

A Review of Trending Salient Properties and its Relevance Towards Suggested Real World Practices Utilizing Quantum Computing

Jude IwedikeOpuh¹; Henry Peter Ovili²; Daniel Ukpenusiowho³;
Samuel Chukwuemeka Nwachokor⁴; Ijeoma Edith Oshiokpu⁵;
Kenneth Obokparo Orugba⁶

¹Computer Science Department, Southern Delta University Ozoro, Delta State. Nigeria.

²Department of Information Systems and Technology, Southern Delta University Ozoro, Delta State. Nigeria.

³Department of Software Engineering, Southern Delta University, Ozoro, Delta State, Nigeria.

⁴Computer Science Department, Southern Delta University Ozoro, Delta State. Nigeria.

⁵Library and Information Science Department, Southern Delta University Ozoro, Delta State. Nigeria.

⁶Department of Information Systems and Technology, Southern Delta University Ozoro, Delta State. Nigeria.

Publication Date: 2026/05/18

Abstract: This study reflects on the salient properties as well as advancement of quantum technologies which has tremendously impacted the cryptography solution that were visibly limited in classical cryptography. Quantum computing properties encompasses namely Superposition, Entanglement, Interference, Teleportation, Cryptography etc. Quantum computing provides numerous algorithms such as QKD, BB84, B91 and more that can offer secure communication in comparison to classical cryptography in high security arrangement that entail key exchange by utilizing quantum principles to identify menace in a system. However, this study not minding challenges like environmental noise output, notable transmission errors as well as limited communication distances that inhibits its practical scalability, guarantees usefulness of incorporating various properties in quantum computing to solve challenges in a real world. Quantum computing has impacted meaningfully in areas such as financial institutions, blockchain technology, drugs as well as MRI etc. Our result in this study suggested that properties such as entanglement, teleportation when accurately measured can be incorporated with superposition as well as cryptography in guaranteeing instant, secured and timely election result.

Keywords: *Quantum Key Distribution, Cryptography, Superposition, Entanglement, Magnetic Resonance Imaging.*

How to Cite: Jude IwedikeOpuh; Henry Peter Ovili; Daniel Ukpenusiowho; Samuel Chukwuemeka Nwachokor; Ijeoma Edith Oshiokpu; Kenneth Obokparo Orugba (2026) A Review of Trending Salient Properties and its Relevance Towards Suggested Real World Practices Utilizing Quantum Computing. *International Journal of Innovative Science and Research Technology*, 11(4), 4809-4816. <https://doi.org/10.38124/ijisrt/26apr1882>

I. INTRODUCTION

Predominantly, prior to delving into the implications of quantum computing properties, it is necessary to have a primary understanding of the technology. In addition, unlike classical computers that use binary digits (bits) to store as well as process information quantum computers utilizes quantum bits (Qubits).

Gisin et al (2002) maintained that these qubits can simultaneously exist in multiple states, ensuring exponentially faster computations. Substantially, quantum computing fundamental aim is to handle computational

problems like integer factorization as well as unstructured search in the classical computing. Fundamentally, quantum computers offer a remarkable opportunity towards understanding the diverse behaviors of quantum properties namely Entanglement, Superposition, Interference, Cryptography and Teleportation etc.

Kaur et al (2011) reiterated that quantum computing symbolizes a model shift in computational theory, providing unprecedented potential to transform various fields by incorporating the principles of quantum mechanics. Consequently, unlike classical computers, that processes data by utilizing bits in a state of either 0 or 1, quantum computers

adopt quantum bits or qubits that simultaneously exist in multiple states owing to superposition. This inherent property approve quantum computers to simultaneously perform numerous calculations in trillion of floating-point execution per second. Substantively, in addition to developing hardware, the principles of quantum computing examines quantum algorithms, cryptography, communication protocols as well as their wider implications as it relates to information processing system. Quantum information processing consistently investigates the revolutionary potential of quantum physics towards information manipulation as well as teleportation.

Consequently, by utilizing quantum phenomena such as superposition and entanglement, scientists intend to surmount certain visible constraints in classical computing. Quantum computing experiences some difficulties such as qubit coherence and error correction, even as it has the capability to solve complicated visible problems very quickly than traditional computers. However, the perceived speed that quantum computing researches as well as development are emerging communicates its importance in determining possible direction of future technology. Quantum computing, absolutely has the potential to change our knowledge in computation as this field develop, providing new approaches towards handling longstanding issues and offering new door for visible discoveries in ample field of study. Quantum computing initiates unprecedented computational capabilities, creating vast opportunities as well as substantial risks to perceive existing cryptographic foundations of study.

