THE POTENTIAL AND CHALLENGES OF QUANTUM TECHNOLOGY IN MODERN ERA

Khandakar Akhter Hossain, PhD

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Abstract: Information is encoded in bits, such as 0 or 1, in a classical computer, whereas a quantum computer (QC) uses qubits, which can be in a superposition of several states. Compared to traditional computers, QCs have several advantages in terms of processing power and speed. A new area of physics and engineering called quantum technology (QT) is based on quantum-mechanical features, including quantum entanglement, quantum superposition, quantum tunneling, etc. The second quantum revolution is characterized by the development of individual quantum systems, such as atoms, ions, electrons, photons, molecules, or even quasi-particles, that enable measurement accuracy to be increased to the conventional quantum limit at quantum scales. Future warfare is one of the many human activities that QT has the potential to influence. It is an emerging and potentially frightening field. Quantum computing has the potential to improve a number of disciplines, including ship design, chemistry, machine learning, and cryptography. IBM recently developed the IBM Osprey, a 433 qubit QC processor. Future warfare will be dominated by QTs in many ways. Future warfare will be transformed by quantum sensing in the areas of detection, monitoring, control, and C5IRS.It is somewhat depressing because both QC and QT face few unique obstacles, but it is possible to predict that in the future, QTs will be used in the communication, precision, intelligence, space, medical, chemical, commercial, service, and military industries. As a result, the effective and efficient employment of QTs will bring about revolutionary change in future warfare and the military industry.

Key Words: Qubits, cryptography, nano-optics, machine learning, QKD, QIN, PQC

INTRODUCTION

1. Decentralization and the loss of nations' monopoly on war[1] characterize today's fourth generation advanced warfare. As we all know, powerful nations' defense forces typically have access to cutting-edge military technology. [2] Quantum technology (QT) will play a major role and may imperil the future military situation. QT is a well-known modern technology that emerged from the second quantum revolution. At the moment, the first quantum revolution has resulted in technology that everyone is familiar with, such as nuclear power, semiconductors, lasers, magnetic resonance imaging, modern communication technologies, digital cameras, and other imaging equipment, and so on. Nuclear and laser weapons are being effectively integrated and tested today. The ability to manipulate and control individual quantum systems, such as atoms, ions, electrons, photons, molecules, or different quasi-particles, is what is known as the "second quantum revolution." This limit is the upper bound on the precision of measurements made at quantum scales. [3] Entanglement, superposition, and tunneling are a few QTs that have a connection to quantum characteristics. The greatest and most difficult objective for quantum properties is the quantum computer (QC). Information is encoded in bits with values of 0 or 1 in a traditional computer. A qubit—the memory component in a quantum computer—can exist in a superposition of several states. [4] As a result, although n qubits can transport information on 2n numbers concurrently, n classical bits can only convey information on 1 number at a time. There aren't many obstacles to achieving the QC goals of qubit identification, production, and error repair. According to Niels Bohr, making predictions, particularly concerning the future, [5] is very difficult. However, quantum-based technologies are probably going to simplify predictions and change certain crucial parts. For these reasons, it is crucial that all parties—researchers, businesspeople, government officials, and foundations— push strongly to realize the quantum transition.[6]

2. It is true that fourth-generation modern warfare is characterized by decentralization[7] and the loss of states' monopoly on war. Advanced militaries typically have access to state-of-the-art military technologies, including emerging quantum technologies.[8] Quantum computing is a promising technology that offers exponential speed-ups in computation compared to classical computing. It has the potential to revolutionize various fields, including cryptography, optimization, and machine learning. Quantum technologies, including quantum sensing and quantum communication, can also have significant implications in the realm of warfare. The recent conflict between Russia and Ukraine, which involved traditional kinetic warfare as well as large-scale cyber warfare, highlighted the interconnected nature of modern threats. In such scenarios, communication networks and space-based capabilities play a crucial role. The denial of existing communication networks can have a significant impact on military operations. In this analytical article, you plan to explore the chronological development of quantum technologies, the working principles of quantum computing, their potential and prospects, and the challenges associated with quantum computing. Additionally, you aim to discuss the utilization of quantum technologies in intelligence and future warfare. It is important to conduct thorough research and collect information from reliable sources to ensure the accuracy and credibility of the article. By examining the current state and

potential of quantum technologies, along with their applications in intelligence and warfare, you can provide valuable insights into the evolving landscape of modern conflicts.

