The moment probability and impacts monitoring for electron cloud behavior of electronic computers by using quantum deep learning model

Dr. B.Gopi [1], J Logeshwaran [2], J Gowri [3], T. Kiruthiga [4]

[1] *Department of Electronics and communication Engineering, Muthayammal Engineering College, India*

[2] *Department of Electronics and communication Engineering, Sri Eshwar College of Engineering, India*

[3] *Department of Electronics and communication Engineering, SNS College of Technology, India*

[4] *Department of Electronics and communication Engineering, Vetri Vinayaha College of Engineering and Technology, India*

E-Mail: dean.ece@mec.edu.in [1], eshwaranece91@gmail.com [2], ergowrij@yahoo.com [3], kirthi.06nov@gmail.com [4]

Abstract

Quantum theory is the most important part of quantum physics. In simple terms, this theory describes the movement, behavior and interaction of microscopic particles. The theory of quantum physics about the behavior and interaction of microscopic particles formed the basis for condensed matter physics, elementary particle physics, and high energy physics. Quantum theory explains to us the essence of many phenomena in our world - from the operation of electronic computers to the structure and behavior of celestial bodies. In this paper a quantum deep learning model was proposed to identify the moment of probability and impacts for electron cloud behavior of electronic computers. This method helps to understand the true essence of many things at the level of fundamental particles. In short, quantum field theory is a descriptive theory of microscopic particles, as well as their behavior in space, interactions with each other, and mutual transformations. This proposed model examines the behavior of quantum systems with so-called degrees of freedom. In a saturation tip the proposed model achieved 86.37% of the light interface management, 89.50% of the photon stream management, 89.52% of the superposition management, 91.30% of the quantum wave function management, 88.61% of the quantities management and 90.39% of the Experimental quantum structure management.

Keywords: Quantum theory, Quantum theory, microscopic particles, computers, deep learning

DOINumber:10.14704/nq.2022.20.8.NQ44634 **NeuroQuantology2022;20(8):6088-6100**

1. Introduction

The quantum mechanical theory of atomic structure is one of the fundamental concepts in quantum physics, and indeed in physics in general [1]. This theory allows us to understand the structure of all matter and opens the veil of mystery to what it actually consists of. The results based on this theory are quite unexpected [2-3]. Briefly consider the structure of the atom. An atom consists of a nucleus and a cloud of electrons. The core of the atom, its nucleus, contains the entire mass of the atom - more than 99 percent [4]. The nucleus always has a positive charge and this determines the chemical element that is part of the atom [5]. The most interesting thing about the nucleus of an atom is that it contains the entire mass of the atom, but at the same time it contains only one ten thousandth of its volume [6]. The founder of the atomic theory, Niels Bohr, proposed an interesting idea that the electrons in the atom do not propagate energy continuously, but only at the moment of transition between their paths of motion. Bohr's theory helped explain many intra-atomic processes, and led to a breakthrough in chemical science by explaining the boundaries of Mendeleev's table [7-8]. According to, the last elements that can exist in time and space are the elements beginning with sequence number one hundred and thirty-seven and one hundred and thirty-eight, because their existence contradicts the theory of relativity [9]. Also, Bohr's theory explained the nature of physical phenomena such as atomic spectra [10].

These are interaction spectra of free atoms that arise when energy is emitted between them. Such phenomena are common to gaseous, vaporous substances and substances in plasma state [11]. Thus, the quantum theory created a revolution in the world of physics and allowed scientists to advance not only in this scientific field, but also in many related scientific fields: chemistry, thermodynamics, optics and philosophy [12-13]. And it allowed humanity to penetrate the secrets of the nature of things. Humanity has much more to do in its consciousness to realize the nature of atoms and to understand the principles of their behavior and interactions [14-15]. If we understand this, we can understand the nature of the world around us, because everything around us, starting with dust particles and ending with the sun, ourselves - everything consists of atoms, the nature of which is mysterious and full of wonderful and many secrets [16-18].

All matter appears dense only because of interactions between atoms. Substances have solid and dense consistency only because of attraction or repulsion between atoms [19]. It ensures the density and hardness of the crystal lattice of chemicals, which contains all the substances. But, an interesting thing is that when, for example, the temperature conditions of the environment change, the bonds between atoms, that is, their attraction and repulsion, may weaken, which leads to the weakening of the crystal lattice and even its destruction [20-21]. It explains the change in physical properties of materials when heated. Scientists have discovered another mysterious property of elementary particles [22]. This is how the concepts of uncertainty and collapse of the wave function appeared in quantum physics. When an electron flies into space, it is in an indefinite state or, as we said above, in a superposition [23]. That is, it behaves like a wave, located simultaneously at different points in space, which has two spin values (a spin has only two values). If we don't touch it, if we don't try to look at it, if we don't find out exactly where it is, if we don't measure the value of its spin, it will fly in a wave in two splits. At the same time, it creates an interference pattern [24]. Quantum physics uses the wave function to describe its path and parameters [25]. Apart from the regular terms in physics, they also use special terms called terms [26]. These are "energy" (in physics it is a measure of different types of contact and movement of matter, as well as transition from one to another), "force" (a measure of the intensity of the influence of other bodies and fields. on a body) and others [27].

