 ISSN: 2321-8169
120 – 122

Review Paper on Quantum Computing and Applications

Prof. Rahul R. Ambalkar
Asst.Prof Depart of EXTC
MGI-COET, Shegaon, Maharashtra.
Ambalkar.rahul@gmail.com

Mr. Rushabh R. Khandare
final year student of EXTC Dept.
MGI-COET, Shegaon, Maharashtra.
Rushabhk30@gmail.com

Abstract-Classical Computers has enabled amazing things, but they lack at various factor like Optimization and Simulation, due to their classical processing of speed and size. There is need for new way that takes less time and space to computing and storing data. One best approach is well known theory of physics is Quantum Computing, which is devolving technology day by day. This paper is about basic ideas behind Quantum mechanics like Superposition and Entanglement and its physical building block. This paper also discussed about its applications.

Keywords—*Quantum computing (QC), Qubits, Conventional coputing, Superpositionand Entanglement.*

*****

I. INTRODUCTION

We want our technology to be faster, small and economically balance. We are well known about how today's computer works. The digital logic behind it is actually very simple and fairly intuitive: an array of 0s and 1s represents a number. Ever since the invention of computers, researchers have tirelessly worked on developing more powerful processors to tackle problems with ever-increasing complexity. Over the past half-century, Moore's Law, which states that the processing power of a circuit board will double every two years, has held true, as 2016 the largest transistor count in processor is over 7.2 billion and minimum size of transistor 14nm. with transistors shrinking to the size of molecules. However, there is physical limitations . Atoms are the smallest unit of matter in the universe, and if we reduce the size of transistor to atom it will hit physcical limit and there is no possible way build more powerful processor by reducing size of transistor by using traditional method. Quantum physics seem to be the perfect solution to this problem. Quantum computers aren't limited by the binary nature of the classical physical world, however – they depend on observing the state of quantum bits or qubits that might represent a one or a zero, might represent a combination of the two or might represent a number expressing that the state of the qubit is somewhere between 1 and 0. quantum computing with processors speed could work millions of time faster than the one we use today.

II. QUANTUM COMPUTING

Quantum physics is the study of physical phenomena that happen at the atomic or subatomic level. Quantum physics have features like Superposition and entanglement to allow for more efficient algorithm. To find prime factor of 2048 bit number, it will take conventional computer millions of years, but Quantum computing could do it in just in minute. Quantum computers are completely new and entirely different kind of computer. Quantum computer works on Qubits instead of classical bits, this device take advantage of quantum superposition to reduce the number of steps required to complete the computation. Particles like an Electron, photon and nucleus of phosphorous atoms can be used as Qubits. Quantum mechanics have many strange property Superposition and Entanglements are of among them.

A.SUPERPOSITION

Superposition is very odd phenomena in which objects are in more than one state at a time, in superposition each Qubits be the combination of 1's and 0 states, this cause QC much more powerful than conventional computers. one Qubits have two state means one qubit contain two bits of information, Two qubits contain four bits of information and it goes up exponentially i.e. two to the power n, n= Qubits. Qubits can make use of superposition to be in multiple states at one, when Qubits is measured the Qubits will collapse to 1's or 0's. This means QC gives many different things at ones but only one of those is output.

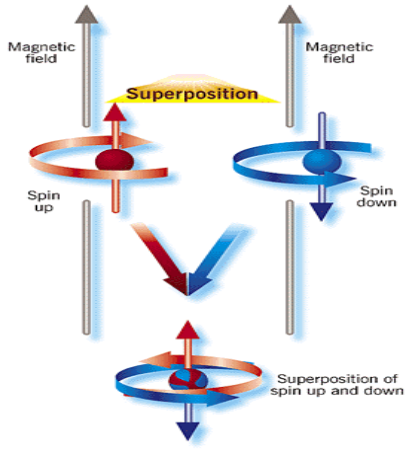

Figure 1.Superposition states

B] Entanglement

Entanglement is property where two particles behave exactly the opposite of each other. If two particle entangled with each other and one of them state is changed somehow the other will react exactly the opposite way, this action of being opposite of other particle is done instantly faster than light speed and no matter how far the particles from each other. For example if two coins is in superposition state spinning and first

 ISSN: 2321-8169
120 – 122

one lands on head, so we can tell second one is going to be tells even if we don't look at it.

III. QUANTUM COMPUTING PHYSICAL BUILDING BLOCK

We encode and access information in classical commuting is by regulating voltage of transistor switches inside the integrated circuits. Quantum computer have similarities to and difference from classical transistor idea.Quantum computing use superconducting qubits, which is the basic building block of QC.

We can call it Quantum transistor which is made up from a metal called Niobium. We can also use other material which shows quantum property. Niobium material has property of interference; it refers to the electrons, which behave as waves which give rise to Quantum effect. When niobium is cooled down, it becomes superconductors and it start to show quantum mechanical effect of superposition. We can control this object so we can put the qubit in superposition of these two states i.e. by adjusting a control knob on QC we can put all the qubit into superposition state. Now to exchange information Qubits must be connected together. This is achieved through elements Couplers. Couplers are also superconducting loops, by putting many qubit and couplers together we can start to build up a fabric of Quantum devices that are programmable. Qubits and couplers are surrounded by framework called switches, for address each qubit. And store information in magnetic memory elements local to each device. Additionally there are read out devices attached to each qubit, after a computation has finished and the Qubits have their finial 0 and 1's states the readout are used to query the value held by qubit and return the answer as bit to end user.

