Identification of Mucormycosis in post Covid-19 case using Deep CNN

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Abstract:

Patients infected by coronavirus disease 2019, particularly in India, are more likely to develop rhino-orbital mucormycosis, which has risen in frequency. Diabetes mellitus (DM) is a renowned chance element during COVID-19 infection and mucormycosis (fungal infection of the gut) (fungal infection). This research aims to conduct a methodical review of the paper to ascertain the characteristics of people who have mucormycosis and COVID-19. We conducted a keyword search of the electronic dataset database from its inception until June 2021, and the findings are presented in the following report. This work compiled all of the fine-grained information from case history records of patients with COVID-19 and mucormycosis worldwide. We next examined the patient steroid usage, health characteristics, mucormycosis location, associated comorbidities, and prognosis of COVID-19 patients, among other things. Many cases of mucormycosis are recorded in people who have been infected with COVID-19, with an additional few other cases reported from other parts of the globe. Most instances (82 percent) occurred in India, with Mucormycosis being found in the vast majority of males (80 percent) and about 40 percent of COVID-19 patients who were active and recovered. Patients with pre-existing diabetes were found to have DM in above 80 percent of patients. The DKA (Diabetic ketoacidosis) was found in 15 percent of patients with pre-existing diabetes. Corticosteroids were utilized to treat COVID-19 in 76.3 percent of individuals studied. Mucormycosis of the nose and sinuses was the most prevalent kind (88.9 percent), followed by rhino-orbital mucormycosis (14 percent). (56.7%). In 30.7 percent of the instances, there was a death to record. Diabetes, prolonged corticosteroid usage, and the presence of COVID-19 all appear to be associated with an increase in mucormycosis. Every effort should be made to maintain optimum glucose levels in COVID-19 patients, with corticosteroids used sparingly. Image binarization is a good approach for image segmentation. Finally, the bacterial edge is removed using the four-neighbor corrosion

approach. If the correct data is identified, the bacterium's size is determined, and the mass of the bacteria density is approximated. The density accuracy of the test has an absolute error of less than 0.015, which fulfills the technical criteria.

Keywords: Diabetes, Mucormycosis, COVID-19, Fungus germs, Image processing, Median filtering, Binarization of images.

1. Introduction

Several opportunistic bacterial and fungal infections have been associated with COVID-19, caused by the SARS-CoV-2 coronavirus [1]. COVID-19 patients are infected with Candida and Aspergillosis identified as the most common fungal infections [2]. Globally, there have been many reports of mucormycosis in people who have the COVID-19 virus, with the vast majority of cases originating in India. Many factors appear to show a part in the development of Mucorales spores in people with COVID-19, including new-onset hyperglycemia, immunosuppression caused by steroids, hypoxia (low oxygen), elevated iron levels (increased ferritins), elevated glucose, diabetes, decreased white blood cell phagocytic activity, and an acidic environmentfprmed by SARS-CoV-2.

Because of increasing living standards and improvements in dietary composition, edible fungal products have become one of the most popular meals for consumers both locally and internationally. Edible fungal products have been recognized as "green, nutritious, and health-care" green foods in the United Nations Food and Agriculture Organization and the World Health Organization (WHO). The black fungus (Mucormycosis) is the utmost well-known comestible fungal species, and it is also the most widely consumed. It is the most well-known of the four most popular edible fungi globally, and it is also the most widely available. As well as possessing anti-aging qualities, it also aids in the reduction of blood sugar and fat levels, the nourishment and improvement in circulation of blood, the cleansing of the lungs and lungs, the promotion of digestion, and the relief of constipation. People worldwide are acquainted with the black fungus, which is easily accessible in supermarkets and small markets. A black fungus grows on almost every table globally, and it is a frequent sight to see it growing. Consumption of black fungus is becoming more common as the general public becomes more aware of its existence [3].

