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# MANAGE MOTO: A WEB-BASED SERVICE HISTORY TRACKER WITH PREDICTIVE ANALYTICS AND NOTIFICATION SYSTEM FOR HAMMERDAD SERVICE CENTER

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## ABSTRACT

For motorcycle service centers, the usual way of record-keeping is manual, making monitoring and management difficult. This study aimed to develop a digitized service-history tracking system for Hammerdad Service Center with predictive analytics and a notification system. The study adopted the Waterfall Software Development methodology and was framed in a layered architecture while predictive analytics was implemented through the Random Forest algorithm. These models were evaluated using Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE) for the regression models. The classification model was assessed through accuracy, precision, recall, and F1-score. Upon observation, the digitized platform reduced processing time by lessening the administrative workloads. The regression models for maintenance services achieved an MAE of 1.88 and RMSE of 3.13 in predicting service intervals, with 52.40 and 149.50 respectively for the cost. The repair interval prediction model recorded an MAE of 9.04 days and an RMSE of 11.86 days. For the classification model, an accuracy of 97.0%, precision of 98.0%, recall of 98.3%, and F1-score of 98.2% were achieved. Moreover, the system received positive ratings with overall means of 3.37, 3.42, and 3.22 across all three sections of the survey. The findings reflect that in a digitized platform, the combination of predictive analytics and a rule-based motorcycle health computation can improve operational efficiency as the system was successful in providing Hammerdad Service Center a tool for improving management and customer service.

**Keywords:** Motorcycle Maintenance, Predictive Analytics, Notifications, Health Scoring, Service Management

## 1 INTRODUCTION

Motorcycle repair shops are common in the Philippines because motorcycles serve as one of the primary modes of transportation in the country due to their accessibility and flexibility for daily use [1,2]. This is particularly significant in urban areas such as Metro Manila, where traffic congestion remains a major concern for residents and workers. In

fact, the metropolis is widely recognized for its severe traffic congestion, which affects daily mobility and productivity [3].

Because motorcycles are two-wheeled vehicles, they provide a more flexible way to navigate roads and highways that are often heavily congested, especially during rush hours when people commute to and from work. Compared with purchasing and owning cars, motorcycles are generally more affordable and consume less fuel, making them a practical option for many individuals. In the Philippines, motorcycles are ranked next to public transportation, such as buses, jeepneys, and trains, as one of the most preferred modes of transportation compared to larger private vehicles [4].

Hammerdad Service Center is a motorcycle repair shop located in Valenzuela, established in 2023, that specializes in various types of motorcycle repair and restoration services. The service center provides maintenance and repair solutions for different motorcycle models and also offers motorcycle parts and accessories needed for repairs. These services help ensure that motorcycles are properly maintained and remain safe and functional for daily use.

The shop offers a range of services, including cleaning, tune-ups, oil changes, diagnostics, and other essential maintenance procedures required for motorcycles. It operates in a workspace that allows motorcycles to be inspected and repaired efficiently. The organized storage of tools, parts, and equipment helps improve the efficiency of the repair process and enables mechanics to perform their tasks more effectively. In addition, maintaining a well-organized workspace contributes to a positive working environment for employees while also providing a professional and comfortable setting.

The service center also caters to a courier company, LBC, where the business handles approximately 10 to 20 motorcycles per appointment during preventive maintenance services. Their partnership started in early 2025, and because of this, the shop maintains a steady flow of business processes and operations despite being a small enterprise. Based on customer feedback, the service center was recognized for providing satisfactory service, which encouraged repeat customers, such as their catered business, and contributed to the growing awareness of the business within the local community.

However, like many small businesses, Hammerdad Service Center also experienced operational challenges. One of the primary concerns was the difficulty in keeping track of the repair history of each motorcycle unit. Without a centralized repair database, it became challenging to determine whether certain mechanical issues were recurring. Identifying such patterns was important in determining whether problems were caused by driving habits, improper maintenance, or the quality of parts installed during previous repairs. In addition, the business regularly performed Preventive Maintenance Services (PMS) for LBC motorcycles that operated in various locations such as Balagtas and Sta Rita, Bulacan. Managing these service records manually can become inefficient as the number of serviced motorcycles continues to grow.

