Final Project Report

Visualization Tool for Electric Vehicle Charge and Range Analysis

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Team Size : 4

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Team member 1: Lokesh Pilla

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Team member 3: Sangeetham Ganesh

1. INTRODUCTION

1.1 Project Overview

The Electric Cars Analytics Dashboard is a data visualization project designed to analyze electric vehicle performance, pricing, charging infrastructure, and brand distribution. The project uses Tableau for interactive visualization, MySQL Workbench for data storage, and Flask for web integration. The objective is to transform raw EV data into meaningful insights through dashboards and storytelling.

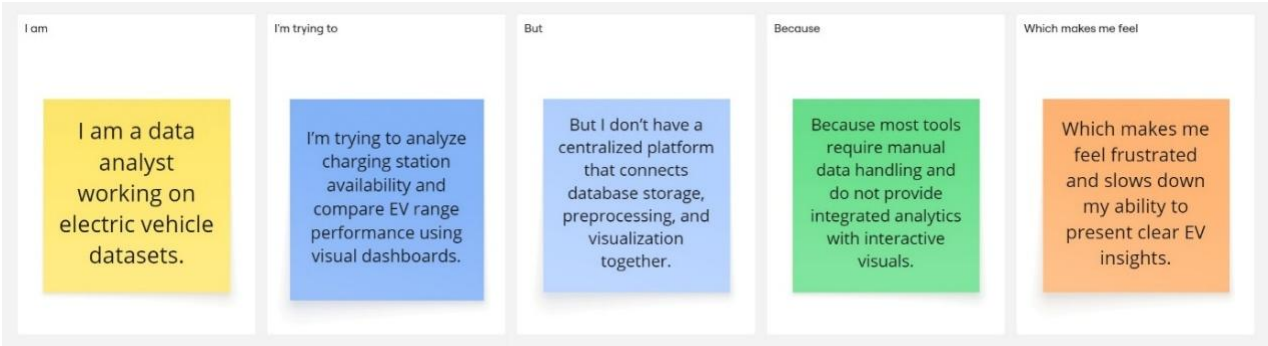
1.2 Purpose

The purpose of this project is to help users understand electric vehicle trends in India and globally by presenting data through interactive charts, maps, and story points. It supports decision-making by providing clear insights into efficiency, body styles, charging stations, and pricing comparisons.

2. IDEATION PHASE

2.1 Problem Statement

Electric vehicle data is complex and difficult to analyze without proper visualization tools. Users need an interactive system to understand EV performance, market availability, and charging infrastructure through visual analytics.



Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	An electric vehicle user or researcher who wants to analyze EV charging infrastructure and vehicle range.	Understand charging availability, compare vehicle range, and analyze EV performance using reliable data.	The data is scattered across multiple platforms and mostly presented in raw or static formats.	Existing tools do not provide centralized interactive dashboards that combine charging and range analysis.	Confused, time-consuming, and difficult to make data-driven decisions about EV usage and planning.
PS-2	A data analyst or student working on EV analytics projects.	Create meaningful visualizations to explore EV datasets and present insights clearly.	Preparing data, connecting tools, and building interactive dashboards requires multiple complex steps.	There is no simple integrated platform that connects SQL, Python preprocessing, Tableau visualization, and web deployment.	Overwhelmed and limited in presenting professional EV analytics solutions.

2.2 Empathy Map Canvas

Users want:

- Easy understanding of EV performance
- Comparison between brands
- Information about charging stations in India

Pain Points:

- Raw data is difficult to interpret

Solutions:

- Interactive dashboard with filters and story navigation

Says

What have we heard them say?
What can we imagine them saying?

- I need a simple way to analyze EV charging and range data.
- Current EV reports are hard to understand.
- I want interactive dashboards instead of static charts.

Thinks

What are their wants, needs, hopes, and dreams?
What other thoughts might influence their behavior?

- Wants accurate and up-to-date EV data insights.
- Needs a centralized platform combining SQL, Python, and Tableau.
- Hopes to make faster data-driven decisions about EV performance.

EV Data Analyst / Electric Vehicle User

A user who wants to analyze EV charging stations and vehicle range through interactive dashboards.

Does

What behavior have we observed?
What can we imagine them doing?

- Searches online for EV datasets and charging information.
- Uses spreadsheets and multiple tools to analyze data.
- Spends time cleaning and preparing datasets manually.

Feels

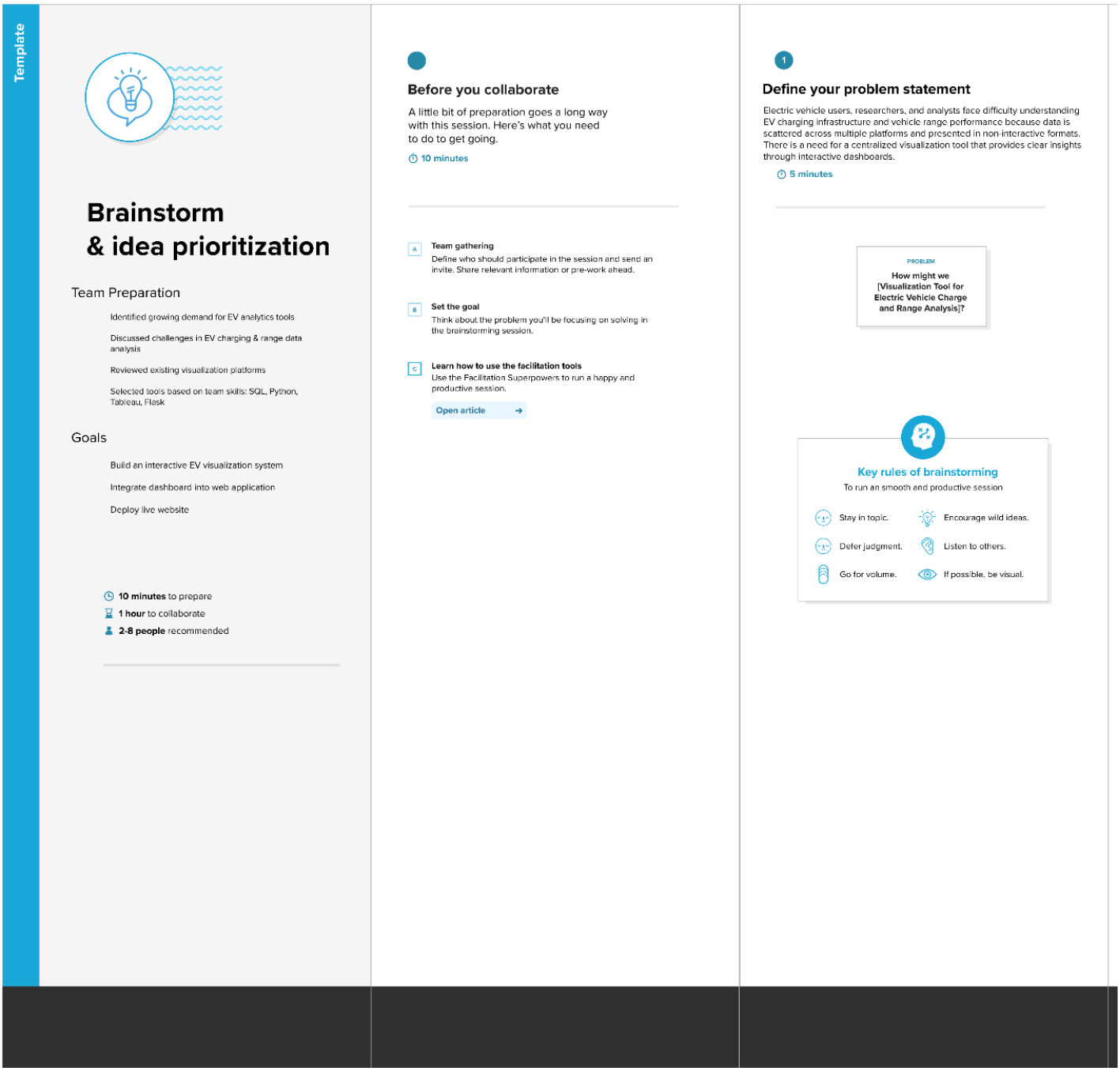
What are their fears, frustrations, and anxieties?
What other feelings might influence their behavior?

