Overview

This AI-powered chatbot is designed to interact with an ERP system (EBuilder) to provide intelligent business insights through natural language processing. The system combines multiple AI technologies to deliver comprehensive sales analysis, forecasting and business intelligence capabilities

Key Capabilities

- Natural Language Processing: Convert business questions into actionable database queries
- Advanced Forecasting: Hybrid Prophet + LSTM neural network predictions

Technology Stack

- Flask Application - Web server handling HTTP requests
- Socket.IO - Real-time communication with the frontend
- PyODBC - Database connectivity to SQL Server
- Prophet - Time series forecasting
- TensorFlow/Keras - LSTM neural networks
- OpenRouter API - Access to multiple LLM providers

System architecture
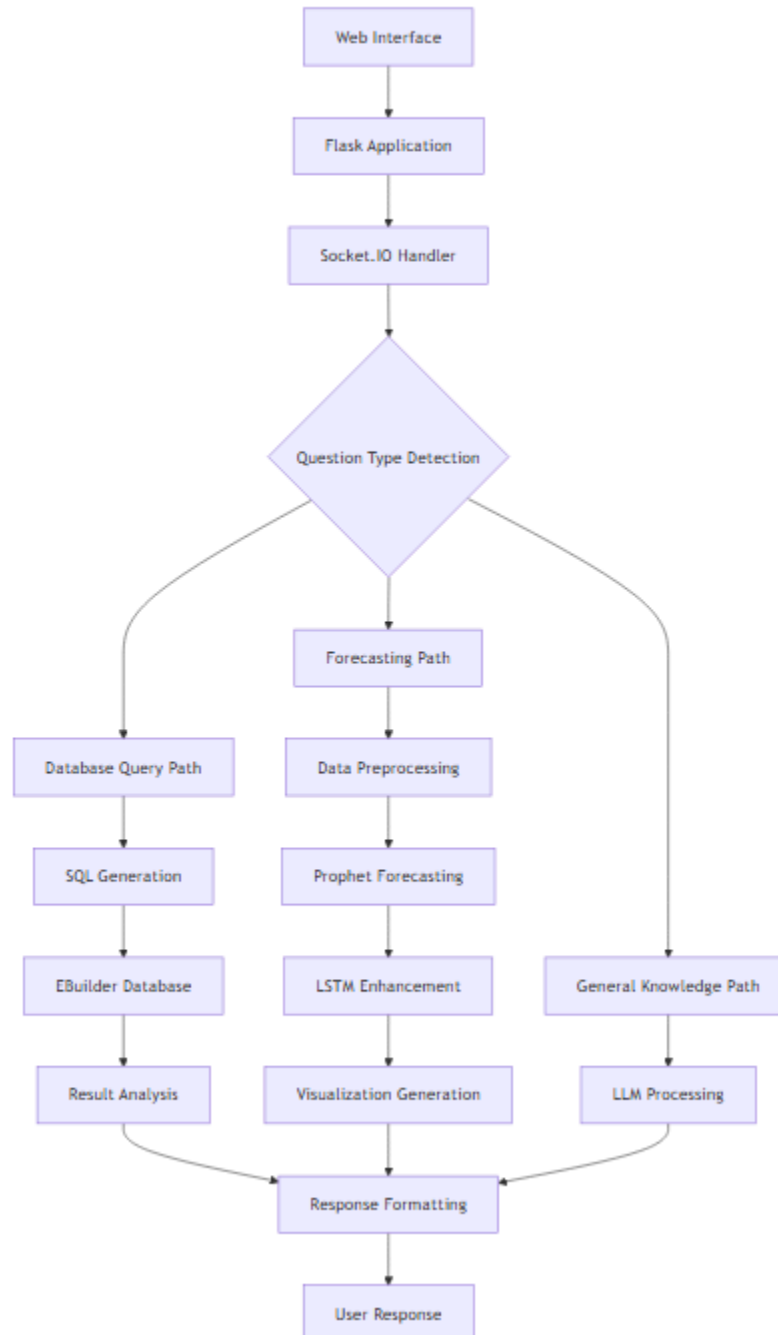
Data Flow

1. User submits question via web interface
2. System determines if question requires:
    - Direct database query
    - Forecasting analysis
    - General knowledge response
3. For database queries:
    - Generates optimized SQL
    - Executes query
    - Analyzes results with LLM
4. For forecasts:
    - Retrieves historical data
    - Cleans and prepares data
    - Runs hybrid Prophet+LSTM forecast
    - Generates visualization
5. Returns formatted response to user

Core Components

1. Flask Application Server

- Purpose: Main web server handling HTTP requests and responses
- Key Files: app.py
- Responsibilities: Request routing, session management, API endpoints

2. Socket.IO Communication Layer

- Purpose: Real-time bidirectional communication
- Implementation: WebSocket fallback support
- Benefits: Instant responses, typing indicators, connection status

3. Database Connectivity Module

- Driver: PyODBC with SQL Server
- Connection: ODBC Driver 17 for SQL Server
- Features: Connection pooling, automatic reconnection, query optimization

4. AI Processing Engine

- NLP: OpenRouter API for multiple LLM access
- Forecasting: Prophet + LSTM hybrid approach
- Analysis: Automated insight generation

Features

1. Natural Language to SQL Conversion

How It Works

1. Question Analysis: LLM analyzes user intent and required data
2. Schema Mapping: Automatic mapping to EBuilder database schema
3. SQL Generation: Optimized query creation with proper joins
4. Execution: Safe query execution with result validation
5. Analysis: Intelligent interpretation of results

Supported Query Types

- Sales performance by period, product, or category
- Customer analysis and segmentation

2. Hybrid Forecasting System

Prophet Component

- Strengths: Handles seasonality, holidays, trend changes
- Data Requirements: Minimum 30 data points for reliable forecasts
- Outputs: Trend, seasonal components, uncertainty intervals

LSTM Neural Network Component

- Purpose: Captures complex non-linear patterns in residuals
- Architecture: Multi-layer LSTM with dropout regularization
- Training: Automatic hyperparameter optimization
- Integration: Applied to Prophet residuals for enhanced accuracy

Forecast Types

- General Sales Forecasting: Overall revenue and volume predictions
- Product-Specific Forecasting: Individual SKU performance
- New Product Forecasting: Using reference product patterns