### 1.1 Statement of the Problem

Ever since the launch of their venture, Hammerdad Service Center lacked a centralized system that enabled them to view the repair history of the motorcycles of their valuable managers and determine the appropriate time for the next maintenance of the individuals' motorcycles. These concerns hindered the venture from having a smooth business process.

- How can the business consolidate scattered service records into a digitized platform and comparatively handle data for stock management?
- By what means can the business determine the appropriate schedule for the next repair or maintenance service using historical service records and maintenance trends?
- In what way can the business systematically monitor the overall condition of motorcycles and effectively communicate these insights to their respective managers?

### 1.2 Objectives of the Study

The general goal of this project was to design and develop a system that tracks the repair history of motorcycles integrated with predictive analytics and notification system for Hammerdad Service Center in order to ease its processes, providing efficiency, accuracy, and reliability in addressing and tracking what was best for the safety of the stakeholders.

- To develop a digitized system for service tracking that consolidates maintenance records into digital motorcycle profiles and supports comparative analytics for effective stock management.
- To integrate predictive analytics that analyzes historical repair data and maintenance trends to estimate optimal service schedules and forecast maintenance needs.
- To implement a rule-based motorcycle health monitoring method using historical repair and maintenance records with an integrated automated notification system for timely service advisories.

## 2 METHODOLOGY

### 2.1 System Architecture

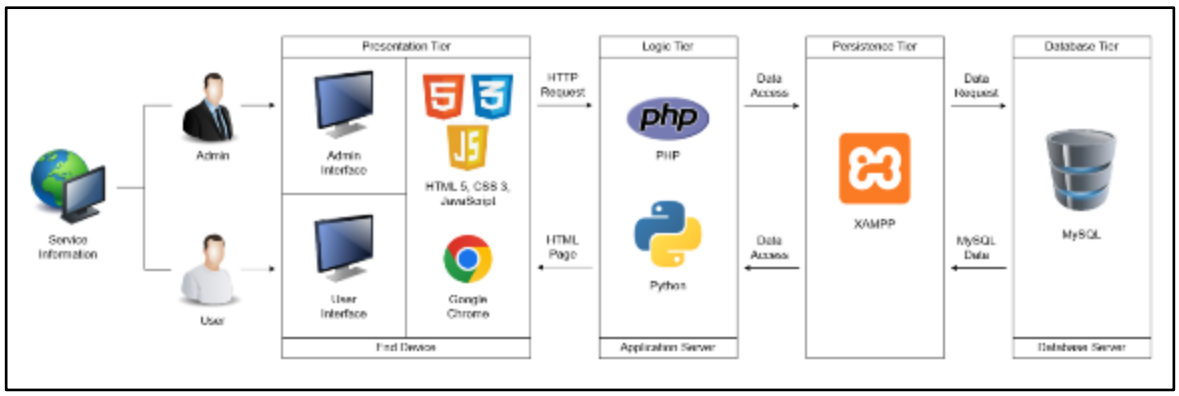



**Figure 1: System Architecture**

Figure 1 shows that the system is used by both the admin and the user, where each has different roles and interfaces when accessing the system. When the user interacts with the system, their actions are sent as HTTP requests from the browser to the backend. The persistence layer handles how data is accessed and ensures proper communication with the database. The layer then sends the request to the database tier, which uses MySQL to store and manage all system data. In addition to this architecture, the notification feature of the system was accomplished through utilizing a third-party library called PHPMailer.

