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Self-aware COVID-19 AI Approach (SIntL-CoV19) by Integrating Infected Scans with Internal Behavioral Analysis

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Abstract: In the Artificial intelligence (AI) field, intelligent social awareness is a quantifiable analysis that interacts with humans socially with other infected or non-infected COVID-19 (CoV19) humans. However, less importance is given in this direction. Clinically, there is a need for a social-awareness automated model design to quantify the self-awareness of infected patients and develop a social learning system. In this research paper, a new model of self-aware internal learning coronavirus 19 (SIntL-CoV19) model technique is presented with quantification measures to represent model requirements as an individual self-aware automated detection. Through this model, a human can communicate with the social environment and other humans with an accurate CoV19 infection diagnosis. SIntL-CoV19 model framework for implementation of self-aware architecture with this model is proposed making the diagnosis process compared with the existing architecture. The proposed model achieves improved accuracy Feature Classifier, which outperforms other learning algorithms for CoV19 and normal scans. The data from the investigation show that the proposed SIntL-CoV19 model method might be more effective than other methods.

Keywords: COVID-19, CT infection region, deep learning, CNN, artificial intelligence.

I. Introduction:

Since December 2019, the epidemic of the 2019 new coronavirus has swiftly expanded to neighboring nations. The World Health Organization has designated the contagious illness brought on by this virus as COVID-19 (WHO). The alternative diagnostic method for confirming CoV19 patients, the use of chest CT scans gathered from CoV19 patients, is a significant screening indicator in the diagnosis of CoV19 owing to its high sensitivity. The follow-up assessment of hospitalized COVID-19 patients has shown the value of the chest CT scan. Follow-up CT scans every 3-5 days are advised to monitor the effectiveness of treatment due to the disease's fast development.

In general, the manual selection process for a radiologist can introduce bias or misdiagnosis, increasing the potential risk of misdiagnosis for tiny scratches. As a result, medical professionals like radiation therapists are greatly benefiting from contemporary artificial intelligence (AI) techniques in the digital COV-19 diagnosis. Caregivers have significantly benefited from the use of AI and cutting-edge technologies in the field of computer vision analysis. Nowadays, the two primary branches of AI—machine learning {ML) and deep learning (DL)—have jointly entered the field of smart medicine.

In order to diagnose CoV19 using CT and X-ray samples, a deep learning-based assistance system will be set up. A network has been used in several ways, although few transfer learning-based strategies based on pre-trained models have been put forward [1]. Despite being distinct topics, data science and machine learning have merged and are dynamically employed in several phases, including prognosis, diagnostics, outbreak prediction, and CoV19 prediction. But practically all DL-based methods for diagnosing diseases need lesion annotation, particularly for diagnosing diseases in CT volumes. The radiotherapist will spend a lot of time and money annotating the CoV19 lesion, which will hinder efficient disease management. CoV19 has spread quickly around the globe, and there is a critical need for radiation oncologists. The community thus places a high value on making a COV-19 diagnosis using DL models. Chest radiographs (CXR), by the literature, have been preferred as a diagnostic technique in several nations [2]. Radiological scans may be used to accurately determine the

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patient's specific disease or recovery stage and the state of the patient's lungs [3]. In the radiological examination reports from patients with CoV19, radiologists have found a variety of anomalies.

DL [4], regarded as a foundational component for advancing AI technology, has recently been attributed to a notable increase in diagnostic precision in medical imaging for the automated identification of lung disorders. performed better than humans on ImageNet classification tasks with a million training photos in 2015, and in 2017, it demonstrated dermatologist-level accuracy when classifying skin lesions. Additionally, it had fantastic outcomes for lung cancer screenings and skin lesion screenings in 2019. Due to a lack of computational techniques to precisely measure areas of infection and their longitudinal changes, qualitative evaluation has only been offered in radiological reports, even though CT gives extensive pathological information. As a result, on subsequent CTs, small alterations are often missed. Additionally, the contouring of the infection areas in the chest CT is needed for a quantitative assessment; however, manually contouring lung lesions is a laborious and time-consuming task, and irregular delineation might potentially cause errors in the evaluation that follows. Therefore, there is an urgent need for a quick, automated contouring tool for CoV19 infections [5] in point-of-care applications for quantitative illness evaluation.