- Feels frustrated by scattered EV data sources.
- Feels overwhelmed by complex analysis steps.
- Feels motivated when using interactive visual dashboards.

The EV user needs a centralized visualization tool that simplifies data analysis, improves decision-making, and provides interactive insights into charging infrastructure and vehicle range.

2.3 Brainstorming

The team discussed multiple visualization ideas including bar charts, maps, treemaps, and summary cards. Tableau was selected due to its strong visualization and storytelling features.



2 Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

TIP

You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

Person 1	Person 2	Person 3	Person 4
EV Charging Station Visualization Dashboard	Electric Vehicle Range Comparison Analysis	Import EV Dataset into MySQL Database	Connect Tableau Desktop with MySQL
Person 5	**Person 6**	**Person 7**	**Person 8**
Data Preprocessing using Python (Cleaning & Transformation)	Create Interactive Charts (Line, Bar, Map, Bubble)	Publish Dashboard & Story to Tableau Public	Flask Web Integration & Render Deployment

3 Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

TIP

Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as the themes within your mind.

Data Management Layer

- Downlowd EV Datasets
- Import Dataset into MySQL
- Darabase Table Management
- Purpose. Store and manage EV charging & range data.

Deta Processing Layer

- Data Cleaning using Python
- Data Transformation & Preparation
- Handling Missing Values
- Purpose: Prepare data before Visualization

Visualization & Analytics Layer

- Connect Tableal. Desktop to MySQL
- Create Charts (Line; Bart Bubble. Map'
- Build Dashboard & Stocy Visualization
- Purpose Analyze EV charging infrastructure and venicle rangs

Web Integration & Deployment Layer

- Publish Dashboard to Tableau Public
- Flask Web Application Denelopment
- Deploy Website using Bonder
- Purpose: Provide web based access to EV analvitos

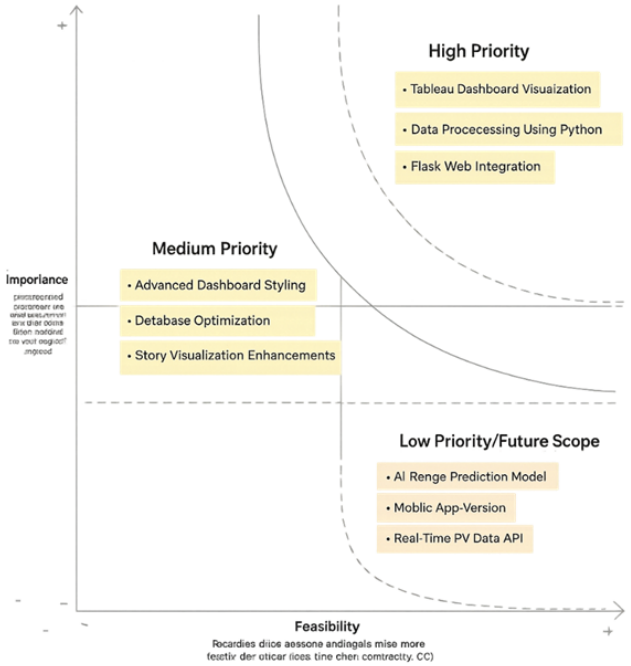
4 Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes

TIP

Participants can use their cursors to point at where sticky notes should go on the grid. The facilitator can confirm the spot by using the laser pointer holding the **H key** on the keyboard.



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After you collaborate

Develop an interactive Electric Vehicle Charge and Range Analysis Visualization Tool that integrates SQL, Python, Tableau, and Flask to provide web-based EV analytics.

Key Decisions Taken by Team

- **Use MySQL for storing EV datasets.**
- **Apply Python preprocessing to clean and transform data.**
- **Create interactive Tableau dashboards & story for visualization.**
- **Publish dashboards using Tableau Public.**
- **Integrate visualization into a Flask web application.**
- **Deploy the final website using Render platform.**

Expected Outcome

- **Centralized EV analytics dashboard.**
- **Easy comparison of charging infrastructure and vehicle range.**
- **Interactive web-based platform accessible to users.**

