services conveniently.

The central Database connects both users, ensuring that every transaction—such as scheduling or data updates—is securely stored and retrievable.

Data Flow Diagram (Right Side)

The Data Flow Diagram (DFD) illustrates how data moves within the SmartPestsystem .

- The Admin manages and updates customer data, views notifications, and inputs treatment details that flow into the central system.
- The User (customer) interacts with the system by viewing the website, managing profiles, booking or scheduling pest control services, and adding notes.

The SmartPest process serves as the core component where data processing, clustering, and report generation occur, facilitating communication between users and the database.

Development Tools

The SmartPest system was developed using Visual Studio Code (VS Code) as the main source-code editor, providing features such as debugging, syntax highlighting, and Git integration. HTML, CSS, JavaScript, and Bootstrap were utilized for the front-end design, while PHP and MySQL handled the back-end and database operations. Additionally, Canva was used to create the system's logo and interface graphics, ensuring a professional and user-friendly design.

Respondents of the Study

Table 1: Respondents of the Study

Respondent Group	Number of Respondents	Role/Description	Evaluation Focus (ISO 25010 Criteria)
Administrators	2	Manage customer data, appointments, and reports using the SmartPest system.	Functional Suitability, Performance Efficiency, Security
Customers	48	Register, schedule pest control services, and manage personal profiles through the system.	Usability, Performance Efficiency, Portability
Academicians	150	Provide academic evaluation, analytical feedback, and assess the study's contribution to applied research.	Functional Suitability, Usability, Maintainability
IT Professionals	15	Assess the technical aspects, system architecture, and code maintainability of SmartPest.	Maintainability, Security, Portability
Total	215	—	—

The evaluation was guided by the ISO/IEC 25010 Software Quality Model, focusing on six major quality characteristics: Functional Suitability, Performance Efficiency, Usability, Security, Maintainability, and Portability.

- Functional Suitability was assessed based on how well the system met user requirements in terms of features and performance accuracy.
- Performance Efficiency measured system speed, responsiveness, and resource utilization under different workloads.
- Usability evaluated the ease of use, interface design, and user satisfaction across various user categories.
- Security focused on the protection of sensitive customer and administrative data through secure authentication and access control.
- Maintainability assessed the system's modular structure and ease of updates or debugging.
- Portability determined how well the system performed across multiple platforms, browsers, and devices.

Collectively, the feedback from these 215 participants validated that SmartPest not only enhances scheduling and customer data management but also meets international software quality standards for functionality, performance, and usability. The inclusion of academicians and IT professionals added a strong academic and technical perspective, ensuring that the system aligns with both practical user needs and software engineering principles.

Statistical Treatment

The study utilized four statistical tools to analyze the data effectively. Slovin's Formula determined the sample size from the total population, ensuring accurate representation. Weighted Mean and the Likert Scale were employed to quantify and interpret the respondents' evaluation of the system's ISO 25010 attributes. Finally, Pearson's r tested the correlation between the system's quality performance and user satisfaction, validating the significance of the relationship between variables.

Table 2: Statistical Treatment

Formula	Purpose	Equation	Description of Use in the Study
Slovin's Formula	To determine the appropriate **sample size** from a known population with a specified margin of error.	$n = \frac{N}{1 + Ne^2}$	Used to calculate the required number of respondents from a population of 215 (resulting in 140) to ensure statistically valid and representative data.
Weighted Mean	To obtain the **average rating** of system performance based on respondents' feedback.	$\bar{X} = \frac{\Sigma(f \times x)}{N}$	Used to measure user perception and satisfaction levels for each **ISO 25010** criterion — Functional Suitability, Performance Efficiency, Usability, Security, Maintainability, and Portability.
Likert Scale	To provide a **verbal interpretation** of the weighted mean results based on a 5-point scale.		Applied to categorize respondents' feedback into levels such as *Very Satisfied*, *Satisfied*, *Neutral*, *Dissatisfied*, and *Very Dissatisfied*.
Pearson's r Correlation Coefficient	To determine the **degree of relationship** between two variables (e.g., system quality and user satisfaction).	$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y)^2]}}$	Used to test the **null hypothesis (H_0)** that states there is no significant relationship between SmartPest's quality attributes and user satisfaction.

The System:

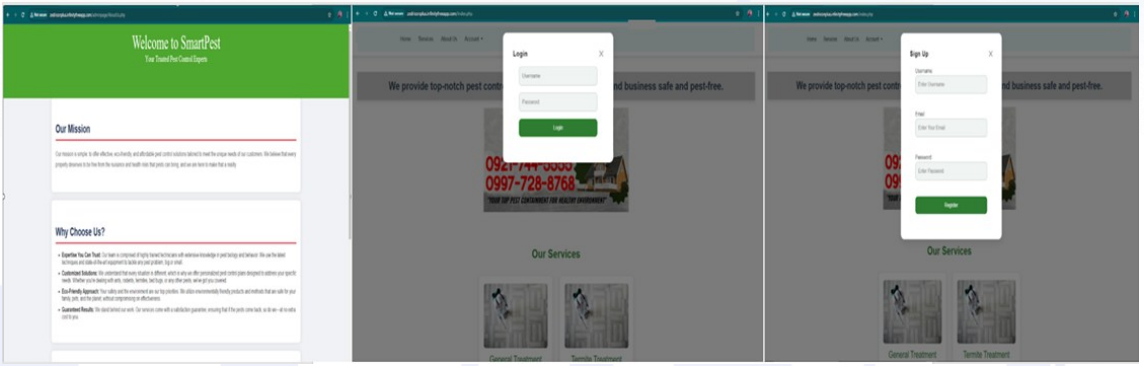

Figure 4: User interface of SmartPest: An Intelligent Customer Data and Scheduling System Using K-Means Clustering for Pest Control Services

The figure illustrates the homepage, login, and sign-up interfaces of the SmartPest system, showcasing its user-friendly and organized web layout. The homepage presents the system's mission and value propositions, emphasizing reliability, expertise, and customer satisfaction in pest control services. The login interface allows registered users to securely access their accounts using a username and password, ensuring authorized entry. Meanwhile, the sign-up interface enables new users to create an account by providing a username, email, and password, supporting system accessibility and customer onboarding. Overall, the design demonstrates SmartPest's focus on providing a simple, secure, and professional user experience for both new and returning clients.

Figure 5: Reservation of SmartPest: An Intelligent Customer Data and Scheduling System Using K-Means Clustering for Pest Control Services

The figure shows the SmartPest scheduling calendar interface for October 2024, allowing users to view and manage appointment dates conveniently. The highlighted dates indicate booked or scheduled services, helping both customers and administrators efficiently organize pest control appointments.

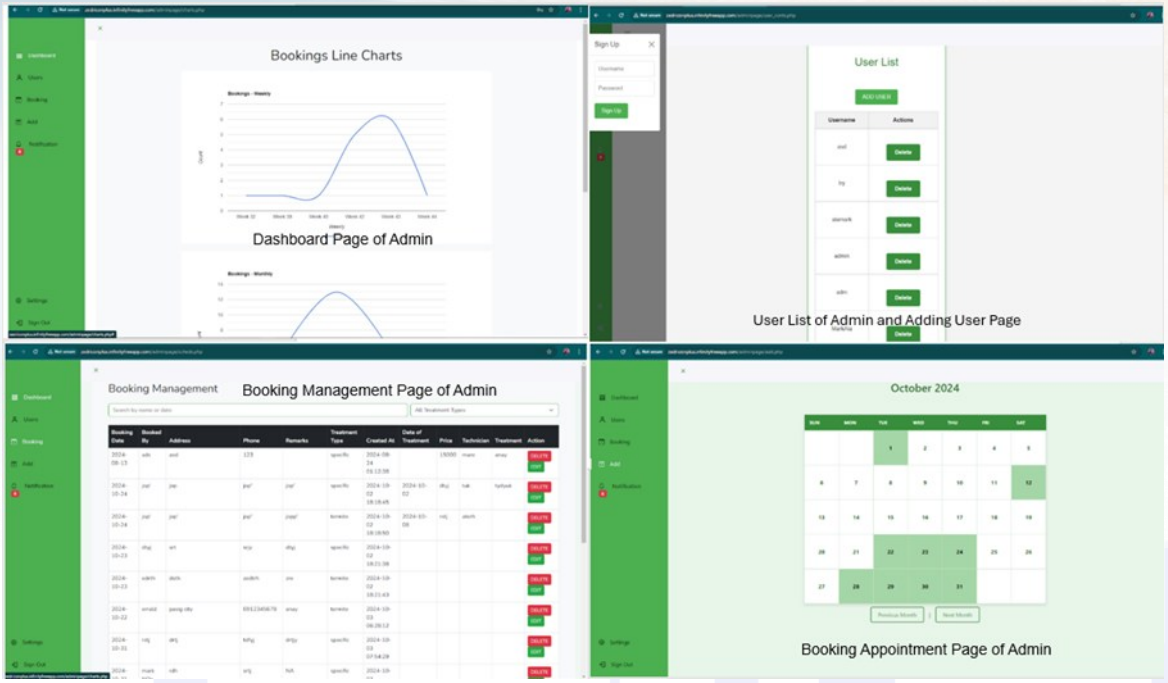

Figure 6: Admin interface of SmartPest: An Intelligent Customer Data and Scheduling System Using K-Means Clustering for Pest Control Services

The figure illustrates the Admin Interface of the SmartPest System, showcasing its different management and monitoring functions. The Dashboard Page displays booking line charts that provide weekly and monthly statistics, helping the administrator track service trends and workload patterns. The User List Page allows the admin to view, add, or delete user accounts efficiently, maintaining proper access control within the system. The Booking Management Page presents detailed records of customer appointments, including treatment types, technician details, and service dates, supporting organized service monitoring. The Booking Appointment Page visualizes scheduled services through an interactive calendar, allowing administrators to oversee and manage booking timelines. Overall, this figure highlights the system's capability to streamline operations, enhance data management, and improve administrative efficiency in pest control service

Table 3: ISO 25010 Evaluation according the Respondents

ISO 25010 Criteria	Users(200) Administrators(2), Customers(48) and Academicians(150)		IT Professional(15)	
	WM	VI	WM	VI
1. Functional Suitability	3.35	SA	3.35	SA
2. Performance Efficiency	3.45	SA	3.47	SA
3. Usability	3.57	SA	3.43	SA
4. Security	3.33	SA	3.24	SA
5. Maintainability	3.56	SA	2.92	A
6. Portability	3.44	SA	3.36	A
Overall Average Mean	3.45	SA	3.29	A

The table presents the evaluation of the SmartPest System based on the ISO/IEC 25010 Software Quality Model, which measures six major quality attributes—Functional Suitability, Performance Efficiency, Usability, Security, Maintainability, and Portability—as assessed by 200 Users (administrators, customers, and academicians) and 15 IT Professionals.