### 2.2 Software Development Model

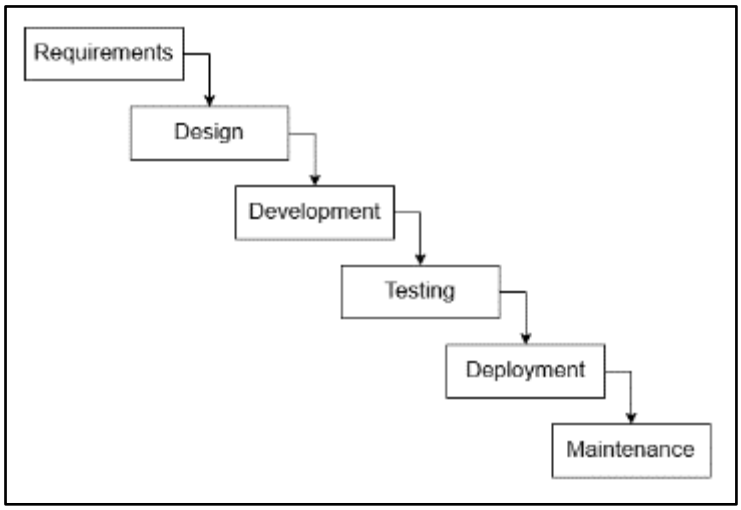



**Figure 2: Waterfall Model**

Figure 2 illustrates the waterfall model, a Software Development Life Cycle (SDLC) model that divides the software development into phases and suggests a sequential flow, which ensures that the developers can only progress onto the next phase once the current one has been successfully accomplished [5].

### 2.3 Research Instrument

At the beginning of the development, the researchers used semi-structured interviews for gathering insights about the difficulties being faced by the business. The researchers also utilized observations and survey questionnaires for the purpose of gathering insightful and valid data from the motorcycle riders which were necessary for supporting the established statement of the problems. The survey contained fifteen (15) questions integrated with a Likert scale to measure the opinions and attitudes of the mentioned population towards the matter.

### 2.4 Model Training

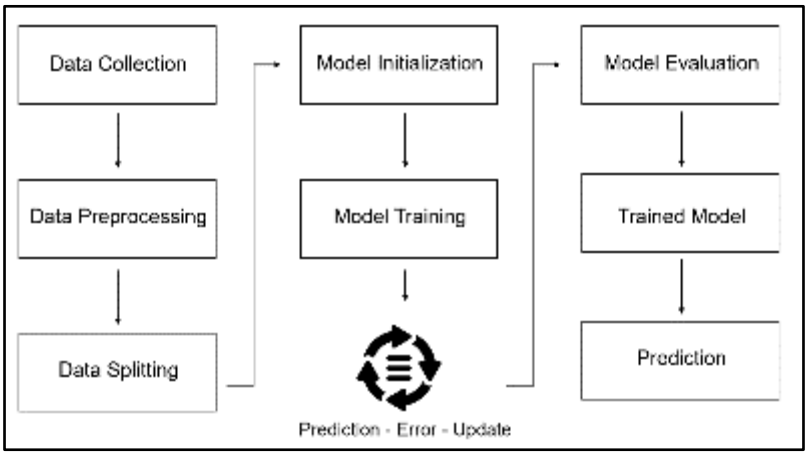



**Figure 3: Model Training Workflow Diagram**

Figure 3 illustrates the end-to-end pipeline for training the model used in the system for predictive analysis. The process began with data collection where service records detailing every transaction made were consolidated from the business client. The data of every maintenance check was gathered and framed in a sourced dataset from Kaggle uploaded by Dulaj [6] with a number of rows estimated to be 8500. These were then subjected to data preprocessing to make it certain that they were suitable and efficient for machine learning. For accuracy to be assessed as well as its generalization ability, the model underwent evaluation through the utilization of the test dataset.

