Review Article

## Quantum computing to leapfrog many Barriers

**Corresponding author: Utpal Chakraborty ***

*\* Head of Artificial Intelligence at YES Bank, AI Researcher*

*Email: utpal_bob@hotmail.com*

### ABSTRACT

*It was probably a mystery for many of us that "why science and mysticism have such strong rivalry despite both are in the service of human wellbeing". They are like two distant islands in people's minds with literally no ferry service. There are metaphors in mysticism about the universe, sub-atomic particles and human life in general which are so profound, logical and compelling that always wondered me if those could have been useful guide for the scientific studies. A time will arrive soon when we will see more and more applications around us based on Quantum Computing which are based on the real nature of universe and the sub-atomic particles that our ancient spiritual scriptures had hinted couple thousand years back.*

**Keywords: Quantum Computing, business, medicine**

## 1. INTRODUCTION:

Quantum computing has the potential to transform every domain, every business and every aspect of our lives, and Quantum-AI combination is going to be bonanza for the humanity. Let's understand how. Google's quantum computer "Sycamore" was been able to solve a complex mathematical calculation in just 3 minutes that a powerful supercomputer would have taken approximately 10,000 years. We call it "Quantum Supremacy" in the world of "Qubits" when a quantum computer outperforms a classic super computer. Now you can easily imagine, that with this enormous computational speed combined with the power of AI how it's going to bring about a radical change in the way we perceive classic computing today. A quantum computer is expected to be at least hundred million times faster than a classic computer.

**\*Corresponding Author:**

**Utpal Chakraborty, Head of Artificial Intelligence at YES Bank, AI Researcher**
**Email: utpal_bob@hotmail.com**
**Contact: 91-99205 76748**
**DOI: https://doi.org/10.5281/zenodo.3989326**

But it will be completely wrong if we think quantum computing will just bring extra speed because it will also bring some other significant dimensions specifically while combined with Machine Learning. Scientists and experts have already forecasted that Qubit in Quantum and Artificial Neurons in AI are going to essentially rule the scientific and technological arena of the future.

We need to also understand that quantum computing is not just a boon but essentially the need of today and tomorrow because the silicon revolution is slowly collapsing as it has almost reached its limit. The rise of quantum along with AI is going to manifest the whole spectrum of new possibilities in the field of science and technology.

The enormous power a quantum computer possesses due to the fact that it can harness some of the fundamental principles like "Superposition" and "Entanglement" of sub-atomic particles which a classic computer is not capable of. We will not go into details of Quantum Dynamics in this article, rather let's discuss how Quantum-AI combo can help us in our business.

First of all, quantum computers can solve the wide range complex optimization problems in all domains which conventional computing struggles to perform on time. These

optimization challenges are intrinsic in the field of aviation, finance, manufacturing, drug research & medicine etc.

In finance, some complex derivatives which are path-dependent; evaluating innumerous paths used to be computationally very expensive and difficulty to understand their interdependence, hence can never calculated near-real-time with classic computers but quantum computer can easily compute those in real-time. This will revolutionize financial market study and prediction of stocks and crypto currencies.

In medicine, quantum computing can optimize radiation therapy procedures in cancer treatment. It will also streamline drug discovery by shortening the timespan and minimizing side effects. It will similarly bring about a huge change in the field of genetic research, preventive healthcare, personalized medicines, critical care decisions and "In Silico Simulations" for various drug designs. Also, "Digital Health" which is much talked about today can only be a reality in true sense if the power of quantum computers can be leveraged.

In aviation, Airbus is doing R&D combining quantum and AI for optimization of structural Wing Box design which is a complex area of flight physics. Other applications pertaining flight safety, optimization of travel routes, travel time are just few examples. Quantum has already proved to be superefficient when it comes to optimizing complex flight systems. Also, the dream of building any superior Decision Support System can only come true when astronomical volume of data can be processed and corelated leveraging Quantum and AI.

Google is already using its quantum computer for its autonomous vehicle project for faster processing of information and hence immediate reaction to any situations. Quantum is transforming the security arena or the encryption world, Qubit states will eventually empower encryptions unhackable. The flipside is if a bad actor having access to quantum computer can literally break any encryption that exists today.

Anomaly Detection is a classic application of AI and machine learning in different domains and quantum computing is going to revolutionized in this area. As per many experts, the day is not far when a meaningful machine learning application will be incomplete without quantum computing.

NASA is using its quantum computer for space exploration, astronomical and weather studies by analyzing data generated by telescopes. Google, IBM, Microsoft and few other companies are already started using their quantum computers for various studies in variety of fields.

Quantum can play a crucial role in any election campaigns as it has got enormous processing power and speed to crunch data and bring inferences out in real-time. Similarly, it can solve many of the Big Data problems by optimizing and accelerating search results and understanding the hidden patterns in much better way.

Various studies in simulated environments is getting transformed using quantum computing capabilities, like in the field of chemistry, medicine and genetics to better understand behavior and interactions of molecules and chemical compounds. Simulation of durable battery designs are already done using quantum computers.

Above all, quantum is going to have the biggest impact on AI and machine learning. Some of the classic ML problems like Linear System Solving can be way faster using HLL algorithm, similarly elementary ML techniques PCA (Principal Component Analysis) can be done much faster in quantum computers using LMR algorithm and many more.

So, Quantum and AI is going to be a great combination and will prove to be panacea for many of the scientific and technological limitations the world today is restricted with and has started solving many unsolved.