2. Literature Review

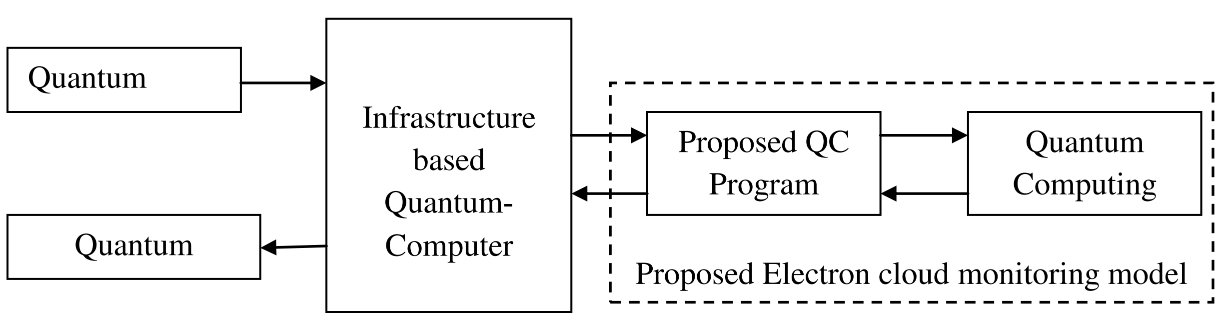
Any fundamental particle is not only a quantum, not only a solid particle, but also a wave. Corpuscular-wave dualism appeared in quantum physics, marking the beginning of the first paradox and discoveries of mysterious phenomena in the microscopic world [1]. The most interesting paradoxes began when the famous double split experiment was carried out, and the mysteries abounded thereafter. Quantum physics can be said to have started with him. For example, when iron is heated, it becomes liquid and can be shaped into any shape. And when ice melts, the destruction of the crystal lattice leads to a change in the state of matter, and it turns from solid to liquid [2]. These are clear examples of weakening of the bonds between atoms, resulting in the weakening or destruction of the crystal lattice, and allowing the material to become amorphous [3].

The reason for such mysterious transformations is precisely that objects contain only ten thousandths of dense matter, the rest being empty. And substances appear to be solid only because of the strong bonds between atoms, and as they weaken, matter changes. Thus, the quantum theory of the structure of the atom allows us to take a completely different view of the world around us [4]. Various processes, changes, i.e. events are constantly happening all over the world. For example, a piece of ice in a warm place will start to melt. And the water in the kettle boils in the fire. Electricity passing through the wire heats it up. Each of these processes is an event. In physics, these mechanical, magnetic, electrical, acoustic, thermal and light changes are studied by science [6]. They are also called physical phenomena. Considering them, scientists calculate laws. The task of science is to discover these laws and study them. Nature is studied by sciences like biology, geology, chemistry and astronomy. They all use the laws of physics [7].

Most of what people know comes from observations. To study events, they are continuously observed. For example, take various bodies falling to the ground. It is important to find out whether this phenomenon differs when bodies of unequal masses, different heights, etc [9] Waiting and looking at different bodies can be very long and not always successful. Hence, experiments are carried out for such purposes. They differ from observations because they are carried out specifically according to a predetermined plan and with specific goals in mind[10]. Usually, in the project, some assumptions are built in advance, that is, they present hypotheses. Thus, in the course of experiments, they are either disproved or confirmed. After considering and interpreting the results of the experiments, conclusions are drawn. This is how scientific knowledge is acquired [12].

3. Proposed Model

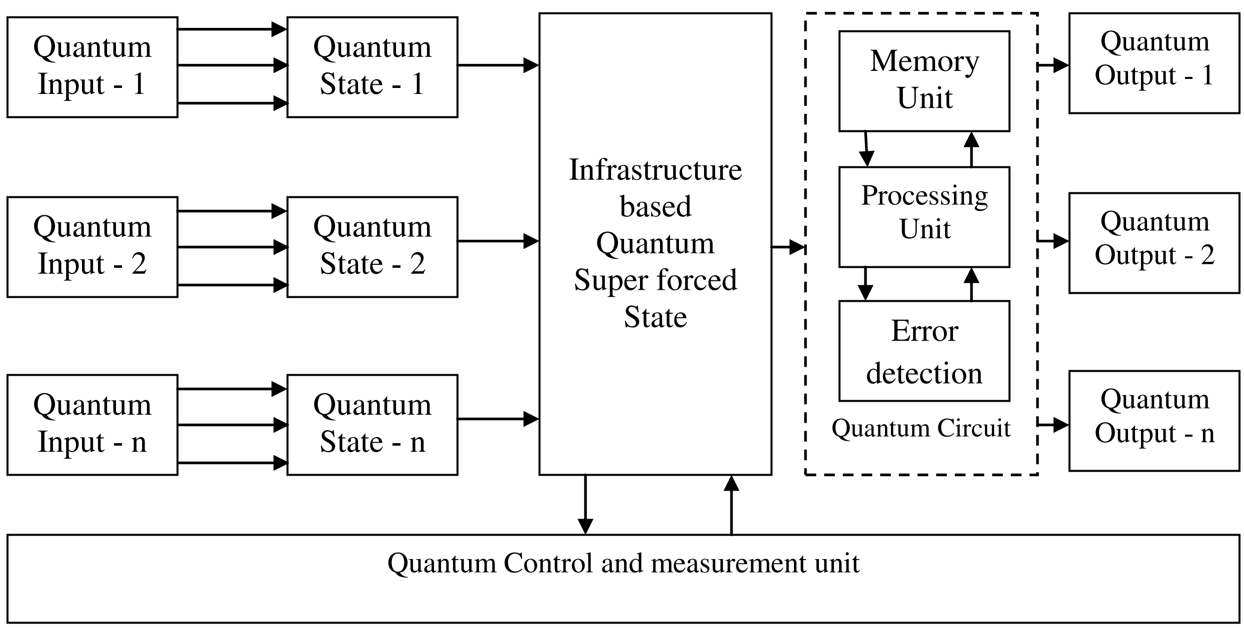
The electron cloud is not permanent and is not really a physical object. An electron cloud is simply the probability of electrons appearing in an atom. That means the nucleus occupies only one ten thousandth of the atom, the rest being empty. If it was take into account that all matter around us, from dust particles to celestial bodies, planets, and stars, consists of atoms, all matter is actually more than 99 percent empty. This theory seems completely implausible, and its author, at least, is a deluded person, because the surrounding things have a solid stability, can weigh and feel.