CHRONOLOGICAL DEVELOPMENT OF QT

3. You have provided a concise and accurate description of the dual nature of particles, such as light, electrons, and atoms. The wave-particle duality is a fundamental concept in quantum mechanics, and it suggests that particles can exhibit both wave-like and particle-like behavior depending on the experimental conditions. When light passes through two slits, it shows interference patterns characteristic of a wave. However, when it interacts with a conducting plate of metal, it behaves like a particle, as individual photons are absorbed or scattered by the electrons in the metal. This dual nature is not limited to light but is observed in all quantum particles. It is difficult to precisely quantify the wave-like or particle-like behavior of a particle, but quantum mechanics provides a mathematical framework to describe and predict their behavior. Max Planck's work on quanta, which led to the development of quantum theory, revolutionized our understanding of energy. Previously, energy was thought to be continuous and flowing in waves. However, quantum theory introduced the concept of energy being quantized into discrete packets or particles. Analogously, we can think of the wave/quantum[9] idea in terms of analog and digital systems. In the analog sense, energy flows continuously without specific quantity, similar to waves. In the quantum view, energy is quantized, and it comes in discrete, indivisible units called quanta or photons. Each photon carries a specific amount of energy, and the brightness of light depends on the number of photons, not their individual energy.Quantum theory indeed presents some strange and counterintuitive aspects of reality. Although it may be challenging to fully comprehend or explain these phenomena, the theory has been extensively tested and has provided remarkable predictive power and practical applications.Accepting the weirdness of quantum science, even without fully understanding it, is an essential aspect of scientific progress. It reminds us that the nature of reality can be deeply counterintuitive and encourages us to continue exploring and uncovering the mysteries of the quantum world.

4. Quantum technology (QT) is indeed an emerging field that builds upon the principles of quantum mechanics, utilizing properties such as quantum entanglement, quantum superposition, and quantum tunneling in individual quantum systems. These properties are harnessed for practical applications across various domains.In the early 20th century, the wave theory of light faced significant challenges, and Einstein's explanation of the photoelectric effect played a crucial role in shaping our understanding of quantum phenomena. The work of Louis de Broglie, Niels Bohr, and Einstein contributed to the development of quantum theory, which highlighted the uncertainty and indeterminacy of electron motion, the concept of wave function, quantum tunneling, and the phenomenon of entanglement. Quantum theory revealed that both electromagnetic radiation and electrons exhibit particle-like behavior.If string theory is valid, it suggests that the wave concept extends beyond a mere tool for modeling the world and implies that the universe, despite its complexity, can be understood as a vast network of interacting waves. [10] The foundation of QT lies in quantum mechanics, a discipline that has been studied for over a century. The initial applications of quantum mechanics, referred to as Quantum Revolution 1.0, have had a profound impact on society. Examples include nuclear fission, lasers, semiconductors, digital cameras, and their effects on various fields such as military technology, atomic weapons, computing, and navigation. [11] The first-generation quantum networks have primarily utilized Quantum Key Distribution (QKD) for secure communication. QKD offers advantages over conventional asymmetric encryption, also known as public-key cryptography, as any attempt to intercept the communication would be instantly detectable.The next generation of quantum networks, often referred to as Quantum Information Networks (QIN) or quantum internet, go beyond QKD and enable the distribution of entangled qubits. [12] These networks have the potential to revolutionize information processing, communication, and computation by leveraging the unique properties of entanglement.As QT continues to advance, it holds promise for transformative applications in various fields, ranging from cryptography and communication to computing and sensing. The development of practical quantum technologies and the realization of large-scale quantum networks are active areas of research and development that aim to unlock the full potential of quantum mechanics for practical use.

