http://www.jctjournals.com ISSN(ONLINE):2278 – 3814

Volume-11, Issue-05, May 2022
JOURNAL OF COMPUTING TECHNOLOGIES (JCT)
International Journal
Page Number: 01-05

COVID-19 Detection From CHEST X-Ray Images Using Convolutional Neural Network & MATLAB : A Review

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***Abstract*— By 2020, the corona virus has emerged as a pandemic affecting public health around the world. Large numbers of people need to be tested to identify those infected and to reduce the spread of the disease. Real-time PCR (polymerize chain reaction) is a standard diagnostic tool for pathological examination. There are failures for this tool as it provides additional false test results that make way for another tool. Chest x-ray is the best PCR test for COVID-19. But here the accuracy of the results is very important. Here is suggested a diagnostic recommender system for diagnosing lung images that can help doctors and reduce the burden on them. The CNN (deep convolution neural network) method is used to achieve the best accuracy results. This is a proposal for automated detection and remote monitoring system based on CNN, Mobile-Net and MATLAB software. This network will be used to monitor the number of people living in a specific area (cities, region, country, etc.). The goal of this system is to detect early diagnosis in people infected with COVID-19, using a device (such as a bracelet or chest band). This device collects in real time all the necessary biomedical measurements of a person, including his or her location, freeing him from any hospitalization or the use of sophisticated and expensive equipment.**

***Keywords*- COVID-19, pneumonia, X-ray, convolutional neural networks, coronavirus**

I. INTRODUCTION

In the year 2019 and in the month of December a new virus was born in China and spread rapidly all over the world within a span of 2 months. World Health Organization (WHO) has termed this with the name COVID-19 and declared this as a pandemic in the month of February. As per the reports till today around 20.1 Million individuals tested positive for covid- 19, with the USA in the top position of the worst affected country in the world with 8.19 Million cases and India in the second place of the worst affected country with 7.50 million cases. The fatality rate all over the world is around 2-3% at present. As this virus is spreading at a very fast rate, all government officials are trying to isolate the patients of covid-19. In order to reduce the spread, many countries are going through a complete lockdown by not allowing anyone on the roads Cough, fever, breathing problems, high fever for a long duration is the symptoms of the covid-19 pandemic novel corona virus. Even though there are zero symptoms of covid- 19, some individuals getting tested positive for covid-19 by looking at the chest scan reports. Here besides Positive pathogenic testing, chest X-rays are also being used to diagnose the corona virus disease. For diagnosis purposes, Real-time PCR (polymerise chain reaction) is used as a tool for diagnosis. Many health care systems are trying very hard in attempting to increase the testing facilities for Covid-19. Many testing facilities are being implemented to identify more and more cases and to isolate the positively tested patients, and thereafter reducing the spread of disease among the community. Major points to worry for the governments are with false-negative results. Even though some patients are really infected but not tested positive with reports. The individual, who is tested false, unknowingly transmits the disease to others. With false results, it becomes difficult to stop the spreading of the disease. In this case, Chest X-rays proved to a better alternative with its high sensitivity.The accuracy of the results of a chest x-ray depends upon the expertise of the radiologists. It is very difficult to into the present situation where the patients are in large numbers. The proposed system can assist the doctors in this present situation which reduces the burden on doctors. In the medical imaging field, deep neural network techniques with

multiple neurons at each layer which helps in the classification.

Since there is no way to control these environmental factors, we have to ensure the algorithm prediction is accurate and robust enough to handle. As read both the techniques yielded almost the same accuracy around 87%. But it is expected to improve the accuracy as much as possible because it can lead to the false acquisition of citizens for acts they didn't commit. Hence, both the papers try to increase accuracy by using Contour and Segment extraction methods respectively.

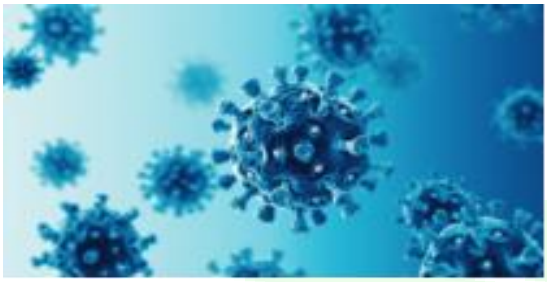

Fig. 1 Covid-19 images frame.

