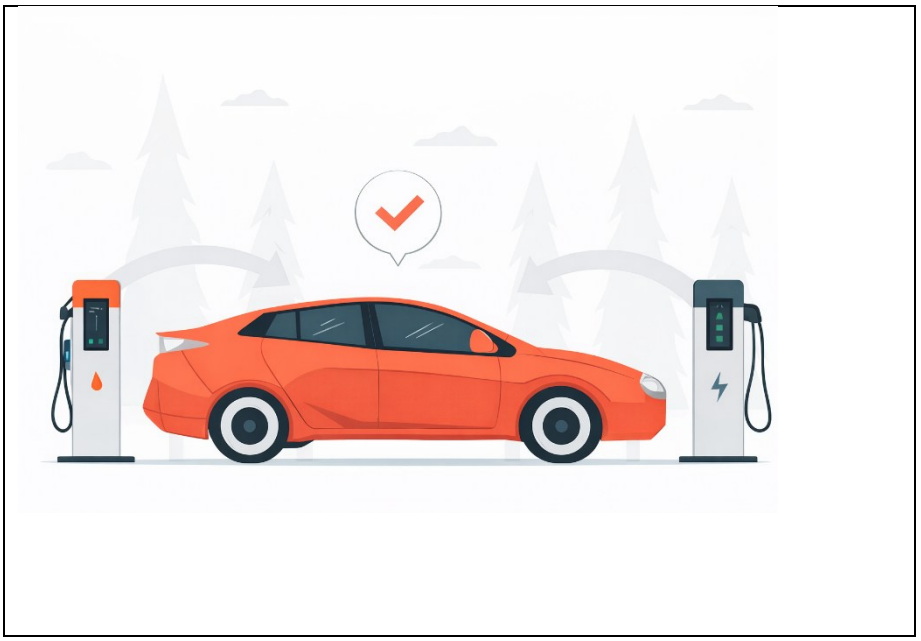
FINAL PROJECT REPORT

Visualization tool for electric vehicle charge and range analysis



A Report submitted by

Nakka Syamala (Team Leader) - 228x1a4285@khitguntur.ac.in

Koneti Anand (Team Member-1) - 228x1a4271@khitguntur.ac.in

Kanaparthi Brahmaiah (Team Member-2) - 228x1a42b0@khitguntur.ac.in

MorlaSivaNagaManikanta (Team Member-3) 228x1a4281@khitguntur.ac.in

TEAM ID: LTVIP2026TMIDS40575

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Project Overview

The project titled **"Visualization Tool for Electric Vehicle Charge and Range Analysis"** is developed to analyze electric vehicle performance using data visualization techniques. The system uses Tableau to create interactive dashboards and stories that help users understand EV range, battery capacity, charging time, and price comparison.

The project connects publicly available EV datasets in CSV format and transforms them into meaningful visual insights.

The dashboard developed in this project provides visual insights into important EV parameters including battery capacity (kWh), driving range (km), charging time, price comparison, and distribution of charging stations. By presenting the data in the form of bar charts, line graphs, maps, and comparison charts, the system allows users to easily understand and compare electric vehicle performance.

1.2 Purpose

The primary purpose of this project is to develop an interactive visualization tool that helps users analyze and compare electric vehicle performance parameters effectively. Many users find it difficult to interpret raw EV data presented in tables or technical specifications. Therefore, this project aims to transform complex numerical data into clear and meaningful visual insights.

The specific objectives of this project include:

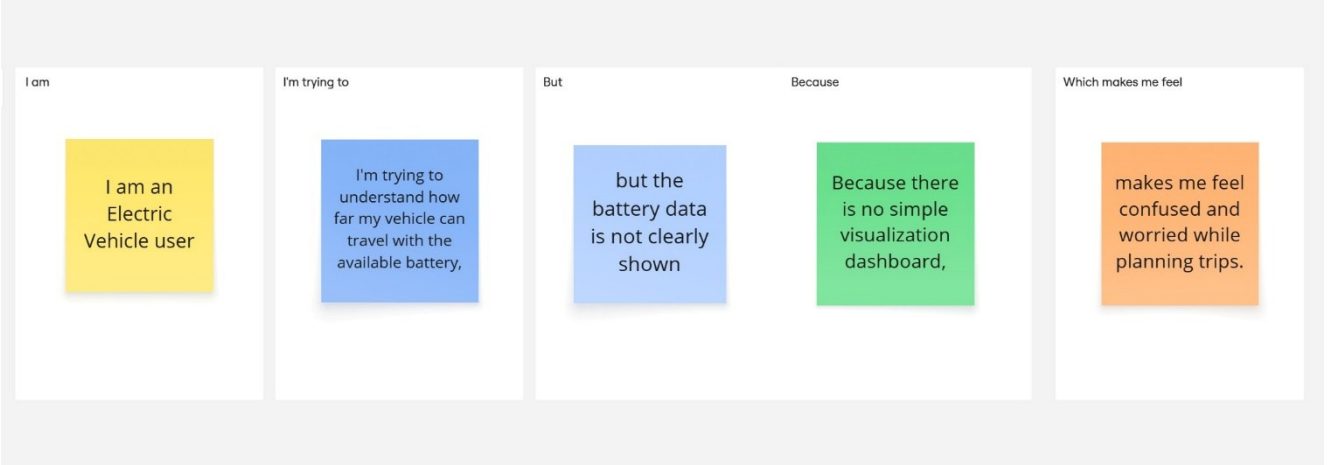
- To collect and integrate electric vehicle datasets from publicly available sources.
- To clean and preprocess the data to ensure accuracy and consistency.
- To design an interactive Tableau dashboard for EV charge and range analysis.
- To implement filters and calculated fields for dynamic data exploration.
- To create a structured story that presents insights in a logical sequence.
- To demonstrate the use of data visualization techniques for decision-making support.

This project not only helps users understand electric vehicle specifications more easily but also showcases the importance of data analytics tools like Tableau in solving practical problems. By converting raw data into visual dashboards, the project supports informed decision-making and enhances user experience.

2. IDEATION PHASE

2.1 Problem Statement

Electric vehicle users often face difficulty in understanding battery capacity, charging time, and actual driving range. There is no simple visual system that clearly compares EV performance parameters in one place.



Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	I am an Electric Vehicle user	I'm trying to understand how far my vehicle can travel with the available battery	But the battery data and range information are not clearly presented	Because most tools show complex technical details instead of simple visuals	Which makes me feel confused and worried about planning trips.
PS-2	I am a daily commuter using an EV	I'm trying to find charging stations and plan my travel efficiently	But the information about charging locations and battery usage is scattered	Because there is no single dashboard that shows clear insights	which makes me feel anxious about battery drain and delays.

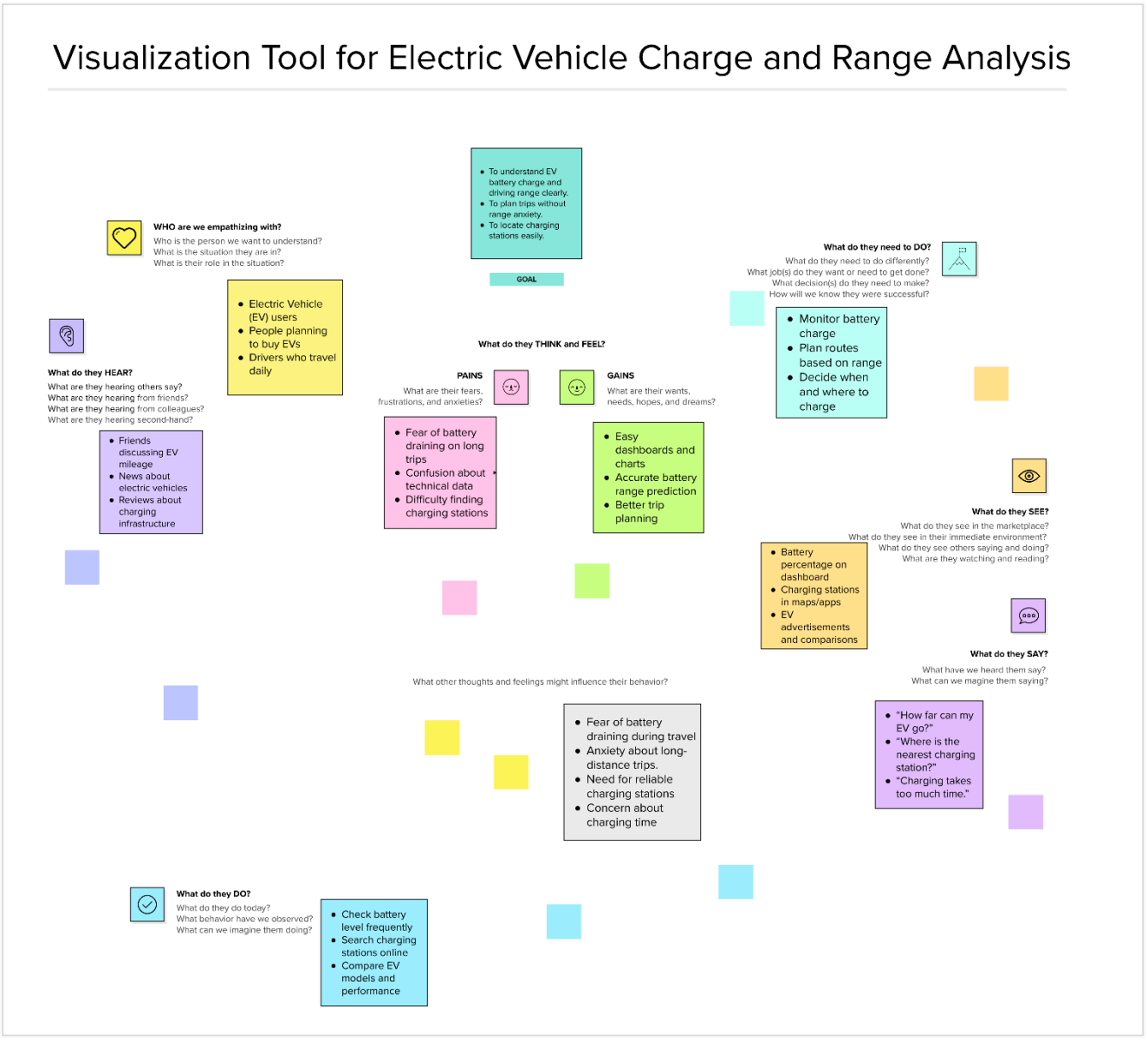
2.2 Empathy Map Canvas

User Thinks:
- Which EV gives better range?
- How long does charging take?