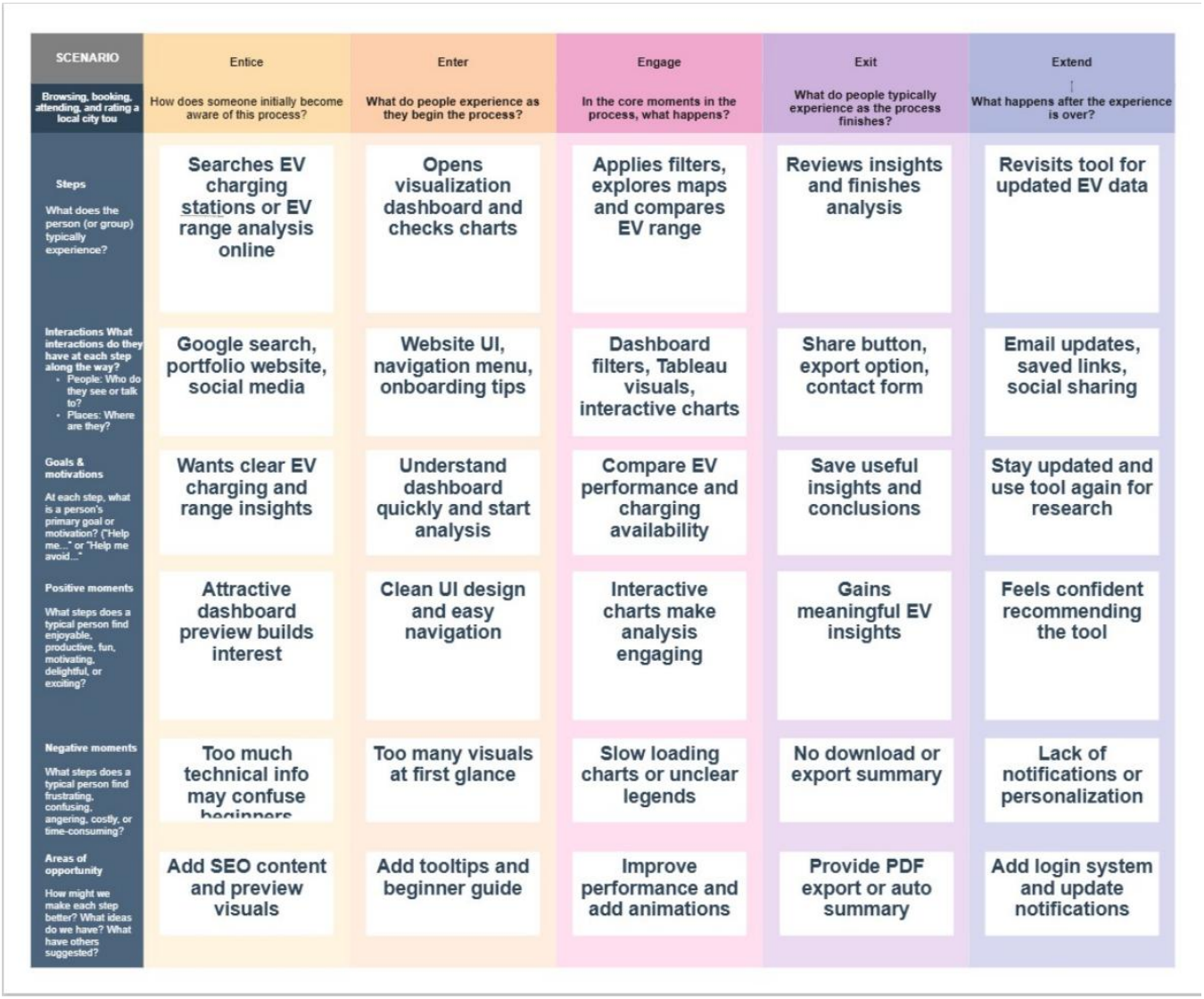
Next Steps

1. **Dataset Download**
2. **Import into MySQL**
3. **Tableau Connection**
4. **Data Preprocessing**
5. **Dashboard & Story Creation**
6. **Publish to Tableau Public**
7. **Flask Web Integration**
8. **Deploy Website using Render**

3. REQUIREMENT ANALYSIS

3.1 Customer Journey Map

User opens Flask website → Views Tableau dashboard → Applies filters → Navigates story slides → Gains insights about EV analytics.



SCENARIO	Entice	Enter	Engage	Exit	Extend
Browsing, booking, attending, and rating a local city tou	How does someone initially become aware of this process?	What do people experience as they begin the process?	In the core moments in the process, what happens?	What do people typically experience as the process finishes?	What happens after the experience is over?
Steps What does the person (or group) typically experience?	Searches EV charging stations or EV range analysis online	Opens visualization dashboard and checks charts	Applies filters, explores maps and compares EV range	Reviews insights and finishes analysis	Revisits tool for updated EV data
Interactions What interactions do they have at each step along the way? • People: Who do they see or talk to? • Places: Where are they?	Google search, portfolio website, social media	Website UI, navigation menu, onboarding tips	Dashboard filters, Tableau visuals, interactive charts	Share button, export option, contact form	Email updates, saved links, social sharing
Goals & motivations At each step, what is a person's primary goal or motivation? ("Help me..." or "Help me avoid...")	Wants clear EV charging and range insights	Understand dashboard quickly and start analysis	Compare EV performance and charging availability	Save useful insights and conclusions	Stay updated and use tool again for research
Positive moments What steps does a typical person find enjoyable, productive, fun, motivating, delightful, or exciting?	Attractive dashboard preview builds interest	Clean UI design and easy navigation	Interactive charts make analysis engaging	Gains meaningful EV insights	Feels confident recommending the tool
Negative moments What steps does a typical person find frustrating, confusing, angering, costly, or time-consuming?	Too much technical info may confuse beginners	Too many visuals at first glance	Slow loading charts or unclear legends	No download or export summary	Lack of notifications or personalization
Areas of opportunity How might we make each step better? What ideas do we have? What have others suggested?	Add SEO content and preview visuals	Add tooltips and beginner guide	Improve performance and add animations	Provide PDF export or auto summary	Add login system and update notifications

3.2 Solution Requirement

- MySQL database connectivity
- Tableau Desktop Public
- Interactive dashboard design
- Flask web integration
- Tableau Public publishing

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIn
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Data Management	Upload EV datasets Store data in MySQL Update/Delete records Data validation and cleaning
FR-4	Visualization & Analysis	Connect MySQL to Tableau Create charts and dashboards Publish to Tableau Public Web integration

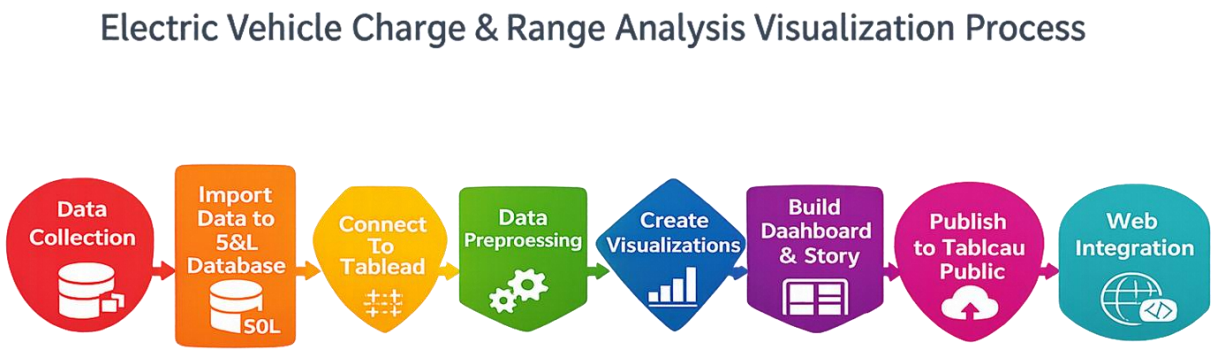
Non-functional Requirements:

