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Quantum Computing: A New Approach for Quantum Computer

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ABSTRACT: Quantum theory is well known theory of physics in which characteristics and behavior of energy and matter of quantum that is of atomic and subatomic particles are discussed. In this connection Quantum computing deals with the developing Computer Technology (CT). This paper focuses on the study and development of the Quantum Computer (QC) on the enhanced quantum computing technique.

In practical sense the computing capability is found to be greater than that from the abacus of today's modern supercomputer. Its performance gains in the billion-fold area and beyond. The quantum computer obeys the definite laws of quantum physics, would give remarkable benefits in processing power and capability, it also gives to perform tasks using all possible permutations simultaneously. This paper presents the innovative development in the quantum computer which is based on the study and current research scenario. In this connection it is found that as on today the measure contributors in research of quantum computing which include MIT, IBM, Oxford University, and the Los Alamos National Laboratory.

This paper also focuses on understanding how the basic ideas of the quantum mechanics for making building blocks of the quantum computers via quantum computing.

KEYWORDS: quantum, computer, CT, state.

I. INTRODUCTION

The system of computer development shows that its working capability and computing ability, the smaller computers give more powerful it has more ability in number-crunching than the big size of the computers. It is known that difference between the today's cellophane and room-sized computer in 50 years ago.

Instead of delightful advances, there are still plenty of complex problems that are found for world's most powerful computers and hence there is no guarantee for solving the critical problems. In today's system of electronic computers, the basic problem in their switching and memory units, Inbuilt transistors are now advising the point where they found as small as individual atoms and they are used in present. However entering in to the area of atoms opens up powerful new possibilities in the field of quantum computing with processors speed could work millions of time faster than the one we use today.

However, the trouble is that quantum computing is more complex than traditional computing wherein quantum physics laws no longer apply. The next point discuses the quantum computing and how does it work for building blocks of the quantum computers.

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II. CONVENTIONAL COMPUTING

The base of the conventional computer is the mathematical computational system which is based on the basic laws of the mathematics. These laws are fired with the electronics system it is also observed in the simple calculator. In Conventional computers work well on two tricks one is it can store numbers in memory and they can process stored numbers with simple mathematical operations like add, subtract, multiply, etc. They can do more complex things by gathering complex problems together; they make the simple operations into a series of statements which are called an algorithm.

All the storage and switching is followed by computer's key, storage and processing is to be accomplished using switches which is called transistors, here on, off logic is used that is it stores a number zero (0) and one (1). It is called binary storage system.

Further development proceeds with calculate by using circuits called logic gates, which are made from a number of transistors connected together which are used for compare patterns of bits, stored in temporary memories known as registers, it is further assembled such a way that pattern of bits are formed and it works like human brain processes.
The major trouble with conventional computers is that they depend on conventional transistors circuit assembly. Inherent problems for computing, storing and processing further handled by integrated circuits, in which billion of transistors have been used in 1960s; according to the Intel co-founder Gordon Moore the power of computers is found to be doubles in the short range of duration.

In this important system innovation, he has missed one important observation that integrated circuit based computer system requires more and more transistors and get and related electronic circuits system to solve the complex problem. Such type of unpredictable development uncertainties come to conclusion that there is need of strong computational system for solving complex problem.

The conventional computers can only do one task at a time, the more complex the problem you want them to solve, the more steps are required complete it. If computing problems are so difficult and complex that they are in need of modern computer which has more computing ability and power with short time. These need want researchers and works of computers greatly attracted towards the new computing system, known as ‘quantum computing (QC)’. This idea of the QC and generation of Quantum Computers (qComputers) is presented in the next section.

III. THE RESEARCH PROBLEM

If we advances the Moore's Law advances and found innovative then the number of inflexible problems disappears. In this advances the advanced computers get more powerful and we can do more with them. The basic trouble is that : we can prepare transistors as small as possible but they are still working on the classical laws of the physics. Hence said problem disappears but not solved or resolved. Here we cannot stop the laws of physics in the Moore’s advanced computer system. Unfortunately, there are still large difficult computing problems we are unable to handle or tackle because such powerful computers find them inflexible. This is unique reasons that why computer scientists and researchers are now getting interested in quantum computing.

“On the basis of above discussion there is a need of a strong research to develop a computing system where in classical laws of physics should stop and turn attention towards the quantum theory of physics application in the building blocks of quantum commuting systems for getting the existence of quantum computer in future.”

Quantum Theory:
This theory began in 1900 which was presented by Max Planck in German Physical Society, in which he pointed out that the idea that energy exists in individual units which he called "quanta", such as it happens with the matter. Matter

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as a discrete unit, wave -particle dual nature and random moments are the characteristic essential elements of the Quantum theory (QT).

IV. CLASSICAL AND QUANTUM COMPUTING TECHNIQUES

Classical computing based on the Boolean algebra, operating with a usually 7-mode logic gate principle, which is responsible to generate three modes which are AND, NOT, and COPY. Data is then processed in an exclusive binary state at any point within a time that is, either 0 means off / false or 1 means on/true. Such values are called binary digits or bits. Here important is that the billions of transistors and capacitors and registers work on the only one state at any point. In another time that each transistor or capacitor need to be either in 0 or 1 before switching states are to be measured in billionths of a second, still there is limit to how quickly these devices may go for switching sate.
Present advances even though have smaller and faster circuits, but there are physical limits of materials and the threshold for classical laws of physics where we have to apply.

