COVID-19 Pandemic: Role of Machine Learning & Deep Learning Methods in Diagnosis

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INTRODUCTION
A central problem of the COVID-19 disease outbreak is already increasingly affecting the universe. This novel Coronavirus epidemic COVID-19 seems to be a global epidemic although, as per the ‘World Health Organization (WHO), over 12.3 million have also been affected and therefore more than 650 thousand have dropped dead globally before July 9th, 2020. This COVID-19 disease outbreak has already become a significant danger not just for the fellow human-being of huge numbers of people, but also to global environment survival but also aspects of society. Depending on different indicators and measurements, several predictive approaches rely on possible developments. Countrywide “Gross Domestic Product Rate (GDP Percent)” has fallen dramatically. Some person has indeed been highly contaminated with COVID-19 when being quarantined much as separated of others, or to provide adequate care but treatment. The entire paper has been divided into several types including implementation of Covid-19 and AI technologies, concerning DL, ML, and subsequent including relevant work, problems, and function of ML and DL, late covering patient evaluation using DL, ML as well as ending future work including thesis conclusions.

MATERIALS AND METHODS
Research on the pandemic COVID-19 seems to be a key area of research. Throughout this portion, we’re discussing plenty of the distinct researchers’ strong research efforts to dealing with this COVID-19 pandemic. The entire universe has been suffering some of the crucial issues related to the COVID-19 disease outbreak, which requires urgent attention. In DL,
a CNN subset of DNN, mainly utilized to exploring visualization. They are often identified as shift invariant ANN based on the shared design as well as interpretation invariance qualities. The Random Forest is just a classifier technique specifically created for the research community. The whole method is currently being recognized in various image classification as well as to the generation of persistent farm data points, like percentage trees and biomass. 

Below Table 1 is showing the certain important research contribution & practical solutions towards this global pandemic using ML and DL.

### Table 1: Comparison of the various ML & DL method throughout the research of COVID-19

| Model                     | Dataset                  | Number of Patients | Validation Framework               | Data set Description                                                                 | Outcomes                                             |
|---------------------------|--------------------------|--------------------|------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------|
| Convolutional Neural Network | Clinical scientific COVID-19 data | 5000 COVID patient data | Validation using Holdout           | COVID-19 clinical CT images including the patient with infectious as well as unusual disease | Precision and Specificity more than 90% [23,24] |
| Machine Learning based SVM Classification | Clinical scientific COVID-19 data | 800 COVID patient data | Validation using Holdout           | COVID infected patients, including critical & non-serious cases. Also includes data for patients diabetics and coronary | Precision and Specificity more than 75%, with training & testing set [25,26] |
| CNN based COVID Net model  | Clinical scientific COVID-19 data | 650 Patient data   | Rotation estimation based Cross-validation | Different x-ray images of COVID patients Male, Female                                  | Precision more than 90% for Binary classes and Multi-classes achieves 88% [27,28] |
| Random forest Machine learning method | Clinical scientific COVID-19 data | 2500 COVID patient data | Rotation estimation based Cross-validation | different BLOOD sample of COVID patients collected from various source               | Accuracy and Specificity more than 93% [29,30] |

The following are among some of the issues about COVID 19 as well as the function of strategies based on artificial intelligence (DL and ML). Challenges in COVID-19 and the Role of ML and DL are as follows-

1. **The identification of more risky objects through COVID-19 data sets**

   The following risks required additional focus throughout the assessment of the COVID-19 disease outbreak: [23,24]
   
   - The risk for infection: what is the probability that somehow a particular person, as well as community, can further infected with COVID-19?
   - Risk of severity: What is the potential for serious COVID 19 effects including symptoms which would require medical attention as well as critical care against a patient-based and community?
   - Effect risk: what is the probability, as well as how probable seems to be specific treatments to fail, of ineffectiveness for such particular person or entity?

2. **The risk and cause of the COVID-19**

   In the initial phases now there is risk research further into a global pandemic. By using the properties such as age, behavioural norms, position including present conditions a COVID-19 patient can analyses. Whenever an individual or group has gotten affected, researchers had to anticipate their risk of infection including emergency hospital attention over this identifiable group. [25,26]

3. **Anticipating COVID-19 patient treatment options**

   An addition of the intensity estimation tends to forecast every outcome throughout the procedure, which is also simply about forecasting life or death. Precisely, considering specific symptoms that would be important to know how probable a person will be to stay alive. [27,28]

4. **Forecasting the propagation of COVID-19 transmission through social media network**

   - The Deep Learning and Machine Learning system predicts the percentage of unique virus transmission through evaluating the nature of personal social media communications. [29,30]

5. **Patient examination and COVID-19 diagnosis**

   Large-scale testing becomes challenging, as well as experiments have become critical in this regard, particularly at the start. [31]

**RESULT**

Covid-19 pandemic is one of the most disastrous issues of the world. It is spreading rapidly and the whole world is facing a shortage of test laborites, testing kits, and also a diagnosis of covid-19 patients. In this research work, we are using chest
images of various persons to identify covid-19 positive or negative, as well as to diagnosis the covid-19 patients.

Data Set
The data set has been collected from Kaggle online Covid-19 X-ray data set that contains a total of 5600 x-ray images. The table-2 is showing the description of Covid-19 image datasets. The data set can be divide into two categories one is normal and another is covid-19 patient data. The normal data set contains 600 X-ray images, 250 images are using for training and 350 images for testing and in the covid-19 patient dataset 2000 images for training and 3000 images for testing purposes.