While the fungus is growing, the Fungus Bacteria infection acts as the fungus's actual physical body. As a result, the fungus' yield, cost, and quality are determined by the quality of the Fungus Bacteria infection. An issue of technical concern to fungus manufacturers is the most effective method to evaluate the quality of a Fungus bacteriainfection before it is sent out to market. It is essential to consider the density of the Fungus Bacteria infection while producing the Fungus Bacteria infection, even if the Fungus Bacteria infection may be made using a standard method and formula for manufacturing bacteria. As a consequence, density is critical for the development of fungal growth. A method for identifying the mass of Fungus Bacteria infections is discussed in this paper, which uses image processing technology to accomplish the task. The Identification of MucormycosisSystem, which detects the presence of fungus and bacteria, is shown in Fig. 1.

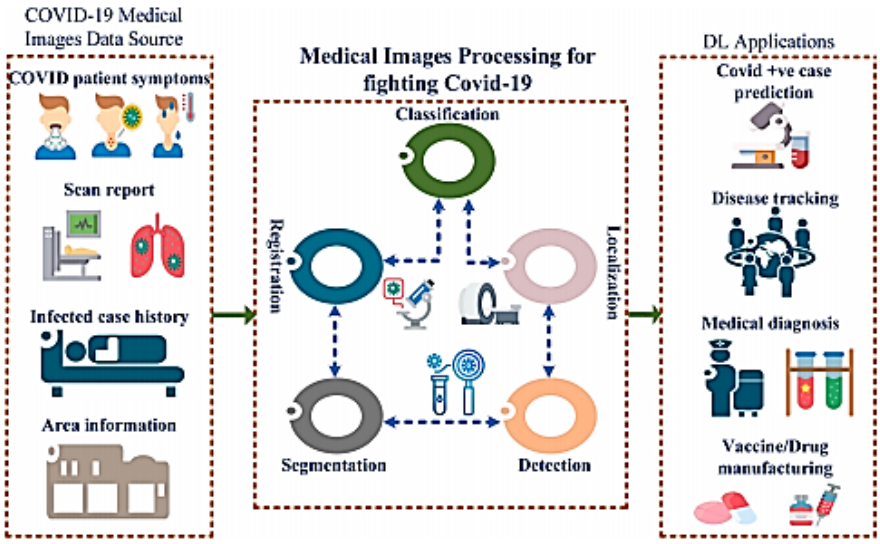

Figure-1: The Identification of Mucormycosis System.

Currently projected global occurrence of mucormycosis ranges between 0.007 and 1.05 per million people in 2020-2021, with India having more than 80 times the prevalence (0.14 per 1000 people) of developed countries [4], with India having over 80 times the prevalence (0.14 per 1000 people) of developed nations. Therefore, the disease is about 80 times more common in India (0.14 per 1000 persons) than it is in industrialized nations [5]. To put it another way, India has the highest prevalence of mucormycosis globally, by a considerable margin. The country still has the second-highest number of individuals living with diabetes mellitus (DM) in the world, and it used to be known as the "Diabetes Capital of the World" [6,] despite this. Particularly notable is that diabetes is the important risk factor for mucormycosis in India, while hematological malignancies and organ transplantation are the top risk factors in the United States and Europe [7, 8]. Diabetic ketoacidosis, which has been related to a 46 percent overall death rate [8], is the most likely factor for mucormycosis globally. As a result, diabetes was identified as an independent risk factor in a 2018 meta-analysis of 851 instances of rare mucormycosis (odds ratio OR 2.69; 95 percent confidence interval (CI) 1.74 to 3.64; P 0.002), with Rhizopus species accounting for 48 percent of all cases [9]. Aspergillosis and mucormycosis are two opportunistic fungal infections that have been linked to chronic corticosteroid use. However, new research shows that even a brief corticosteroid course is associated with mucormycosis, which is more common among diabetic patients and patients with other chronic illnesses. [10] Immunocompromised people are more vulnerable to mucormycosis if they get increasing prednisone quantity of more than 500 mg or a total methyl prednisone dose of 1 to 8 g over a month. Mucormycosis has been reported in a small number of cases, most of which were caused by a short course of steroid therapy (5–14 days), a condition that is especially common among people with diabetes [11]. Research performed by the European Confederation of Medical Mycology discovered that 46 percent of patients diagnosed with mucormycosis got corticosteroids within a month of their diagnosis [12].