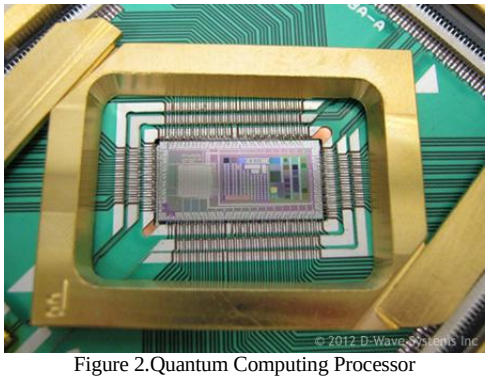

Figure 2.Quantum Computing Processor

This architecture is very different from conventional computing, it's like biological brain and Qubits as being like neurons and the couplers as flow control of information. For the processor to function there is need of reduction in temperature below approximately 80 mk. and generally the lower the temperature betters the performance. The currently quantum computer uses approximately 15mk. This is approximately 180 times colder than Interstellar space.

The input output subsystem is responsible for passing information from user to Quantum computer and opposite. The signals which uses are low frequency analog currents (>30MHZ) carried by metal lines at lower temperature. Currently there are web client libraries are available provided by currently Quantum computing company and research labs for user to access the quantum computer easily which allow user to use C and C'++ , python and Mat lab language to access quantum computer.

For the past decades, the number of qubits has steadily doubling each years as shown in following picture and expected to continue. To create quantum processor with number of qubits up to around 10,000 just have to add more qubits in the same way and there are certainly ways to go beyond 10,000 qubits.

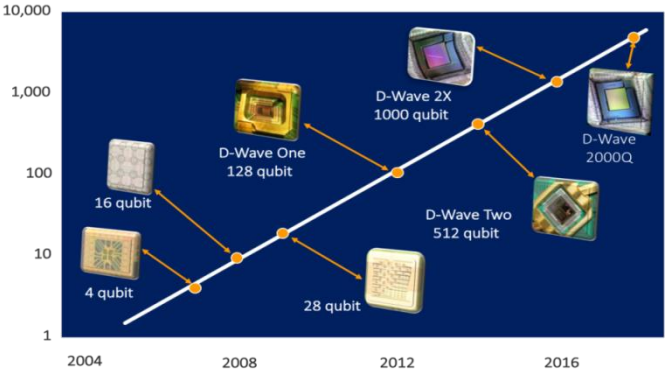

Figure 3.D-wave growth of qubits in Processor.

IV. APPLICATIONS OF QUANTUM COMPUTING

Quantum computing offers the possibility of technology millions of times more powerful than current system and there are many areas where quantum computing can bring revolution are as follows.

1. Machine Learning and Medical Science
2. Artificial Intelligence
3. Chemistry and Cryptography
4. Material Science and Engineering
5. Allows us to understand the building block of human beginning
6. Simulating molecular bond
7. Rapid search of complicated data base
8. Factoring large number
9. Optimization
10. Radiotherapy Optimization
11. Protein Folding
12. Object Detection, Image processing and Video Compression

V. CONCLUSION

Quantum Computing is microscopic high-tech and vibrant field related with mathematics, physics and computer science. It's hard to control at very small scale and impossible to predict. It will truly change the future, allowing us to do things that never would be possible with classical computers. The strange property of this QC will open up whole new world and promises a new level of computational power. While we still have a long way to go and many details to work out. This paper starts with the basics of quantum mechanics concept and ended with currently base physical building block of actually quantum computing scenario and its applications. Rapid improvement in experimental quantum hardware shoes that the

 ISSN: 2321-8169
120 – 122

goal of building useful and reliable quantum computing will be within reach for better and fast future.

REFERENCES

[1] Engineer MR. Pedram Khalili, "Quantum Computers", and Publish on IEEE potentials, December 2002/January 2003. (*references)*

[2] DR.Simn J-Devitt, Scientist William J. Munro and Prof. Kae Nemoto,"High performance Quantum Computing/Program in Informatics", No.8,PP.49-SS,(2011)(*references)*)

[3] Dr.Magan P. Ghatule And Dr.Versha Ghatule,"Quantum Computing: A new approach for Quantum Computing" Publish in IJI RCCE, Vol.5 Issue 2,February 2017.(*references)*)

[4] R.Landauer, 'Information is Inevitably Physical', published in 'Feynman and Computation' edited by Anthony J.G.Hey (Addison WesleyLongman, Reading MA 1998).

[5] 2. J.A.Wheeler, 'Information, Physics, Quantum: The Search for Links', reprinted in 'Feynman and Computation', ibid.; originally published in

[6] Proceedings of 3rd Int. Symp. Foundations of Quantum Mechanics, Tokyo, p. 354 (1989).

[7] 3. A.J.G. Hey and P. Walters, 'The Quantum Universe' (CUP, Cambridge 1987).

[8] C.H. Bennett, 'Logical Reversibility of Computation', IBM J. Res. Dev. 17 (1973) 525.

[9] "Quantum Computing Primer." D-Wave Systems. Accessed 1.8.2017

[10] "Introduction to the D-Wave Quantum Hardware." D-Wave Computing. Accessed 1.8.2017.