Edge Computing and Quantum Computing to Find Statistics of Pandemic

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ABSTRACT

Edge computing and quantum computing to find statistics of pandemic′ analysis the use of edge and quantum computing in tracking the events happening in the world to get the statistical analysis done to find pandemic causing factors and situations so that authorities can be notified so that a potential pandemic can be avoided in the near future. An edge computing system enables customer data to be processed at the edge of the network to as close as possible to the originating source. Quantum computing is an aspect of computer processing that concentrates on creating machines, computer systems, and technology using the tenets of quantum theory. The application of edge and quantum computing in the healthcare sector, just like in other industries, can enable significant advantages that only traditional computers may not bring.

Key words:
Quantum Edge, Pandemics Disease, Healthcare Statistics, Qubits, Bits

12/21/2018 **Source of Support:** None, **No Conflict of Interest:** Declared

INTRODUCTION

According to researchers and developers, Quantum and edge computers would help make healthcare services more accessible and cheaper for most people. At a time when the world is fighting against pandemics disease and its vast effects. The advent of these technologies could not be more timely. Various pandemics diseases have exposed the inefficiencies in our healthcare systems by stretching them to the limit. This has caused the need for more ways to enhance the healthcare system to deal with possible pandemic and viruses. Quantum and edge computing have been tipped by many as part of the ways to improve the healthcare system.

EDGE COMPUTING

An edge computing system is a shared IT (Information Technology) system where customer data can be processed at the edge of the network to as close as possible to the originating source. It is the base on which modern age industries strive. It provides important knowledge and makes it possible for vital business operations and processes to take place.

Currently, there are excess data, and businesses are overwhelmed with the enormous amount of data available. Issues such as latency, bandwidth limitations, and unpredictable network interference can all combine to make it difficult to manage and handle huge amounts of data.

After analyzing data and process, insights in real-time business, predictions for equipment maintenance, and other set functions, the reports are transmitted to the central database for assessment and human supervision (Ganapathy & Neogy, 2017).

Edge computing deals mainly with locations. In common business processing, data is created at a customer's endpoint, and this is the customer's device (laptop, mobile phones, and so on). Data is transmitted using wide area networks (WAN), like the Internet, through the corporate local area networks. This is where storage and processing of the data by the corporation's application are carried out. After the process has been carried out, the results are transmitted to the customer's computer (the endpoint).

According to Gardner, by 2025, most business-generated data will not be generated on the centralized data centre. The possibility of moving too much data can lead to a waste of time, and sensitive data may be disrupted. This would negatively affect the Internet, which is sometimes clogged and may crash. Information Technology designers have moved from focusing on central servers to the practical edge of the technology.

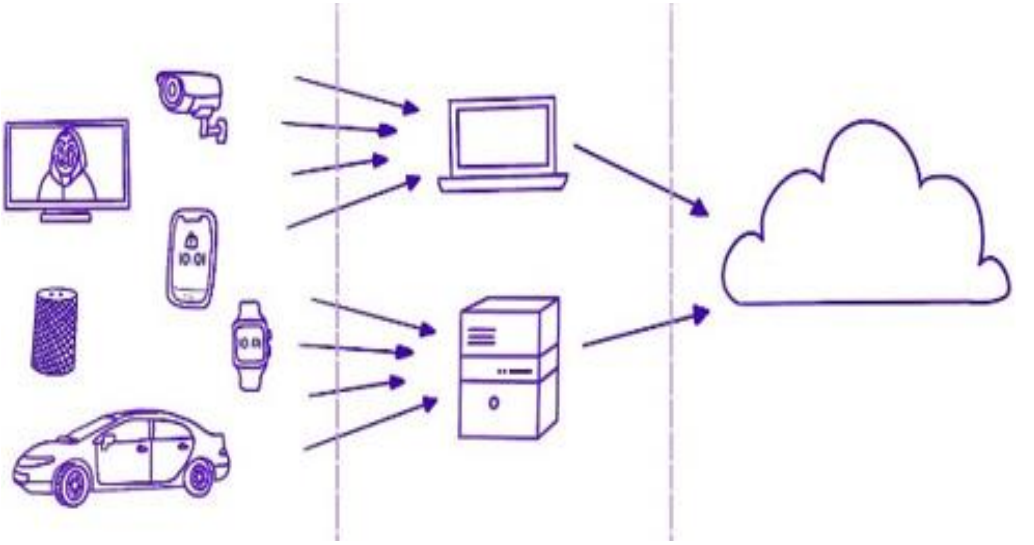

Figure 1: Edge Computing (Source: medium.com)

