農業水庫智慧管理平台之建置

Development of a Smart Management Platform for Agricultural Reservoirs

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摘　要

隨著社會結構轉變，農業水庫原以提供灌溉用水為功能，現今因應多元用水需求，部分農業水庫供水標的已擴展至涵蓋民生、工業及水力發電用水等多元化目標，因此透過巡檢與各項維護管理作為，確保水庫設施安全與運作效能，為水庫營運管理上重要課題之一。因此建置「農業水庫智慧管理平台」，以整合水庫監測與維護管理相關資訊，並強化數位治理功能。平台除提供即時水庫水情資訊外，亦整合枯旱預警、防洪預警及供水調度決策支援等相關資訊，可作為決策參考之依據；同時，平台亦整合設施監測資訊並納入智慧圍籬等功能，能於壩體監測數據異常或人員、船隻進入禁止活動區域時，及早發現異常狀況並發布告警資訊，提供全面性的管理支援。

因應農業水庫功能擴展與管理需求提升，平台亦導入人工智慧技術，以優化巡檢流程與整體管理效率。平台內建置 AI 智慧巡查服務，強化水庫或農田水利構造物高效與系統化的巡檢流程。巡檢人員可藉由 GPS 座標定位，自動快速搜尋鄰近設施或新增設施展開巡檢作業，並採用先進的語音識別模型(如 OpenAI Whisper)，將現場語音紀錄自動轉換為文字，進一步生成詳盡且結構化的巡檢紀要。此功能不僅簡化後續行政作業流程，亦大幅減輕表單填寫負擔，全面提升巡檢與維護管理效能。

此外，平台亦導入自然語言處理(NLP)、大語言模型(LLM)、檢索增強生成(RAG)及生成式 AI 等技術，建置具備處理自然語言與複雜邏輯問答之 AI 導航員。該系統可回應業務相關資訊，並透過知識庫與 API 串接功能，提供即時且準確的資料查詢服務，有效簡化使用者的操作流程，提升整體資訊獲取效率。

整體而言，藉由導入 AI 技術(代理 AI (Agentic AI)／推理 AI (Reasoning AI))於農業水庫智慧管理平台之智慧巡查與 AI 導航員，不僅提升巡檢作業的效率與準確性，也有助於強化資料查詢與決策支援功能。透過跨系統整合、AI 技術導入與自動化工具的應用，促進管理流程優化與智慧轉型，進一步邁向系統化與現代化的管理模式，為農業水庫永續經營奠定堅實的技術基礎。

關鍵詞：農業水庫，人工智慧，智慧巡查，智慧化管理

Abstract

With the transformation of social structures, agricultural reservoirs, originally designed primarily for irrigation, now serve broader purposes, including domestic, industrial, and hydroelectric water supply. Consequently, regular inspections and the implementation of diverse maintenance strategies have become essential to ensure the safety and operational efficiency of reservoir infrastructure. In response to these evolving needs, the Smart Management Platform for Agricultural Reservoirs has been established, integrating monitoring data, maintenance information, and digital governance functions. The platform provides real-time reservoir water conditions, drought and flood early warnings and water supply allocation information to support policymaking. It also features real-time dam safety monitoring and a digital fencing system to enhance security. Abnormal dam monitoring data or unauthorized entry into restricted areas can be detected early with timely warning notifications issued.

In response to the expanding roles and increasing complexity of reservoir management, the platform actively integrates artificial intelligence (AI) technologies to optimize inspection procedures. An AI-powered inspection service is embedded within the platform to strengthen and systematize inspection tasks. Through GPS-based navigation, inspection personnel can quickly locate nearby or newly added facilities. By employing advanced speech recognition models, such as OpenAI Whisper, on-site voice recordings are automatically transcribed into text, generating detailed and structured inspection reports. This feature not only simplifies subsequent administrative workflows but also significantly reduces the burden of manual data entry, thereby improving the overall effectiveness of inspections and maintenance activities.

Furthermore, the platform incorporates Natural Language Processing (NLP), Large Language Modeling (LLM), Retrieval Augmented Generation (RAG), and Generative AI technologies to develop an AI navigator. This intelligent assistant can respond to business-related questions and provide real-time and accurate information enquiry service.

Overall, by integration of AI technologies (Agentic AI / Reasoning AI) into the platform not only improves the efficiency and accuracy of the inspection operations, but also strengthens data access and decision-making support. Through cross-system integration, AI adoption and automation tools application, it promotes the optimized management processes and smart transformation, and further moves towards a systematic and modernized management mode.

Keywords: agricultural reservoir, artificial intelligence, smart inspection, intelligent management