Post Covid-19 Bio-Imaging: Cancer Detection & Secured Procurement through Dual Neurons Genetic Key (DNGK) in Advanced Medical Sciences

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Abstract:

Cancer is one of the highly-rated causes that lead to human mortality. Nowadays with the greater affect of the COVID-19 pandemic, co-morbid patients are at the dual risk of death. Therefore, the main aim of this paper is the specific detection of the cancer cells using nanoparticles further, report analysis using Artificial intelligence, and then the transmission of the medical report is to be done in a neural secured procurement. A simple mechanism to detect cancerous cells through Artificial Neural Networks (ANN) has been proposed here. Moreover, secure attainment of the patients' medical data has been shown here with the help of Dual Neurons Genetic Key (DNGK). Structural and functionally equivalent ANNs have been iterated to generate the DNGK. In addition, genetic operations were included to make the session key more secured from the opponents. Nanoparticles are frequently used for specific cancer detection on the human body. A revolution in the form of telemedicine in the advanced medical sciences has emerged with the cameo of novel coronavirus things (IoT). It has helped to curtail the coronavirus chain through remote treatments. An Artificial Neural Network will be trained to detect the cancerous cells of the human body. The decision generated by ANN would be encrypted through the AES algorithm and DHNK before procured to the network. The Artificial Neural Network had been trained on different bio-images so that it generates an automated decision. Thus, prompt, safe, and automated cancer detection may be done using this proposed technique. Results derived from different tests on the proposed technique were evaluated and thus, validating the entire proposed technique. Thus, loads of societal development would happen in the fields of Medical Sciences, especially during these post- COVID-19 crisis hours.

Keywords: *COVID-19, Cancer, Artificial Neural Network, Dual Neurons Genetic Key (DNGK)*

1. Introduction

The critical part of this paper is to channelize an online transmission of COVID-19 cancer patients' data through made sure about its acquirement on the telemedicine networks. The unprecedented arrival of the novel corona virus has brought a revolution in the telemedicine section of the advanced medical sciences. Cancer patients are one of the most prone to the COVID-19 attacks. Telemedicine has invariably provided a lot of support to such patients by providing remote services. Bio-imaging mechanism could be expressed as the way of image production and processing of living organisms by X-rays, ultrasound, magnetic resonance imaging, etc. It could be stated as the branch of bioscience dealing with human health that too in a secured environment, for data extraction as well as data transfer. It will help to create a detailed image of the cancerous spot, either benign or malignant. Through image classification using Artificial Neural Networks (ANN), a mechanism to detect cancerous cells in the human body has been shown in this paper i.e. highly specific nanoparticles were used for this. Nanoparticles are microscopic particles having less than one dimension less i.e. 100 nm; which are used for the detection of cancer within the human body. The nanoparticles used either stick to the cancerous cells inside the body, or if not found they are absorbed automatically. They do not damage any other human cells. The images will be classified automatically by the ANN. The initial task is to train and test the ANN so that it can recognize and classify between normal cells and different types of cancerous cells.

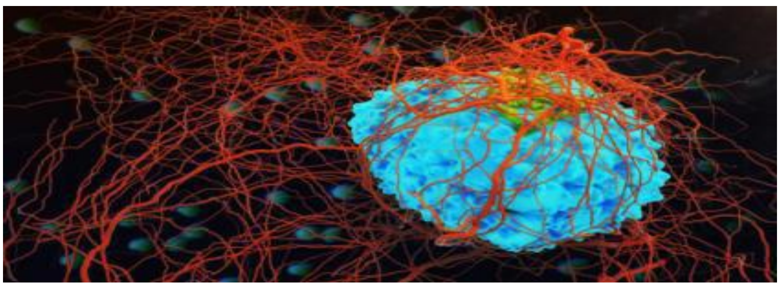

Fig1. Cancerous Breast Cell

Artificial Neural Networks (ANNs) are designed for the simulation type model of the human nervous system. A key innovation is to optimize the real-life problems by the computers during the extreme corona pandemic era. ANNs are vividly trained and tested on different data sets. There are various areas of applications of ANN, likes Speech recognition, Medical diagnosis, Data clustering, Routing, Fuzzy Intelligent systems, etc.