QUANTUM COMPUTING

This is an aspect of computer processing that concentrates on creating machines, computer systems, and technology using the tenets of quantum theory. Quantum theory describes the energy on the level of subatomic and atomic. Unfortunately, the information encoding is done only in bits of 1 or 0 in modern-day computer usage. This restricts its ability.

However, in quantum computing, encoding is done in qubits or quantum bits. Quantum computing adds to a unique subatomic feature that makes it possible for them to exist in multiple states, for example, a 0 and a 1.

Quantum computing is based on two quantum physics, entanglement and superposition. This feature enables a quantum computer to carry out tasks using lesser energy and much higher speed than traditional computers.

In history, the subject of quantum computing started during the 1980s. Experts learned that several computer process issues might be efficiently solved using quantum algorithms instead of traditional algorithms. Quantum computing may be utilized in several fields of drug manufacturing, finance, and intelligence, information technology, artificial intelligence, and heavy data search, finance, designing aerospace, nuclear fusion, digital building, and so much (Paruchuri, 2017). Leading technology companies and enterprises like Google, IBM, Google, HP, Microsoft, Nokia, Alibaba, Airbus, Toshiba, NEC, Mitsubishi, SK Telecom, Volkswagen, Biogen, D-waves, Lockheed Martin, Raytheon, and Rigetti have been attracted by quantum computing and the potential size of its market.

Figure 2: IBM Quantum Computer (Source: www.cnet.com)

Bits and qubits

A key difference between the quantum computer and traditional computer is processing different information. Past developments in computer technology like integrated circuits allowed quicker computing; however, they were still established on traditional data processing. Quantum computers use qubits (quantum bits). Traditional computers utilize 1 or 0 transistors. As stated earlier, quantum computers quantum bits (qubits).

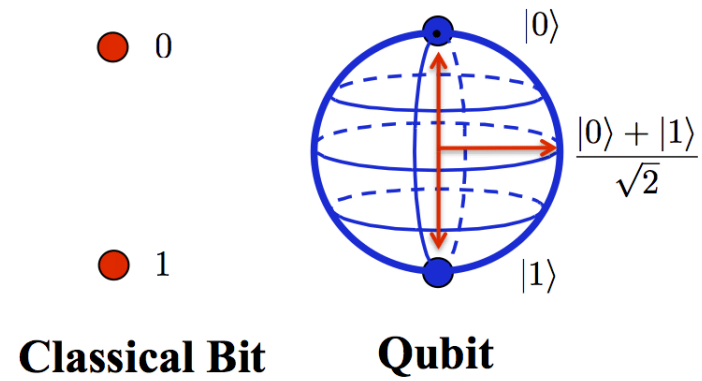

Figure 3: Buts and Qubits (Source: researchgate.net)

Quantum nits are both 1 and 0 at once. The network on qubits increases quantum computing power extensively. The connection of more transistors may only add to the capacity linearly (Neogy & Paruchuri, 2014). Supercomputers are based on two quantum physics, entanglement, and superposition in understanding quantum computing. This feature enables a quantum computer to carry out tasks using lesser energy and much higher speed than traditional computers. It makes it feasible to develop quantum algorithms that can surpass the traditional and classical computers which cannot use the quantum framework.

Some of the problems which can be resolved using quantum computing include:

- Artificial Intelligence (machine learning) chemistry, task simulation, and optimization. Machine learning has exhibited great potential to be more enhanced using quantum computer procedures and develops the quantum computer.
- Complex interdependence and correlations and several other essential elements that are interconnected many electrons in molecular structures.
- Intrinsic scaling limits of related traditional algorithms. For example, the material needs of traditional algorithms may rise extensively with issue size, just like in the issue of the time evolution of quantum procedures.