We predicted a human-self-aware-in-the-loop (SITL) technique to iteratively produce the training samples in order to define hundreds of CoV-19 CT training pictures, which is a laborious and time-consuming task. This approach considerably shortens the algorithm development period by requiring radiologists to quickly modify the DL segmentation outcomes and iteratively add additional training samples to the model. To our knowledge, only a few papers have discussed the use of this technique for detecting CoV19 infection on CT scans.

The remaining of this study is prepared as follows: Sec 2 summarizes the current associated previous works of the proposed system. Sec 3 explains the proposed work. Sec four denotes the dataset collection and assessment metrics as the numerical result is mentioned. Finally, the conclusions of the proposed work are mentioned in Section 5.

II. Literature Survey of Previous Works:

Globally, investigators have been making a conscious effort toward creating effective diagnoses and intensifying the generation of therapies and vaccines [6]. Three analysis procedures are often the most used, including laboratory investigations, infection screenings, and medical image processing. [7] Reverse transcription-polymerase chain reaction (RT-PCR), which is employed as the first-line evidence technique, is one of the most commonly used viral tests and is considered to be the gold standard for identifying CoV19. The testing findings, according to several academics, only had a sensitivity between 50 and 62%. This demonstrates [8] the possibility of the first RT-PCR findings being unfavorable. Several RT-PCR tests are carried out throughout a 14-day observation period in order to confirm the precision of the experimental diagnosis. In other words, if no positive RT-PCR results are obtained from nations after testing within the 14-day observation period due to a lack of RT-PCR kits and trained workers, the negative RT-PCR result for a suspected CoV-19 case is considered a genuine negative. Due to an increase in anxiety, sadness, post-traumatic stress disorder (PTSD), and even suicidal thoughts and actions, the COV-19 pandemic [9] has caused enormous pressure around the globe. The incidence and prevalence of mental health illnesses may rise globally due to a shortage of sufficient psychiatrists, a lack of diagnostic biomarkers, and human subjectivity in evaluation [10].

Recently [11-13], DL systems have been intended to identify enduring infected with CoV19 through radiological images [14]. CT imaging is a popular method for diagnosing lung diseases [15]. They provide clinicians with crucial information for the diagnosis and quantification of lung diseases. Recently, many papers have been submitted and promising results have been obtained. These algorithms [16] often use a feature-extracted classifier for nodal segmentation on breast CT. An innovative trend of AI-based psychiatric tools may make it easier to identify severe depression and anticipate the risk of serious mental well-being problems due to psychiatric disorders. They may also offer enhanced treatment adherence, assist in understanding key aspects of cognitive therapy, and reduce difficulties associated with reporting psychological issues. AI-based advancements [17] thus demonstrate an impactful tendency to accelerate a descriptive process based on the self, conversations, and interpretations in mental disorders to a more data- and information-rich and quantitative system, even if there are still some challenges along the way. This is true whether in prediction, prevention, diagnosis, or treatment. One of the main advantages of statistical and AI methods [18–19] is their capacity to locate specific patterns within highly diversified multi-modality datasets pertinent to psychiatric evaluation that are not obvious beyond human computational capabilities. This is crucial for the early identification of ex-CoV-19 patients at high risk of mental health deterioration. Various rating scales used by patients and doctors, EHRs, brain imaging data, genomics, blood biomarkers, data gathered from Smartphone usage, texts from social networking sites, voice and pronouncement audio data, facial video data, various factors influencing

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physiological reactions, have all been discovered to be used in such classifiers in various publications on AI in mental health, assuming mentally vulnerable. A thorough AI-based predictive approach should result in better detection of high-risk ex-CoV19 patients and more successful prevention measures [20-22] because resilient people have a different profile of neuro psycho physiological indicators as well as differences in personality traits and psycho-behavioral situations.

Different investigations have greatly contributed in recent history to the advancement of methods for the accurate diagnosis and screening of CoV19. Current advances in AI and ML, which were successfully applied to other jobs [23], made this feasible. Through the study of lung images discovered by computed tomography (CT), CXR, occupational health and safety, and symptom identification recorded using fuzzy systems and hospital assistance with robots, many AI and ML-driven techniques have been created to support COV-19 [24]. DL models [25–27] have a great degree of complexity and sometimes require irrational computing expenses.

