

Generative AI-driven Cognitive Digital Health Expert Twin: A Survey and System Blueprint

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Abstract: Multimodal generative AI is rapidly transforming how preliminary diagnosis, triage, and patient guidance can be delivered through intelligent assistants. Unlike traditional symptom checkers or text-only chatbots, contemporary systems blend large language models (LLMs), vision-language models (VLMs), speech recognition/synthesis, retrieval-augmented generation (RAG), and clinical decision support (CDS) logic to provide context-grounded, explainable, and more accessible care experiences. This survey synthesizes prior work on multimodal medical chatbots and digital twin concepts, reviews enabling architectures (RAG, knowledge graphs, explainable AI, and privacy-preserving learning), and positions a practical implementation that uses the GROQ API and a built-in multimodal model to accept voice and image inputs and return a voice response and a structured prescription with do's/don'ts. Building on lessons from digital twin frameworks and multimodal diagnosis assistants, the survey proposes advanced enhancements: longitudinal patient-twin modeling, rationale-guided retrieval, clinical protocol validation, medication-safety checks, bias and uncertainty calibration, and privacy-preserving synthetic data pipelines. The result is a blueprint for a safe, extensible, and clinically aligned medical AI assistant suitable for academic research and eventual clinical piloting.

Keywords: Generative AI, Multimodal AI, Digital Twin, Cognitive Health, Retrieval-Augmented Generation (RAG), Clinical Decision Support (CDS), Explainable AI (XAI)