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	User-friendly dashboards with interactive visualizations
NFR-2	**Security**	Secure database access and safe publishing
NFR-3	**Reliability**	Accurate and consistent visualization results
NFR-4	**Performance**	Fast dashboard loading and query execution
NFR-5	**Availability**	Dashboards accessible anytime via Tableau Public
NFR-6	**Scalability**	Supports large datasets and future expansion

3.3 Data Flow Diagram

Data flows from CSV dataset → MySQL Workbench → Tableau Desktop → Tableau Public → Flask Web Interface → End User.



User Stories

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Web user)	Dashboard	USN-1	As a user, I want to view the Electric Cars Analytics Dashboard to understand EV insights.	Dashboard loads and filters work properly.	High	Sprint-1
Customer (Web user)	Story Navigation	USN-2	As a user, I want to navigate Story of Electric Cars in India step-by-step.	Story points change using navigation arrows.	High	Sprint-1
Customer (Web user)	Filters	USN-3	As a user, I want to apply BodyStyle and PowerTrain filters.	Visualizations update dynamically.	High	Sprint-1
Customer Care Executive	Analysis	USN-4	As an analyst, I want to analyze EV brands by efficiency and speed.	Charts display aggregated results correctly.	Medium	Sprint-2
Customer Care Executive	Charging Stations	USN-5	As an analyst, I want to view charging station distribution.	Map shows region markers accurately.	Medium	Sprint-2
Administrator	Data Connectivity	USN-6	As an admin, I want to connect Tableau with MySQL database.	Database connection succeeds without errors.	High	Sprint-1

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Administrator	Publishing	USN-7	As an admin, I want to publish Dashboard & Story to Tableau Public.	Public link generated successfully.	High	Sprint-2
Administrator	Flask Integration	USN-8	As an admin, I want to embed Tableau dashboard into Flask website.	Dashboard loads inside web interface.	High	Sprint-3
Administrator	Deployment	USN-9	As an admin, I want to deploy Flask app online.	Live website opens without errors.	High	Sprint-3
Customer (Web user)	Dashboard	USN-1	As a user, I want to view the Electric Cars Analytics Dashboard to understand EV insights.	Dashboard loads and filters work properly.	High	Sprint-1
Customer (Web user)	Story Navigation	USN-2	As a user, I want to navigate Story of Electric Cars in India step-by-step.	Story points change using navigation arrows.	High	Sprint-1
Customer (Web user)	Filters	USN-3	As a user, I want to apply BodyStyle and PowerTrain filters.	Visualizations update dynamically.	High	Sprint-1

3.4 Technology Stack

- MySQL Workbench – Data Storage
- Tableau Desktop Public – Visualization
- Tableau Public – Publishing
- Flask – Web Integration
- HTML/CSS – Interface Design

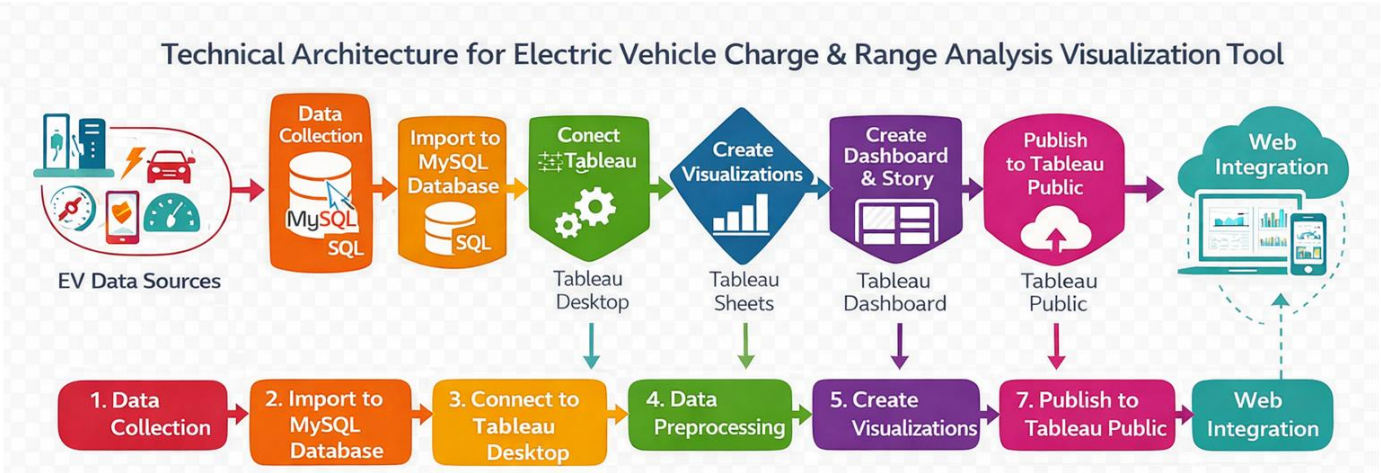


Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	Logic for a process in the application	Java / Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.
6.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
7.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
8.	External API-1	Purpose of External API used in the application	IBM Weather API, etc.
9.	External API-2	Purpose of External API used in the application	Aadhar API, etc.
10.	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model, etc.
11.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	Local, Cloud Foundry, Kubernetes, etc.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	Technology of Opensource framework
2.	Security Implementations	List all the security / access controls implemented, use of firewalls etc.	e.g. SHA-256, Encryptions, IAM Controls, OWASP etc.
3.	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services)	Technology used

S.No	Characteristics	Description	Technology
4.	Availability	Justify the availability of application (e.g. use of load balancers, distributed servers etc.)	Technology used
5.	Performance	Design consideration for the performance of the application (number of requests per sec, use of Cache, use of CDN's) etc.	Technology used

4. PROJECT DESIGN

4.1 Problem Solution Fit

The dashboard converts complex EV datasets into visual insights, helping users understand performance metrics and charging infrastructure easily.

