DEVELOPMENT OF AN ECOSYSTEM TO ALERT THE USERABOUT THE SERVICE OF THE PART

Sahil Sarvankar [1], Gauri Badade [2], Krishnaprasad [3], Prasad Baravkar [4], Shivapradeep [5]

[1,2,3,4]Student, Dept. of Automobile Engineering, Pillai College of Engineering, New Panvel, India
[5]Professor, Dept. of Automobile Engineering, Pillai College of Engineering, New Panvel, India

---

Abstract - *The unfortunate reality is that a lot of car owners don't know how well their parts are wearing, which can cause unanticipated breakdowns and expensive repairs as a result. Specifically, it is critical to repair the parts as soon as possible because a single malfunction might have a domino effect that harms other parts. The study's solution to these problems is our ecosystem which is composed of two main components: a data acquisition module and a predictive analytics module. The data acquisition module is responsible for collecting sensor data from various car parts, such as engine temperature, oil pressure, and brake wear. The predictive analytics module uses machine learning algorithms, implemented in Python, to analyze the collected data and identify patterns and anomalies. This work created a system that can precisely forecast when to replace parts by analyzing the relationship between automotive part life cycle data and deceptive reading. This made it possible for car owners to schedule the necessary replacement work ahead of time and track the wear status of their parts in real time. In the long run, it is anticipated that the established system will lessen the financial burden on car owners by greatly increasing the efficiency of vehicle maintenance. This study investigates the viability of real-time component wear prediction systems and builds on previous research on vehicle maintenance. It also outlines the path for further research and addresses the possible effects this system may have on the auto repair sector.*

***Key Words*: Vehicle maintenance, data acquisition module, machine learning algorithms automotive, predictive analytics module**

1. INTRODUCTION

The project was developed to address the major problems facing vehicle owners regarding vehicle parts wear. In many cases, vehicle owners do not know exactly when their vehicle parts should be replaced. This leads to unexpected vehicle breakdowns, which leads to high cost repairs. To address these issues, the system serves to predict the expected life of each part based on the vehicle's misleading data, and inform the user when to replace it. The core functions of the system are. First, we collect the vehicle's misleading data and the life cycle data for each part. This data is stored in the Google sheet (Google Sheets), which facilitates data management and analysis. Second, the collected data is analyzed through a multi-logistic regression model. This model uses machine-learning techniques to predict the wear condition and replacement need for each part. Third, the results of these analyzes are provided to users through web applications developed using Python(Python) and flask(Flask). Users can check in real time the status of their vehicle parts and when they need to be replaced through the landing page of this web application. The development of this system aims to significantly improve the efficiency of vehicle maintenance. The user can prevent unexpected vehicle failures and the resulting high cost of repair by monitoring the wear status of vehicle parts in real time through this system and planning replacement at the right time. In addition, the system opens up the possibility of extending the life of the vehicle by providing economic benefits to vehicle owners. For the implementation of these systems, the project team has actively utilized the latest data analysis techniques and web development technologies. Machine-learning algorithms were used for data analysis and predictive modeling, and flask frames optimized for web development were used to provide a user-friendly interface. This technical approach played a key role in the successful implementation of this project.

1.1 SCOPE OF THE PROJECT

The project focuses on the development of a system that monitors and evaluates the vehicle's worn parts in real time to inform the driver. The system continuously detects the condition of the main parts of the vehicle through sensors based on IoT technology, and uses data analysis algorithms to assess the degree of wear. This information is communicated to the driver through a user-friendly interface, helping to perform the necessary maintenance tasks in a timely manner. The main purpose of the project is to improve the safety of the vehicle and the efficiency of maintenance. This project is designed taking into account various use cases. For example, in addition to a basic wear detection system for personal vehicle users, it may include advanced monitoring and data analysis services for companies or organizations managing large-scale vehicle operations. This helps to maximize operational efficiency by processing large amounts of vehicle data and quickly identifying vehicles that require maintenance. In addition, vehicle manufacturers can take advantage of this system to evaluate the durability of their products, and get a greeting for future vehicle designs. Insurance companies can also explore the possibility of developing insurance products based on the vehicle's condition and maintenance history. Various technical, business and legal aspects must be considered for the successful implementation of the project. Technically the development of high-precision sensors, efficient data collection and analysis methods, and user-friendly interface design are key elements. On the business side, the development of a flexible service model that can meet the needs of different customers is important, and requires thorough preparation for privacy and data security. Legal regulation is also an important consideration, and must comply with laws specifically related to privacy. Collectively, the project has the potential to innovate the way vehicle maintenance is maintained, improve driver safety and convenience, and provide new opportunities for related industries. Systematic project management, continuous technology development, and close collaboration between stakeholders are essential for successful implementation.