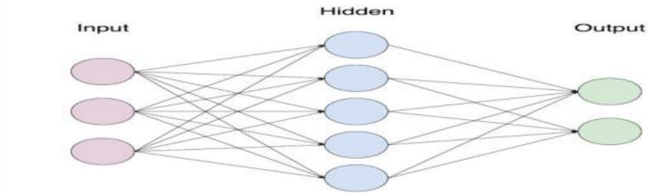

Fig 2. A Simple ANN

Furthermore, the process of encryption is added aid to the data transfer to the server. Data security is ubiquitous in medical data transmission protocols. Advanced Encryption Standard (AES) is symmetric block encryption done COVID-19 secured transmission. The same key would be applied at the ANN site and the server site in this proposed IoT-based technology [1-2]. A similar dual set of ANN topology has been recommended at the patient's and oncologist's end. Furthermore, the genetic movement has been carried after achieving the entire process of weight synchronization. Different lengths of keys may be used in AES likes of 128 bits, 192 bits, and 256 bits. Bytes operations are performed here with an interpretation using the following polynomial equation.

$$f(n)= \Sigma ci * xi : \text{for } i = 0 \text{ to } (n-1) \quad \dots \quad (1);$$ where ci stands for either 0 or 1.

2. Literature Survey

Researches on Nanoparticle are an important area to be dealt with, because of its huge applications in biomedical and engineering fields. According to ISO Technical Determination 80004, nanoparticles are nano-object with all measurements in nanoscale, and whose longest and most limited hub doesn't contrast altogether. "Ultrafine particles" (UFP) are like nanoparticles and reach somewhere in the range of 1 and 100 nm in size, rather than "fine particles" estimated somewhere in the range of 100 and 2,500 nm and "coarse particles" going from 2,500 to 10,000 nm [3]. The most compatible carriers for nanoparticles are protein, lipid, and polymer-based biomaterials. Therefore, protein tagged nanoparticles are used including albumin, ferritin, gelatin, and transferrin [4]. Further, a modified form of glucose can also be used for cancer detection as a cancerous cell. Image generations by these nanocarriers are done using near-Infrared fluorescence, MRI, positron emission tomography, photoacoustic imaging, CT scan, etc [5].

Graphene subsidiaries in low fixation and being nano in nature are significantly viable to the body with no poisonous effect. In the investigation of biosensors, it has been seen that graphene-based immunoassay having 2D level nanostructure can be clinically significant, being malignancy cell biomarkers. Graphene has an antimicrobial action toward

Escherichia coli forestalling enteric infection of the body [6]. Dong et al. initially blended multi-layer GQD (Graphene Quantum Dots) to mark the core of a cell. Further, marked Hela cells [7-9], A-549 cells [10-11], bosom disease cell, gastric carcinoma cells, and hepatocellular cells, and U251 Brain malignancy cells [12]. Counterfeit Neural Network (ANN) models will help the specialists in the conclusion of the infection. Various models of neural organizations in particular Back Propagation Algorithm, Radial Basis Function Networks, Learning vector Quantization, and Competitive Learning Network are regularly utilized in current cryptography. Exploratory outcomes show that Learning Vector Quantization shows the best exhibition in the testing informational collection. This is continued altogether by CL, MLP, and RBFN. The high precision of the LVQ against different models demonstrates its better capacity for tackling the classificatory issue of Breast Cancer conclusion [14]. Advanced Encryption Standard (AES) calculation is one of the most well-known and generally applied symmetric square code calculations. This calculation has an own specific design to scramble and decode touchy information. It is very hard for the gatecrasher to get genuine information while encoding by AES calculation [15-16]. To date isn't any proof to crake this calculation. A mystery message covered up inside a picture, the picture's Encryption, and Decryption utilizing AES (Advanced Encryption Standard) calculation, LSB calculation and pressure and decompression of that picture utilizing Huffman Coding are proposed in this referred to paper [17]. The plan utilizes the iterative methodology with a block size of 128 cycles and key size of 256 digits. The quantity of rounds for a key size of 256 pieces is 14, as the mystery key builds the security just as the unpredictability of the cryptography calculations. This paper presents a calculation, wherein the picture is a contribution to AES Encryption to get the scrambled picture, at that point it is packed with Huffman Coding and the encoded picture is uncompressed and given as the contribution to AES Decryption to get the first picture [17].

