Indian Institute of Technology, Jodhpur

Fundamentals of Distributed Systems

Assignment 1 – Project Report

Dynamic Load Balancing for a Smart Grid

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1. Overview:

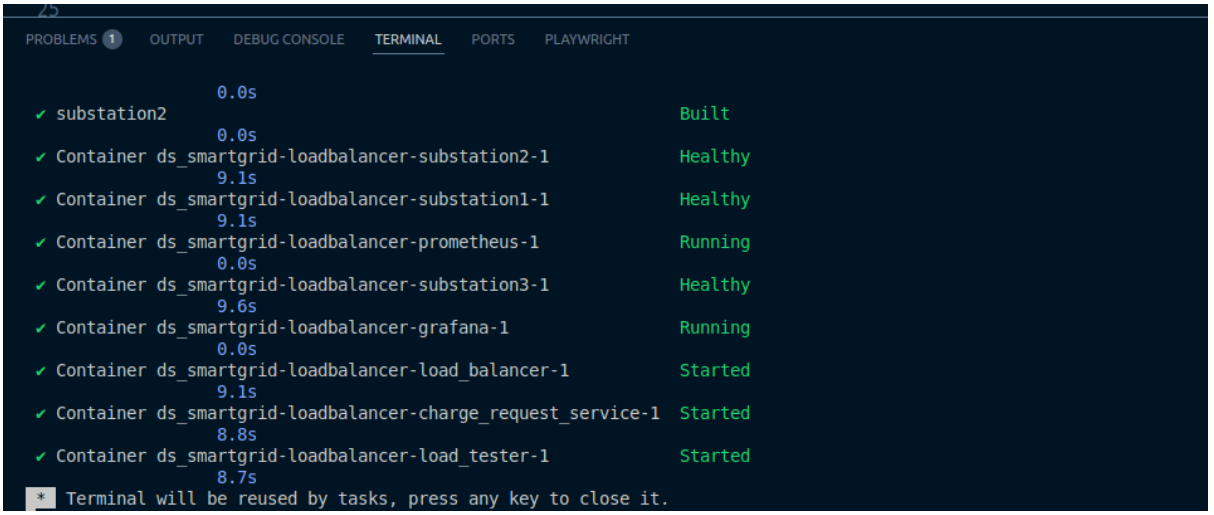
The objective of this project is to design and implement a scalable Smart Grid Load Balancer system that dynamically distributes electric vehicle (EV) charging requests across multiple substations based on real-time load. This system aims to optimize charging efficiency, prevent substation overload, and provide full observability into system performance using modern monitoring tools.

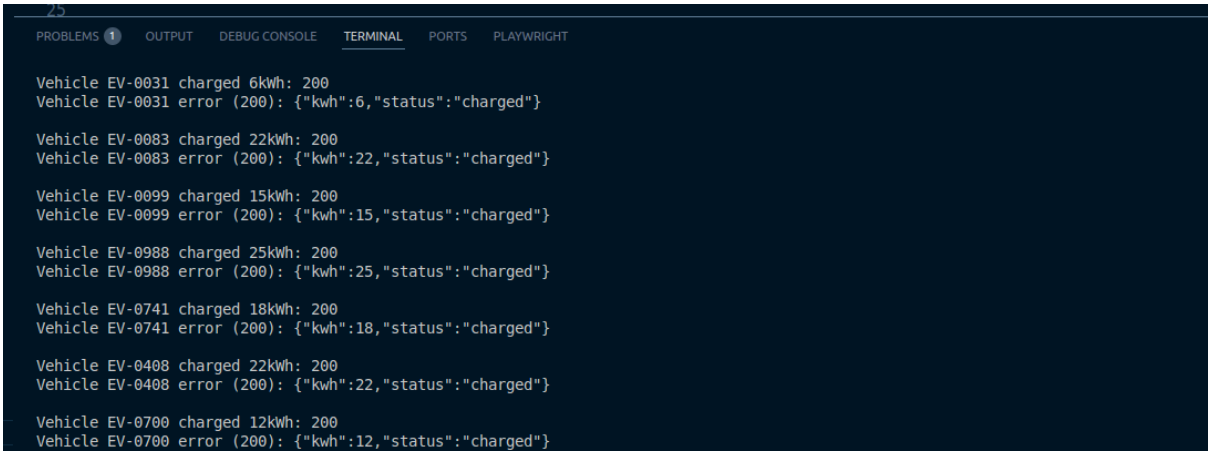
2. System Architecture:

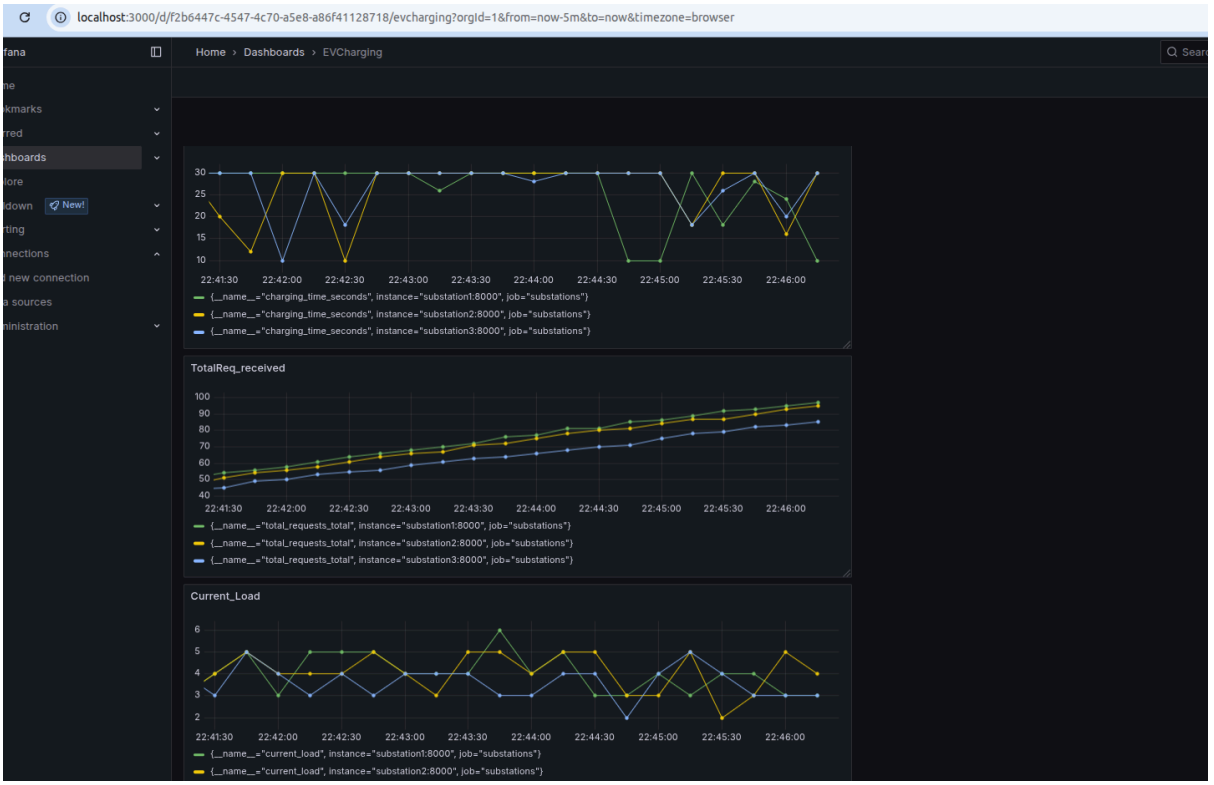
Charge Request Service - Entry point for EVs to send charge requests via REST API.
Load Balancer - Core logic that polls real-time substation load using Prometheus metrics and routes each request to the least-loaded substation.
Substation Services (2 replicas) - Simulate EV charging and expose a Prometheus gauge metric substation_load.
Observability Stack - Prometheus: Scrapes metrics from substations & Grafana: Visualizes substation load trends in a live dashboard.
Load Tester - Python script simulating a high-traffic scenario with 50 EV charging requests.

3. Screenshots:

Here, the screenshots display the terminal logs and status of the various services up and running. Also displayed the screenshots of the grafana dashboard created







5. Important Links:

Public Repository: https://github.com/AKB47-001/ds_smartgrid-loadbalancer.git
Video Link:
https://drive.google.com/file/d/1I-jfeZLqYCkslTpD-XI4hhcdGxwmH9Fm/view?usp=sharing