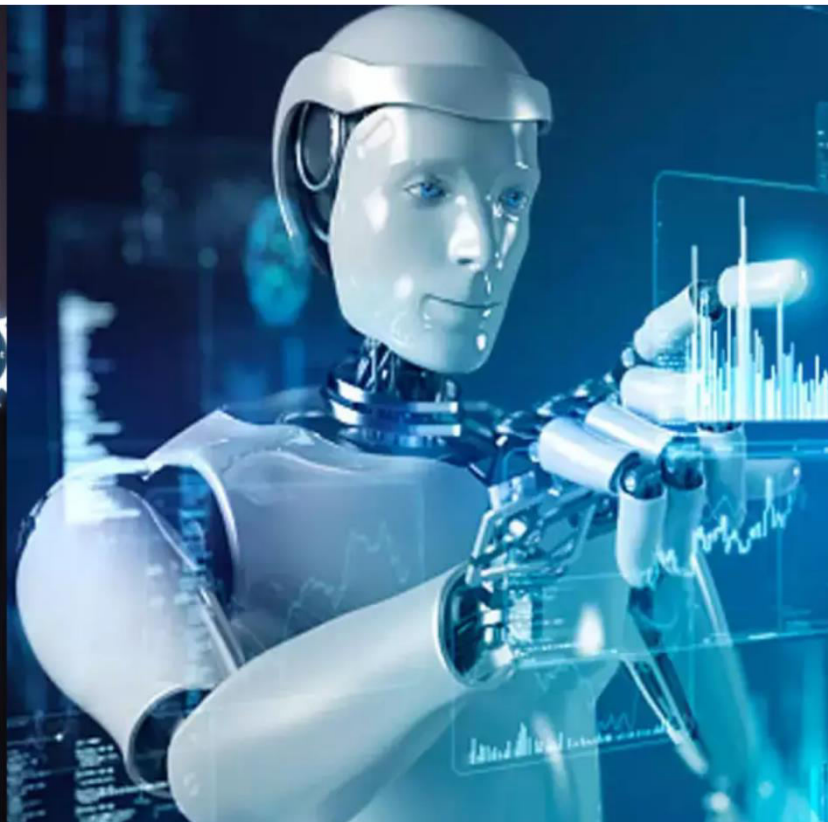




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GenAI-Powered Automated Data Analytics and Visualization

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ABSTRACT: The Automated Data Analytics System leverages Generative AI, specifically OpenAI's GPT-4, to empower non-technical users to interact with enterprise data through natural language queries. Seamlessly integrated with a Snowflake data warehouse and built on a Streamlit-based user interface, the tool automatically translates user input into SQL queries, executes them, and delivers structured insights along with dynamic visualizations. This eliminates the need for manual SQL writing and custom development, significantly lowering the technical barriers traditionally associated with data analysis. The intuitive interface enables business analysts and decision-makers to independently explore data, identify trends, and generate real-time reports without relying on developers or data teams. By automating the entire analytics workflow from natural language query generation to result visualization the platform simplifies data exploration, enhances user autonomy, and fosters a data-driven culture across the organization. As a result, businesses can make faster, smarter decisions and extract actionable insights from raw data with minimal effort and no coding required.

KEYWORDS: Automated Data Analytics, Generative AI, Natural Language Querying, Business Intelligence Automation, No-Code Insights.

I. INTRODUCTION

The Automated Data Analytics System is an AI-powered platform designed to enable business users to explore and analyze data without needing technical expertise or developer support. Leveraging OpenAI's GPT-4, the system translates natural language queries into SQL commands, executes them on a Snowflake data warehouse, and presents the results through an intuitive Streamlit-based interface. This removes the traditional barriers of manual SQL writing and complex data visualization tools, allowing users to interact with their data using simple, conversational language.

The intuitive interface allows users to explore data trends, filter metrics, and generate custom reports in real-time, all through simple, conversational input. Built with scalability and security in mind, the platform integrates seamlessly into existing enterprise infrastructure, ensuring robust performance even with large datasets. Visualizations are generated dynamically, offering interactive charts and dashboards that make complex data easy to understand. With built-in support for multi-user access and role-based controls, the system ensures data governance while fostering collaboration across departments. By bridging the gap between business and data, the tool accelerates insight generation, reduces time-to-decision, and lowers the barrier for data-driven culture adoption—making it a powerful solution for organizations looking to modernize their analytics capabilities without heavy investment in technical resources or training.

