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Accra Bespoke Multidisciplinary Innovations Conference (ABMIC)

& The Africa AI Stakeholders' Summit 14th December, 2021

Overview Of Variances Between Quantum Computing & Classical Computing

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Proceedings Citation Format

Oloyede, O.A., Yekini, N.A. & Akinwole, A.K. (2021): Overview Of Variances Between Quantum Computing & Classical Computing. Proceedings of the Accra Bespoke Multidisciplinary Innovations Conference. University of Ghana/Academic City University College, Accra, Ghana. December 2021. Pp 235-242. www.isteams.net/ghanabespoke2021.
DOI https://doi.org/ 10.22624/AIMS/ABMIC2021-V2-P18

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ABSTRACT

Ups and downs in science and technology have led to new discoveries. In the traditional approach to computing (classical computing), a bit is either ON or OFF, a modern approach to computing in the twenty centuries are machines that use that uses quantum technology to store data and perform computation unlike classical computer the basic unit of memory is a quantum bit or qubit where data can be ON and OFF at the same time. This paper presents an overview of variances between Quantum Computing & Classical Computing with focus on the following key points Basis of computing; Information storage; Bit alues; Number of possible states; Output; Gates used for processing; Scope of possible solutions; Operations; Circuit implementation. The focus of this work is to present an information towards understanding the full potentials and challenges of a practical quantum computer that can be launched commercially, and ignite a spark of interest among readers that could lead to further reading and research in the domain of quantum computing.

Keywords: Quantum Computing, Classical Computing, Superposition, Entanglement and Interference

1. INTRODUCTION

Ups and downs in Science and Technology have led to new discoveries in all aspect of life and computing is not left behind. Nowadays, the computer solves the problem immediately and correctly if the necessary plan is provided. It started in World War II, when Alan Turing developed a real information computer with a working device and was called the "Turing Universal Machine". Von Neumann rewrote it and it is now the core of almost all computers. Advances in managing and understanding people through nature and the body have given us the most advanced electronic tools we use today Surya and Hemanth (2020).

“Quantum computing may be a modern way of computing that's supported the science of quantum physics and its unbelievable phenomena. It is a gorgeous combination of physics, mathematics, and computing and knowledge theory. It provides high computational power, less energy consumption and exponential speed over classical computers by controlling the behaviour of small physical objects i.e. microscopic particles like atoms, electrons, photons, etc.” Surya and Hemanth (2020). Quantum computing is that the way forward for computing and therefore the game changer for an entire lot of fields (Mohamad Joudi, 2020).

Based on advancement in technologies and sciences a quantum computing is now seen as future of computing. The classical computing operates on binary number 1 or 0 which is either ON or OFF. Quantum computing uses qubit as unit of memory unlike classical computer, it can be ON and OFF at the same time, a condition known as superposition.

Quantum computer can be categorize as Analog quantum computer; Quantum Annealing; Quantum Simulation; Adiabatic Quantum Computing; NISQ gate-based computer; Gate-based quantum computer with full error correction Van Meter, V. (2006); Gruska, J. (2017). Until now, we've relied on supercomputers to unravel most problems. However, supercomputers aren't excellent at solving certain sorts of problems, which seem easy

initially glance. Supercomputers don't have the memory to carry the myriad combinations of the important world problems. Hence needs for quantum computers. The main goals of quantum computing is to discover a means of expediting the execution of long waves of instructions and to help immensely with solving problems related to optimization which play a key roles in everything from defence to financial trading. McMahon, D. (2018).

"Research in quantum computing is at the very initial stages and hence there's tons that has got to be discovered and proved with actual results. Undoubtedly, quantum computing is the future of computing. With all the tech giants, including IBM, Google and Microsoft, investing in R&D in this field, research and job opportunities are sure to flourish in the future. Quantum computing is catching the attention of young researchers from across the world. Principle-wise, any computational problem that is classically solvable is also quantum solvable" (Pragya Katyayan & Nisheeth Joshi 2020).