Li et al (2020) communicated certain happening in Quantum Key Distribution (QKD) that entail two parties Y and Z, signaling each other (quantum bit or qubit) towards generating key, thereafter, someone attempt to read having been eavesdropping in their communication. In the past, certain issues were visibly fixed by utilizing quantum teleportation protocol as well as increasing resource allocation in communication channel distance and encrypting with distinctive identification pass incorporated socket.

Noh and Angelak (2017) suggested that conventional computers were expected to take further than hundred years to ascertain the prime factor of such big number. This will pose no risk in communication except with a presence of quantum computer in the field that relates to computing and communication.

Shor's algorithm was a quantum algorithm originated by Peter Shor in the year 1994, can be utilized by quantum computer in factoring large numbers as well as crack trapdoor based possible codes within shortest reasonable period of time.

Tittel et al (2001) reiterated that University of Geneva in Switzerland, from inception was the first to ever verify the quantum secret sharing arrangement based on GHZ triplet state as well as communicated with empirical evidence in the year 2006. Lastly, from inception till date, various companies like IBM, Google, IonQ and Rigetti were committed in

building a universal quantum computers that can overwhelm all the limitations associated with conventional computers.

II. LITERATURE REVIEW

In this study, we reviewed some primary counterpart as well as relevant properties of quantum computing.

➤ *Qubit:*

Carleo et al(2021) mentioned that a qubit denote a quantum bit, the counterpart that is well known in quantum computing as binary digit or bit in classical computing. In quantum computing, this qubit or quantum bit is the elemental/core unit of quantum information. In addition, to define the quantum unit of information, eventually necessitated creating qubit by Schumacher. In classical computer, semiconductor devices such as transistors and capacitors were used in representing binary bit that store information. Substantially, a fully charged capacitor may represent 1 while the discharged capacitor will represents 0. The limitations perceived in binary digit connote that it can either exist in state 0 or 1 at a given time. This limitation currently has been enhanced with the emergence of quantum bit. An atom or ion precisely in the controlled quantum state will behave as a qubit. Quantum world today has some peculiar features such as superposition that enables qubit to possibly represent all known quantum states between 0 and 1 as well as simultaneously including 0 and 1. According to Motta and Rice (2022), pure states lie on the outer shell and mixed states inside. Predominantly, analogous to classical computers, quantum computers utilize qubits as an alternative of bits to store data as well as perform computation. Also, generation of an efficient as well as stable qubit is the primary step in quantum computing. Currently, diverse companies are using various techniques in handling the ion or atom that represents a qubit, to store data as well as execute quantum computing and communication. On a silicon chip in ultrahigh-vacuum chambers to trap individual atoms. Superposition and entanglement visibly are known to be fragile. Consequently, how long these interesting states are preserved communicates a measure of its quantum-ness or coherence in such system as well as determines the quality of a quantum computer. Fundamentally, measuring the coherence time is significant in evaluating any quantum system. Also, another form of decay distorts the phase relationship between these $|00\rangle$ and $|11\rangle$ states, limiting their quantum lifetime as a qubit. External factors ranging from the lifetime of such excited states, temperature as well as ambient fields may influence whether this superposition state persist or transform into these apparent $|01\rangle$ and $|11\rangle$ states.

➤ *Preparation of Qubits:*

Griffiths and Schroeder (2018) stated that the qubit, branded as quantum bit, is the elemental unit of quantum information and corresponds with basic information unit as communicated in classical theory bit. Substantially, the beam splitter has four input and output ports respectively. In addition, as the name implies, it can be adopted to split basically light of two input ports denoted as a and b, eventually termed two output ports, a0 and b0. Also, to prepare a qubit, one requires a quantized and coherent system

comprising two levels. Substantively, such system can be actualized using the energy intensity of an atom, spin of particles as well as any other possible degree of freedom. There are numerous techniques that assist in creating entangled qubits and we will take a quick look at various method of representing the qubits namely:

➤ *Polarization Qubit:*

The most popular techniques to create a qubit is the polarization of an electrical field. The polarization can be H/V (Horizontal/Vertical), D/A (Diagonal/ Anti-diagonal) or R/L (Right/Left circular), giving rise to three mutually unbiased bases.

Chen (2021) emphasized that the state of a classical bit is 0 or 1, but that of a qubit state was explained by a linear combination of computational elemental states 0 or 1, equivalent of this notation $|0\rangle$, $|1\rangle$ respectively, typically branded as superposition and if normalized, it sum to 1.

