Deficient Computing Power and New Alternatives to Moore's Law

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I. Introduction

Computational power is significant for various groups of data experts to draw analytical processes and conclusions. It provides the basis for further data analysis in an event where a more specific solution is required for a problem. In the modern technological world, different processes have emerged for a new generation of data, which is fast, safe, and accurate for other analytical solutions. An example, Google generation in its global primary data center operates with an electrical power that ranges between 500 and 681 megawatts.[1] Nevertheless, the emergence of the modern form of data algorithms and processing assist in the extraction of nonobvious and critical patterns form large data sets. The new algorithms get based on the contemporary excavation of data and information to create a broad data spectrum for analysis and transformation. Further studies indicate that more than 11 .6 quintillion bytes of data get generated in phases, of which 86.6 percent of the big data has been created in the last 24 months.[2] As a result, the error decay always accompanies data volume and appears to be considerably slow to the extent of becoming impractically slower even in the face of zettabytes. However, the massive number of data that is generated daily raises the need to practically increase data storage with a significant increase in computing power to convert data into information. Most times, data scientists find Digital Integrated Circuit (DIC) method to be less effective than modern algorithms due to impracticability.[2] Nonetheless, Moore's law shows a direct relationship with the level of computing power. Gordon E. Moore postulated this law and observed that transistors number in dense integrated circuit doubles in an estimated two years. The observation and projection are based on the historical trend because it is an empirical relationship rather than natural or physical law.

II. THE PROPOSALS

New studies have indicated that Moore's Law is under threat because it does fail to offer possible emergency sources of computation power. The law observes that projects on the doubling of the computation power within two years. As a result, scientists in the 21st century have continued to progress towards enhancing the semiconductors in the Central Processing Units (CPU) of computers. They go a long way in increasing the computer's operating speed every year for faster computation of data elements. However, maintaining significant and exponential progress in achieving this milestone has been met with many obstacles. Moore's law had weaknesses that limit the purpose of its operation, and thus scientists work diligently hard to seek alternatives that would achieve fastness increased computational power and mass storage. In as much as there is a need for the increased computation power, Bremermann's Limit forms the maximum amount that is ideal for a processing power within a specified space. An example is a computer system with a total mass of the whole earth and operates within the Bremermann's limit. It performs within an estimated 1075 mathematical computation per second.[2] In this case, various qualitative and innovational technologies revolutionized the computer science world besides the universal common law. Through this paper, the 3D Computing devices, DNA Computing and Quantum Computing will serve as the researched alternatives to Moore's universal code for swifter computations.

A. *3D Computing Devices*

Moore's law is not an actual law; instead, it is a forecast or an observation. Since 1965, ordinary and universal Marxism has been in use, and with the advent of new technology in the 21st century, the conventional view will break down. Originally, transistors installed in different forms of computers were large and ineffective in that they had small storage space. Also, there were slow because their computation power was also in a regulated capacity. However, today's transistors are microscopic but faster, practical, and have massive storage that allows different forms of computations. Though few manufactures still use Moore's law, many technologies have predicted that it will breakdown in between 2022–2025.[3] The new devices follow a mechanism for speed and efficiency by scaling down the device dimension to fit a significant number of transistors onto a computer chip about Moore's law. Nevertheless, the increased number of transistors within

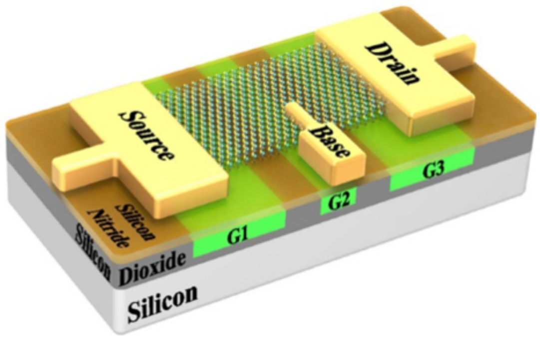

Fig. 1. A reconfigurable device with three buried gates

a computer reduces exponentially, and this aspect serves as a motivating concept for research scientists to seek other modes of enhancing semiconductor technologies.

New studies by a research group from SUNY-Polytechnic Institute in Albany, New York, indicates a combination of multiple functions within single semiconductor devices improves device functionality and minimizes fabrication complexity. Thus, it provides an alternative mechanism to scale down the device dimensions as the only method of progressing functionality. In a demonstration, the researchers developed a fabricated form of re-configurable device that morphed into three essential semiconductor devices: a p-n diode, bipolar junction transistor, and a MOSFET. An example of such a device is the 3D chip technology by Intel (INTC), which was planned to get introduced next year.

