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REPORT FOR PLAGIARISM CHECK ON THE DISSERTATION/PROJECT REPORTS FOR UG/PG PROGRAMMES

(To be attached in the dissertation/ project report)

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7	Title of the Dissertation/Project	Sustainable Mobility Tracker: Car Metrics Calculator
8	Whether the above project /dissertation is done by	Group Project Samanyu B Rao RA2011003011063 Smit Vichare RA2011003011089
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CHAPTER 1

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INTRODUCTION The contemporary automotive industry is in the midst of a profound transformation, driven by an increasing focus on sustainability, fuel efficiency, and reduced carbon emissions. This shift is largely a response to mounting global concerns about climate change, environmental sustainability, and the need to reduce greenhouse gas emissions. As a result, consumers, regulators, and the automotive industry itself are placing a higher premium on vehicles that are not only technologically advanced but also environmentally responsible. Fuel consumption and carbon dioxide (CO_2) emissions from vehicles play a pivotal role in this context. They are central factors in determining a vehicle's environmental footprint and cost of operation. Consequently, understanding and accurately predicting fuel consumption and CO_2 emissions have become critical considerations for various stakeholders, including individual car buyers, businesses, government agencies, and environmental advocates. The traditional approach to assessing a vehicle's fuel efficiency and environmental impact relied on standardized testing procedures, such as those established by regulatory bodies. However, these standardized tests may not always reflect real-world conditions accurately. Real-world driving patterns, maintenance, and individual driving habits can all impact a vehicle's fuel consumption and CO_2 emissions, making accurate predictions a complex task. To address these challenges and meet the demand for more precise and personalized information, this web application leverages the power of machine learning. By implementing advanced regression models, including linear regression, ridge regression, lasso regression, and elastic net regression, the application can generate accurate predictions of a vehicle's CO_2 emissions based on its specific features. Users can input details like engine size, number of cylinders, and other key attributes to obtain predictions that are tailored to the vehicle in question. Moreover, the application doesn't stop at predictions. It takes the analysis a step further by comparing the predicted values to real-world CO_2 emissions data, thereby providing

CHAPTER 2

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The motivation behind the development of the provided code is deeply rooted in addressing pressing environmental concerns and the imperative need for informed decision-making when it comes to choosing vehicles. In today's world, where environmental sustainability has become a paramount global issue, the transportation sector stands out as a significant contributor to greenhouse gas emissions and air pollution. It is crucial to recognize the profound impact that our choices of vehicles have on the environment and the economy. First and foremost, the code is driven by the critical need to mitigate climate change. The automotive industry is one of the largest sources of carbon dioxide (CO_2) emissions globally. The burning of fossil fuels for transportation not only leads to increased CO_2 levels but also contributes to other pollutants harmful to air quality. The motivation for this code is to empower consumers with the tools to make environmentally conscious choices when it comes to their vehicles. By providing predictions of CO_2 emissions and fuel consumption, users can directly assess the environmental footprint of their vehicle selection. Furthermore, the economic aspect is a substantial driver for developing this application. Fuel consumption is a significant ongoing expense for vehicle owners. With the price of fuel continuously fluctuating, owning a vehicle with better fuel efficiency can lead to substantial cost savings over time. The motivation is to assist individuals and businesses in making more financially responsible choices, considering both the purchase price of the vehicle and the long-term operating costs. In addition, the code encourages the adoption of cleaner and more fuel-efficient technologies in the automotive industry. By making fuel efficiency data readily accessible and allowing

CHAPTER 3

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3.2 Analysis: 3.2.1. Data Collection and Preprocessing: • Aggregate comprehensive and diverse datasets encompassing vehicle attributes, usage patterns, fuel types, driving conditions, historical emission data, and fuel consumption metrics. • Employ meticulous data cleaning and preprocessing procedures to rectify outliers, address missing values, and ensure the uniformity and integrity of the collected data. 3.2.2. Predictive Model Integration: • Implement four distinct prediction models: Linear Regression, Ridge Regression, Lasso Regression, and Elastic Net Regression. • Train and fine-tune these models using the meticulously pre-processed dataset, establishing robust relationships between vehicle-related parameters, CO2 emissions, and fuel efficiency. 3.2.3. Model Evaluation and Selection: • Utilize evaluation metrics including Mean Squared Error (MSE), Root Mean Squared Error (RMSE), R-squared, and custom metrics for fuel efficiency assessment. • Selecting the most suitable model based on its consistent ability to provide accurate CO2 emission forecasts and reliable fuel efficiency calculations. 3.2.4. Enhanced Forecasting and Mitigation Strategies: • Generate precise and reliable projections of future CO2 emissions and fuel efficiency measures using the selected predictive model. • Integrate model outputs into existing environmental impact assessment to guide effective mitigation strategies

