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QUANTUM COMPUTING

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Abstract:A quantum computer, if built, will be to an ordinary computer as a hydrogen bomb is to gunpowder, at least for some types of computations. Today no quantum computer exists, beyond laboratory prototypes capable of solving only tiny problems, and many practical problems remain to be solved. Yet the theory of quantum computing has advanced significantly in the past decade, and is becoming a significant discipline in itself. This paper explains the concepts behind quantum computing and communication, an essential component of future quantum information processing and its applications that would lead to a technological revolution. One such revolution is the emergence of Li-Fi.

Introduction:

Computer users have become accustomed to an exponential increase in computing speed and capacity over the past few decades. An enormous amount of computing power is required for the complex software used in computer animations, molecular biology analyses, computational fluid dynamics, global climate and economic modeling, worldwide credit card processing, and a host of other sophisticated applications [1]. The demands of these problem domains have led researchers to develop distributed computing systems harnessing the power of thousands, and in some cases more than a million, processors into clusters. Yet there are limits to this approach. Adding more processors increases the computing capacity of these clusters only linearly, yet many problems, particularly in physics and computer science, increase exponentially with the size of their inputs [2].

The doubling of computing power every 18 months has enabled scientists to tackle much larger problems than in the past, but even Moore's law has limits. For each new chip generation, the doubling of capacity means that about half as many atoms are being used per bit of information. But when projected into the future, this trend reaches a limit of one atom per bit of information sometime between 2010 and 2020. Does this mean that improvements in computing will slow down at that point? Fortunately, the answer is "not necessarily." One new technology, *quantum computing*, has the potential to not only continue, but in fact dramatically increase the rate of advances in computing power, at least for some problems.

"There are functions that can be computed using quantum computing that cannot be computed using a classical computer."

Quantum Computing:

Quantum computers replace traditional bits that are used in digital communications with quantum bits, or 'qubits'. Potential applications can be found in a variety of fields, from medicine to space travel.

Qubits exist in a state of superposition, meaning they can be in both states at once, rather than restricted to either binary state as traditional bits function. Quantum computing works on entanglement and superposition.

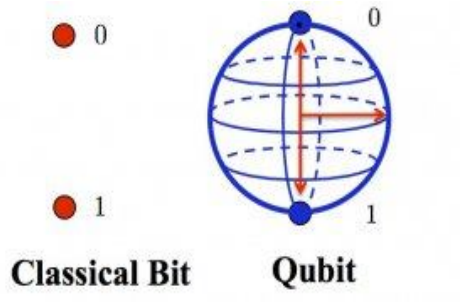

Fig 1 :Classical bit and Qubit

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Quantum Parallelism:

The ability of a single quantum processor to perform more than one calculation simultaneously is said to be quantum parallelism. Quantum computers can perform calculations in parallel since they can exist in more than just 0s and 1s state. Highly efficient algorithms for cracking the codes have been proposed that can factor huge numbers at speed that are nearly impossible to attain by a conventional computer. Two significant algorithms up to date have been proposed by Shor and Grover.

Implementation of qubit:

Quantum dot, an electron trapped inside a cage of atoms. When the dot is exposed to a pulse of laser light of precise wavelength and duration, the electron is raised to the excited state. The second burst of light causes electron to fall back to its ground state. Here, ground state and excited state can be considered as 0 and 1respectively.

Qubits	Classical bits	Power
■	0 or 1	2
■ ■	00,01,10,11	4
■ ■ ■	000,001,010,011, 100,101,110,111	8
N		2^N

Table 1: Classification of bits

Quantum computer's power doubles every time another qubit is added. A 30-qubit quantum computer could be more powerful than a supercomputer!

Future is here

Quantum computing would enable exponential jumps in computing power. According to the research, it could happen in the next few years. Conventional (or classical) computers use electrical circuits whereas quantum computers run on quantum bits or 'qubits' of cubans that are tiny particles magnetically suspended in extreme cold conditions.

The implications of this computing are enormous in heavy number crunching . Banks can use quantum computing to calculate risks faster than theircompetitors giving them an edge in their markets. Tech companies could figure out if their code is bug-free. So, testing made easy! Power is a critical factor in any technology. The world's fastest supercomputer draws 17.6MW of power. But with quantum physics, it gets fascinating. Quantum computers will reduce power consumption by factor of 100.A fully-fledged version of such a machine could theoretically tear through calculations that the most powerful mainframes would take eons to complete. Further, it has vast applications in the field of

- Factorization(data security)
- Physical modeling(i.e. climate, economic, engineering)
- Simulations (i.echemistry, materials)
- Database searching(i.e. bio-informatics)