➤ *Phase Qubit:*

The phase is one most commonly adopted representation of qubit in faint-pulse states of quantum cryptography. The phase is naturally accepted to encode information that surmounts the problems utilizing polarization in optical fibers. This phase-qubit was prepared and analyzed incorporating interferometers and phase-modulators. The photon coherence length requires to be longer than the path-length disparity between observed diverse arms of these interferometers.

➤ *Dual-Rail Qubit:*

In this arrangement, the qubit is visibly encoded in two spatially diverse modes, such that any single photon will exist in a superposition of being in possible either mode. Predominantly, sometimes it is branded as a bosonic qubit. The qubit is arranged utilizing a semi-transparent mirror or through beam splitter. This photon in each mode was assigned the value 0 or 1, according to the notation $|n0\rangle$ or $|n1\rangle$, where n connote the amount of photons in each visible arm (mode). Also, the two modes describe a single qubit system that has this form $|\psi\rangle = |n0\rangle + |n1\rangle$.

➤ *Continuous-Time Qubit:*

This kind of coding is basically associated with entanglement related to two systems, branded as energy-time entanglement and it was initiated by Franson. It comprises two unbalanced Mach-Zehnder interferometers. The coding utilizes phase information to encode expected information likened to phase-qubits. In addition, when detecting dual energy-time correlated photons in a defined coincidence, one cannot be able to determine the exact direction either of them followed in the interferometers. Consequently, the dual paths, long-long and short-short, will end up interfering (long-short and short-long cases may not create coincidences). Also, depending on the phase, these photons will emerge in either port of such last beam splitters correlated.

➤ *Spatial Qubit:*

Spatial qubit can be realized through adoption of higher orders transverse Hermite-Gaussian (HG_n, m) and Laguerre-

Gaussian (LG_p, m) modes, as both encompasses an infinite set of visible orthogonal modes. The possible mathematical structure of such dual modes, indexed as {n, m} and {p, m} respectively.

➤ *Frequency Qubit:*

This method of frequency multiplexing has created a strong impact in classical communication, more so, in the case of a qubit, it would entail encoding of one frequency $|\omega_1\rangle$ as $|0\rangle$ and second frequency $|\omega_2\rangle$ as $|1\rangle$ that is ω_1 and ω_2 were sidebands of anticipated center frequency ω_0 . The photon pairs actualized by spontaneous parametric base conversion will have envisaged quantum correlations in frequency (entanglement) that makes it an appropriate basis for qubits etc.

➤ *Related Works*

Rina and Rohtas (2023) studied a recent trend in Quantum Computing. Quantum computing utilizes laws of quantum mechanics towards solving complex problems that were difficult to solve by traditional computers. Quantum computers rely on qubits in running and solving multidimensional quantum algorithms. The quantum computer arrangement gives entirely diverse perspective to concepts of traditional computer. Quantum computing is the potential computing technology that was widely used in the fields from Cryptography to Material Science, Agriculture and Computer science. Quantum computers may be best option in running simulations and data analyses as it can run complex problems faster in minimal time. Quantum computing is definitely the future computing technology that adopted quantum mechanics techniques to perform cryptographic tasks with ample potential applications in Medicine, Agriculture and Computer Science.

Karthikeyan and Guruprasath (2025) worked on distributed quantum communication channel through Quantum Teleportation, The progress in quantum technologies has greatly impacted cryptographic solution. Quantum computing offers diverse algorithms such as Quantum Key Distribution (QKD), BB84, B91 and other numerous secure communication compare to classical cryptography in high security key exchange mechanism as well as by leveraging quantum principles in detecting Eves. In their study, it sort out these limitations by utilizing measurement based quantum teleportation protocol by incorporating automated noise detection, self-correction, reset dynamically to improve fidelity, enhance security of the distributed quantum network or between several /private parties as well as extenuating eavesdropping in the system.

• *Trending Quantum Properties*

The various trending quantum computing properties are namely:

III. QUANTUM ENTANGLEMENT

One of the fundamental properties of quantum computing is quantum entanglement that is a phenomenon whereby particles in quantum states correlate over a measured distance. Entanglement facilitates instant

information sharing among qubits in quantum algorithms, resulting to exponential speedups when compared with classical computing as well as parallel processing. Gyongyosi and Imre (2019) communicated that in quantum internet, the quantum node share quantum entanglement among each other as well as provide an entangled ground-based network structure as it relates to diverse quantum networking protocols. The salient facts about the entanglement are such that, once entangled, visible particles preserve quantum states even if they were separated over a wide distance.