### 2.5 Model Evaluation

For the system, the main metric utilized was Mean Absolute Error (MAE) for the regression models. Between the predicted and actual values, the average absolute difference was highlighted. Its formula is as follows:

$$MAE = \frac{1}{n}\sum_{i=1}^{n}|y_i - \hat{y}_i|$$

As a supporting metric, Root Mean Squared Error (RMSE) was also put into use. This put a greater impact onto errors that were larger, helping the model to become sensitive when deviations were drastic. Its formula is as follows:

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}$$

For the classification model which determined the timely need for maintenance, accuracy, precision, recall, and F-1 score were evaluated in order to assess the predictive performance of the model with the mentioned target variable. The formulae are as follows:

- $Accuracy = \frac{Correct\ Predictions}{Total\ Predictions}$
- $Precision = \frac{TP}{TP + FP}$
- $Recall = \frac{TP}{TP + FN}$
- $F1\ Score = 2 \cdot \frac{Precision \cdot Recall}{Precision + Recall}$

### 2.6 Rule-Based Approach

Table 1 presents the basis for generating the motorcycle health scores of the vehicles at hand in which the service types were assigned with their respective maximum recommended interval, indicated in days, and the associated maximum value for penalty. The maximum days highlight the suggested interval of service for every type and the maximum penalty represents the highest penalty that is given to every service type when it exceeds the suggested interval of repair. In total, the motorcycle health score could be penalized by 100%.

**Table 1: Rule-Based Motorcycle Health Scoring**

| Service Type | Maximum Days | Maximum Penalty |
|---|---|---|
| PMS | 31 | -20% |
| Engine System | 75 | -15% |
| Drivetrain & Transmission | 45 | -10% |
| Brake System | 45 | -10% |
| Electrical System | 75 | -10% |
| Chassis/Suspension/Wheels | 40 | -10% |
| Fuel & Fluids | 35 | -15% |
| Body/Accessories/Exterior | 75 | -10% |

### 2.7 System Evaluation

**Table 2: Likert Scale Interpretation**

| Interpretation | Value | Range |
|---|---|---|
| Strongly Disagree | 1 | 1.00 - 1.75 |
| Disagree | 2 | 1.76 - 2.50 |
| Agree | 3 | 2.51 - 3.25 |
| Strongly Agree | 4 | 3.26 - 4.00 |

Table 2 presents the Likert Scale Interpretation used in assessing the respondents' perceptions of the motorcycle health monitoring and notification features integrated into the system. The scale ranged from 1 (Strongly Disagree) to 4 (Strongly Agree), and the corresponding mean score ranges were used to determine the level of agreement for each survey statement.

## 3 RESULTS AND DISCUSSION

### 3.1 Comparison of Manual and Digital System Utilization

**Table 3: Duration Of Searching For A Certain Transaction**

| Manner | T1 | T2 | T4 | T5 |
|---|---|---|---|---|
| Manual | 1:13 | 1:04 | 1:25 | 1:05 |
| Digital | 0:06 | 0:07 | 0:05 | 0:07 |

Table 3 presents the duration required to search for a specific transaction across five trials. Manual searching ranged from 57 seconds to 1 minute and 25 seconds, with an average search time of 68.8 seconds (approximately 1 minute and 9 seconds). In contrast, the digitized system returned results within 5 to 10 seconds, with an average search time of 7 seconds.

**Table 4: Duration of Recording a Transaction**

| Manner | T1 | T2 | T3 | T4 |
|---|---|---|---|---|
| Manual | 3:29 | 2:21 | 1:09 | 1:25 |
| Digital | 0:43 | 0:35 | 0:22 | 0:27 |

Table 4 presents the duration required to record a transaction across five trials. The manual process ranged from 1 minute and 9 seconds to 5 minutes and 47 seconds, with an average recording time of 170.2 seconds (approximately 2

minutes and 50 seconds). In contrast, the digitized system recorded the same transactions within 22 to 54 seconds, with an average recording time of 36.2 seconds.

The results presented in Tables 3 and 4 show that the digitized system completed every measured task in substantially less time than the manual process, with reductions ranging from a few seconds to several hours depending on the task. These findings suggest that replacing manual, typewritten record-keeping with a centralized database significantly improved the efficiency of recording, searching, monitoring, and consolidating motorcycle service records.