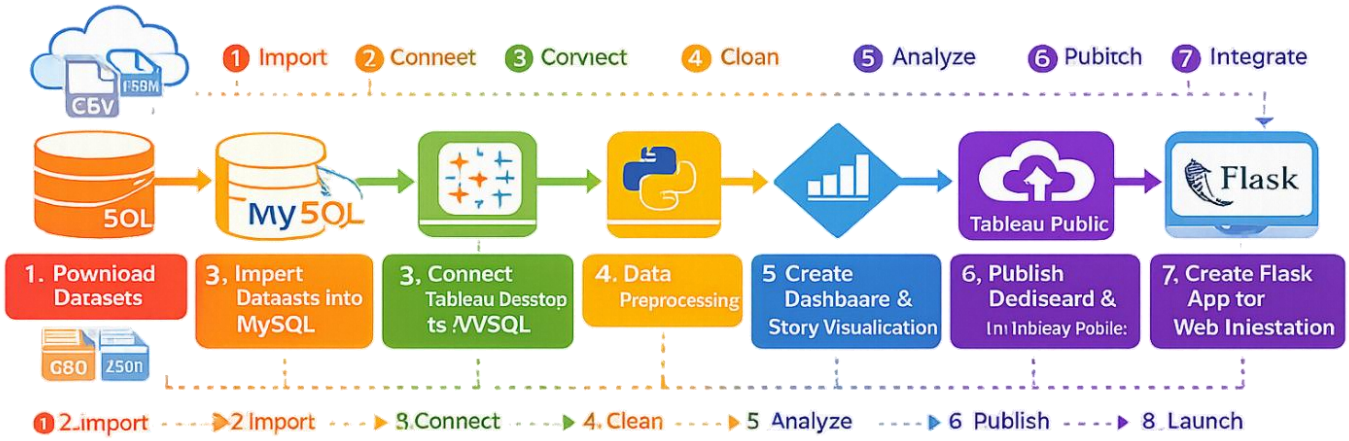
4.2 Proposed Solution

A visualization platform that integrates Tableau dashboards with a Flask website, allowing users to interact with charts and story points.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Electric vehicle users and researchers face difficulty understanding EV charging availability and vehicle range due to scattered datasets and lack of centralized visualization platforms. Existing tools provide static reports rather than interactive analysis, making decision-making slow and complex.
2.	Idea / Solution description	Develop an interactive web-based visualization tool using Flask and Tableau that analyzes EV charging stations and vehicle range data. The platform provides dynamic charts such as line graphs, stacked bars, maps, and bubble charts with filter options to help users explore EV performance and charging infrastructure efficiently.
3.	Novelty / Uniqueness	Combines EV charging infrastructure and vehicle range analysis in a single dashboard. Uses interactive filters, real-time insights, and visual storytelling instead of traditional spreadsheets or static dashboards. Designed specifically for academic and analytical use cases.
4.	Social Impact / Customer Satisfaction	Helps promote sustainable transportation by increasing awareness about EV infrastructure and performance. Enables researchers, policymakers, and users to make eco-friendly decisions through clear visual insights. Improves accessibility of EV data for non-technical users.
5.	Business Model (Revenue Model)	Freemium model with free public dashboard and premium analytics features for organizations. Potential revenue through data insights services, institutional subscriptions, and dashboard customization for EV companies or research institutions.
6.	Scalability of the Solution	The platform can scale by integrating real-time EV datasets, expanding to multiple countries, adding AI-based predictions, and supporting mobile-friendly dashboards. Cloud deployment allows easy expansion for large datasets and multiple users.

4.3 Solution Architecture

MySQL → Tableau Desktop → Tableau Public → Flask Application → User Interface.



5. PROJECT PLANNING & SCHEDULING

5.1 Project Planning

- Dataset collection and cleaning
- MySQL database integration
- Tableau sheet creation
- Dashboard and Story design
- Publishing to Tableau Public
- Flask web deployment

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	USN-1	Download EV datasets	2	High	Member 1
Sprint-1	Database Setup	USN-2	Import data into MySQL	3	High	Member 1
Sprint-1	Tableau Connection	USN-3	Connect Tableau to MySQL	2	High	Member 3
Sprint-2	Data Preprocessing	USN-4	Clean data using Tableau Prep	3	High	Member 2
Sprint-2	Visualization Creation	USN-5	Create charts & visuals	5	High	Member 3
Sprint-3	Dashboard & Story	USN-6	Build interactive dashboard	4	High	Member 3
Sprint-3	Publish Dashboard	USN-7	Publish in Tableau Public	2	Medium	Member 3

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-4	Flask Integration	USN-8	Integrate dashboard into web app	4	High	Member 4

Project Tracker, Velocity & Burndown Chart: (4 Marks)

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	9	6 Days	01 Feb 2026	06 Feb 2026	9	06 Feb 2026
Sprint-2	8	6 Days	08 Feb 2026	13 Feb 2026	8	13 Feb 2026
Sprint-3	6	6 Days	15 Feb 2026	18 Feb 2026	6	18 Feb 2026
Sprint-4	7	6 Days	19 Feb 2026	24 Feb 2026	7	24 Feb 2026

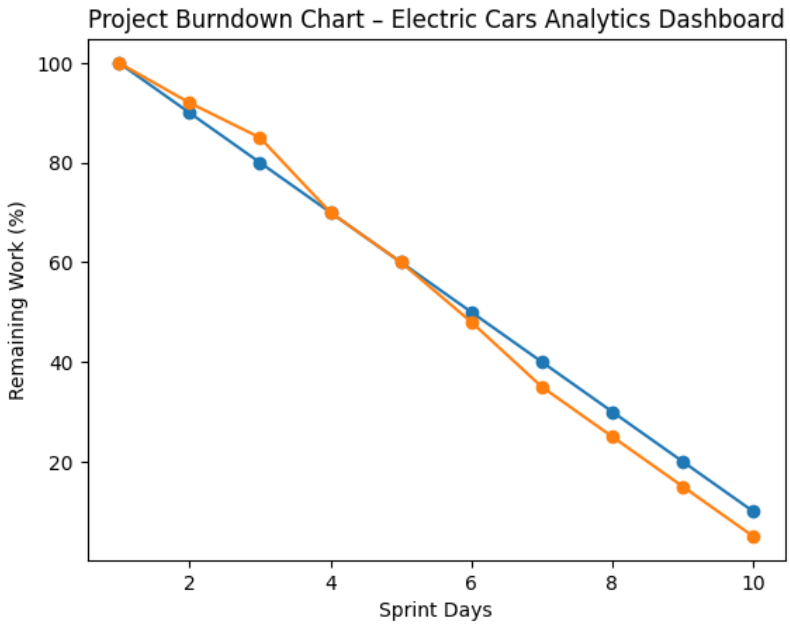
Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

Burndown Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.