2. Literature Review

A study by Prakash et al. [13] into 388 supposed or confirmed instances of mucormycosis in India before the release of COVID-19 revealed that 18 percent of patients had diabetes with or without insulin and that 57 percent of patients had uncontrolled diabetes. [14]. As reported by Prakash et al. [13], who examined 465 cases of mucormycosis in India without the presence of COVID-19, the rhino-orbital symptom was the most likely in more than 60 percent, trailed by pulmonary 14 percent and cutaneous of 12 percent. Diabetes, which accounts for 73.5 percent of all Indians, is the most common risk factor for the disease.

Aside from that, malignancy and organ transplantation are also known risk factors for ovarian cancer. Individuals with diabetes are about ten times more likely with diabetes to get ROCM, according to the findings of an Indian study done before the COVID-19 epidemic. In a recent comprehensive investigation conducted on 9th April 2021 in patients with COVID-19 and 41 confirmed occurrences of mucormycosis, DM was confirmed in 93 percent of the cases, 88 percent of which were treated with corticosteroids the time of the study. An even larger sample of 101 Covid-19 mucormycosis patients was studied, with 80 percent of the patients achieving similar outcomes in corticosteroid treatment and more than two-thirds of the patients achieving similar results in corticosteroid therapy. It is more likely that people with COVID-19 will suffer from the unholy trinity of mucormycosis, diabetes, and steroid usage, according to this finding[15].

3. An ensemble Image Processing with Deep CNN

In the classification techniques, deep learning is a technique that uses numerous nonlinear transformations to summarise data at different abstract levels[21]. Convolutional Neural Network (CNNs) are a kind of architecture used in deep learning that includes, among other components, one or more convolutional layers, a lower probe, and a complete connection layer at the top. In contrast to a typical artificial neural network, the weight-sharing network design of the CNN is similar to the biological brain network, resulting in decreased model weighting and complexity compared to the standard Artificial Neural Network (ANN). Moreover, raw data is accepted directly as input by a CNN simulating a brain feedback circuit with several layers to extract characteristics from the data[19]. Because any form that meets ideal characteristics can be classified as translating, scaling, tilting, or any other invariant deformations [16] [15]. The precise identification technique is used with conventional recognition algorithms for the reconstruction and extraction of complex characteristics is no longer necessary.

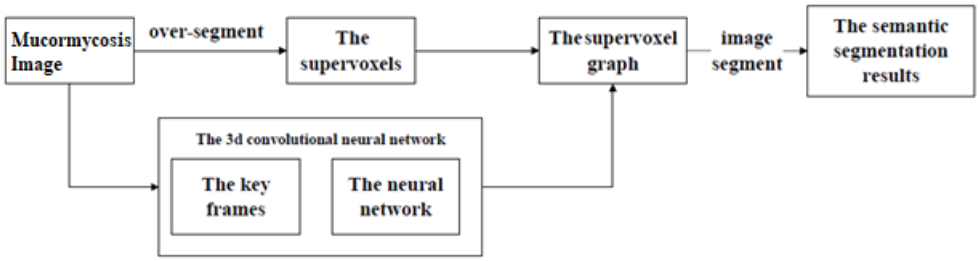

Figure-2 Illustrates the flow of a CNN used for Mucormycosis Detection.

The mucormycosis picture scene semantic tagging method's fundamental design is using 3D image processingwith CNN for identifying mucormycosis images.

Algorithm-1: Modified Deep CNN

(1) The user picks multiple frames from the scene sequence and manually annotates the appropriate frames using the keyframes in the provided mucormycosis image sequence.

(2) To train a supervised 3D CNN, pixel points are evenly sampled on the sampled pixel points and the keyframe, serve as the core of the 3D convolutional network's spatial and temporal bodies.

(3) Every pixel is sampled from the mucormycosis picture series throughout the whole sequence to determine the spatial-temporal body. Then, the chance of matching sampled pixel spots from different semantic categories is computed. Mucormycosis semantic segmentation study results use a pre-trained 3D CNN model.

(4) The super voxel graph was built to verify that the segmentation results were consistent in both space and time.

(5) The semantic segmentation findings for the mucormycosis image scene material were obtained by optimizing the image segmentation approach.