5. The first quantum revolution, known as Quantum Revolution 1.0, gave rise to significant advancements such as nuclear weapons, nuclear energy, and classical computers. Currently, laser weapons are being developed and tested, [13] representing the ongoing progress in military technology.The second quantum revolution is characterized by the manipulation and control of individual quantum systems, enabling the achievement of measurement accuracy at quantum scales. [14] Quantum technology (QT) is expected to enhance measurement capabilities, sensing, precision, and computational power, revolutionizing future military technologies. [15] It is worth noting that many quantum technologies have dual-use potential, meaning they can have applications both in the military[16] and civilian sectors.The increasing likelihood of realizing quantum technologies has led to various studies and recommendations emphasizing their importance. [17] We are now entering Quantum Revolution 2.0, where we are harnessing the full range of quantum physics. This revolution involves exploiting the behavior of individual quantum systems such as electrons, atoms, nuclei, molecules, and quasi-particles. In the realm of defense, quantum technologies are anticipated to enhance existing sensing, communication, and computing capabilities rather than introducing fundamentally new weapons like nuclear and laser weapons did. While many aspects of quantum technology are still in the realm of fundamental research, several applications relevant to defense[18]

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are foreseen. QTs are a crucial part of long-term defense planning for advanced nations including the USA, China, the UK, France, Australia, India, Russia, Canada, and others. [19] It is fascinating to note that the founders of quantum mechanics did not envision advances in computation or the invention of the transistor. However, today we have a strong belief that advancements in the field of atomic optics and nano-optics[20] will significantly progress as we approach absolute zero temperature.The potential of quantum effects extending to entire human beings is an intriguing possibility for the future. However, it is important to note that the realization of such advancements is subject to ongoing research and technological development.

POTENTIALS OF QUANTUM COMPUTING

6. Quantum computing has the potential to revolutionize various fields, including cryptography, chemistry, machine learning, optimization and ship design. Today quantum computing potential has recognized in several aspects.[21] However, these potentials of quantum computing are just the beginning, and as the technology continues to advance, we can expect to see more applications and use cases emerging in various fields.

a. Cryptography. QCs have the potential to break many of the currently used encryption techniques, such as the RSA and elliptic curve cryptography.[22] However, QCs can also be used to develop new encryption techniques that are secure against attacks by classical computers.

b. Chemistry. Quantum computers can be used to simulate the behavior of molecules and chemical reactions, which is currently not feasible with classical computers. This can help accelerate the development of new drugs and materials.[23]

c. Machine Learning. QCs can be effectively used to perform machine learning tasks, such as clustering, classification, and regression, at a faster speed than classical computers. This can lead to the development of more accurate and efficient machine-learning models.[24] In future help medical sector very widely.

d. Optimization. QCs can be used to solve optimization problems, like traveling salesman problem and the knapsack problem, faster than classical computers. This can lead to more efficient and optimized solutions in various fields, such as logistics and supply chain management.[25]

e. Big Data. Quantum computing has the potential to analyze and process very big datasets at a faster speed than classical computers. This can lead to the development of more accurate and efficient data analysis techniques.[26]

f. Ship Design. Computing Fluid Dynamics or CFD Analysis is used in ship design and ship performance testing ground. Quantum computing will be more useful to speed up and better analytical process of ship design field.[27] Complicated ship design software can perform better by using quantum computing system.

PROSPECTS OF QUANTUM COMPUTING

7. The future prospects of quantum computing are very promising. As the technology continues to improve and more powerful quantum computers are developed, there is great potential for quantum computing to revolutionize several fields and industries.

a. Material Science. One of the most promising areas of application is in the field of materials science. QCs can 'simulate the behavior of molecules and materials at the quantum level, which could enable the discovery of new materials with novel properties that could have important applications in areas such as electronics, energy storage, and renewable energy. This could lead to inventions in areas such as battery technology and solar power.'[28]

b. Transformation of Industries. Quantum computing has the potential to transform several industries, such as finance and logistics[29]. QCs can be used to optimize complex financial portfolios and trading strategies, and to solve logistics problems such as route optimization and supply chain management.