Entangled qubits assure for new quantum teleportation in quantum cryptography. A dual or groups of particles were entangled if the quantum state of each particle cannot be explained independently of quantum state in another particle. The quantum state of a system as a whole can be described. More so, for instance, two particles were created in such a way that their complete spin in a system is zero. Fundamentally, if the spin one particles was measured on a particular axis and discovered to be anticlockwise, then it will be guaranteed that a measuring spin of the second particle following same axis will depict such spin to be clockwise. Quantum entanglement is elemental and crucial in establishing of entangled network arrangement of quantum Internet.

Arun & Mishra (2014) reaffirmed that this offers a communication engineer to utilize the property better as well as using it to enhance security and possibly other aspects in communication. Substantially, there are four significant maximally and visibly entangled states in a two-qubit space, branded as the Bell-states, predominantly, to absolutely realize the assurance in quantum computing, accurate manipulation techniques and error correction in a fault tolerant quantum computing with secure communication channels as well as essential control of entangled qubits. In addition, current research activities are now concentrated on improving entanglement establishment and exploitation towards revolutionary computational success.

➤ *Quantum Interference:*

Algorithms adopted in quantum computing rely heavily on quantum interference, which is an elemental phenomenon in quantum physics. It appears whenever measurement results were affected visibly by constructive or destructive interference between amplitudes probability of such quantum states.

Qi, et al (2010) mentioned that it was first emphasized in a noise photons from inelastic dispersion of the high-power visible classical light which can obscure the revealing of often sub-photon-level quantum signals. Interference was engaged in quantum computing to amplify processing speed by extending possible probability and executing parallel operations. More so, in order to maximize this probability of exact solutions while intending to reduce the probability of incorrect possibilities, quantum algorithms adopted interference.

According to Thomas et al (2023), more specifically, they allocated co-existing photons to the 1290-nm quantum channels to accomplish nearly its lowest SpRS creation probability achievable utilizing telecom-band wavelength engineering. This outcome in exponential speedups guaranteed computational work-loads. This visibly interference-based exploration of such solution spaces permits quantum computers to operate at originally unheard-of speeds; examples of these algorithms were Grover's database search algorithm and Shor's prime factorization technique. Also, quantum and classical signals unarguably can willingly share a single fiber visibly through a wavelength division multiplexing.

➤ *Quantum Superposition:*

Bateman (2005) mentioned that a robust technique for the creation of equivalent superposition in Rubidium was its implication in momentum visible state quantum computer. Also, in such a device, information was stored in this momentum state as a collection of atoms. More so, at quantum level, the particle experienced difficulty in understanding very peculiar phenomenon such as superposition. A quantum particle can exist simultaneously in multiple states before/even if its measurement will be executed. The elemental feature of a quantum system lies in its existence in numerous quantum states visibly at the same time. Substantially, for example, electrons possess a kind of intrinsic angular momentum branded as spin and in the workings of a magnetic field; electron can exist possibly in two spin states, namely spin-up and spin-down. In addition, prior to measurement, this electron has a possible finite opportunity to exist as up spin or down spin. Consequently, only after this measurement can the electron possess an exact spin state. Superposition plays a crucial function in quantum communication as well as quantum computing.

Younes (2010) described a technique to hide certain quantum states utilizing superposition to improve on the security of a visible quantum communication. The proposed concept was used to encrypt message adopting superposition when executing data transmission. He affirmed that, if a message was hidden using their proposed technique, an eavesdropper applied direct measurement; outcome of such message will be absolutely 100% safe. More so, if the eavesdropper processes such superposition, visible message outcome will be 75% safe while communicating parties have a likelihood chance of 81.25% to detect existence of someone eavesdropping /attempting to intercept in the communication. Quantum superposition is branded as a state of possessing quantum particles visibly in all possible combinations available in such system. These particles continue to transform, progress in movement even as the quantum computer ascertain, measures as well as observes each particle. The actual fascinating effect about superposition is in its ability to view quantum states in numerous ways. Quantum computers can execute vast numbers of parallel computations unlike traditional computer that sequentially perform tasks in a system. Entanglement is a property in quantum computing that enable particles to meaningfully engage to collaborate measurements with each other and accomplish desired outcome in a system. Quantum

superposition and entanglement were elemental concepts in quantum mechanics as well as computing. Superposition communicated visibly that like waves in classical physics, given any two (or more) quantum states can possibly be superposed or sum together and the outcome will be a legitimate quantum state. Superposition is branded as a property in quantum computing as well as valid solutions to the Schrödinger equation. Predominantly, since this Schrödinger equation is linear, any visible linear combination of solutions appropriately will be a solution.

➤ *Quantum Teleportation:*

Information security visibly is one of the core issue with classical communication system. Also, new techniques and models were required to lessen the menace in data security.