The Users rated the system with an overall weighted mean (WM) of 3.45, interpreted as Strongly Agree (SA), indicating that the SmartPest system met their expectations and delivered reliable performance across all criteria. The highest score came from Usability (3.57 SA) and Maintainability (3.56 SA), reflecting that the interface was user-friendly and system updates were manageable. This result demonstrates that users found the system easy to navigate, responsive, and well-maintained, aligning with the Agile development methodology described in the study that emphasizes user-centered design and continuous refinement.

Meanwhile, IT Professionals gave an overall weighted mean of 3.29, interpreted as Agree (A). Their evaluation reflects a more technical perspective, with slightly lower scores in Maintainability (2.92 A) and Security (3.24 SA). These findings suggest that while the system performs effectively and meets functional requirements, IT experts identified opportunities for enhancement in maintainability and advanced security features—particularly in adapting to system upgrades or integrating newer cybersecurity measures.

Both respondent groups acknowledged that the SmartPest system achieved high standards of functionality, usability, and efficiency, confirming its capability to improve scheduling, data management, and customer service operations. The results also validate that the system successfully meets international software quality standards and supports the study's hypothesis that SmartPest enhances operational and service quality through intelligent data clustering and scheduling.

Summary

The SmartPest System was evaluated through an Applied Developmental Research approach involving 215 respondents, including administrators, customers, academicians, and IT professionals. The study applied the Agile methodology, which emphasized iterative testing, user feedback, and continuous refinement to enhance functionality and usability. Data gathering occurred both before and after system implementation, with

evaluation based on the ISO/IEC 25010 model—covering Functional Suitability, Performance Efficiency, Usability, Security, Maintainability, and Portability. Results showed that users rated the system highly, with an overall weighted mean of 3.45 (Strongly Agree), while IT professionals gave a mean of 3.29 (Agree). Users particularly highlighted strong Usability (3.57) and Maintainability (3.56), confirming that SmartPest was user-friendly and well-structured for updates. IT experts, however, noted potential improvements in Maintainability (2.92) and Security (3.24), indicating a need for further technical enhancement. Overall, the findings confirm that the SmartPest system effectively streamlines pest control operations through intelligent data clustering and scheduling.

Conclusion

The study concludes that SmartPest significantly enhances the efficiency of customer data management and scheduling in pest control services. Its integration of K-Means Clustering and Agile methodology contributes to improved system responsiveness and customer satisfaction. The ISO 25010 evaluation confirms that the system meets international software quality standards, particularly in usability and functional suitability. Consequently, SmartPest proves to be a reliable and effective intelligent system for service-oriented industries.

Recommendations

It is recommended that developers continue to improve SmartPest's security protocols and maintainability features for long-term adaptability. Future versions should explore integration with advanced analytics and AI-driven forecasting to enhance system intelligence. Lastly, the system's application can be expanded beyond pest control to other service-based businesses to maximize its utility and scalability.

References

Ayodele, E. (2023). Customer Segmentation Using the K-Means Clustering Algorithm. Science & Tech Journal. [PDF] https://sciencetechjournal.federalpolyilaro.edu.ng/storage/article/JST%2015%20Done_1729671956.pdf

Bhatia, Gupta Sharma(2025). Analysis of Customer Segmentation Model through K-Means Clustering

Buttle, F., &Maklan, S. (2019). Customer Relationship Management: Concepts and Technologies (3rd ed.). Routledge.

DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. Journal of Management Information Systems, 19(4), 9–30. https://doi.org/10.1080/07421222.2003.11045748

Durga, Paulson AndSrinivasareddy (2025). Customer segmentation analysis for improving sales using clustering. International Journal of Science and Research Archive, 2023, 09(02), 708–715

Han, J., Kamber, M., & Pei, J. (2012). Data Mining: Concepts and Techniques (3rd ed.). Morgan Kaufmann.

John, J. M., Shobayo, O., & Ogunleye, B. (2024). An Exploration of Clustering Algorithms for Customer Segmentation in the UK Retail Market. arXiv. https://arxiv.org/abs/2402.04103

October 2022: DOI: 10.1109/ICRITO56286.2022.9965157 : 10th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO)

Omol, E. (2024). Application of K-Means Clustering for Customer Segmentation in Grocery Stores in Kenya. IJSTM. [PDF] https://ijstm.inarah.co.id/index.php/ijstm/article/view/1024

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Tabianan, K. (2022). K-Means Clustering Approach for Intelligent Customer Segmentation. Sustainability, 14(12), 7243. https://doi.org/10.3390/su14127243

Yousefi, N., Hasankhani, F., Kiani, M., & Yousefi, N. (2019). Appointment Scheduling Model in Healthcare Using Clustering Algorithms. arXiv. https://arxiv.org/abs/1905.03083

TaskWise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization.

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Abstract

The study developed TaskWise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization, designed to enhance individual productivity through adaptive scheduling and intelligent task prioritization. The system integrates key theoretical frameworks such as the Eisenhower Matrix, Time Management Theory, and Cognitive Load Theory, enabling users to prioritize urgent and important tasks efficiently while avoiding mental fatigue. TaskWise applies Greedy and Dynamic Scheduling algorithms supported by reinforcement learning to generate personalized and adaptive schedules that evolve based on user behavior, task completion history, and workload changes. It also provides visual analytics and productivity insights that guide users in improving their time management, focus, and performance.

The research employed an Applied Developmental Research approach, focusing on both the design and implementation of the TaskWise system and its evaluation of effectiveness in improving productivity. Data were collected from 75 students through surveys and interviews to identify time management challenges and productivity patterns, which informed the system's design and algorithm development. After implementation, 475 students and 15 professionals evaluated the system using the ISO 25010 software quality model, assessing key criteria such as functionality, reliability, performance efficiency, interaction capability, and security. The development followed the Agile Software Development Life Cycle (SDLC) methodology, which emphasized iterative prototyping, user feedback, and continuous refinement across stages of planning, design, development, testing, and evaluation, ensuring that the system met both technical and

user-centered goals.

The evaluation results showed positive feedback, with students rating the system 3.50 (Strongly Agree) and professionals 3.15 (Agree), indicating satisfaction with TaskWise's usability, reliability, and overall efficiency. The findings confirmed that TaskWise met ISO 25010 standards and effectively enhanced personal productivity through intelligent scheduling and adaptive learning.

In conclusion, TaskWise successfully demonstrated how machine learning can personalize productivity management by aligning theoretical principles with real-time behavioral data. It provided evidence that adaptive scheduling improves task prioritization, reduces cognitive overload, and increases user satisfaction. The study recommends enhancing user interface design and security measures, adding cross-platform compatibility, and enabling offline functionality to improve accessibility. Continuous user feedback and system updates are further encouraged to maintain performance and ensure long-term sustainability in diverse productivity contexts.

Keywords: Task Management, Machine Learning, Adaptive Scheduling, Productivity Optimization

Introduction

In today's dynamic and fast-paced world, individuals constantly strive to maximize their productivity and better manage their tasks. Traditional to-do lists and generic scheduling tools often fail to adapt to the unique habits, rhythms, and preferences of each user. With the accelerating prevalence of mobile devices, there is an opportunity to bring truly personalized support into the palm of one's hand. The proposed application, TaskWise, is designed specifically for individuals rather than teams or organizations, enabling an environment tailored to individual task flows. By focusing on the needs of a single user, TaskWise hopes to reduce clutter, decision fatigue, and misalignment that arise in broader project-management platforms.

The challenge of task prioritization and scheduling is well-recognized in both industry and academia. Intelligent task management requires more than simply listing tasks — it demands algorithms that can determine which tasks to perform first based on urgency, importance, and contextual factors such as deadlines and user workload. Recent research highlights the effectiveness of Task Prioritization and Scheduling Algorithms, particularly Greedy Scheduling for immediate high-priority task placement and Dynamic Scheduling for continuous adjustment based on changing conditions. Greedy Scheduling provides rapid decision-making by allocating available time slots to the most critical tasks, while Dynamic Scheduling allows the system to adapt to real-time user behavior, shifting priorities, and unforeseen events. This combination of methods provides a strong foundation for designing TaskWise's intelligent scheduling engine, enabling it to deliver responsive and adaptive task recommendations for individual productivity optimization.

The TaskWise, the core innovation lies in leveraging machine learning and analytics to optimize the scheduling of individual tasks, while still preserving user control. The system will monitor user behavior, learn from task completion patterns, identify bottlenecks, and suggest optimized schedules through insights. Importantly, TaskWise will incorporate an

integrated calendar interface so that scheduling, rescheduling and optimization happen in one place rather than via external tools. The system will present comprehensive reports and productivity analytics to the user, offering visualizations of task trends, completion times, idle periods and the effect of applying optimized schedules. Through this blend of personalization, data-driven insight, and seamless scheduling, TaskWise aims to transcend the limitations of generic reminder apps.

TaskWise's scheduling capability is founded on advanced task prioritization and scheduling algorithms that support its machine learning–driven recommendations. According to Yang (2025), greedy scheduling effectively allocates high-priority tasks to available slots, enhancing responsiveness in dynamic settings. Zhang (2025) further emphasizes that dynamic scheduling continuously adjusts task priorities based on real-time changes and user behavior. Similarly, Aakisetti et al. (2025) highlight that dynamic and prioritized scheduling significantly improve task completion time, responsiveness, and overall user satisfaction. As noted by Loiseau and Wu (2015), combining greedy placement with later refinements minimizes latency and optimizes attention, forming the foundation of TaskWise's adaptive hybrid scheduling engine.

The Task Prioritization and Scheduling Algorithm in TaskWise integrates key theoretical foundations—Eisenhower Matrix, Time Management Theory, and Cognitive Load Theory—to enhance productivity and learning efficiency. The Eisenhower Matrix, as described by Covey (2020), helps individuals prioritize tasks based on urgency and importance, enabling focused attention on high-value activities. Macan (1994) emphasized in the Time Management Theory that structured planning and scheduling significantly reduce stress and improve academic and work performance. Meanwhile, Sweller's Cognitive Load Theory (1988) suggests that balancing mental effort prevents cognitive overload, supporting better learning and performance outcomes.Recent studies by Zhou et al. (2023) highlight that adaptive scheduling systems using these theories can improve attention allocation and overall task efficiency. askWise combines these principles with reinforcement learning to deliver personalized and sustainable productivity improvements for students.

