

## 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