Transforming Mining Operations with GenAI

A conversational GenAI solution for a leading Middle Eastern mining enterprise, enabling seamless, natural language access to critical operational KPIs and transforming how executives interact with complex data.

Overview

QBurst implemented a mobile-first GenAI solution that modernized how a major mining enterprise accessed and interpreted its operational data.

- **Natural Language Access:** The AI system enabled seamless retrieval of real-time and historical KPIs using simple text or voice commands, eliminating the complexity of traditional database navigation.

- **Query Reliability:** Developed a robust Hybrid Query Architecture (RAG + Text-to-SQL) to ensure high precision when accessing complex, structured data.

- **Decision Acceleration:** Accelerated executive decision-making, saving approximately 55% of weekly time previously spent navigating database systems.

Client Profile

A leading Middle Eastern mining enterprise operating multiple extraction and processing sites. With a strong focus on digital transformation, the client sought a conversational interface to simplify access to operational KPIs for executives and stakeholders.

Challenges

- **Technical Barrier to KPIs:** Operational managers and executives could not access real-time or historical data without relying on technical teams for manual database queries.

- **Data Fragmentation and Context:** Data was scattered across disparate mining systems, making efficient retrieval of cross-site or trend data difficult, especially when requiring context from internal reports.

- **Query Reliability:** Initial attempts at Text-to-SQL struggled with complex mining schemas, leading to inconsistent and unreliable Large Language Model (LLM) generated outputs.

- **Cross-Platform Accessibility:** The solution needed to support natural language queries via both voice and text across mobile platforms for users in remote locations.

QBurst Solution: Conversational KPI Access

QBurst developed a mobile-first GenAI chatbot solution with voice and text interfaces, seamlessly integrated with the client's existing backend systems. The solution focuses on providing real-time, natural language access to operational KPIs through a sophisticated Hybrid Query Architecture.

Key Elements of the Architectural Approach:

- **Data Integration:** Established REST APIs over existing KPI databases and built a Python-based transformation layer to unify and cache metrics across all sites.

- **Knowledge Base (RAG):** Processed internal mining reports using tools like LangChain and stored vector embeddings in ChromaDB. This Retrieval-Augmented Generation (RAG) system grounds the AI's responses in internal documentation.

- **Hybrid Query Engine:** To ensure reliability, the system combines controlled Text-to-SQL translation with the RAG context engine. This uses mining documentation and schema metadata to enhance prompt accuracy, ensuring high precision even for complex structured data requests.

- **AI Model Strategy:** Leveraged GPT-4 Turbo for high-accuracy, complex use cases and GPT-3.5 Turbo for cost-efficient queries, applying advanced prompt engineering techniques to simulate expert reasoning.

Technical Highlights

- **Hybrid Query Engine:** Combines the flexibility of LLMs with the reliability of pre-tested SQL templates, achieving high precision through schema-aware, context-enriched prompts.

- **Vector Search Implementation:** Utilized vector search in ChromaDB to quickly identify relevant document chunks, which are then injected into the OpenAI prompt for contextual grounding.

- **Mobile-First UI:** Built with Flutter for cross-platform mobile support, integrating voice-to-text, multilingual capability, and visual KPIs.

- **Security and Governance:** Enforced fine-grained Role-Based Access Control (RBAC) across the platform and secured all API endpoints with robust authentication.

Impact

The GenAI solution delivered transformative improvements in executive decision-making and operational efficiency:

- **Accelerated Executive Decision-Making:** Instant voice and text access to critical KPIs accelerated strategic planning, saving stakeholders an estimated 55% of weekly time previously spent navigating database systems.

- **Reduced Operational Costs:** Automated reporting and data processing significantly reduced manual data effort, saving an estimated 45% of monthly person-hours and minimizing training requirements for new users.

- **Strengthened Compliance:** By providing instant, standardized access to operational metrics, the solution reduced the time required for government audit data preparation by 60%.

- **Smarter Strategic Planning:** Comprehensive access to historical trends and real-time performance metrics across all mining sites supports data-driven growth decisions.

- **Future Innovation:** Established the infrastructure for advanced analytics, predictive insights, and AI-driven operational optimization across mining operations.