

Modular AI-Enhanced System for Predictive and Real-Time Clinical Decision Support

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The increasing availability of real-time clinical data from medical devices and health information systems creates new opportunities to enhance diagnostic accuracy, preventive care, and patient engagement. This paper proposes a modular, AI-driven architecture for a healthcare decision support platform that integrates predictive analytics, medical image processing, real-time patient monitoring, explainable recommendations, and personalized health education. The architecture is organized into distinct functional modules with well-defined responsibilities and interfaces, supporting scalable, containerized deployment and standards-based interoperability. Data from heterogeneous sources, including HL7, FHIR, and DICOM-compliant systems, are ingested through an integration gateway, standardized, and processed by analytical engines for risk scoring, anomaly detection, and imaging-based diagnostics. A decision support layer combines AI-generated insights with clinical guidelines to generate actionable recommendations, while an alerting mechanism ensures the timely delivery of critical notifications. Patient engagement is supported through a personalized education component that delivers context-aware health information. The proposed design addresses key challenges in real-time healthcare AI systems, including heterogeneous data integration, model interpretability, scalability, and alignment with clinical workflows, making it suitable for integration with existing hospital information systems and deployment in both centralized and distributed healthcare environments.

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