Table 2: Covid-19 data Set description

| Category       | Normal images | Covid-19 Patient | Total Images |
|----------------|---------------|------------------|--------------|
| Training dataset | 250           | 2000             | 2250         |
| Testing dataset  | 350           | 3000             | 3500         |
| All images      | 600           | 5000             | 5600         |

Simulation And Results
The Simulation was performed using python programming on a 5600, X-ray dataset. Figure-1 is showing X-ray images of the Covid-19 dataset, in which the first row is showing normal images and the second row is showing Covid-19 patient images. Based on the training and testing dataset various experimental parameters were calculated. These parameters contain true positive, true negative, false positive, false negative, and finally calculated accuracy, detection rate, and f-measure.

Table 3: Performance of CNN & Random Forest

| Scenario   | X-Ray image Dataset | Method            | Accuracy | Specificity | Sensitivity |
|------------|---------------------|-------------------|----------|-------------|-------------|
| Scenario-1 | Training            | Testing           | Random Forest [2] | 87.9       | 91.2        | 90.9        |
|            | 2250                | 3500              | CNN [1]   | 92.4        | 98.8        | 98.3        |
| Scenario-2 | Training            | Testing           | Random Forest [2] | 86.5        | 93.5        | 91.7        |
|            | 1125                | 1750              | CNN [1]   | 91.74       | 96.28       | 95.13       |

Figures 2 to 4 are mainly showing the experimental results of the CNN and Random forest method on the X-ray dataset (Table 3). In Figure 2, a graph is plotted between numbers of Covid-19 cases Vs X-ray images. The detection rate of the CNN method is higher than the Random forest method for various image sets.
DISCUSSION

We employed the simulation on the Kaggle Covid-19 dataset for machine learning and deep learning methods. The experiment mainly finds out the various features include texture, morphological, and image quality to distinguish Covid-19 infected patients and normal person based on lung infections. The main finding of the research was able to detect the Covid-19 infected patients among two popular Machine learning (Random forest) and Deep learning (CNN) methods.

In the previous research machine learning methods and research paper deep learning methods were used. It is crucial to formulate a deep neural network system like COVID-Net with transparency and accountability in view, because of the mission-critical nature of biomedical studies such as COVID-19 identification that really can affect patients’ wellness and well-being. This research work evaluated the performance of machine learning-based random forest and deep learning-based CNN method. In the existing research researchers are mainly utilizing the machine learning method, which perform better when the data size is limited. The precision of the experiment, together with the complexity of the design, the number of parameters, and the complexity of data processing are shown in Tables 2 and 3. This can be noticed that just by accomplishing more than 90% test accuracy of CNN achieves better accuracy, consequently illustrating the effectiveness of exploiting participatory management framework strategies to build fully personalized deep neural network system in an increased way made to fit assignment, statistics, and strategic goals.

The various experimental parameters include detection rate, accuracy, and F-measure were calculated for CNN (Deep learning) and Random Forest (Machine learning method). The leading multi-class characteristic was the boundary. This same boundary seems to be the total pixel quantity at the edge of a picture. The fastest-growing functionalities from COVID-19 Vs viral infection were skewness, randomness, compact size, and thin proportion. The experimental results The CNN model outperforms over Random forest method, it shows an accuracy of 92.4% (Figures 2-5) by considering the 40% of training data and 60% of testing data for the Covid-19 X-ray data set. Together, these results indicate that the boundary is a key differentiated characteristic, coherent with a closely examining which lung infection with COVID-19 appears to become more extraneous and lateral along the lung borders.

To determine a better understanding of the overlap between all the decision-making procedure of deep neural networks besides potential treatments as well as the policy procedure of healthcare professionals throughout chest radiographs, these observations are therefore informative. All performance indicators fell substantially although expected mostly
with multi-class classification. Even so, the Classifier and accuracy coupled remained high. These research results are enabling and recommend that COVID-19 lung infection can indeed be distinguished from many other comparable lung infections by the multi-class categorization.

The purpose of this research was to enhance forecasting power by retrieving texture as well as morphological characteristics from X-ray images. The process of machine-learning is a hard process to retrieve the investigators’ most suitable and important characteristics. Findings demonstrate that the most suitable and important hidden details provided in the COVID-19 lung infection, which also enhanced the multiple as well as inter classification, is available throughout the segmented images utilizing the CNN approach. These characteristics are most often used as feedback to the CNN process. The findings acquired outperformed these earlier conventional techniques.

**CONCLUSION**

The outbreaks of COVID-19 is not even the first pandemic, as well as doubtful to be last. However, over the first time, modern communities get the resources that provide a structured, evidence-based, equitable, as well as international solution towards human health. If we try to analyze these images manually it takes lots of time as well as some possibility of inaccuracy. Due to the rapid growth of the Covid-19 pandemic and limited resources (detection kits, lab, health workers, and medicines), the need for an automatic and accurate detection system is always an interesting hot topic for researchers. By using the effectiveness of the whole solution increasing depends partially on ML and DL methods. This research mainly utilizes various chest images (X-ray) of covid-19 patients. The experimental results influence that the CNN method shows a 92.4 % accuracy result over the machine learning method. We could also save numerous human lives now and in the future, unless we begin taking the whole chance to acquire data, pool our expertise as well as incorporate our skill and knowledge. Throughout future work, we will build a methodology premised on artificial intelligence and machine learning to battle in monitoring and mitigation with pandemic COVID-19.

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