CHAPTER 4

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This dataset captures the details of how CO2 emissions by a vehicle can vary with the different features. The dataset has been taken from Canada Government official open data website. This is a compiled version. This contains data over a period of 7 years. There are few abbreviations that has been used to describe the features. They are listed Below. The same can be found in the Data Description sheet: • Model: 4WD/4X4 = Four-wheel drive, AWD = All-wheel drive, FFV = Flexible-fuel vehicle, SWB = Short wheelbase, LWB = Long wheelbase, EWB = Extended wheelbase. • Transmission: A = Automatic, AM = Automated manual, AS = Automatic with select shift, AV = Continuously variable, M = Manual, 3 - 10 = Number of gears. • Fuel type: X = Regular gasoline, Z = Premium gasoline, D = Diesel, E = Ethanol (E85), N = Natural gas. • Fuel Consumption: City and highway fuel consumption ratings are shown in litres per 100 kilometres (L/100 km) - the combined rating (55% city, 45% hwy) is shown in L/100 km and in miles per gallon (mpg). • CO2 Emissions: The tailpipe emissions of carbon dioxide (in grams per kilometre) for combined city and highway driving Linear regression is a fundamental supervised learning algorithm used for predicting a continuous target variable based on one or more input features. In your project, it's used to model the relationship between fuel consumption and various vehicle

CHAPTER 5

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5.1 Performance Analysis The provided Flask web application offers a range of features related to vehicle model comparison and prediction. In this section, we'll perform a performance analysis based on several key aspects. 1. Model Loading and Prediction: • The application loads four machine learning models (linear_model, ridge_model, lasso_model, elastic_net_model) from pickle files. This step is efficient and doesn't noticeably impact application performance as model loading is typically a one-time operation. • When making predictions, the application iterates through these models for each user input. This process is relatively quick, even with multiple models, thanks to Python's numerical computing library, NumPy. 2. Data Loading: • The application loads vehicle fuel consumption data from a CSV file ('FuelConsumption.csv') during initialization. This operation is efficient, and the data is organized into a dictionary structure for easy access. 3. User Interface: • The user interface is clean and user-friendly, with dropdown menus for selecting vehicle makes and models. JavaScript is used to dynamically populate model options based on the selected make, enhancing user experience. • The web pages (HTML templates) render efficiently, displaying data and results in an organized manner. 4. Prediction Accuracy: • The application calculates and presents the prediction error rate, which indicates the accuracy of machine learning models in estimating CO2

CHAPTER 6

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CONCLUSION AND FUTURE SCOPE 6.1 Conclusion: In this project, we have developed a Flask web application that provides users with the ability to predict and compare the CO2 emissions of various vehicle models. The application employs machine learning models to make predictions and allows users to compare the specifications of two different vehicles. The following key points summarize our findings and achievements: • Machine Learning Models: We have successfully implemented and integrated multiple machine learning models, including linear regression, ridge regression, lasso regression, and elastic net regression. Users can select a model of their choice to predict CO2 emissions based on input features. • Data Visualization: The application provides data visualization capabilities, allowing users to explore fuel consumption data through interactive line plots. Users can select a make to view the fuel consumption trends for different models from the dataset. • Model Comparison: Users can make informed decisions by comparing the specifications of two different vehicle models. This feature enhances the user's ability to choose a vehicle that aligns with their preferences and requirements. • Error Rate Calculation: The application calculates and presents an error percentage, helping users understand the accuracy of the chosen model's predictions concerning actual CO2 emissions. 6.2 Future Scope: As we conclude this project, we acknowledge the potential for further enhancements and expansion of our web application. Here are some avenues