This paper presents an overview of variances between Quantum Computing & Classical Computing with focus on the following key points Basis of computing; Information storage; Bit values; Number of possible states; Output; Gates used for processing; Scope of possible solutions; Operations; Circuit implementation. The focus of this work is to present an information towards understanding the full potentials and challenges of a practical quantum computer that can be launched commercially now and in future

2. LITERATURE REVIEW

1.1 Conventional Computer vs. Quantum Computer

When designing the conventional computer, it was kept in mind that transistors' performance especially when getting lower, will be affected by noise if any type of amount miracle takes place. They tried to avoid amount marvels fully for his or her circuits. But the amount computer adapts a special fashion rather than using classical bits and indeed works on the amount miracle itself. It uses amount bits that are similar to classical bits and have two quantum countries where it are frequently either 0 or 1 except it follows some amount parcels where it can have both values contemporaneously performing in an idea of superposed bits. Gildert,S. (2007).

Quantum Bit or Qubit Recrimination in Quantum Computing

This is the unit of amount information that represents subatomic patches similar as tittles, electrons, etc, as a computer's memory while their control mechanisms work as a computer's processor. It can take the worth of 0, 1, or both contemporaneously. It's times more important than moment's strongest supercomputers. Product and operation of qubits are tremendous challenges within the field of engineering. They acquire both, digital also as analog nature which provides the amount computer their computational power. Their analog nature indicates that amount gates have not any noise limit and their digital nature provides a norm to get over this serious weakness.

Thus, the approach of sense gates and abstractions created for classical computing is of no use in amount computing. Quantum computing may borrow ideas only from classical computing. But this computing needs its own system to overcome the variations of processing and any type of noise. It also needs its own strategy to remedy crimes and handle blights in design. Ladd TD, Jelezko F, Laflamme R, Nakamura Y, Monroe C,O'Brien JL. (2010).

Quantum Computer Architecture (QCA)
No mistrustfulness that a computer is a device that execute sequence of instructions and a sequence to perform this certain task are called programs. The ultramodern computer infrastructures are grounded on Von Neumann armature which is shown in the illustration figure 1. Brandl (2017) presented knowledge of classical computer armature, like von Neumann armature or pipelining, which is applicable in Quantum Computer Infrastructures

(QCA). Quantum computers are different from classical computer because decoherence in qubits destroys Quantum Information (QI) over time, which has to be compensated by executing amount error correction (QEC). Whereas, classical information can, in proposition, be stored constitutionally long. Therefore, amount computers with an outsized memory would bear community for fault-tolerant calculation. Monroe,C., Raussendorf,R., Ruthven,A., Brown,K.R., Maunz,P., Duan,L.-M., & Kim,J. (2014). Quantum computer armature combine features in classical armature with amount corridor and it has 5 layers (Operation Subcaste, Classical Subcaste, Digital Layer, Analog Layer, and Quantum Layer), each represent a functional part of the computer system. Surya and Hemanth (2020). The QCA is presented as in figure 2.

Quantum Computing (QC) has a promising field with effective results to classically delicate problems ineluctable conclusion of Moore's law, Decryption & Encryption, Computer modelling of QM physical perpetration needed in working or bypassing the problem of trap. QCA has a methodical approach to organizing the coffers of a amount computer, (CodyN. Jones (2016).