3. Different Problem Aspects

Cancer is one of the fatal mortalities in humans even in the post-COVID-19 period too. Like cancer, the art of hacking data is also at its peak spread with the increased advancement and development in the technological dependent pandemic time. The biggest thing that is percolating its extent is that intruders have found a way to crack into systems and snatch away medical data. Graphene-based immunoassay possessing nanostructure is used for distinguishing cancer cells from normal cells. Further, to protect any medical data there needs to deploy a well-secured mechanism. Medical data being highly sensitive, there exists a high chance of data sniffing. Moreover, the server may be compromised. Thus, the disease diagnosis and the treatment will be pushed backward. No paper in the literature survey has done works on patients' information security on cancer COVID-19.

4. Proposed Methodology

The first way to fight against this disease is its distinct diagnosis, which could be done with the help of nanoparticles, that are highly specific towards its target cancerous cell, and the process like CT scan could be used as the simplest way of its identification either visualizing the heterogeneity, water imaging, tumor detection, angiogenesis, specific receptor proteins or antigens or hypoxia. Dawidczyk et al. [18] called attention to in 2014 that the absence of all-inclusive guidelines in preclinical preliminaries has blocked a methodical correlation of these investigations. The issues which were expressed in the previous segment 3 have been tended to in this proposed technique. In the field of advanced medical sciences, the need for secured medical data is essential [19]. The patients' privacy maintains in this technique is the key objective [20]. Here a Dual Neurons Genetic Key (DNGK) has been proposed to deal with COVID-19 telemedicine security. Its algorithmic approach has been given as follows.

***Proposed Algorithm*: *Secured Cancer Cell Detection* & *Procurement by Dual Neurons Genetic Key*(*DNGK*)**

*/*Generation of Dual Neurons Genetic Key */*

$Set\ N = 128$

$Assign\ Epochs1 \leftarrow 0$

$While\ [Counter\ ! =\ Maximum\ Epoch]$ /*/Perceptron No. 1 based first weight vector*/

Assign $X1_i \leftarrow 1, X_1, X_2, \ldots, X_N$ $/*\ Peceptron\ No. 1\ Input\ Vector\ */$

$WT1[i] = RandomRealNumber(-1, +1)$ $/*\ Weight\ Initialization\ */$

$$H1 \leftarrow WT1[Bias] + \sum_{i=1}^{N} WT1_i * X1_i \quad /*\ Hidden\ Output\ */$$

$If\ (H1 <= Desired\ Value) Then$ $/*\ Output\ Unit\ /$

$Z1_i \leftarrow 0$

$Else$

$Z1_i \leftarrow 1$

$If\ (Z1_i\ != Desired\ Value)\ Then/*\ Learning\ Rule\ /$

$WT1_{Next} = WT1_{Prev} + \{ LR * X1_i \}$

$Bias_{\ Next} = Bias_{Prev}$ + [LR * Desired Value]

$Else$

$WT1_{Next} = WT1_{Prev}$

$Bias_{\ Next} = Bias_{Prev}$

$Assign\ Epochs1 \leftarrow Epochs1 + 1$

$Assign\ Epochs2 \leftarrow 0$

$While\ [Counter\ != Maximum\ Epoch]$ /*/Perceptron No. 2 based first weight vector*/

