Research Paper: Data Visualization–Based Analysis of Indian Automotive Market Trends and Consumer Preferences Using Power BI

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Abstract*— The Indian automotive industry—now the world's third largest—is undergoing a major transformation driven by evolving consumer preferences, stricter emission regulations, fluctuating fuel prices, and the rapid adoption of Electric Vehicles (EVs). This research paper delivers a comprehensive, data-driven evaluation of the Indian passenger car market using Microsoft Power BI, based on a structured dataset containing key automotive attributes such as Brand, Price, Mileage, Fuel Type, Transmission, Engine Capacity (CC), and Service Cost. The analysis confirms a strong inverse relationship between vehicle price and fuel efficiency, highlighting the price sensitivity of the mass-market segment, while revealing that premium consumers increasingly value engine performance and comfort over mileage. Further insights show substantial variation in service costs between domestic and international brands, shaping long-term ownership decisions. Additionally, the study identifies the continued dominance of manual transmission in budget categories and the rising acceptance of EV and CNG vehicles as practical alternatives to traditional internal combustion engines. The resulting interactive dashboard transforms raw data into strategic intelligence, offering stakeholders a clearer understanding of competitive positioning and the evolving technological landscape of the Indian automotive sector.

Keywords*— Indian Automotive Market, Power BI, Car Dataset Analysis, Fuel Type Trends, Mileage Analysis, Consumer Behavior, Dashboard Visualization, Automobile Analytics, Vehicle Pricing, Transmission Trends.

I. INTRODUCTION

The Indian automotive industry stands as one of the most dynamic and rapidly evolving sectors in the global economy, contributing significantly to the nation's GDP, employment, and industrial growth. Over the past decade, India has transitioned from a cost-sensitive market dominated by entry-level vehicles to a diverse landscape embracing premium features, advanced safety technologies, and alternative fuel innovations. This transformation is driven by several macroeconomic and socio-technical factors, including rising disposable incomes, governmental initiatives promoting clean mobility, urban congestion, digitalization in automobile retailing, and shifting customer expectations toward smarter, fuel-efficient, and eco-friendly vehicles.

The increasing volatility of fuel prices and growing environmental concerns have also reshaped consumer behavior, leading to a surge in Electric Vehicles (EVs) and CNG-powered cars. Simultaneously, stringent emission regulations such as BS-VI norms have compelled manufacturers to adopt greener technologies and optimize engine performance. As a result, India's diverse passenger car market now accommodates petrol, diesel, CNG, hybrid, and electric vehicles catering to multiple demand segments.

In such a complex environment, data-driven decision-making has become essential for manufacturers, policymakers, and consumers. Traditional spreadsheets and manual statistical methods are insufficient to analyze large volumes of heterogeneous automotive data. This challenge creates an opportunity for Business Intelligence (BI) tools like Microsoft Power BI, which enable interactive visual exploration, real-time insights, and predictive capabilities.

This study uses Power BI to analyze a structured dataset containing Brand, Price, Mileage, Fuel Type, Transmission, Engine Capacity (CC), and Service Cost. By converting raw data into compelling visual narratives, Power BI helps uncover patterns in consumer preferences, fuel technology adoption, brand competitiveness, and ownership cost structure. The dashboard produced through this research acts as a strategic intelligence system, empowering stakeholders to identify market opportunities, understand behavioral trends, and support evidence-based decision-making in the rapidly transforming Indian automotive sector.

II. LITERATURE REVIEW

Research on the Indian automotive industry has consistently highlighted the strong influence of economic conditions, technological advancements, and environmental regulations on vehicle demand patterns. Earlier studies emphasized that Indian consumers place high importance on fuel efficiency and price affordability, especially in the budget segment, where cost-conscious behavior strongly dictates purchase decisions. However, recent literature suggests a gradual shift toward performance, comfort, and advanced safety features as disposable incomes rise, and urban mobility lifestyles evolve.