(6) Stop

Digital image processing is a relatively new technology that is still in its early stages. On the other hand, improvements in computer technology have made it possible to process digital images in real-time [17]. There have also been improvements made to digital image processing algorithms to increase the speed with which images may be processed and improve the user experience for the end-user. In digital image processing, graphical images are created via the use of a computer algorithm. Digital imaging is a computer-based method for processing graphic images that employ a particular procedure [18]. For example, digital image processing is extensively used and is growing more popular in various applications, including medical imaging. The following summarizes the picture measuring system: Imaging systems typically comprise light, a CCD camera with an image capture card attached, laser pointer if applicable.computer with the necessary picture processing software,

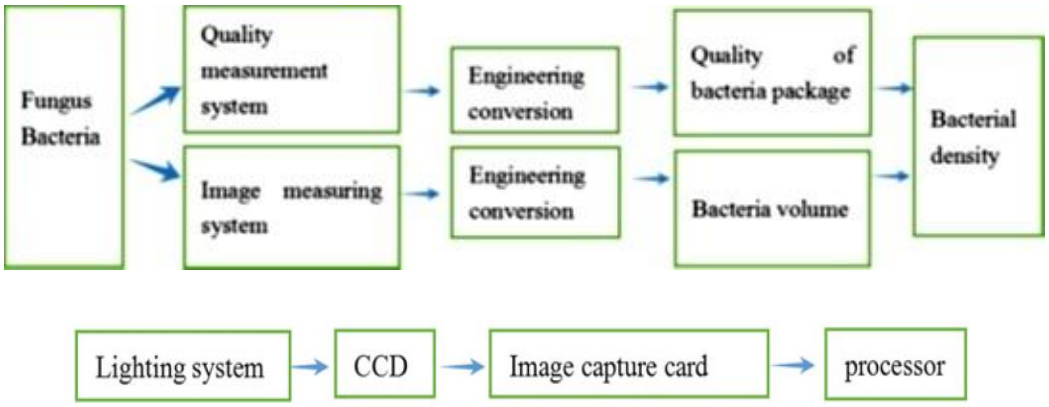

Figure 3: Image measurement system

Algorithm-2: Ensemble Digital Image Processing

(1) Load Identification of Mucormycosis: Because noise is happened in images at all times, it must be eliminated throughout the image processing process.

$$\mathrm{Fuzz(i,j)} = \mathrm{Med}\{\mathrm{G}(\mathrm{x_i}+\mathrm{n}, \mathrm{y_i}+\mathrm{m})(1-\mathrm{N_i})/2 \le n, m \le (\mathrm{N}-1)/2\} \quad (1)$$

(2)Image segmentation is a simple and actual method for segmenting images.

$$BlaFun(x_i, y_i) = \begin{cases} 1 & IF \quad Fung(x,y) > T \\ 0 & ELSE \quad F(x,y) \le T \end{cases} \quad (2)$$

(3) Edge contour extraction is used to extract picture edges. Additionally, identification of edge operators, edge tracking, and mathematical morphology is frequently employed.

$$\begin{aligned} &\text{IF } \mathrm{BlaFun(x, y-1)} = 1, \\ &\text{ELSE IF } \mathrm{BlaFun(x-1, y)} = 1 \\ &\text{ELSE IF } \mathrm{BlaFun(x, y+1)} = 1, \\ &\text{ELSE IF } \mathrm{BlaFun(x+1, y)} = 1 \\ &\text{ELSE THEN } \mathrm{E}\,ntr(x,y) = 0 \\ &\text{ELSE } \quad Entr(x,y) = BlaFun(x,y) \end{aligned} \quad (3)$$

(4) Edge contour extraction is used to extract picture edges. Additionally, identification of edge operators, edge tracking, and mathematical morphology is frequently employed.
(5) Stop

4. Results and discussion

Due to publication biases and a high degree of heterogeneity in the cases reported, conducting a regular evaluation of case studies/sequence offers several difficulties. The study reports of mucormycosis are very certainly an underestimate of the disease's actual burden. It was owing to a problematic microbiological or histological diagnosis, particularly during a raging epidemic [20]. While some case reports included every detail imaginable, others omitted critical information.

