

Project Design Phase

Solution Architecture

Date	15 Feb 2026
Team ID	LTVIP2026TMIDS43270
Project Name	Visualization Tool for Electric Vehicle Charge and Range Analysis with Tableau
Maximum Marks	4 Marks

Solution Architecture:

Electric Vehicle Charge & Range Analysis Dashboard

1. User Interface Layer

- Platforms:
 - Web Application (React.js / Embedded Tableau Dashboard)
 - Mobile (Future Expansion – Flutter or React Native)
- Features:
 - Interactive EV performance dashboards (Battery %, Range, Energy Consumption, Charging Time)
 - Filters for Vehicle ID, Region, Date Range, Charging Station
 - KPI cards (Average Range, Efficiency, Charging Cost)
 - Geo-map visualization for charging station performance
 - Export/share insights (PDF, Image, Dashboard Link)
 - Executive story view for presentation mode
- Interaction:
 - RESTful API calls to backend services for EV data queries
 - Tableau JavaScript API for embedding dashboards and enabling filter interactions
 - Real-time or scheduled data refresh from telematics systems

2. Application Layer

- Backend Framework:
 - Node.js / Django / Flask (API orchestration & business logic)
- Microservices:
 - EV Performance Service: Processes trip logs, battery charge data, and range metrics
 - Charging Analytics Service: Analyzes charging duration, peak hours, and station utilization
 - Environmental Analysis Service: Correlates temperature, terrain, and speed with EV range
 - User Management & Authentication: Handles login, roles, and dashboard access permissions

- Data Integration Service: Connects telematics APIs and external weather APIs

3. Data Layer

- Databases:
 - Relational Database (PostgreSQL / MySQL):
Stores user profiles, dashboard configurations, structured EV trip data
 - NoSQL Database (MongoDB):
Stores unstructured telematics logs and charging session details
- External APIs:
 - Weather API (for temperature-based range analysis)
 - EV Telematics API (real-time battery & trip data)
 - Charging Station Network APIs
- Data Warehouse:
 - Cloud Data Warehouse (AWS Redshift / Google BigQuery) for historical analytics

4. Analytics & Intelligence

- Tools:
 - Tableau for interactive visualization and dashboarding
 - Python (Pandas, NumPy) for data processing
- ML Models:
 - EV Range Prediction Model (Regression-based forecasting)
 - Battery Degradation Prediction Model
 - Energy Efficiency Optimization Model
- ETL Pipeline:
 - Apache Airflow / Scheduled Python Scripts
 - Data ingestion from telematics & APIs
 - Data cleaning & transformation
 - Load processed data into warehouse

5. Infrastructure Layer

- Cloud Provider:
 - AWS / Azure / Google Cloud Platform
- Components:
 - Load Balancer (AWS ELB / Azure Load Balancer)
 - Auto-scaling groups for backend services
 - Cloud Storage (S3 / Blob Storage)

- CDN (CloudFront / Cloudflare)
- CI/CD Pipeline (GitHub Actions / Jenkins)
- Containerization (Docker + Kubernetes)

6. Security & Compliance

- Security Protocols:
 - HTTPS with TLS 1.2+
 - OAuth 2.0 / JWT Authentication
 - Role-Based Access Control (RBAC)
 - Data encryption at rest (AES-256)
 - Secure API Gateway for external integrations
- Compliance:
 - Data privacy compliance for telematics and user data
 - Audit logging and activity monitoring
 - Secure handling of vehicle performance and operational data