c. Application of Quantum Machine Learning. The development of quantum machine learning algorithms has the potential to revolutionize several areas, including image and speech recognition, natural language processing, and recommendation systems[30]. Quantum machine learning algorithms could also be used to analyze large datasets in fields such as healthcare and finance, leading to new insights and innovations.[31]

d. Simulate and Analyze Data. There is great potential for quantum computing to be used to solve some of the most pressing problems facing humanity, such as climate change and disease. Quantum computers could be used to 'simulate the effects of climate change and to design new materials and technologies to combat it. They could also be used to analyze genomic data and to develop new treatments for diseases such as cancer and Alzheimer's.'[32]

PRESENT QUANTUM COMPUTERS (QCs)

8. Several companies and research institutions have developed QCs. One of the most well-known quantum computers is the D-Wave System, which is a commercial QC. Another example is IBM's Quantum Experience, which is a cloud-based quantum computing platform that allows users to experiment with quantum algorithms. IBM has made several significant contributions to the field of quantum computing. It is one of the leading companies in the development of QCs. IBM has made significant progress in increasing the number of qubits in their quantum computers, with discrete improving the performance and stability of their systems.[33] In 2016, IBM launched the IBM Quantum Experience, which allowed users to access IBM's quantum computing hardware over the internet. 'This platform has enabled researchers, developers, and students to experiment with quantum computing and develop new algorithms and applications. IBM has also developed several QCs with increasing numbers of qubits.

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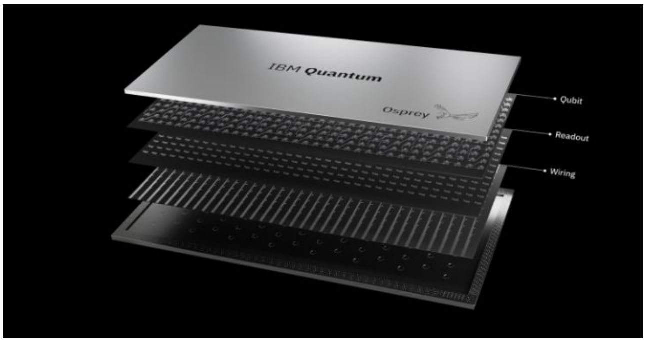

Figure 2: IBM Osprey; IBM's new 433-quantum bit (qubit) processor[34]

9. In 2017, IBM announced the development of a 50-qubit QC, which was a significant milestone in the field of quantum computing.'[35]IBM is a significant contributor to the development of quantum computing and has made significant progress in increasing the number of qubits and improving the performance and stability of their QCs. Very recently IBM has invented 433 qubit QC processor (IBM Osprey) and which has been shown in figure 2 above. InNew York, USA on Nov 9' 2022 during IBM Quantum Summit 2022, Dr. Darío Gil, Senior VP, IBM and Director of Research has declared, 'the new 433 qubit 'Osprey' processor brings us a step closer to the point where quantum computers will be used to tackle previously unsolvable problems. We are continuously scaling up and advancing our quantum technology across hardware, software and classical integration to meet the biggest challenges of our time, in conjunction with our partners and clients worldwide. This work will prove foundational for the coming era of quantum-centric supercomputing. We continue to increase the scale of quantum systems and make them simpler to use, we will continue to see adoption and growth of the quantum industry in future.'[36]

10. Quantum technology has emerged as a revolutionary field with the potential to revolutionize various sectors, including computing, cryptography, communication, sensing, and more. By leveraging the principles of quantum mechanics, such as superposition and entanglement, quantum technology promises exponential improvements over classical systems. However, the road to harnessing its full potential is fraught with numerous challenges that need to be overcome. In this article, we will explore some of the key challenges faced by quantum technology, shedding light on the complex journey toward its widespread implementation.

a. **Quantum Computing**. Building Powerful Quantum Computers Quantum computing holds immense promise for solving complex computational problems exponentially faster than classical computers. However, the development of practical, error-resistant, and scalable quantum computers remains a major challenge. Quantum bits or qubits are extremely sensitive to environmental noise and prone to errors. Achieving quantum error correction, improving qubit stability, and developing fault-tolerant systems are key areas of focus for researchers[37]. Moreover, the number of qubits needs to be significantly increased to perform computations at a useful scale, requiring innovative qubit fabrication, connectivity, and control methods.[38] Overcoming these challenges will pave the way for quantum computers to tackle real-world problems more efficiently.