The burndown chart represents the progress of the Electric Cars Analytics project over a 10-day sprint period. The ideal line shows the planned reduction of work, while the actual line represents the real progress made by the team during development.

At the beginning of the sprint, 100% of the work was pending, including data connectivity, preprocessing, sheet creation, dashboard design, story development, and Flask integration. As the project progressed, tasks such as visualization creation and publishing were completed, reducing the remaining workload gradually. The chart shows that the team maintained consistent progress and successfully completed most tasks by the end of the sprint.

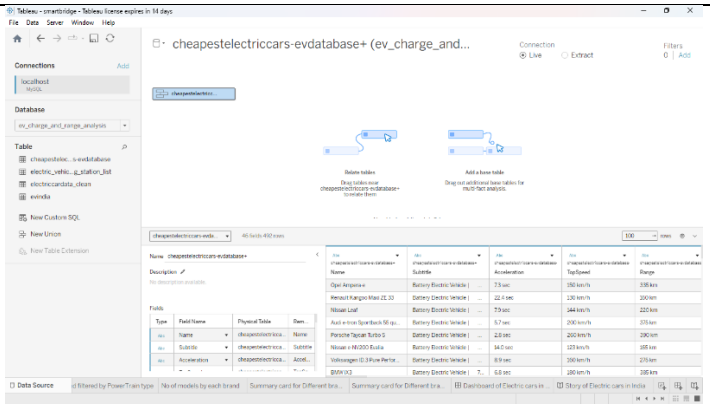
6. FUNCTIONAL AND PERFORMANCE TESTING

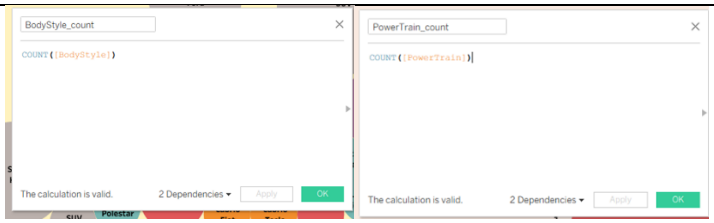
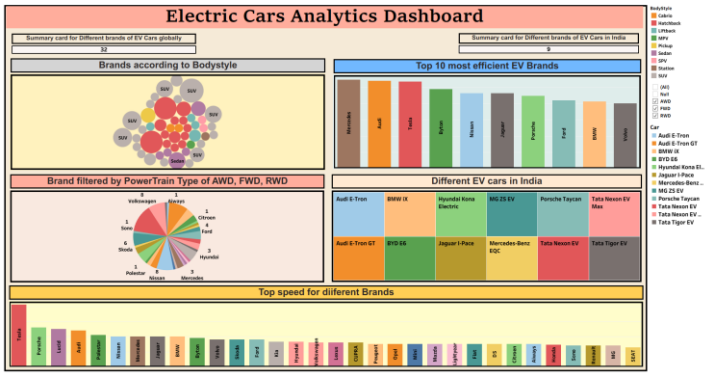
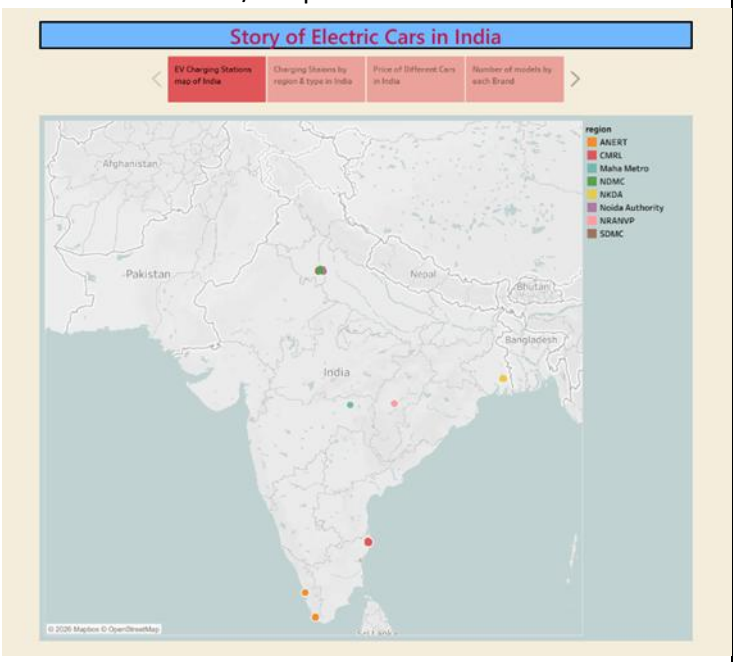
6.1 Performance Testing

- Verified database connectivity
- Tested filters and calculated fields
- Checked dashboard responsiveness
- Confirmed story navigation functionality

Model Performance Testing:

Project team shall fill the following information in model performance testing template.

