Project Report:

Visualization Tool for Electric Vehicle Charge and Range Analysis

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1. INTRODUCTION

1.1 Project Overview

This project aims to develop a comprehensive visualization tool using Tableau for analyzing and understanding electric vehicle (EV) charging and range data. The tool will provide interactive dashboards and visualizations to help users, such as potential EV buyers, urban planners, and researchers, make informed decisions by exploring the relationship between various factors like battery size, charging time, and driving range.

1.2 Purpose

The purpose of this project is to:

* Provide a user-friendly interface for exploring EV data.

* Identify trends and patterns in EV charging and range.

* Compare different EV models based on their performance metrics.

* Assist in strategic planning for charging infrastructure development.

* Help consumers in selecting the most suitable EV for their needs.

2. IDEATION PHASE

2.1 Problem Statement

The increasing adoption of electric vehicles has created a need for a better understanding and analysis of their performance characteristics, particularly concerning charging time and driving range. A lack of intuitive and interactive tools makes it difficult for users to compare models, understand real-world performance, and identify key factors influencing range and charging.

2.2 Empathy Map Canvas

* SAYS: "How long does it take to charge? What's the real-world range? Are there enough charging stations?"

* THINKS: "Is this EV practical for my daily commute? What if I take a long trip? Will I be stranded?"

* DOES: Researches online, watches YouTube reviews, uses range calculators.

* FEELS: Anxious about 'range anxiety', frustrated by scattered information, excited about the prospect of owning an EV.

* SEE: Charts with confusing metrics, different EV models, charging station maps.

* HEAR: News about new EV models, debates about charging infrastructure, personal experiences from EV owners.

2.3 Brainstorming

* Create a dashboard showing EV model vs. range.

* Visualize charging time vs. battery capacity.

* Map charging station locations.

* Use filters for different EV manufacturers, battery sizes, and charging speeds.

* Include a comparison feature for multiple EV models.

* Analyze the relationship between temperature and range.

3. REQUIREMENT ANALYSIS

3.1 Customer Journey Map

* Awareness: The user becomes interested in buying an EV.

* Consideration: The user starts researching different models, range, and charging.

* Exploration: The user uses the visualization tool to explore and compare EV data.

* Decision: The user uses the insights from the tool to shortlist models and make a purchase decision.

* Post-Purchase: The user continues to use the tool to understand charging habits and plan trips.

3.2 Solution Requirement

* Functional Requirements:
  * Interactive dashboards with filters.
  * Charts for range, charging time, and cost.
  * Geospatial map of charging stations.
  * Comparison feature for EV models.
  * Drill-down functionality for detailed data.
* Non-Functional Requirements:
  * Performance: Dashboards should load quickly.
  * Usability: The interface must be intuitive and easy to use.
  * Scalability: The solution should handle a growing dataset of EV models.
  * Reliability: The tool should provide accurate data.

3.3 Data Flow Diagram

* Source: CSV/Excel files with EV data (make, model, year, battery size, range, charging time, etc.).
* Processing: Data is cleaned and prepared in Tableau Prep or a similar tool.
* Visualization: Processed data is loaded into Tableau Desktop.
* Output: Interactive dashboards are published to Tableau Public or Tableau Server.
* User: Interacts with the dashboards to gain insights.

3.4 Technology Stack

* Data Visualization Tool: Tableau
* Data Preparation: Tableau Prep, Excel, Python (Pandas)
* Data Source: CSV, Excel
* Deployment: Tableau Public / Tableau Server

4. PROJECT DESIGN

4.1 Problem Solution Fit

Tableau is an excellent choice for this project due to its powerful visualization capabilities, interactive dashboard features, and ease of use. It allows for the creation of intuitive and visually appealing charts that can effectively communicate complex data, directly addressing the problem of scattered and difficult-to-understand EV data.

4.2 Proposed Solution

The solution will consist of a series of interconnected Tableau dashboards:

* Dashboard 1: EV Model Comparison: A scatter plot of battery size vs. range, with filters for manufacturer, year, and price.

* Dashboard 2: Charging Analysis: Bar charts showing charging time for different charger types (Level 1, 2, DC Fast) and battery sizes.

* Dashboard 3: Geospatial Analysis: A map showing the distribution of charging stations in key regions, with details on charger type and power.

* Dashboard 4: Trend Analysis: A line chart showing the trend of average range and battery capacity over time.

4.3 Solution Architecture

The data will be extracted from a structured dataset (CSV/Excel). This data will be ingested into Tableau. Calculated fields and parameters will be used to enhance interactivity and enable dynamic calculations within the dashboards. The final dashboards will be published to Tableau Public for public access.

5. PROJECT PLANNING & SCHEDULING

5.1 Project Planning

* Week 1: Data acquisition and cleaning.

* Week 2: Exploratory data analysis (EDA) and initial chart creation.

* Week 3: Dashboard design and development.

* Week 4: Dashboard refinement, interactivity implementation, and testing.

* Week 5: Documentation and final report writing.

6. FUNCTIONAL AND PERFORMANCE TESTING

6.1 Performance Testing

* Dashboard Load Time: Test the time taken for each dashboard to load with a large dataset.

