# COVID-19 DIAGNOSIS SYSTEM BY JOINT CLASSIFICATION AND SEGMENTATION

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**ABSTRACT:** This paper develops a novel Joint Classification and Segmentation (JCS) system to perform real-time and explainable COVID-19 chest CT diagnosis. For controlling such disease, limited diagnostics techniques are utilized to identify COVID-19 patients, which are not effective. To hinder the terrific infection of COVID-19, medical radiology imaging is employed as a complementary tool for the RT-PCR test. The above complex circumstances need to detect suspected COVID-19 patients based on routine techniques like chest CT scans or CT scan analysis immediately through computerized diagnosis systems such as mass detection, segmentation, and classification. JCS system consists of an explainable classification branch to identify the COVID-19 opacifications and a segmentation branch to discover the opacification areas. The classifier is trained on many images with low- cost patient-level annotations and some images with pixel-level annotations for better activation mapping. And the segmentation branch is trained with accurately annotated CT images, performing fine-grained lesion segmentation. By integrating the two models, our JCS system provides informative diagnosis results for COVID- 19.

## INTRODUCTION

In December 2019, a novel coronavirus, named SARS-CoV-2, emerged in Wuhan, China, which caused the COVID-19 disease when infecting humans. COVID-19 is a serious illness that can lead to the death of the infected host. The threat posed by COVID-19 led the World Health Organization (WHO) to declare the COVID-19 pandemic by March 2020.

Coronaviruses are a group of highly diverse, enveloped, positive-sense, single- stranded viruses and are widely spread in birds and mammals. Sometimes these viruses infect humans, causing mild to moderate respiratory diseases.

Before SARS-CoV-2, two coronaviruses were known to cause severe human disease: SARS-CoV, which causes severe acute respiratory syndrome (SARS) and MERS- CoV, which causes Middle East Respiratory Syndrome (MERS).

With the rise of deep learning techniques, medical imagery has increasingly claimed attention for the computed assisted analysis of pulmonary conditions.

Automated analysis of Computed Tomography (CT) scans, has enabled the identification of malignant nodules.

Radiographic analysis, in turn, has also obtained fair results in the detection of tuberculosis signs as well as other multiple cardiothoracic abnormalities. Emerging pathogens are a big concern for global public health, and technology may help classify potential cases more rapidly in order to bring in timely treatments. The Envision 2030 agenda of the United Nations have included 17 sustainable development goals towards a promising future for persons with disabilities aligned with Saudi Vision 2030. As per the SD goals set and implemented by the United Nations, the proposed work targets promoting the transformation of disabilities.

## PROPOSEDSYSTEM

**Existing system**

JCS system consists of an explainable classification branch to identify the COVID-19 opacifications and a segmentation branch to discover the opacification areas. The classifier is on many images with low-cost patient-level annotations and some images with pixel- level annotations for better activation mapping. And the segmentation branch is trained with accurately annotated CT images, performing fine-grained lesion segmentation. By integrating the two models, JCS system provides informative diagnosis results for COVID-19

Proposed System:

As the diagnosis process of CNN classification is in a black box, we employ the activation mapping to increase the explainable transparency of our COVID-19 diagnosis system on its predictions. The last convolutional layer of the classification network is followed by a global average pooling (GAP) layer and a fully-connected layer. Through the GAP layer, our classification model down- samples the feature size from (H, W) to (1, 1), and thus lost the spatial representation ability. Through activation mapping [20]

## LITERATURE SURVEY

COVID-19 has to be detected properly without any negligence else can lead to a severe impact on the country's economy and country's citizen health. The person who is suspicious ofCOVID-19 is suggested to

undergo a chest CT scan. Analysis of CT scans by humans can lead to various human errors, which can lead to a huge impact on patients and society. So, a computer-aided system can help the doctors for proper analysis of chests of the COVID-19 affected human. Throughout underdeveloped and developing nations, where the number of patients is high and medical care cannot be adequately delivered, these programs may be a tremendous benefit. The authors have worked on CT Scan imaging techniques for the detection of bone fractures.

They have applied edge detection and segmentation techniques to ease the process of the diagnosis system. These methods will reduce the processing time and other physical evaluation procedures. So, while working with CT Scan images, we need to consider the noises which have to be reduced. The random noises occurring during the process of image acquisition degrades the image quality leading to an incorrect diagnosis.

