

P-09 | A Framework for Digitizing P&IDs Using GPT and Retrieval-Augmented Generation to Enhance Asset Data Interoperability



Chan Young Park

Piping and Instrumentation Diagrams (P&IDs) are essential documents in process plant projects, providing critical information for engineering, construction, installation, operation and maintenance phase. Ensuring interoperability of P&IDs across different project phases is crucial. However, this remains challenging due to the use of diverse software and varying production and utilization methods by different stakeholders. This heterogeneity exacerbates interoperability issues leading to waste of resources in asset data alignment.

To address these challenges, this study proposes a framework to enhance P&ID interoperability by leveraging Large Language Models (LLMs) and Retrieval-Augmented Generation (RAG). The framework operates in two main stages: (1) Information extraction and analysis: A fine-tuned LLM analyzes P&ID drawings using specific prompts to extract embedded information and infer the underlying processes represented by the diagrams. (2) Code generation: The extracted information is used to generate XML code that complies with the industry standards, ensuring compatibility with various P&ID software tools. This is achieved through a GPT-based RAG approach, which integrates retrieval mechanisms to fetch relevant document snippets from extensive repositories, including specifications, reference data libraries, and XML code examples. The RAG-enhanced LLM leverages this external information to produce accurate and standardized XML outputs.

Through this framework, analog P&ID drawings can be digitized, enhancing information usability and enabling seamless interoperability across different P&ID software platforms that support standardized formats.