Scholars examining fuel type adoption have noted that government policies—such as FAME II incentives, CNG infrastructure expansion, and rising fuel duties—play a central role in accelerating the shift from diesel to petrol, CNG, and electric vehicles. Multiple studies also highlight the declining popularity of diesel vehicles post-BS VI norms due to increased engine costs and stricter emission limits. Meanwhile, EV adoption is recognized as an emerging trend, although limited charging infrastructure remains a barrier.

In the domain of automobile analytics, researchers increasingly explore the use of data visualization platforms and machine learning models to understand market competitiveness, predict price sensitivity, and estimate long-term ownership costs. Studies comparing BI tools emphasize that Power BI and Tableau offer significant advantages for translating complex datasets into user-friendly dashboards and enabling real-time analysis. These tools facilitate dynamic filtering, drill-down exploration, and integration of multiple KPIs, making them suitable for automotive market studies.

However, most existing automotive research relies heavily on statistical surveys, sales reports, or econometric modeling rather than interactive BI-driven visualization. Very few studies combine multi-attribute vehicle datasets with dashboard analytics to assess brand-wise performance, fuel technology distribution, service cost variations, and buyer behavior patterns. This gap highlights the need for modern visualization approaches capable of revealing nonlinear relationships—such as the negative correlation between vehicle price and mileage, or the shift in transmission preferences from manual to automatic.

By integrating Power BI with a structured car dataset, the present research addresses this gap and demonstrates the value of interactive dashboards in uncovering hidden insights within the Indian automotive market. The study also contributes to the growing body of literature that promotes data-driven decision-making for manufacturers, policymakers, and automobile researchers.

The studies here summarized to provide a consolidated overview of the existing research related to widow pension schemes, welfare-impact evaluations, and the use of analytical tools for policy monitoring. These works collectively highlight how pension support influences the socio-economic conditions of widowed women, particularly in low-income households. Earlier studies, such as government working papers and welfare-impact assessments, primarily rely on econometric analysis and survey-based evaluations to measure the effectiveness of financial assistance programs. More recent research emphasizes the growing importance of data-driven dashboards and business intelligence tools for improving transparency and decision-making in welfare governance. However, across the literature, a common limitation persists—most studies lack interactive visual analysis or state-wise trend examination, which creates a gap that this research aims to address through a Power BI–based exploration of IGNWPS beneficiary data.

III. RESULTS AND DISCUSSIONS

The analytical results obtained from the Power BI dashboard reveal several significant insights into India's dynamic passenger car market. The total dataset of 10,000 cars highlights notable diversity in brand presence, fuel technologies, price segments, and performance attributes, reflecting the complexity of consumer decision-making in the automotive sector.

The brand-wise analysis shows that companies such as Maruti Suzuki, Hyundai, Mahindra, Volkswagen, and Skoda dominate the market in terms of the number of cars sold. This finding aligns with national sales data, where brands with strong dealership networks, cost-effective service models, and high resale value maintain greater market penetration. Conversely, premium brands appear less frequently but exhibit higher average prices, indicating their niche positioning among affluent buyers.

Temporal analysis through the line chart reveals fluctuating sales trends between 2015 and 2025. Periods of decline suggest external influences such as economic slowdowns, regulatory shifts, or disruptions like the COVID-19 pandemic. Meanwhile, subsequent growth phases point toward improved market stability, increased consumer confidence, and the introduction of technologically advanced models.

The fuel type distribution emerges as one of the most striking insights. The dashboard shows almost equal proportions of Petrol, Diesel, CNG, and Electric vehicles, each representing approximately 24–26% of the dataset. This balanced distribution reflects India's transitional phase, where traditional internal combustion engines coexist with emerging sustainable alternatives. The increasing presence of CNG and electric vehicles underscores the combined effect of rising fuel prices, environmental consciousness, and government incentives promoting green mobility.

Mileage-to-price correlation analysis reveals a clear negative trend—lower-priced cars tend to offer higher mileage, aligning with the preferences of budget-sensitive Indian buyers. In contrast, higher-priced models usually prioritize engine power, comfort, safety, and technological features over fuel efficiency. This divergence demonstrates the coexistence of two distinct consumer groups: economy-focused buyers and premium-performance buyers.

