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An Overview on Deep Leaning Application in Coronavirus (COVID-19):Diagnosis, Prediction and Effects

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***Abstract*—** Recently, the coronavirus 2019 or COVID-19, which originated in China, has spread to other countries' population. It is critical to evaluate an automated detection system for rapid alternative prediction and diagnosis in order to reduce the impact of COVID-19. Because of the constant increase in cases, there are fewer COVID-19 available kits than are required for testing in hospitals. Deep learning methods are evolving to provide outstanding performance in the medical field. Deep learning inspired by brain structure is referred to as machine learning. This paper provides an overview of COVID-19's detection applications based on deep learning. Furthermore, a comprehensive review of the literature on deep leaning in COVID-19 disease has been illustrated. The proposed research study shows that in spite of presence of issues in medical database, where the transfer method can be used effectively.

Keywords—Coronavirus, COVID-19, deep learning, diagnosis, predictions effects.

I. INTRODUCTION

Today, "COVID-19" refers to coronavirus, which has been referred to as a "novel" since December 2019 due to its most recent strain in the virus family. According to the World Health Organization, it is a member of a large family that includes everything from a deadly disease to a common cold (WHO). It is capable of infecting the living beings such as humans and animals. The strain of this virus began spreading in the capital of China's Hubei region, Wuhan, and was identified in two different viral categories: Middle East respiratory syndrome (MERS) and severe acute respiratory syndrome (SARS). The basic symptoms of this virus consist of complication like kidney disorder, liquid development in lungs. It goes from normal condition to seriousness. The Director-General of WHO, Dr. Tedros Adhanom Ghebreyesus, indicated that this virus's brought infection namely "coronavirus disease 2019" or "COVID-19" on February 2020. The first epidemic started in China then spread to others twenty-four countries and causes 8000 infected cases along with 800 deaths. The second epidemic started in Saudi Arabia causes 2500 infected cases along with 800 deaths [1].

The coronavirus disease is becoming unstoppable and already reached to be an important epidemiological criteria called as pandemic, which infected lots of people approximately one lack in one hundred countries. Thus, to meet this exceptional challenge, a global coordinated response extremely required to manage health systems. However, in China, the containment observed have reduced new cases by larger than 90%, this degradation is not same in Italy and Iran countries. Recently, Italy has about twelve thousand confirmed cases and on 827 deaths March 11. Till now, the deaths recorded in China because of COVID-19 outbreak in mean age 81 years. The two-thirds died of these people had diseases like diabetes, cancer, cardiovascular of addicted smokers. These died patients were 42·2%, 32·4%, 8·4% and 2·8% in age group of 80 to 89 years, 70 to79 years, 60 to 69 years and 50–59 years respectively. Out of these patients, female to male ratio is 20% to 80% [2]. The key features of COVID-19 disease are presented in Table 1 as follows:

TABLE I. PRIMARY FEATURES OF THE COVID-19 DISEASE [3]

Parameter of Virus	Feature
Name	SARS-CoV-2
Family	Coronaviridae
Type	(+)-ssRNA
Disease	Coronavirus or COVID-19
Transmission	Respiratory droplet
Viral infected period	1-14 days (median)
Period of infectiousness	1 day post-exposure
	10 days post symptom resolution

Table 1 shows the hypothetical triage for a patient illustrating to a radiation clinic with a latest positive test for the coronavirus disease. Moreover, recently, deep learning has gained significant performance, like human experts in classification computer vision tasks from breast cancer, lung disease, skin lesion, attention deficit hyperactivity disorder (ADHD) diabetic retinopathy and disease of Alzheimer to enhancing reformation for PET/CT/MRI diagnostics. However, it is complex to estimate medical images uncertainty to enhance the decision making reliability [4].

To deal with COVID-19, is one of most challenging task in healthcare field in today world. As the already present infrastructure for detecting COVID-19 infected patients is inappropriate and time consuming process. Deep learning is expected to be one of the possible solutions that will soon be combined and developed with clinical tests to allow accurate, economical, and easily

performed automatic COVID-19 detection to support the screening procedure due to the increasing global incidences [4].