In these above uncertainties and difficulties, beyond this the quantum technology was born from its theory which opens great potential as the challenges that are presented in the above paragraph (classical theory).

On the contrary the Quantum Computer can work with a two-mode logic gate one is XOR and another is mode we will call QO1 it has the ability to change 0 into a superposition of 0 and 1. This type of logic gate cannot exist in classical computing.

In a quantum computer (QUC), a number of elemental particles such as electrons or photons can be used with either their charge or polarization acting for 0 and/or 1. Each of these particles is known as a quantum bit, or 'qubit'. The nature and behavior of it is then forwarded for becoming a basis of quantum computing (QC), with relevant aspects of quantum physics with its principles of superposition and *entanglement.*

Superposition: let us consider the qubit as an electron in a magnetic field with two states are: *spin-up* and *spin-down* state. While changing their states i.e. electron's spin from one state to another is achieved by using or generating a pulse of energy, which is called laser, more correctly we can say that one unit is of laser energy. Here if we consider it will be free from all external influences and according to quantum law, the particle then enters a superposition of states, in which it behaves in both states simultaneously. Thus unique qubit utilized for superposition of both 0 and 1.

In conclusion, the number of computations could be noted as 2^n, where n is the number of 'qubits' is used. For example quantum computing system have 300 qubits would have a power and potential to do the operational computation is 2^{300} in a single step. When we compare this number 2^{300} in classical parallel processing computer system then it is clear that this number is found to be infinitely more atoms than in the known universe, but they would do via quantum entanglement.

Entanglement Particles like photons, electrons, or qubits that have interacted at certain point and retain energy in with each other in pairs. This process is known as *correlation.* If we know the *spin state* of it, i.e. up or down posses the superpostition state, the measured particle simultaneously in both a *spin-up and spin-down (SU and SD) state.*

The spin state of the particle being measured and communicated to the correlated particle, which simultaneously assumes the opposite spin direction to that of the measured particle. Research and development survey shows that at present this mechanism has not any theoretical explanation. Quantum entanglement allows qubits that are separated by *incredible distances* to interact with each other instantaneously which is not limited to the speed of light. Not sure how great the distance between the correlated particles, it will remain entangled till they are isolated.

From the above discussion it is clear that if we take together: the quantum superposition and entanglement create an enormously enhanced computing power. Where a 2-bit register in an ordinary computer can store only one of four

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binary configurations (00, 01, 10, or 11) at any given time, a 2-qubit register in a quantum computer can store all four numbers simultaneously, because each qubit represents two values. If more qubits are added, the increased capacity is expanded exponentially

In conclusion measure components of the ordinary computer are bits, registers, logic gates, algorithms, and so on which have a analogous characteristics in a quantum computer. However instead of bits, a quantum computer has *quantum bits or qubits*, which work in a particularly stimulating way.

In the classical model of the computer the most fundamental unit is bit which can exit in one of two states i.e. 0 or 1. However in the quantum computer rules are changed, instead of bit, qubit have been referred. At a state every bit can store either a zero or a 1, while *qubit* can store a 0 in one universe and 1 is in another, both 0 and 1, or an infinite number of values in between and creating multiple states which store multiple values at the same time.

Quantum computer can store multiple numbers at a time; therefore it can process them simultaneously. Instead of working in serial it can work in parallel way in which we have tried to find out its actually state in at any given moment. Finally this would suggest that a quantum computer's ability to work in parallel would make it millions of times faster than any conventional computer provided state remain quantum mechanically stable at that moment.

V. DISCUSSION ON CONCLUSION AND FUTURE SCOPE

Quantum Computing is a new and vibrant field interrelated with mathematics and union of computer science and physics. It utilizes the quantum mechanics to improve the efficiency and capability of computation for complex problem. This paper starts with introduction with motivational steps in which the central ideas of quantum mechanics / physics is presented.

Here we focus on the '**qubits'** in comparison of normal '**bit'** in digital computer. It is better to conclude that the quantum theory is very useful to develop a quantum computer in future. The Idea of the computing is found to be invariant and uncertain but definite restores on the computational methods so that quantum dot will become a strong base and in applied manner.

At present, quantum computers and quantum technology remains in its revolutionary stage. In true sense the quantum computers are generally superior to conventional one. The difficulty arises of actually building them. Research and innovative steps in this field pointed out that the said problem will be resolved and solved by means of improving concern technology in time.

VI. CONCLUSION

At this moment obstacles are being surmounted that will provide the knowledge needed to thrust quantum computers up to their rightful position. Such error correction has made promising progress which may have the tools required to build a computer robust enough to adequately withstand the effects of decoherence. On the other hand Quantum hardware remains unrecognized emerging field with other quantum algorithms. Thereby, quantum computers will emerge as the superior computational devices with reference to today's modern computer obsolete.

Thus Quantum computation has its origins in highly specialized fields of theoretical physics which indeed will effect in future, then only true outcome effect will be seen in the form of quantum computers.

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