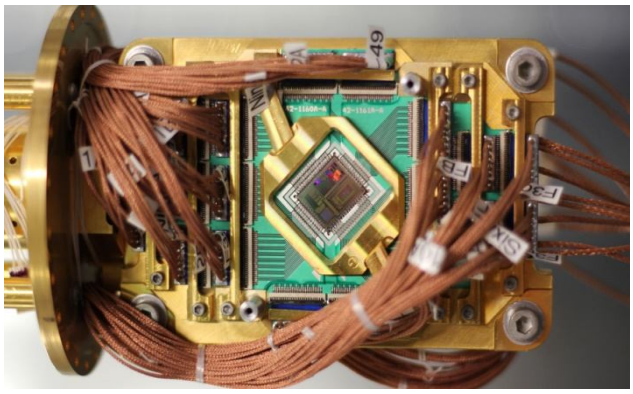

Fig 2 D-Wave's Quantum Computer

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D-wave is the only company manufacturing quantum computers for prominent research labs such as Lockheed Martin, US National Security Agency, Google, NASA and Microsoft.

Although these computing techniques are of little use to consumers,they are delicate, easily disturbed and require cooling near to absolute zero temperatures. Once data is sent into the quantum computer we generate instant output. There is a central problem, i.e. if you are running a quantum computation, if you are running a sequenceof operations that has to be very well concealed, not just from you and from Spiro's but also from the outside world. Classically, if we look at the computer's state at the time of computing, it wouldn't prevent the computer from giving the right output but in quantum, if we look at the computer, it will destroy the delicate superpositions. i.e. we can't be looking at the computer while performing the computation. So, there won't be any record left behind of what it was doing at intermediate stages of computation. This is the leakage of information is said to be decoherence. Usage of 10 qubitsand beyond is unlikely to be practical and decoherence makes them too fragile. This is what makes it challenging!!

Quantum computers redefine security. Quantum computers will have the power to break security codes in a short span. In contrast, they could provide security that no conventional computer on earth could provide. Since encryption systems like RSA, DSA etc are more widely spread in the cyber space, the chances of getting hacked by Quantum computers also increases.

The artificial intelligence of today is in its beginning stages but still lacks the factors that make them really "Intelligent". Quantum computers take A.I. to the next level. Evolution needs stuff like these often. Quantum computers have an edge over conventional computers in terms of information processing.

There is a whole quantum world which is largely unexplored because it is only now that within a decade or so the technological capabilities are being developed.

***Quantum Communication*:**

Quantum computing will lead to high speed communications. One among the inventions through quantum computing is Li-Fi. Li-Fi (Light Fidelity) is a wireless optical device that uses visible light from LEDs for data transmission. It is a bidirectional high speed and fully networked wireless communication technology. It is said to be a 100 times faster than Wi-Fi, reaching speed 224 Giga bits per second.

Since light waves do not penetrate through walls, Li-Fi has a much shorter range. Yet, it provides more security compared to Wi-Fi i.e. less sensitive to breaching etc.

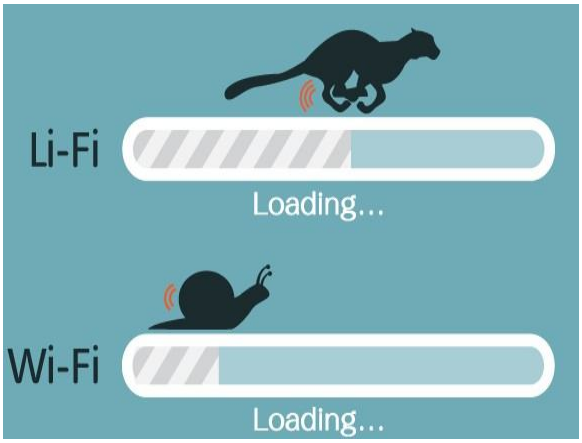

Fig 3: Li-Fi Technology

Conclusion:

The idea of quantum computation theory will continue to exert a decisive influence on further investigation of the fundamental quantum properties of complex quantum systems, and will stimulate many creative and exciting developments for many years to come.

There have been many predictions about the emergence of quantum computing. One such

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prediction is that, by 2028, intelligent machines will exist that can do anything humans can do; quantum computers will have played a critical role in the creation of this new type of intelligence. Also, By 2018, NASA will have found a planet with oceans of liquid water and Earth like atmosphere within 40 light years of earth using quantum computer; serious discussion about going there will begin.

References:

[1] Ref Author Simon Bone and Matias Castro "A brief history of Quantum Computing".

[2] David P. DIVINCENZO "The Physical Implementation of Quantum Computation".