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# Quantum Teleportation in Security

Shivani Sanjiv Shukla[1] , Jayant Pramod Varma[2]

[1](Computer Engineering Department, Viva Institute of Technology, Mumbai University)

[2](Computer Engineering Department, Viva Institute of Technology, Mumbai University)

***Abstract :*** *As world is getting more and more faster day-by-day and craving for more fastest technology. So, this need for getting more faster technology can be fulfilled with the help of Quantum Computers. As our classical computers works on the 2-bit, i.e., 0's and 1's. But quantum computers work on the combination of the real numbers between 0 and 1, i.e., 0.0000000…….1 to 0.999999999…….999. Entanglement and superposition are a two different property that helps to find the solution of problem like encryption method, modelling of molecules and the numerical of a number such as factorisation of a number. Quantum teleportation is transfer of message without any medium . It transfers the message in form of energy variation . With help of Quantum teleportation, it is possible to transfer information without interruption of any noise in channel.*

***Keywords -*** *Bloch-sphere , Entanglement ,Quantum Computers, Qubit, superposition.*

## I. INTRODUCTION

This research article is an effort to understand the technology of Generation Industry 6.0. Quantum Computers works on **QUBIT Q**uantum **B**inary Dig**it** as classical computers in **BIT B**inary Dig**it.** This article contains the introduction to some of the quantum phenomena upon which Quantum Computer works. As like that Superposition, Entanglement, and some more. Quantum Teleportation is one of the applications of Quantum Computer. Under the Quantum computer we transfer energy and not mass. In Quantum teleportation it is possible to generate and distribute the key among the sender and receiver with help of transformation of energy. A Bloch sphere is the presentation of the state and phase of a qubit [1]. In quantum Mechanics whatever operator will be attached by qubit state function, gives that value of that qubit. Quantum computer has got so many applications over classical computers some of that have been discussed below in this article.

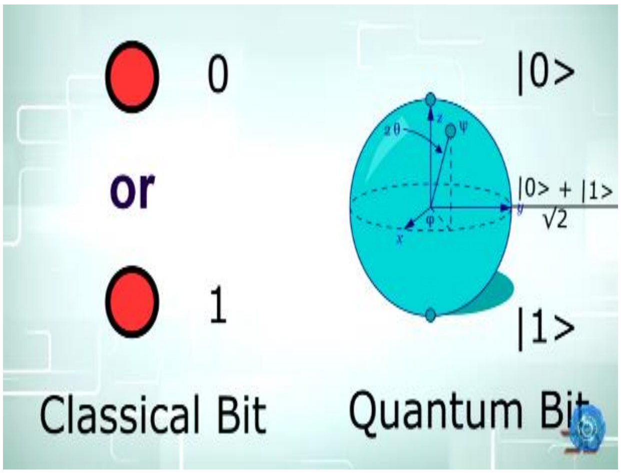


fig. 1 Classical and Quantum Bit

## II. BASIC CONCEPTS USED IN QUANTUM TELEPORTATION

1) Superposition

Superposition is a state in which qubit shows the behaviour of being in so many of the other states at the same time. It is like resonance. It is specified in certain areas of a sphere or spindle-shaped area. It is better described by the Heisenberg uncertainty principle [10] .It is represented by (<0|+<1|)/2 in terms of Qubit which means that the probability of correct answer is (50-50) % in |0> and |1> when only 1 qubit is there. It is a property under which it shows both <0| and |1>. In simple words, we can say that the state in which a Qubit can be a |0> and |1> at the same time that state is called a superposition state[10] .


fig. 1 Superposition state in Hadamard gate

And this qubit can also represent in matrix form

|0>= [1  0 ]

|1>= [0  1] (1)

2) Entanglement

This is a property of quantum mechanics. According to this property, their two are **or** more qubits give output depending on another entangled qubit without depending upon it and the distance doesn't affect their results.


fig.3 Bell States

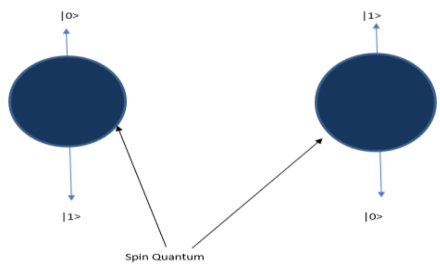


fig.4 Spin Quantum

3) Bloch Sphere

It is the sphere of radius one with Hilbert spaces where position, state and phase, and energy of a qubit can be seen [10] . It consists of the X, Y, and Z-axis. X varies from |+> to |->. z varies from |0> to |1> [10]. whereas y varies from |-i> to |i>. when an electron moves from state|0> to |1> it is an exciting state and in opposite direction, it is relaxing similarly for +ve to -ve state and i to -i state. In the Bloch sphere, a qubit is rotating from north to south pole and south to north pole.