User Feels:
- Confused about technical specifications
- Needs simple comparison

User Says:
- I want easy comparison
- I need clear visual insights

User Does:
- Searches EV details online
- Compares different models manually

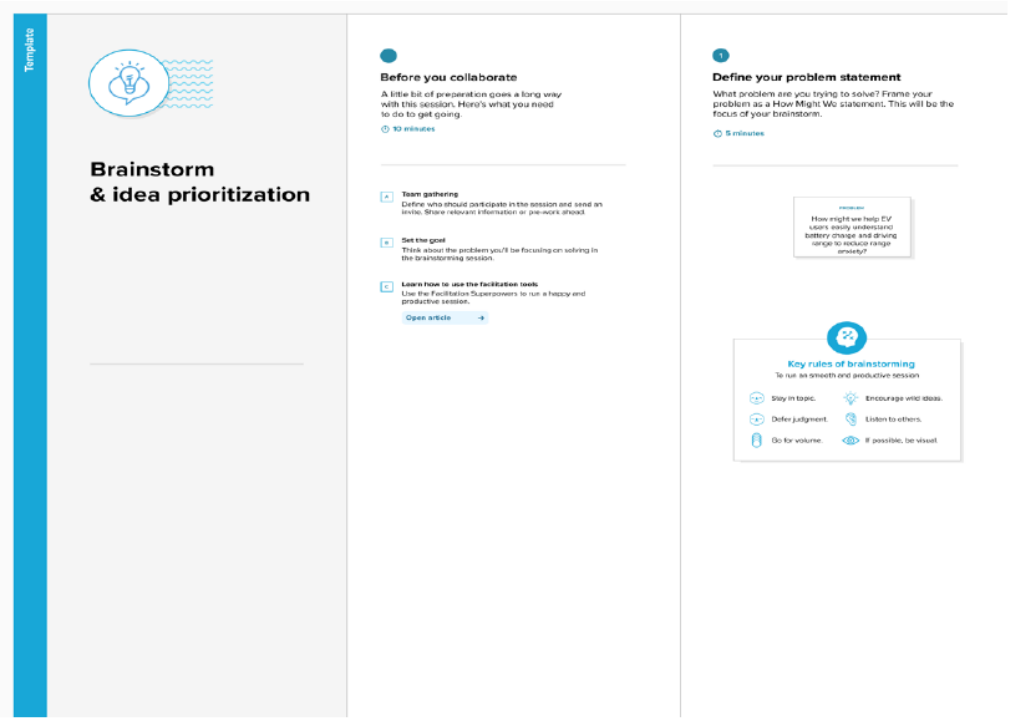


2.3 Brainstorming

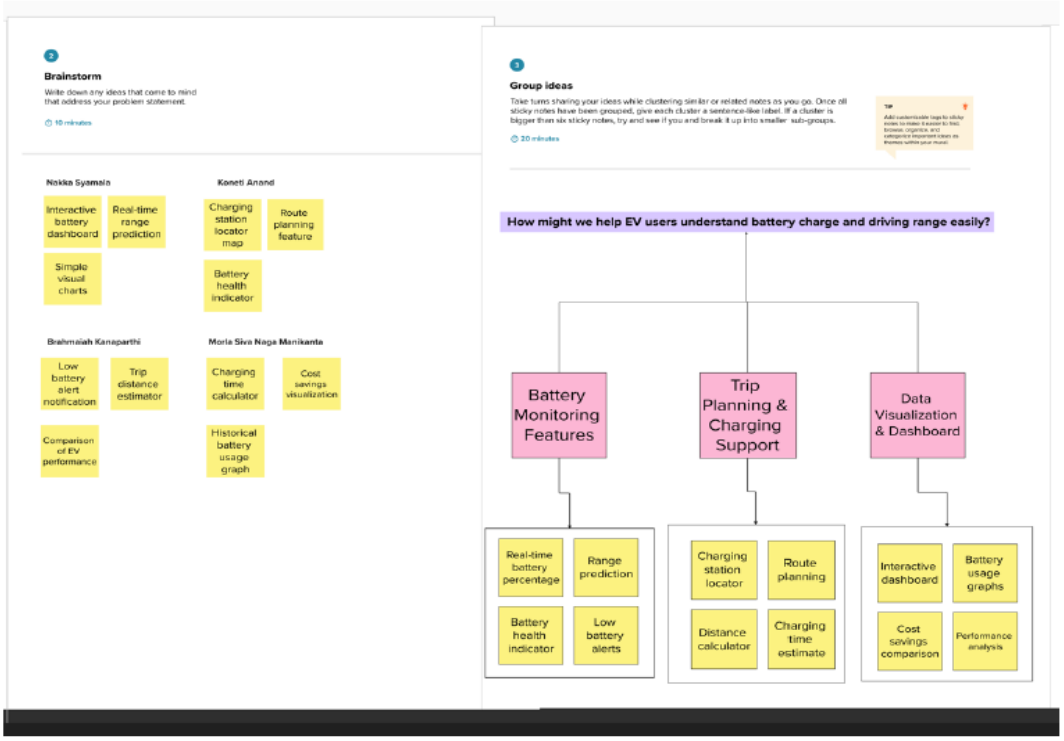
The team discussed various ideas such as:

- Comparing EV models
- Range vs charging time analysis
- Battery efficiency comparison
- Charging station availability visualization

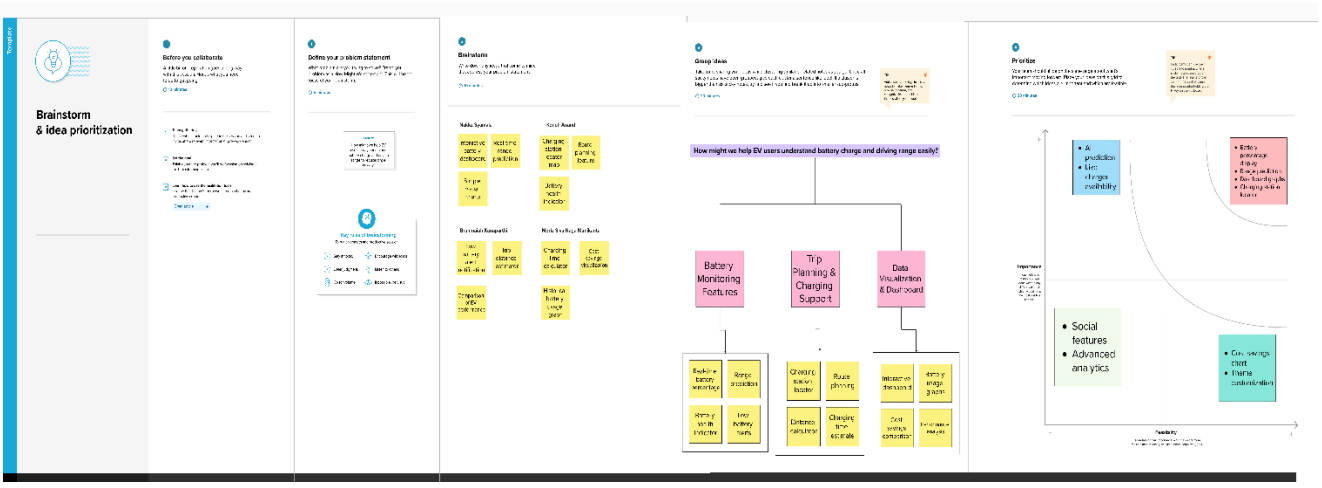
Step-1: Team Gathering, Collaboration and Select the Problem Statement



Step-2: Brainstorm, Idea Listing and Grouping



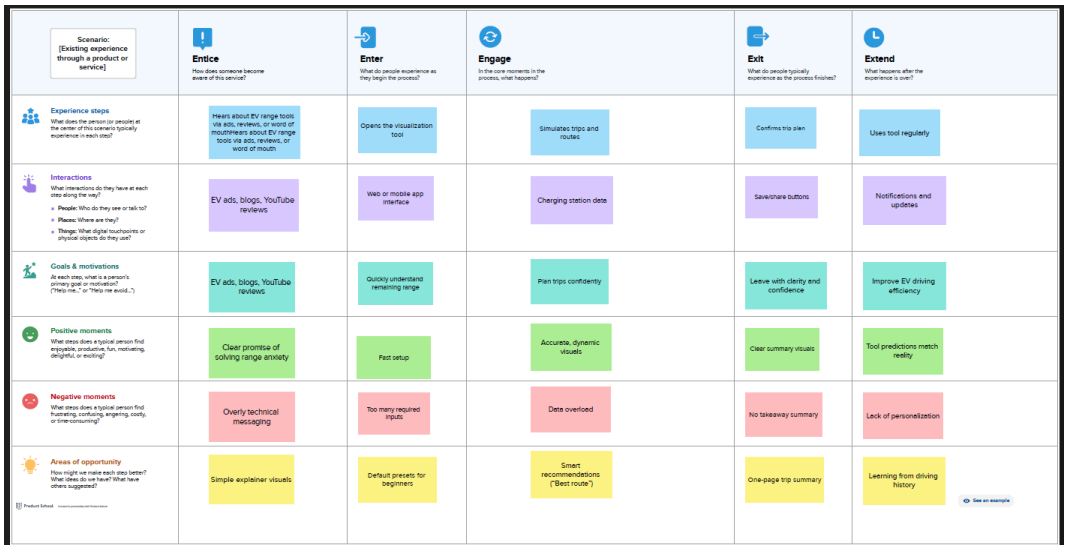
Step-3: Idea Prioritization



3. REQUIREMENT ANALYSIS

3.1 Customer Journey Map

1. User selects EV model
2. User checks battery capacity
3. User compares charging time
4. User analyzes driving range
5. User makes decision



3.2 Solution Requirement

Functional Requirements:

- Display EV model comparison
- Show battery and range analysis
- Provide interactive filters
- Generate visual dashboard and story

Functional Requirements:

Following are the functional requirements of the proposed solution

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Dataset Upload & Integration	Upload EV dataset (CSV/Excel) Connect dataset to Tableau
FR-2	Data Cleaning & Processing	Remove missing/null values Format columns (Range, Battery Capacity, Charging Time) Filter incorrect or duplicate data
FR-3	Data Visualization Dashboard	Display charts (Bar chart, Pie chart, Line chart) Show EV range comparison Show charging time analysis
FR-4	User Interaction	Apply Filters like vehicle type , range View dashboards
FR-5	Data Analysis	Compare EV efficiency Identify high range EV models
FR-6	Report Viewing	View dashboards on web browser Access dashboard through Tableau Public