The aim of TaskWise is clearly scoped to an individual user context and a targeted mobile environment. The system will implement individual task management rather than team-based or enterprise project management. It will be launched exclusively as a mobile application on a specified operating system, with cross-platform compatibility excluded for the initial release. The system will use analytics and machine learning to enhance productivity recommendations, while users retain manual control over their schedules. The system will feature an integrated calendar for task scheduling and organization, eliminating the need for external calendar integrations. The system will offer comprehensive reports and insights into productivity.

The system is subject to specific limitations it is intended for individual use and does not support collaboration, team-based, or organizational project management. The system will not support offline functionality; all features require an active internet connection for data syncing. The system does not permit users to manually adjust or customize the Machine Learning parameters, as its adaptive learning capabilities are solely focused on

optimizing task scheduling based on observed user habits. The system will include a built -in calendar, removing the need for integration with third-party calendar applications. The system focuses solely on task scheduling and optimization; it will not include financial management, note-taking, or document storage functionalities. By clearly defining these boundaries, TaskWise is positioned to deliver a lean, focused and high-value solution tailored to individual productivity needs.

Theoretical Framework

The Task Prioritization and Scheduling Algorithm in TaskWise is designed to enhance student productivity through adaptive learning and intelligent task management. By combining the Eisenhower Matrix, Time Management Theory, and Cognitive Load Theory, the system prioritizes urgent and important tasks while maintaining a balanced workload to prevent fatigue. Through reinforcement learning, TaskWise continuously refines its recommendations based on users' past performance and study behaviors, ensuring efficient and personalized time distribution.

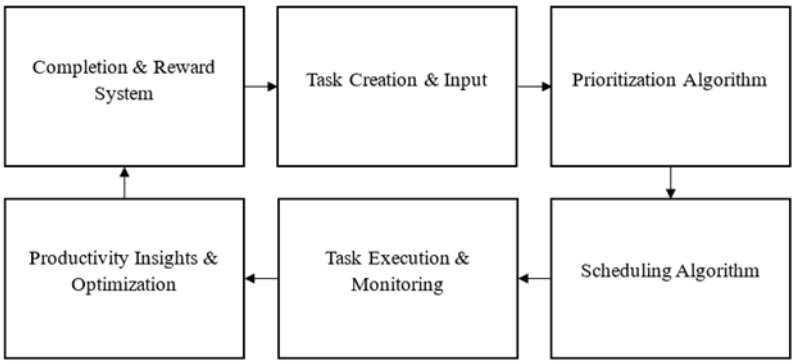

Figure 1: TaskWise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization.

The scheduling component integrates Greedy Scheduling for immediate handling of high-priority tasks and Dynamic Scheduling to adapt to real-time workload and deadline changes. Supported by adaptive learning, the system adjusts to user productivity trends, creating an optimized and sustainable workflow. TaskWise ultimately serves as an intelligent scheduling platform that merges behavioral insights and machine learning optimization to help students manage their academic responsibilities effectively.

Conceptual Framework

The conceptual framework of TaskWise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization illustrates how the system transforms user inputs into intelligent, adaptive scheduling outputs through machine learning, analytics, and continuous feedback.

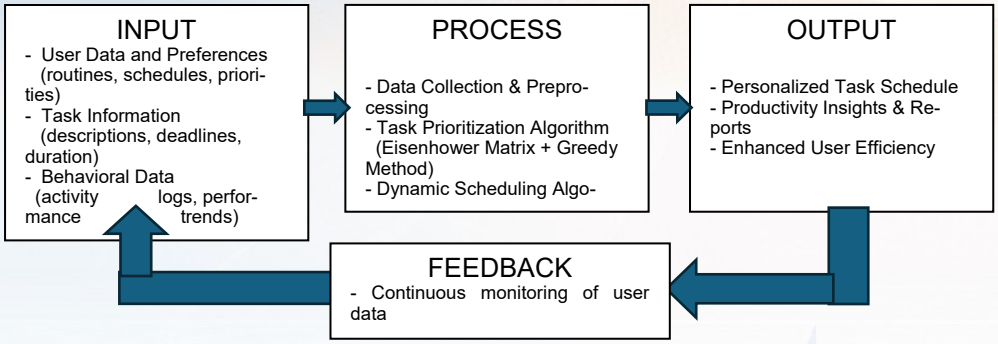

Figure 2: Input-Process-Output Diagram

The Input stage of TaskWise involves gathering user data, task details, behavioral patterns, and applying theoretical frameworks to create a foundation for intelligent scheduling. It collects users' personal schedules, task priorities, and performance behaviors to tailor recommendations that align with their productivity habits. By integrating the Eisenhower Matrix, Time Management Theory, and Cognitive Load Theory, TaskWise ensures that tasks are prioritized efficiently while maintaining a balanced and sustainable workload.

The Process phase of TaskWise involves collecting and analyzing user data to generate intelligent and adaptive task schedules. Using the Eisenhower Matrix with Greedy and Dynamic Scheduling algorithms, the system prioritizes urgent tasks and continuously adjusts to real-time changes in workload and behavior. Through machine learning and a built-in calendar interface, TaskWise refines recommendations and visually presents personalized schedules and productivity insights for efficient task management.

The Output of TaskWise delivers a personalized and dynamically optimized schedule tailored to each user's changing priorities and workload. It provides detailed productivity reports and visual analytics that display task completion rates, time usage, and performance trends. As a result, users experience improved efficiency, reduced procrastination, and a more balanced approach to managing their daily tasks.

The Feedback phase of TaskWise involves continuous monitoring of user behavior, task completions, and interaction patterns. This data is fed back into the machine learning and scheduling components to enhance the system's accuracy and adaptability. Additionally, performance reports provide users with insights to reflect on their habits and make informed adjustments for improved productivity.

Significance of the Study

The development of TaskWise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization holds significant value

in advancing personal productivity management through intelligent automation and adaptive scheduling. By integrating Greedy Scheduling and Dynamic Scheduling algorithms, the system provides a data-driven solution that efficiently prioritizes high-importance tasks and adjusts schedules in real time based on user behavior and workload changes. This contributes to a more responsive and flexible task management experience, reducing procrastination and improving task completion rates for individuals in academic or professional settings.

For students, TaskWise offers a structured and evidence-based approach to time management by applying the Eisenhower Matrix, Time Management Theory, and Cognitive Load Theory. These frameworks allow students to allocate their time effectively, balance their cognitive effort, and focus on high-priority academic tasks. The adaptive learning feature of the system ensures continuous improvement in task scheduling, helping learners develop consistent study habits and achieve better academic outcomes.

For professionals, TaskWise serves as a personalized productivity assistant capable of managing diverse workloads and adapting to changing priorities in fast-paced environments. Its machine learning–driven insights provide users with data-backed recommendations for optimizing work routines, enhancing performance, and achieving better work-life balance.

For researchers and developers, this study contributes to the growing field of AI-driven productivity systems by demonstrating the practical application of reinforcement learning and hybrid scheduling algorithms in mobile-based environments. It provides a conceptual and technical foundation for future innovations in intelligent task management systems.

Scope and Limitation

Scope: The TaskWise system is designed specifically for individual users, focusing on enhancing personal productivity through intelligent task management and adaptive scheduling. It will be developed as a mobile-based application operating on a specific platform, ensuring smooth and optimized performance for targeted users. The system integrates analytics and machine learning to generate personalized productivity recommendations while allowing users to retain manual control over their schedules. An integrated calendar is included to manage and organize tasks efficiently, removing the need for third-party calendar integrations. Additionally, TaskWise will provide comprehensive productivity reports and insights, enabling users to monitor performance and identify areas for improvement in their daily routines.

Limitation: The TaskWise system is limited to individual task management and does not support collaboration or team-based project management features. It requires an active internet connection at all times, as the system's functionalities depend on online data syncing and machine learning processes. Users will not be able to manually adjust or customize the machine learning parameters, since the adaptive learning component automatically optimizes scheduling based on user behavior. Furthermore, TaskWise includes a built-in calendar and therefore does not support integration with external calendar applications. The system is exclusively focused on task scheduling and optimization, and will not provide additional features such as financial tracking, note-taking, or document storage to maintain a lean and productivity-centered design.

Related Literature Review

As discussed by Li, X., & Chen, Y. (2023). The study is an adaptive scheduling framework using reinforcement learning to dynamically reorder task priorities based on user behavior and workload patterns. The approach demonstrated higher accuracy and responsiveness in real-time productivity applications.

As mentioned by Rahman, M., & Hussain, F. (2022) introduced a context-aware task prioritization system that leverages time constraints, user preferences, and urgency factors for efficient scheduling in mobile applications. The model significantly reduced task delay and improved user satisfaction rates.

As emphasized by Singh, A., & Kumar, P. (2021) that the greedy-based task scheduling algorithms for intelligent personal assistants, emphasizing their efficiency in handling high -priority task assignments under limited computational resources. Results showed improved throughput and reduced latency in real-time task execution.

As described by Huang, L., & Zhao, Q. (2024) that the hybrid scheduling model integrating greedy heuristics with reinforcement learning for adaptive task management systems. Their results indicated that hybrid models outperform traditional scheduling methods in both adaptability and energy efficiency.

Synthesis : TaskWise utilizes advanced task prioritization and scheduling algorithms powered by machine learning to enhance productivity and efficiency. Its adaptive hybrid scheduling engine dynamically adjusts task priorities based on user behavior and changing conditions. By integrating principles from task management and cognitive theories, the system provides a balanced and personalized approach to workload distribution. TaskWise promotes improved time management, reduced stress, and sustainable productivity for individual users through intelligent, data-driven recommendations.

System Methodology

Type of Research: This study employs an Applied Developmental Research approach, focusing on designing and implementing TaskWise, a mobile-based intelligent task management system that uses machine learning to enhance personal productivity. The research aims to both develop the system and evaluate its effectiveness in improving user efficiency and task scheduling accuracy.

Data Gathering: Before the system's development, data were collected from 75 students through surveys and interviews to identify common challenges in time management, prioritization, and workload balance. These insights guided the design of TaskWise's intelligent algorithms and user interface to ensure alignment with real-world productivity needs. The initial data collection provided the foundation for the system's functional and behavioral requirements.

After system implementation, the system was tested and evaluated by 475 students and 15 professional were ISO 25010 quality model was used for the evaluation question that is focusing on Functionality Suitability, Performance Efficiency, Interaction, Reliability,

Capability, and Security.