b. **Quantum Communication**. Securing Data Transmission Quantum communication, enabled by quantum key distribution (QKD), offers unprecedented levels of security for transmitting sensitive information. QKD relies on the principles of quantum mechanics to ensure the absolute integrity and confidentiality of data transmission.[39] However, there are several challenges associated with implementing practical quantum communication systems. One of the primary hurdles is the limited range of QKD systems, which typically operate over relatively short distances due to signal degradation and loss.[40] Developing methods for long-range QKD and establishing reliable quantum networks are ongoing research areas. Additionally, ensuring scalability, cost-effectiveness, and integration of quantum communication technologies with existing infrastructure pose significant challenges for widespread adoption.[41]

c. **Quantum Cryptography**. Protecting Against Quantum Attacks While quantum technology brings the promise of advanced security measures, it also poses threats to classical cryptographic systems. The development of quantum computers with sufficient computational power could potentially break many of the encryption algorithms used today, rendering sensitive information vulnerable to attacks.[42] This highlights the urgent need for quantum-resistant cryptographic solutions, also known as post-quantum cryptography (PQC).[43] However, transitioning to PQC involves significant

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challenges, including the need for new algorithms, cryptographic standards, and widespread adoption across different systems.[44] Addressing these challenges is crucial to safeguard sensitive information in the era of quantum computing.

d. **Quantum Sensing**. Enhancing Precision Measurement Quantum sensing offers remarkable advancements in precision measurement, enabling applications in areas such as navigation, imaging, medical diagnostics, and more. Quantum sensors, leveraging properties such as entanglement and superposition, can achieve unprecedented levels of sensitivity and accuracy.[45] Nonetheless, several obstacles impede the widespread adoption of quantum sensing technologies. These challenges include reducing the sensitivity of quantum sensors to environmental factors, developing robust and cost-effective sensor designs, and integrating them into existing measurement frameworks.[46] Overcoming these hurdles will unlock the potential of quantum sensing, revolutionizing fields that rely on precise measurements.

e. **Quantum Materials**. Designing and Controlling Quantum Systems Quantum technology heavily relies on the development of novel materials with tailored quantum properties. Designing and controlling quantum systems at the atomic and molecular level present formidable challenges in material science and engineering.[47] The discovery and synthesis of materials that exhibit desired quantum properties, such as long coherence times for qubits or efficient photon emission for quantum communication, remain a significant hurdle.[48] Additionally, integrating these materials into practical devices while maintaining their quantum properties poses additional challenges. Extensive research efforts are focused on advancing our understanding of quantum materials to overcome these challenges and drive technological progress.

f. **Timekeepers**. Harnessing Quantum Precision in Timekeeping One promising application of quantum technology is in the field of timekeeping. Traditional atomic clocks already provide remarkable precision, but quantum technology opens up new possibilities for even higher accuracy. Quantum clocks based on the behavior of trapped ions or single atoms show great potential in improving timekeeping precision by exploiting quantum coherence and superposition. However, challenges such as environmental disturbances, atom loss, and coherence time limitations need to be addressed to realize the full potential of quantum timekeepers.[49]

g. **Quantum Magnetic Field Sensors**. Pushing the Limits of Sensitivity Quantum magnetic field sensors hold promise for a wide range of applications, including detecting brain activity, monitoring geological activities, and improving magnetic resonance imaging (MRI) technology. These sensors, which utilize the quantum properties of atoms or solid-state systems, offer the potential for unprecedented sensitivity and resolution. However, challenges related to reducing noise, enhancing signal-to-noise ratios, and improving scalability need to be addressed to fully exploit the capabilities of quantum magnetic field sensors.[50]

h. **Electrical Quantum Metrology**. Advancing Precision Measurements in Electrical Metrology Quantum technology can also revolutionize electrical metrology by enabling highly precise measurements of electrical quantities. Electrical quantum metrology leverages quantum phenomena to achieve measurements with extremely low uncertainties, surpassing the limitations of classical metrology. However, challenges related to reducing noise, improving the stability and coherence of quantum systems, and developing scalable quantum electrical standards pose significant hurdles in the practical implementation of electrical quantum metrology.[51]

