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Quantum Computer Technology

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Abstract: A quantum computer has many advantages over a classical computer for exhaustive search. It can tackle problems in science, chemistry, and mathematics that are well beyond the reach of supercomputers. With every additional quantum bit computing power doubles. In this paper I will introduce the basic concepts of quantum computing, and explain the major open challenges in the realization of large-scale quantum circuits systems. It broadens the scope for implementation as it demonstrates quantum mechanical algorithms that can adapt to available technology.

Keywords: Classical computers, quantum computers, quantum computer systems, quantum simulators, Shor's algorithm.

I. INTRODUCTION

Quantum computers use the properties of quantum physics that stores data and perform computations. This can be more advantageous for certain tasks where they could vastly perform better than our supercomputers. Classical computers encode information in binary "bits" that is 0s or 1s but a quantum computer encodes in quantum bit or qubit. Currently classical technology can manage any task thrown at a quantum computer.

Qubits are made using the spin of an electron or the orientation of photon i.e physical systems. Qubits can also be linked together using quantum entanglement. A series of qubits can represent different things simultaneously. In situations where there are a large number of possible combinations, quantum computers can consider them simultaneously. Examples include trying to find the prime factors of a very large number or the best route between two places. For now, due to heat, electromagnetic fields and collisions with air molecules can cause a qubit to lose its quantum properties. Quantum decoherence, causes the system to crash and it happens more quickly the more particles that are involved.

II. METHODOLOGY

A. *How Do Quantum Computers Work?*

Quantum computers have the potential to process exponentially more data compared to classical computers. Classical computers carry out logical operations using binary, which are based on one of two positions. In quantum computing, operations use the quantum state of an object to produce a qubit. At the quantum level things work differently from how they work in macroscopic world. Tiny particles like electrons and photons can simultaneously take on states that would normally be considered mutually exclusive like on or off. They can be in two or more states at once. This attribute of quantum particles is called superposition. It is possible to take advantage of superposition to perform calculations incredibly quickly. Qubit can exhibit '0' spin down, '1' spin up or both simultaneously with certain probability of each scenario. The true potential of quantum computers comes when you combine several quantum particles. As you scale up the number of qubits, the amount of information contained rises to 2n of classical bits.

B. *Quantum computing supremacy*

Currently classical technology can manage any task thrown at a quantum computer. Quantum supremacy describes the ability of a quantum computer to outperform their classical counterparts some companies claim that they are close, as they continue to cram more qubits together and build more accurate devices. Shor's algorithm performs factoring of a large integer in polynomial time, whereas classical factoring algorithms can do it in exponential time. In this paper we briefly survey the current status of quantum computers, quantum computer systems. Quantum computer perform random sampling calculations in three minutes and 20 seconds, while supercomputer takes about 10000 years to solve the same. Not everybody understands that quantum computers are worth the effort. Some mathematicians believe there are obstacles that are putting quantum computing forever out of reach. Time will tell who is right.

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III.RESULT

TABLE I COMPARISON OF QUANTUM COMPUTER AND CLASSICAL COMPUTER

SN.	Classical computer	Quantum computer
1	Information stores in bit.	Information stores in qubit
2	Information processing by logic gates	Information processing by quantum logic gates
3	Information processing in sequential basis	Information processing in parallel basis
4	Run calculations slower than quantum computers	Run calculations exponentially faster than classical computers
5	Circuits uses fast, scalable macroscopic technologies	Circuits uses slow , fragile macroscopic technologies

IV. CONCLUSION

Quantum computing can provide a huge change in the computation performed till date. This technology will be used sooner in large scale industry for doing large calculations within limited period. This technology has various advantages over classical computers like qubits, its entanglement, superposition, faster, powerful etc. It would definitely revolutionize our current technology. Quantum simulators are making strides in fields varying from molecular energetics to many-body physics. There are some algorithms utilizing the advantage of quantum computers. Current quantum based machines are too large to use in everyday society but soon it will be used in all over the world.

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