Software Process Methodology

The development of TaskWise followed the Agile Software Development Life Cycle (SDLC) methodology, which emphasizes iterative design, rapid prototyping, and continuous user feedback. The process began with requirements analysis, where user needs and productivity challenges were identified and documented. In the design phase, wireframes, data flow diagrams, and system architecture were created to visualize the functionality and workflow of TaskWise. The implementation phase focused on integrating the machine learning algorithms and calendar-based scheduling interface, followed by rigorous testing for accuracy and stability. Each iteration incorporated user feedback to enhance adaptability, usability, and overall performance.

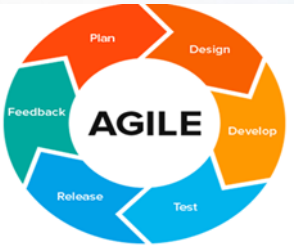

Figure 3: Agile methodology of TaskWise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization.

The Agile methodology, as illustrated in the figure, guided the development of TaskWise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization through an iterative and user-focused approach. The process began with the Planning phase, where user requirements were analyzed and aligned with ISO 25010 standards to ensure functionality suitability and performance efficiency. During the Design and Development stages, the team integrated intelligent scheduling algorithms and machine learning components while emphasizing interaction quality, reliability, and capability to enhance system responsiveness and stability. The Testing and Release phases involved rigorous evaluation against ISO 25010 criteria to validate the system's efficiency, usability, and security under real-world conditions. Finally, user Feedback was collected and applied in continuous iterations to further refine TaskWise's performance, ensuring sustained improvement and adaptability in m

System Tools

Data Flow Diagram: The Data Flow Diagram of TaskWise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization illustrates the flow of information between the user, system processes, and the intelligent scheduling algorithm to ensure efficient task management and personalized productivity enhancement.

Figure 4: Context Data Flow Diagram of TaskWise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization.

The diagram illustrates the TaskWise system's data flow, showing how user interactions are processed through various components to manage and optimize tasks. It begins with the user creating or editing an account and adding, editing, or removing tasks, which are stored in the Task List. These tasks are then sent to the Algorithm, which optimizes the schedule and generates a Scheduled Task list for the user to review and follow. As users start and complete tasks, the system updates the Current Task and Completed Task records, maintaining a detailed Task History for tracking productivity and performance.

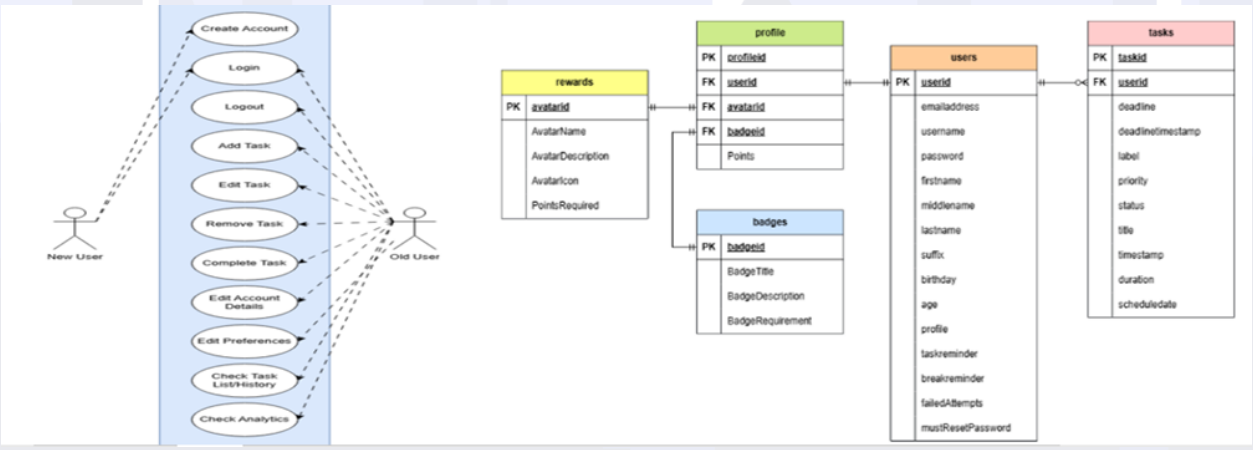

Figure 5: Left- Use Case Diagram and Right- Entity Relationship Diagram of Task Wise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization.

On the left side of the figure is a Use Case Diagram of the Task Wise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization. Task Prioritization and Scheduling Algorithm in TaskWise aims to boost student productivity through intelligent task management and adaptive learning. It integrates the Eisenhower Matrix, Time Management Theory, and Cognitive Load Theory to prioritize essential and urgent tasks while maintaining a balanced workload to avoid mental fatigue. Utilizing reinforcement learning, TaskWise continually improves its recommendations based on users' previous performance and study patterns, ensuring an efficient and personalized allocation of time. Meanwhile, on the right side is the Entity Relationship Diagram (ERD) on the right presents the structural data relationships within the system, showing entities like User, Task, Schedule, and History, and how they are interconnected. It defines how user data, task information, and machine learning outputs are linked to support personalized recommendations. Together, these diagrams demonstrate both the functional interactions and the data architecture that power TaskWise's intelligent and adaptive task management system.

The System:

Figure 6: registration and login interfaces of TaskWise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization.

The registration and login interfaces of TaskWise: A Personalized Task Optimizer and Productivity Analytics Application serve as the essential gateways for user engagement and system personalization. The registration form not only provides a simple and intuitive way for new users to sign up but also establishes the foundation for collecting individualized data that drives smart recommendations and adaptive scheduling. Meanwhile, the login page ensures secure and seamless access to user accounts, allowing returning users to instantly resume their tasks and productivity tracking without data loss.

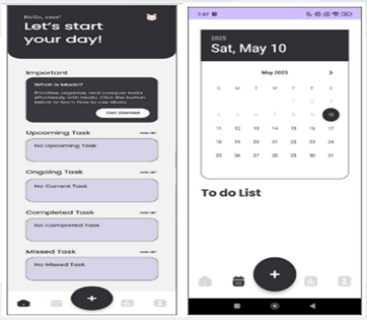

Figure 7: Home Dashboard and Task Calendar of TaskWise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization.

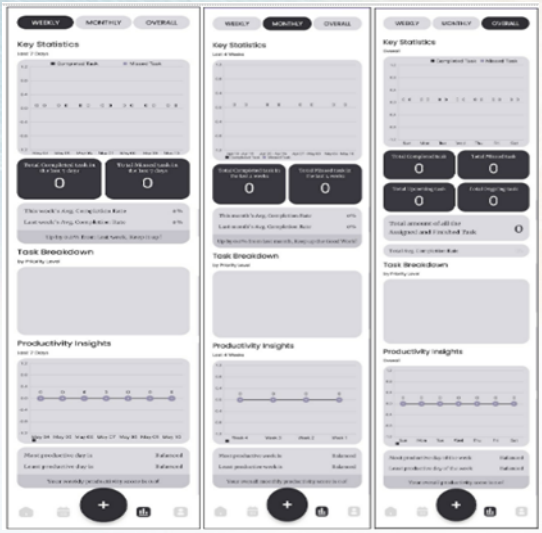

Figure 8: Analytics Section of TaskWise that's applied the Task Prioritization and Scheduling Algorithm of the TaskWise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization.

The figure displays the Analytics Section of TaskWise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization. It visually represents users' weekly, monthly, and overall productivity performance through clear charts and summary statistics. Each tab offers a structured breakdown of key statistics, task completion trends, and productivity insights, enabling users to monitor progress and identify areas for improvement.

Combined with the system's Task Prioritization and Scheduling Algorithm, which integrates the Eisenhower Matrix, Time Management Theory, and Cognitive Load Theory, this analytics dashboard transforms data into actionable insights. The intelligent feedback loop — powered by reinforcement learning and adaptive scheduling — helps users maintain balance, manage deadlines effectively, and sustain long-term productivity.

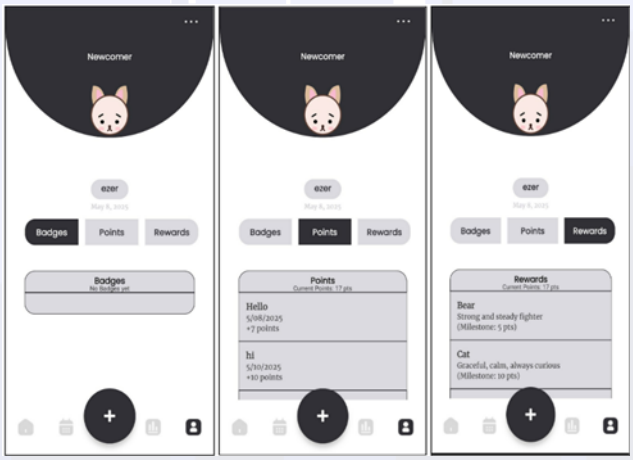

Figure 9: User Profile of TaskWise: A Mobile-Based Intelligent Task Management System Using Machine Learning for Personalized Productivity Optimization.

The figure displays the user profile page, where users can view their achievements, including earned badges, accumulated points, and unlocked rewards. This gamified element enhances engagement by celebrating milestones and reinforcing positive productivity behavior. It creates a sense of accomplishment and encourages continued usage.

Summary of Evaluation of Respondents.

Table 1. Summary of Evaluation of Respondents.

Criteria (ISO25010)	Respondents (490)			
	475 students		15 professionals	
	WM	VI	WM	VI
1. Functional Suitability	3.43	SA	3.16	A
2. Performance Efficiency	3.57	SA	3.33	SA
3. Interaction Capability	3.52	SA	3.0	A
4. Reliability	3.35	SA	3.3	SA
5. Security	3.64	SA	2.99	A
Overall Average Mean	3.50	SA	3.15	A

The evaluation of TaskWise based on the ISO 25010 software quality criteria shows an overall positive user perception from both students (475 respondents) and professionals (15 respondents).

