Hybrid Quantum Encoding: Combining Amplitude and Basis Encoding for Enhanced Data Storage and Processing in Quantum Computing

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CNT 4504

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April 5th, 2024

Introduction

The research article, “Hybrid Quantum Encoding: Combining Amplitude and Basis Encoding for Enhanced Data Storage and Processing in Quantum Computing”, published by the International Joint Conference on Computer Science and Software Engineering (JCSSE), details a novel technique of hybrid quantum encoding. Authors Bhattaraprot Bhabhatsatam and Sucha Smanchat of the University of Technology North Bangkok, explain in their article how their research on Bit-Partition hybrid encoding could improve quantum information processing functions. The research focuses on, “search problems involving large-scale data, emphasizing developing methods for converting data from classical systems to work effectively with quantum computers, thereby accelerating the processing time.” ( Bhabhatsatam and Smanchat 1), mainly working with encoding and decoding DNA data [1]. A substantial amount of background research has gone into this project, including information about the two primary types of quantum computing: gate-based quantum computing and adiabatic quantum computing. The background research delves into the benefits and drawbacks of each approach.

Major Ideas

The main ideas explored in the article revolve around leveraging the unique properties of quantum computing to achieve superiority over classical methods. The research was conducted on DNA data as it is a type of unstructured data, which allowed for the authors to test efficient data preparation techniques to adapt the unstructured data into a proper format for quantum computing. With traditional computing methods the time and computational resources needed to process such a large data would be too costly and inefficient. Quantum computing provides massive benefits through applications of quantum phenomena such as superposition and entanglement to perform complex calculations simultaneously and more efficiently [1]. The article details the use of Grover's algorithm, a type of quantum algorithm used for more efficient searching of unstructured data sets such as DNA sequences. The research aims to improve areas of quantum computing such as data preparation, encoding, and implementation of algorithms to fully utilize quantum computing.

Tests Conducted

A variety of tests were conducted as part of this research. These tests mainly consisted of theoretical algorithm simulations. The emphasis of the research was on Grover’s algorithm and its time complexity in searching unsorted databases. These tests showed how efficient quantum algorithms can be in pattern matching and search tasks. The simulations and theoretical analysis of these algorithms show the practical application of quantum computing principles in processing data and how it compares to classical computing. Overall, the tests helped to confirm the concepts discussed in the article and demonstrate the practicality of quantum computing for efficient data processing and analysis.

Lessons Learned

I had little knowledge on the topic of quantum computing before I read this article, and it provided me with an extensive amount of information in just a few pages. For instance, quantum tunneling was a phrase I have heard before, but never fully understood its meaning or relevance. Now I know it is a crucial part of quantum computing as it allows for more efficient optimization through simultaneous exploration of solutions. I also learned more about encoding and decoding, which is a topic we have touched upon in class. I learned of a new form of encoding called Angle Encoding, which is a type of quantum encoding that utilizes qubits to represent classical data [1]. I am excited for the future of quantum computing and what secrets of the world it may unlock for mankind.

References

[1] B. Bhabhatsatam and S. Smanchat, "Hybrid Quantum Encoding: Combining Amplitude and Basis Encoding for Enhanced Data Storage and Processing in Quantum Computing," *2023 20th International Joint Conference on Computer Science and Software Engineering (JCSSE)*, Phitsanulok, Thailand, 2023, pp. 512-516, doi: 10.1109/JCSSE58229.2023.10201947.