Second, the absence of a denominator value and controls may complicate estimating the incidence of mucormycosis in individuals with COVID-19. Third, because of the low sensitivity of RT-PCR, it may not distinguish between active and recovered COVID-19, as well as their connection with the onset of mucormycosis. Finally, evaluating outcomes in patients with mucormycosis and COVID-19 may be difficult due to the large number of instances recorded and the large number of patients currently receiving treatment. Table 1 also contains a summary of the minor flaws that have been discovered.

Table 1: Comparison automatic system measurement Manual measurement

	Number of parameters		
Frequency	Manual measurement	Automatic system measurement	Absolute error
1	0.8338	0.8217	0.0121
2	0.8437	0.8283	0.0154

3	0.8338	0.8195	0.0143
4	0.8426	0.8547	0.0121
5	0.8437	0.8327	0.011
6	0.8426	0.8558	0.0132

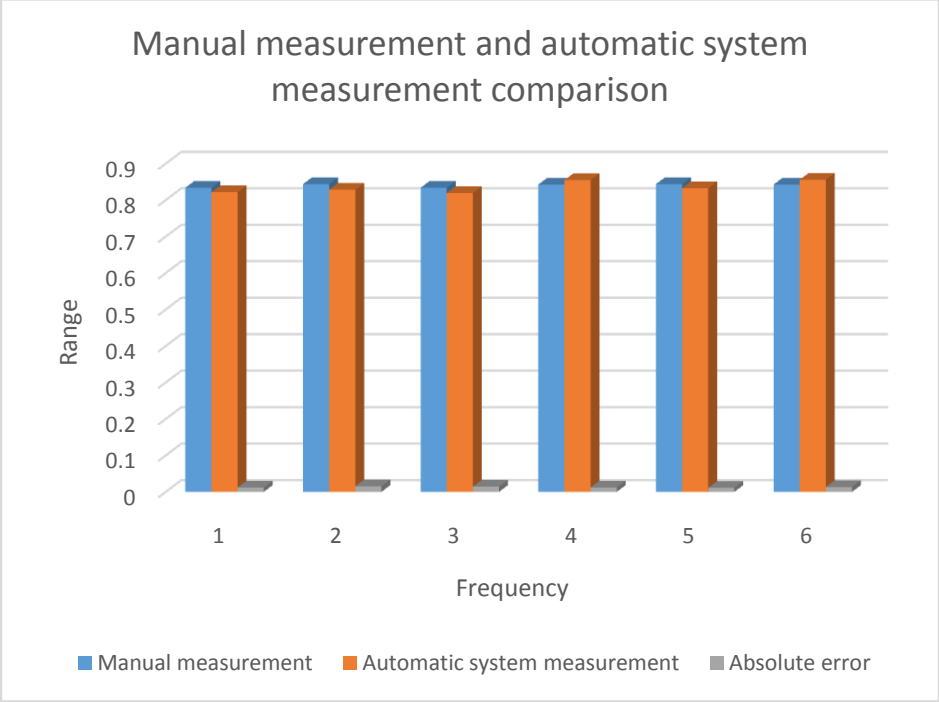

Figure 4: Comparison automatic system measurement Manual measurement

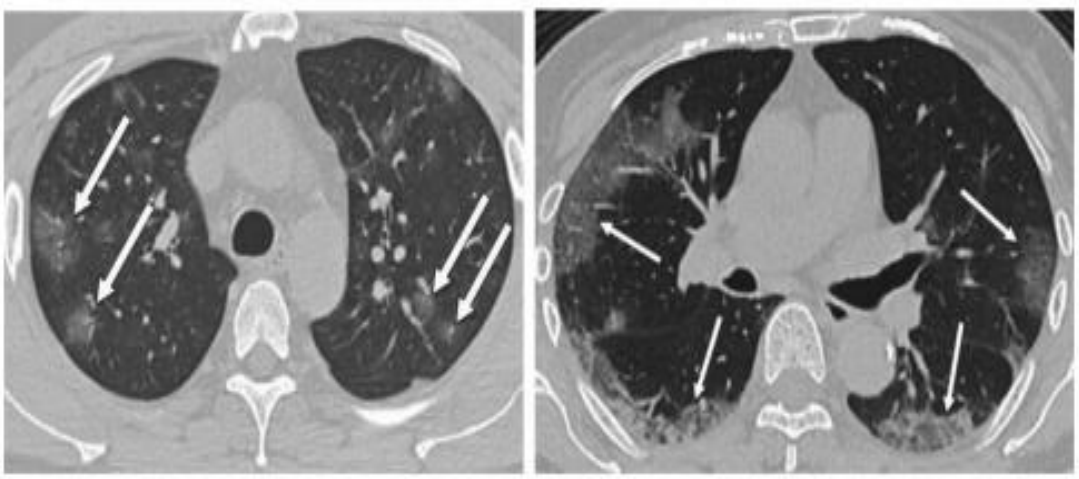

Figure 5, 6: CT scan images Sample and X-ray of Mucormycosis [2].

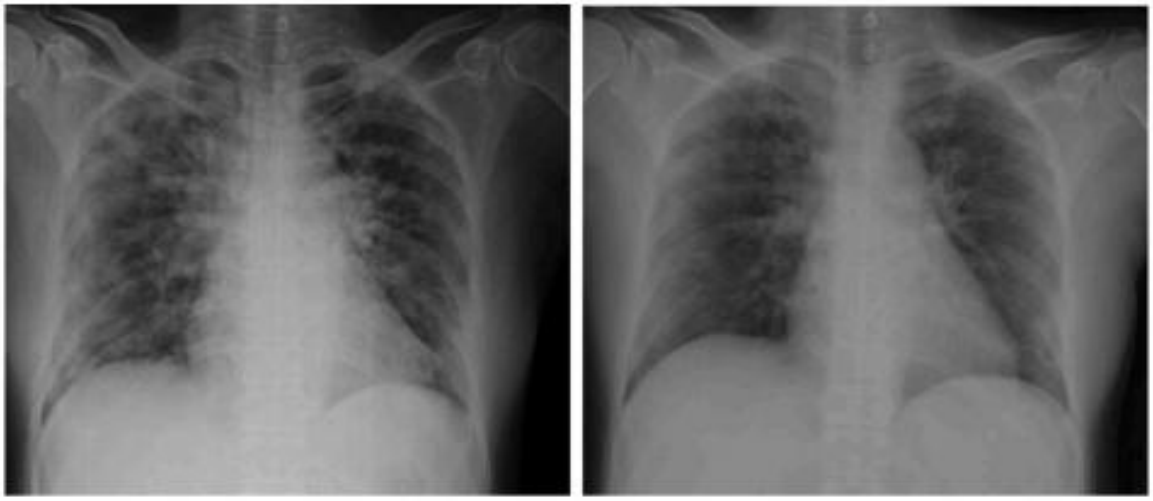

Figure 7, 8: CT scan images Sample and X-ray of COVID-19 Lungs [2].

Table 1 and Figure 4, Figure 5, Figure 6, Figure 7, and Figure 8 depict the contrast of the calculated values of bacterial density to the automated system. Comparing sample CT scan and X-ray images of COVID-19 patients to the automated system is measured values. The experiment practices an image processing system composed of a CCD camera with a resolution of 144*900 and LED lighting is used to illuminate the surroundings, an industrial control computer to measure the picture quality, an 8-bit color depth, and a grey scale image gaining card.The bacteria and measurement equipment calibration, the image of the bacterial density was taken and analyzed in detail.

5. Conclusion

It seems that the trifecta of diabetes (which is highly heritable), widespread use of corticosteroids and COVID-19 infection are contributing to the surge in mucormycosis in many countries (cytokine storm, lymphopenia, endothelial damage). When treating people who have COVID-19, all efforts should be made to decrease the danger of deadly mucormycosis, and maintain best hyperglycemia. Only careful evidence-based use of corticosteroids is recommended. Estimating the number of bacterial identifications was accomplished via the use of digital image processing methods. The development of an ensemble Image Processing with Deep CNN method for estimating the radius of the lowest circle and the stature of the bacterial bundle is one aspect of this investigation. To measure the bacterial density at an absolute temperature of 1170 degrees Celsius, a 144*900 CCD camera was utilized in conjunction with a CCD camera to capture the images. The difference in value between a value produced by the system and a value measured by a person was less than 0.015 percent. Observed the requirements of the measuring system while doing measurements.

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