II. LITERATURE SURVEY

The COVID-19 pandemic has caused an unprecedented global crisis. Currently, the rapidly increasing number of COVID-19 cases leads to a severe shortage of test kits and calls for a more efficient and accurate way to diagnose COVID-19 infections. To address the COVID-19 diagnosis kits shortage issue, researchers have been applying machine learning technologies, especially deep learning on medical diagnostic image (e.g., CT scan or X-Ray) recognition. However, the deep learning model performance is heavily dependent on the training data set size and diversity. Moreover, data hungriness is a critical challenge due to the concern for data privacy. To protect privacy-sensitive patients' data, the sharing of medical data across medical institutions is not allowed, which causes the issue of insufficient data sets for model training.

There are several techniques have been reviewed into different stage of the entire COVID-19 Detection process. Each stage has its own algorithm to achieve the goal respectively. A brief description of each stage and the working environment behind is covered in this section. The accuracy of the result very much dependent on the resolution i.e., pixels of the image capture, the higher the resolution, the higher the accuracy of the result.

Manoj, Mk, et al. "An Incentive Based Approach for COVID-19 planning using Blockchain Technology". 2020 IEEE Globecom Workshops (GC Wkshps. IEEE, 2020 [1]. The current situation of COVID-19 demands novel solutions to boost healthcare services and economic growth. A full-fledged solution that can help the government and people retain their normal lifestyle and improve the economy is crucial. By bringing into the picture a unique incentive-based approach, the strain of government and the people can be greatly reduced. By providing incentives for actions such as voluntary testing, isolation, etc., the government can better plan strategies for fighting the situation while people in need can benefit from the incentive offered. This idea of combining strength to battle against the virus can bring out newer possibilities that can give an upper hand in this war. As the unpredictable future develops, sharing and maintaining COVID related data of every user could be the needed trigger to kick start the economy and blockchain paves the way for this solution with decentralization and immutability of data.

Zhang Weishan, et al. "Dynamic fusion-based federated learning for COVID-19 detection." IEEE Internet of Things Journal 2021 [2]. Medical diagnostic image analysis (e.g., CT scan or X-Ray) using machine learning is an efficient and accurate way to detect COVID-19 infections. However, the sharing of diagnostic images across medical institutions is usually prohibited due to patients' privacy concerns. This causes the issue of insufficient data sets for training the image classification model. Federated learning is an emerging privacy-preserving machine learning paradigm that produces an unbiased global model based on the received local model updates trained by clients without exchanging clients' local data. Nevertheless, the default setting of federated learning introduces a huge communication cost of transferring model updates and can hardly ensure model performance when severe data heterogeneity of clients exists. To improve communication efficiency and model performance, in this article, we propose a novel dynamic fusion-based federated learning approach for medical diagnostic image analysis to detect COVID-19 infections. First, we design an architecture for dynamic fusion-based federated learning systems to analyze medical diagnostic images. Furthermore, we present a dynamic fusion method to dynamically decide the participating clients according to their local model performance and schedule the model fusion based on participating clients' training time. In addition, we summarize a category of medical diagnostic image data sets for COVID-19 detection, which can be used by the machine learning community for image analysis. The evaluation results show that the proposed approach is feasible and performs better than the default setting of federated learning in terms of model performance, communication efficiency, and fault tolerance.

Fiorino Gionata, et al. "Inflammatory bowel disease care in the COVID-19 pandemic era": the Humanitas, Milan, experience." Journal of Crohn's and Colitis 14.9 the IEEE conference on computer vision and pattern recognition, 2020 [3],The outbreak of the COVID-

19 caused by coronavirus SARS-CoV2, is rapidly spreading worldwide. This is the first pandemic caused by a coronavirus in history. More than 150 000 confirmed cases worldwide are reported involving the SARS-CoV2, with more than 5000 COVID-19-related deaths on March 14, 2020. Fever, chills, cough, shortness of breath, generalised myalgia, malaise, drowsiness, diarrhoea, confusion, dyspnoea, and bilateral interstitial pneumonia are the common symptoms. No therapies are available, and the only way to contain the virus spread is to regularly and thoroughly clean one's hands with an alcohol-based hand rub or wash them with soap and water, to maintain at least 1 m [3 feet] distance from anyone who is coughing or sneezing, to avoid touching eyes, nose, and mouth, and to stay home if one feels unwell. No data are available on the risk of COVID-19 and outcomes in inflammatory bowel disease [IBD] patients. Outbreak restrictions can impact on the IBD care. We aim to give a viewpoint on how operationally to manage IBD patients and ensure quality of care in the current pandemic era.