Non-Functional Requirements:

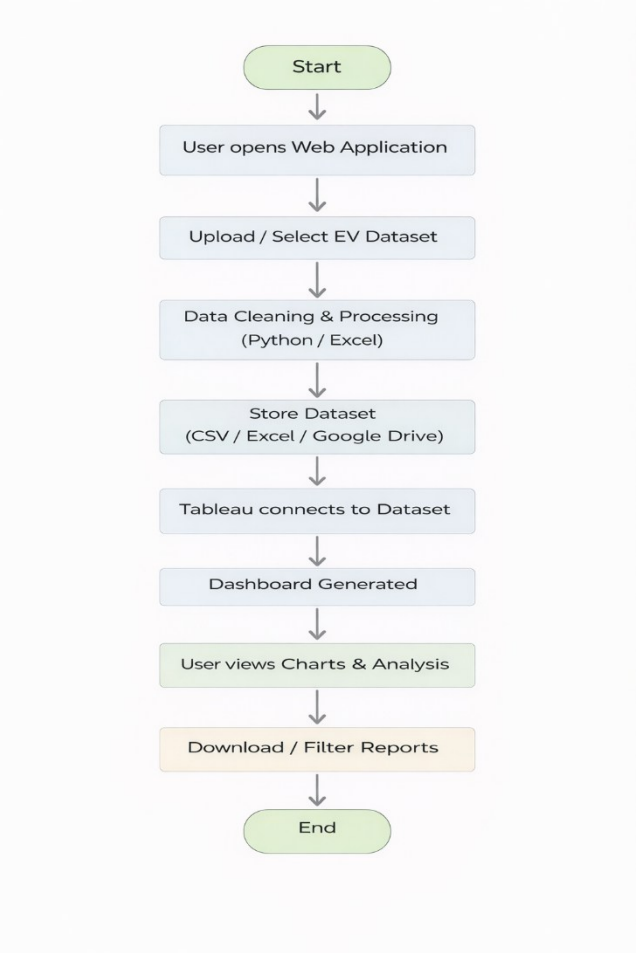
- Easy to use
- Fast data rendering
- Clear visualization

Non-functional Requirements:

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

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The dashboard should be simple, user-friendly, and easy to understand.
NFR-2	**Security**	Dataset access controlled through Google Drive & Tableau Public permissions.
NFR-3	**Reliability**	System should correctly display EV data without errors or data loss.
NFR-4	**Performance**	Dashboard should load within few seconds after dataset optimization.
NFR-5	**Availability**	Dashboard available 24/7 through cloud hosting (Tableau Public).
NFR-6	**Scalability**	System should support adding more EV datasets in future without redesigning architecture.

3.3 Data Flow Diagram



3.4 Technology Stack

- Tableau (Data Visualization)
- Microsoft Excel (Data Cleaning)
- CSV Files (Dataset Storage)

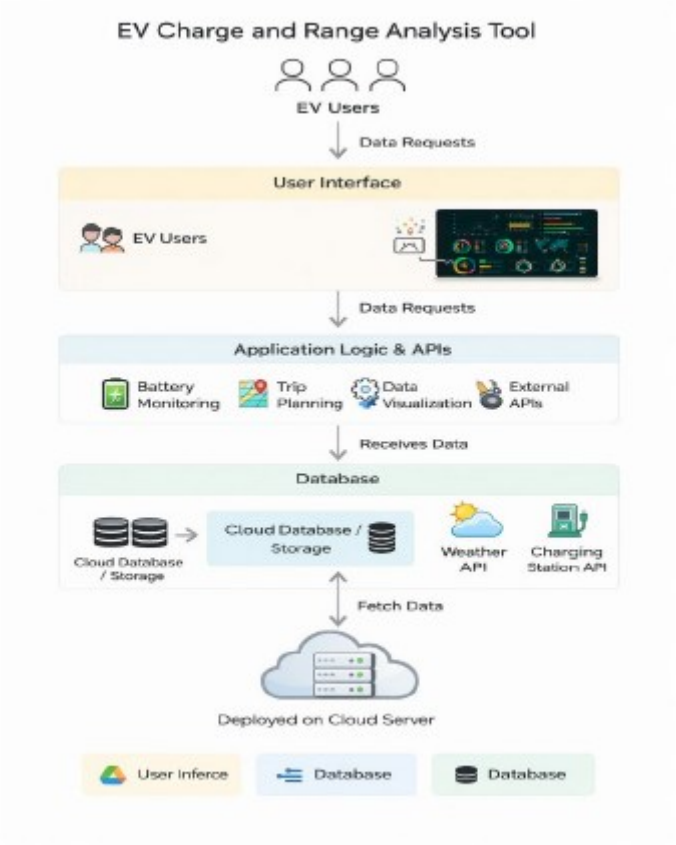


Table-1 :

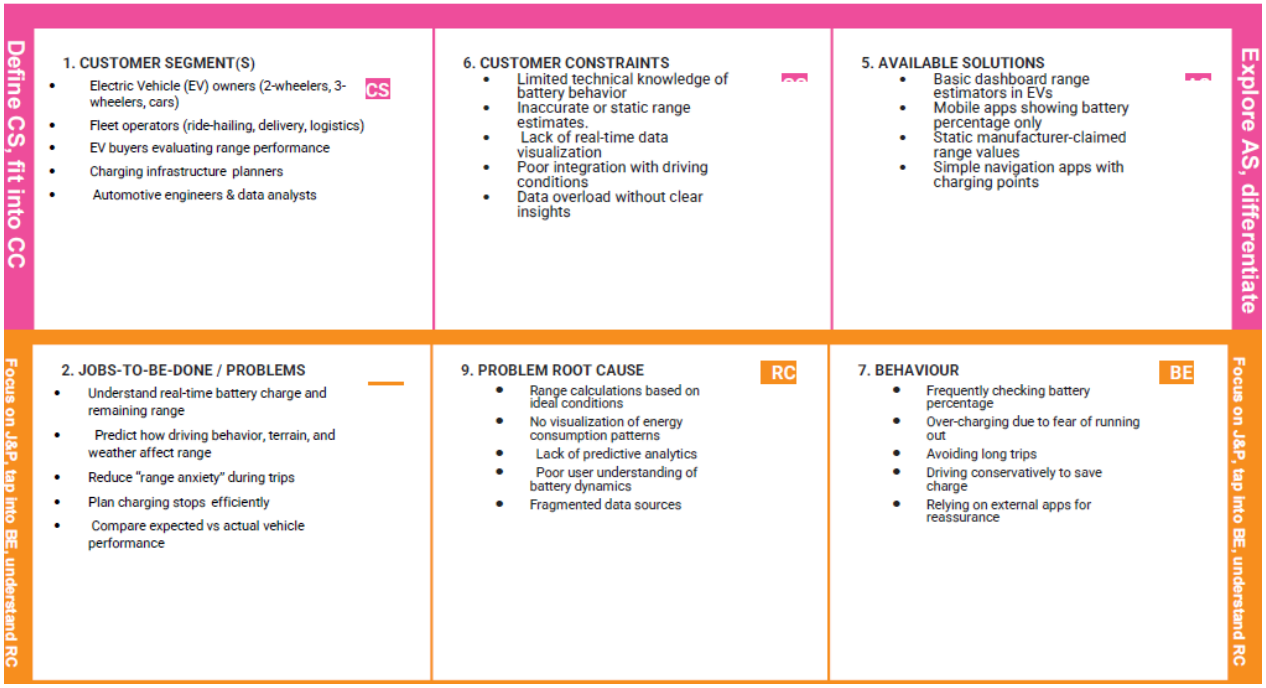
Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	Users interact through a web-based dashboard to view EV charge & range insights.	HTML, CSS, JavaScript
2.	Application Logic-1	Handles data processing and transformation before visualization.	Python
3.	Application Logic-2	Data cleaning and preprocessing (removing nulls, formatting columns, filtering).	MS excel / Python (pandas)
4.	Application Logic-3	Data aggregation & calculations (range comparison, efficiency metrics) .	python
5.	Database	Stores structured EV dataset.	CSV / Excel files
6.	Cloud Database	Cloud-based Storage for dataset sharing.	Google Drive
7.	File Storage	Local system storage for dataset files.	Local File System
8.	External API-1	EV dataset collection from public open data portals.	Public Open Data APIs
9.	External API-2	Fetch charging station locations.	Google Maps API
10.	Machine Learning Model	Not Implemented	Not Applicable
11.	Infrastructure (Server / Cloud)	Deployment of dashboard.	Tableau Public

4. PROJECT DESIGN

4.1 Problem Solution Fit

The solution directly addresses the problem by providing:
- Clear visual comparison of EV models
- Interactive filters for better analysis
- Easy understanding of charging and range



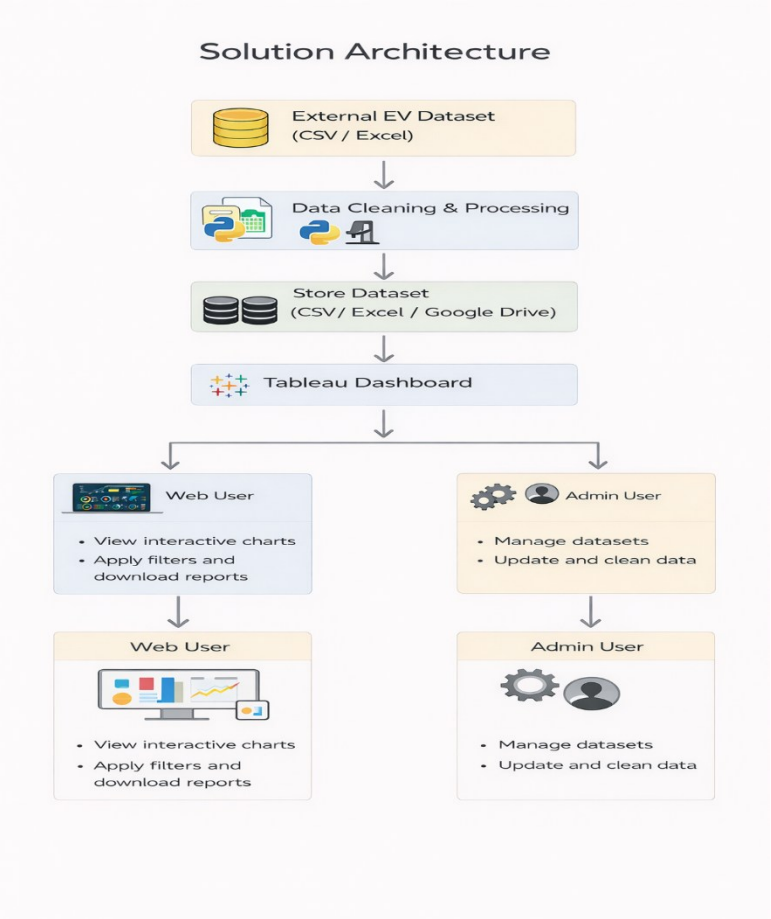
4.2 Proposed Solution

A Tableau-based visualization system that:

- Connects EV dataset
- Cleans and preprocesses data
- Creates dashboards and stories
- Provides interactive analysis

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Electric vehicle users and researchers often find it difficult to analyze charging time, battery range, and performance data because the information is scattered and not presented in an easy-to-understand format. There is a need for a system that can clean, analyze, and visualize EV data clearly.
2.	Idea / Solution description	The proposed solution is a visualization tool that collects EV datasets, cleans the data using Excel/Python, and creates interactive dashboards in Tableau. Users can view charging trends, range comparisons, and performance insights through charts and filters.
3.	Novelty / Uniqueness	➢ Combines data cleaning, analysis, and visualization in one workflow ➢ Interactive dashboards for better understanding of EV performance ➢ Easy-to-use interface for students and researchers
4.	Social Impact / Customer Satisfaction	➢ Helps people understand electric vehicles better ➢ Supports awareness of eco-friendly transportation ➢ Useful for students, researchers, and EV users to analyze trends easily
5.	Business Model (Revenue Model)	➢ Free dashboard for basic users ➢ Advanced analytics or customized reports can be offered as a paid service ➢ Can be used by automobile companies or research organizations
6.	Scalability of the Solution	➢ Can handle larger datasets in the future ➢ Can be extended to real-time EV data ➢ Can integrate cloud storage and web dashboards for multiple users.

4.3 Solution Architecture



Dataset (CSV)

↓

Excel Data Cleaning

↓

Tableau Data Import

↓

Dashboard & Story Creation

↓

User Interaction

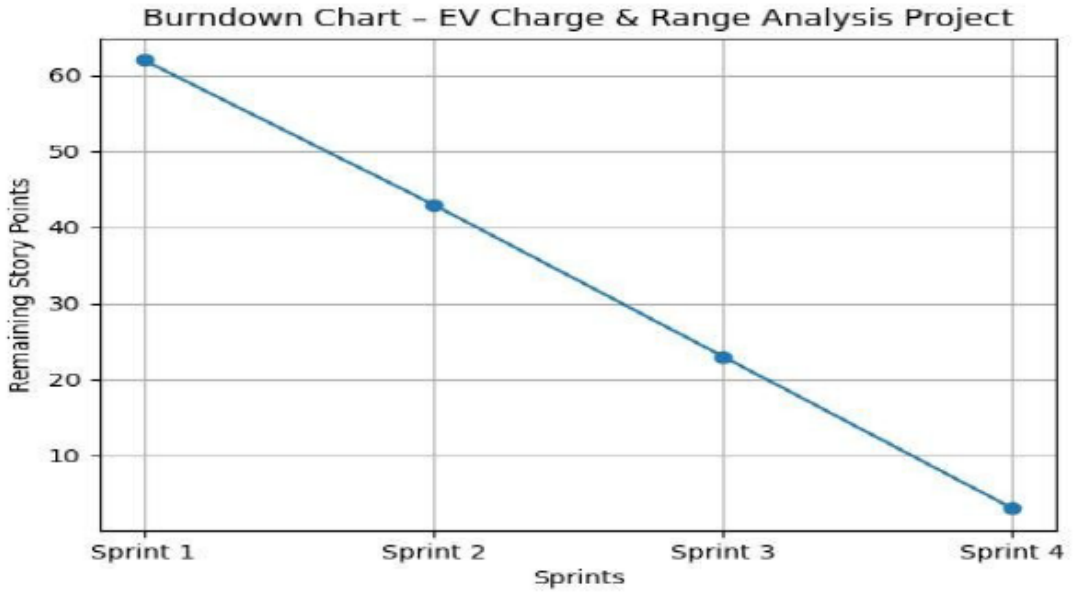
5. PROJECT PLANNING & SCHEDULING

5.1 Project Planning

The project was divided into four sprints:

- Sprint 1: Data Collection & Cleaning
- Sprint 2: Range Calculation
- Sprint 3: Dashboard Development
- Sprint 4: Story & Reporting

Velocity = 77 ÷ 4 = 19.25 story points per sprint



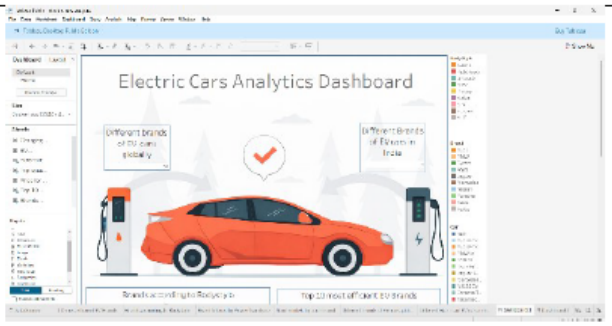
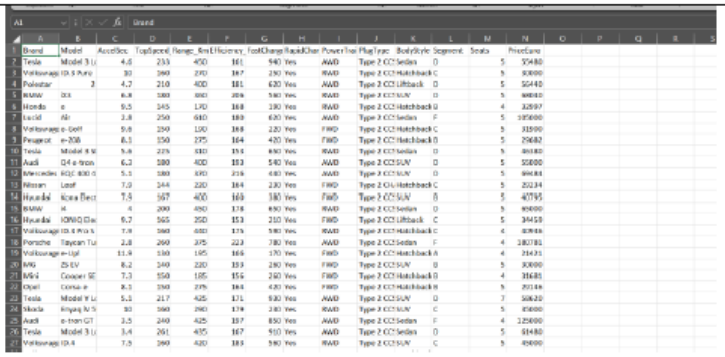
Project Tracker, Velocity & Burndown Chart:(4Marks)

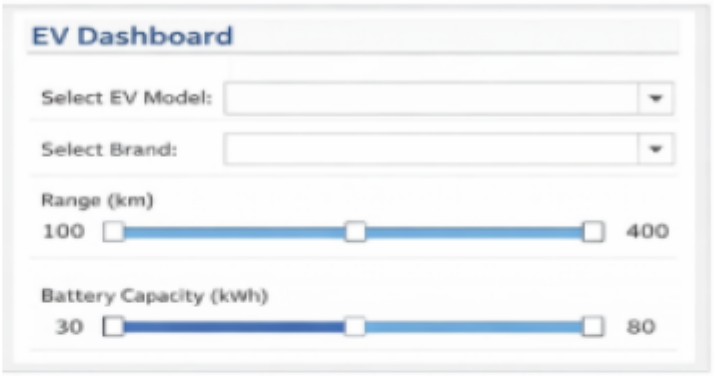
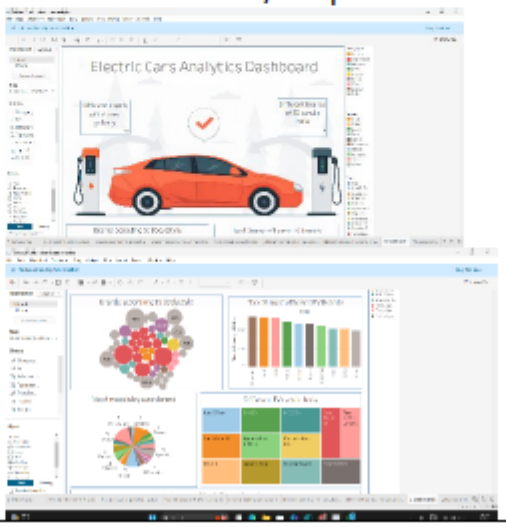
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6Days	2 February2026	7 February2026	18	7 February2026
Sprint-2	20	6Days	9 February2026	14 February2026	19	14 February2026
Sprint-3	20	6Days	16 February2026	21 February2026	20	21 February2026
Sprint-4	20	6Days	23 February2026	28 February2026	20	28 February2026

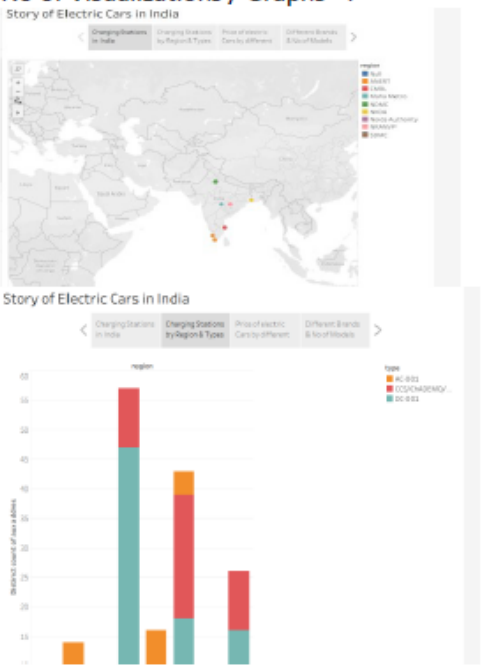
6. FUNCTIONAL AND PERFORMANCE TESTING

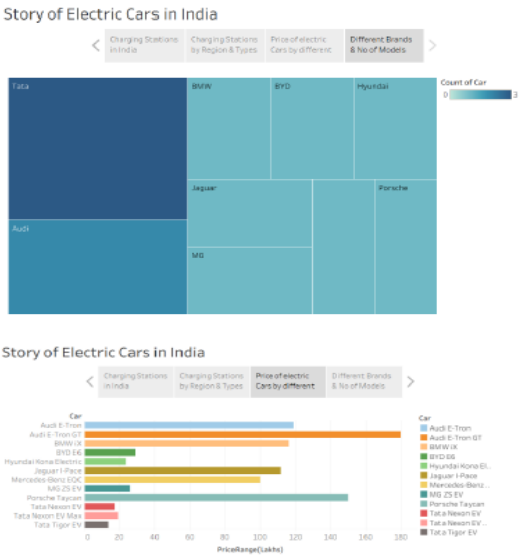
6.1 Performance Testing

- Data rendered successfully without errors
- Filters respond dynamically
- Calculated fields work correctly
- Dashboard loads efficiently
- Story presents insights clearly

S.No.	Parameter	Screenshot / Values
1.	Data Rendered	 The dashboard successfully renders EV data including vehicle model, battery capacity (kWh), charging time, price, and driving range (km). The data is visualized using charts and map representations for better understanding.
2.	Data Preprocessing	 Data was cleaned before visualization by removing null values and duplicate records. Column names were standardized and units such as km and kWh were formatted properly to ensure consistency and accuracy.

