

Full Stack Development with MERN

Project Documentation format

1. Introduction

- **Project Title:** IntelliSQL: Intelligent SQL Querying with LLMs Using Gemini Pro
- **Team Members:**

| Name | Role |
|------------------------|--------------------|
| Pasupuleti Tiru Ganesh | FrontEnd |
| Porumalla Sai Muneesh | BackEnd |
| Puli Sai Madhu Preethi | AI Integration |
| Putta Sai Manohar | DataBase & Testing |

2. Project Overview

- **Purpose:**

IntelliSQL enables users to convert natural language queries into SQL statements using Gemini Pro LLM. It reduces the complexity of SQL writing and improves data accessibility for non-technical users.

Features:

- Natural Language to SQL conversion using Gemini Pro
- Secure relational database connectivity
- Query validation and execution
- Data visualization (tables and charts)
- Query history management
- JWT-based authentication

3. Architecture

- **Frontend(React):**

Built using React.js for creating an interactive dashboard that allows users to input queries, view generated SQL, and analyze results visually.

- **Backend(Node.js & Express.js):**

Handles API requests, integrates with Gemini Pro API for NL-to-SQL conversion, validates SQL queries, and manages secure communication with

databases.

Database:

MongoDB stores user credentials and query history. MySQL/PostgreSQL databases are dynamically connected for executing generated SQL queries.

4. Setup Instructions

• Prerequisites:

- Node.js
- MongoDB
- MySQL or PostgreSQL
- Gemini Pro API Key
- npm package manager

Installation:

1. Clone the repository.
2. Run npm install in client and server directories.
3. Configure environment variables (DB credentials, API key).
4. Start backend and frontend servers.

5. Folder Structure

- **Client:** Contains React components, pages, services, and UI assets
- **Server:** Contains routes, controllers, models, middleware, and Gemini integration logic.

6. Running the Application

- Frontend: npm start (inside client folder).
- Backend: npm start (inside server folder).

7. API Documentation

- POST /api/generate-sql – Convert natural language to SQL.

- POST /api/execute-query – Execute SQL and return results.

GET /api/history – Retrieve past queries

8. Authentication

- JWT-based authentication ensures secure access. Role-based authorization controls database query permissions.

9. User Interface

- Includes login page, dashboard for query input, SQL output display, results table, and graphical visualization section.

10. Testing

- Unit testing for APIs and integration testing for NL-to-SQL workflow. Performance testing for large datasets.

11. Screenshots or Demo



The screenshot shows a Streamlit application running in a browser. The top navigation bar includes File, Edit, Selection, View, Go, Run, Terminal, Help, and a search bar. The main area displays a Python script titled 'app.py' with syntax highlighting for code. The script imports Streamlit, os, sqlite3, and genai, and defines a client using the Google Gemini API. It then provides examples of how to query the database for student information, such as counting entries and listing students in the MCom class. A function 'get_response' is defined to generate content from the client's models, specifying the model as 'models/gemini-2.5-flash'. The generated SQL query is stripped of whitespace and markdown formatting. The bottom status bar shows the file path 'C:/Smartintenz > app.py > ..', the current column 'In 1, Col 1', and the Python version '3.11.9'.

```
File Edit Selection View Go Run Terminal Help ← → Search
C: > Smartintenz > app.py > ..
1 import streamlit as st
2 import os
3 import sqlite3
4 from dotenv import load_dotenv
5 load_dotenv()
6 from google import genai
7
8 client = genai.Client(api_key=os.getenv("GOOGLE_API_KEY"))
9 print("API KEY LOADED!", os.getenv("GOOGLE_API_KEY"))
10
11 prompt = """
12 You are an expert in converting English questions to SQL queries.
13
14 The SQL database has one table named Students with the following columns:
15 name, class, marks, company.
16
17 Examples:
18 How many entries are present?
19 SQL: SELECT COUNT(*) FROM Students;
20
21 Tell me all the students studying in MCom class?
22 SQL: SELECT * FROM Students WHERE class='MCom';
23
24
25 Only return the SQL query. Do not explain anything.
26 """
27
28 def get_response(que, prompt):
29     response = client.models.generate_content(
30         model="models/gemini-2.5-flash",
31         contents=prompt + "\n" + que,
32     )
33
34     sql = response.text.strip()
35
36     # Remove markdown formatting if present
37     sql = sql.replace("``sql", "")
```

```

app.py
1 import sqlite3
2
3 # Connect to database
4 connection = sqlite3.connect("data.db")
5 cursor = connection.cursor()
6
7 # Create table (if not exists)
8 table = """
9     CREATE TABLE IF NOT EXISTS Students(
10         name VARCHAR(30),
11         class VARCHAR(10),
12         marks INT,
13         company VARCHAR(30)
14     )"""
15
16 cursor.execute(table)
17
18 # Insert records
19 cursor.execute("insert into Students values('Sijo', 'BTech', 75, 'JSW')")
20 cursor.execute("insert into Students values('Lijo', 'MTech', 69, 'TCS')")
21 cursor.execute("insert into Students values('Nijo', 'BSc', 79, 'WIPRO')")
22 cursor.execute("insert into Students values('Sibin', 'MSc', 89, 'INFOSYS')")
23 cursor.execute("insert into Students values('Dilsha', 'MCom', 99, 'Cylent')")
24
25 # Query records
26 print("Inserted Records:\n")
27
28 data = cursor.execute("select * from Students")
29
30 for row in data:
31     print(row)
32
33 # Save changes and close
34 connection.commit()
35 connection.close()

```

Navigation

- Home
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- Intelligent Query Assistance**

Enter Your Query:

Get Answer

Generated SQL Query: SELECT COUNT(*) FROM Students;

The Response is:

| | value |
|---|-------|
| 0 | 5 |

12. Known Issues

- SQL accuracy depends on database schema clarity.
- Complex nested queries may need refinement.
- Performance varies with dataset size

13. Future Enhancements

- Multi-LLM support.

- Advanced optimization engine.
- Voice-based querying.
- BI tool integration.