Liu, Boyi, et al. "Experiments of federated learning for covid-19 chest x-ray images." the IEEE conference on computer vision and pattern recognition, 2020 [4], AI plays an important role in COVID-19 identification. Computer vision and deep learning techniques can assist in determining COVID-19 infection with Chest X-ray Images. However, for the protection and respect of the privacy of patients, the hospital's specific medical-related data did not allow leakage and sharing without permission. Collecting such training data was a major challenge. To a certain extent, this has caused a lack of sufficient data samples when performing deep learning approaches to detect COVID-19. Federated Learning is an available way to address this issue. It can effectively address the issue of data silos and get a shared model without obtaining local data. In the work, we propose the use of federated learning for COVID-19 data training and deploy experiments to verify the effectiveness. And we also compare performances of four popular models (MobileNet, ResNet18, MoblieNet, and COVIDNet) with the federated learning framework and without the framework. This work aims to inspire more researches on federated learning about COVID-19. Novel Coronavirus disease (COVID-19) has abruptly and undoubtedly changed the world as we know it at the end of the 2nd decade of the 21st century. COVID-19 is extremely contagious and quickly spreading globally making its early diagnosis of paramount importance. Early diagnosis of COVID-19 enables health care professionals and government authorities to break the chain of transition and flatten the epidemic curve. The common type of COVID-19 diagnosis test, however, requires specific equipment and has relatively low sensitivity. Computed tomography (CT) scans and X-ray images, on the other hand, reveal specific manifestations associated with this disease. Overlap with other lung infections makes human-centered diagnosis of COVID-19 challenging. Consequently, there has been an urgent surge of interest to develop Deep Neural Network (DNN)-based diagnosis solutions, mainly based on Convolutional Neural Networks (CNNs), to facilitate identification of positive COVID-19 cases. CNNs, however, are prone to lose spatial information between image instances and require large datasets. The paper presents an alternative modeling framework based on Capsule Networks, referred to as the COVID-CAPS, being capable of handling small datasets, which is of significant importance due to sudden and rapid emergence of COVID-19. Our results based on a dataset of X-ray images show that COVID-CAPS has advantage over previous CNN-based models. COVID-CAPS achieved an Accuracy of 95.7%, Sensitivity of 90%, Specificity of 95.8%, and Area Under the Curve (AUC) of 0.97, while having far less number of trainable parameters in comparison to its counterparts. To potentially and further improve diagnosis capabilities of the COVID-CAPS, pre-training and transfer learning are utilized based on a new dataset constructed from an external dataset of X-ray images. This is in contrary to existing works on COVID-19 detection where pre-training is performed based on natural images. Pre-training with a dataset of similar nature further improved accuracy to 98.3% and specificity to 98.6%.

Tsiknakis Nikos, et al. "Interpretable artificial intelligence framework for COVID-19 screening on chest X-rays." Experimental and Therapeutic Medicine 20.2 IEEE international conference on computer vision 2020 [6], COVID-19 has led to an unprecedented healthcare crisis with millions of infected people across the globe often pushing infrastructures, healthcare workers and entire economies beyond their limits. The scarcity of testing kits, even in developed countries, has led to extensive research efforts towards alternative solutions with high sensitivity. Chest radiological imaging paired with artificial intelligence (AI) can offer significant advantages in diagnosis of novel coronavirus infected patients. To this end, transfer learning techniques are used for overcoming the limitations emanating from the lack of relevant big datasets, enabling specialized models to converge on limited data, as in the case of X-rays of COVID-19 patients. In this study, we present an interpretable AI framework assessed by expert radiologists on the basis on how well the attention maps focus on the diagnostically-relevant image regions. The proposed transfer learning methodology achieves an overall area under the curve of 1 for a binary classification problem across a 5-fold training/testing dataset.At the dawn of 2019 the World Health Organization (WHO) was notified by the Chinese authorities on novel coronavirus (2019-nCoV) causing severe respiratory illness emerging from Hubei Providence of China and particularly linked to the seafood market of Wuhan city.

