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A REVIEW OF LITERATURE ON THE POTENTIAL USE OF QUANTUM COMPUTING IN DIFFERENT INDUSTRIES

¹ Dr. Sourav Gangopadhyay, ² Dr. Jayeeta Majumder,

¹ Assistant Professor, ²Assistant Professor

¹Department of Management,

¹ Haldia Institute of Management, Haldia, India

Abstract : Quantum computing is capable to make our world looks like science fiction movies. Classical computers have several limitations. The need for a computer is increasing day by day. The need is becoming so intense that a classical computer even a supercomputer is now showing its incompetence. So more powerful and more reliable technologies are needed and in this regard, the quantum computer is doing the same thing. Quantum computer is more fast and reliable than any classical computer available nowadays. The mechanism of a quantum computer is entirely different than all computers nowadays, instead of bits, quantum computers are made by using qubits. In this paper, we have done an extensive review of literature on the use of quantum computing in various fields and we have found it can bring a dramatic change in medicine, defense, finance, aviation industry, Artificial intelligence, and many more.

IndexTerms - Quantum computing, classical computer, supercomputer, medicine, defense, finance, aviation industry, Artificial intelligence.

Introduction

The basic of any classical computer is binary representation of information by a series of sequence of bits. Bits can have two states 0 and 1. In case of quantum computer basics is have three bits instead of 2 bits. These three bits together called qubits. Adding extra bit is proving a concept known as quantum superposition. In superposition both 0 and 1 exist at one time. In order to make a quantum computer apart from superposition, two other concepts are to be used – quantum entanglement and parallelism. Many scientists, researchers, and different R & D sectors all over the world are devoting themselves to Quantum computing technology. Many leading IT companies such as Intel, IBM, QuTech, and many more are spending millions of dollars on that field. Scientists are claiming that quantum computers can execute computation far faster than an ordinary computer (Devoret, 1908; Nakamura, 1997; Mooij, 1999; Wallraff, 2004; Koch, 2007). It is understood that quantum computers can perform far better and they can solve many problems in the fields of physics, chemistry, mathematics, and many more (Feynman, 1982). Previously the concept of quantum computers was placed in theories but now recent development draws everyone's attention. (Achintya, 2013). Quantum computer has huge potential and it can be used in machine learning (Farhi, 2018; McClean, 2018; Cong, 2019; Bravyi, 2018), Chemistry material science (Aspuru, 2005; Peruzzo, 2014; Hempel, 2018), and optimization (Kechedzhi, 2018; Somma, 2008). In this paper, we will be trying to understand how quantum computing can bring a remarkable change in different sectors. Different researchers are trying to find out the application and the reach of quantum computing, some of them are given below.

Review of Literature

Societal applications for quantum computing

This paper will discuss how quantum computers are able to change the social system as the first generation quantum devices are being simulated which is known as D wave system (1). Also we will discuss how in the future the quantum computer will bring the dramatic change in different field.

Green aircraft

It will take around 7 years for Traditional computers or the classical computers to produce simulation of air flowing in the wing of the aircraft but in case of quantum computer it will take only few weeks. It is also capable to simulate every molecule of air flowing in the wing considering every angle and speed. For that reason the big air craft companies are now trying to develop quantum computers (A. Tovey 2017). It will help them to develop quickly more efficient, strong air craft which is noiseless and fuel efficient so as to reduce CO₂ emission.

Optimization in space application

Quantum Artificial Intelligence Laboratory of NASA is doing research on quantum computers to reduce various problems in aerospace applications. Through the quantum computer in this field is to develop several applications such as quantum artificial intelligence algorithms, problem decomposition and hardware embedding techniques, and quantum-classical hybrid algorithms and many more (3).

Secured Communication Technology

Quantum encryption is another remarkable and mostly discussed topic nowadays. Recent encryption can easily be broken by quantum computers. In case of traditional computers breaking the encryption is time consuming affairs but as new quantum algorithms are now developing so it can be predicted that quantum computer can break any code. The quantum encryptions technology can be used in fast moving object too such as air craft. Also optical communication system can also be able to convey the information (22).

Flood Prediction

With the help of quantum computers, a quantum simulator was developed and it helps to encode fluid dynamics transport phenomena within a lattice kinetic formalism. By that, it can predict the flow of water, air, and other kinds of liquid (A. Mezzacapo, 2015).

Medicine

Quantum computers can bring revolution in the medical field. Quantum computers can go into analyzing the molecular interaction which is important to design new medicine. It can create models of all types of protein in the human genome so that time for designing a new drug will be much shorter. Designing medicine for many life-threatening diseases like cancer will be easy with the help of quantum computers (P. Diamandis, 2016). Quantum computing is also able to bring a dramatic change in the diagnostics too, like with the help of quantum computing the analyzing image, matching the image will be vastly improved also with the help of single-cell method, single-cell sequencing, and flow cytometry will be possible and by that implacable diagnosis will be possible (P. Diamandis, 2016; Andreyev, 2020). Furthermore, with the help of the quantum computer,s we can develop biomarkers and by that, we can create data set of genomics, transcriptomics, proteomics, and metabolomics (McDermott, 2012).

Finance

Quantum computing can improve financial forecasting, solve complex optimizing problems, detection of fraud, and many more. With the help of Monte Carlo Simulation, the quantum computer can detect the risk and uncertainty of any financial forecasting model. This was tested by IBM.

Artificial Intelligence

Quantum computing can manage large data set, simulate more profound and complex models, solve problems quickly, these are all necessary for artificial intelligence. For that reason, organizations that are working in artificial intelligence are seeing prospects in quantum computing. Like Google is developing machine learning tools with the combination of a quantum computer and classical computer. Quantum computing can bring a more advanced form of pattern detection, voice recognition, machine translation, and many more.

Defence

Quantum computing is being used by many developed countries to boost up their national security. Quantum computing is extremely helpful to break the code, spying, making accurately simulated battles field, and many more. Both China and the USA are spending billions on a quantum computer to make their defense system more powerful and invincible than any other countries.

Conclusion

Quantum computers are able change our known world in such a way that we cannot be able to comprehend. Before the world is totally controlled by quantum computer, there will be some problems for those countries those are not able to adopt this because to establish and implement quantum computer requires funds, infrastructure which will not be possible for many countries. Also quantum computer is able to create more accurate simulation, so there could be a chance blind trust on

simulation rather on reality. Other problems of quantum computer could be improper inputs because in that case simulation model will not be able to predict. Apart from that due to quantum effect on the computation, it leads develop difficulties in interpretation. So a robust error estimation process is needed to be implemented for that reason extensive research on error estimation is needed most.

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