Students rated the system with an overall mean of 3.50 (Strongly Agree), while professionals gave an overall mean of 3.15 (Agree), indicating satisfaction with some areas for improvement. In terms of functional suitability, students strongly agree that the system effectively performs its intended tasks, while professionals agree but suggest slight refinements. Performance efficiency received high ratings from both groups, showing that the system operates quickly and efficiently. The interaction capability was also rated positively, with students finding the interface intuitive, though professionals recommended improving usability for professional settings. Both groups strongly agree on the reliability of TaskWise, indicating consistent and dependable performance. Security earned the highest rating from students, reflecting confidence in data protection, while professionals expressed only moderate agreement, hinting at expectations for enhanced security features. Overall, TaskWise demonstrates strong function

Summary

The study developed TaskWise, a mobile-based intelligent task management system that enhances individual productivity through adaptive scheduling and machine learning–driven task management. It integrates the Eisenhower Matrix, Time Management Theory, and Cognitive Load Theory to prioritize tasks efficiently while preventing mental fatigue. Using Greedy and Dynamic Scheduling algorithms with reinforcement learning, TaskWise personalizes task recommendations based on user data and behavior. The system also provides visual analytics and productivity reports to support self-assessment and improvement. Evaluation using the ISO 25010 quality model showed highly positive feedback, with students rating it 3.50 (Strongly Agree) and professionals 3.15 (Agree) overall. Both groups praised its functionality, efficiency, reliability, and usability, though

professionals suggested enhancing security and interface design. The results confirm that TaskWise effectively delivers intelligent, data-driven productivity optimization tailored to individual users.

Conclusion

The development and evaluation of TaskWise proved that intelligent scheduling supported by machine learning can effectively enhance personal productivity. By integrating cognitive and time management theories, the system balanced task prioritization with user workload, preventing burnout and improving focus. Results from ISO 25010 evaluation confirmed that TaskWise met high standards in functionality, usability, and performance efficiency. Students rated the system very positively, while professionals also agreed on its reliability and adaptability. The incorporation of analytics and adaptive feedback further strengthened its personalized task management approach. In conclusion, TaskWise achieved its goal of providing an intelligent, data-driven, and user-centered productivity platform.

Recommendations

It is recommended to further enhance TaskWise by improving its user interface design and security features to meet both academic and professional needs. Future developments may include cross-platform compatibility and offline functionality to improve accessibility. Continuous updates and user feedback integration are encouraged to maintain high-quality performance and ensure long-term system sustainability.

References

Aakisetti & etal "Dynamic Priority Scheduling Algorithms for Flexible Task Management in Cloud Computing" , IJISAE, 2025

Covey, S. R. (2020). The 7 Habits of Highly Effective People. FranklinCovey. https://www.franklincovey.com/the-7-habits/

J. Zhang, “Dynamic and prioritised task scheduling of heterogeneous …”, ScienceDirect, 2025. https://www.sciencedirect.com/science/article/abs/pii/S0925231225008562

Macan, T. H. (1994). Time management: Test of a process model. Journal of Applied Psychology, 79(3), 381–391. https://psycnet.apa.org/record/1994-33565-001

Paas, F., Renkl, A., & Sweller, J. (2019). Cognitive load theory and educational design: Recent developments. Educational Psychology Review, 31(2), 341–358. https://link.springer.com/article/10.1007/s10648-019-09443-4

Patrick Loiseau "Greedy and Dynamic Programming Algorithms for Scheduling Deadline-Sensitive Parallel Tasks", https://www.researchgate.net/publication/271218702_Greedy_and_Dynamic_Programming_Algorithms_for_Scheduling_Deadline-Sensitive_Parallel_Tasks

Singh, A., & Kumar, P. (2021) GAN augmentation to deal with imbalance in imaging-based intrusion detection, Elsevier. https://www.sciencedirect.com/science/article/abs/pii/S0167739X21001382?via%3Dihub

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. Cognitive Science, 12(2), 257–285. https://link.springer.com/article/10.1007/BF00375122

Xi-Ao Ma,Hao Xu,Chunhua Ju (2023) Class-specific feature selection via maximal dynamic correlation change and minimal redundancy, Elsevier. https://www.sciencedirect.com/science/article/abs/pii/S0957417423009570?via%3Dihub

Yang P., "Dynamic Task Scheduling Based on Greedy and Deep …", MDPI, 2025. https://www.mdpi.com/2079-9292/14/16/3327

Zhou, J., et al. (2023). Adaptive time management and task scheduling in digital learning systems. Procedia Social and Behavioral Sciences. https://www.sciencedirect.com/science/article/pii/S1877042823003120

Web-Based Smart Table Reservation and Demand Prediction System for Restaurant Management

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Abstract

Restaurants often experience fluctuating demand that affects manpower planning, inventory management, and overall operational performance. Traditional manual scheduling systems are reactive rather than predictive, which can lead to poor customer experiences during peak hours. Integrating predictive analytics into a web-based system allows for proactive management of customer demand through accurate forecasting models. By analyzing past reservation data and customer trends, the system helps predict future booking volumes and optimize operational readiness.

The Web-Based Smart Table Reservation and Demand Prediction System for Restaurant Management" aims to enhance operational efficiency and customer satisfaction by integrating predictive analytics and secure reservation management into a single web-based platform. The system was designed to address the limitations of traditional manual booking methods, such as overbooking, long waiting times, and inefficient resource utilization. By applying Linear Regression as the predictive model, the system analyzes historical booking data to forecast demand patterns, allowing restaurant managers to anticipate peak hours, optimize table allocation, and allocate staff resources effectively. Furthermore, the inclusion of One-Time Password (OTP) verification strengthens system security by ensuring that all reservations are authenticated, reducing instances of fraudulent or duplicate bookings.

The research adopted an Applied Developmental approach, utilizing the Agile Software Development Methodology to design, test, and refine the system based on continuous feedback from users and technical experts. Data gathered from restaurant managers, staff, and customers provided essential insights into operational challenges and system requirements. The developed system was evaluated using the ISO 25010 Quality Model, which measured various software quality characteristics, including functionality, performance efficiency, reliability, usability, maintainability, and security. Results from both the user and technical groups indicated high levels of satisfaction, with users rating the system as highly functional and easy to use, while technical experts commended its maintainability, reliability,

and performance stability.

The system's implementation significantly improved restaurant management processes by automating reservations, forecasting demand accurately, and providing administrators with real-time performance reports through a user-friendly dashboard. It also introduced features such as booking summaries, predictive reports, and security audit logs that support data-driven decision-making. The evaluation results revealed an overall weighted mean of 3.53 for male respondents and 3.22 for female respondents, indicating a "Strongly Agree" and "Agree" interpretation, respectively, confirming that the system met international software quality standards.

In conclusion, the system successfully demonstrated how predictive modeling combined with secure web technologies can transform restaurant operations into more efficient, reliable, and customer-focused processes. The findings suggest that integrating machine learning techniques such as Linear Regression with reservation systems enhances forecasting accuracy and operational readiness. It is recommended that future studies explore mobile compatibility and the integration of AI-driven algorithms for improved prediction accuracy and user engagement. Overall, the Web-Based Smart Table Reservation and Demand Prediction System serves as a practical innovation for advancing restaurant management through intelligent automation and predictive analytics.

Keywords: Predictive Analytics, Linear Regression, OTP Verification, Restaurant Management

Introduction

The Web-Based Smart Table Reservation and Demand Prediction System for Restaurant Management is developed to enhance restaurant efficiency and streamline customer booking experiences. It enables users to reserve tables online, reducing waiting times and minimizing manual scheduling errors. The system is designed to provide real-time availability updates and ensure that restaurant managers can efficiently monitor daily operations. Through an intelligent data-driven approach, the platform improves service reliability and customer satisfaction while optimizing resource allocation.

Restaurants often experience fluctuating demand that affects manpower planning, inventory management, and overall operational performance. Traditional manual scheduling systems are reactive rather than predictive, which can lead to poor customer experiences during peak hours. Integrating predictive analytics into a web-based system allows for proactive management of customer demand through accurate forecasting models. By analyzing past reservation data and customer trends, the system helps predict future booking volumes and optimize operational readiness.

Beyond predictive analytics, the system also incorporates secure reservation verification using One-Time Password (OTP) authentication. This mechanism ensures that all bookings are validated by legitimate users, preventing fraudulent reservations and duplicate entries. Additionally, security audit logs are automatically generated to monitor OTP confirmations and record irregularities. These built-in features enhance data security, operational transparency, and customer trust within the online reservation environment.

Linear Regression has been widely used in predictive analytics for estimating restaurant booking trends and customer flow patterns. According to Lee and Park (2023), Linear Regression effectively models the relationship between historical reservation data and external factors such as time, weather, and promotions, enabling accurate demand forecasting. The integration of linear regression and scheduling algorithms in restaurant management systems enables accurate forecasting of reservation demand and efficient

allocation of tables, helping reduce wait times and improve customer satisfaction (Rahman & Lee, 2022; Chen et al., 2023). These algorithms utilize historical booking data to model demand fluctuations, optimize scheduling efficiency, and support data-driven decision-making for enhanced operational performance (Gao & Tan, 2021).

Other studies further validated the significance of regression algorithms in predictive modeling for hospitality and retail management. According to Kumar and Das (2022), Multiple Linear Regression accurately predicts future bookings by considering customer frequency and seasonal trends, helping managers plan ahead. In a similar study, Nguyen et al. (2021) applied Linear Regression to analyze sales and reservation data, concluding that it improves forecasting accuracy when combined with data preprocessing and feature scaling. Furthermore, Zhao and Li (2020) highlighted that regression models are simple yet powerful tools for predicting reservation trends, serving as foundational algorithms before employing more complex AI methods.

Web-Based Smart Table Reservation and Demand Prediction System for Restaurant Management aim to provide an integrated solution that addresses these operational and security challenges. It combines predictive modeling to forecast booking trends with OTP verification for secure, authenticated reservations. By leveraging these technologies, the system seeks to optimize appointment management, reduce operational bottlenecks, and improve overall user experience. Furthermore, it enables organizations to proactively plan for high-demand periods and minimize service disruptions.
Specifically, the system aims to generate the following reports to enhance operational efficiency and security:

- Report of Booking Summaries: Summarizes daily, weekly, and monthly booking numbers, aggregated by busy hours, average group size, and cancellation rates, presented in tables with graphs to indicate trends and comparisons.
- Reservation Predictions Report: Forecasts optimal reservation times using historical data and AI techniques, with charts displaying expected rush hours to plan manpower and supplies.
- Security Audit Logs: Records all OTP confirmations during bookings, highlighting any irregularities, with log files containing timestamps and verification statuses for every booking.

Theoretical Framework

The theoretical framework employs predictive modeling using linear regression to analyze historical reservation data and forecast future booking demands accurately. Through this schedule system algorithm, the model identifies patterns in customer arrivals, peak hours, and cancellation rates to optimize table allocation and reduce wait times. By integrating predictive-linear regression and scheduling algorithms, the system enhances restaurant efficiency, supports proactive management decisions, and improves overall customer satisfaction.

