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Potential and Emergence of Quantum Computers – A Review

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ABSTRACT

Computers are one of the most integral parts of modern human life style from analyzing tiny sub atomic particles to exploring the secrets of outer space it has become the most vital tool in the development of our civilization Right from its invention these machines are increases its capacity exponentially and decreases in its physical size but that change is about to meet its physical limit as the transistors are shrunken and now it is about the size of an atom the electrons from one end can pass through to other end with a process called quantum tunneling so the transistors are no longer acts as a switch but we can use particles which are in entanglement to pass the information

Keywords: computers, quantum tunneling, entanglement, error, logic gates

I.INTRODUCTION

A computer is made of simple components like Memory Unit, Arithmetic Unit, Control Unit and they do simple things like storing the data, the means of processing it and control mechanisms.

All these units consist of Control Chips which contain modules which consist of logic gates which contain transistors with all these mechanisms collectively work to gather we get the out put.

So, by this we know that transistor is the simplest form of data processor in the computer and it act as a switch which either block or open the way for information coming through, this information is made up of bits which can be set to either 0 or 1 combination of several bits are used represent more complex information and these transistors are combined to create logic gates like NAND, OR, NOR, AND these logic gates are also do the same depending on the type of gate we use they will give different output based on their input Combination of these logic gates finally forms a meaning full module for example adding of two numbers once you add you can multiply and if you can multiply you can do anything since all the basic operations are like first class math.If you have a large enough data module you can process any thing from quantum physics to astrophysics.However, the problem comes from shrinking parts like transistors are going tinier and tinier parts quantum physics is making things tricky.

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A transistor is acts as a switch electricity is the flow of electrons. A modern-day transistor is about 14nm as transistors are shrinking to the size of only a few atoms electrons may just travel to other side of the switch through a process called Quantum Tunneling,and by the effects of these processes.

II. QUANTUM COMPUTER

i. In classic. Computers BITS are the smallest units in which their values are 1 or 0 of information. However, quantum computers use QUBITS they have either 0 or 1 at the same time.

ii. **QUBITS:** Qubits are the entangled protons that are used in quantum computer unlike bits these qubits have either 0 or 1 at the same time due a process called QUANTUM SUPER POSITION, super position is a game changer .

iii. **QUANTUM SUPER POSITION:** let assume two photons which are vertically and horizontally polarized until you measure one the photon you can't really tell how it is polarized after measuring the value it will collapse to a value this is called super position.

iv. **Quantum entanglement:** It is the process which includes two particels if we measure the properties of one particle it will deduce the properties of another particle no matter the what is the distance between those particels.

v. By using these qubits, we can create quantum gates which can used in place of logic modules.

vi. These logic gates measures probabilities of the given situation and shows it in output which will be represented in 0's and 1's Which means you can get entire set of calculations all done at the same time.

vii. A classical computer can only process once at a time, so you need to follow trail and error to get the output.

viii. But in case of quantum computer all the possible ways are analyzed at the same time

Several studies are carried out on Intrusion Detection System since last 26 year. It is one of the imperative research area where more than 300 papers already published. M.Tavallaee surveyed on anomaly based intrusion detection and published his research work during the amount of 2000-08. In his research paper he had mentioned that, researchers uses their self-created dataset or they uses various publically available dataset like DARPA data , KDD cup'99 and NSL KDD dataset to spot attack or normal supported their classification accuracy, false positive rate or detection rate. Some of the researcher uses feature selection and reduction to scale back the dimensionality of dataset and it also improves the performance. Muhammad Imran et al applied K- resampling methods on 20% of NSL KDD training dataset for training and testing. Ibrahim et al. applied SOM on KDD 99 and NSL dataset and show the higher result of binary classification on KDD 99 dataset then that of NSL dataset. Bhoria et al. uses cart 4.5 to detect DOS attack. She applied resampling procedure used to evaluate machine learning techniques on 20% NSL KDD dataset for training and testing. The dataset of NSL KDD contains of 22,495 records with normal and DOS attack. Bajaj et al. applied information gain model for feature selection then applied J48, Naïve Bayes, NB tree, SVM and straightforward cart methods for binary classification. R.Patil et al. uses Adaboost machine learning on NSL KDD dataset.

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III.LITURATURE SURVEY

A) APPROXIMATE COMPUTING

Quantum computing is not entirely equivalent to classical approximate computing. In many quantum algorithms, if the result is wrong, it is not usable. Quantum states that are very far from the correct result will usually have some probability of being measured. In this case, the measured result is not an approximation and there is no way to recover a correct answer; the algorithm must simply be restarted. However, a recent trend has been the combination of classical optimization techniques and quantum subroutines

B) THE POSITION OF QUANTUM TECHNOLOGY

It is often noted that quantum computing, in the foreseeable future, is not a direct competitor to classical computers. The general notion is that quantum computers are capable of things that classical ones are not, but typically perform relatively poor on applications that classical computers can do well. The main reason for this is that quantum operations are slow, relative to classical transistor-based operations, and are error prone. Thus, there is often not much to gain by replacing a classical computer with a quantum one. Other relevant and useful applications have already been found. It is possible that the best uses of quantum hardware are currently unknown to us. For example, in addition to quantum computing, quantum metrology and quantum communication show much promise.

C) ERROR CORRECTION

When discussing the scalability of quantum technology it is necessary to understand the role of quantum error correction. Error correction is a necessary component of all computing systems. However, for quantum computers it takes center stage. Noise is essentially inevitable in quantum computation, and it's the main reason for large scale computers have not been built yet.

D) FUTURE WORK:

While much progress has been made, there is still a long ways to go. Quantum remains an emerging field and there are many open problems to pursue.

Devices with significantly lower error rates are essential to building large-scale computers. Architectures that are scalable with the number of qubits are required to build larger computers. Noise becomes more of an issue with increasing size and the architecture has to be built to handle this. Designs must be capable of implementing complex control operations and performing efficient error correction, all while not introducing excessive noise themselves. Additionally, the chips they require must be mass producible.

Algorithms that make use of noisy quantum computers are in high demand. Clever algorithms can lower the physical and engineering requirements in order to build useful quantum machines. Such algorithms are useful not only because they provide applications and benchmarks for current quantum computers, but they provide insight into the potential of quantum computing and motivate efforts towards ever larger scale implementations.

IV. CONCLUSION

Quantum computers, if fully realized, promise to be a revolutionary technology. As a result, quantum computing has become one of the hottest areas of research in the last few years while quantum computers cannot replace our classic computers for domestic use but in some areas it is superior like data base searching,

interspacial travelling and the most important field that benifical from these computers is simulations, simulations in quantum world are so intense, much effort is being applied at all levels of the system stack, from the creation of quantum algorithms to the development of hardware devices so why not simulate quantum physics with actual quantum physics Quantum simulations can provide new insights of galaxy which can revolutionige space field for now we don't know quantum computers are just a very special tool or a big revolution for humanity. The quantum age appears to be arriving sooner rather than later as commercially useful small-to-medium sized machines have already been built. However, full-scale quantum computers, and the full-scale algorithms they would perform, remain out of reach for now- only time will tell us

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