Assign $X2_i \leftarrow 1, X_1, X_2, \ldots, X_N$ $/*\ Peceptron\ No.1\ Input\ Vector\ */$

$WT2[i] = RandomRealNumber(-1, +1)\ /*\ Weight\ Initialization\ */$

$$H2 \leftarrow WT2[Bias] + \sum_{i=1}^{N} WT2_i * X2_i \quad /*\ Hidden\ Output\ */$$

$If\ (H2 <= Desired\ Value) Then\ /*\ Output\ Unit\ /$

$Z2_i \leftarrow 0$

$Else$

$Z2_i \leftarrow 1$

$If\ (Z2_i\ != Desired\ Value)\ Then/*\ Learning\ Rule\ /$

$WT2_{Next} = WT2_{Prev} + \{ LR * X2_i \}$

$Bias_{Next} = Bias_{Prev}$ + [LR * Desired Value]

$Else$

$WT2_{Next} = WT2_{Prev}$

$Bias_{Next} = Bias_{Prev}$

$Assign\ Epochs2 \leftarrow Epochs2 + 1$

$/*\ Genetic\ Operation\ */$

$PointP = Enter\ the\ point\ of\ genetic\ crossover?$

$DNGK[128] \leftarrow \boldsymbol{Call\ Crossover}(\ WT1[N], WT2[N], PointP)$

$/*\ Injecting\ nanoparticles\ */$

$Body \leftarrow \boldsymbol{Injecting}\ (\ Nanoparticles, Dimension)$

$/*\ Scanning\ through\ XRay\ */$

$XRay\_Img[R][C] \leftarrow \boldsymbol{Positron\ Emission\ Tomography}$

$/*\ Training\ the\ Artificial\ Neural\ Network\ */$

$ANN \leftarrow \boldsymbol{Train}\ (Datasets\ of\ Bioimages)$

$/*\ Feeding\ into\ Artificial\ Neural\ Network\ */$

$ANN \leftarrow \boldsymbol{Inputs}\ (XRay\_Img[R][C])$

$/*\ Classification\ done\ by\ ANN\ */$

$Decision \leftarrow \boldsymbol{Classify}\ (\ ANN\ )$

$/*\ Encryption\ by\ AES\ */$

$Ciphertext \leftarrow \boldsymbol{AES}\ (\ Decision, DNGK[128]\ )$

The novel idea behind this proposed technique is to automate and secure the detection of such critical cancer. A double neural network has been fitted to generate two weight vectors after having a certain number of maximum iterations. Furthermore, a genetic crossover operation has been involved to induce strength to the proposed DNGK. In the above section Positron Emission Tomography is used to detect the severely affected organ and using the ANN this image would be classified based on their features. Finally, the decision generated in such IoT-based medical sciences would be encrypted through the AES algorithm. Thus the proposed system is likely to be immune to malicious attacks, especially when there is extreme pressure on COVID-19 digital health [21].

5. Results Section

Figure 3 shows the absorption spectrum of GQD particles by UV in different solutions i.e. in aqueous solution and humic acid respectively.

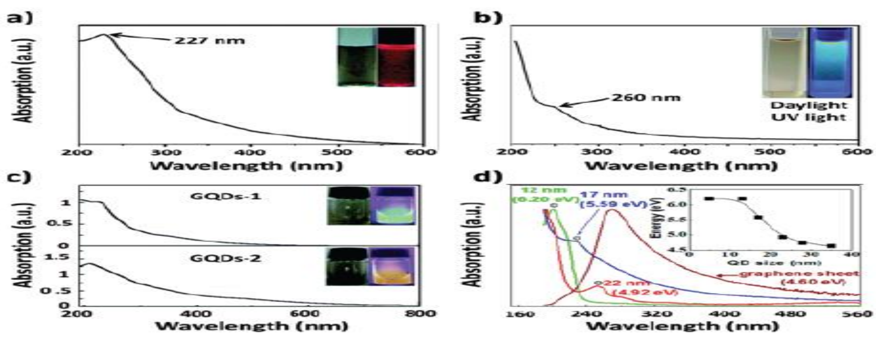

Fig.3. a) UV-vis absorption spectrum of GQDs aqueous solution. b) UV-vis absorption spectrum of GQDs from humic acid