3.	Utilization of Filters	 Interactive filters were implemented in the dashboard to allow users to analyze data based on EV model, brand, range, and battery capacity. These filters enable dynamic and customized data exploration.
4.	Calculation fields Used	 Calculated fields were created in Tableau to perform additional analysis such as average range and efficiency comparison. These calculated fields improve analytical insights and dashboard performance.
5.	Dashboard design	No of Visualizations / Graphs – 6 

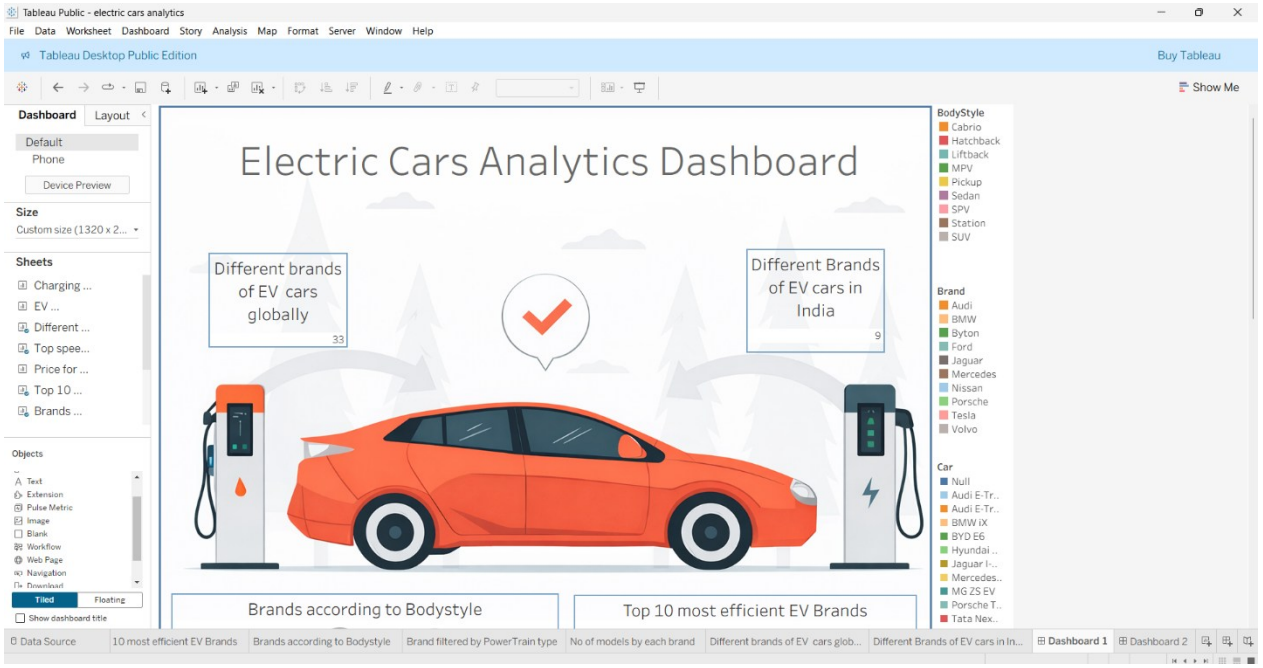
		 The dashboard combines multiple visualizations to provide a clear overview of EV charge and range analysis
6	Story Design	No of Visualizations / Graphs -4 

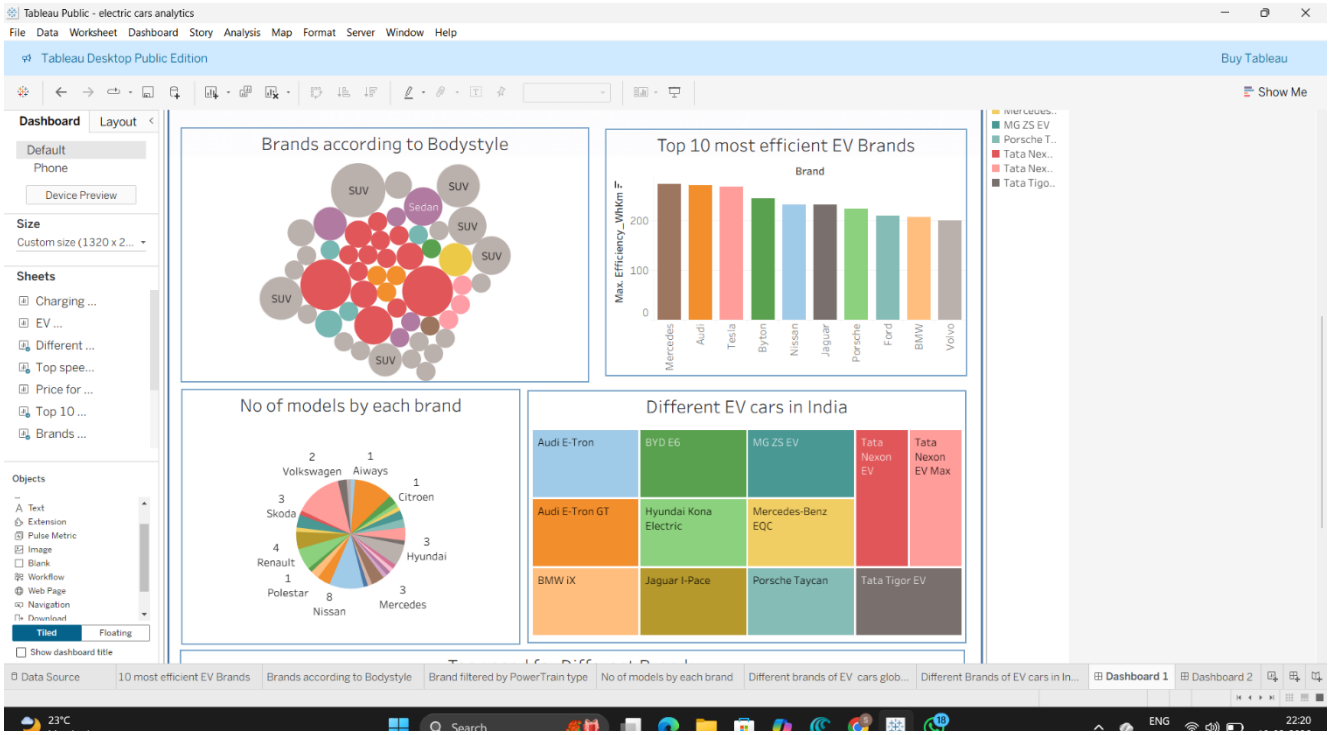
		 A Tableau story was created to present insights in a step-by-step manner. It includes range overview, charging analysis, station distribution, and key observations.