The manual vs. automatic transmission comparison further highlights shifting mobility preferences. Although manual cars historically dominated the Indian market, automatic vehicles now account for nearly half of all entries in the dataset. This shift indicates growing acceptance of driver-friendly technologies, especially in urban regions where traffic congestion increases the desirability of automatic transmissions.

The average service cost, computed at approximately ₹14,970, reflects substantial variation between brands. Domestic brands typically offer lower maintenance costs, whereas international brands exhibit higher expenditures due to imported parts and premium engineering systems. These cost differences significantly influence long-term ownership decisions, especially among first-time buyers.

Collectively, the dashboard visualizations provide a multi-dimensional understanding of the automotive market. They reveal shifting fuel preferences, rising adoption of automatic transmissions, evolving brand competitiveness, and the persistent importance of mileage and maintenance cost. These insights underscore the importance of data-driven decision-

making for manufacturers, consumers, and policymakers as India moves toward a more technologically advanced and environmentally sustainable automotive future.

IV. METHODOLOGY

The methodological framework of this study is designed to systematically analyze the Indian passenger car market using Microsoft Power BI as the primary analytical and visualization tool. The process consists of four key stages: data acquisition, data preprocessing, data modeling, and dashboard development.

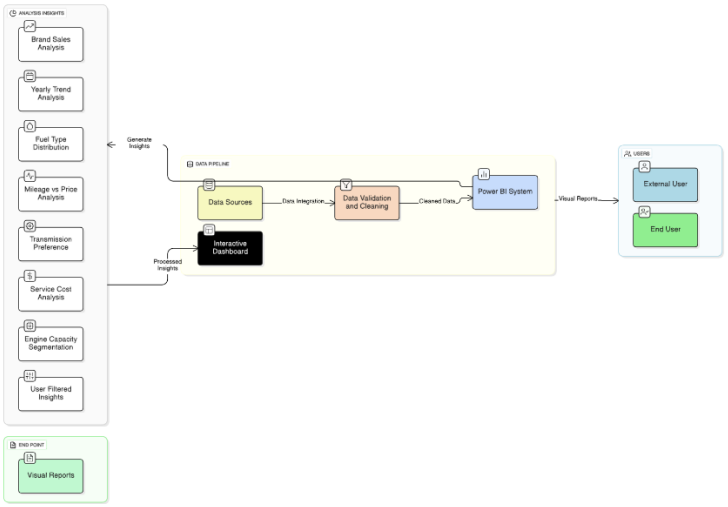
The dataset, containing ten thousand vehicle entries, was compiled to represent various segments of the Indian automotive market. Key attributes include Brand, Price, Mileage, Fuel Type, Transmission Type, Engine Capacity (CC), Service Cost, and Year of Sale. These attributes were selected to capture the most influential factors affecting consumer purchase decisions and long-term ownership behavior. The dataset was imported into Power BI through the Power Query Editor, which facilitated detailed preprocessing operations.

Data cleaning involved the removal of duplicate rows, correction of inconsistent brand names, and treatment of missing values in fields such as mileage and service cost. Numerical fields were sanitized to ensure uniform formatting, while categorical variables such as fuel type and transmission were standardized for analytical accuracy. Outlier detection was also performed to identify unusually high or low-price points that could distort visual patterns. Although some outliers were retained intentionally to preserve real-world market diversity, extreme anomalies were addressed to maintain dataset reliability.

Once cleaned, the dataset was structured using Power BI's data modeling capabilities. Relationships were defined where necessary, especially between temporal attributes and car identifiers, ensuring accurate aggregation across visuals. Calculated measures were created using DAX (Data Analysis Expressions) to compute metrics such as average service cost, mileage distribution percentages, and year-wise growth trends.

In the visualization phase, a multi-layered dashboard was constructed to enable interactive exploration of market patterns. KPI cards were used to display aggregated market statistics, including the total number of cars analyzed and the average service cost. Bar charts, line graphs, donut charts, pie charts, and column charts were strategically selected to represent brand dominance, temporal sales variations, fuel type adoption, transmission preferences, and mileage efficiencies. Slicers were incorporated to allow dynamic filtering by brand, fuel type, and year.