QUANTUM COMPUTING IN HEALTH CARE

The application of quantum computing in the healthcare sector, just like in other industries, can enable significant advantages that only traditional computers may not bring. This has resulted in the pursuit of quantum applications. The three key areas where quantum computing may be potentially applied and are currently transforming the healthcare sector include:

- Diagnostic aide: patients are diagnosed early, efficiently and accurately.
- Precision medicine: individuals are treated using personalized treatments and interventions.
- Pricing: enhances prices and premiums on insurances.

Figure 4: Quantum Computing in Healthcare (Source: atos.net)

Diagnostic assistance

Better outcomes and reduced costs of treatment may be possible through early, efficient and accurate diagnoses. For instance, early diagnoses increase the survival ratio by about 9%, and costs of treatment of colon cancer are reduced by 4% through early diagnosis. Modern diagnostics are relatively expensive and complex for an extensive spectrum of ailments. After the diagnosis is concluded, figures show that it is just 80-95% correct in most cases.

MRI, X-ray, and CT scans are medical imaging methods that have become important diagnostics tools, medical practitioners over the last century. There is currently a rapid development in computer-enabled diagnosis and detection techniques for medical imaging (Vadlamudi, 2015). However, most imaging methods are greatly affected by low replicability, low resolution, and noise due to the need to maintain high safety procedures.

Quantum computing can potentially enhance medical image analysis and processing steps like image identification and edge detection. Additionally, single-cell techniques are part of procedures included in diagnosis currently. Single-cell and flow cytometry sequencing data normally need developed analysis methods, particularly during the combination of different datasets from diverse methods. One of the challenges is cell classification using their different biochemical and physical features. These increase the abstract space where the predictor variable lives. (Highdimensional).

This classification is quite essential in cases of separating normal cells from cancer-causing cells. Classification and single-cell diagnostic techniques can be boosted and enhanced by advanced quantum machine learning techniques like quantum-enabled vector machines. Also, finding and classifying biomarkers can bring about the need to analyze complicated "-omics" datasets like transcriptomics, metabolomics genomics, and proteomics. These would mean a big abstract space and several features that will lead to correlation, interdependence, and sequence that are difficult to discover with normal computer processing techniques.

The additional extension of biomarker awareness down to the layer of a person will commonly need further advanced modelling. The highlighted features imply that quantum computing can enable the finding of biomarkers and possibly for humans. Care providers may utilize quantum computing in improving diagnoses and at the same time removing the need for reoccurring intrusive diagnostic testing. Also, continuous monitoring and analysis of individual health may be possible. Aside from the help to patients, health service providers and plans also benefit from decreased cost of treatment resulting from early diagnosis. Further and more detailed diagnostic using meta-analyses procedures may be feasible to define the kind of procedure that should be done and the time. In the long run, the cost would be reduced further, and data-driven conclusions could be reached by health plans and government decisions for individuals and providers.

Precision-based medicines

Precision medicine intends to design treatment and prevention methods for the individual. This is down, taking into account the complicated nature of human biology. Individually tailored medicine needs to take different aspects that will be in line with medical standards of care. Medical care only contributes 10 to 20% to the outcome. Environmental and socioeconomic aspects, as well as health-related behaviors, account for the remaining 80 to 90%.

The correlation and interdependence between the different contributors enabled difficult issues regarding the enhancement of effective treatment computationally. This brought about failures by current therapists in achieving their intended outcomes because of individual irregularities. For instance, according to research, just three out of ten respond to drug-based cancer therapies. The result of drug-based cancer therapies may be disastrous. Over two hundred thousand people die every year as a result of adverse drug effects just in Europe.

A vital part of precision medicine technique is proactivity. As earlier pointed out, the cost is reduced while outcomes are greatly enhanced by preventive intervention and early treatments. Traditional machine learning has greatly shown some potential through predictive analytics, which allows predicting the risk of possible diseases for a set of patients' categories using EHRs. The use of EHRs results in some challenges due to its features as well as other health-related data. Also, areas like space, noise, interaction complexities, and size of significant feature space are some other challenges noted.

This means that more accurate risk predictions could be possible through supervised, unsupervised, and semi-supervised quantum-enabled machine learning methods. Subsequently, practitioners may eventually get tools that can be used to understand the changes that occur over time individual risk conditions. This may be possible through the continual virtual diagnosis using current individual data streams.

