Quantum Computing and Healthcare

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Abstract: *The use of quantum computing[1] in healthcare represents a significant shift with the potential to revolutionize medical research, diagnostics, and treatment. Quantum computing can process and analyze large datasets much faster than classical computing, offering new opportunities in healthcare. This paper examines the various ways quantum computing can be applied in healthcare, such as in drug discovery, genetic research, personalized medicine, and complex disease modeling. By using quantum algorithms, researchers can identify new treatment targets and simulate the effects of drugs on human biology in ways that were previously impossible, which can reduce the time and cost of bringing new drugs to market. Quantum computing also allows for analyzing large genomic datasets[2], which can help tailor treatments to individual genetic profiles. Additionally, this technology helps in modeling complex biological systems and disease processes, providing insights into the mechanisms of diseases at a molecular level and enabling the development of more effective treatments. However, integrating quantum computing into healthcare comes with challenges such as technical limitations, the need for specialized expertise, data security concerns, and ethical considerations. This paper provides a comprehensive overview of the potential applications of quantum computing in healthcare, addresses the associated challenges, and discusses the future directions of this growing field, emphasizing the importance of interdisciplinary collaboration in fully utilizing quantum technologies in medicine. In recent years, quantum computing has rapidly advanced and attracted significant interest from academia and industry due to its unique ability to process information differently, resulting in previously unattainable computational capabilities. Despite its potential, the full impact of quantum computing on healthcare has not been thoroughly explored. This survey paper provides a systematic analysis of quantum computing's various capabilities in improving healthcare systems, focusing on its potential to transform compute-intensive healthcare tasks such as drug discovery, personalized medicine, DNA sequencing[4], medical imaging[5], and operational optimization. Through a comprehensive review of existing literature, we have developed taxonomies[6] covering different aspects, including background and enabling technologies, applications, requirements, architectures, security, open issues, and future research directions, offering a comprehensive view of the quantum computing paradigm for healthcare. Our survey aims to assist new and experienced researchers in quantum computing and healthcare by helping them comprehend the current research landscape, identify potential opportunities and challenges, and make informed decisions when developing new architectures and applications for quantum computing in healthcare*

Keywords: quantum computing, genomic databases, data security, DNA sequencing, medical imaging, taxonomies.

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