The Next Frontier In Computing Quantum Computers

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Abstract- *Combing physics and computer science, quantum computing are used to tackle fundamental problems that normal computers cannot resolve by harnessing the basic principles of quantum mechanics. Quantum computers are fundamentally different from the normal ones. Their number crunching is fundamentally different from that of older computers which function on binary systems. Rapidly advancing, quantum computers process information using quantum bits, or qubits that can be in multiple states at once. This document provides an overview of these concepts as well as the technologies, challenges, and applications of quantum computing. These are just a few examples of where quantum computing may expand the frontier of what is possible with medicine, artificial intelligence, and cryptography. As this paper illustrates, the myriad opportunities in quantum computing seem limitless. But, it is equally difficult to ignore the significant challenges that lie ahead.*

Keywords- Quantum computers, Qubits, Superposition, Entanglement.

I. INTRODUCTION

Quantum computers perform tasks that normal computers cannot comprehend. As it stands, computers utilize quantum physics, a term that may sound farfetched and utterly unbelievable, but such are the developments in the field of technology. Normal computers are constrained with working on bits that can only work on 2 raw states i.e. 0 and 1. This poses a challenge in itself as we are even unable to comprehend the possibilities that 1s and 0s curtail. In comparison, quantum computers work on 'qubits', a state of simplicity where both 0 and 1 coexist. A quantum computer's performance extends to simulating molecules and decoding encryption at incomprehensible speeds. It's crucial to keep in mind that today's quantum computers have a pesky checklist that include solid hardware, reliability issues, and functions that can be addressed appropriately in quantities that are suitable to today's world.

II. QUANTUM COMPUTERS

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III. QUANTUM COMPUTERS ANALYTICAL CAPACITY

The exceptional analytical capacities of a quantum computer can be delegated to the two aforementioned characteristics: superposition and entanglement

Superposition: At the very basic level, superposition enables a qubit to be in several states at the same time. This is analogous to an electronic atom which is placed in a magnetic field and during the application of energy; the atom begins to behave as though it is both spinning up and down. In qubits, when energy is applied, they can simultaneously represent 0 and 1, greatly improving the power of computations. For instance, using 500 qubits one can accomplish 2 to the power of 500 calculations in a single step which allows this minimalistic module to achieve vastly superior results compared to traditional computers.

Entanglement: Entanglement is when 2 qubits are intertwined such that, upon measuring one qubit, the other qubit's state is known without a single measurement being done on it. Just like superposition, entangled qubits lack a definite state until

they get their values measured. The existence of one qubit measurement determines the value of the other: if one qubit is set to zero, the other must be set to one. This interaction which a distance can be encompassed by qubit attachment provides even more strength to quantum computing.

IV. QUANTUM INTERFERENCE

Quantum interference occurs due to superposition, which is where a qubit's state can change the probability of it resulting in a certain output when it is measured. It is, in other words, how the different outcomes can affect each other. In order for quantum computers to work, they have to limit the interference that they do not want as much as possible.

V. QUANTUM HARDWARE TECHNOLOGIES

The single most important piece of a quantum computer is the qubit and it can be realized in various physical platforms, having its cons and pros:

Trapped Ions: Ions are trapped by means of electromagnetic fields and then altered with lasers. This kind of qubit has very high durability (coherence time) but is very difficult to set up and requires precise manipulation.

Superconducting Circuits: This qubit type is embedded in superconducting loops, within which electric currents are passed through. It is cheap and easy to manufacture, therefore is commonly used in the production of quantum computers.

VI. CONCLUSION

In conclusion of this research we have found the huge benefits of quantum computer and the challenges we face. But there are many benefits that will increase the quality of Technology and the speed of processing data. This research highlights the fundamentals principles of quantum computer and their application in developing quantum computing. But there are many obstacles in the way of development

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