It is not enough to know an individual's disease risk. However, understanding how to medically step in effectively for each individual is equally important. The analysis of cellular level drug sensitivity is a path under this subject. For instance, currently, there are investigations into the accounting of drugs' chemical properties and elements, models that can carry out predictive analytics for the cancer drugs' effectiveness at a detailed level. (Granular level).

Further breakthroughs in this field may be enabled by quantum enhancement machine learning, which will eventually lead to causal drug inference models. Precision medicine aims are quite huge. Detecting and describing the interactions between treatments and interventions on one side and the results opposite to enable it to deliver the best possible medical action at the level of the individual. Normally patient condition diagnosis is largely subjected to reported symptoms by the patient who is time costly. It also ends up in a wide range of diagnoses, and treatments connected with it are mostly unsuccessful. There is currently a shift towards a platform that insights from more health-related data may enhance precise and continuous health monitoring with personalized interventions. This is still far from realizing; however, and quantum computing can hasten the development of an innovative system by solving diagnosing and precision medicine problems.

Pricing

It takes very complex processes to determine premiums on health care insurance. Several factors must be considered in designing a general pricing policy by a health plan (considering that the US and other countries may restrict the number of factors used in calculating premiums). These may be factors such as complex interdependencies like disease risks and health levels, cost and treatment suitability and the potential exposure a health plan is able and willing to cover due to their company policies and regulations. Considerable development by health plans has been made in this area using traditional data science strategies. Acquiring more granular models with reduced skepticism remains

problematic. Through precision medicine, quantum computing could enable greater access to an individual's potential risk for a specific medical situation.

Basing on the data on disease potential at the level of the population with the combination of a quantum risks system that can compute risk in finance with higher levels of efficiency could permit health plans to get advanced pricing and risk systems (Ganapathy, 2017).

Additionally, another significant means quantum computer processes can help pricing policies is through advanced fraud detection. As of today, in the US alone, billions of dollars are lost to healthcare fraud. The traditional data mining methods currently help detect and reduce fraud in the health care sector. However, there is a need for more advanced computer-based techniques. Quantum algorithms can allow superior categorization and sequence detection and eventually discover the abnormal character and remove medical claims based on fraud. This will enable health plans to enhance pricing techniques and bring about decreased premiums resulting from lower cost connected to fraud loss and schemes from prevention. Quantum computing's advanced algorithms can considerably optimize pricing computations. This would lead to average premiums being lowered and better designed premium options. The complicated nature of healthcare systems can be seen in the challenges connected with preparing easy-to-understand pricing strategies. The emergence of regulatory frameworks makes it necessary to have lower average cost and increased transparency. This has further necessitated the need for more enhanced printing models.

Majority of health-related data collected from several systems and environment that surrounds patients are under deployed currently. Clinically related factors represent only a minimum per a cent of health-related data. To obtain usable knowledge from other sectors like social, genomics and environmental factors is therefore essential. The extensiveness and breath of quantum-enhanced quantum-enhanced machine learning algorithms make it stand out from the crowd of the several quantum algorithms related to the health care industry. As a result, there is a movement towards an age where the features of health datasets (often being heterogeneous and unequally shared) create complicated computational issues in modern artificial intelligence. Different research has found possible ways to increase the pace of computational algorithms at the centre of artificial intelligence modelling and machine learning using quantum techniques like task involving large matrices.

EDGE COMPUTING IN THE HEALTH SECTOR

Chain supply for pharmaceuticals

Supply chain optimization has been a long-time motive in distribution and manufacturing because goods and resources come from different locations without steady and dependable access to secure and fast networks.

The chain of supply for pharmaceutical is the same. With components arriving from every part of the world, it becomes important that the supply chain remain traceable for safety and security reasons. Ingredient safety and quality protection remain an ever-constant concern for most pharmaceutical companies in the chain of supply. Dangerous ingredients can cause substantial damage; this would increase the possibility of brand investigations and litigation (Ganapathy, 2016a).