4. Fig 1: Proposed Electron cloud monitoring model

4.1. System design

Imagine a plate with two spaces in the form of vertical lines. Let's place a screen behind this plate. If we shine light on the plate, we will see an interference pattern on the screen. That is, alternating dark and bright vertical lines. Interference is the result of the wave behavior of something, in our case light. If you pass a wave of water through two holes located side by side, you will understand what interference is. That is, light becomes wave-like in nature. But physics, or as Einstein proved, it is propagated by photons particles are already a contradiction. But no matter, corpuscular-wave dualism no longer surprises us. Quantum physics says that light behaves like a wave but is made up of photons. But the miracles are just beginning. Let's place a gun in front of a plate with two slots, which will emit not light but electrons. Let's start shooting electrons. After all, electrons are particles, that is, the flow of electrons, through two slits, should leave only two lines on the screen, two traces opposite the slits. Electrons travel in waves. So electrons are waves. But above all it is a fundamental particle and back to corpuscular-wave dualism in physics. But at a deeper level, we can think of an electron as a particle, and when these particles come together, they start acting like waves. For example, an ocean wave is a wave, but it is made up of water droplets and smaller molecules and atoms. Well, the logic is solid. Then we fire the gun not through a stream of electrons but after a certain period of time we emit electrons individually. What we pass through the cracks is not an ocean wave, but like spitting individual drops from a children's water gun.



6091

Fig 2: Proposed Quantum deep learning model

In this case it is quite logical that different drops of water fall in different places. On the screen behind the plate, no interference pattern from the wave can be seen, but two clear fringes from the impact opposite each slit. We will see the same thing if we throw small stones, they fly into two cracks and leave a trail like a shadow from two holes. Let us now shoot individual electrons to see these two lines on the screen from electron impacts. They released one, waited, the second, waited, and so on. Quantum physicists were able to perform such an experiment. Instead of these two edges, the same interference alternatives of multiple edges are obtained. This can happen if the electron flies through two slits simultaneously and collides with itself behind the plate, like a wave, and interferes. But this cannot be, because a particle cannot be in two places at the same time. It flies either through the first slot or through the second.

4.2. Superposition

Through a deeper analysis, scientists have discovered that any fundamental quantum particle or the same light (photon) can actually exist in many places at once. These are not miracles, but real truths of subtlety. This is what quantum physics says. That is why when a single particle is fired from a cannon, we see the effect of interference. Behind the plate, the electron collides with itself and creates an interference pattern. The ordinary objects of the macrocosm are always in the same place, in the same state. For example, you are now sitting on a chair, weight; say 50 kg, beats 60 per minute. Of course, these symptoms will change, but they will change after some time. After all, you cannot be at home and at work at the same time weighing 50 and 100 kg. All this is understandable, it is common sense. In the physics of microcosms, everything is different. Quantum mechanics asserts, and it has already been confirmed experimentally, that any fundamental particle exists not only at many points in space at the same time, but also at the same time in many states, such as spin. This is how we understand the term "superposition" in quantum mechanics. Superposition means that an object of microorganism can be in different places at the same time, and can have several states at the same time. And this is normal for elementary particles. As strange and wonderful as it may seem, this is the rule of the microcosm.

4.3. Decline of wave function

Then the scientists decided to look more precisely to see if the electron actually passes through the two slits. Suddenly it passes through a crevice, then somehow separates, forming an interference pattern as it passes. Well, you never know. That is, some device must be placed near the slits, which will accurately record the passage of the electron through it. Of course, this is difficult to implement, you do not need a device, but something else to see the passage of the electron. But scientists have done it. As soon as we begin to see the gap through which an electron passes, it begins to behave not like a wave, not like a strange object located at different points in space at the same time, but like an ordinary particle. That is, it begins to show the specific properties of a quantum: it is located only in one place, it passes through a slot, it has a spin value. What appears on the screen is not the interrupt mode, but a simple trace opposite the splitter. But how is that possible. Electron mocks us as if toying with us. At first, it behaves like a wave, then, after deciding to see its passage through a slit, it exhibits the properties of a solid particle and passes through only one slit. But that's how it is in microcosm. These are the laws of quantum physics.