II. LITERATURE SURVEY

[1] Conny Walchshofer, Vaishali Dhanoa, Marc Streit, and Miriah Meyer "Transitioning to a Commercial Dashboarding System: Socio-technical Observations and Opportunities", Vol. 30, NO. 1, 2024.

The paper explores the challenges organizations face when adopting tools like Microsoft Power BI. Despite being marketed as user-friendly, these tools often require significant technical skills and self-learning. Many users

struggled with creating meaningful visualizations and preferred static reports due to confusion with interactivity. The lack of standardized design led to inconsistent dashboards. Non-technical users felt overwhelmed, indicating a need for better support and tailored training. The paper recommends developing organization-specific guidelines, collaborative tools, and rethinking dashboard design to improve accessibility and effectiveness.

[2] Zecheng Zhan, E. Haihong, and Meina song “Leveraging Large Language Model for Enhanced Text-to-SQL Parsing, Vol. NO. 13, 2025.

The paper presents SLENet, a novel Text-to-SQL model that uses large language models (LLMs) to generate accurate SQL queries from natural language. It combines three key innovations: context-aware embeddings, syntax-constrained decoding, and search-based prompt optimization. SLENet outperforms existing methods on the Spider benchmark by better handling complex queries and schema comprehension, showcasing the power of integrating LLMs with structured decoding and external knowledge.

[3] Adem Alparslan “The Role of Accuracy and Validation Effectiveness in Conversational Business Analytics, Vol. NO. 13, 2025.

This paper explores how Conversational Business Analytics (CBA), driven by Large Language Models (LLMs) and Text-to-SQL technology, can enhance self-service analytics by enabling natural language interaction with data systems. It introduces two AI support models—Partial Support (direct SQL generation) and Full Support (with validation)—and uses expected utility theory to analyze their effectiveness. The study emphasizes the importance of both the accuracy of AI-generated SQL queries and the effectiveness of validation in ensuring reliable decision-making.