Quantum and edge computing can enable the verification and tracing of pharmaceutical products as they move within the supply chain. There is also a constant need for a stable

temperature of pharmaceutical supplies in the chain of supply. Most biological drugs are made from living organisms and need a particular temperature range during storage and transportation. When there are fluctuations outside the specified temperature, the whole supply might be compromised. With edge computing, the temperature can be continuously monitored and regulated during storage and transportation using real-time IoT devices and sensors and enabled localized monitoring. A leading company in this field is Microsoft. Partnering with Wipro and several pharmaceutical chains, it has utilized the Azure (Internet of Things technology) in developing the WST (Wipro Smart Track) system. This framework utilizes edge technology in temperature monitoring and attempts at counterfeiting in real-time. It sends geospatial warnings immediately it detects problems in the chain of supply.

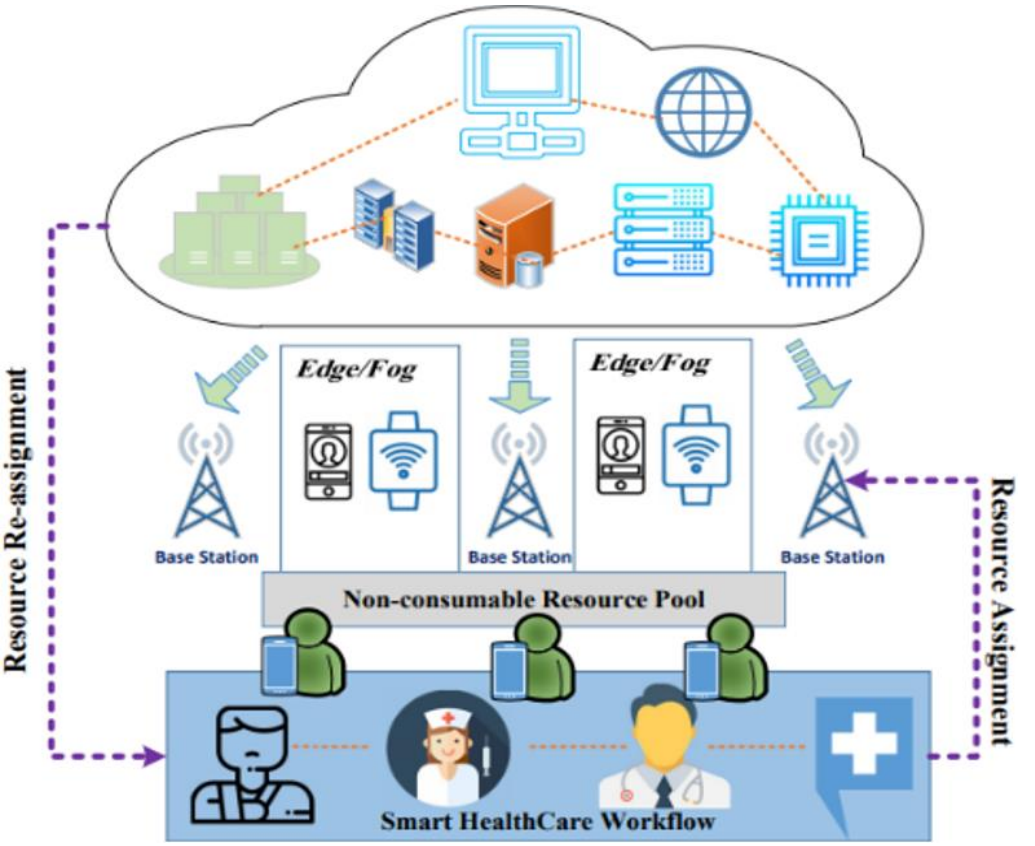

Figure 5: Edge Computing in Healthcare (Source: mdpi.com)

Infection control

Edge computing has a huge benefit to hospitals as it improves and enhances communication speed through reduced latency and increased bandwidth useful when multiple IoT devices and connections are happening on a particular system.

This is highly beneficial to both medical practitioners and patients. There can more rigid monitoring and control regulations. Companies in infection control management sectors are using Artificial Intelligence to enhance the prevention and reduction of hospital infection and healthcare establishment.

For example, Vitality built a Bluetooth enabled system of smart bands which can connect to an application. The smart bands can automatically trace contracts. It monitors by recording and sending signals to professionals when it detects concerns a distance away. Some sensors help ensure adherence to regulation like hand sanitizing by tracking users' location and sanitization duration. Monitoring patients is an important area of infection control. Edge computing can utilize an ambient monitoring system for patients through audio and video feed and PPE detection (Personal Protective Equipment). When a patient is marked as a possible risk, the system sends a warning to medical practitioners in real-time to enable them to take the necessary precautions.