Mark et al (2023) posit that biological systems such as cells, bacteria, chloroplasts, other micro-organisms communicate quantum particles like electrons, photons and gravitational waves and can exhibit long distance information teleportation. Quantum communication presents a useful role in managing the risk of possible data lost and security. Substantively, the limitation of qubits in losing its entangled states owing to noise presence in a communication channel limit its application towards short distance. This is where teleportation exhibits its elemental role in Quantum Computing. Quantum teleportation is a visible quantum communication property in the potential field of quantum information. In this process, quantum information that was embedded in an unidentified quantum state can be legitimately transmitted from one location to another with an assistance of an exchanged entangle state between the initiator and recipient.

A salient element utilized in the execution of quantum teleportation assures preservation of visible quantum channel that was assumed to be an absolutely entangled pure state as it relates to Alice and Bob.

More so, Bell 1 state is unarguably the best quantum channel to accomplish quantum teleportation protocol irrespective of noise environment in quantum computing as depicted in figure 1.

Hala and Alaa (2020) made available a teleportation scheme that controlled quantum teleportation. This new scheme can execute the controlled quantum teleportation utilizing both GHZ and GHZ-like visible states as quantum channels. They affirmed that GHZ state is unarguably the dominant quantum channel if a network user cooperates in transmitting information from sender to legitimate recipient.

IV. QUANTUM CRYPTOGRAPHY

According to Abidin (2021), Bennet and Brassard was the first to ever design the Quantum Key Distribution (QKD) arrangement in 1992. Consequently, many systems adopted the technique, including systems that were built by Los Alamos, British Telecom, Johns Hopkins University and IBM Almaden Research Center. Cryptography entail secret writing, where crypto signify secret and graphy likewise is writing. It is about practice and study of encrypting and decrypting hidden messages to facilitate/ ensure secure /assured communications. Predominantly, there are basically two sure types of QKD schemes. One is branded as prepare-and measure scheme like BB84 and the second is entanglement based QKD, such as Ekert91 and BBM92. Quantum cryptography or quantum key distribution (QKD) applies elemental laws of quantum physics to guarantee secure communication. It enables as well as assures two legitimate users, classically named Alice and Bob, to create a shared secret random qubit string that can be adopted as a key in encrypting any given message. Shor's algorithm can effortlessly overwhelm this universal RSA algorithm that relies on the complexity in factoring large integers /numbers.

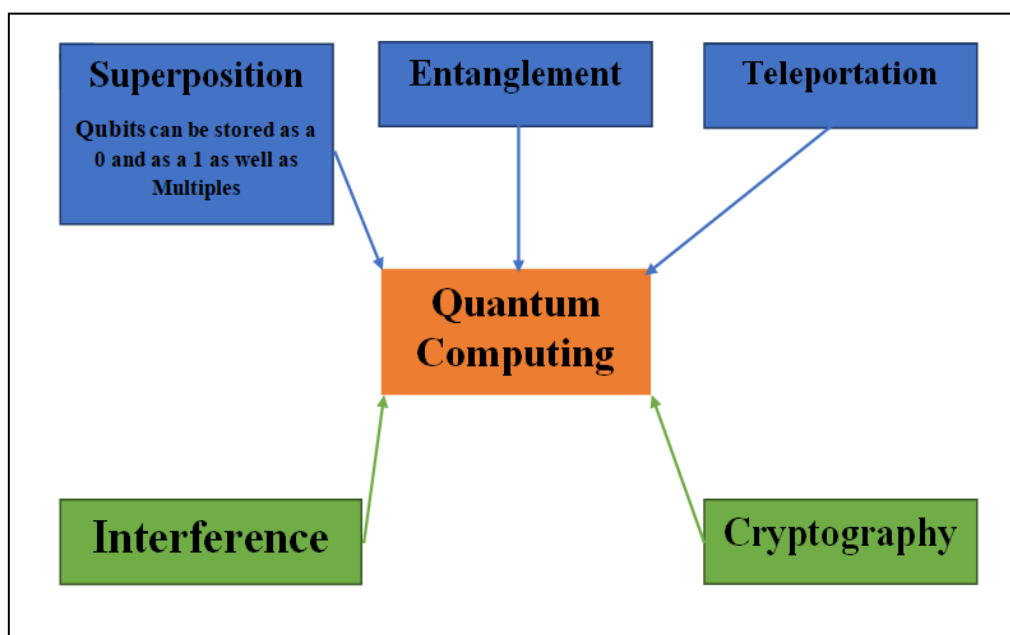


Fig 1 Elemental Properties of Quantum Computing

Shi et al (2023) revealed that there are two salient aspects of QKD performance namely key rate and maximal secure distance. Quantum cryptography is a visible cryptographic arrangement based on quantum mechanics. It is predominantly branded as quantum key distribution since quantum mechanics was used to deliver an encrypted key and not for transmitting data message among users. More so, encryption in quantum cryptography is executed using visible quantum states branded as qubits. It is infeasible to measure and clone any quantum states where an eavesdropper will clone or measure the qubits.

