Software Requirements Specification (SRS)

Project: Energy Demand Forecasting System using Machine Learning for Indian Power Grid

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# 1. Introduction

## 1.1 Purpose

The purpose of this document is to define the Software Requirements Specification (SRS) for the Energy Demand Forecasting System using Machine Learning. The system aims to provide accurate short-term and medium-term forecasts of electricity demand for the Indian grid, helping utilities and policymakers optimize power distribution.

## 1.2 Scope

The system will process historical energy demand datasets from POSOCO/NLDC, integrate external factors such as weather and holidays, and generate accurate forecasts. A user-friendly dashboard will provide interactive visualization, forecasting results, and scenario simulations. The scope covers development, deployment, and demonstration of the system as a capstone project.

## 1.3 Definitions, Acronyms, Abbreviations

POSOCO: Power System Operation Corporation Limited  
ML: Machine Learning  
API: Application Programming Interface  
UI: User Interface

## 1.4 References

1. POSOCO NLDC Data Portal – https://posoco.in  
2. Facebook Prophet Documentation – https://facebook.github.io/prophet  
3. XGBoost Documentation – https://xgboost.ai  
4. J. Brownlee, Introduction to Time Series Forecasting with Python, 2020.

## 1.5 Overview

The Energy Demand Forecasting System is structured as a web-based application with a machine learning backend and interactive frontend. It allows users to explore demand forecasts, analyze trends, and run what-if scenarios for better decision making.

# 2. Overall Description

## 2.1 Product Perspective

The system is an independent forecasting application that consumes historical demand data and external factors to generate predictions. It is built as a web application with modular design.

## 2.2 Product Functions

- Upload historical demand data  
- Generate forecasts using ML models  
- Display results in interactive charts & maps  
- Provide scenario simulation tools  
- Export reports in CSV/PDF format

## 2.3 User Characteristics

Target users include power utility analysts, policymakers, and researchers. Users are expected to have basic computer literacy but not deep technical expertise in ML.

## 2.4 Constraints

- Dependent on availability of reliable historical and weather data  
- Cloud hosting required for full deployment  
- Limited to short-term (hours to weeks) forecasts

## 2.5 Assumptions and Dependencies

- Data from POSOCO is updated and accessible  
- Weather APIs (Meteostat/NOAA) are available  
- Deployment platform (Render/Streamlit Cloud) is operational

# 3. Specific Requirements

## 3.1 Functional Requirements

FR1: System shall allow uploading historical demand datasets  
FR2: System shall process data and generate forecasts  
FR3: System shall display interactive charts, tables, and maps  
FR4: System shall provide scenario simulation features  
FR5: System shall export reports in PDF/CSV format

## 3.2 Non-Functional Requirements

- Performance: Forecast generation within 5 seconds  
- Usability: Simple, modern, and mobile-friendly dashboard  
- Reliability: >95% uptime on cloud deployment  
- Security: Role-based access for admin/users  
- Maintainability: Modular code, Dockerized deployment

## 3.3 System Interfaces

- User Interfaces: Web dashboard  
- Software Interfaces: FastAPI backend, PostgreSQL database  
- Hardware Interfaces: Standard cloud hosting infrastructure

# 4. System Models & Design

The system follows a client-server architecture. Users interact with the frontend dashboard, which communicates with the backend API for forecasts. The backend uses ML models trained on POSOCO data enriched with weather and holiday inputs.

Diagrams (to be included): Context Diagram, DFD, Use Case Diagram, ER Diagram.

# 5. Other Requirements

- Compliance with academic project guidelines  
- Ethical use of publicly available datasets  
- Extendable for renewable energy forecasting in future