III. SYSTEM IMPLEMENTATION

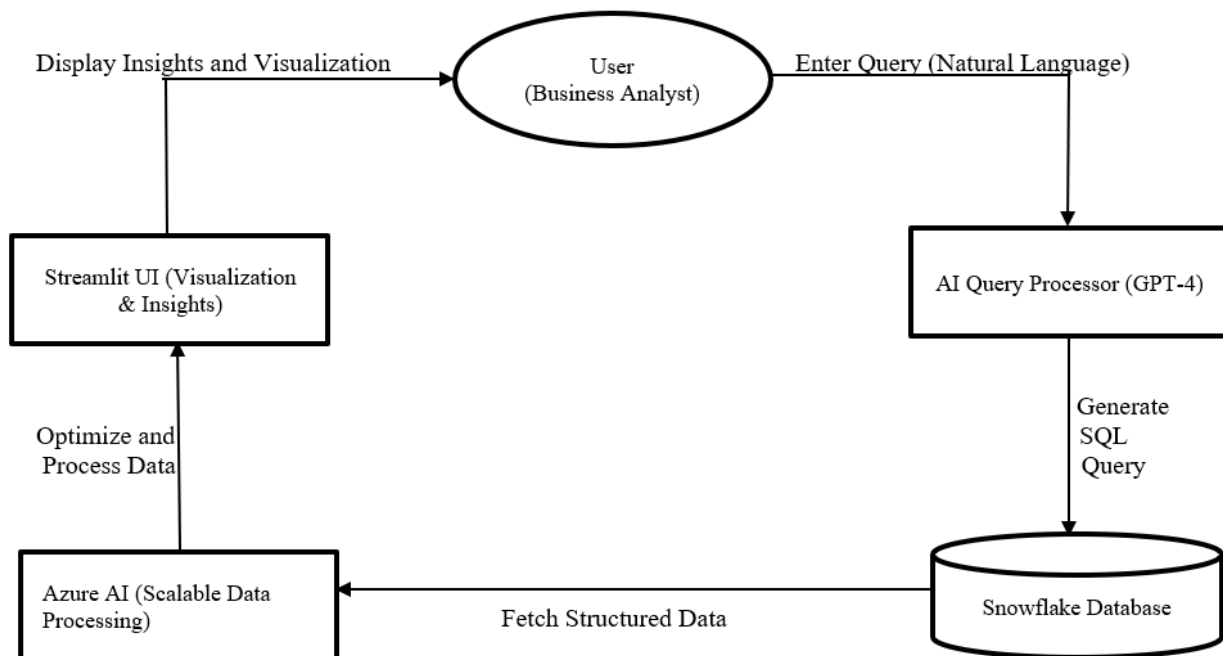


Figure 1: Flow Chart

The above figure illustrates an Automated Data Analytics system using GPT-4, Snowflake, and Streamlit. The user enters a natural language query, which is converted into SQL by GPT-4 and executed on the Snowflake database. The resulting data is presented through the Streamlit UI, providing users with clear insights and visualizations without the need for coding.

1. Natural Language Processing Module

This part of the system is responsible for converting user queries written in plain English into accurate SQL statements using Generative AI. It carefully interprets the user's intent, identifies relevant filters, metrics, and fields, and maintains conversational context to handle follow-up questions naturally. It also manages ambiguity in queries by prompting for clarification and ensures that generated SQL is correct, refined, and ready for execution.

2. Database Connection and Query execution Module

This section securely connects the application to the Snowflake data platform using encrypted credentials. It sends SQL queries to Snowflake, executes them efficiently, and retrieves structured data for further processing. It handles dynamic query execution, optimizes for performance with caching and indexing techniques, and ensures any errors are caught and reported clearly. The output is formatted in a way that's ready for visualization or further exploration.

3. Data Visualization and Reporting

This component presents the results of SQL queries in a visually interactive format such as tables, line charts, and bar charts. It intelligently selects the appropriate visualization based on data structure and volume. Users can explore data by switching between formats, filtering, or exporting insights for reporting. It supports large datasets by ensuring smooth performance and provides clear visuals to make patterns and trends easily understandable.

4. Streamlit-Powered Chat Interface

The interactive chat UI allows users to ask questions naturally and receive answers instantly. It displays real-time conversation history, shows both the AI-generated SQL and the resulting data outputs, and enables seamless user engagement. This part also supports actionable suggestions and lets users interact with the data without needing technical expertise. The interface manages session states and ensures a smooth conversational experience throughout the user's exploration.

5. API Communication & Integration

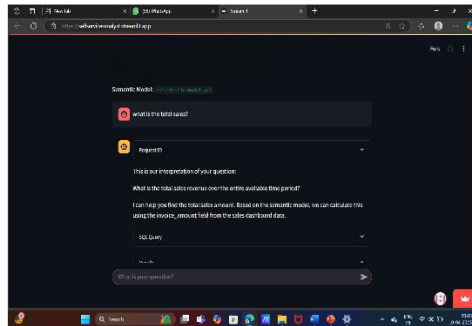
This functional area facilitates communication between the user interface, the Generative AI backend, and Snowflake's REST APIs. It packages the user query into a structured request, authenticates API calls with token-based security, and processes responses from the AI model. It manages performance through throttling, handles errors with retry mechanisms or fallback messages, and logs request IDs for easy debugging when needed.

IV. METHODOLOGY

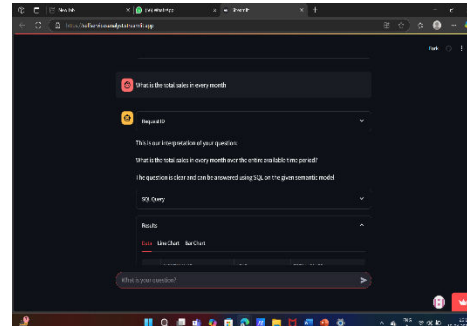
The methodology for developing the Automated Data Analytics System involves integrating Generative AI with cloud data warehousing and a user-friendly interface to enable natural language-based data exploration. The process begins with identifying user requirements and defining relevant business use cases. The system architecture is designed to combine GPT-4 for natural language to SQL translation, Snowflake as the data warehouse for executing queries, and Streamlit for building an intuitive interface. Natural language queries entered by users are processed by GPT-4, which generates corresponding SQL queries that are securely executed on Snowflake. The retrieved data is then visualized using dynamic charts and dashboards within Streamlit, enabling real-time insights without technical expertise. Security and governance are enforced through role-based access controls, while usability is enhanced through iterative testing, performance optimization, and user feedback. The final tool is deployed on scalable cloud infrastructure with continuous monitoring to ensure reliability, responsiveness, and seamless integration with enterprise systems.