From below figure 4, there exist several techniques to retrieve cancerous cell detection. Out of which Positron Emission Tomography has been used in this paper.

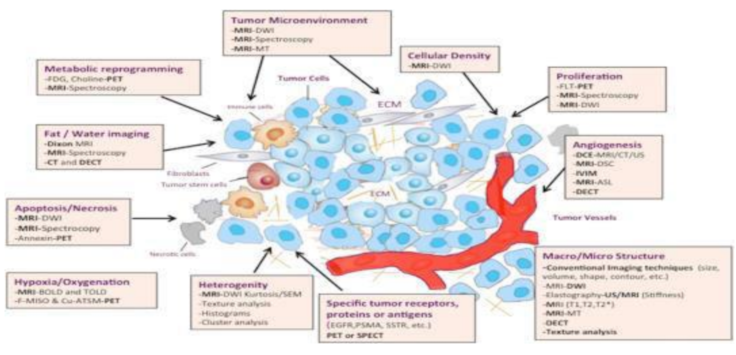

Fig4: Different method for bio-imaging for cancer detection

Graphene oxide nanoparticles give solid bioimaging as it is optically dynamic and can associate with single abandoned nucleic corrosive (DNA/RNA), and makes it profoundly valuable in differing stage at some point as a biosensor for in vitro microplate diagnostics and even as a medication conveyance transporter for focused conveyance for example customized medication. It is having enormous surface territory and solid absorbance to approach infrared to upgrade the restorative impact with ample stacking of medications for conceivable photograph warm and photodynamic treatment. Further, it is likewise utilized for following in vivo pharmacokinetics during simultaneous treatment. Fluorescence, either signal on or off, Raman and surface-upgraded Raman dissipating photoacoustic, and radionuclide imaging modalities can likewise be utilized for theranostic purposes utilizing Graphene oxide nanoparticles.

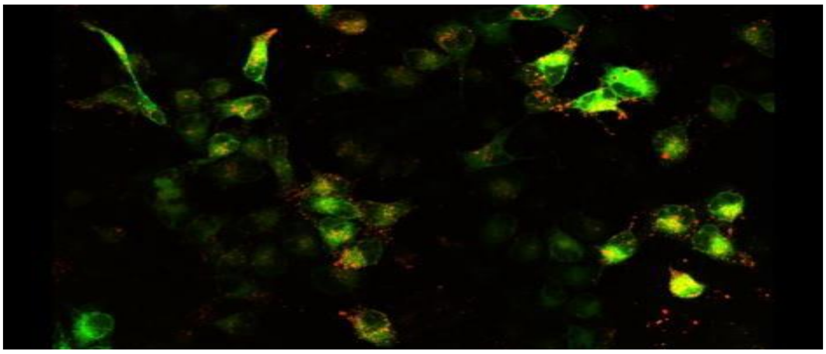

Fig5: Green means Selected marker for phagosome, Red means LAMP1 H1299 cell line in nine hours confocal live-cell imaging process