Shemin and Vipinkumar (2015) insisted that this arrangement require two classes of channels namely quantum channel for secure transmission of key and classic channel for assured verification of received key. The elemental principle of QKD is sender such as (Alice) that transmit a string of polarized photons to a receiver like (Bob) utilizing optical fibre as transmission medium in their visible communication. Fundamentally, the stream of polarized photons can signify ones and zeros, according to the polarization of photons. Substantially, for instance, a vertically polarized (V) or photon ascribed $+45^\circ$ visible state can represent 1 while a horizontally polarized (R) or photon ascribed -45° state can as well represent 0. These strings of polarized photons were nothing but merely qubits comparable to bits in a binary system.

More so, at Bob end, the string of photons will be transmitted randomly through a visible beam splitter and thereafter, Bob sends for its comparison the acquired data. Consequently, Alice will compare with her own data and remove photons that deviated to wrong beam splitter and ultimately the left sequence operate as key that is used in encrypting message. QKD assures the transmission of data devoid of any threat from eavesdroppers in this visible communication. Today, China is one of those countries that demonstrated a stable and advanced QKD over large network coverage in communication. They have proposed QKD as well as the incorporation of visual cryptography and steganography towards securing data transmission in communication.

V. APPLICATION AREAS OF QUANTUM COMPUTING

Predominantly, technologies that depend on visible quantum phenomena are utilize daily by us.

- The first ever wave of quantum technologies brought about transistor. This device became an elemental concept in modern computers and digital communication.
- Magnetic Resonance Imaging (MRI) that has visibly transformed how medical practitioners diagnose diseases, offering medical experts with a non-invasive method to turn out images from inside human bodies. MRI machines execution were based on quantum property of spin that grant each atom with visible predictable magnetic property
- Drug development where quantum computing provides significant role in drug development. These inherently

assure drugs can be tested for visible as well as stable molecular configuration using certain molecular modeling processes incorporating running innovative simulations.

- Substantially, aircraft development companies can adopt quantum computing concept in the development of aircraft design. The whole aircraft can be visibly modeled, digitized and enables prompt simulation.
- Financial system is one fundamental area that has improved tremendously incorporating quantum computing. It can overcome the challenges of known traditional algorithms that act poorly in anticipated time-sensitive financial transactions.
- Quantum computing is crucial in development of current climate models. Climate models utilized in predicting weather are not reasonably very accurate owing to diverse inputs representing real-world conditions were meant to be simulated. In addition, classical computing systems were limited in handling tremendous data inputs, which is a deviation on the relevance of quantum computers that can contain numerous inputs to facilitate enhanced accurate climate models.
- Blockchain Technology requires a fortified security arrangement, exhibiting a decentralized network in the peer-to-peer system. One of its predominant features is immutability and quantum cryptography handles such visible challenges in blockchain technology that comprises cryptocurrency, smart contracts etc. The volatile and other associated risk in blockchain technology necessitates an infeasible and a fortified security set-up.

VI. RESULTS

Quantum computing properties is of great potential in significantly impacting cryptography by overwhelming the arrangement within encryption algorithms security that have been in existence for decades. This is largely owing to the visible capabilities in quantum computing to execute certain calculations in faster succession than classical computers, where it can break numerous encryption algorithms, with no exception to widely utilized RSA encryption algorithm.

Other properties such as entanglement, teleportation when accurately measured can be incorporated with superposition as well as cryptography in guaranteeing instant and timely election result. The visible impact of quantum computing as well as its relevance on cryptography is significant as it can overwhelm many widely utilized cryptographic arrangements that rely on the complexity of factoring enormous numbers or visibly computing discrete logarithms. It has been suggested that Shor's algorithm can easily overpower the trendy RSA algorithm which rest on the difficulty factoring tremendous numbers in cryptographic set-up.

VII. CONCLUSION

This study demonstrated the salient properties as well as advancement of quantum technologies which has tremendously impacted the cryptography solution that were visibly limited in classical cryptography. Quantum

computing properties encompasses namely Superposition, Entanglement, Interference, Teleportation, Cryptography etc. Quantum computing provides numerous algorithms such as QKD, BB84, B91 and more that can offer secure communication in comparison to classical cryptography in high security arrangement that entail key exchange by utilizing quantum principles to identify menace in a system. Our result in this study suggested that properties such as entanglement, teleportation when accurately measured can be incorporated with superposition as well as cryptography in guaranteeing instant, secured and timely election result.