Consequently, comprehensive behavioral health monitoring metrics are considered vital, especially as they relate to the prognostication and initial diagnosis of people who have been exposed to high levels of stress related to the COV19, particularly when they have low general resilience, indicate stress, and other specific problems and vulnerabilities. It is critical to identify and target such at-risk individuals early in stressful situations in order to prevent the long-term emergence of more severe mental health conditions. The study paper's suggested prediction technique is based on relevant multimodal stimuli, matching multimodal neuro-psycho-physiological traits, and their AI-based integration and analysis.

III. Proposed self-aware AI approach

In the AI approach for CoV19 self-learning, intelligent analysis is a socio-interaction reactively with the social environment with other diagnosed humans and proactively in an analysis-directed manner. More diagnosed analysis with intelligent models is required with human scan reports in near future. As the virus enters into humans organs in their workplace and social-environment, humans need to be self-aware of their surrounding variations, mainly with infected the vicinity the humans are moving socially. At the early stage of the virus, it is very crucial to identify the co-existing infections that interacted with humans while the contact is self-un-aware. In this situation, how infection should be identified and analyzed to ensure the self-aware and safety of humans should be paid more attention.

In this research paper, the notion of self-aware is the main aspect in making the AI diagnosis have a better understanding of the social environment of humans. The approach to analyzing self-aware CoV19 AI is to put humans oneself as the social-focus-attention through defining the infection of human self and self-awareness as the main implementation in this paper.

A. Dataset

Conventional CoV19 testing methods proposed earlier need costly and time-consuming process, which suffers from high detection accuracy and need for repetitive diagnosis to identify the exact status of the virus. To ease the process of CoV19 testing, AI-based models were developed recently by many authors to test and predict CoV19 presence in the human body, but they limit to analyzing the social-environment changes before the infection enters the human body. In the proposed Self-aware Internal Learning Coronavirus 19 (**SIntL-CoV19**) technique, the analysis through deep learning (DL), convolutional neural networks (CNN), and artificial intelligence (AI) by integrating infected scans with internal behavior analysis of infection regions by human-self-aware analysis.

To implement and analyze the proposed **SIntL-CoV19 technique**, the data selection approach is divided into four phases, they are: diagnosis, rescale, training, recognition, and detection.

In the diagnosis stage, the medical images in the form of scans: chest X-rays, and CT, are collected from publicly available datasets: posterior-anterior chest radiography images [19], containing 1200 CoV19 and 1400 posterior-anterior chest X-ray scans with dimensions 450 x 456. In this stage, the scanned dataset is classified based on the *range of symptoms*: early, mild, moderate, and severe, which are analyzed within the quarantine period of the virus-infected human body with CoV19. And these symptoms are categorized into the following *types of symptoms*: cough, fever, chills, headache, sore throat, loss of taste or smell, muscle pain, and difficulty in breathing.

In rescale stage, for easy access to the needs of the proposed learning model, *the diagnosed scans are rescaled to the appropriate size*. By rescaling the diagnosed scan data, we can attain the training time based on the model performance like features, size, and regions. And in this stage, *the diagnosed scans were refined from noise components* such as compressed, cropped, and blurred, which can improve the accuracy to predict the infection regions.

In the training stage, the rescaled scans are trained for the **SIntL-CoV19 technique** using CNN along with internal learning and feature tuning. These methods make the **SIntL-CoV19 technique** identify the scans for chest X-rays and classify them based on the scans considered during the diagnosis stage. Next, the classified scans were sampled to split the scans according to normal scans and covid scans, which were trained with 1:2 ratio-based training: learning for validation, which is considered with 4:1 ratio-based training: testing from the diagnosed scans.

In recognize stage, to overcome the prediction problems, the trained scans are grouped into a recognizable matrix format where the associated pixels of each scan have an s row and t column in the p'th layer of CNN having q'th scan infection feature pattern with its associated scan pattern. And in this stage, infection feature patterns are mapped to the defined convolution layer to achieve an exact filter map.

B. Algorithm

The SIntL-CoV19 technique is an internal behavioral learning method to help humans' to be self-aware of the social environment. A non-infected human can be aware of infection if the infected human maintains a self-aware model about the infection in infection criteria as an input to the model analyzing to **SIntL-CoV19 model.** The **SIntL-CoV19 model** is a quick check of the actual infection represented by an infected human. Here identifying the infected human means that the human must be learned with the **SIntL-CoV19 model** for features and infection criteria. When the non-infected human learns the presence of an infected human, then the **SIntL-CoV19 model** identifies the presence and it refers to the non-infected human diagnosis process.