2. LITERATURE SURVEY

- Marco Fischer (Germany) and Ana García (Spain) established an IoT-based framework for real-time vehicle condition monitoring in their article "An IoT-Based Framework for Real-Time Vehicle Condition Monitoring." Drivers and service providers may access real-time information about the state of the car thanks to a system that the research built that integrates many sensors and cloud computing. The global efficiency of vehicle maintenance can be improved with the help of this framework.

- The paper "Predictive Maintenance of Vehicles Using Machine Learning Algorithms" by Sarah Johnson (USA), Raj Patel (India) has developed a system that leverages machine learning algorithms to predict when a vehicle will be maintained. This study analyzes large quantities of vehicle operation data, learns the wear patterns of vehicle parts, which suggests a model that informs you in advance when maintenance is needed. This system can play an important role in improving the efficiency of vehicle operations worldwide.

- The paper "High-Performance Sensor Technologies for Detection of Vehicle Part Wear" by Jean Dupont (France), Elena Rodriguez (Mexico) studied how to detect wear on vehicle parts using high performance sensor technology. This study covers the development of sensors that can precisely detect wear that can occur in various parts of the vehicle and the implementation of a wear diagnostic system through it. This technology can help improve vehicle safety and operational efficiency.

- Isabella Rodriguez (Spain) and Takumi Sato (Japan) created deep learning based visual recognition systems in their work "Enhancing Autonomous Vehicle Safety through Deep Learning Approaches" to increase the safety of autonomous cars. This study shows how well the deep learning model recognizes and predicts the environment, with an emphasis on enhancing vehicle response times, particularly on intricate roads. The safety and dependability of autonomous driving technology may be improved by the findings of this significant study.

- The paper "Predictive Modeling of Electric Vehicle Battery Lifespan" by Eleanor Thompson (England), Anil Kumar (India) developed a model that predicts the life of an electric vehicle battery using machine learning techniques. This study analyzes battery usage patterns and external environmental factors to predict battery performance degradation, which suggests ways to optimize the electric vehicle's maintenance plan and battery replacement strategy. It provides important research results for the efficient operation and sustainable use of electric vehicles.

3. PROPOSED SYSTEM

The systems proposed in this study aim to develop vehicle data analysis and forecasting models by incorporating Python, Flask, Google Sheets (GSheet), and mechanical lessons utilizing multi-regression analysis. Python is an ideal programming language for data science and mechanics projects thanks to its flexibility and extensive library support. Flask is a Python-based lightweight web framework that is useful for integrating user interfaces and data processing capabilities. Google Sheets is used for data collection and management, and works with Flask applications to enable real-time data analysis. A key component of this system is a mechanical learning model using multi-regression analysis. Multi-regression analysis models the effect of multiple independent variables on dependent variables, through which predictions are made. In this study, vehicle performance data (e.g. speed, fuel consumption, engine temperature, etc.) are used as independent variables, and the need for maintenance of the vehicle is set as dependent variables. The mechanic model learns this data to accurately predict when the vehicle will be maintained.

The overall working flow of the system is. First of all, data collected from vehicle sensors is stored in Google Sheets. Flask applications periodically read this data and perform data preprocessing and purification operations.

Preprocessed data is entered into the mechanical learning model to proceed with learning above maintenance timing predictions. Finally, the forecast results are visually displayed to the user to help manage the vehicle.

4. WORKING METHODOLOGY

The systems proposed in this study develop vehicle data analysis and forecasting models by incorporating mechanical learning models based on Python, Flask, Google Sheets, and multi-regression analysis. The system leverages the advantages of each component to maximize the accuracy and efficiency of vehicle maintenance forecasts. Below is a detailed description of system integration and user elements.