5. Results and discussions

The proposed quantum deep learning model (QDLM) was compared with the existing Empirical Analysis of Security Enabled Quantum Computing (EASQC), deep learning-associated quantum computing framework (DLAQC), data gathering and incident response model (DGIRM) and Fuzzy probabilistic based semi-morkov model (FPSMM)

5.1. Light interference

This is the "wave" behavior of light, when lots of alternating bright and dark vertical lines are displayed on the screen. And those vertical lines are called the pattern of intersection. It is now clear to us that light has a wave nature, and if 2 slits are illuminated by light, we will see an interference pattern on the screen behind them with a lot of vertical lines. That is, electrons, like light, can have a wave nature and can interfere. On the other hand, it became clear that light is not just a wave, but a particle - a photon. The comparison between the existing and proposed model was shown in the following table 1.

Table 1: Comparison of Light Interference

No of Inputs	EASQC	DLAQC	DGIRM	FPSMM	QDLM
100	70.62	70.22	67.60	70.66	89.13
200	69.13	68.29	65.40	69.22	88.09
300	67.32	66.56	64.25	67.50	87.32
400	65.72	64.70	62.40	65.97	86.37
500	64.07	62.87	60.73	64.39	85.47
600	62.42	61.04	59.05	62.81	84.56
700	60.77	59.21	57.38	61.23	83.66

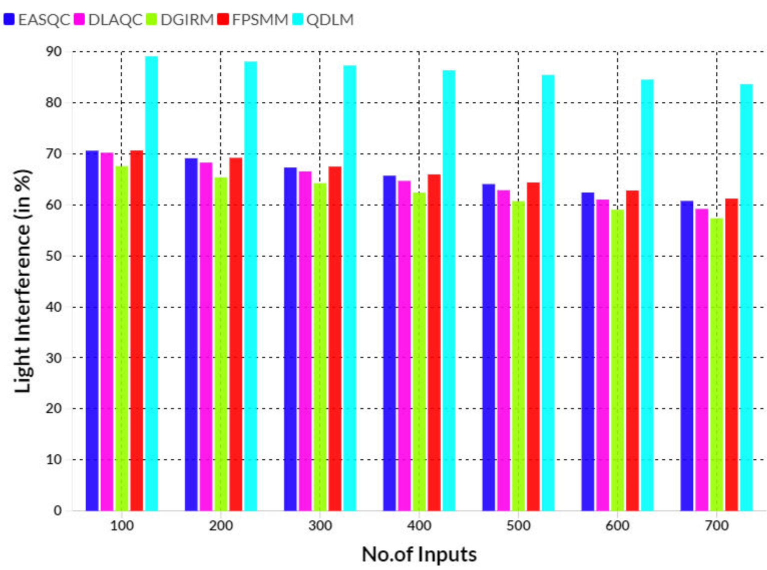


Fig 3: Comparison of Light Interference

The saturation tip in fig 3, the proposed quantum deep learning model achieved 86.37% of the light interface management. In the same range the existing models EASQC achieved 65.72%, DLAQC achieved 64.70%, DGIRM achieved 62.40% and FPSMM achieved 65.97% of Light interface management.

5.2. Stream of photons

It shines our slits with a stream of photons (electrons) - and we see an interference pattern (vertical lines) behind the slits on the screen. Presumably, one electron flies to the left slit and the other to the right. But 2 vertical lines should appear on the screen directly opposite the slots. After flying through the slits the electrons can somehow interact with each other already on the screen. The result is such a waveform. Now, when the electron flies alone, it cannot interact with other electrons in the screen. Let's record each electron on the screen after throwing. One or two, of course, will not "paint" a clear picture for us. But this happens when we send many to the slots one by one. The comparison between the existing and proposed model was shown in the following table 2.

Table 2: Comparison of photon stream

No of Inputs	EASQC	DLAQC	DGIRM	FPSMM	QDLM
100	76.13	77.40	74.15	77.80	92.69
200	74.50	75.66	72.57	76.38	91.40
300	74.02	73.32	70.37	75.12	90.39
400	72.73	72.51	68.74	73.13	89.50

500	71.68	70.47	66.85	71.79	88.35
600	70.61	68.77	65.01	70.26	87.29
700	69.54	67.07	63.16	68.74	86.23