In the **SIntL-CoV19 model,** self-awareness among non-infected human occurs whenever the model predicts with "Internal-Behavior" identity through objective or opinion or balanced observations and subjective or influence or interpretations analysis.

Objective analysis: This analysis is an internal behavioral analysis of infected scans to represent individual humans' self-aware as a diagnosis of social interaction self-unware individual's environment within the awareness model of non-infected humans, which are under awareness structure.

Subjective analysis: In this analysis, the non-infected human learns from the proposed model that there is a representation of individual humans' are self-aware as diagnosis of socially interacted self-aware individual's environment within the un-awareness model of an infected human, which is under the un-awareness structure. **The subjective self-awareness structure is shown in fig:**

Algorithm 1 shows the overall operation cycle of the **SIntL-CoV19 model** to execute the process of integrating infected scans with internal behavioral analysis.

Algorithm 1: Self-aware Internal Learning Coronavirus 19 (SIntL-CoV19) technique.

Input: Patient ID and diagnosis symptoms.

In detect stage; the recognized scans were analyzed for single-particle imaging to detect the unique structure of covid, which classifies the microscopic virus features in scans. This stage improves the high detection precision with testing infrastructure to the proposed model. And in this stage, the detected covid features avoid test failures through its classified covid features.

The proposed model approach is to achieve a self-aware diagnosis process among humans, in detecting CoV19 cases in a social environment. In this work, the scans dataset used for analysis is categorized as testing 20% and training 80%, through affected CoV19 scans and normal scans.

Step 1: Analyze the virus symptoms via the Patient ID data selection approach.

Step 2:

a) Let P_{id} be a person with a valid Patient ID in the population where $0<i_d<N$, where N is the number of people in the population.
b) Each P_{id} is represented as $P_{id}= (i_1,i_2,i_3,\ldots,i_\kappa)$ where κ is the number of diagnosed features in the dataset and i_κ is the range of selected rescaled symptoms.

Step 3:

a) Let P_{id} be a person with a valid Patient ID for the features $i_\kappa > 5$ having trained feature classifier $\dot{F}_{cfr}$ range between $\dot{F}_1$ and $\dot{F}_2$: are two zero-mean real-valued trained features.
b) Calculate the recognized feature fitness value: $\dot{F}_{fi}= \dot{F}_{cfr}(\kappa: i_\kappa > 5)$, indicating iκ range as a subset of the detected dataset.

while true do

for every feature $\dot{F}_{fi}$ produced by SITL Learning System (LS) and every learning status changes $\dot{F}_{fi}^{S}$ classified results by Self-awareness System (SS) do

create a classified awareness unit $\dot{F}_{fi}^{A} \leftarrow Ca(\dot{F}_{fi})$ to update Symptoms Awareness (SA).

update the awareness unit in SA accordingly

end for

for every $\dot{F}_{fi}^{AS}$ in SA do

if $\dot{F}_{fi}^{AS}$ is self-awareness of human beings at an un-awareness structure

then

action type $\dot{F}_{fi}^{AS}(S_t)$, where S_t is the type of symptoms to diagnose and realize the range of symptoms through $\dot{F}_{fi}^{S}$.

else if

action type $\dot{F}_{fi}^{AS}(Q_t)$, where Q_t is the quarantine period to be considered to analyze the S_t at the earliest.

else

update the SA unit in LS accordingly

end if

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update LS unit based on ḞfiAS(St) accordingly with ḞfiAS(Qt), having a symptomatic model of awareness units.
end for
end while

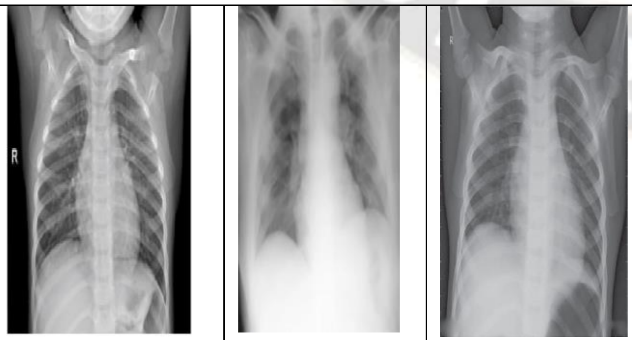
Algorithm 1 described above is considered a do-main AI algorithm for a self-awareness framework to develop an awareness of humans in a social environment. In Algorithm 1, the awareness and social availability of infection are specified accordingly. This makes the AI system more reliable and customized according to the ML systems knowledge repository.