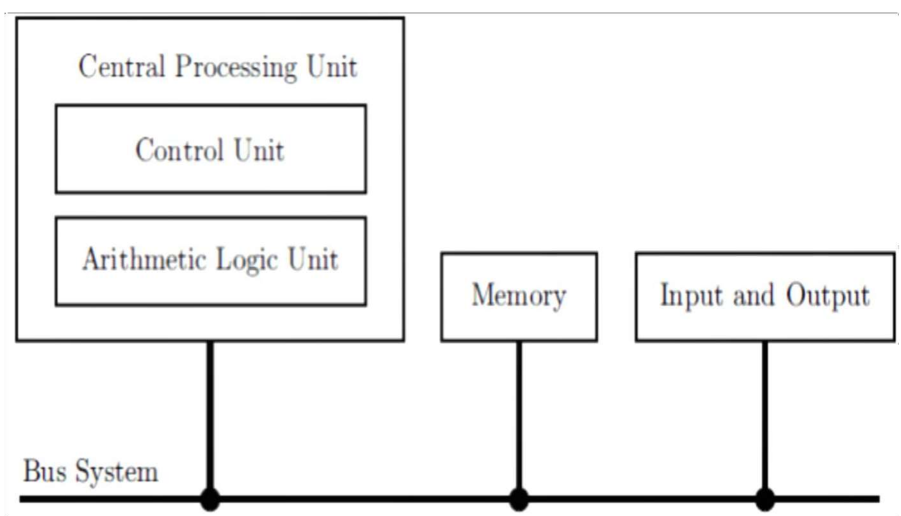

Figure 1. Von Neumann architecture
Robert Sizemore, 2015)