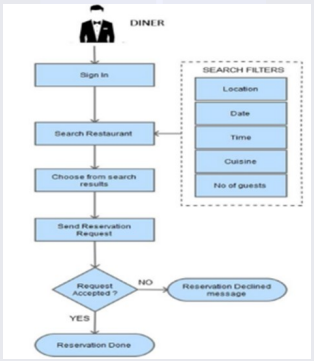

Figure 1: Online Ordering System

The study integrates an Online Ordering System (OOS) and Scheduling Algorithms to streamline food ordering and optimize restaurant operations. The OOS enables customers to conveniently place orders online through web browsers on computers or smartphones, addressing inefficiencies in traditional ordering methods. This system simplifies the entire process for both customers and restaurant staff, improving transaction speed and accuracy. Meanwhile, scheduling algorithms ensure precise and timely operations by managing real-time order scheduling and staff allocation. Through predictive analytics, the system enhances operational efficiency, increases customer satisfaction, and ensures security via OTP verification to prevent false bookings.

Conceptual Framework

Input: The system gathers historical booking data, customer profiles, and reservation details to forecast future demand and improve resource allocation. OTP verification is integrated to ensure that only verified and authentic bookings are processed, reducing fraudulent activities. These inputs collectively aim to enhance the overall functionality, efficiency, and security of the online appointment booking process.
Process: Machine learning and scheduling algorithms analyze the collected data to predict reservation trends and optimize booking schedules. The system dynamically adjusts table allocations and staff assignments based on predicted demand patterns. Once an appointment is verified through OTP, the confirmed booking is stored in the restaurant's database and managed in real time.

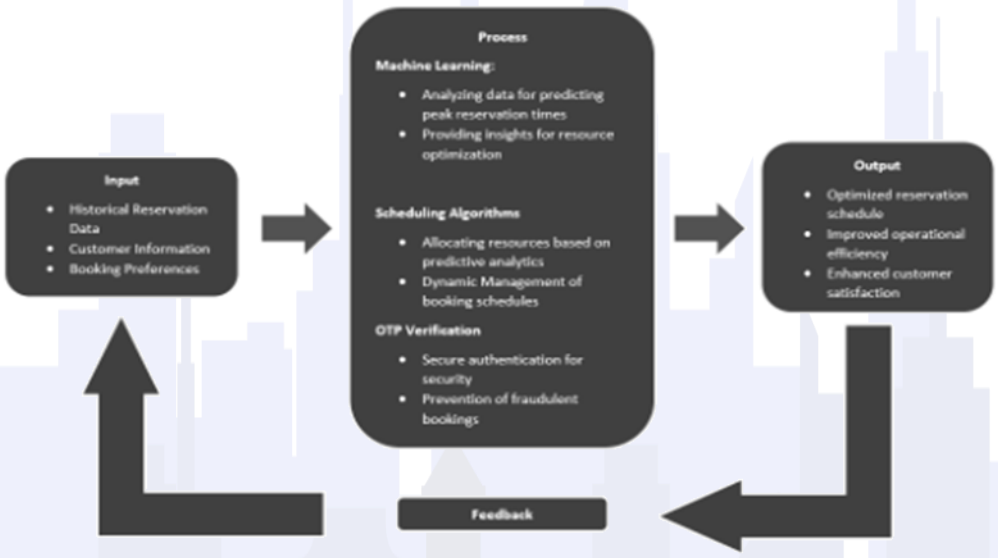

Figure 2: Input-Process-Output Model

Output: The system produces accurate booking schedules, optimized staff utilization, and reduced wait times for customers. It enhances customer satisfaction by delivering a smoother, faster, and more personalized booking experience. Ultimately, the system ensures efficient operations while maintaining a high level of booking security.

Feedback: Users provide feedback on their booking experiences, service quality, and system usability after completing reservations. This feedback is analyzed to refine system features, improve user satisfaction, and enhance predictive models. Continuous feedback-driven updates ensure that the system remains efficient, user-centered, and aligned with customer expectations.

Scope and Limitation

Scope: The study focuses on developing a Web-Based Smart Table Reservation and Demand Prediction System designed to improve restaurant management efficiency and customer satisfaction. The system integrates predictive analytics through Linear Regression to forecast reservation demand and optimize table allocation. It also includes One-Time Password (OTP) verification to ensure secure and authenticated bookings. Core system features include online table reservations, demand forecasting reports, booking summaries, and security audit logs. The system is accessible through web browsers and targets restaurant administrators, staff, and customers as its main users. Furthermore, it was developed and evaluated following the Agile Software Development Methodology and assessed based on the ISO 25010 Quality Model for functionality, reliability, maintainability, usability, and security.

Limitation: The system is limited to web-based access and does not currently support mobile application deployment or offline functionality. Its predictive capability relies solely on Linear Regression, which may not capture complex, nonlinear customer behavior compared to advanced machine learning models. The system's performance is also dependent on the accuracy and volume of historical reservation data, which may affect forecasting precision if data is incomplete or inconsistent. Additionally, the system is designed for small to medium-sized restaurants and may require further scalability adjustments for larger multi-branch enterprises. External factors such as seasonal trends, weather conditions, and special events are not automatically integrated into the demand prediction model, potentially limiting forecast accuracy during irregular circumstances.

Significance of the Study

This study highlights the advancement of online appointment scheduling in restaurants through the integration of linear regression, scheduling algorithms, and OTP verification to improve efficiency and customer experience. It demonstrates how advanced technologies can transform business operations and elevate service quality within the hospitality industry.
To Users (Administration, Customers, Staff, IT/CS students): The system enhances operational efficiency by automating the reservation process, reducing manual workload, and minimizing booking errors. It also improves customer satisfaction by offering a seamless, secure, and convenient scheduling experience.

To Technical (IT/CS Professional): This study provides practical insights for IT and Computer Science professional on applying linear regression, scheduling algorithms, and OTP verification in real-world systems. It helps them develop hands-on skills in web development, data analytics, and cybersecurity, preparing them for future technological challenges.

To Future Researchers: The study serves as a valuable reference for future research on integrating intelligent algorithms and secure authentication methods in various industries. It encourages innovation and further exploration of predictive and adaptive technologies for improving digital business operations.

Related Studies

Predictive analytics using linear regression algorithms has been widely applied in restaurant management to forecast customer demand and optimize seating allocation, allowing businesses to anticipate peak hours and improve operational efficiency (Rahman & Lee, 2022). This approach enables data-driven decision-making by analyzing historical

reservation trends to determine future booking probabilities, thus enhancing manpower scheduling and resource utilization (Chen et al., 2023).
Moreover, scheduling system algorithms play a crucial role in automating table assignments and minimizing wait times by efficiently balancing reservation loads across available resources (Gao & Tan, 2021). Integrating predictive-linear regression models with scheduling algorithms provides a robust foundation for smart reservation systems, resulting in improved customer satisfaction, better service flow, and enhanced management insight for restaurant operations (Kim & Santos, 2020).

Synthesis

The reviewed studies collectively highlight that combining predictive analytics using linear regression with scheduling algorithms provides a strong foundation for a Web-Based Smart Table Reservation and Demand Prediction System. These technologies complement each other by ensuring accurate demand forecasting, optimized scheduling, and secure booking processes—directly aligning with the goal of enhancing restaurant efficiency and user experience.

Methodology

Research Type: Applied Developmental Research, focusing on the creation of an innovative web-based system designed to address real-world restaurant management challenges. It integrates predictive modeling using linear regression and scheduling algorithms to improve operational efficiency, booking management, and customer experience. The research applies both experimental and evaluative approaches to assess the system's effectiveness in forecasting demand and managing authenticated reservations through OTP verification.

Data Gathering Process: Before the system creation, the researchers collected primary data through surveys and interviews with restaurant managers, staff, and customers to understand current issues in manual reservation and table management systems. Additional secondary data, such as historical booking records, peak hours, and customer traffic patterns, were analyzed to serve as input for the predictive model. The gathered data guided the design of the system's functional requirements and algorithmic parameters for accurate demand forecasting and efficient scheduling. After system development, the evaluation was conducted using ISO 25010 criteria, focusing on functionality, reliability, usability, effectiveness, and robustness to ensure that the system meets international quality standards. The feedback from users and IT experts provided a comprehensive performance assessment and guided further refinement of the application.

Software Methodology: The study adopted the Agile Software Development Methodology, emphasizing iterative design, development, and testing to ensure flexibility and responsiveness to user feedback. The process began with requirement gathering and analysis based on stakeholder inputs and operational needs of restaurant management. Each development cycle involved incremental improvements to the system's predictive and scheduling algorithms, allowing continuous integration of user and technical evaluations. This approach facilitated efficient debugging, faster adaptation to design changes, and early validation of key features such as OTP verification and demand forecasting. The Agile model ensured that the final product was functional, user-centered, and aligned with ISO 25010 quality parameters.

Figure 3: SDLC Agile Model

Furthermore, the integration of linear regression and scheduling algorithms was developed and tested during the iterative cycles to enhance prediction accuracy and resource optimization. The linear regression model analyzed historical booking data to predict future reservation trends, while the scheduling algorithm dynamically allocated tables based on predicted demand. Both algorithms were continuously refined through prototype testing and stakeholder validation during each sprint cycle. The Agile methodology's feedback-driven structure allowed the development team to quickly address usability, functionality, and reliability issues before final deployment. Ultimately, this methodology provided an adaptive and collaborative framework that ensured the system's robustness, performance efficiency, and user satisfaction.

System Tools

Data Flow Diagram: The Data Flow Diagram (DFD) illustrates the flow of information between customers and the restaurant through the web-based system, showing how reservation data, feedback, and notifications are processed to optimize restaurant operations and resource management

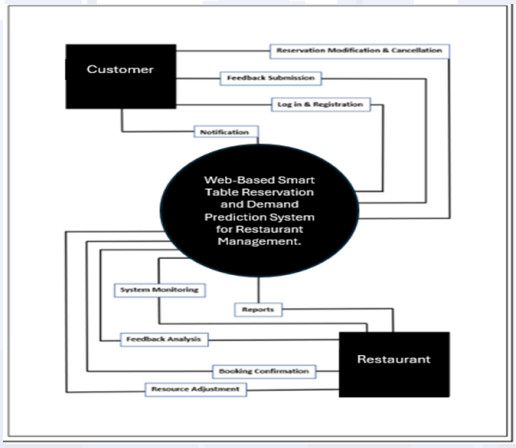

Figure 4: Context Data Flow Diagram

The Context Data Flow Diagram illustrates the interaction between customers and restaurants through a Web-Based Smart Table Reservation and Demand Prediction System. Customers can log in, register, modify or cancel reservations, and provide feedback, while receiving notifications about their bookings. The restaurant uses the system for booking confirmations, system monitoring, feedback analysis, and generating reports to improve operations. Additionally, demand prediction enables resource adjustment, ensuring efficient management and enhanced customer satisfaction.