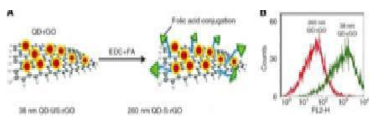

Fig6: Reaction of Graphene oxide on the cancer cells

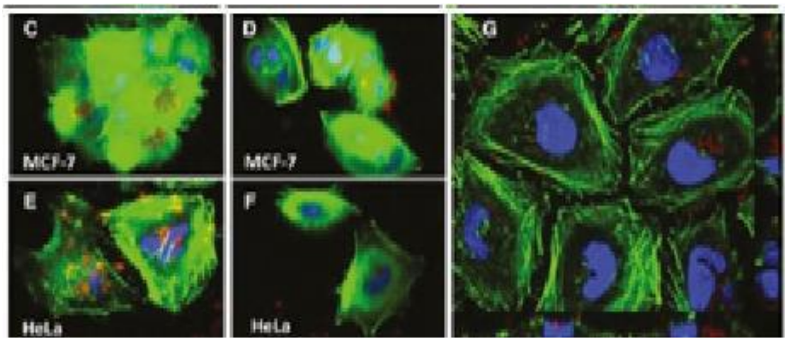

Fig7: Multi-functional Graphene oxide done at bioimaging

An analysis has been performed on the proposed DNGK. RSA, Triple-DES (168 bit length), AES (128 bit length) have been compared on six hundred different neural datasets data with our proposed method.

Table 1. Comparisons on different neural datasets

Serial Number	Cryptography Name	Mean Avalanche Test	Mean Strict Avalanche Test	Mean Bit Independence Test
1	Proposed DNGK	0.90481	0.93274	0.41897
2	RSA	0.94024	0.94128	0.54295
3	Triple DES(168 bits)	0.95406	0.95014	0.59178
4	AES(128 bits)	0.92700	0.97687	0.67476

In the above stated table 1, a fruitful comparison has been made on our proposed (DNGK) technique with respect to other classical techniques. Avalanche test, Strict Avalanche test, and Bit Independence test are crucial testing parameters in cryptographic engineering [22]. Avalanche test refers to the fact that a minor change in the key or plain data will bring abrupt changes in the cipher text. On different datasets, we have observed 90.48 % changes on an average in the proposed DNGK. However, 94.02%, 95.4%, 92.7% were observed on the same datasets in case of RSA, Triple DES, and AES respectively.

Strict Avalanche test is the extended format of the Avalanche test [23]. There should be more than 50% changes in the cipher text when a bit of the session key is mutated. We could be able to observe 93.27 % changes in our proposed DNGK. Moreover, 94.12%, 95.01%, 97.68% were noted in case of RSA, Triple DES, and AES respectively.

Bit independence test is the statistical test which aims to have every output bits of the cipher text is dependent on all the input bits of the plain text [24]. Bit Independence Criterion

(BIC) is satisfied if any change in the single input bit i in the session key would bring changes in the cipher text such that any two output bits j and k in the proposed cipher text are altered independently. We could be able to observe 41.89% changes in our proposed DNGK under this test. Moreover, 54.29%, 59.17%, 67.47% were recorded in RSA, Triple DES, and AES algorithm respectively

Once, the ANN generates a decision on the type of cancerous cell that would be encrypted through AES using the proposed DNGK. Following table 2 contains the cipher text on different types of cancerous cells. Moreover, the same values were detected at the oncologist's end through the same DNGK.

TABLE 2: CIPHER TEXT BY PROPOSED ENCRYPTION

Decision by ANN	Cipher Text by AES Encryption with DNGK	Proposed DNGK Size	Data After Decryption	Outcome
Breast Cancer	A9e49f6d743530e757454793a1cbf363	128	Breast Cancer	Success
Prostate Cancer	0b27a5dcf4940f44db3d3ad25db5d007	128	Prostate Cancer	Success
Colorectal Cancer	45297ca94c9d87c13939d64b3e724e88	128	Colorectal Cancer	Success
Lung Cancer	d87c763e1702f94209feb29f221de72b	128	Lung Cancer	Success
Lymphoma	5fea4ed5db0085c2b0579d98d486e681	128	Lymphoma	Success
Leukemia	c8bcaa40f3ac1db6eabd01eea212403c	128	Leukemia	Success
Carcinoma	f06566f9cdd0caf88175444976503e1f	128	Carcinoma	Success
Sarcoma	de4cdc73df720684ee1b130e7c8d0af4	128	Sarcoma	Success
Melanoma	eb6e07e7acff3f9841f6cf91f7078a54	128	Melanoma	Success