4.1 Google Sheets and Flask:

Google Sheets is a platform that allows you to easily and efficiently collect and manage vehicle sensor data. Flask applications can access and process this data in real time using the Google Sheets API. This allows users to always perform analytics and predictions based on the latest data.

4.2 Python-based data processing and analysis:

Flask applications are based on Python and utilize various Python libraries (e.g. pandas, numpy, sklearn, etc.) for data pretreatment, analysis, and mechanic model training. These libraries enable advanced data analysis and modeling.

4.3 Mechanical learning model through multiple regression analysis:

Mechanical models using multi-regression analysis comprehensively take into account the vehicle's various performance indicators to predict maintenance needs. This model can be updated regularly to reflect new patterns that appear in the data.

4.4 User interface (UI):

Flask application provides a web-based user interface. This UI is designed to make it easy for users to look up data and check forecast results. In addition, users can perform data filtering, sorting, etc. operations as needed.

4.5 Custom notifications:

The system sends a notification to the user when it identifies a vehicle that needs maintenance. This notification can be configured with email, SMS, or notifications within a web application, and can be set in a user's preferred way.

4.6 Security and data privacy:

The security and privacy of user data is a key element of system design. The system uses technology such as data encryption, user authentication, access control, etc. to keep user data safe.

5. MODULE IMPLEMENTATION

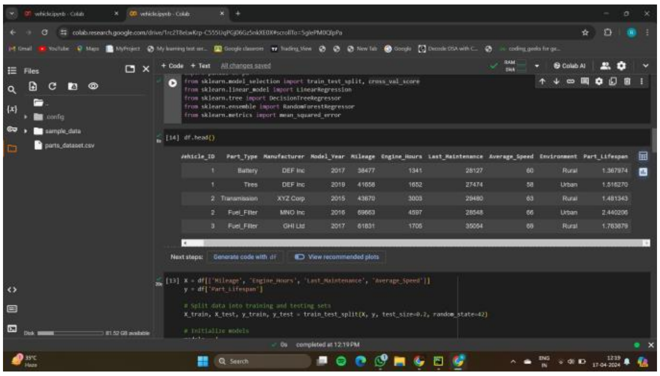

Fig. 5.1 First few rows of vehicle dataset

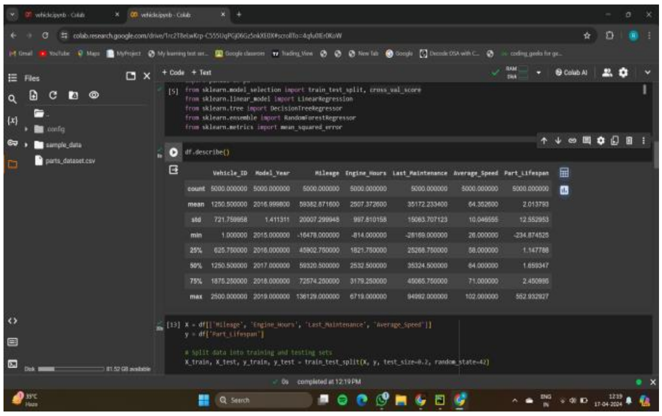

Fig. 5.2 Descriptive statistics of numerical columns

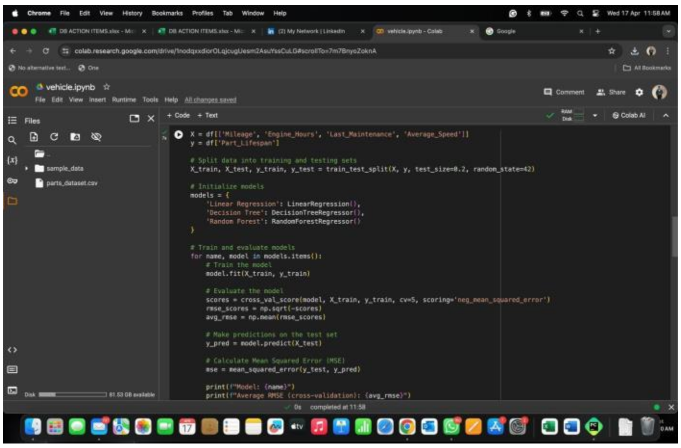

Fig. 5.3 Different algorithms prediction model comparison

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 04 | Apr 2024 www.irjet.net p-ISSN: 2395-0072