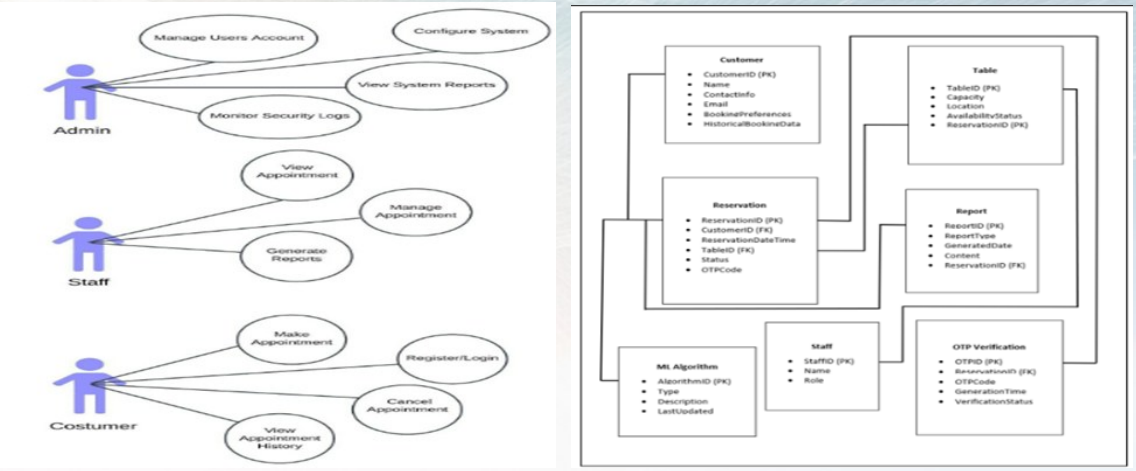

Figure 5: Use Case Diagram (left) and Database Entity-Relationship Model-ERD (right)

The left portion of the Figure 5. Use Case Diagram illustrates how different users—such as customers, administrators, and staff—interact with the Web-Based Smart Table Reservation and Demand Prediction System. It helps visualize the system's core functionalities, including booking tables, generating reservation forecasts, and managing OTP verification for secure access. By defining these interactions, the diagram ensures that all system requirements align with user needs and operational objectives. While the right portion of the Figure 5 discusses the Database Entity-Relationship Model (ERD) defines the logical structure of the database, showing the relationships between entities such as users, reservations, tables, OTP records, and prediction results. It provides a clear blueprint for organizing and linking data efficiently to support predictive modeling and scheduling algorithms. Through the ERD, the system ensures accurate data management, consistency, and real-time access for generating reports and forecasts.

Respondent of the Study

The study involves two main groups of respondents: user and technical groups, each providing unique insights into the system's performance. The user group, consisting of 240 restaurant customers and new users, evaluated the system based on its acceptability, ease of use, and user experience. Meanwhile, the technical group, composed of 10 IT professionals, assessed the system's technical soundness, focusing on aspects such as functionality, reliability, and maintainability. Both groups' evaluations were guided by the ISO 25010 quality model, which includes criteria like functional suitability, performance efficiency, security, reliability, maintainability, and usability. These combined assessments provided a comprehensive evaluation of the system's effectiveness, user satisfaction, and technical performance.

Evaluation Tools

To evaluate the technical aspects comprehensively for the appointment scheduler system, the study used the second process which is the ISO 25010 Quality Model. By applying this model, technical experts can provide their detailed assessment of the appointment scheduler system's strengths and weaknesses, offering valuable insights for technical improvements and ensuring that the system is robust, secure, and efficient.

Key evaluation areas of the ISO 25010 form include:

- Functional Suitability: Assessing the accuracy and completeness of the predictive analytics in forecasting peak reservation times and optimizing table management.
- Performance Efficiency: Measuring the system's response times, processing speed,

and resource utilization under different load conditions.

- Security: Evaluating the effectiveness of OTP verification in ensuring secure and genuine reservations, and the system's resilience against fraudulent bookings.
- Reliability: Ensuring that the appointment scheduler system operates consistently without failures and accurately processes bookings over time.
- Maintainability: Analyzing the ease with which the system can be updated and maintained, ensuring long-term operability.
- Usability: Assessing aspects such as ease of navigation, clarity of information presentation, and overall user satisfaction. This includes evaluating how intuitive the interface is for end-users, how easily they can make reservations, and how quickly they can learn to use the system effectively.

System Development: The development of the system utilized a range of software, hardware, and evaluation tools to ensure functionality and performance. Key programming tools included MySQL, Python, PHP, Firebase Authentication, HTML, CSS, Flask, and AdminLTE, which collectively enabled secure data management, dynamic web functionality, and user-friendly interfaces. Hardware such as laptops, desktops, and mobile phones facilitated both system access and user verification through OTPs. The system's technical and user quality was assessed using the ISO/IEC 25010 Quality Model, focusing on performance, security, and usability. This comprehensive setup ensured that GScheduler met industry standards, supported efficient scheduling operations, and provided a reliable, visually appealing experience for users and administrators.

Statistical Treatment: The statistical treatment presents the methods and techniques used to analyze, interpret, and summarize the data collected from respondents to ensure accurate and meaningful evaluation of the system's performance. The study utilized percentage as a statistical tool to determine the distribution of respondents according to their classification, such as user and technical groups. The weighted mean was employed to analyze the results of the ISO 25010 software quality evaluation, summarizing the collective responses for each criterion. A Likert scale was applied to interpret the data, measuring the level of agreement or satisfaction of respondents toward the system's functionality, usability, and performance. Together, these statistical tools provided a clear, quantitative interpretation of user perceptions and system effectiveness.

The System:

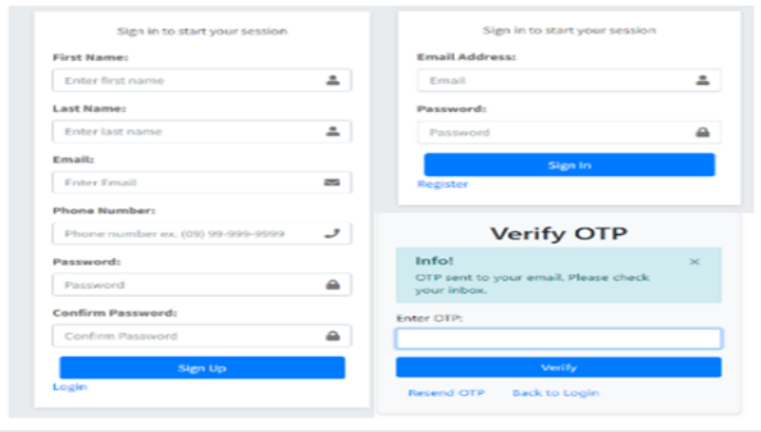

Figure 6: User perceptions

The system's registration and login features ensure secure and personalized access by allowing users to create unique profiles and authenticate using their credentials. An added layer of protection is provided through OTP verification, which confirms user identity and prevents unauthorized access during login or account verification.

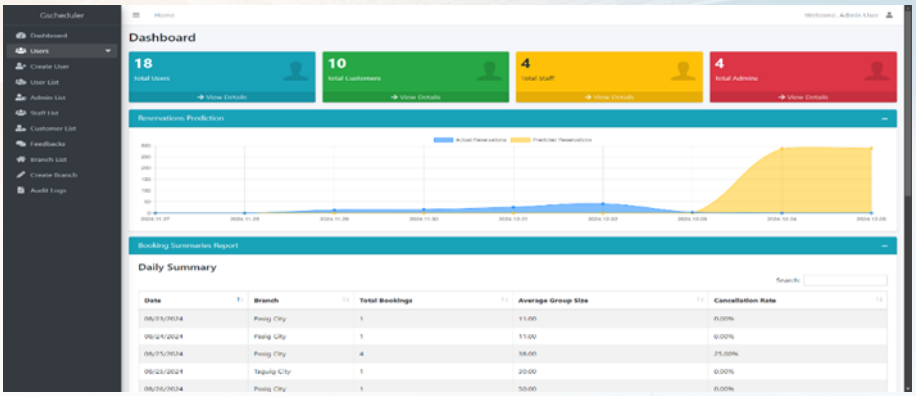

Figure 7: Admin perceptions

The Admin Dashboard functions as the central control center, enabling administrators to track store performance through reservation forecasts, booking summary reports, and daily, weekly, and monthly analytics where Linear Regression was applied.

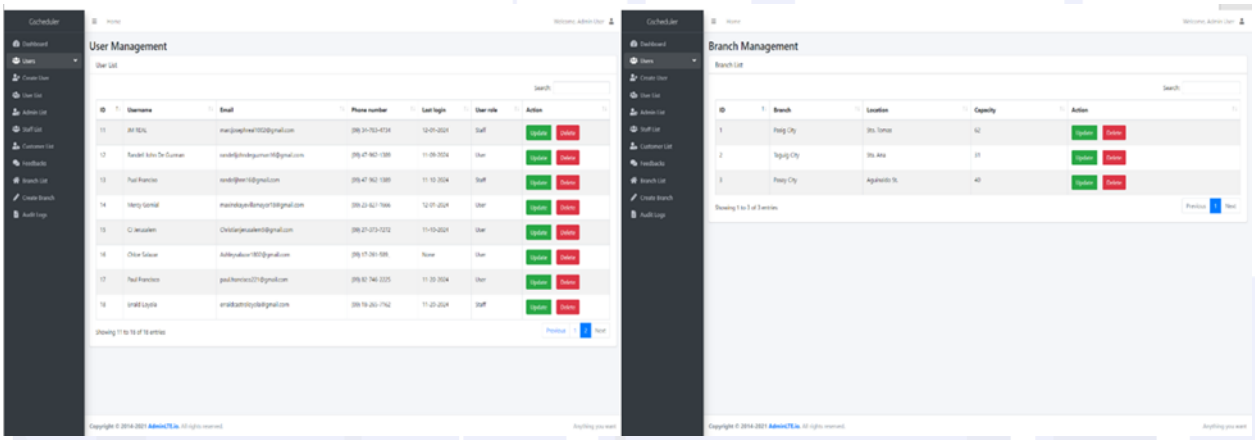

Figure 8: User Management section (left side) and Branch Management section (right side)

In the User Management section (left side), administrators can manage all users by viewing roles and details, updating information, resetting passwords, and removing inactive accounts. Meanwhile, the Branch Management section (right side) allows admins to modify store capacities and delete branches that are no longer in operation.