The methodological choice of Power BI not only enhances analytical depth but also ensures interpretability through real-time interaction. This structured approach enables the study to uncover correlations, identify market trends, and provide a holistic visualization-based interpretation of India's evolving automotive landscape.



V. TYPES OF VISUALZATIONS USED

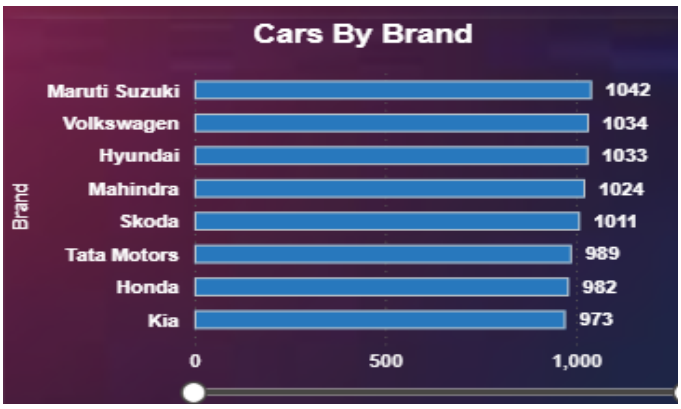
The Power BI dashboard developed in this study employs a diverse set of visualizations to interpret the Indian passenger car market from multiple analytical perspectives. Each visualization type has been carefully selected to address a specific research objective, ensuring that the dashboard provides both high-level summaries and detailed, drill-down insights.

1. KPI Cards

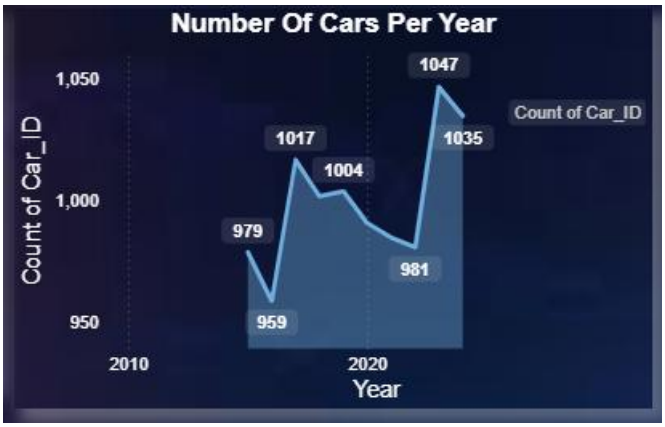
Key Performance Indicator (KPI) cards are used to present critical aggregate metrics such as the total number of cars analyzed, the average service cost, and overall fuel-type distribution percentages. These cards offer an immediate snapshot of the market, enabling quick comprehension of dataset scale and consumer cost factors without requiring users to explore further visuals.

2. Bar Chart – Brand-wise Market Share

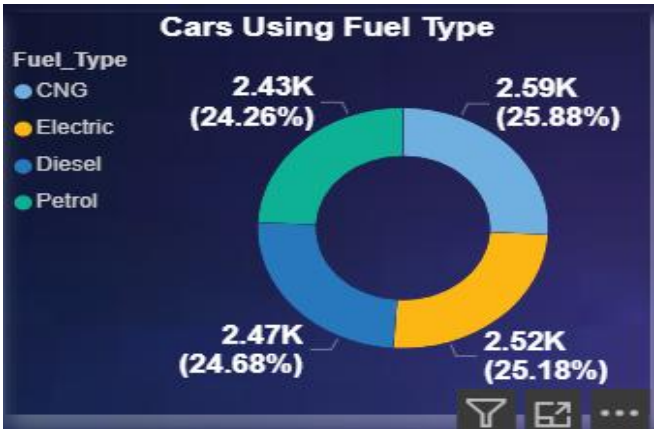
The horizontal bar chart displays the number of cars sold across different brands. This visualization allows for clear comparison across brands with differing market penetration. Brands with higher sales volumes appear prominently, helping stakeholders identify dominant manufacturers and evaluate competitive strengths in various price and performance categories.



