

PowerPrompt: LLM Framework for Power Systems

- A Domain-Adaptive Prompt Engineering Architecture
- Based on IEEE 14-Bus & PowerGridModel-IO
- Modules: PowerGrid2Text, RAG Fault Retrieval, LLM Decision Support

Problem Statement

- Power systems lack standardized LLM prompt frameworks.
- Existing models: purely numerical, non-textual.
- LLMs require structured & interpretable text for reasoning.
- No equivalent to FHIR2Text exists in the power domain.

Proposed Solution: PowerPrompt

- A domain-adaptive LLM Prompt Builder.
- Inspired by MedPrompt (FHIR2Text architecture).
- Modular pipeline for grid data → LLM reasoning.

PowerPrompt Architecture

- SCADA / CIM / Loadflow / Logs
- ↓ PowerGrid2Text conversion
- ↓ Embedding + Vector DB (Chroma/Redis)
- ↓ LangChain Templates + Agents
- ↓ LLM Decision Support Output

Dataset

- IEEE 14-Bus System (Loadflow & Topology)
- SCADA-like synthetic measurements
- Fault logs (synthetic historical events)

Functionality Tested

- 1. PowerGrid2Text Accuracy & Clarity
- 2. RAG Fault Retrieval Performance
- 3. LLM-Based Loadflow Interpretation

Result 1: PowerGrid2Text

- Converts structured grid values → natural language.
- Improves interpretability for LLM reasoning.
- Template-driven, consistent, reproducible.

Result 2: Improved Interpretability

- LLM reasoning is more accurate with structured text.
- Identifies voltage issues, overloads, frequency deviations.
- Matches engineering rules with high correctness.

Result 3: RAG Fault Retrieval

- Vector embeddings created for past fault events.
- High similarity match for new grid anomalies.
- Improves diagnostic explanation quality.

Conclusion

- Introduced PowerPrompt: first LLM prompt framework for power systems.
- Created PowerGrid2Text conversion layer.
- Demonstrated improved reasoning & retrieval accuracy.
- Modular, extensible, suitable for grid operations & research.

Thank You

- Questions?