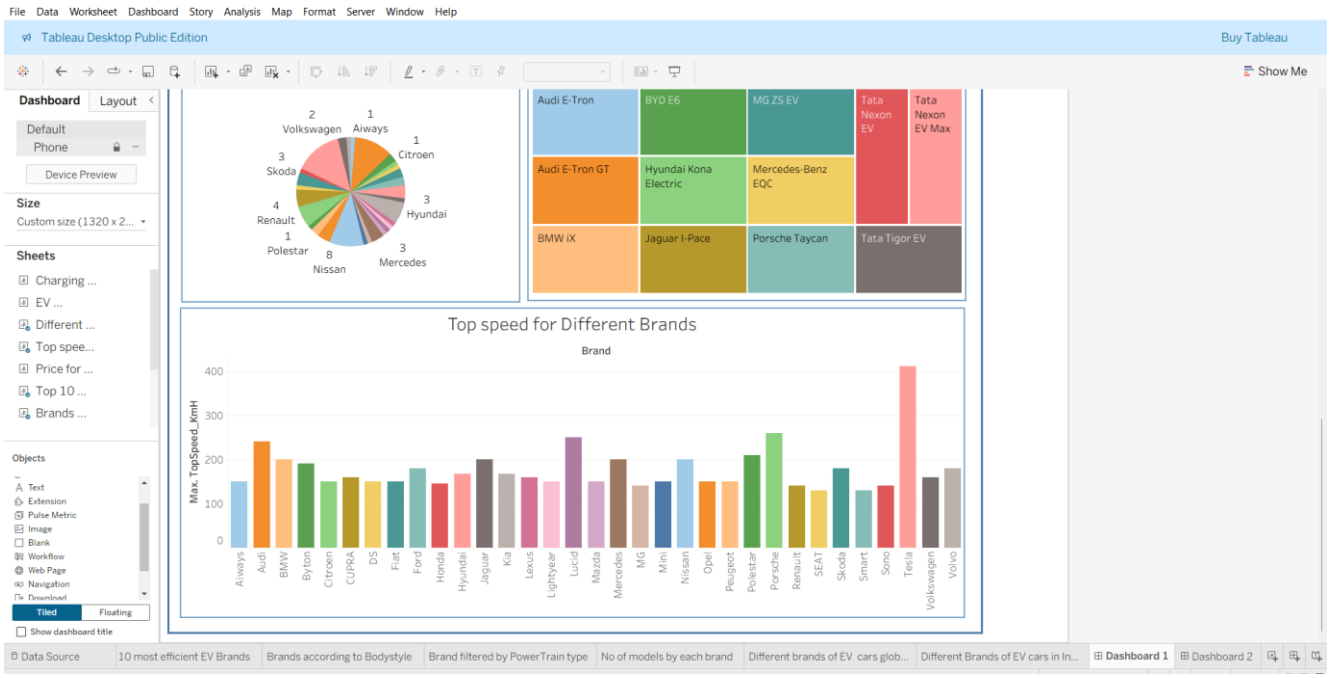
7. RESULTS

7.1 Output Screenshots

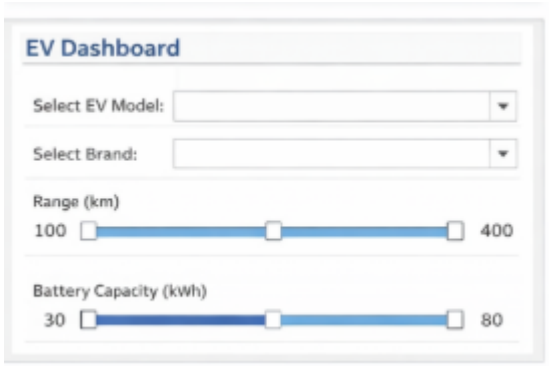
- **Dashboard Screenshot**



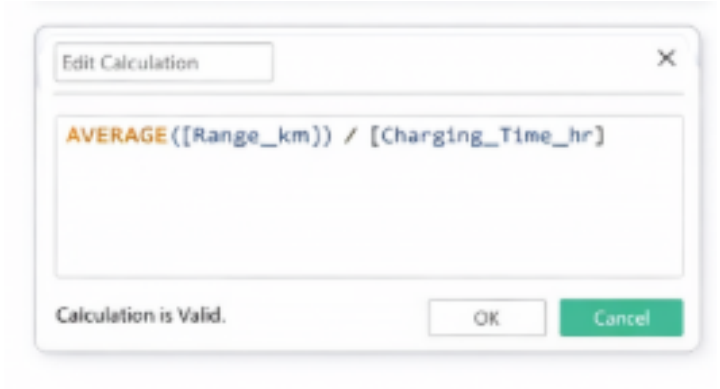




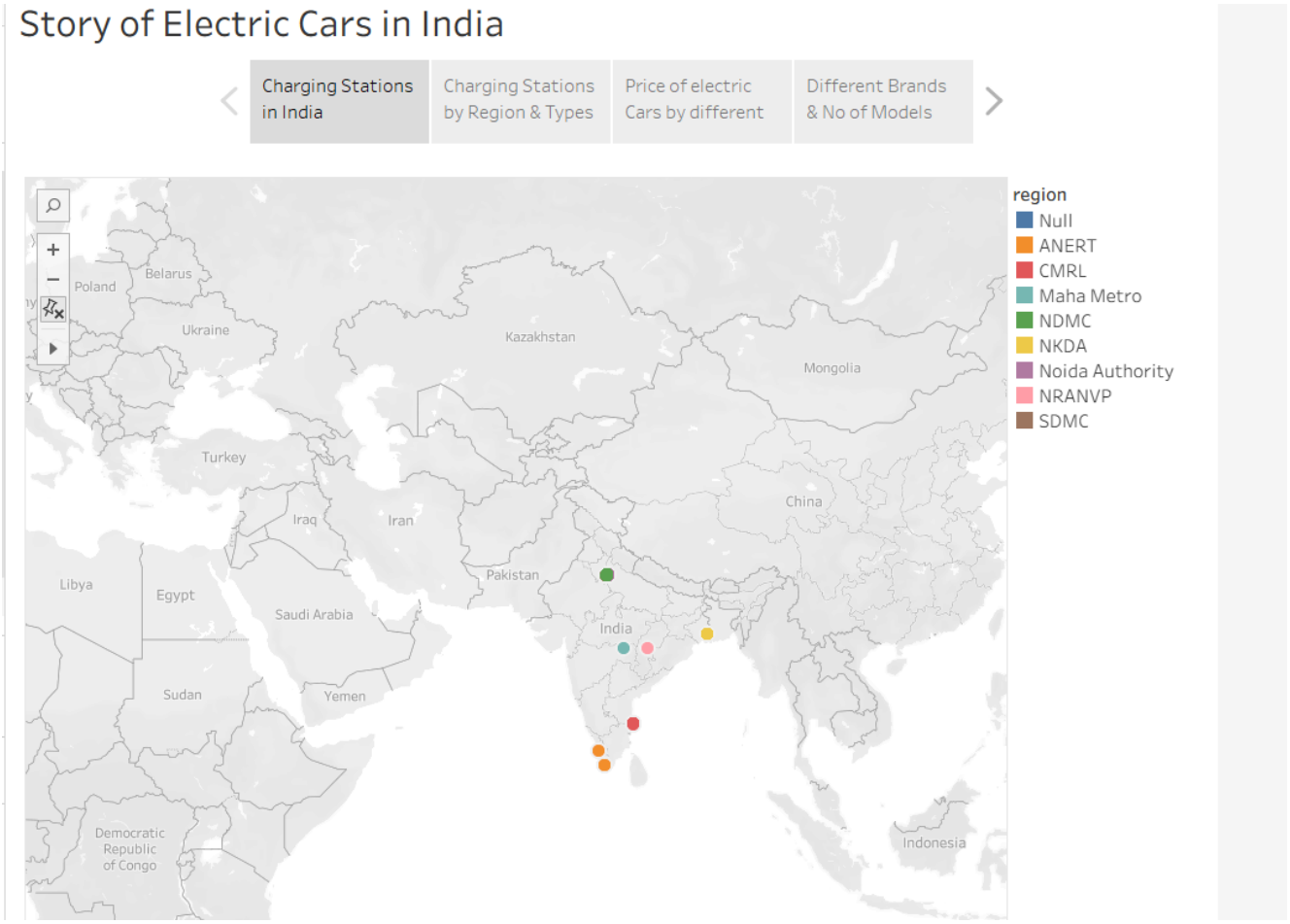
- **Filter Screenshot**

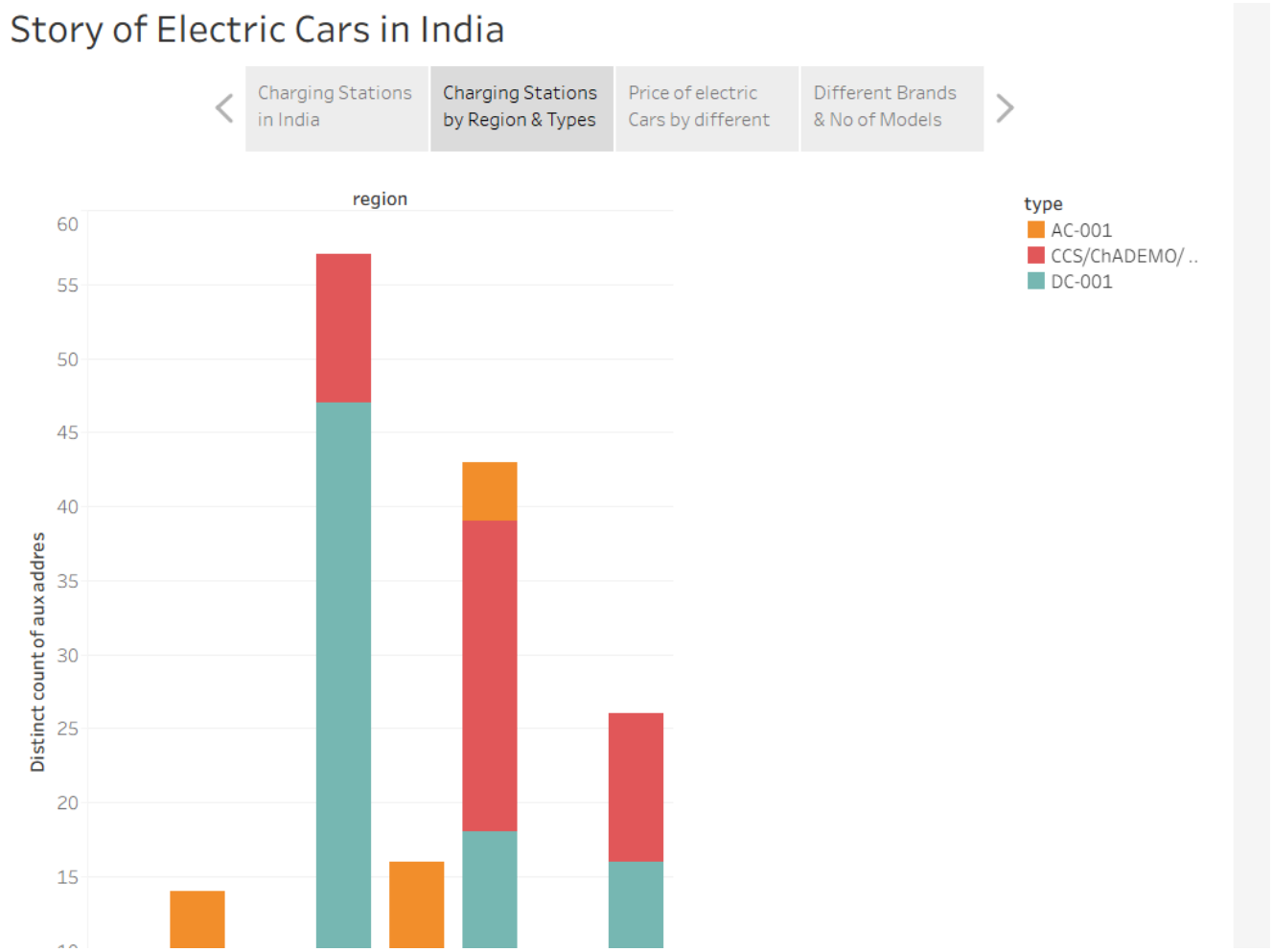


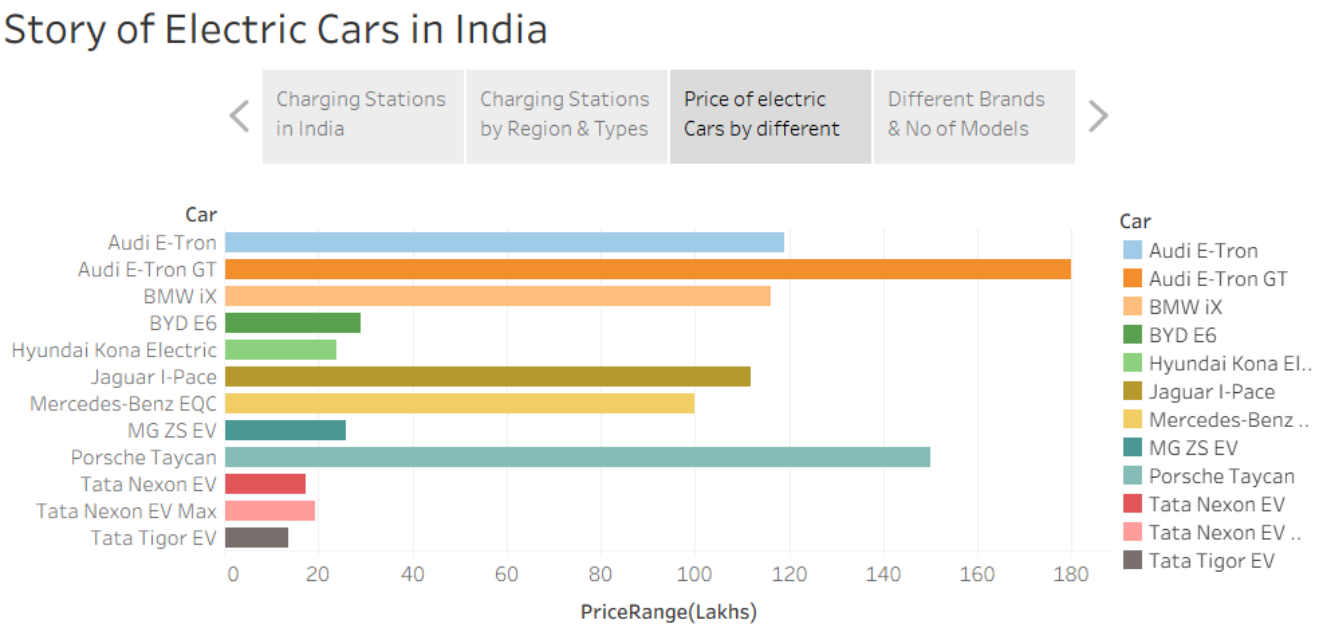
- **Calculated Field Screenshot**

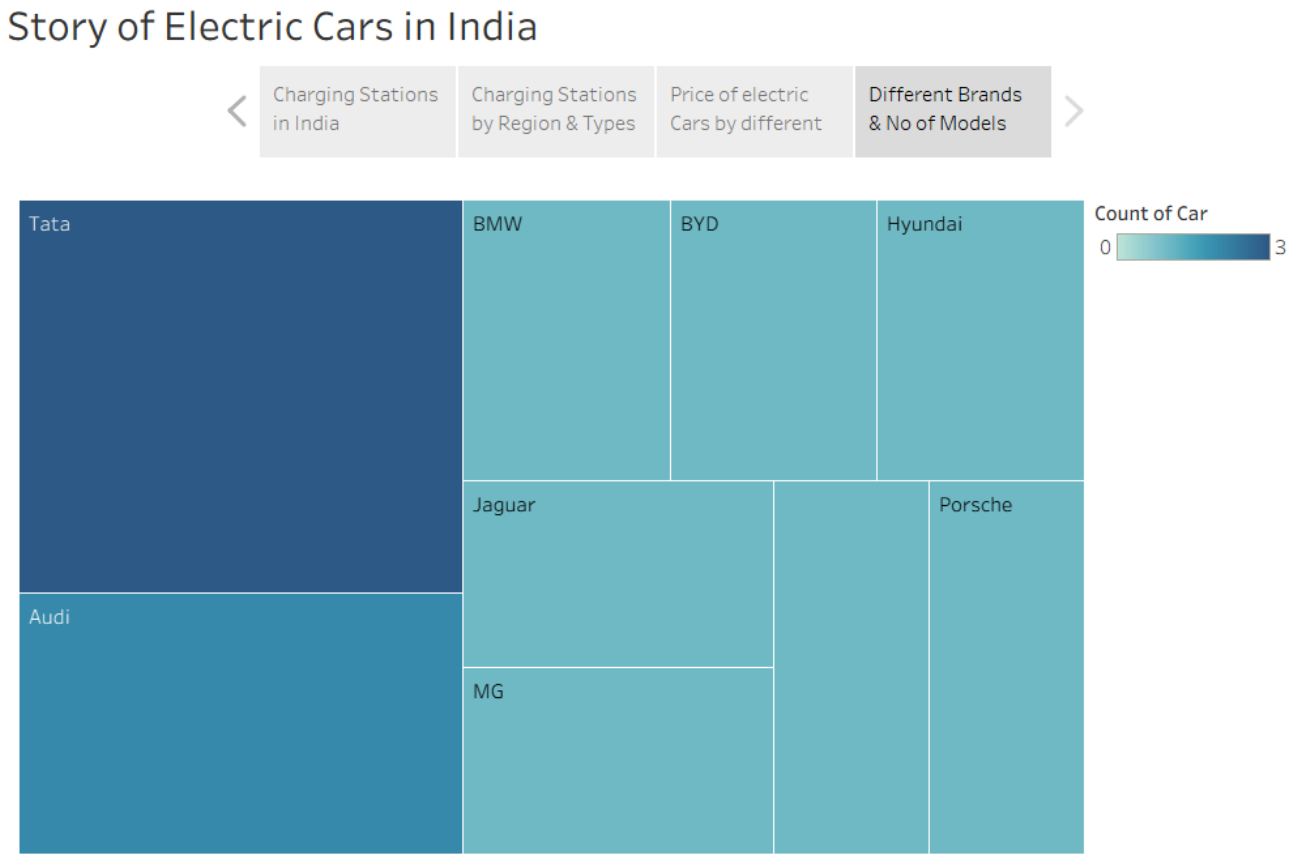


- **Story Screenshot**









The results show successful visualization of EV charge and range analysis.

8. ADVANTAGES & DISADVANTAGES

Advantages:

- Easy comparison of EV models
- Interactive and user-friendly
- Clear graphical insights

Disadvantages:

- Depends on dataset accuracy
- Limited to available EV data

---

9. CONCLUSION

The project successfully demonstrates the use of data visualization techniques to analyze electric vehicle performance. The dashboard and story provide meaningful insights into EV battery capacity, charging time, and driving range. The system is interactive, informative, and useful for decision-making.

---

10. FUTURE SCOPE

- Integration of **real-time electric vehicle data** using APIs instead of static CSV files.
- Implementation of **predictive analytics** to estimate driving range based on factors like weather, traffic, and battery health.
- Development of a **web-based or mobile application** for easy access from anywhere.
- Addition of more **global electric vehicle datasets** for wider comparison.
- Inclusion of **cost analysis** such as maintenance cost and long-term savings.
- Comparison between **electric vehicles and fuel-based vehicles**.
- Integration of **carbon emission analysis** to show environmental impact.
- Implementation of **charging station route optimization** using geographic data.
- Adding **personalized vehicle recommendations** based on user budget and travel distance.
- Deployment of the dashboard on **cloud platforms** for better scalability and accessibility.

---

11. APPENDIX