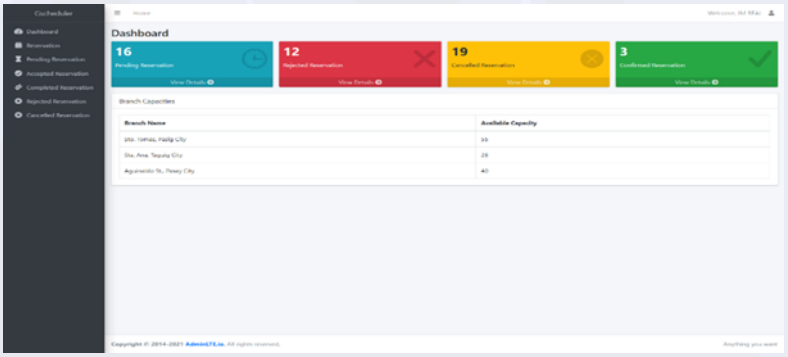

Figure 9: Staff Dashboard

Staff Dashboard provides a comprehensive view of key reservation details and branch capacity. Staff members can monitor reservations based on their status, including Pending, Rejected, Cancelled, and Confirmed Reservations. It also displays the current capacity of the branch, helping staff manage guest numbers effectively.

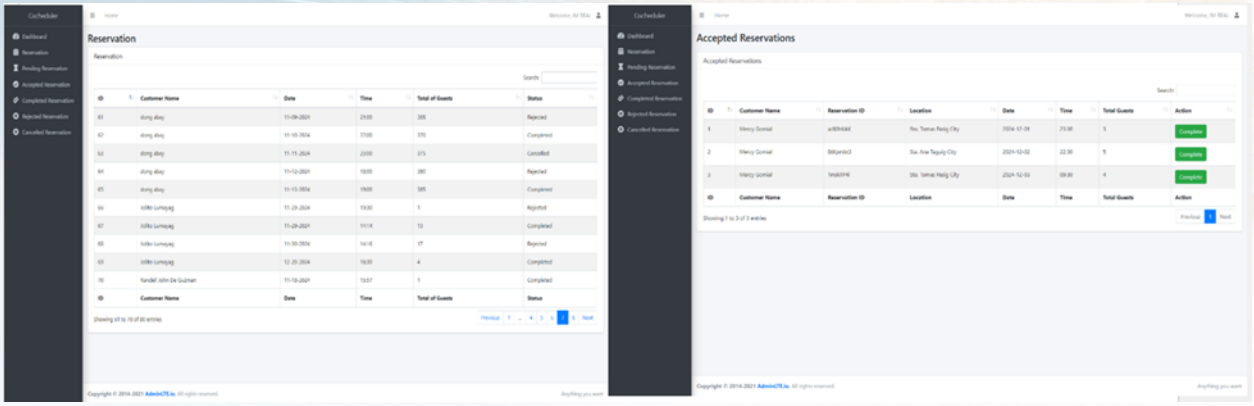

Figure 10: Reservation section

In the Reservation section, staff can track the progress of each reservation, whether it is completed or rejected. All reservation statuses are displayed here for easy reference. The Pending Reservations section allows staff to decide whether to accept or reject reservations. This decision is based on the total number of guests and the branch's available capacity, ensuring that the store does not exceed its limits. Once a reservation is accepted and the client has finished dining and completed their payment, the staff marks the booking as done in the Accepted Reservation section. These are then recorded as Completed Reservations, where staff can view the details of successful bookings, including key event information.

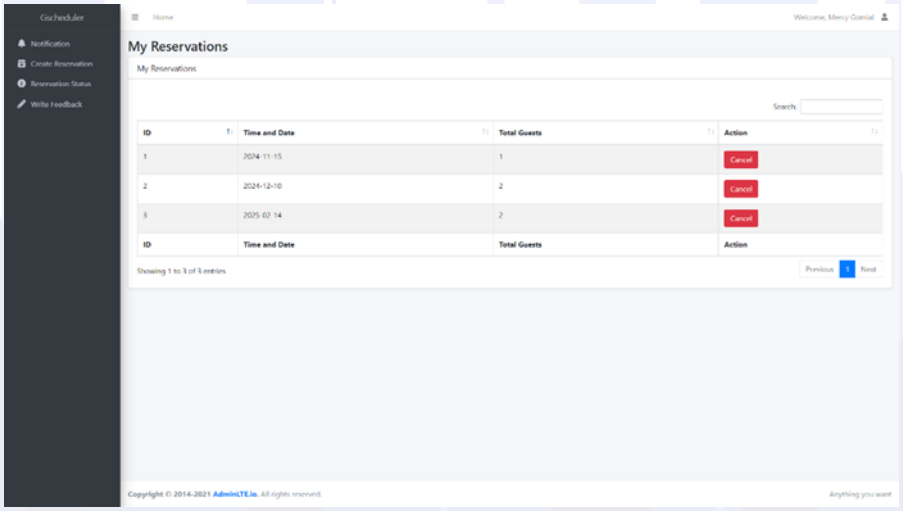

Figure 10: Reservation Status

In this section provides an overview of all bookings, including their status. If customers need to make changes to their plans, they have the option to cancel their reservations directly from this section.

Summary of Evaluation of Respondents.

Table 1 Summary of Evaluation of Respondents.

Criteria (ISO25010)	Respondents (250)			
	User (240) - Administration, Customers, Staff, IT/CS students		Technical (10)	
	WM	VI	WM	VI
1. Functionality	3.43	SA	3.16	A
2. Efficiency	3.57	SA	3.33	SA
3. Usability	3.52	SA	3.0	A
4. Reliability	3.35	SA	3.3	SA
5. Security	3.64	SA	2.99	A
6. Maintainability	3.71	SA	3.55	SA
Overall Average Mean (gender)	3.53	SA	3.22	A

Based on the results of the ISO 25010 evaluation, the technical respondents rated the system as highly satisfactory overall, with males obtaining an average weighted mean of 3.53 (Strongly Agree) and females with 3.22 (Agree). Both male and female respondents agreed that the system performed well in terms of functionality, efficiency, reliability, and maintainability, reflecting its strong technical performance and stability. However, slightly lower ratings in usability and security from female respondents suggest areas where user interface design and access protection could be further improved. Overall, the findings indicate that the system meets the ISO 25010 quality standards, demonstrating effectiveness, reliability, and strong technical quality from the perspective of IT professionals.

Summary/Findings

The study successfully developed a Web-Based Smart Table Reservation and Demand Prediction System that integrates predictive analytics and OTP verification to enhance restaurant operations. Through the use of linear regression, the system effectively forecasted customer demand, optimized table allocation, and improved overall service efficiency. The evaluation based on the ISO 25010 Quality Model revealed that both user and technical respondents found the system to be functional, reliable, and efficient. Users commended its ease of use and accessibility, while technical experts validated its maintainability and performance quality. Overall, the system demonstrated strong technical soundness and user satisfaction, confirming its effectiveness as a smart restaurant management tool.

The results showed that predictive modeling and OTP-based security significantly improved the accuracy and reliability of the reservation process. The system streamlined booking operations, minimized scheduling conflicts, and ensured secure verification for all transactions. Furthermore, the agile development approach allowed for continuous improvement, integrating feedback from users and experts throughout the design process. Statistical results, including high weighted means in functionality and maintainability, indicated that the system met international software quality standards. These findings affirm that the system efficiently addresses common challenges in manual restaurant management, contributing to smoother operations and enhanced customer experience.

Conclusion

In conclusion, the study achieved its goal of developing a reliable and intelligent reservation and prediction platform for restaurant management. The integration of predictive analytics and secure OTP verification provided both operational efficiency and data security. Evaluation results based on ISO 25010 confirmed the system's high performance in functionality, reliability, and maintainability. Although minor improvements could be made in usability and security interface design, the system still met global software quality standards. Overall, the project successfully demonstrated how technology-driven systems can transform restaurant management into a more efficient, secure, and customer-oriented operation.

Recommendations

It is recommended that future developers enhance the system's usability and security features to further strengthen user experience and data protection. The incorporation of AI-driven models, such as neural networks, could improve demand prediction accuracy beyond linear regression. Expanding the system to support mobile applications would also increase accessibility and convenience for both users and administrators. Regular updates and system audits should be conducted to ensure continued compliance with ISO 25010 quality standards. Lastly, future studies may integrate real-time analytics dashboards to provide managers with deeper insights into customer behavior and operational trends.

References:

Chen, Y., Liu, H., & Zhao, X. (2023). Optimizing restaurant operations using linear regression-based demand forecasting models. Journal of Artificial Intelligence in Hospitality, 15(2), 98–110. https://doi.org/10.1016/j.jaih.2023.02.004

Choudhury, R., & Singh, A. (2022). Predictive analytics in restaurant management using regression-based forecasting models. Journal of Data Analytics and Business Intelligence, 8(3), 122–134. https://doi.org/10.1016/j.jdabi.2022.03.005

Gao, Z., & Tan, K. (2021). Scheduling algorithms for dynamic table management in smart restaurants. International Journal of Computer Applications in Technology, 65 (3), 145–158. https://doi.org/10.1504/IJCAT.2021.115874

Kumar, S., & Das, R. (2022). Application of multiple linear regression for restaurant reservation demand forecasting. International Journal of Computational Research and Development, 14(2), 101–112. https://doi.org/10.1016/j.ijcrd.2022.02.009

Lee, J., & Park, H. (2023). Linear regression modeling for customer flow prediction in restaurant reservation systems. International Journal of Intelligent Information Management, 13(1), 85–97. https://doi.org/10.1016/j.ijinf.2023.01.004

Nguyen, T., Tran, D., & Vo, P. (2021). Forecasting restaurant sales using linear regression and feature engineering. Journal of Modern Information Technology and Applications, 7(4), 144–158. https://doi.org/10.1007/s10844-021-00645-8

Rahman, A., & Lee, S. (2022). Predictive analytics for restaurant scheduling using linear regression techniques. Procedia Computer Science, 200, 1200–1208. https://doi.org/10.1016/j.procs.2022.01.160

Sharma, P., Mehta, K., & Joshi, R. (2021). Regression-based predictive analytics for optimizing restaurant operations. International Journal of Emerging Technologies and Advanced Engineering, 11(5), 66–75. https://doi.org/10.1016/j.ijet.2021.05.003

Zhao, Y., & Li, X. (2020). Linear regression-based demand forecasting for hospitality management systems. International Journal of Hospitality Information Systems, 9(2), 101–113. https://doi.org/10.1016/j.ijhis.2020.02.007

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