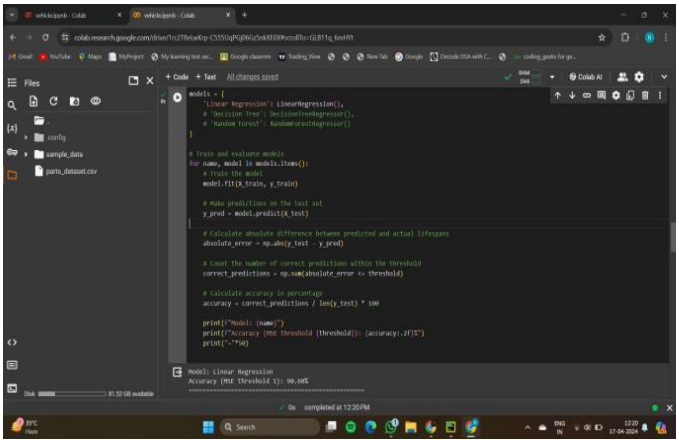

Fig. 5.4 Accuracy of linear regression model

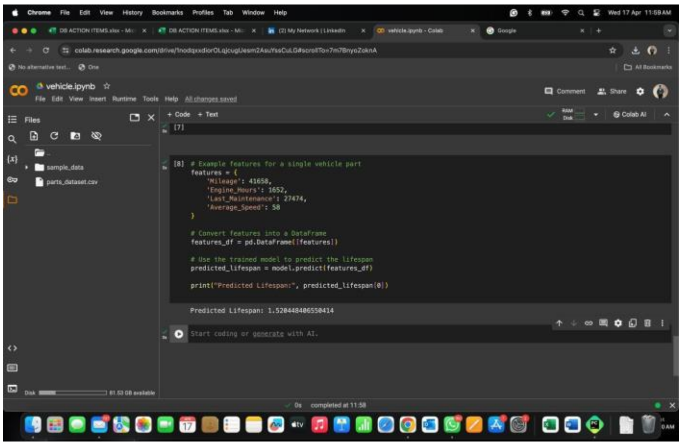

Fig. 5.5 Sample input data

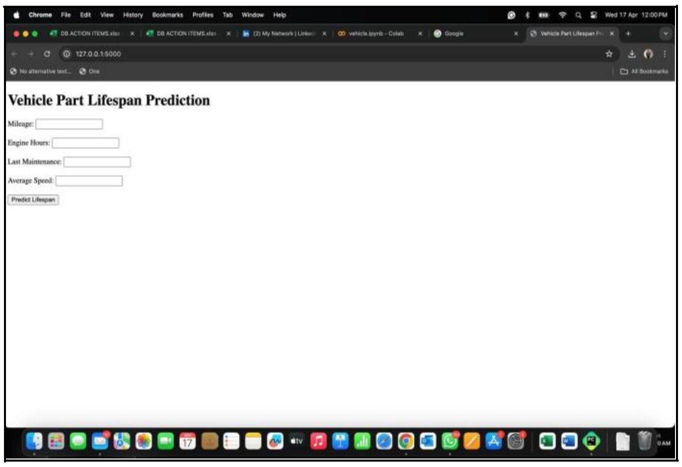

Fig. 5.6 Home page

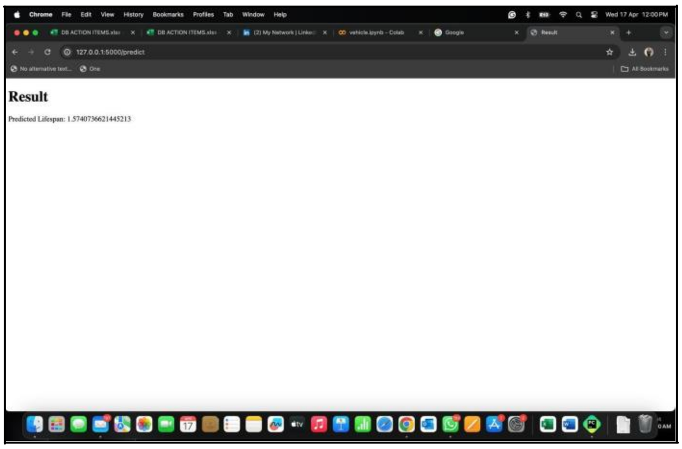

Fig. 5.7 Final Output

6. FUTURE SCOPE

1. Forecasting and real-time data analysis:

Present systems evaluate and forecast data on a regular basis. We are able to deliver immediate prediction and feedback as the vehicle's state changes by combining real-time data streaming and real-time prediction capabilities. It makes vehicle management and maintenance more effective by being able to identify and address issues with vehicles more quickly.

2. Machine learning model diversification:

Apart from multi-regression analysis, you can experiment with and use different machine learning methods, such time series analysis models or deep learning models. The system's utility can be greatly enhanced by achieving more precise forecasts and thorough data analysis.

3. Extension of user-customized services:

We are able to offer personalized services according to user preferences, past interactions, car attributes, etc. For instance, having the capacity to suggest the best maintenance schedule for every single person. A better user experience can satisfy a wide range of user needs and raise system satisfaction.

4. Integrated vehicle management system:

To create a complete vehicle management solution, integrate this system with other vehicle management features (such as route optimization, fuel usage analysis, etc.). enhance the ease of use and efficiency of vehicle management considerably. Users will have access to a range of vehicle management services via a single platform.

5. Interface and interaction design enhancement:

By making constant improvements to the user interface (UI) and user experience (UX) design, you may put in place a system that is easier to use and more intuitive. Users interact with the system more frequently and are happier as a result of it being simpler and more efficient for them.

7. CONCLUSION