Source Code:

app.py story.html home.html Launch e.css

C: > Users > HP > OneDrive > Visualization Tool for Electric Vehicle Charge and Range Analysis > Project Files > templates > story.html > html > body > script

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <meta name="description" content="Narrative story on Electric Vehicles in India.">
    <title>EV Story</title>
    <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.3.0/dist/css/bootstrap.min.css" rel="stylesheet">
    <link href="https://cdn.jsdelivr.net/npm/bootstrap-icons@1.10.0/font/bootstrap-icons.css" rel="stylesheet">
    <style>
        body { background: #f8f9fa; }
        .navbar { box-shadow: 0 2px 4px rgba(0,0,0,0.1); }
        .container { max-width: 1200px; }
        .tableauPlaceholder { border-radius: 10px; overflow: hidden; box-shadow: 0 4px 20px rgba(0,0,0,0.1); }
        .loading { display: flex; justify-content: center; align-items: center; height: 900px; background: #e9ecef; }
        .back-to-top { position: fixed; bottom: 20px; right: 20px; display: none; }
        footer { background: #343a40; color: white; padding: 10px 0; text-align: center; margin-top: 20px; }
    </style>
</head>
<body>
    <nav class="navbar navbar-dark bg-dark">
        <div class="container-fluid">
            <a href="/" class="navbar-brand"><i class="bi bi-house"></i> ← Home</a>
            <span class="navbar-text">EV Story</span>
        </div>
    </nav>

    <div class="container mt-4">
        <nav aria-label="breadcrumb">
            <ol class="breadcrumb">
                <li class="breadcrumb-item"><a href="/">Home</a></li>
                <li class="breadcrumb-item active" aria-current="page">Story</li>
            </ol>
```

app.py story.html home.html Launch e.css

Users > HP > OneDrive > Visualization Tool for Electric Vehicle Charge and Range Analysis > Project Files > templates > dashboard.html > html > body > div.conta

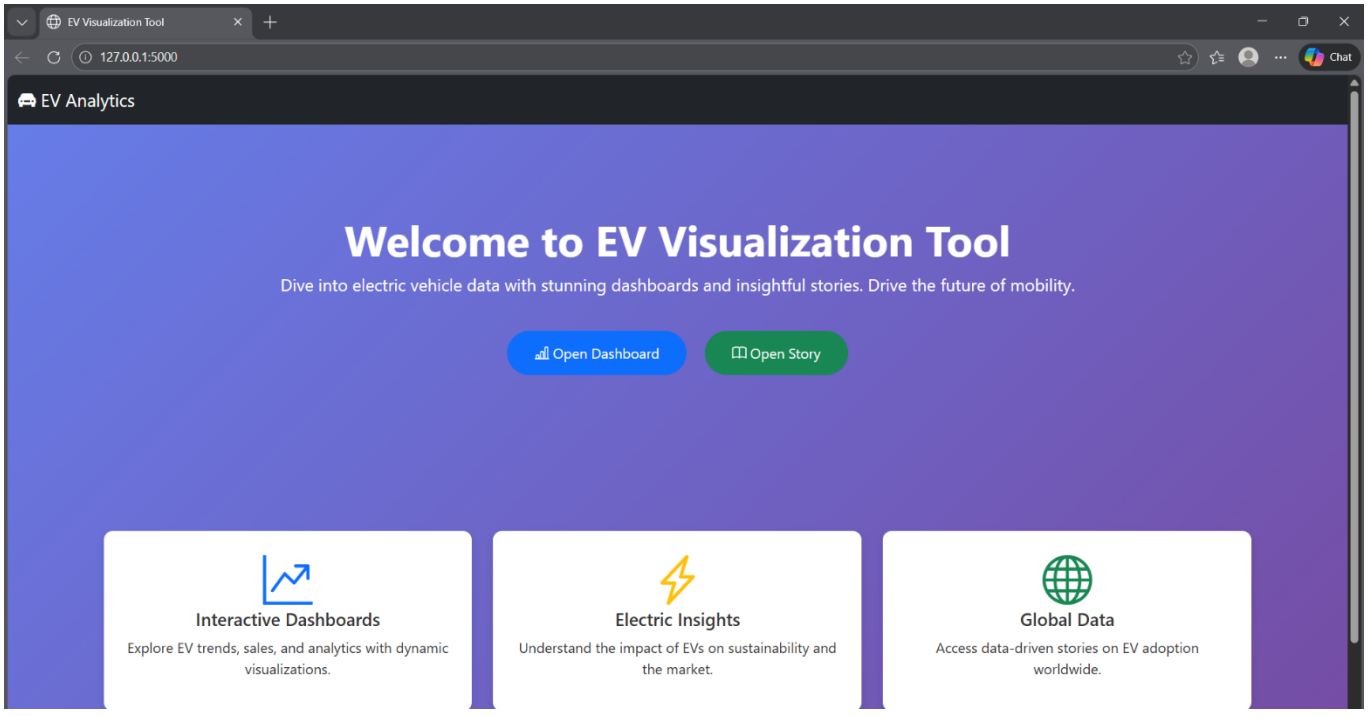
```
<html lang="en">
<body>