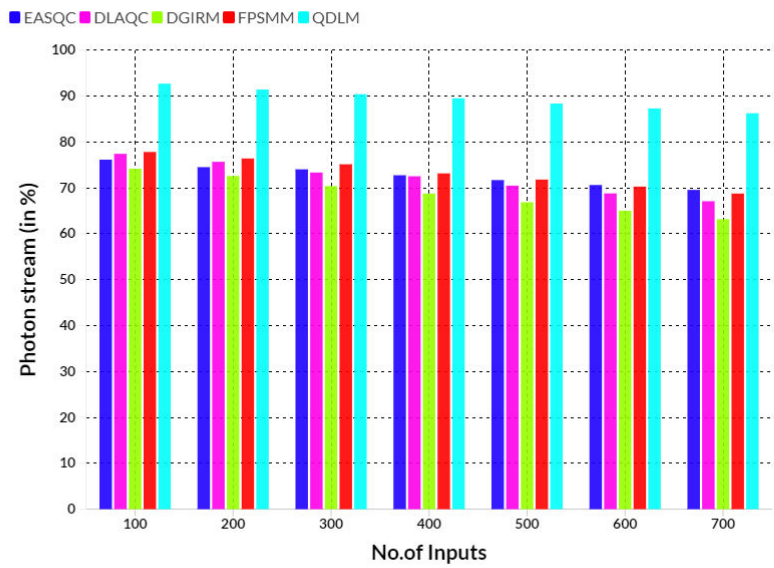


Fig 4: Comparison of photon stream

The saturation tip in fig 3, the proposed quantum deep learning model achieved 89.50% of the photon stream management. In the same range the existing models EASQC achieved 72.73%, DLAQC achieved 72.51%, DGIRM achieved 68.740% and FPSMM achieved 73.13% of photon stream management.

5.3. Management of superposition

We know that a photon can act as both a particle and a wave. Inexplicably we can travel in 2 slots at the same time. Therefore, it will be easy for us to understand the following important statement of quantum mechanics. Quantum mechanics tells us that this photon behavior is the rule, not the exception. Any quantum particle, as a rule, exists simultaneously in many states or in many points in space. The objects of the macro world can only exist in a certain place and in a certain state. But a quantum particle exists by its own rules. She doesn't care that we don't understand them. This is the point. We have to accept as a theory that the "superposition" of a quantum object can exist in 2 or more paths at the same time, at 2 or more points at the same time. The comparison between the existing and proposed model was shown in the following table 3.

Table 3: Comparison of superposition management

No of Inputs	EASQC	DLAQC	DGIRM	FPSMM	QDLM
100	73.53	65.66	62.67	64.83	91.73
200	72.82	64.73	61.56	63.50	90.49
300	71.52	63.73	60.86	62.63	90.38
400	70.61	62.78	59.89	61.45	89.52
500	69.61	61.81	58.98	60.35	88.84
600	68.60	60.85	58.08	59.25	88.17
700	67.60	59.88	57.17	58.15	87.49

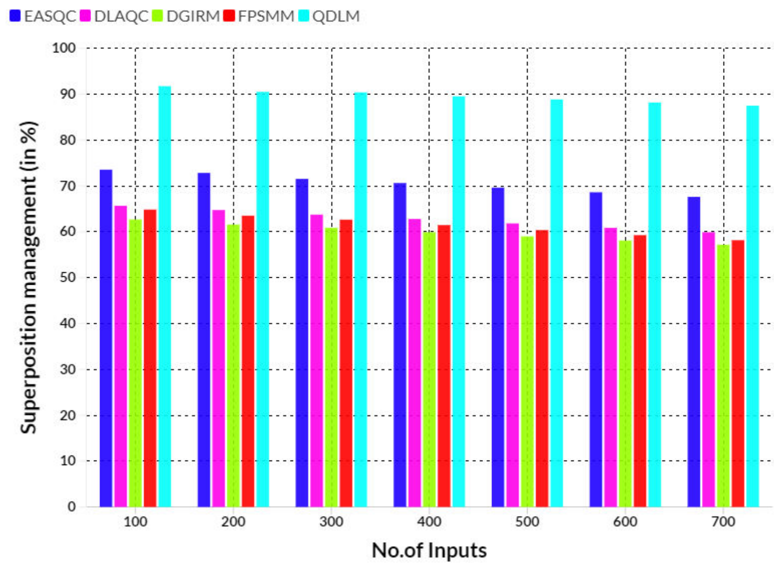


Fig 5: Comparison of superposition management

The saturation tip in fig 5, the proposed quantum deep learning model achieved 89.52% of the superposition management. In the same range the existing models EASQC achieved 70.61%, DLAQC achieved 62.78%, DGIRM achieved 59.89% and FPSMM achieved 61.45% of superposition management.

5.4. Management of Quantum wave function

The same holds true for another photon parameter—spin (its own angular momentum). A spin is a vector. A quantum object can be thought of as a microscopic magnet. We use whether the magnetic vector (spin) is directed up or down. Suppose we have an electron, which flies on its own in an unstable state, its spin being driven up and down at the same time. We have to measure his position. Let's measure using a magnetic field: electrons directed spin in the direction of the field will deflect in one direction, and electrons directed against the field will deflect in another direction. Photons can be sent to a polarizer and a filter. If the photon's spin (polarization) is +1, it passes through the filter. As long as you don't measure the position of a quantum object, it can spin in any direction (its own angular momentum vector - the spin direction). But the moment you measure his position, which spin vector to take. The comparison between the existing and proposed model was shown in the following table 1.