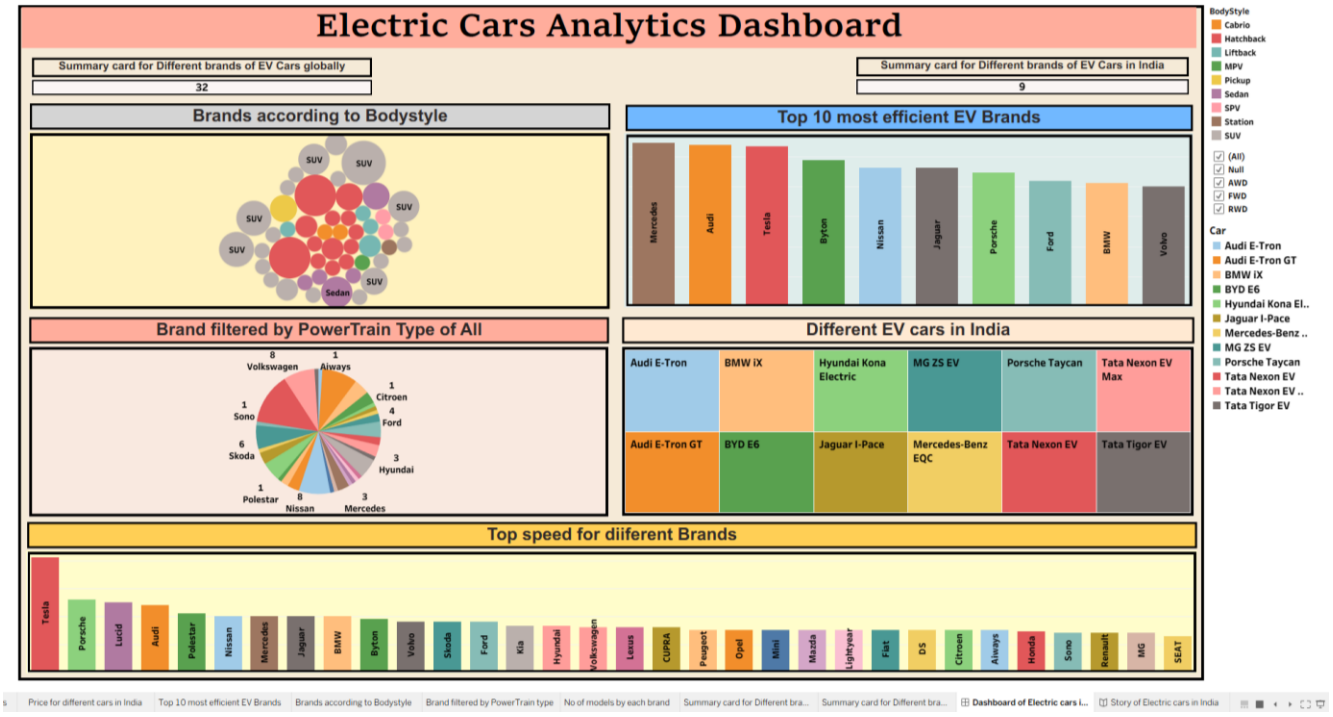
S.No.	Parameter	Screenshot / Values
1.	Data Rendered	
2.	Data Preprocessing	• Removed null values and duplicates • Renamed columns for clarity • Changed incorrect data types • Created calculated fields • Applied geographic roles • Added filters (BodyStyle, PowerTrain, Region) • Sorted and formatted data fields
3.	Utilization of Filters	Filters used: BodyStyle, Car, Brand, PowerTrain, Region. Filters applied on dashboard right panel for interactive analysis. Dynamic updates verified.

4.	Calculation fields Used	
5.	Dashboard design	No of Visualizations / Graphs - 
6	Story Design	No of Visualizations / Graphs - 