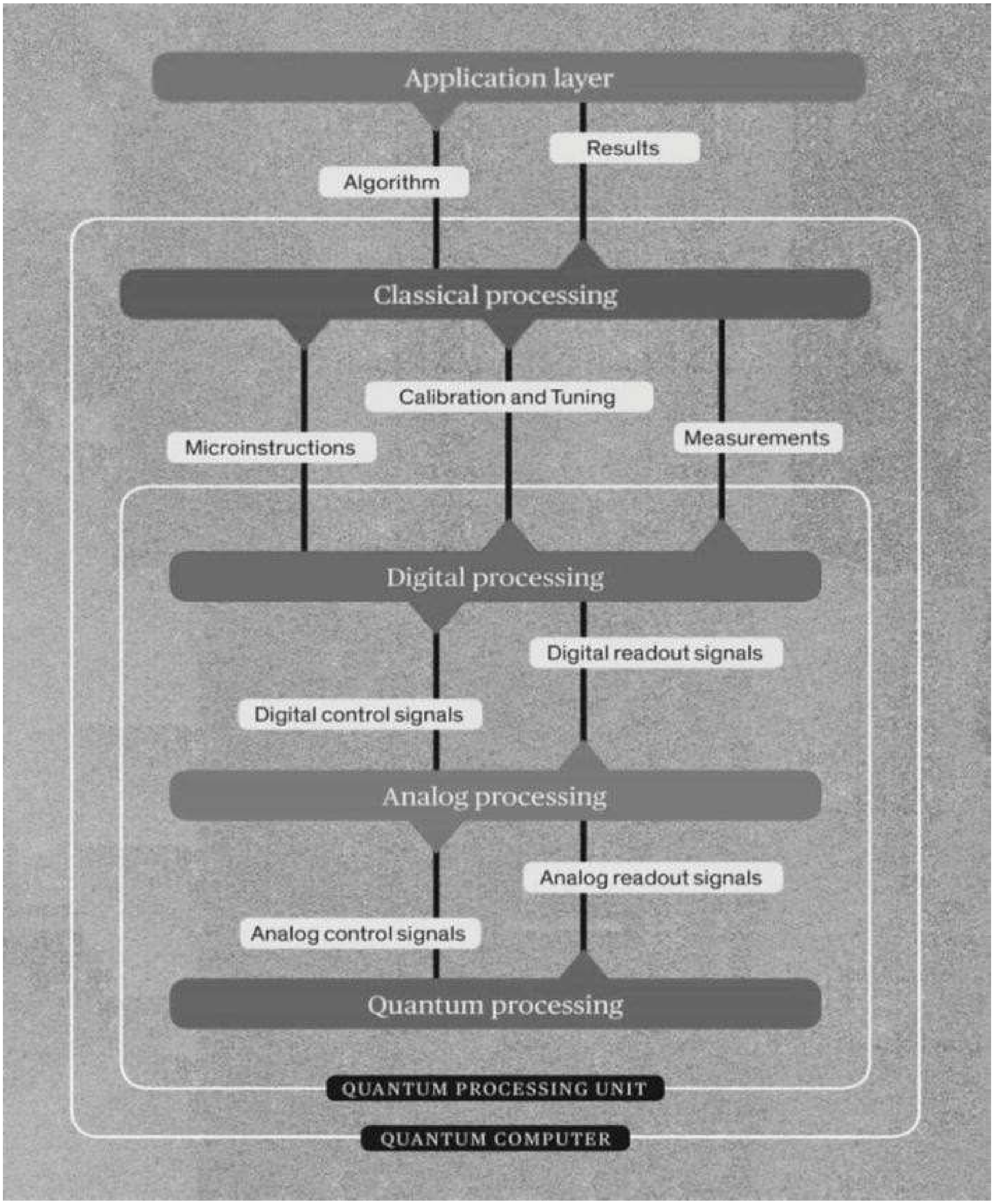

Figure 2: Quantum Computer Architecture (QCA) (Source: Surya and Hemanth (2020)

3. METHODOLOGY & FINDINGS

Methodolgy

The focus of this work is to present an information towards understanding the full potentials and challenges of a practical quantum computer that can be launched commercially. To achieve the objectives we review some of the few available works on quantum computer and compared the functionality of the quantum computer with classical computer with particular attention on Basis of computing; Information storage; Bit values; Number of possible states; Output; Gates used for processing; Scope of possible solutions; Operations; Circuit implementation.

Findings

The findings revealed the following variances between quantum & classical computing using the following comparison key: Basis of computing; Information storage; Bit values; Number of possible states; Output; Gates used for processing; Scope of possible solutions; Operations; Circuit implementation. The findings is as tabulated in the table below.

Table 1: Comparison

Comparison Factor	Classical Computer	Quantum computer
Basis of computing	Large scale integrated multipurpose computer grounded on classical physics	High speed resemblant computer grounded on amount quantum mechanics
Information storage	Bit based information storage using voltage/ charge	Quantum bit (qubit) grounded information storehouse using electron spin
Bit values	Bits having a value of either 0 or 1 and can have a single value at any instant.	Qubits having a value of or occasionally negative and can have both values at the same time
Number of possible states	The number of possible state is 2 which is either 0 or 1	The number of possible states is horizon less since it can hold combinations of 0 or 1 along with some complex information
Output	Deterministic- Affair Deterministic- (reiteration of calculation on the same input gives the same output)	Probabilistic- (reiteration of calculation on superposed countries gives probabilistic answers)
Gates used for processing	Logic gates process the information sequentially, i.e. AND, OR, NOT, etc.	Quantum logic gates process the information parallel
Scope of possible solutions	Defined and limited answers due to the algorithm's design probabilistic and multiple answers are considered due to superposition and trap parcels	Probabilistic and multiple answers are considered due to superposition and trap parcels.
Operations	use Boolean Algebra Operations	Use direct algebra and are represented with unitary matrices..
Circuit implementation	Circuits enforced in macroscopic technologies (e.g. CMOS) that are fast and scalable.	Circuits enforced in bitsy technologies (e.g. nuclear glamorous resonance) that are slow and delicate.

It was also discovered that potential and projected market size of quantum computer have resulted to engagement of some of the most prominent technology companies to work in the field of quantum computing, including IBM, Microsoft, Google, D-Waves Systems, Alibaba, Nokia, Intel, Airbus, Hp. Etc. percentage of large companies planning to create initiatives around quantum computing by 2025.

4. CONCLUSION

Quantum computers have the potential to revolutionize computation by making certain types of classically intractable problems solvable. A few large companies and small start-ups now have functioning non-error- corrected quantum computers composed of several tens of qubits, and some of these are even accessible to the public through the cloud. Additionally, quantum simulators are making strides in fields varying from molecular energetic to many-body physics. Some prominent technology companies like IBM, Nokia, Google, Intel etc are currently working on quantum computing and it advancement. Quantum computing is a future of computing as reflected from finding resulted from comparison of classical computing and quantum computing using this nine classical factors Basis of computing; Information storage; Bit values; Number of possible states; Output; Gates used for processing; Scope of possible solutions; Operations; Circuit implementation.

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