B. DNA Computing

DNA computing is a scientific branch that leverages on DNA, molecular biology hardware, and biochemical processes rather than the ancient silicon-based computer technologies. It is an emerging field and deviated from Moore's mechanism and use of Silicon-based products.[2] The fundamental research and development formed in this area concern the theoretical elements, experimentation, and applications of different technologies of DNA computing. Some sections of researchers believed that molecular computers could solve human-related challenges and cause the existing machines to strive as a result of inherent but massive biological parallelism. Through the biochemical based information technology, the programmable information chemistry will permit the construction of new forms of biochemical systems that possess the ability to sense the own understanding. According to Cringle, "even though chemical reactions take place at the nanoscale, it is due to the former's reliance on relatively large-scale molecular systems".[4]

Nadrian Seeman, an American biochemist, pioneered the DNA-based technology that used a particular form of a molecule to manipulate and regulate other bits. However, another computer scientist, Eric Winfree, who worked in collaboration with Seeman, demonstrated how dual dimensional "sheets" DNA could create an assemblance of the enlarged structures . He later, together with his student, Rethermed demonstrated how the tiles are designed in such a way that the process of self-assembly implementation for a specific computation. Other experimentations indicate that necessary calculations can be done through the different numbers of the building blocks. An example of simplified molecular "machines" that are dependent on the combined elements of protein-based enzymes and DNA.[2] In this regard, harnessing power for the molecules, there is a possibility of forming new types of information processing technology . The processing technology becomes self-repairing, self-replicating, and responsiveness. In this aspect, the possible implication and the application of emerging technology in different areas include tissue engineering, environmental conservation, and intelligent medical diagnostics.

C. Quantum Computing

Quantum Computing leverages the use on the technology of quantum-mechanical phenomena, which remains a critical component of a fundamental theory that describes nature at the smallest scales of energy levels of atoms and particles. The critical element of all modern alternatives to Moore's law is to execute computations in the most effectively and efficiently. For that reason, entanglement and superposition are fundamental in computational performances. Quantum Computing has brought in the technology of using qubits, which form its fundamental building blocks.[2] Besides, superposition occurs where the qubit presents itself simultaneously. The computation power in quantum computing ten times that applicable in microprocessor chips in Moore's and therefore increasing computational tasks at a go. However, there is a concern across governments for power injustices in the use of this alternative, and there must get formulated policies for the benefit of the manufacturers.[3]

However, new studies have indicated that quantum computing is expected to reach an important milestone. The new system will have the capacity to solve problems that no existing traditional computers could solve.[2] The integration of the silicon CMOS architecture reinforced with high power chips in quantum computing creates the basis of efficiency in computational operations. According to Menno Veldhorst, a Dutch researcher, Silicon CMOS IC's are the "prototypical" example for scalable electronic platforms. The integration of transistors is crucial in the development of high-quality spin qubits. On the other hand, the potential size of the physical circuit single extendable element is extraneously dependent on the specificity of details of the CMOS fabrication process. In as much as the qubits usable is low, the technology is in the process of enhancement with increased mass storage sufficient to replace the current relevant computing technology.[1]

III. Comparison of Innovative Alternative Methods

In the modern science, the creative and the innovative alternative methods have posed significant improvements in computing operations. In this regard, they bear some come

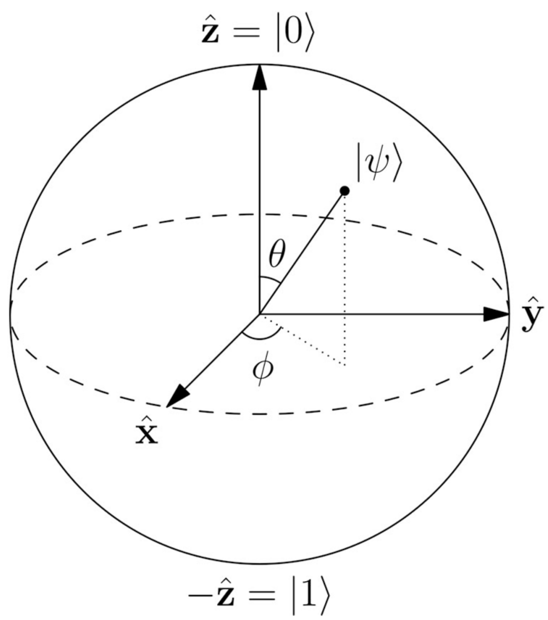

Fig. 2. Representation of qubit that forms the building blocks for quantum computers.

features which is an Improvement from the traditional Moore's Law. The moderate performance of the Moore law is attributed to low computing power. As a result, they all possess high computation power that has assisted in increased task computation. New studies have shown that inadequacy of the computing power renders Moore's Law ineffective. Further, the three new alternative methods despite having microprocessors have mass storage in comparison to Moore law devices. For that reason, they have increased the capacity for data and information with maximized speed and efficiency.[2] In contrast, the 3D Computing devices possess the highest number of transistors hence the highest speed among the three alternatives. Though they all follow different principles of operation, , DNA Computing provides the basis of biological computation system which cannot be performed by other alternatives. Quantum Computing uses leverages on silicon technology unlike the others.

IV. Conclusion

In conclusion, Moore's law of observation formed the basis of computing power and was responsible for limited tasks. Computational power is significant for various groups of data experts to draw analytical processes and conclusions. It provides the basis for further data analysis in an event where a more specific solution is required for a problem. Moore's law involves an observation that indicates the doubling of the number of transistors in a dense integrated circuit within 24 months. As an observational law, it seeks to create a projection of a historical trend and empirical relationship. However, due to the inadequacy of computing power, modern science has discovered new alternatives to Moore's Law, such as the 3D Computing devices. Quantum computing and DNA Computing technologies. The new inventions have changed the computing world by increased computation power, massive storage, fastness in computation.

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