***Simulation of quantum systems***

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***Abstract***

Quantum computers are devices that use quantum-mechanical phenomena to perform calculations. These computers are different in many ways from the computers used today. For example, a quantum computer can be in multiple states simultaneously. In contrast, a classical computer can only be in one state simultaneously, allowing quantum computers to perform several calculations simultaneously [1]. Traditional computers use a series of 0s and 1s, called bits, to represent information. A quantum computer uses quantum bits or qubits. In a quantum computer, a qubit can simultaneously be a 0, a 1, or both. This is because a qubit is a two-state quantum system, and the two states can be superimposed on each other. The laws of classical physics limit traditional computers. These laws do not limit quantum computers. Implying that they can perform computers can perform certain calculations much faster than traditional computers.

I. INTRODUCTION

Quantum Computing is where quantum mechanical phenomena are exploited to perform operations on data. A quantum computer harnesses the features of a quantum system to perform calculations that are generally impossible for a classical computer. The basic principle behind quantum computing is that a quantum bit (qubit) can represent a zero and a one simultaneously [3]. Quantum computers can exploit this fact to solve certain problems much faster than classical computers. The first quantum computers were limited to a few qubits, but now, there are quantum computers with hundreds of qubits

Quantum computers are not only faster than classical computers, but they are also more powerful. They can solve certain problems that are impossible for classical computers. Classical computer [2].The factoring algorithm is the basis for many modern cryptographic algorithms, and a quantum computer can easily break these algorithms. Another example of a problem that can be solved by a quantum computer, but not by a classical computer, is the simulation of quantum systems. Quantum computers can simulate quantum systems with a high degree of accuracy, which has led to many new insights into the behavior of quantum systems.

In general, quantum computers are still in the early stages of development and are not yet widely available. However, a few companies offer cloud-based quantum computing services, and it is expected that quantum computers will become more widely available. Notably, quantum computers are still not as powerful as classical computers. They may require further improvements before they can be used for complex tasks such as machine learning or artificial intelligence.

*1.1Problem Identification*

The main problem facing quantum computing is the development of a quantum computer that can scale up to a large number of qubits to be used in high-level programming languages. The current state of quantum computing is such that quantum computers with a few dozen qubits have been built, but these computers cannot solve problems beyond the reach of classical computers. To build a quantum computer that can solve problems beyond classical computers' reach, it is necessary to develop a quantum computer that can scale up to many qubits. Developing a scalable quantum computer is a difficult task because of the fragility of quantum states.

In addition, it is difficult to perform quantum computations on a large number of qubits because the quantum states of the qubits can become entangled, which makes the qubits difficult to control. Several different approaches are being developed to build a scalable quantum computer using error-correcting codes, which can protect the quantum state of a qubit from errors. Another approach is to use quantum computers based on topological qubits, which are less susceptible to errors. However, the progress that has been made in the development of quantum computers suggests that it is possible to build a scalable quantum computer, and it is only a matter of time before a quantum computer is developed that can solve problems that are beyond the reach of classical computers

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