iMedPub Journal www.imedpub.com

International Journal of Innovative Research in Computer and Communication Engineering **2022** Vol.8 No.01:101

# **Quantum Mechanics Concepts like Superposition and Interference**

#### **Xavier Dowert**\*

Department of Computer Science, University College Dublin, Dublin, Ireland

\*Corresponding author: Xavier Dowert, Department of Computer Science, University College Dublin, Dublin, Ireland, E-mail: Dowert\_x@gmail.com

Received date: December 31, 2022, Manuscript No. IJIRCCE-23-15781; Editor assigned date: January 02, 2023, PreQC No. IJIRCCE-23-15781 (PQ); Reviewed date: January 11, 2023, QC No. IJIRCCE-23-15781; Revised date: January 22, 2023, Manuscript No. IJIRCCE-23- 15781 (R); Published date: January 28, 2023, DOI: 10.36648/ijircce.8.01.101.

Citation: Dowert X (2023) Quantum Mechanics Concepts like Superposition and Interference. Int J Inn Res Compu Commun Eng Vol.8 No.01:101.

# Description

A computer that makes use of quantum mechanical phenomena is known as a quantum computer. Quantum computing makes use of the fact that physical matter has properties that are both waves and particles at very small scales by making use of specialized hardware. A scalable quantum computer would be able to perform certain calculations exponentially faster than any modern "classical" computer, and classical physics cannot explain how these quantum devices operate. Even though the current state of the art is still largely experimental and impractical, a large-scale quantum computer could break widely used encryption schemes and aid physicists in performing physical simulations. Quantum circuits are the most common quantum computation model, but there are several others. The quantum Turing machine, quantum annealing, and adiabatic quantum computation are three additional models.

## **Quantum Bit**

The quantum bit, or "qubit," which is somewhat analogous to the bit in classical computation, serves as the foundation for the majority of models. A qubit can be in a superposition of the states 1 and 0 or in either the 1 or 0 quantum states. However, when measured, it is always either 0 or 1. The guantum state of the qubit immediately prior to measurement determines the likelihood of either outcome. It has been hard to physically engineer high-quality qubits. Quantum decoherence occurs when a physical qubit is not sufficiently isolated from its environment, introducing noise into calculations. The goal of experimental research funded by national governments is the creation of scalable quits with shorter coherence times and lower error rates. Ion traps, which use electromagnetic fields to confine a single atomic particle, and superconductors, which eliminate electrical resistance to isolate an electrical current, are two of the most promising technologies. A quantum computer can solve any computational problem that a classical computer can. In contrast, if enough time is given, any problem that can be solved by a quantum computer can also be solved by a classical computer, at least theoretically. Quantum computers, in other words, adhere to the Church-Turing thesis. This indicates that quantum algorithms for certain problems have significantly lower time complexities than corresponding known classical algorithms, despite the fact that quantum computers do not offer any additional advantages over classical computers in terms of computability. "Quantum supremacy" refers to the ability of quantum computers to solve problems in a fraction of the time it would take a classical computer to accomplish. Quantum complexity theory is the study of quantum computer problems' computational complexity. For a long time, the fields of quantum mechanics and computer science had their own distinct academic communities. Digital computers emerged in subsequent decades to replace human computers for laborious calculations, and modern quantum theory was developed in the 1920s to explain the wave-particle duality observed at atomic scales.

During World War II, both fields had practical applications Quantum physics was necessary for the nuclear physics that was utilized in the Manhattan Project, and computers played a significant role in the cryptography used during the war. The fields of quantum mechanics and computer science began to merge as physicists applied quantum mechanical models to computational issues and exchanged digital bits for quantum bits (quits). When digital computers became faster, physicists faced an exponential increase in overhead when simulating quantum dynamics. As a result, Yuri Manin and Richard Feynman independently suggested that hardware based on quantum phenomena might be more efficient for computer simulation. In 1980, Paul Belief introduced the quantum Turing machine, which uses quantum theory to describe a simplified computer. Charles Bennett and Gilles Brassard demonstrated in a 1984 paper that quantum key distribution could improve information security by applying quantum theory to cryptography protocols. In 1994, Peter Shor, depicted here in 2017, demonstrated that a scalable quantum computer would be capable of breaking the RSA encryption. Quantum algorithms for solving oracle problems followed, including the Bernstein-Vazirani algorithm in 1993, Simon's algorithm in 1994, and Deutsch's algorithm in 1985.

## **Simplified Computer**

Although these algorithms did not provide solutions to actual issues, they did mathematically demonstrate that superposition, also known as quantum parallelism, could be used to query a black box for additional information. With his 1994 algorithms for breaking the widely used RSA and encryption protocols, which drew a lot of attention to the field of quantum computing, Peter Shore built on these findings. Unstructured search was

Vol.8 No.01:101

given a quantum speedup by Grover's algorithm in 1996, making it a problem that was used widely. In 1998, a two-quit quantum computer demonstrated the technology's viability, and subsequent experiments have increased the number of guits and decreased error rates. In the same year, Seth Lloyd demonstrated that quantum computers could simulate quantum systems without the exponential overhead of classical simulations. Over time, experimentalists have constructed smallquantum computers using trapped scale ions and superconductors. With a 54-qubit machine, Google AI and NASA announced in 2019 that they had achieved quantum supremacy, performing a computation that no classical computer could. However, research into this claim's validity is still ongoing. Noise in quantum gates limits the reliability of noisy intermediate-scale quantum (NISQ) machines, despite the possibility of specialized applications in the near future, according to some researchers. While fully fault-tolerant quantum computing is still "a rather distant dream," the threshold theorem demonstrates that increasing the number of qubits can reduce errors. In five

months, a quantum computer with nearly 3 million fault-tolerant qubits could factor a 2,048-bit integer, according to estimates. In recent years, both the public and private sectors have increased their investments in quantum computing research. Quantum computing startups are multiplying, according to a summary provided by a consulting firm. Although use cases are largely experimental and hypothetical at this early stage, quantum computing promises to assist businesses in solving problems that are beyond the reach and speed of conventional highperformance computers. The operation of a modern computer is typically described by computer engineers using classical electrodynamics. Some parts of these "classical" computers may rely on quantum behaviour, like random number generators and semiconductors. However, these parts are not isolated from their surroundings, so any quantum information quickly breaks apart. Quantum mechanics concepts like superposition and interference are largely irrelevant for program analysis, despite the fact that programmers may rely on probability theory when creating a random algorithm.