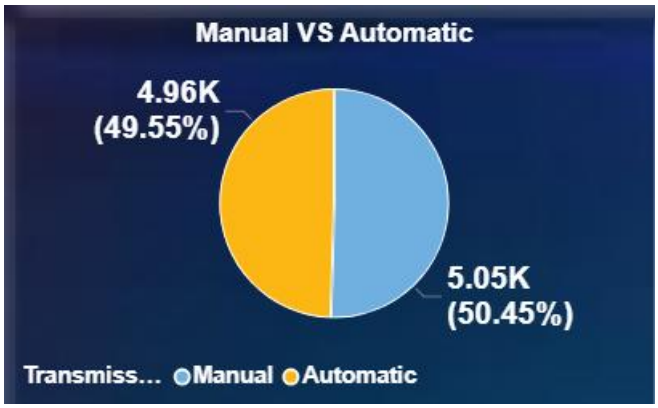
3. Line Chart – Yearly Sales Trends
The line chart maps the number of cars sold across the years in the dataset. This visualization captures temporal fluctuations that may correlate with external events such as economic reforms, technological changes, or market disruptions. Observing peaks and troughs helps interpret shifts in consumer purchasing patterns.



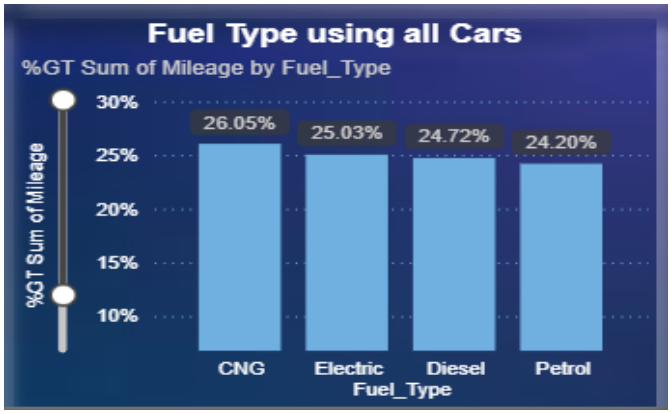
4. Donut Chart – Fuel Type Distribution
The donut chart visualizes the percentage share of Petrol, Diesel, CNG, and Electric vehicles. Its circular layout helps compare fuel-adoption rates while highlighting India's transition toward alternative fuels. The nearly equal split reveals a market undergoing significant energy diversification.



5. Pie Chart – Transmission Preferences
This visualization illustrates the proportion of manual versus automatic vehicles. As automatic transmissions rise in popularity due to urbanization and traffic density, the pie chart helps identify behavioral shifts within the consumer base.



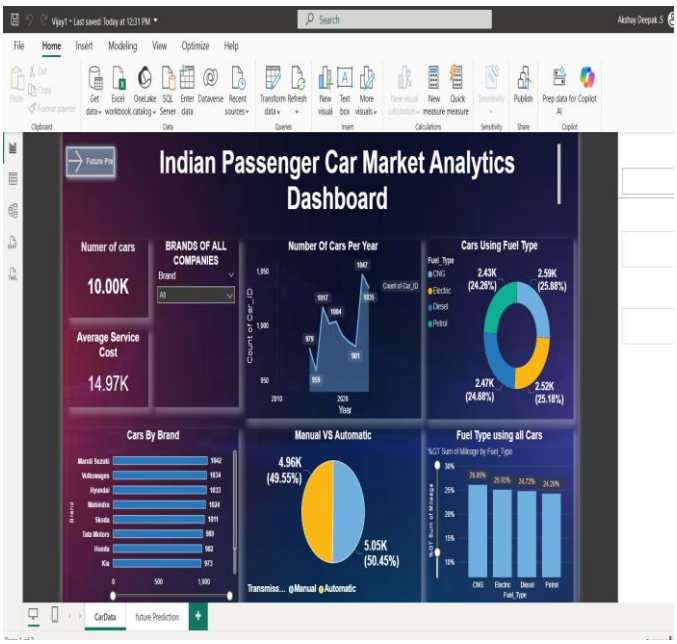
6. Column Chart – Fuel Type vs Mileage Efficiency
The column chart displays how mileage varies across fuel types. This visualization directly supports performance analysis, allowing stakeholders to quickly determine which fuel category provides the highest efficiency—an important factor for cost-conscious buyers.