As, in spite of incredible performance, various deep learning approaches incline construct overconfident predictions. This is critical in finding COVID-19 infected patients from others non-infected patients. Thus it is compulsory to evaluate uncertainty in a deep learning approaches based models' predictions. In this paper, the application of deep learning in diagnoses and prediction of coronavirus has been presented. It is shown that how deep learning helps in enhancing diagnostic performance of machine-human interaction utilizing available COVID-19 datasets and shown that the deep learning application enables for the identification of wrong and unknown cases prediction [4-32]. Here, Section 2 describes the research background of deep leaning in COVID-19 disease. Section 3 presents the motivation of this research. In Section 4, various possible deep learning approaches for COVID-19 diagnosis and prediction are defined. Sections 5 and 6 illustrate its major open challenges and future effects respectively. Finally, conclusion is shown in Section 7.

II. Research Background

The literature review of deep learning for COVID-19 is given as follows:

Wang S. et al. hypothesized that deep learning method will be enable to extract and provide COVID-19's graphical features along with clinical diagnosis for saving disease control time. For this they fetch 453 computed tomography (CT) scan data of COVID-19 pathogen-confirmed demonstration along with past viral pneumonia detection. The results show that for internal validation the entire accuracy upto 82.9% can be achieved with 80.5% and 84% of specificity and sensitivity respectively. But for external validation, a total accuracy upto 73.1% can be achieved with 67% of specificity and 74% of sensitivity. The obtained results show the great importance of using deep learning approach to exact the graphical features radio logically for effective COVID-19 diseases diagnosis [5].

Wang Z. et al. proposed the ontology-based SE prediction framework (OSPF) evolved using deep learning approach to access the TCM prescriptions which are regularly recommended in China in SE prediction for COVID-19. The proposed SI from maximum to minimum re-organizes the prescription recommended list. In addition, some TCM prescriptions are also examined for safety in traditional flu-treatment document for improving significant treatments. The results show that the work will provide a sensible suggestion for the community to select real TCM as secondary treatment for coronavirus. It also provides an enlightening and pilot method for creating a reasonable recommendation TCM list in others diseases treatments [6].

In [29], wearable internet of things (IoT) based distributed framework for ubiquitous computing has been presented. The performance of the proposed framework has been analyzed on the basis of parameters such as bandwidth, request failure, request backlogs, storage utilization, request time and request handled parameters.

In [30], location-based orientation context dependent recommender system for users has been incorporated. Here, IoT based smart devices such as Google home; smart watches, smart phones etc. are used to analyze the preference of user to gauge the supreme results.

In [28], the deep learning based brain's neuron connection for human beings has been presented. Also, to deeply identify the requirement of the initial steps over various application of deep learning have been studied.

In [31], the experimental analysis of COVID-19 using deep learning based models with laboratory identification in preference to CT images or X-ray to establish the prediction model has been presented.

In [32], the deep learning interpretation architecture with COVID-19 disease has been presented. The deep model provides the optimum performance in terms of 94.75%, 96.69%, 91.88%, 93.22% and 97.27% for accuracy, specificity, negative predictive, sensitivity and, positive predictive value respectively.

III. Deep Learning for COVID-19

Deep learning based computational approaches for drug locating has been exploited to enable drug-like chemical place. These techniques instinctively extract large dimensional conceptual data without the requirement for learn and attributes design for nonlinear mappings among molecular formation along with pharmacological and biological properties. Deep learning based generative framework can use huge datasets for performance and training in silicon and de novo design of molecular formations such as adversarial auto-encoder (AAE) for generating molecular fingerprints [9].

Lots of proposed architectures were generated with valid chemical formations, molecules matching; novelty profiles, bioactivity and others interested features. Various milestones are achieved by using generative chemistry in discovery of drugs, demonstrating possible for generating molecules to synthesize, metabolically firm and elicit in disease framework. The some models are as follows: [9]

1. JAK3 inhibitor
2. Generative Tensorial Reinforcement Learning (GENTRL)
3. DDR1 and DDR2 inhibitors

The machine learning sub-branch means deep learning, inspired by the brain structure. Deep learning methods are continuing growing to presents a magnificent performance in medical image processing field as in other fields. It can be used to find out the meaningful results in lots of fields such as segmentation, classification of medical image data. Magnetic Resonance Imaging (MRI), X-ray and CT scan can be easily implemented by deep learning models to diagnose and detect deceases like diabetes mellitus, skin cancer, brain tumor and breast cancer conveniently [10].

However, in data analysis related to medical, the biggest difficulty is limited number of already existing database. For this, deep learning need a large amount of data with labeling and it is time consuming and costlier way. Thus for this transfer method can be utilized [10].