These findings were consistent with what Aji & Kana [7] reported that digitized service and maintenance applications reduced record-management issues while improving workflow reliability. Similarly, the faster recording and searching observed in this study supported the findings of Ruswita, Muharmi, & Amelia [8], who noted that information systems can improve operational efficiency and reduce administrative errors.

The reduction in processing time can benefit Hammerdad Service Center by reducing the administrative workload associated with managing service records and transaction documents. Faster access to information supports more efficient record management and contributes to smoother day-to-day operations.

### 3.2 Evaluation of Predictive Models

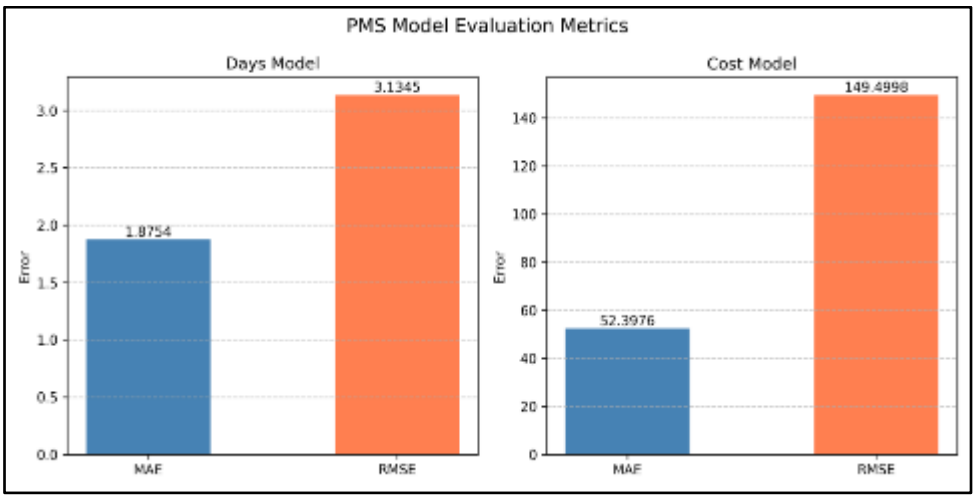



**Figure 4: MAE and RMSE of PMS Model for Days and Cost**

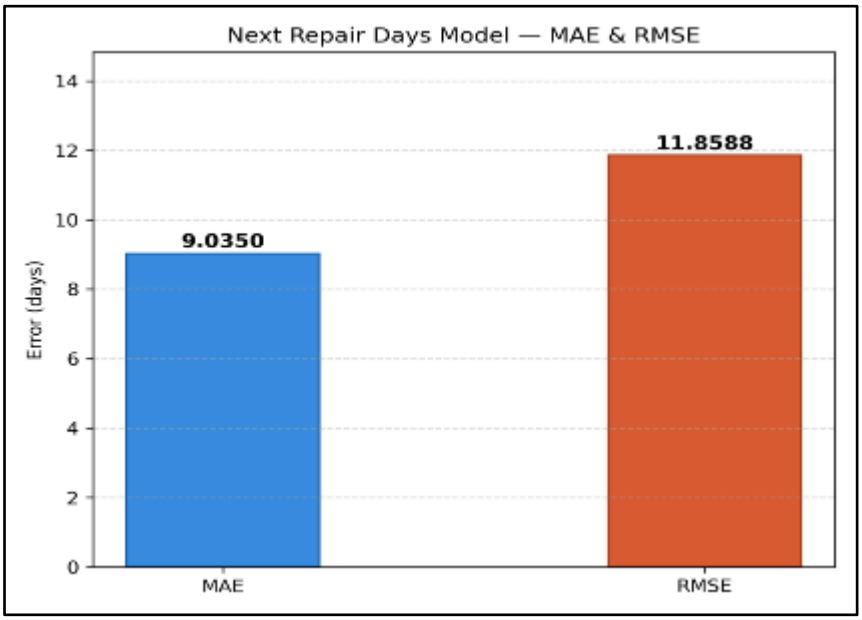



**Figure 5: MAE and RMSE of Repair Model**

Figure 4 shows the Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE) which were computed from the performance of the Random Forest models in predicting the intervals in preventive maintenance services in addition to their potential costs. The model which forecast the days achieved an MAE of 1.88 days and an RMSE of 3.13 days which

reflected that predictions deviated by just a few days from the actual values. Meanwhile, the model which forecast the cost achieved an MAE of ₱52.40 and an RMSE of ₱149.50, indicating that the predicted maintenance costs were usually close to the actual expenses. These low error values suggested that both models used for PMS became reliable in producing necessary estimations.