|+>=|0>= [1 0 ]

|->= |1>= [0 1 ] (2)

Any point or state in the block sphere is represented in the Bloch sphere only and it is represented as

$$\psi = cos\left(\frac{\theta}{2}\right) + sin\left(\frac{\theta}{2}\right) e^{\phi} \quad (3)$$

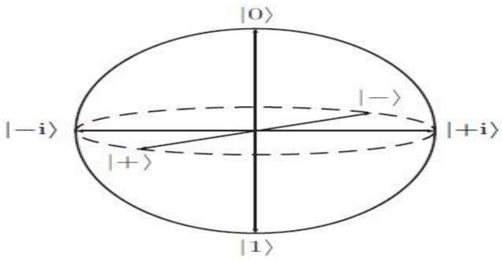


fig.5 Bloch Sphere

4) Quantum Operators

Quantum Operator is a basic which is defined with some of the property and on applying that we can get the desired output from operation [9]. it is used to shift the point in the Bloch sphere. There is a psi function that represents the state of any function.

$$|\psi| = \frac{\alpha|0>+\beta|^{1}>}{2} \quad (4)$$

To perform this operator, we take the help of rotation about the axis.

4.1 Energy Operator

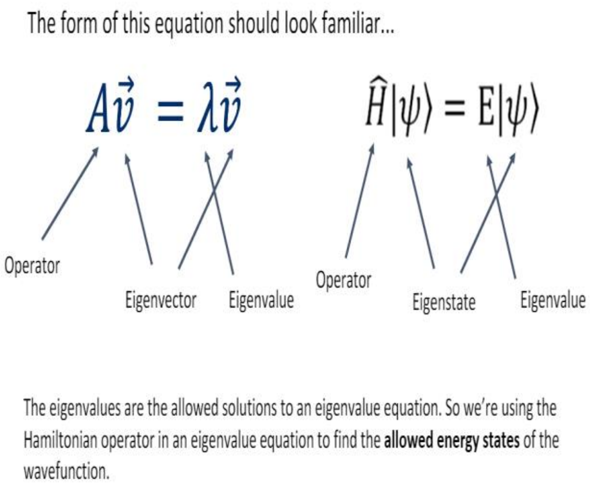


fig. 6 Energy Operator in Quantum Mechanics equivalent to A Operator in Matrix

Here A=Matrix Operator

$\lambda$ =Eigenvalue

V=Eigenvector

Likewise in Quantum Computers, there is

H=Hamiltonian Operator =Energy operator in Quantum computer

E= Eigenvalue for calculating energy

Psi= It shows eigenstate of a qubit.

4.2 Interference

It is a property by which a person can increase the chances of getting the desired output as it is done by creating a probability of constructive interference and we can also reduce the chances of getting desired output by creating destructive interference.

## III. Analysis

QUANTUM TELEPORTATION quantum communication protocol to “efficiently” transmit a quantum state only using classically communication channels in quantum Teleportation we can transmit our quantum state more efficiently with the help of classical communication channel only. like this transmission of the state is called quantum Teleportation.
China has recently studied successfully on Quantum Computer [13] . They have put one satellite in space and from there they have sent the photons by dividing it into two entangled particles. They have received so many of those particles at the different station. Over them out of few millions of photons they have received a few hundreds of photons. On that they have performed research and they have found that it works successfully. With help of this quantum computer, they have shared the two photos. If this key has been interrupted by any of the hacker in between then it will be known by the receiver and sender both and they can disconnect their connection. This medium is very safe for encryption related sharing of information.
Analysis has been done of IBM qiskit. There the execution of different gates has been analysed and that was accurate according to research . We have also seen and analysed the formula for energy operator . With that we have described about the Bloch sphere and its formula . We have also analysed that with help of the concept of Superposition and Entanglement we can implement the concept of security in quantum computers

## IV. Conclusion

As the growing demand for speed and accuracy of the market will be fulfilled by quantum computers. As this technology is still under development in so many aspects. It also performs the task which is not performed by normal classical computers. It can provide speed more than that of supercomputers of today’s date.
As we have gone through some of the basic but very crucial fundamentals of quantum computers, it shows that quantum mechanics has played a very vital role in the growth and improvement of these computers. We can see the fully fledge application of this in era industry 6.0.

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