V. EXPERIMENTAL RESULTS

Figures (a) to (f) illustrate the sequential workflow of the Automated Data Analytics System, which enables non-technical users to perform advanced data analysis through simple natural language queries.

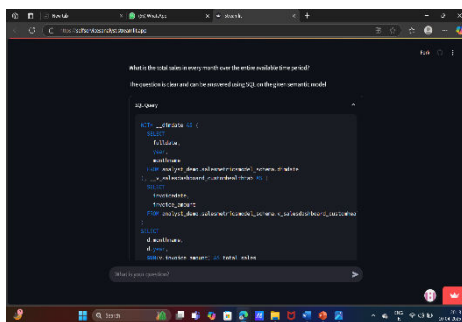


(a)

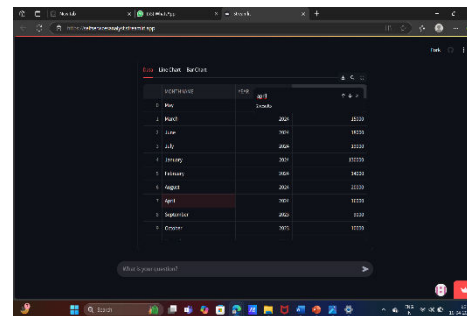


(b)

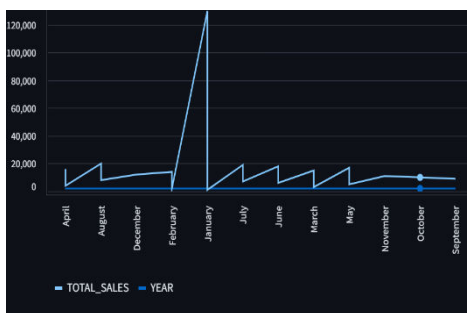
Fig. (a) and Fig. (b) both display the user interface where users input queries using plain, conversational language serving as the starting point for the analytics process.



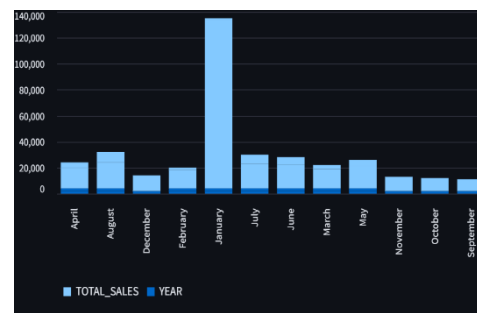
(c)



(d)



(e)



(f)

Fig. (c), the system converts the natural language input into an SQL query using GPT-4, ready for execution on the Snowflake data warehouse. Fig. (d) shows the resulting data in a structured tabular format after the query is executed, along with built-in options for downloading and searching the data enhancing usability and accessibility. Fig. (e) visualizes the output as a line chart, helping users easily identify trends over time. Finally, Fig. (f) displays a bar chart for comparing data across different categories. This sequence demonstrates how the tool transforms raw data into actionable insights through an intuitive, no-code workflow tailored for business users.

VI. CONCLUSION

The Automated Data Analytics System represents a significant advancement in making data-driven decision-making accessible across all levels of an organization. By leveraging the power of OpenAI's GPT-4 for natural

language processing, the system allows users to interact with complex datasets using simple conversational queries, removing the dependency on SQL expertise or technical developers. The integration with Snowflake ensures high-performance, secure data handling, while the Streamlit-based interface provides an intuitive and engaging user experience. This seamless end-to-end workflow—from natural language input to dynamic visualizations—not only improves efficiency and productivity but also encourages a culture of data literacy and self-reliance among business users. With built-in scalability, governance, and customization capabilities, the tool is adaptable to diverse business needs and domains, making it a powerful solution for organizations looking to modernize their analytics infrastructure, reduce operational bottlenecks, and unlock the full value of their data assets.

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