Otoom Mwaffaq, et al." An IoT-based framework for early identification and monitoring of COVID-19 cases". Biomedical Signal Processing and Control 62 IEEE international conference on computer vision 2020 [7],

The world has been facing the challenge of COVID-19 since the end of 2019. It is expected that the world will need to battle the COVID-19 pandemic with precautious measures, until an effective vaccine is developed. This paper proposes a real-time COVID-19 detection and monitoring system. The proposed system would employ an Internet of Things (IoTs) framework to collect real-time symptom data from users to early identify suspected coronaviruses cases, to monitor the treatment response of those who have already recovered from the virus, and to understand the nature of the virus by collecting and analyzing relevant data. The framework consists of five main components: Symptom Data Collection and Uploading (using wearable sensors), Quarantine/Isolation Center, Data Analysis Center (that uses machine learning algorithms), Health Physicians, and Cloud Infrastructure. To quickly identify potential coronaviruses cases from this real-time symptom data, this work proposes eight machine learning algorithms, namely Support Vector Machine (SVM), Neural Network, Naïve Bayes, K-Nearest Neighbor (K-NN), Decision Table, Decision Stump, OneR, and ZeroR. An experiment was conducted to test these eight algorithms on a real COVID-19 symptom dataset, after selecting the relevant symptoms. The results show that five of these eight algorithms achieved an accuracy of more than 90 %. Based on these results we believe that real-time symptom data would allow these five algorithms to provide effective and accurate identification of potential cases of COVID-19, and the framework would then document the treatment response for each patient who has contracted the virus.

III CONCLUSION

3.1 CONCLUSION

Early prediction of COVID-19 patients is vital to prevent the spread of the disease to other people. In this study, we proposed a deep transfer learning-based approach using chest X-ray images obtained from normal, COVID-19, bacterial and viral pneumonia patients to predict COVID-19 patients automatically. Performance results show that ResNet50 pre-trained model yielded the highest accuracy among five models for used three different datasets (Dataset-1: 96.1%, Dataset-2: 99.5% and Dataset-3: 99.7%). In the light of our findings, it is believed that it will help radiologists to make decisions in clinical practice due to the higher performance. In order to detect COVID-19 at an early stage, this study gives insight on how deep transfer learning methods can be used. In subsequent studies, the classification performance of different CNN models can be tested by increasing the number of COVID-19 chest X-ray images in the dataset. This work focused on the working principle of transfer learning and explored the use of Pretrained model Resnet-50 on chest X-rays. This study shows how use of these concepts in medical image processing and AI will help in fast and reliable detection of COVID-19 with extreme accuracy. So, it is believed that this will contribute in overcoming the current diagnosing and screening problems for COVID-19 detection as it seems like the pandemic is not stopping soon. The proposed model obtained best results with 96 % accuracy and it proved to be very sensitive and specific to the dataset.

The framework presented in this manuscript uses an ensemble of three most common and up-to-date DCNN structures for detection and classification of Chest X-Ray images. The combination of features extracted from the three DCNN structures namely NASNet, MobileNet and DenseNet leads to a better generalization performance than single classifier as counterparts. The results obtained by our framework not only outperformed the individual DCNN architectures but also some of the state-of-the-art models presented in the literature. And most importantly the ensemble model takes a little over one second to classify the input test images, whereas each of the individual models takes less than a second. But this little delay can be afforded when accuracy of the model is our priority.With the increasing number of cases, it is also important to ensure that no single COVID-19 patient goes undetected. The proposed method can assist the radiologists to have a deeper understanding of the critical aspects related to COVID-19. We strongly believe that once more training data becomes available, the accuracy will go up.