Security of patient's data transmission

Several health care practitioners, hospitals and clinics are eying technology in the decentralization of the medical administration system to allow health practitioners to pay more attention to patients.

Through edge computing, the speed of patient data transmission can be increased significantly. Medical centers and hospitals cannot afford to be bothered about network reliability, sluggish processing, and latency issues. Workflow can be optimized with high-speed reliability of data access. This would boost decision-making processes, save time and increase revenue. Several companies are designing edge enabled devices that go past data management using artificial intelligence and adaptive devices to reduce workflows (Vadlamudi, 2016). An example of such companies is BioSigns. It provides an internet of things enabled telehealth and mobile monitoring application that can immediately transmit patient data on a moving ambulance to the hospital emergency room (ER). Through this means, professionals can receive patient's condition updates in real-time and take quick decisions accordingly in preparation for the patient's arrival.

Security of patient data is also an area of concern for healthcare providers. This is also complying with the Health Insurance Portability and Accountability Act (HIPAA). In this area, edge computing has a significant advantage over cloud computing as it can decentralize the method of processing patient data. Instead of a single remedy for transmission and storage of all patient data, smaller information centers and networks can be made and connected to devices or particular wearables.

It would make shorter transmission time between different devices and data centers possible. Edge computer developers are designing edge computing frameworks that can provide data security between mobile networks, hardware, and Internet of things connected devices. With the decentralization of patient data through edge computing, pharmaceutical companies, medical centres, and other health-related health-related sectors can be less vulnerable to data infringements. Also, a security breach on an edge network will not affect all the data on the network as hackers will not access all the information on the system from a single endpoint.

Rural medicine

The provision of sufficient healthcare services to remote and rural areas has been a problem for many years. Even with technological advancements like telemedicine and increased accessibility of health data, the delivery of fast and quality health care services to people in rural areas remains a struggle. The challenges faced by traditional healthcare database is majorly due to issues of connectivity. However, edge computing applications and medical-based medical-based IoT devices can be used to makeover these challenges easily.

Convenient Internet of Things healthcare devices designed by edge computing companies can collect, store, develop, and carry out a detailed analysis of patient's data. It removed the need to be in continuous contact with a network system. Portable IoT medical devices can quickly diagnose patients with it. The diagnosis data can then be transferred from the device to the main servers after connections are restored. IoT healthcare devices can extensively connect to networks and allow medical experts to access important patient data through their connection to an edge data centre. This edge advantage can increase the reach of healthcare services greatly, even to poor internet connectivity areas (Vadlamudi, 2017).

Fighting pandemic before its impact

Pandemics do not happen from anywhere. Normally, there are signs and patterns before an outbreak of disease happens. Those patterns and signs could be very delicate. The factor that could alert epidemiologists is so numerous to the extent that traditional supercomputers might find it difficult to predict possible pandemic outbreaks.

Quantum computers, according to quantum scientists, can provide data-crunching powers for researchers to predict the spread of diseases. Research conducted at the University of Alabama indicates that quantum computer processes can analyze widespread in networks. It could be a circulating video on social media or the next virus outbreak at the initial stage of becoming a pandemic.

Designing immediate Drug Response

Many quantum companies are currently designing quantum software that can be the extraordinary quantum computational power to create medicines and interventions for several ailments and health situations. It is not far-fetched to believe that quantum computing power and speed can be used to tackle a viral and fast-expanding pandemic diseases.

Normally, epidemiologists would provide drug developers with a timely warning of possible diseases and information and data of the situation. After that, the drug developers would proceed from there with the provided information. According to research, the current combination of quantum-classical methods is a sign that we are not very distant from it at present (Ganapathy, 2016b). However, we can predict that the time it takes to develop a cure or vaccination for a pandemic would reduce from years, months, to even days as the technology develops.

The problem of vaccination movement

Part of the problems quantum computing algorithms can analyze is the transportation of vaccines by a travelling salesman problem. The addition of new cities to a salesman's list increases the complex nature remarkably. Quantum computer processes can help resolve these issues and potentially in a more advanced way than compared to classical computers.