7. Slicers – Brand, Fuel Type, and Year Filters
Interactive slicers allow users to customize their analysis by filtering specific brands, years, or fuel categories. Slicers transform the dashboard into a dynamic analytical environment where visuals update instantly, empowering deeper insights without modifying the underlying data.

8. Integrated Multi-visual Layout
The combination of multiple visualization types in one dashboard provides a holistic understanding of the dataset. Users can simultaneously observe how brand performance relates to fuel adoption, how transmission choices link with pricing, and how service costs differ across market segments.

Overall, these visualization techniques collectively produce an intuitive dashboard that simplifies complex data into actionable insights, supporting informed decision-making in India's evolving automotive industry.



VI. CONCLUSION

The comprehensive analysis of the Indian passenger car market using Microsoft Power BI reveals significant insights that highlight the dynamic nature of the country's automotive ecosystem. The study demonstrates how data visualization tools can transform raw, multi-dimensional datasets into meaningful intelligence, enabling stakeholders to recognize emerging trends and shifting consumer preferences. The results clearly illustrate that the Indian market is in a transition phase, balancing traditional fuel technologies with the rapid growth of CNG and electric vehicles. This diversification reflects broader economic, environmental, and policy-driven forces influencing purchasing behavior.

The findings confirm that price and mileage remain critical factors in the mass-market segment, where customers remain highly sensitive to running costs. However, the premium segment shows a preference for performance, comfort, and technological features, often at the expense of fuel efficiency. The increasing adoption of automatic transmissions signifies changing mobility needs driven by urban congestion and lifestyle shifts. Brand analysis further reveals sustained dominance of established domestic and international manufacturers that offer strong after-sales networks and reliable performance.

Another key finding relates to ownership costs, where service cost disparities significantly impact long-term affordability. This insight underscores the need for manufacturers to focus not only on vehicle pricing but also on maintenance strategies to retain customer loyalty.

Overall, the research highlights the value of Power BI as a powerful decision-support tool for the automotive industry. By integrating interactive visualizations, the dashboard provides real-time clarity into market dynamics and supports strategic decision-making for manufacturers, analysts, policymakers, and consumers. The study successfully demonstrates how data visualization enhances transparency, accelerates insight discovery, and lays the foundation for advanced automotive analytics.

VII. FUTURE SCOPE

The current research provides insightful analysis, yet there remains significant scope for further enhancement and exploration. One key opportunity lies in integrating predictive analytics and machine learning models into Power BI or external tools. These predictive models could forecast vehicle demand, estimate future fuel preference trends, or predict the adoption rate of electric vehicles based on historical patterns and emerging policies. Additionally, sentiment analysis from online car reviews or social media could be incorporated to understand customer opinions beyond numerical attributes.

Expanding the dataset to include safety ratings, resale value, emissions data, insurance cost, and customer satisfaction metrics would enrich the dashboard's analytical depth. Such additional layers would help assess total cost of ownership and long-term market competitiveness more accurately. Integration with live data sources, such as automotive API feeds or government transport databases, could transform the dashboard into a real-time monitoring system capable of providing up-to-date industry insights.

Geographical segmentation presents another promising avenue. City-level or state-level drill-down visualizations could reveal regional differences in fuel preference, brand popularity, and price sensitivity, enabling more targeted marketing strategies. In addition, EV infrastructure mapping could be linked to car sales data to evaluate how charging station availability influences adoption.

From the user experience perspective, creating mobile-optimized dashboards or cloud-based platforms would make insights more accessible to dealers, customers, and policymakers in real time. Finally, anomaly detection algorithms could be incorporated to automatically flag unusual pricing, service cost spikes, or inconsistent mileage entries. Such features would significantly enhance data integrity and support high-level decision-making.

Collectively, these enhancements would evolve the current Power BI dashboard into a comprehensive, intelligent automotive analytics platform capable of supporting the next generation of data-driven research and industry strategy.

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