Table 4: Comparison of Quantum wave function

No of Inputs	EASQC	DLAQC	DGIRM	FPSMM	QDLM
100	77.39	69.66	66.59	69.36	93.43
200	77.06	68.16	66.00	67.49	92.39
300	75.72	67.05	65.02	66.66	92.26
400	74.58	66.67	63.81	65.75	91.30
500	73.75	65.37	63.03	64.40	90.72
600	72.77	64.36	62.09	63.23	90.06
700	71.79	63.35	61.16	62.07	89.41

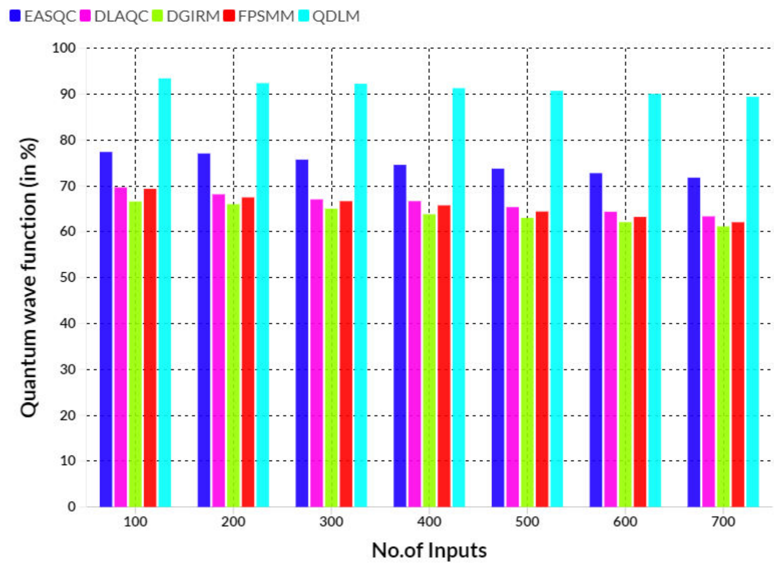


Fig 6: Comparison of Quantum wave function

The saturation tip in fig 6, the proposed quantum deep learning model achieved 91.30% of the quantum wave function management. In the same range the existing models EASQC achieved 74.58%, DLAQC achieved 66.67%, DGIRM achieved 63.81% and FPSMM achieved 65.75% of quantum wave function management.

5.5. Quantities and units Management

Most of the time, studying anything makes different measurements. When a particle falls, for example, height, mass, speed, and time are measured. All this means something that can be measured. To measure a value is to compare it with the same value, which is taken as a unit (the length of the table is compared with a unit of length - a meter or another). Each such value has its own units. It is often necessary to use larger units than regular multiples. The comparison between the existing and proposed model was shown in the following table 5.

Table 5: Comparison of Quantities management

No of Inputs	EASQC	DLAQC	DGIRM	FPSMM	QDLM
100	71.23	63.36	66.07	67.57	90.82
200	70.52	62.43	64.96	66.24	89.62
300	69.22	61.43	64.26	65.16	89.46
400	68.31	60.48	63.29	63.91	88.61
500	67.31	59.51	62.38	62.71	87.93
600	66.30	58.55	61.48	61.50	87.25
700	65.30	57.58	60.57	60.30	86.57

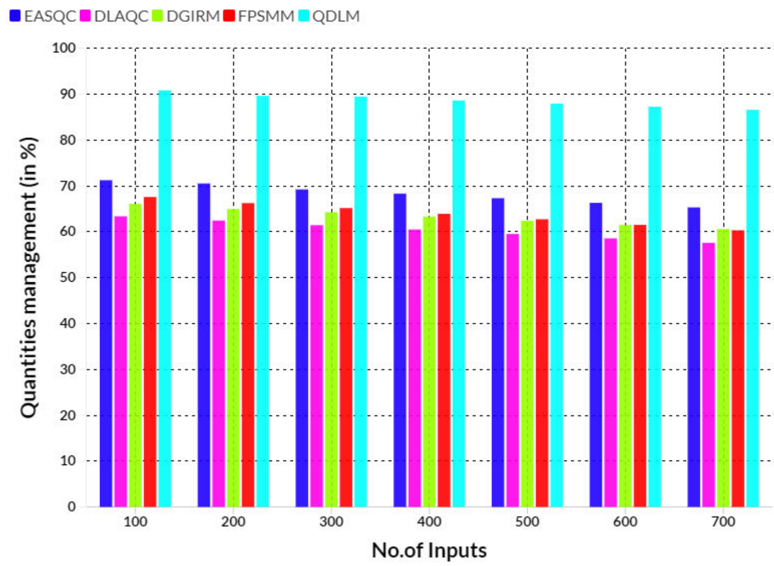


Fig 7: Comparison of Quantities management

The saturation tip in fig 7, the proposed quantum deep learning model achieved 88.61% of the quantities management. In the same range the existing models EASQC achieved 68.31%, DLAQC achieved 60.48%, DGIRM achieved 63.29% and FPSMM achieved 63.91% of quantities management.

5.6. Experimental Quantum structure

These are the major calculation of quantum science. They may seem far-fetched, especially since most people are theorists or experimenters. However, they continue to evolve side by side. Any problem is considered by theorists and experimenters. The business of the former is to describe data and derive hypotheses, while the latter is to test theories in practice, conduct experiments, and obtain new data. Sometimes achievements result from experiments only, without theories being explained. In other cases, on the contrary, it is possible to obtain later verified results. The comparison between the existing and proposed model was shown in the following table 1.