In a prospective pandemic, vaccines can be passed out by quantum computers to providers of healthcare services in the best possible and most effective ways (Paruchuri, 2015). This would help reduce time spent and reduce the spread of the pandemic. This kind of system is most suitable and important for countries like African countries that were hard hit by pandemics diseases. For instance, China has numerous big cities spread out across the huge country. Effective and efficient delivery of medicine to the right people and on time would greatly impact saving a significant number of lives.

Emergency Management Placing response teams where they need to be.

Like vaccine transport, quantum computing processes can be used to position the right response team with the proper resources to help reduce the spread of a pandemic. Quarantined areas, for instance, required unique considerations like emergency water, food and energy supply (Ganapathy, 2015). Quantum computers would greatly help categorize and classify the supplies for delivery to the proper places.

Continuous monitoring

In all, the best way to deal with a pandemic is to prevent it from starting in the first place. Quantum computers can provide data monitoring perpetually to reduce any possible outbreak. Through health statistics analysis to use natural language processing and analyzing messages on social media for hints on the possible pandemic outbreak. Quantum computers can provide useful information against possible deadly pandemics.

CONCLUSION

Using the impact of pandemics disease on our economy, society, and the healthcare system as a case study, we can picture the possible application of quantum and edge computing in developing vaccines, enhancing results, and detecting and containing widespread disease and pandemics. Various investors are currently looking for ways and solutions to reduce the possible future spread of pandemics.

Although edge and quantum computing full potentials have not been attained, there are significant indications that current research and investments into it would result in tremendous success. The two technologies may be applied in the health sector and other big industries with more enhanced solutions.

REFERENCES

Ganapathy, A. (2015). AI Fitness Checks, Maintenance and Monitoring on Systems Managing Content & Data: A Study on CMS World. *Malaysian Journal of Medical and Biological Research*, *2*(2), 113-118. https://doi.org/10.18034/mjmbr.v2i2.553

Ganapathy, A. (2016a). Blockchain Technology Use on Transactions of Crypto Currency with Machinery & Electronic Goods. *American Journal of Trade and Policy*, *3*(3), 115-120. https://doi.org/10.18034/ajtp.v3i3.552

Ganapathy, A. (2016b). Speech Emotion Recognition Using Deep Learning Techniques. *ABC Journal of Advanced Research*, *5*(2), 113-122. https://doi.org/10.18034/abcjar.v5i2.550

Ganapathy, A. (2017). Friendly URLs in the CMS and Power of Global Ranking with Crawlers with Added Security. *Engineering International*, *5*(2), 87-96. https://doi.org/10.18034/ei.v5i2.541

Ganapathy, A., & Neogy, T. K. (2017). Artificial Intelligence Price Emulator: A Study on Cryptocurrency. *Global Disclosure of Economics and Business*, *6*(2), 115-122. https://doi.org/10.18034/gdeb.v6i2.558

Neogy, T. K., & Paruchuri, H. (2014). Machine Learning as a New Search Engine Interface: An Overview. *Engineering International*, *2*(2), 103-112. https://doi.org/10.18034/ei.v2i2.539

Paruchuri, H. (2015). Application of Artificial Neural Network to ANPR: An Overview. *ABC Journal of Advanced Research*, *4*(2), 143-152. https://doi.org/10.18034/abcjar.v4i2.549

Paruchuri, H. (2017). Credit Card Fraud Detection using Machine Learning: A Systematic Literature Review. *ABC Journal of Advanced Research*, *6*(2), 113-120. https://doi.org/10.18034/abcjar.v6i2.547

Vadlamudi, S. (2015). Enabling Trustworthiness in Artificial Intelligence - A Detailed Discussion. *Engineering International*, *3*(2), 105-114. https://doi.org/10.18034/ei.v3i2.519

Vadlamudi, S. (2016). What Impact does Internet of Things have on Project Management in Project based Firms?. *Asian Business Review*, *6*(3), 179-186. https://doi.org/10.18034/abr.v6i3.520

Vadlamudi, S. (2017). Stock Market Prediction using Machine Learning: A Systematic Literature Review. *American Journal of Trade and Policy*, *4*(3), 123-128. https://doi.org/10.18034/ajtp.v4i3.521

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