Project Design Phase
Solution Architecture

Date	20 February 2026
Team ID	LTVIP2026TMIDS66135
Project Name	IntelliSQL: Intelligent SQL Querying with LLMs Using Gemini Pro
Maximum Marks	4 Marks

Solution Architecture:

Solution Architecture bridges the gap between business needs and technical implementation. For **IntelliSQL**, the goal is to ensure a scalable, responsive, and secure Text-to-SQL system using **Streamlit**, **Python**, and **Google Gemini AI**, with clear data flow for administrators and non-technical users.

Objectives of the Architecture:

- **Define Component Interaction:** Establish how the Streamlit UI, Gemini API, and SQLite database interact.
- **Separation of Concerns:** Maintain clear boundaries between the UI, AI logic, and data storage.
- **Smooth Data Flow:** Enable rapid translation of natural language into SQL and immediate data retrieval.
- **Support Future Scaling:** Allow for easy upgrades to more powerful LLMs (e.g., Gemini Pro) or cloud databases.

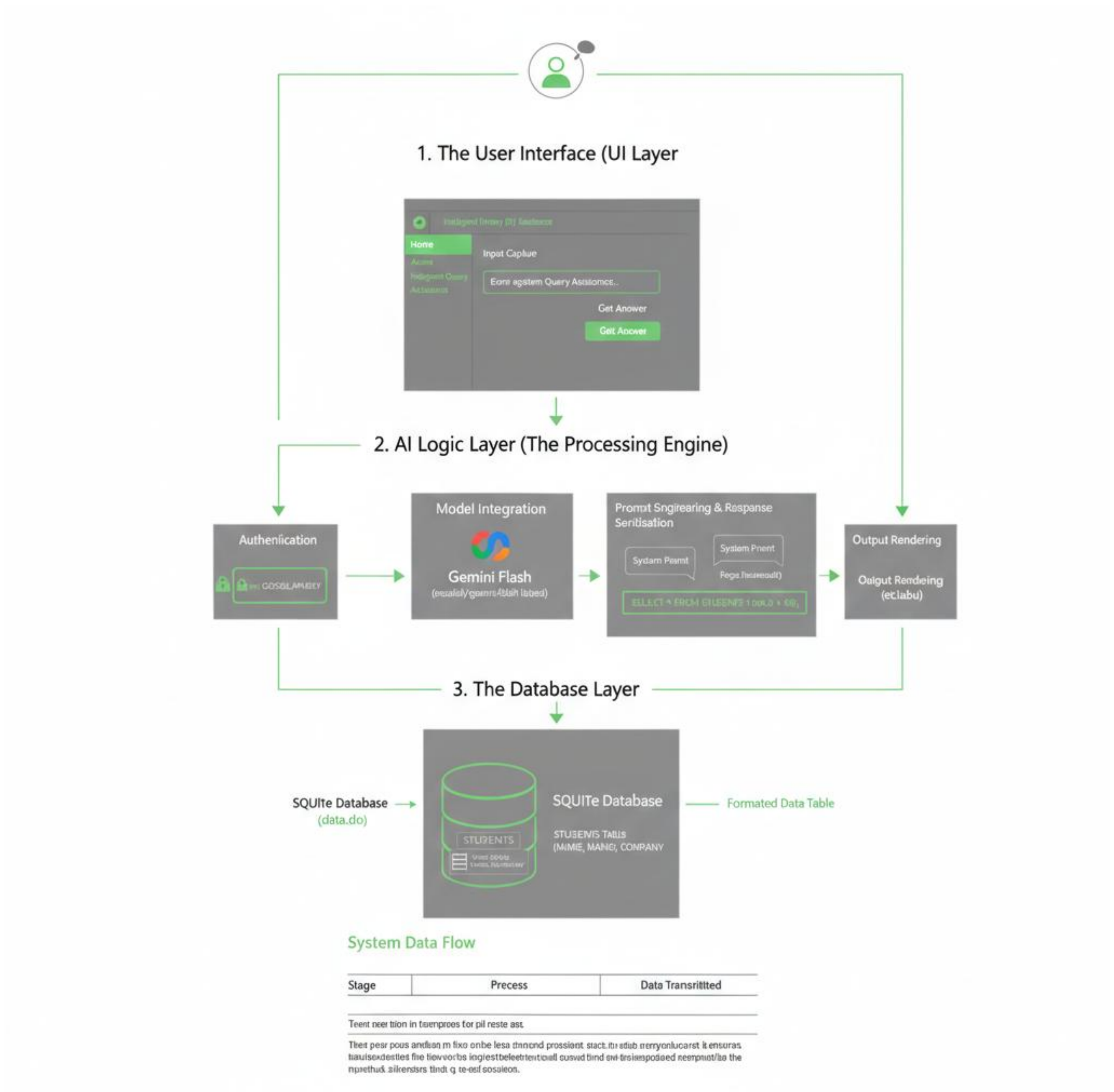
Architecture Layers and Components:

Layer	Components / Tools Used	Description
Frontend	Streamlit, HTML/CSS	Web interface featuring a dark theme and sidebar navigation for Home, About, and Query pages.
Backend	Python, Google Generative AI SDK	Core logic for prompt engineering, SQL generation via Gemini Flash, and Regex-based sanitization.
Database	SQLite (data.db)	Local relational storage for the STUDENTS table including Names, Classes, Marks, and Companies.
Security	.env (python-dotenv)	Secure management of the GOOGLE_API_KEY to prevent exposure in source code.
Dev Tools	Git, VS Code, Regex	Development environment used for building, testing, and isolating valid SQL from AI responses.

Data Flow Summary

1. **User Journey:**
   - User accesses dashboard → inputs natural language question → system attaches context prompt → Gemini generates SQL → Regex cleans query → data displayed in table.
2. **Admin/System Journey:**
   - System loads API key → initializes database connection → validates SQL commands against the STUDENTS table schema.

Example - Solution Architecture Diagram:


1. The User Interface (UI Layer
Home
Input Caplue
Eore agstem Query Assiomce..
Get Anower
Get Anower
2. AI Logic Layer (The Processing Engine)
Authenlication
Model Integration
Gemini Flash
(eeaisly/gemrs4blsh labed)
Promnt Sngirearing & Raspanse Seritisation
Sydam Pesnt
System Pnent
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Output Rendering
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3. The Database Layer
SQUIte Database
(data.do)
SQUITe Database
STUDENTS
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Formated Data Table
System Data Flow
Stage
Precess
Data Transritited
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Feature	Handled By	Status
Natural Language Processing	Google Gemini Flash	✓ Implemented
SQL Extraction/Cleaning	Python Regex (re)	✓ Implemented
Database Persistence	SQLite	✓ Implemented
Secure Key Handling	.env, python-dotenv	✓ Implemented
Modular UI Navigation	Streamlit Sidebar	✓ Implemented
Performance Optimization	Gemini 1.5 Flash Model	✓ Optimized

Notes:

- The current design supports future enhancements like multi-table joins, voice-to-query integration, and export-to-CSV features.
- The modular 3-tier architecture ensures that the database can be migrated to a cloud-based SQL server (e.g., PostgreSQL) without rewriting the AI logic.