Table 6: Comparison of Experimental quantum structure

No of Inputs	EASQC	DLAQC	DGIRM	FPSMM	QDLM
100	75.09	67.36	69.99	72.10	92.52
200	74.76	65.86	69.40	70.23	91.51
300	73.42	64.75	68.42	69.40	91.35
400	72.28	64.37	67.21	68.49	90.39
500	71.45	63.07	66.43	67.14	89.81
600	70.47	62.06	65.49	65.97	89.15
700	69.49	61.05	64.56	64.81	88.50

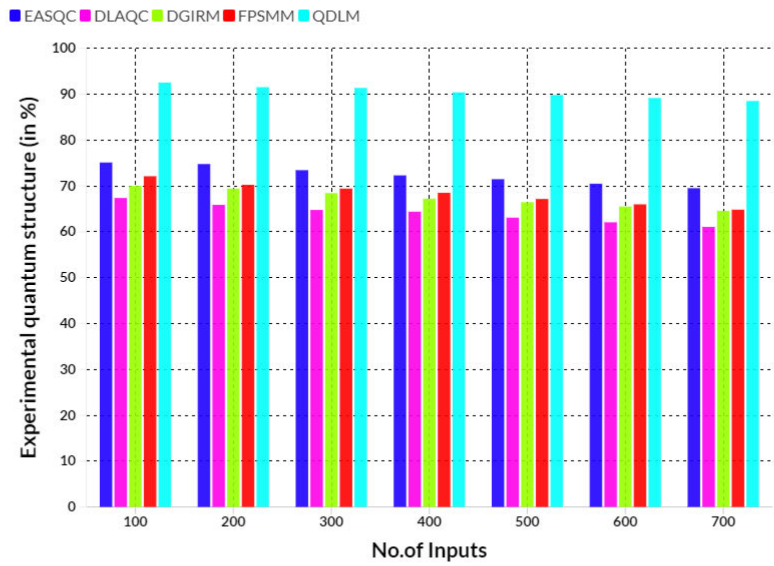


Fig 8: Comparison of Experimental quantum structure

The saturation tip in fig 8, the proposed quantum deep learning model achieved 90.39% of the Experimental quantum structure management. In the same range the existing models EASQC achieved 72.28%, DLAQC achieved 64.37%, DGIRM achieved 67.21% and FPSMM achieved 68.49% of Experimental quantum structure management.

6. Conclusions

All bodies in physics are called physics. They have size and shape. They contain objects, which are one of the object types. This quantum object is very cool and it makes decisions about its position. And we can't predict in advance what decision it will make when we fly through a magnetic field that we measure. The probability that a spin vector decides to be "up" or "down" is 50 to 50%. But once decided, a particular spiral will remain in a particular position in the direction. The reason for this result is our "dimension". The proposed quantum deep learning model (QDLM) was compared with the existing Empirical Analysis of Security Enabled Quantum Computing (EASQC), deep learning-associated quantum computing framework (DLAQC), data gathering and incident response model (DGIRM) and Fuzzy probabilistic based semi-morkov model (FPSMM). In a saturation tip the proposed model achieved 86.37% of the light interface management, 89.50% of the photon stream management, 89.52% of the superposition management, 91.30% of the quantum wave function management, 88.61% of the quantities management and 90.39% of the Experimental quantum structure management. Wave function decay means that the wave function is infinite before measurement, the electron spin vector was in all directions simultaneously, and after the measurement, the electron fixed a particular direction of its spin vector.

References

[1] Ahmad, S., Mehfuz, S., & Beg, J. (2022). Empirical Analysis of Security Enabled Quantum Computing for Cloud Environment. In Quantum and Blockchain for Modern Computing Systems: Vision and Advancements (pp. 103-125). Springer, Cham.

[2] Hasan, T., Ahmad, F., Rizwan, M., Alshammari, N., Alanazi, S. A., Hussain, I., & Naseem, S. (2022). Edge caching in fog-based sensor networks through deep learning-associated quantum computing framework. Computational intelligence and neuroscience, 2022.

[3] Sutharsan, M., & Logeshwaran, J. (2016). Design intelligence data gathering and incident response model for data security using honey pot system. International

Journal for Research & Development in Technology, 5.

[4] Sreedevi, M., Jena, S. R., & Rajasekar, V. (2022). Introduction to Quantum Computing & Machine Learning Technologies (Vol. 1). DRAFT2DIGITAL.

[5] Wang, H., Huang, Z., Zhang, X., Huang, X., wei Zhang, X., & Liu, B. (2022). Intelligent power grid monitoring and management strategy using 3D model visual computation with deep learning. Energy Reports, 8, 3636-3648.

[6] Gupta, C., Johri, I., Srinivasan, K., Hu, Y. C., Qaisar, S. M., & Huang, K. Y. (2022). A Systematic Review on Machine Learning and Deep Learning Models for Electronic Information Security in Mobile Networks. Sensors, 22(5), 2017.

[7] Ahsan, M., Nygard, K. E., Gomes, R., Chowdhury, M. M., Rifat, N., & Connolly, J. F. (2022). Cybersecurity Threats and Their Mitigation Approaches Using Machine Learning—A Review. Journal of Cybersecurity and Privacy, 2(3), 527-555.