This research deals with the problem of COVID-19 disease detection and monitoring. An intelligent algorithm for its accurate diagnosis has been studied to avoid this issue. The proposed solution approach is based on different technologies. Effectively, the suggested diagnosis approach correctly treats the problem with satisfactory performance. In addition, the proposed system constitutes an effort toward the design of an intelligent, flexible and integrated fuzzy logic based home healthcare system. Simulation results proves the COVID-19 detection accuracy and the knowledge extraction feasibility.

3.2 FUTURE SCOPE

Covid-19 pandemic is a growing manifold daily. With the ever-increasing number of cases, bulk testing of cases swiftly may be required. In this work, we experimented with multiple CNN models in an attempt to classify the Covid-19 affected patients using their chest X-ray scans. Further, we concluded that out of these three models, the X Ceptionnet has the best performance and is suited to be used. We have successfully classified covid-19 scans, and it depicts the possible scope of applying such techniques in the near future to automate diagnosis tasks. The high accuracy obtained may be a cause of concern since it may be a result of overfitting. This can be verified by testing it against new data that is made public shortly. In the future, the large dataset for chest X-rays can be

considered to validate our proposed model on it. It is also advised to consult medical professionals for any practical use case of this project. We do not intend to develop a perfect detection mechanism but only research about possible economically feasible ways to combat this disease. Such methods may be pursued for further research to prove their real case implementation. Furthermore, it is concluded from the obtained outcomes that the proposed remote diagnosis task has been accomplished successfully in real-time. This promotes the experimental validation and evaluation of the system of the performance in a university hospital center with COVID-19 patients. As perspectives, we proposed to extend this work to establish a comparative study towards other types of fuzzy inference engine : Tsukamoto, Takagi-Sugeno and ANFIS for an accurate diagnosis of COVID-19. At present health of the individuals in the entire world is getting affected at an alarming rate. It is very difficult to test a large number in a short time to curb the spread of the disease. Major points to worry for the governments are with false- negative results. Here suggested proposed methodology proved to best for classification of covid-19 patients which used convolution neural network and Mobile Net with maximum F1 score. Future work suggests the development of the architecture for large amounts of datasets too applications.

REFERENCES

[1.] Manoj, Mk, et al. An Incentive Based Approach for COVID-19 planning using Blockchain Technology. 2020 IEEE Globecom Workshops (GC Wkshps. IEEE, 2020.

[2.] Zhang Weishan, et al. Dynamic fusion-based federated learning for COVID-19 detection. IEEE Internet of Things Journal (2021).

[3.] Fiorino Gionata, et al. Inflammatory bowel disease care in the COVID-19 pandemic era: the Humanitas, Milan, experience." Journal of Crohn's and Colitis 14.9 the IEEE conference on computer vision and pattern recognition, (2020): 1330–1333. pmid:32211765

[4.] Liu, Boyi, et al. Experiments of federated learning for covid-19 chest x-ray images." arXiv preprint arXiv:2007.05592 the IEEE conference on computer vision and pattern recognition, (2020).

[5.] Afshar Parnian, et al. Covid-caps: A capsule network-based framework for identification of covid-19 cases from x-ray images. Pattern Recognition Letters 138 the IEEE conference on computer vision (2020): 638–643. pmid:32958971

[6.] Tsiknakis Nikos, et al. Interpretable artificial intelligence framework for COVID-19 screening on chest X-rays. Experimental and Therapeutic Medicine 20.2 IEEE international conference on computer vision (2020): 727–735. pmid:32742318

[7.] Otoom Mwaffaq, et al. An IoT-based framework for early identification and monitoring of COVID-19 cases. Biomedical Signal Processing and Control 62 (2020): 102149. arXiv:2008.07343 IEEE international conference on computer Mvision (2020). pmid:32834831

[8.] T Haque, A. K. M., et al. Insight about Detection, Prediction and Weather Impact of Coronavirus (COVID-19) using Neural Network. arXiv preprint IEEE international conference.

[9.] Carrillo-Larco Rodrigo M., and Castillo-Cara Manuel. Using country-level variables to classify countries according to the number of confirmed COVID-19 cases: An unsupervised machine learning approach. Wellcome Open Research 5 IEEE international conference (2020).

[10.] Khanday Akib Mohi Ud Din, et al. Machine learning based approaches for detecting COVID-19 using clinical text data. International Journal of Information Technology 12.3 IEEE (2020): 731–739. pmid:32838125.