Figure 5 shows the computed Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE) of the implemented model for predicting repair intervals. It instilled an MAE of 9.04 days and an RMSE of 11.86 days, indicating that the predictions tend to deviate by about 9 days on average. This average discrepancy was found to be acceptable due to the repairs having unexpected patterns. Given the unpredictable nature of motorcycle repairs, these findings showed that the model may generate relatively reasonable estimates for repair scheduling and maintenance planning.

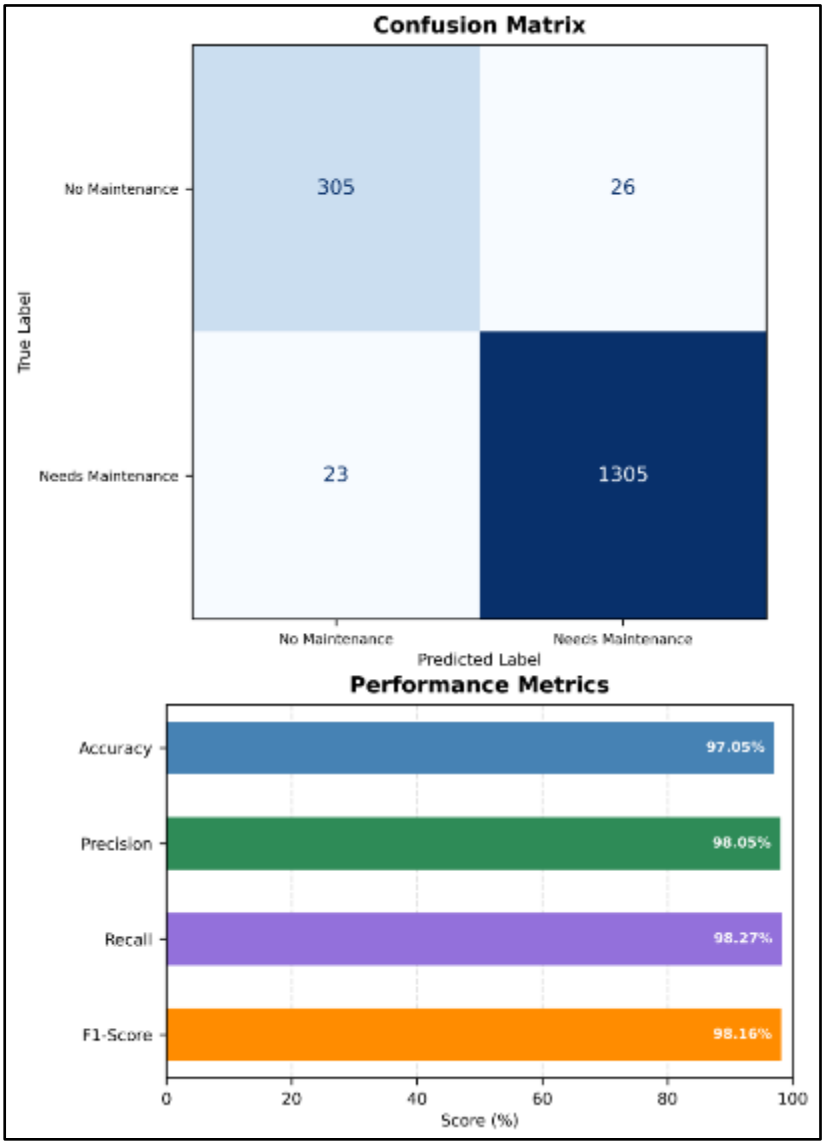



**Figure 6: Confusion Matrix and Performance Metrics for Maintenance Prediction**

Figure 6 depicts the confusion matrix and performance metrics for the maintenance prediction model. It accomplished 1,610 instances of successful predictions with 305 occurrences of the motorcycles needing no maintenance and 1,305 of them requiring a service. The figure also presents that the model only generated 26 false positives and 23 false negatives. These findings showed that the classification model could accurately distinguish those maintenance-needing motorcycles from those ones that were not. This was a significant result as based on Narayan & B.A. [9], this approach helps reduce the likelihood of overdue maintenance and minimizes the risk of failures associated with neglected vehicle servicing.

### 3.3 Evaluation of Motorcycle Health Scoring and Notification System

**Table 5: Section A: Awareness and Understanding**

| | Frequency | | | | |
|---|---|---|---|---|---|
| **Statements** | 1 | 2 | 3 | 4 | $\underline{x}$ |
| 1. The system enables me to comprehend the existing condition of my motorcycle. | 0 | 1 | 30 | 19 | **3.36** |
| 2. The health monitoring feature aids in my awareness when potential maintenance is needed. | 0 | 1 | 23 | 26 | **3.50** |
| 3. The information about the status of the motorcycle that the system indicates seems to be clear and understandable. | 0 | 1 | 26 | 23 | **3.44** |
| 4. The system helps me recognize possible motorcycle issues in a timely manner. | 0 | 5 | 22 | 23 | **3.36** |
| 5. I can easily understand the information that the system provides. | 0 | 6 | 29 | 15 | **3.18** |
| *Overall Mean* ($\mu$) | | | | | **3.37** |