The study discussed the design and implementation of vehicle data analysis and prediction systems. The system consists of data collection, preprocessing, model learning, prediction and result display, and user interface modules. Each module performs specific functions to increase the efficiency of vehicle maintenance and management, and by integrating them, it provides real value to the user. The main purpose of the system is to accurately predict the timing of maintenance of the vehicle, to prevent unexpected failures and to extend the life of the vehicle. Learn a multi-regression analysis model based on actual vehicle data, which predicts maintenance needs. In this process, the accuracy of the data and the predictive power of the model directly affect the performance of the system. In addition, in the future prospects, real-time data analysis and forecasting, diversification of machine learning models, user-customer service expansion, integrated vehicle management system construction, It also provided ways to expand and improve the functionality of the system through interface and mutual improvement. Taken together, this study explored the possibilities of systems that utilize vehicle data to predict the timing of maintenance, and presented implementation methods. The proposed system will be a useful tool to improve the efficiency of vehicle management and reduce the cost of vehicle maintenance for users. Furthermore, with the future prospects presented in the study, the system is expected to develop continuously and provide greater value in vehicle management.

REFERENCES

[1] Weiting Zhang, Dong Yang, "Data-Driven Methods for Predictive Maintenance of Industrial Equipment: A Survey" in IEEE Transactions on Industrial Informatics, vol. 19, no. 4, pp. 1-15, April2023, doi: 10.1109/JSYST.2019.2905565.

[2] Dazhong Wu, Connor Jennings, Janis Terpenny, Robert X. Gao, Soundar Kumara, “A Comparative Study on Machine Learning Algorithms for Smart Manufacturing: Tool Wear Prediction Using Random Forests”, April 18, 2017, MANU-16-1567, doi:10.1115/1.4036350.

[3] Sherin Thomas, Abhishek Dubey, Magson Zanette, “Digital Fleet Management: A Scalable Cloud Framework based on Data-driven Prediction Models”, November 2020, doi:10.36001/phmconf.2020.v12i1.1273

[4] Andreas Theissler a, Judith Pérez-Velázquez, “Predictive maintenance enabled by machine learning: Use cases and challenges in the automotive industry”, Reliability Engineering & System Safety, 2021, Volume 215 , doi: 10.1016/j.ress.2021.107864

[5] Rohit Dhall, Vijender Kumar Solanki, “An IoT Based Predictive Connected Car Maintenance Approach”, International Journal of Interactive Multimedia and Artificial Intelligence, 2017, pp. 16-22, doi:10.9781/ijimai.2017.433.