REFERENCES

- [1]. Abidin Shafiqul, “Quantum cryptography technique: A way to improve security challenges in mobile cloud computing (MCC)”, *Materials Today: Proceedings*, 2021, <https://doi.org/10.1016/j.matpr.2021.05.593>.
- [2]. Arun, G & Mishra Vivekan and, A Review on Quantum Computing and Communication, *IEEE*, 2014
- [3]. Bateman J., “A Robust Method for the Creation of Equal Super positions in Rubidium: A pulse scheme for the Momentum State Quantum Computer”, *IEEE*, 2005.
- [4]. C. Noh and D. G. Angelakis, “Quantum simulations and many-body physics with light,” *Rep. Prog. Phys.* 80, 016401 (2017).
- [5]. Carleo, G., E. Altman, K. R. Brown, G., “Quantum simulators: Architectures and opportunities,” *PRX Quantum* 2, 017003 (2021).
- [6]. Chen Jiajun, „ Review on Quantum Communication and Quantum Computation“, *Journal of Physics: Conference Series*, 2021, 10.1088/1742-6596/1865/2/02200
- [7]. Daley, A. (2023). Twenty-five years of analogue quantum simulation. *Nat. Rev. Phys.* 5(12), 702–703 (2023). <https://doi.org/10.1038/s42254-023-00666-0>
- [8]. De Leon, N. K.M. Itoh, D. Kim and D.W. Steuerman (2021), Materials challenges and opportunities for quantum computing hardware. *Science*. <https://doi.org/10.1126/SCIENCE.ABB2823>
- [9]. DiVincenzo, D (1998).Quantum information is physical. *Superlattices Microstruct.* 23(3), 419–432 (1998). <https://doi.org/10.1006/spmi.1997.0520>
- [10]. Dykman, M., P. M. Platzman, P. Seddighrad (2003), Qubits with electrons on liquid helium. *Phys. Rev. B* 67(15), 155402 (2003). <https://doi.org/10.1103/PhysRevB.67.155402>
- [11]. Fernandez-Carames,T., P. Fraga-Lamas, Towards post-quantum blockchain: a review on blockchain cryptography resistant to quantum computing attacks. *IEEE Access* 8, 21091–21116 (2020). <https://doi.org/10.1109/ACCESS.2020.2968985>
- [12]. Georgescu. I (2020), The DiVincenzo criteria 20 years on. *Nat. Rev. Phys.* 2(12), 666–666 (2020). <https://doi.org/10.1038/s42254-020-00256-4>
- [13]. Gill, S A. Kumar, H. Singh, M. Singh & R. Buyya (2022), Quantum computing: a taxonomy, systematic review and future directions. *Softw. Pract. Exp.* 52(1), 66–114. <https://doi.org/10.1002/spe.3039>
- [14]. Gisin, N, G. Ribordy, W. Tittel, and H. Zbinden,(2002). Quantum cryptography," *Reviews of Modern Physics*, vol. 74, no. 1, pp. 145-195.
- [15]. Griffiths,G and D. F. Schroeter, Introduction to quantum mechanics. , 2018.
- [16]. Gyongyosi Laszlo and Imre Sandor, Entanglement access control for the quantum Internet, *Quantum Information Processing*, 2019.
- [17]. Gyongyosi, L & S. Imre (2019), A survey on quantum computing technology. *Comput. Sci. Rev.* 31, 51–71 (2019). <https://doi.org/10.1016/J.COSREV.2018.11.002>
- [18]. Hamdoun Hala and Sagheer Alaa, “Information security through controlled quantum teleportation networks”, *Digital Communications and Networks*, 2020.
- [19]. Hellenbrand, M. J. MacManus-Driscoll (2023). Multi-level resistive switching in hafnium-oxide-based devices for neuromorphic computing. *Nano Convergence* 10, 44 (2023). <https://doi.org/10.1186/S40580-023-00392-4>
- [20]. Junggren, I Daniel, Entanglement in quantum communication, Doctoral Thesis Stockholm, Sweden 2006
- [21]. Karthikeyan,B and N Guruprasath (2025). Distributed Quantum Communication Channel via Quantum Teleportation, *International Journal of Research Publication and Reviews*, 6, (2), and Page – 3539-3544.
- [22]. Kaur, N., Singh, A., and Singh, S. (2011). Enhancement of Network Security Techniques Using Quantum Cryptography. *International Journal on Computer Science and Engineering*, Vol. 3, Issue 5, pp.1960-1964 (2011)
- [23]. Krinner, S., N. Lacroix, A. Remm., C. & A. Wallraf, Realizing repeated quantum error correction in a distance-three surface code. *Nature* 605(7911), 669–674 (2022). <https://doi.org/10.1038/s41586-022-04566-8>
- [24]. Li et al L L, Li J, Chang Y. Quantum key distribution based on single-particle and EPR entanglement. *Sci China Inf Sci*, 2020, 63(6): 169501, <https://doi.org/10.1007/s11432-018-9851-6>
- [25]. Lloyd, S, (1994).Necessary and sufficient conditions for quantum computation. *J. Mod. Opt.* 41(12), 2503–2520 (1994). <https://doi.org/10.1080/09500349414552341>
- [26]. M. Xiongfeng, “Quantum cryptography: from theory to practice” Doctor of Philosophy Thesis Graduate Department of Department of Physics, University of Toronto, 2008.
- [27]. Mark, D., H.Y. Huang, A. Kale, H. Pichler, F.G. Brandão, S. Choi, M. Endres, Preparing random states and benchmarking with many-body quantum chaos. *Nature* 613(7944), 468–473 (2023). <https://doi.org/10.1038/s41586-022-05442-1>
- [28]. Motta,M, & J.E. Rice, Emerging quantum computing algorithms for quantum chemistry. *Wiley Interdiscip. Rev. Comput. Mol. Sci.* 12(3), e1580 (2022). <https://doi.org/10.1002/WCMS.1580>