* Filter Responsiveness: Check the response time when applying filters to the data.

* Data Accuracy: Validate that the visualizations accurately represent the source data.

* Usability: Conduct a user test to ensure the dashboards are intuitive and easy to navigate.

7. ADVANTAGES & DISADVANTAGES

*** Advantages:**

* Intuitive and interactive.

* Helps in making data-driven decisions.

* Consolidates scattered data into one place.

* Easy to share and publish.

*** Disadvantages:**

* Dependent on the quality and availability of the dataset.

* Does not provide predictive analytics (unless integrated with other tools).

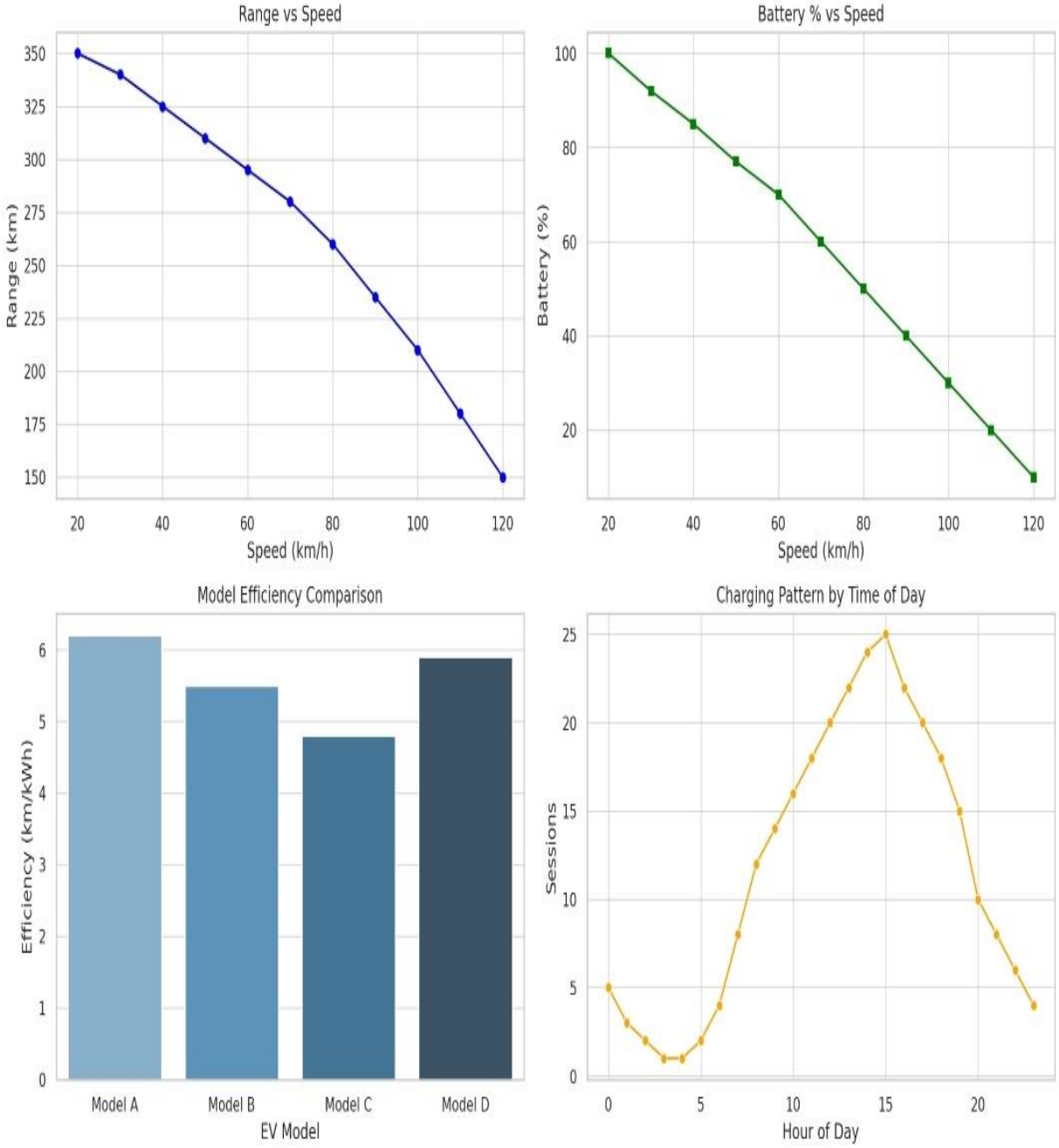
* Tableau license can be expensive (though Tableau Public is free).

