Study on Quantum Computing

Abhirami.N[1], Ranganathan. H[2], Sakthi Dharani Dharan.D[3]

Assistant Professor[1], III BCA Student[2,3]
Sri Krishna Arts and Science College, Coimbatore[1,2,3]

Abstract:

Quantum computing is a giant leap in the tech industry. Quantum computing is a blend of two polar opposites – quantum physics and computers. Quantum computers also has protons, atoms and their working is based on these movements. Though it is not made to the market, the theories around it reigns supremely. Top tech companies like Google, IBM have planned to get into quantum computing and they have started to develop quantum computers. This paper deals with quantum computing, the definition of quantum computing and qubits, the functioning and the pros of quantum computers over the supercomputers.

Keywords: *Quantum computing, optimization, supercomputers, qubits, superposition, entanglement.*

I. INTRODUCTION

In today's world Supercomputers are widely used for different purpose by different organizations. While supercomputers are pro in their best, they do have a certain limitation. In short a supercomputer is suitable for performing operation over a large scale database but it might fail in detecting the shape of proton or an atom and complex mathematical solutions. In such cases to overcome these drawbacks quantum computing was developed. In the further paragraphs a detailed look on quantum computing and its functionalities can be seen.

II. BACKROUND OF QUANTUM COMPUTING

Quantum computing is a method of developing computers based on the principles of quantum mechanics. It is made up of qubits. Standard computer operates on binary level – 0 or 1 whereas quantum computers operates upon qubits. It is also called as quantum bits.[1] In other words, Quantum computers are machines that use the property of quantum physics to store data and perform calculations. Qubit or quantum bit is a basic unit of memory storage in quantum computers.[2] Quantum computers promises to overshadow conventional supercomputers.[3]

III. DEFINITION OF QUBITS

Qubits are the basic unit of memory storage in quantum computers.[2] Qubits have two basis stages 0 or 1 and the superposition of these two states. Quantum circuit is composed of quantum gates. Quantum gate is the quantum circuit operating upon a small number of qubits. Quantum gates are the analogues of quantum computer. A quantum gate can involve one or two qubits. In two bit quantum gates one is the target bit whereas the other is the control bit. Qubits can be made from trapped ions, photons, artificial or real atoms whereas binary bits are often silicon-based chips.[3]

IV.QUANTUM STATES

Superposition and entanglement are two principles of quantum computing. These principles are phenomena that applies to the tiny particles such as photons, atoms and electrons. Superposition is the ability of a quantum system to be in multiple state. Entanglement is a strong relation or connection that is present between two or more quantum particles.[4] A qubit with several superposition can process various outcomes simultaneously. In entanglement changes in one quantum particle will cause changes to other particles as well irrespective of the distance between the particles.[5]

V. WORKING OF QUANTUM COMPUTERS

Quantum computers performs operations by entanglement of qubits and superposition probabilities. These operations are manipulated so as to increase/decrease the certain probabilities. Quantum computer holds three parts,

1.   a part that holds the qubits,

2. part that transfers signals to qubits,

3. computer to run and give instructions.[6]

Quantum computers uses variety of algorithms to make manipulations and perform operations. These algorithms are input given by the user, the computer then creates a space where patterns and individual data points are stored.[7]

VI. DIFFERENCE BETWEEN CONVENTIONAL SUPERCOMPUTERS AND QUANTUM COMPUTERS

1.Processing information – Conventional supercomputers uses transistors which represents 0 or 1 whereas quantum computers uses qubits. Qubits follows the principle of superposition and it has the ability to process 0 or 1 at the same time,

2.Power – The power of classical computers grows linearly whereas the power of quantum computers grows exponentially,

3.Versatility – Quantum computers are often suited for complex tasks which requires high computational speed and power. It is best suited and highly used for data analysis, process and simulations whereas classical computers are suitable for daily needs,

4.Data Processing – Quantum computers uses Quantum Processing Unit for processing data whereas traditional computers use Central Processing Unit,

5.Storage of computer – Quantum computer needs to be retained in ultracold temperature whereas classical computer can be stored in room temperature. [7][8]

VII. RISKS INVOLVED

1. Creation of Algorithm – For every new type of operation, a new algorithm has to be created. Quantum computers needs special type of algorithm to perform computations in their environment,

2. Lowest Temperature needed – The quantum computer generates a lot of heat waves due to its heavy processing so it must be retained in an extreme lower temperature,[8]

3. Use case of the computer – Since quantum computers are too complex to control and suitable for only high end process, it is not made available to market,

4. Security – Since these computers have the capability to decrypt codes on internet, the internet security might be at risk and chances for data to be breached. [9]

VIII. USES OF QUANTUM COMPUTER

There are several use cases for quantum computing: artificial intelligence, cryptography, cyber security, drug development, traffic optimization, financial modelling and solar capture. It is also useful in various sectors like Finance, Healthcare, Marketing and Meteorology. In healthcare, quantum computers does diagnosing in faster way and produces accurate prediction results with the help of artificial intelligence. On the lines of prediction and pattern identification quantum computing is highly useful for fraud detection in finance sector. Machine learning accelerated to quantum computers with previously recorded data would result in more accurate predictions which is more beneficial in meteorological sector for reporting weather forecast.[10][6]

IX. CONCLUSION

Quantum computing is easily the next big thing in tech industry. This is gonna applied in every sector and the interesting thing is that all sectors will benefit from it. This paper has outlined the background of Quantum Computing and functionalities of Quantum Computing. Also the advantage of quantum computing over the supercomputers and the uses of Quantum computing are shown. The world is in the very early stage of experiencing Quantum Computing. The features and functionalities of quantum computing might seem overwhelming but once it gets into the market, many organization would make benefit out of it.

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