The above-mentioned table 2 constitutes the medical report transmission strategy in a secured key means. It means that if an individual is having any specific cancer and then she / he is injected with the nanoparticles and undergoes bio-imaging strategies, like X-ray or PET scan. The detected images are analyzed by Artificial intelligence and give an estimated result like, lymphoma or leukemia. This message is transmitted through the above-stated algorithm. The detection chances are correct as per our observations found in table 2.

The proposed method works better at the patient as well as oncologist end with number processors. In the following diagram 8 and 9, encryption and decryption time has been measured. The green, red and blue lines represent 3, 2, and 1 processor involved in the proposed technique.

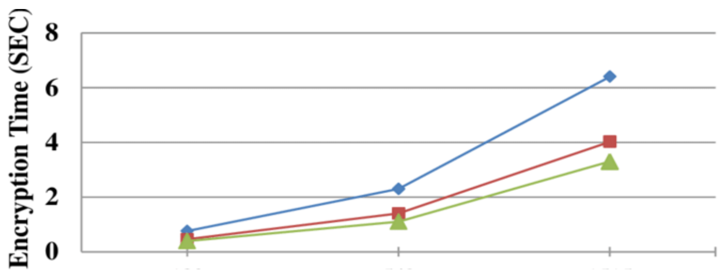

Fig8. Graph for Encrypting with DNGK

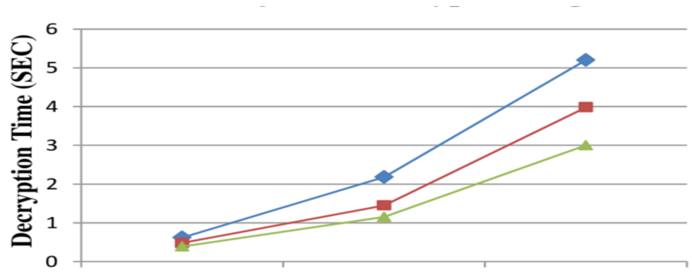

Fig9. Graph for Decrypting with DNGK

Figure 8 and 9 shows the AES encryption and decryption time needed using the different number of processors. The above graphs are acceptable for post-COVID-19 telemedicine [25].

The proposed technique performs AES on the proposed DNGK on n number of bits in plaintext to the n number of bits cipher text at the patient's and oncologist's terminals. The robustness of the proposed DNGK has been accelerated by the crossover operation on the dual weight vectors.

6. **Conclusion**

There are potential outcomes to make diverse nanoparticles as imaging contrast specialists and remedial media. The methodology of utilizing nano-objects for explicit focusing on, sub-atomic imaging and specific treatment is a more flexible method of imaging. It is a powerful instrument that might be used in the advanced COVID-19 medical sciences. The overall norm of this proposed strategy has been grounded: combination, fictionalization, and portrayal and execution assessment. Nanoparticles having exceptional optical, electrical and attractive properties make it feasible for us to analyze and treat malignancy in more than one manner. The scrambled instrument prior to continuing to the worker is more significant as far as privacy statement. This strategy makes customized and incorporated treatment plausible. Moreover, the key utilized might be made powerfully to diffuse the clinical information [26-28]. Statistical robustness of the proposed Dual Neurons Genetic Key (DNGK) has been done smoothly here. This proposed DNGK technique, therefore, prevents the complexity of cancer report analysis, helps in remote diagnosis, and prevents the threat of error in health treatment. Thus, cancer patients will be benefitted from such secured protocols in the post-COVID-19 era.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding this publication.

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