j. **Quantum Cryptography**. Securing Communication in the Quantum Age Quantum cryptography aims to provide secure communication channels that are invulnerable to eavesdropping or tampering. Quantum key distribution (QKD) is a crucial aspect of quantum cryptography, ensuring secure key exchange between parties. However, challenges such as limited transmission distances, compatibility with existing communication infrastructure, and high implementation costs hinder the widespread adoption of quantum cryptography. Ongoing research, development of new protocols, and efforts to overcome technological barriers are essential to realize the full potential of quantum cryptography in safeguarding communication.[52]

k. **The Quantum Technology Competence Center (QTZ)**. Fostering Collaboration and Innovation To address the challenges faced by quantum technology, collaborative efforts are essential. The Quantum Technology Competence Center (QTZ) is an example of a collaborative initiative that brings together experts from academia, industry, and research institutions to accelerate the development and deployment of quantum technologies. The QTZ facilitates interdisciplinary research, knowledge exchange, and industry partnerships, promoting innovation and addressing challenges collectively.[53]

CHALLENGES OF QUANTUM COMPUTING

11. Quantum computing has many potential advantages, as well as there are also few disadvantages and challenges. The cost of building and operating QCs is currently very high. This limits the accessibility of quantum computing technology to only a few large corporations and research institutions. So, ‘there are several significant challenges that need to be addressed and solved before the use of technology widely adopted around the world. Quantum computing also faces several challenges, including hardware limitations, error correction, and scalability, which need to be addressed and solved before realizing and utilizing the full potential of quantum computing.’[54]

a. Error Correction. QCs are prone to errors due to the delicate nature of quantum states, and these errors can accumulate over time, leading to incorrect results. This is a significant challenge that needs to be overcome before quantum computing can be used to solve real-world problems[55]. In addition, QCs are very sensitive to their environment, and any interference or noise can cause errors in calculations. This requires the use of specialized equipment and facilities to maintain the stability of the quantum states in the computer.

b. Availability of Qubits. Another challenge is the limited number of qubits currently available in QCs. While the number of qubits in QCs has been increasing, it is still much smaller than the number of bits in classical computers. This means that QCs can only solve a limited number of problems that are beyond the capabilities of classical computers.

c. Primitive Stage. The development of quantum algorithms is still in its early stages, and there are very limited number of algorithms that have been developed that can take advantage of the unique properties of QCs. This limits the types of problems that QCs can currently solve. While quantum computers have shown impressive performance for some tasks, they are still relatively small compared to classical computers. So, scaling up QCs to few thousands of qubits while maintaining high levels of consistency and low error rates is remains a major challenge’ still today.[56]

d. Hardware and Software Development. Developing high-quality quantum hardware, such as qubits and control electronics, is a major challenge. There are many different qubit technologies, each with its own strengths and weaknesses, and developing a scalable, fault-tolerant qubit technology is a major focus of research. Again quantum algorithms and software development tools are still in their infancy, and there is a need for new programming languages, compilers, and optimization tools which can effectively and successfully utilize the power of QCs.

e. Classical Computer Interfaces and Protocols. QCs won’t replace classical computers; they will serve as balancing technology. Developing efficient and reliable methods for transferring data between classical and quantum computers is essential for practical applications. Again, as the field of quantum computing matures, there is a need for standards and protocols for hardware, software, and communication interfaces. ‘Developing these standards will be essential for ensuring compatibility and interoperability between different quantum computing platforms. We need to do benchmarking; as it is the ability to measure performance standards is still in its infancy for quantum computing design, development and operation.’[57]