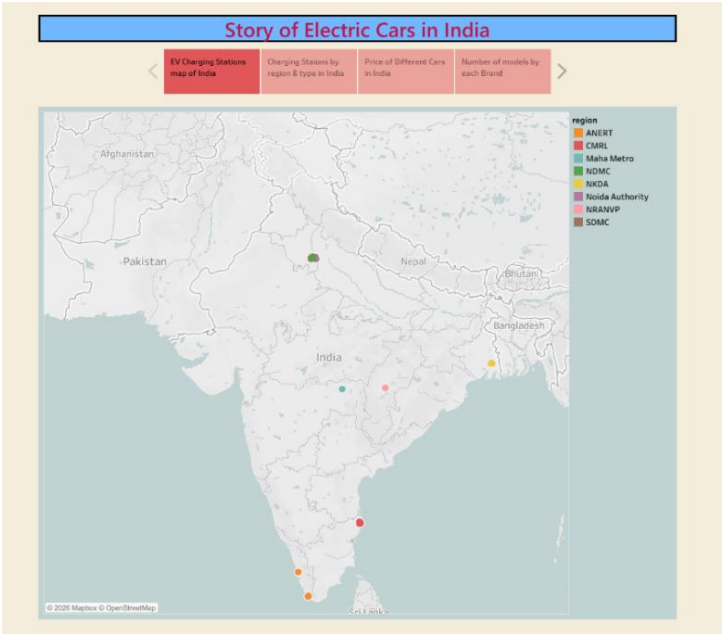
7. RESULTS

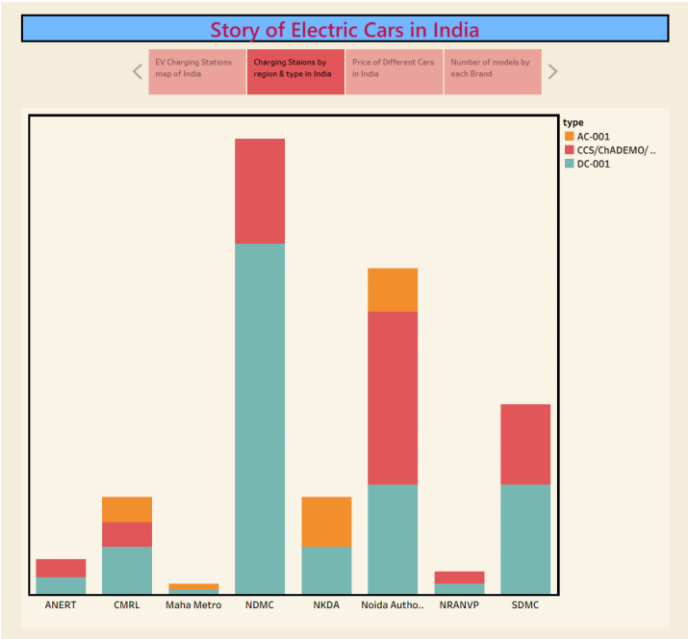
7.1 Output Screenshots

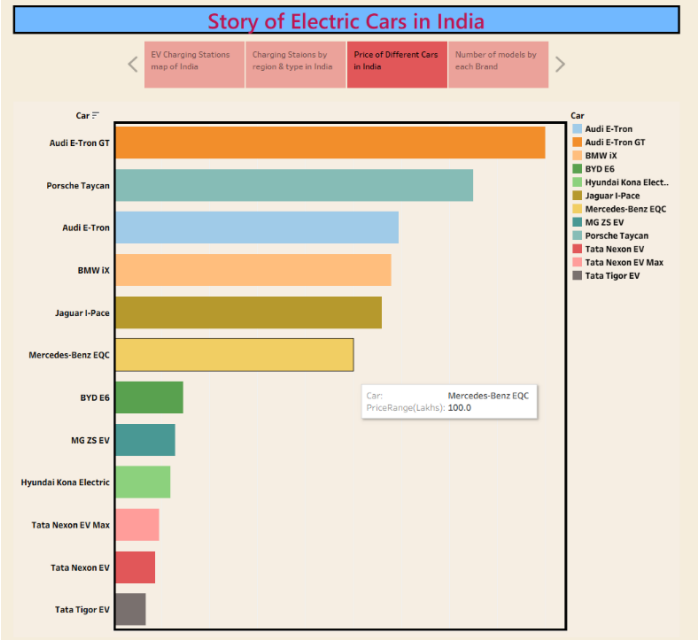
- Electric Cars Analytics Dashboard

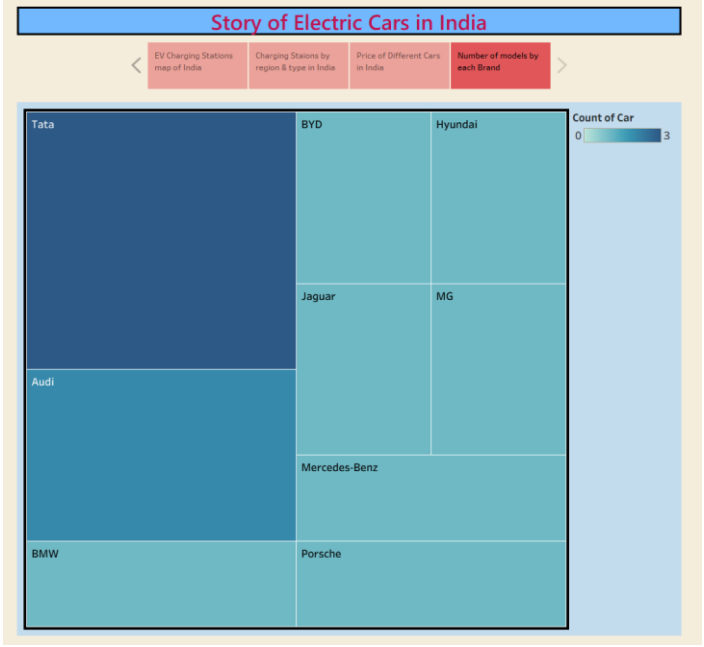


- Story of Electric Cars in India

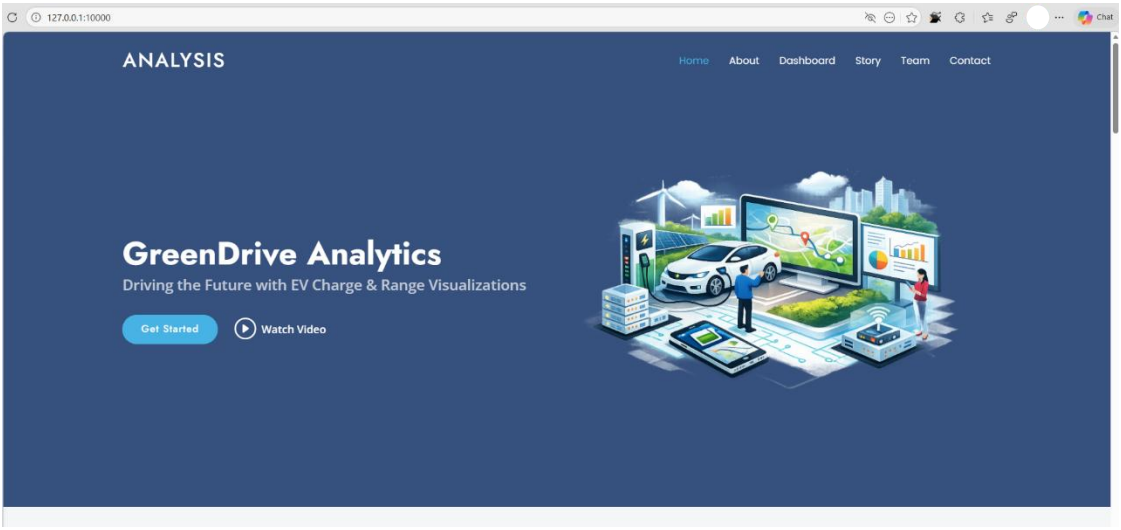








- Flask Website Interface



The dashboard successfully visualizes EV efficiency, pricing, and charging station distribution.

8. ADVANTAGES & DISADVANTAGES

Advantages

- Interactive visualization
- Easy comparison between EV brands
- Real-time dashboard filtering
- Web integration using Flask

Disadvantages

- Requires internet for Tableau Public
- Static dataset updates need manual refresh

9. CONCLUSION

The Electric Vehicle Analytics project demonstrates how visualization tools can transform raw EV datasets into meaningful insights. By integrating MySQL, Tableau, and Flask, the project provides a complete end-to-end solution for analyzing electric vehicle trends. The dashboard and story help users understand EV efficiency, pricing, and charging infrastructure effectively.

10. FUTURE SCOPE

The Electric Cars Analytics Dashboard project can be further enhanced by integrating advanced technologies and real-time data capabilities. The following improvements can be implemented in future versions to increase functionality, performance, and user experience.

1. Real-Time EV Data Integration

Currently, the project uses a static dataset for visualization. In the future, the system can be upgraded to fetch live electric vehicle data using APIs or real-time databases. This will allow automatic updates of charging stations, vehicle availability, efficiency metrics, and pricing trends. Real-time integration will make the dashboard more dynamic and useful for continuous monitoring and decision-making.

2. AI-Based Prediction Models

Machine Learning models can be integrated to predict electric vehicle trends such as battery efficiency, future pricing, charging demand, and market growth. Algorithms like regression models or classification techniques can be developed using Python libraries such as Scikit-learn or TensorFlow. This will transform the project from descriptive analytics to predictive analytics.

3. Mobile-Responsive Dashboard

The current dashboard is designed mainly for desktop viewing. In the future, responsive UI design can be implemented so that the dashboard adapts to mobile devices and tablets. This will improve accessibility and allow users to analyze EV data anytime through smartphones.

4. Advanced Analytics Using Python

Python-based analytics tools such as Pandas, Matplotlib, and Plotly can be integrated to perform deeper statistical analysis and data preprocessing. Advanced features like automated data cleaning, anomaly detection, and performance benchmarking can enhance the analytical capabilities of the project.

5. Cloud Deployment and Scalability

The project can be deployed using cloud platforms such as AWS, Azure, or Google Cloud to improve scalability and performance. Cloud hosting will enable faster loading of dashboards and support multiple users simultaneously.

6. Interactive User Personalization

Future versions can include user login systems where users can save filters, customize dashboards, and track preferred EV brands. This will make the system more interactive and user-focused.

11. APPENDIX

Source Code

- Source Code

Dataset Link

- Datasets

GitHub & Project Demo Link

📽️ Demo Video: Demo

🔗 GitHub Repository: GitHub link

🌐 Live Website: https://smartinternz-web-integration.onrender.com/