IV. Comparative Results and Discussions

The proposed self-ware model through the proposed SIntL-CoV19 technique is implemented as a human-awareness agent system to analyze the individual human Self-Awareness Learning Diagnose as socio-environment non-medical analysis to improve objective and subjective awareness for individual-human suffering from internal behavioral issues through human-to-human interactions and social-behavioral changes. The proposal model designed through the AI SIntL-CoV19 chatbot creates awareness in humans when they are in a social environment and contact with other humans.

IV. A. Dataset Evaluation

All simulations were performed using python code on the Google Collaboratory platform, running on Server Intel® CPU @ 2.30 GHz with 120 GB disk space. Python imaging library is used to extract the features from scans and the algorithm is developed using Python 3.6.x as the language. Some samples of the data set for different classes are shown in **Figure 1.**



(a) Normal Scan Image | (b) CoV19 positive scan | (c) Diagnosed CoV19 negative scan

Figure 1: Scan samples of the CoV19 data set.

A. Evaluation metrics:

The metrics used to evaluate the proposed model are accuracy (Acc), recall (R_{eC}), and CoV19-positive-precision-($+P_C$), i.e.,

$$Acc = \frac{TP + TN}{TP + FP + TN + FN}$$

$$R_{ec} = \frac{TP}{TP + FN}$$

$$+P_C = \frac{TP}{TP + FP}$$

B. Results

To evaluate the performance of the proposed model and experiments to verify the suitability of our model, the comparative results are illustrated in **table 1**.

Table 1: Comparative results of proposed model SIntL-CoV19 with existing models

Method	Images of Used Dataset	Imaging Modalities	Adopted Model	$+P_C$	R_{eC}	Acc
CNN [20]	CoV19 vs. normal	X-ray	ConvNet#4	98.87	98.77	98.82
Social Mimic Optimization [21]	CoV19 vs. normal	X-ray	SqueezeNet & MobileNetV2	98.89	98.33	99.27
Light CNN [22]	CoV19 vs. normal	CT	CNN	81.73	85	83
Proposed Model	CoV19 vs. normal	X-ray	SIntL-CoV19	98.92	98.82	99.31
Proposed Model	CoV19 vs. normal	CT	SIntL-CoV19	85.01	86.57	86.72
Proposed Model	CoV19 vs. normal	CT + X-ray	SIntL-CoV19 & ConvNet#4	98.90	98.79	99.29

The SIntL-CoV19 model parameters for each comparative model are tuned to optimize the best performance in feature classification in terms of evaluation metrics. The performance comparative evaluation metrics for the three models are listed in **Table 1.** The best performance metrics in terms of accuracy, precision, and recall is achieved for the proposed SIntL-CoV19 model. During the feature classification method considered in the proposed model, providing self-awareness by classifying the scan features as CoV19 POSITIVE or NEGATIVE, the limitation associated with un-awareness is very high for "false negative", which is a high-quality metric value for our proposed work. Through the proposed SIntL-CoV19 model, the unawareness of

CoV19 POSITIVE infections was classified with an improved accuracy value.

V. Conclusions and Future Scope

In this research paper, a new SIntL-CoV19 model technique for detecting and classifying CoV19 using medical imaging is presented. The proposed SIntL-CoV19 model technique includes various operational steps such as preprocessing, feature extraction, optimization, and classification. To demonstrate the applicability of the proposed SIntL-CoV19 model technique, comparative experimental analysis is performed and the results were evaluated in the aspect of accuracy, precision, and recall with better values of 99.31 %, 98.92 %, and 98.82 %. The simulation results demonstrate the improved performance of the SIntL-CoV19 model technique compared to existing models. In the future, the approach of the SIntL-CoV19 model technique can be validated using a feature representation AI algorithm to diagnose the effect of the spreading of CoV19.

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