Table 5 presents the respondents' assessment of the system in terms of Awareness and Understanding. The overall mean of 3.37 indicated that the respondents strongly agreed that the motorcycle health monitoring system effectively enhanced their awareness and understanding of their motorcycle's condition.

**Table 6: Section B: Usefulness and Decision-Making**

| | Frequency | | | | |
|---|---|---|---|---|---|
| **Statements** | 1 | 2 | 3 | 4 | $\underline{x}$ |
| 1. I find the reminders timely and effective when I receive a notification about the motorcycle status. | 0 | 2 | 28 | 20 | **3.36** |
| 2. The notifications are helpful for me to prevent unforeseen motorcycle issues. | 0 | 1 | 22 | 27 | **3.52** |
| 3. The system is beneficial and influences me in deciding when to have the motorcycle serviced. | 0 | 2 | 26 | 22 | **3.40** |
| 4. The health monitoring feature helps me properly decide how I should use the motorcycle in an efficient manner. | 0 | 2 | 25 | 23 | **3.42** |
| 5. The system helps me understand how often the motorcycle is prone to repairs. | 0 | 1 | 28 | 21 | **3.40** |
| *Overall Mean* ($\mu$) | | | | | **3.42** |

Table 6 presents the respondents' assessment of the system in terms of Usefulness and Decision-Making. The overall mean of 3.42 indicated that the respondents strongly agreed that the motorcycle health monitoring system is useful and supports their decision-making regarding motorcycle maintenance and usage.

**Table 7: Section C: Accuracy and User Satisfaction**

| | Frequency | | | | |
|---|---|---|---|---|---|
| **Statements** | 1 | 2 | 3 | 4 | $\underline{x}$ |
| 1. The health score that the system gives accurately reflects the condition of my motorcycle. | 0 | 7 | 30 | 13 | **3.12** |
| 2. I find the health score reliable. | 0 | 6 | 26 | 18 | **3.24** |
| 3. The system provides health scores that are consistent, dependable, and useful. | 0 | 5 | 34 | 11 | **3.12** |
| 4. I am satisfied with the manner the system gives evaluation to the status of the motorcycle. | 0 | 1 | 27 | 22 | **3.42** |
| 5. The system enhances my confidence in managing how I use the motorcycle. | 0 | 7 | 26 | 17 | **3.20** |
| ***Overall Mean*** ($\boldsymbol{\mu}$) | | | | | **3.22** |

Table 7 presents the respondents' assessment of the system in terms of Accuracy and User Satisfaction. The overall mean of 3.22 indicated that the respondents agreed that the motorcycle health monitoring provided accurate and reliable health scores and contributed positively to their satisfaction with the system.