Researchers suggest the application of the temporal recursive filter. Also, they propose an improved self-adaptive filter. This was a combination of FPGA with image processing techniques. The authors have recommended region localization which offers a close level of precision.

Few other image preprocessing techniques are adaptive histogram-based equalization, adaptive contrast enhancement, and histogram equalization. There is the presence of multiple noises during capturing the images because of device mobility and motion artefact. But in CT Scan images mostly Gaussian, salt and pepper noises are present. To reduce the noise, a digital median filtering technique is used as per the researches.

Chest CT Scans aid in the diagnosis of pneumonia. Researchers seek the help of CNN in classifying normal and abnormal CT scans. The feature extracted from the chest CT scan improves the functionality of the classifier. This method is useful where a large dataset is received. In another similar work, deep learning techniques are applied for the analysis of chest CT scans. Pulmonary infections are easily identified using these radiography images. This is extended in the detection of coronavirus disease.

## RELATED WORK

### MANUAL COVID-19 DIAGNOSIS:

The most crucial step of preventing the spread of the COVID-19 is immediately identifying every patient from normal people. Missing any patient will probably cause secondaryCOVID-19 infections in large areas. Currently, the main manual diagnostic tool is the RT-PCRtest.

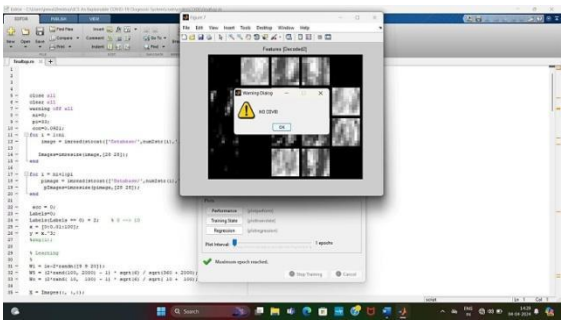
However, the sensitivity of the RT-PCR test is not high enough to effectively prevent the pandemic. As widely available in many hospitals, the CT scan provides a valuable complementary tool to the RT- PCR test. However, some special cases with the RT-PCR test confirmed positive have normal CTs.

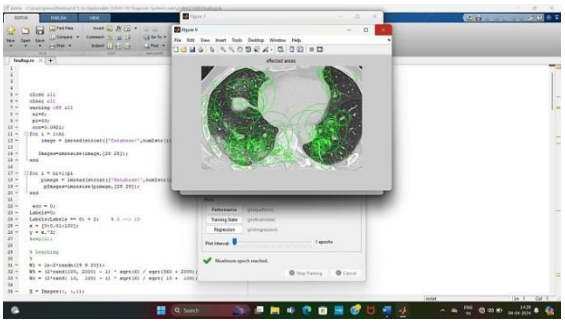
- **We construct a new large scale COVID-19 dataset,** called COVID-CS, which contains 3,855 fine-grained pixel-level labeled CT images from 200 COVID-19 patients, 64,771 patient- level annotated CT images from 200 other COVID-19 patients, and 75,541 CT images of 350 uninfected cases.

We develop a novel COVID-19 diagnosis system to perform explainable Joint Classification and accurate lesion Segmentation (JCS), showing clear superiority over previous systems.

- **On our COVID-CS dataset**, our JCS system achieves 95.0% sensitivity and 93.0% specificity on COVID-19 classification, and 78.5% Dice score on segmentation, surpassing previous state- of-the-art segmentation methods.

## SAMPLE RESULTS





## CONCLUSION

A novel method has been proposed for the efficient classification of respiratory diseases from chest CT Scan chest images. The existing technologies focus on COVID-19 diagnosis whereas this proposed method focuses on all bacterial and viral infection chest diseases. In this pandemic situation, it is necessary to differentiate COVID-19 from pneumonia. The proposed method targets preprocessing and feature descriptors to efficiently classify life-threatening chest diseases. The chest CT Scan images are pre-processed by applying various image processing algorithms. Then, the pre-processed images are subjected to transform filters with various kernels to extract predominant features of the CT Scan image. Gradient direction and magnitudes are

calculated for every pixel, and feature vectors are also extracted using histograms.

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