    <div class="container mt-4">
        <nav aria-label="breadcrumb">
            <ol class="breadcrumb">
                <li class="breadcrumb-item"><a href="/">Home</a></li>
                <li class="breadcrumb-item active" aria-current="page">Dashboard</li>
            </ol>
        </nav>
        <h3 class="text-center mb-4"><i class="bi bi-bar-chart-line"></i> EV Dashboard</h3>

        <div class="loading" id="loading">
            <div class="spinner-border text-primary" role="status">
                <span class="visually-hidden">Loading...</span>
            </div>
            <p class="ms-2">Loading Dashboard...</p>
        </div>

        <div class='tableauPlaceholder' id='vizDashboard' style='position: relative; display: none;'>
            <object class='tableauViz' style='display:none;'>
                <param name='host_url' value='https://public.tableau.com/' />
                <param name='embed_code_version' value='3' />
                <param name='name' value='electriccarsanalytics/DashboardofElectricCars' />
                <param name='tabs' value='no' />
                <param name='toolbar' value='yes' />
            </object>
        </div>
    </div>

    <button class="btn btn-primary back-to-top" onclick="window.scrollTo({top: 0, behavior: 'smooth'});"><i class="bi bi-arrow-u
```

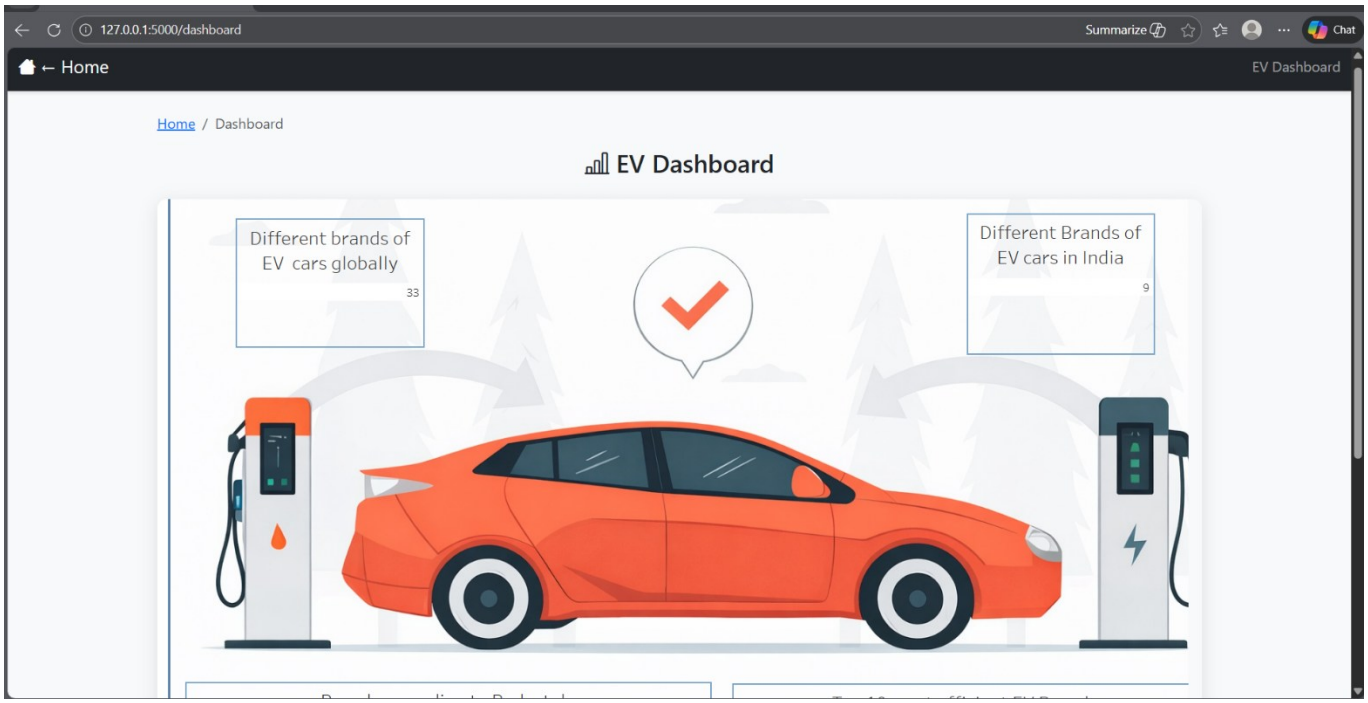
Users > HP > OneDrive > Visualization Tool for Electric Vehicle Charge and Range Analysis > Project Files > static > css > # st

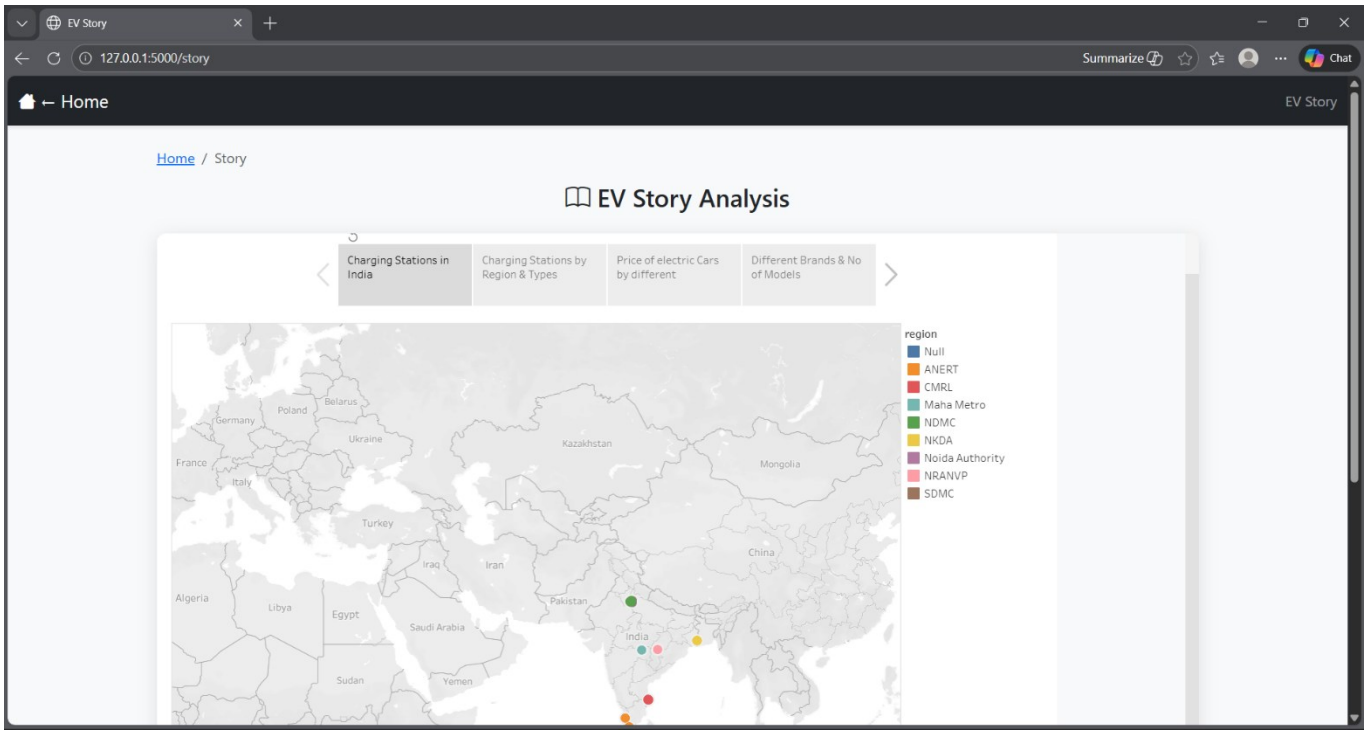
```css
body {
    font-family: 'Inter', sans-serif;
    background-color: #f4f6f9;
    margin: 0;
}

/* Navbar */
.navbar {
    background-color: #1f2937 !important;
    padding: 15px 0;
}

/* Accent Color */
:root {
    --primary-accent: #2563eb;
    --primary-hover: #1d4ed8;
}

/* Hero Section */
.hero {
    padding: 120px 20px;
    background: linear-gradient(to right, #ffffff, #f9fafb);
    text-align: center;
}

.hero h1 {
    font-size: 3rem;
    font-weight: 700;
    color: #111827;
}

.hero p {
    font-size: 1.2rem;
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS AZURE

Output Screenshot :




127.0.0.1:5000/dashboard
Summarize
Chat
← Home
EV Dashboard
Home / Dashboard
EV Dashboard
Different brands of EV cars globally
33
Different Brands of EV cars in India
9


EV Story
127.0.0.1:5000/story
Summarize
Chat
← Home
EV Story
Home / Story
EV Story Analysis
Charging Stations in India
Charging Stations by Region & Types
Price of electric Cars by different
Different Brands & No of Models
region
Null
ANERT
CMRL
Maha Metro
NDMC
NKDA
Noida Authority
NRANVP
SDMC
Belarus
Poland
Germany
Ukraine
Kazakhstan
Mongolia
France
Italy
Turkey
Iraq
Iran
China
Algeria
Libya
Egypt
Saudi Arabia
Pakistan
India
Sudan
Yemen

Dataset Links:

1. https://drive.google.com/file/d/1rMhNvFitXodYzuPbxJ60dy4s2zaYGyR/view?usp=drive_link
2. https://drive.google.com/file/d/1rTANUsWxe2Et5vF6ik0SWjUTUTNoZhP/view?usp=drive_link
3. https://drive.google.com/file/d/1mv1GcOzwShlv4vYyXF82kBfLtZMqIDoN/view?usp=drive_link
4. https://drive.google.com/file/d/1f8hcispK439nJNgcAb13tBEsCx2vTcv/view?usp=drive_link

GitHub & Project Demo Link:

GitHub Link:

Demo Link:
https://drive.google.com/file/d/1dQjSiVJlcQHL61TIUk4S0PEksfhhjPwg/view?usp=sharing