IV. CHALLENGES AND ISSUES

The major challenges and issues related to proposed model is given as follows:

1. The large training sample in deep learning datasets helps in performance improvement of system. The restricted training data is a restriction for deep learning based approaches in healthcare field. But by using transfer learning this issue can be minimized [8].
2. The transfer learning uses the pre-skilled network for feature extraction and for refine tuning by weight fixing in network. It is further divided into cross-domain and cross-model learning. Out of these two cross-domains is most common to achieve various tasks in medical analysis. But is not an optimal choice for medical field. This is due to reason for mapping from fresh data image pixels to characterized vectors for a definite work [8].
3. Medical images have complex pre-skilled case and need enormous training samples at high performance. Thus it is more suitable to use small network as compared to smaller-scale [8].
4. The models trained on real images are not suitable for medical images related to single channel, texture rich and low contrast, especially in breast imagining where multiple modalities like X-ray, MRI etc. are mostly used in diagnosis the images workflow. Moreover it is costlier and time consuming way for screening of the collected sufficient training datasets [8].
5. Besides this, other challenges are learning algorithms which need to address by avoiding negative transfer, dealing with heterogeneous feature and improving the generalization across distinct tasks. This is done to enhance learning performance in target task [8].

V. FUTURE EFFECTS

A coronavirus positive patient poses significant health related challenges to the administration, physician and staff, who are involved in patient's well-being and care. Figure 1 shows a decision tree hypothetical triage with a COVID-19 virus positive patient. For management of coronavirus patients, American Society of Radiation Oncology (ASTRO) is regularly working to upgrade evidence-based and useful guidelines. The clinicians are doing encourage work on this virus for latest coronavirus management information. The various COVID-19 risk management strategies are as follows in Fig. 1 [3].

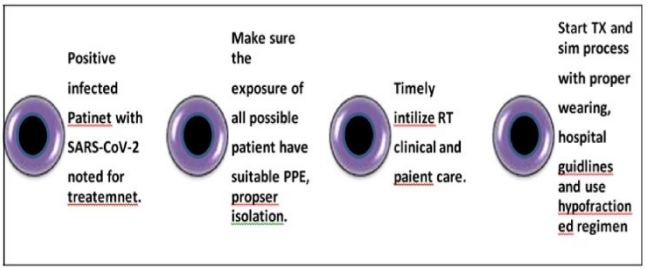

Fig. 1: A hypothetical Triage Testing Tree for decision about a COVID-19 infected patient [3]

The various COVID-19 Risk Mitigation Strategies are given as follows [3]:

1. **Screening**: It develops exterior risk exposure questionnaire for head desk skilled staff or ward to screen infected patients through appointment time schedule & check-in. It also provides screening of risk questionnaire for medication update and review of system information. It includes viral-exposure problems queries in nursing triangle [3].
2. **Sanitation**: It enhances enforcement and encouragement of proposed guidelines for hand-wash. It implements sanitation precautions, increased for remedy equipment for various patient disclosures. It helps in implementing deep QD/ID cleaning of equipment for various patient exposures. It removes unwanted items such as magazines from waiting rooms. It instructs all patients for hand wash after entering to department immediately. It helps in transition to tumor boards and online meetings [3].
3. **Containment**: It indicates that the infected non halted treatment patients, should wear protective equipment during the whole process of medical encountered treatment as per by hospital guidelines. The ward who is interacting patients and cannot halt treatment, should wear protective equipment [3].
4. **Exposure**: The staff must be trained on COVID-19 evaluating and interaction guidelines as per by hospital appropriately. The infected patient must be supplied testing as per by hospital guidelines. Here, consider the telemedicine or phone call follow-up if appropriate for a clinical scenario. The patient having latest respiratory symptoms should be provided with suitable mask and hand wash guidelines [3].

Artificial Intelligence and machine learning can be employed in different domains like drug discovery [11-12], fraud prediction [13-14], cancer prediction [15-16], etc. Authors in [17-19] describe the security and privacy aspects of the information especially the sensitive attributes like location and user identification present in the datasets used for empirical studies, while some good works discusses the same issue for discrete point dataset used for publishing the user data publicly [20-27].

VI. CONCLUSION

The earlier forecasting of COVID-19 infected patients is essential to restrict the disease spread worldwide. For this an overview of application of deep learning in COVID-19's perception and prediction has been illustrated. It is concluded that, the deep leaning significantly provide high accuracy and helpful for staff/doctors etc., to make decision clinically through deep learning methods with high performance. Although, it has lots of challenges and issues but the early stage detection can minimize the impact of COVID-19 decease among people. Moreover, its future effects help in leveraging restrictions to avoid the disease spread.

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