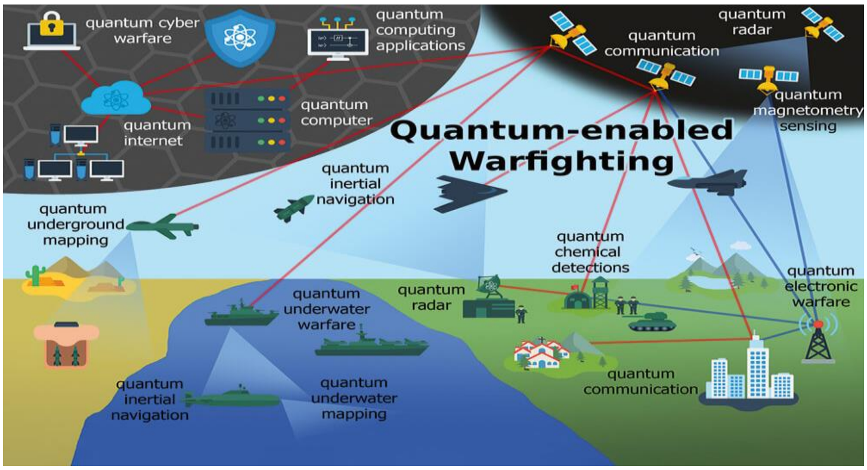

Fig 4: Concepts of quantum warfare using various QTs based systems[58]

f. Training and HR Development. The number of people properly educated and trained to enter the quantum workforce is small and spread across the world. Finding the right workers and training the new people is a challenge. At present scenario, government and business owners won’t increase the number of people motivated to enter the quantum workforce until they have more practical quantum computers and they won’t have more practical QCs until they have more people motivated to become part of the quantum workforce.

g, Capital and Cost. Expense remains as a main roadblock for quantum computing industry or QTs development. Quantum talent and training is expensive. Quantum hardware and software development is expensive. Supply chains are complex, vulnerable and expensive. Dealing with these expenses and finding investments to offset these costs will remain as the biggest challenge and that somehow failed to encourage the institutional scientists and commercial entrepreneurs for the expected future.

CONCLUSION

12. Quantum computing is a promising technology that has the potential to revolutionize several industries. Quantum computing operates on qubits, which can exist in multiple states simultaneously, allowing quantum computers to perform operations

exponentially faster and user friendly manner than classical computers. IBM has been one of the leading companies in the field of quantum computing and has developed several quantum computers. As quantum computing continues to evolve, it is essential to address the challenges and develop solutions to ensure the commercialization and adoption of quantum computing. The development of quantum computing will have a significant impact on several industries, and it is essential to ensure that the potential of quantum computing is realized. QT is an engineering system which utilizes the quantum properties of photons, electrons, atoms, or molecules. Today, the challenges as discussed above are a little discouraging, but there are lots of reasons for hope and trust. Funding agencies and interested government agencies are rising to the occasion to invest in solving these quantum computing challenges. Scientist and researchers are making advances in the engineering and technical challenges to create practical QCs. However, we can anticipate that, in future, QTs will use in the field of communication, precision, intelligence, space, medical, chemical, commercial, service and military industries.

13. QTs hold great promise in the long term for a broad range of applications, from sensing to communications including computing, but should not be unspecified to revolutionize defense applications in the predictable future. Even though principles were proven successful in laboratories, the transition from laboratory to real-world applications is still in progress. Again, necessities, like low SWaP, mobility, and cost, still represent significant restrictive factors. Above all limitation and challenges, for a good reason, QTs have captured government and business owner of potential nation's attention and mind's eye. Based on theoretical and laboratory work, scientists and researchers have an appreciation of the technology and its possible uses in real-world applications. Actually, the role of potential nations and entrepreneurs is to set goals and standards to encourage development and ensure interoperability. Meanwhile, the potential nations and entrepreneurs must invest in the necessary research and look for dual-use opportunities to speed development and reduce cost. With this understanding, scientists, researchers, engineers and technologists need to pursue the great promise of QTs with a realistic understanding of the timeline and effort involved. Quantum computing has great potential in many applications, such as improved machine learning and artificial intelligence, better aerodynamic designs for aircraft and shipbuilding industry, faster simulations, and many more. We hope that, there will be revolutionize change in future warfare and military industry by the effective and efficient use of QTs in full extent.

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ABOUT AUTHOR

Khandakar Akhter Hossain, PhD is a professor/researcher/Examiner at MIST, and BUET. Email: khandokarhossain1969@gmail.com

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