Chapter 5
Enabling Smart Power Grids Through Quantum Computing and Artificial Intelligence

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ABSTRACT

Quantum computers make it possible to solve hard planning problems, accurately simulate how grids change over time, and improve the efficiency of grid activities. Quantum algorithms have changed the way grids are managed, how demand is predicted, and how energy is distributed in real time. In addition, AI technologies like machine learning, deep learning, and others improve quantum computing by looking at the huge amounts of data that smart power grids create. Using quantum mechanics in AI models and algorithms makes it possible for advanced control systems to handle grid processes automatically, adapt to changing conditions, and quickly fix problems. This research looks into how these technologies could be used, what problems they might cause, and what areas of research should be done in the future to help build safe, resilient, and efficient energy infrastructure. When quantum computing and artificial intelligence come together, they will change the energy business right away. This will create a power grid environment that is smarter, cleaner, and more resilient.

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INTRODUCTION

I'm interested in how quantum computation could completely change many fields, such as data science and artificial intelligence. Because qubits can be in more than one state at the same time, they open up new ways to handle data and solve complex problems that are currently beyond the reach of traditional computers. One interesting thing about quantum computing is that it can make machine learning methods much faster. Quantum computing can make a big difference in jobs like optimisation, data analysis, and pattern recognition. This could be helpful in fields that need to quickly handle large amounts of data, like finding new medicines, modelling finances, and predicting the weather.

Giants in the tech industry like Intel, Google, and Microsoft spend millions of dollars on research and development to make tools for quantum computing. This makes the point that this technology is important and could have big effects. A lot of people are excited about the possibilities of quantum computing, which is expected to create a market worth $65 billion by 2030. However, it is important to remember that quantum computing is still very new and that many technology problems need to be solved before its full potential can be realised. Some of these problems are making quantum technology more scalable, making qubits more stable and coherent, and lowering the number of errors (Mouchlis et al., 2021).

Although these problems exist, quantum computation still has the ability to completely change artificial intelligence and many other fields. Because technology is always getting better and study is always being done, quantum computers might get stronger and more useful over time. This could push the limits of what is possible in artificial intelligence and data science. When artificial intelligence (AI) and quantum computing work together, they are likely to cause a lot of problems in many fields, especially in the area of smart power systems, where the results look good. Using smart grids, which use cutting edge technology to make power networks more reliable, long-lasting, and efficient, is one way to improve the control of power networks. Intelligent computers and quantum computers can help smart grids go beyond their current limits and start a new era of energy management by using their adaptability and processing power.

When conventional power systems try to add renewable energy sources, they run into a number of problems, such as old infrastructure, unpredictable demand, and other issues. To solve the problems listed above, we need to create cutting-edge technology that can improve the flow of energy, cut down on power outages, and adapt to the grid's growing complexity. Quantum computing can get around these problems by handling huge amounts of data quickly and effectively and by solving difficult optimization problems at a speed and accuracy that has never been seen before (Gómez-Bombarelli et al., 2018).

As well as this, quantum computing could improve AI algorithms by letting them make decisions quickly and adapt to changing conditions in the grid environment. By looking at data from sensors, meters, and other grid devices and using machine learning algorithms, it is possible to predict trends in demand, find outliers, and improve how resources are distributed. Artificial intelligence systems can make the grid more stable, cut down on energy waste, and lower running costs by constantly updating models and using data-driven learning (Jo et al., 2020).

Christo Ananth 2020 In the context of intelligent energy networks, this research looks at how artificial intelligence and quantum computing might work together. This research will talk about the pros, cons, and possible uses of this integration. Along with that, this research finds important research topics and areas that need more work. The main reason for our in-depth look at how quantum computing and artificial intelligence are connected is to show how these technologies could bring about hugely important changes in the future of energy management.

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