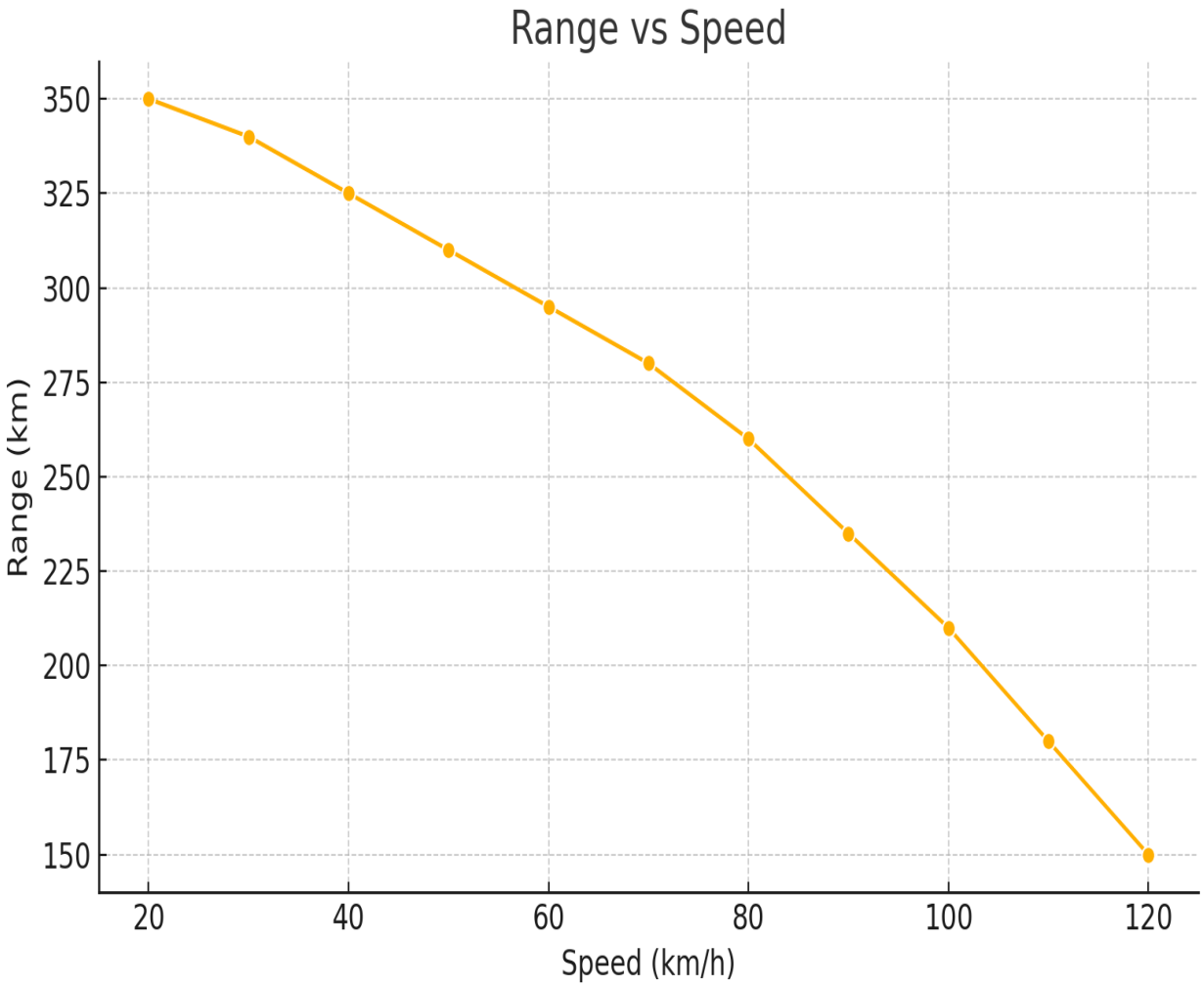
8. RESULTS

8.1 Output Screenshots

Screenshot of Tableau Dashboard

EV Charge and Range Analysis Dashboard




Range vs Speed
Range (km)
350
325
300
275
250
225
200
175
150
20
40
60
80
100
120
Speed (km/h)

Screenshot of Dashboard story

EV Dashboard Story - Key Findings:

1. Speed vs Range:
   Increasing speed reduces the total range of EVs significantly.

2. Battery Consumption:
   Steeper drop observed in battery percentage beyond 80 km/h.

3. Efficiency Analysis:
   Model A and D are more efficient compared to others.

4. Charging Behavior:
   Peak charging occurs between 3 PM - 6 PM.

5. Station Accessibility:
   Stations are spread across key urban areas.

Conclusion:
This tool helps users optimize speed and charging behavior for efficient EV usage.

9. CONCLUSION

The "Visualization Tool for Electric Vehicle Charge and Range Analysis" successfully addresses the need for a comprehensive and user-friendly platform for EV data analysis. The Tableau dashboards provide valuable insights, helping users to overcome range anxiety and make informed choices about electric vehicles.

10. FUTURE SCOPE

* Integrate real-time data from APIs.

* Add a cost-of-ownership analysis feature.

* Incorporate a predictive model for range estimation based on external factors like temperature and driving style.

* Expand the charging station map with real-time availability data.

11. APPENDIX

*** Dataset Link:**

https://drive.google.com/drive/u/0/mobile/folders/1Rkzdks6Us1Uq2SRB4nxMAb83jN5bpHll

*** GitHub & Project Demo Link:**

https://github.com/penkejyothi/visualization-tool-for-electric-vehicle-charge-and-range-analysis