These findings were consistent with existing literature on notification systems and health monitoring. Sruthiya & Sasikumar [10] noted that notification systems enhance user engagement by delivering timely and relevant updates. The positive ratings obtained across all three sections suggested that the integrated notification and health monitoring features were effective in informing users of motorcycle conditions and supporting maintenance-related decisions. Overall, the results indicated that the third specific objective of the study was successfully achieved.

## 4 CONCLUSION

The operational comparison demonstrated substantial improvements in the management of motorcycle service records after the implementation of MANAGE MOTO. Collectively, the results of model evaluation demonstrated that the integrated predictive analytics reliably served their purposes across both tasks in regression and classification. Lastly, the implementation of the rule-based motorcycle health monitoring method and the integrated email notification system successfully addressed the third specific objective of the study. The survey results yielded overall means of 3.37, 3.42, and 3.22 across the three evaluation sections, indicating positive user perceptions of the system.

## STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

## REFERENCES

[1] Godoy, C. H. (2020). Motorcycle System for Optimum Road Safety with Anti-theft Capability. In International Journal of Innovative Science and Research Technology (IJISRT) (Vol. 5, Issue 6, p. 422). https://doi.org/10.38124/ijisrt20jun314

[2] Sarita, V., & Bautista, C. (2025). LUWAS: An assessment on the occupational safety practices among motorcycle repair shops in the City of Mati, Davao Oriental, Philippines. International Journal of Research and Innovation in Social Science, 9(1), 3608–3612. https://dx.doi.org/10.47772/IJRISS.2025.9010288

[3] Gatarin, G. (2023). Untangling the traffic gridlock: Towards a sustainable transport system in Metro Manila, Philippines (Doctoral dissertation, Università degli Studi di Ferrara). Università degli Studi di Ferrara Repository. https://hdl.handle.net/20.500.14242/118854

[4] Statista. (2025, December 17). Motorcycle industry in the Philippines - statistics & facts. https://www.statista.com/topics/12057/motorcycle-industry-in-the-philippines/?srsltid=AfmBOoon_91nD3FP41fNOBgZ6v5tuiO9lp3uFJqJvOQOAFrDbJ5hE9Bb

[5] Kalso, R. (2020). Waterfall model. EBSCO Research. https://www.ebsco.com/research-starters/computer-science/waterfall-model

[6] Dulaj, C. (2024). Vehicle maintenance data. Kaggle. https://www.kaggle.com/datasets/chavindudulaj/vehicle-maintenance-data

[7] Kana, E. W. A., & Aji, A. S. (2024). Web and Android-Based Motorcycle Service and Maintenance Application. International Journal Software Engineering and Computer Science (IJSECS), 4(3), 1015-1025. https://doi.org/10.35870/ijsecs.v4i3.3253

[8] Ruswita, I., Muharmi, Y., & Amelia, D. (2025). Analysis and design of website-based e-business information systems in heavy equipment companies. Jurnal Pepadun, 6(1), 32–38. https://doi.org/10.23960/pepadun.v6i1.261

[9] R. Narayan and C. B. A, "Vehicle Kilometer Reading and Service Interval Monitoring System," 2025 International Conference on Transformative Computing Technologies (ICTCT), Bangalore, India, 2025, pp. 323-329, doi: 10.1109/ICTCT69201.2025.00067.

[10] Sruthiya, V., & Sasikumar, A. (2025). Consumer perception and app loyalty through personalized push notifications. International Journal of Research in Commerce and Management Studies (IJRCMS), 7(2), 16–25. https://doi.org/10.38193/IJRCMS.2025.7202