[8] Logeshwaran, J., & Shanmugasundaram, R. N. (2019, December). Enhancements of resource Management for device to device (D2D) communication: A review. In 2019 Third International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud)(I-SMAC) (pp. 51-55). IEEE.

[9] Alagumalai, A., Shou, W., Mahian, O., Aghbashlo, M., Tabatabaei, M., Wongwises, S., ... & Matusik, W. (2022). Self-powered sensing systems with learning capability. Joule.

[10] De Maio, V., Aral, A., & Brandic, I. (2022, July). A Roadmap To Post-Moore Era for Distributed Systems. In Proceedings of the 2022 Workshop on Advanced tools, programming languages, and PLatforms for Implementing and Evaluating algorithms for Distributed systems (pp. 30-34).

[11] Rahman, M. Z. U., Raza, A. H., AlSanad, A. A., Akbar, M. A., Liaquat, R., Riaz, M. T., ... & Alsagri, H. S. (2022). Real-time artificial intelligence based health monitoring, diagnosing and environmental control system for COVID-19 patients. Mathematical Biosciences and Engineering, 19(8), 7586-7605.

[12] Logeshwaran, J., Ramkumar, M., Kiruthiga, T., & Ravi, S. P. THE ROLE OF INTEGRATED STRUCTURED CABLING SYSTEM (ISCS) FOR RELIABLE BANDWIDTH OPTIMIZATION IN HIGH-SPEED COMMUNICATION NETWORK.

[13] Wang, P., Gao, Z., Li, Y., Zeng, L., & Zhong, H. (2022). Design and Implementation of a Radioactive Source Intelligent Search Robot Based on Artificial Intelligence Edge Computing. Wireless Communications and Mobile Computing, 2022.

[14] Venketeswaran, A., Lalam, N., Wuenschell, J., Ohodnicki Jr, P. R., Badar, M., Chen, K. P., ... & Buric, M. (2022). Recent advances in machine learning for fiber optic sensor applications. Advanced Intelligent Systems, 4(1), 2100067.

[15] Anjum, M., Khan, M. A., Hassan, S. A., Jung, H., & Dev, K. (2022). Analysis of time-weighted LoRa-based positioning using machine learning. Computer Communications.

[16] Makroum, M. A., Adda, M., Bouzouane, A., & Ibrahim, H. (2022). Machine learning and smart devices for diabetes management: Systematic review. Sensors, 22(5), 1843.

[17] Kulkarni, S. (2022). Expert Systems in Behavioral and Mental Healthcare: Applications of AI in Decision-Making and Consultancy. Big Data Analytics and Machine Intelligence in Biomedical and Health Informatics: Concepts, Methodologies, Tools and Applications, 147-186.

[18] Logeshwaran, J., Rex, M. J., Kiruthiga, T., & Rajan, V. A. (2017, December). FPSMM: Fuzzy probabilistic based semi morkov model among the sensor nodes for realtime applications. In 2017 International Conference on Intelligent Sustainable Systems (ICISS) (pp. 442-446). IEEE.

[19] Poe, D. N. (2022). Modeling Deep Eutectic Solvents: Linking Macroscopic Behavior and

Molecular Level Features (Doctoral dissertation, University of Notre Dame).

[20] Kumar, A., de Jesus Pacheco, D. A., Kaushik, K., & Rodrigues, J. J. (2022). Futuristic view of the internet of quantum drones: review, challenges and research agenda. Vehicular Communications, 100487.

[21] Nagarajan, R., Kannadhasan, S., & Venusamy, K. (2022). Recent Developments in Quantum Computing and Their Challenges. Technology Road Mapping for Quantum Computing and Engineering, 24-35.

[22] Konstantopoulos, G., Koumoulos, E. P., & Charitidis, C. A. (2022). Digital Innovation Enabled Nanomaterial Manufacturing; Machine Learning Strategies and Green Perspectives. Nanomaterials, 12(15), 2646.

[23] Morgan, D., Pilania, G., Couet, A., Uberuaga, B. P., Sun, C., & Li, J. (2022). Machine learning in nuclear materials research. Current Opinion in Solid State and Materials Science, 26(2), 100975.

[24] Lv, C., Zhou, X., Zhong, L., Yan, C., Srinivasan, M., Seh, Z. W., ... & Yan, Q. (2022). Machine learning: an advanced platform for materials development and state prediction in lithium-ion batteries. Advanced Materials, 34(25), 2101474.

[25] Moud, A. A. (2022). Recent advances in utility of artificial intelligence towards multiscale colloidal based materials design. Colloid and Interface Science Communications, 47, 100595.

[26] Kornaros, G. (2022). Hardware-assisted Machine Learning in Resource-constrained IoT Environments for Security: Review and Future Prospective. IEEE Access.

[27] Shahsavar, A., Mirzaei, M. A., Shaham, A., Jamei, M., Karbasi, M., Seifikar, F., & Azizian, S. (2022). Experimental exploration of rheological behavior of polyethylene glycol-carbon dot nanofluid: Introducing a robust artificial intelligence paradigm optimized with unscented Kalman filter technique. Journal of Molecular Liquids, 358, 119198.