- [29]. Nielsen, M & I.L. Chuang, *Quantum Computation and Quantum Information*, 10th edn. (Cambridge University Press, 2011)
- [30]. Niu, J., L. Zhang, Y. Liu, J. Qiu and D. Yu (2023). Low-loss interconnects for modular superconducting quantum processors. *Nat. Electr.* 6(3), 235–241. <https://doi.org/10.1038/s41928-023-00925-z>
- [31]. Perdomo-Ortiz, A., M. Benedetti, J. Realpe-Gómez, R. Biswas, Opportunities and challenges for quantum-assisted machine learning in nearterm quantum computers. *Quant. Sci. Technol.* 3(3), 030502 (2018). <https://doi.org/10.1088/2058-9565/AAB859>
- [32]. Qi, W. Zhu, L. Qian, (2010). “Feasibility of quantum key distribution through a dense wavelength division multiplexing network,” *New J. Phys.* 12, 103042.
- [33]. Rina and Rohtas, G. (2023). Quantum Computing: Recent trend in Computing. *International Journal of Breative Research Thoughts (IJCRT)* 11(1), 2320-2882.
- [34]. Sevilla, J & C. J. Riedel. Forecasting timelines of quantum computing. *arXiv:2009.05045* (2020)
- [35]. Shemin P and Vipinkumar K, “E-PAYMENT SYSTEM USING VISUAL AND QUANTUM CRYPTOGRAPHY”, *ICETEST*, 2015.
- [36]. Shi, Y., Y. Liu, Y.R. Zhang, Z. Xiang & H. Fan (2023), Quantum simulation of topological zero modes on a 41-qubit superconducting processor. *Phys. Rev. Lett.* 131(8), 080401. <https://doi.org/10.1103/PHYSREVLETT.131.080401>
- [37]. Thomas J, G. S. Kanter, and P. Kumar, “Designing noise-robust quantum networks coexisting in the classical fiber infrastructure, **31**, 43035–43047 (2023).
- [38]. Tittel, W., H. Zbinden, and N. Gisin, "Experimental demonstration of quantum secret sharing," *Physical Review A*, vol. 63, no. 4, p. 042301, 2001.
- [39]. Wang, J., F. Sciarrino, A. Laing, M.G. Thompson, Integrated photonic quantum technologies. *Nat. Photonics* 14(5), 273–284 (2020). <https://doi.org/10.1038/s41566-019-0532-1>
- [40]. Weinstein, J., M.D. Reed, A.M. Jones, R.W. Andrews & M.G. Borselli (2023). Universal logic with encoded spin qubits in silicon. *Nature* 615(7954), 817–822 (2023). <https://doi.org/10.1038/s41586-023-05777-3>. *arXiv: 2202.03605*
- [41]. Younes A., “Enhancing the security of quantum communication by hiding the message in a superposition”, *Information Sciences*, 2010.
- [42]. Zhong, H., H. Wang, Y.H. Deng, & J.W. Pan, Quantum computational advantage using photons. *Science* 370(6523), 1460–1463(2020). <https://doi.org/10.1126/science.abe8770>
- [43]. Zou Nanxi, “Quantum Entanglement and Its Application in Quantum Communication”, *Journal of Physics: Conference Series*, 2021.