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COVID-19 Detection using SVM Classifier

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Abstract:
Viral lung disorders are increasing day by day throughout the globe. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the main cause for Coronavirus Disease (COVID-19) pandemic. The disease is contagious during close contact and via respiratory droplets produced when people cough or sneeze. In this paper a method is proposed to detect the COVID-19 using chest X-Ray images. In order to classify the normal and COVID-19 cases, a CAD system is developed using Support Vector Machine (SVM) Classifier with a Graphical User Interface. An accuracy of 57.1% is achieved with the dataset of 15 COVID-19 and 15 normal X-Ray images.

Keywords: CAD, COVID-19, SARS-CoV-2, Support Vector Machine.

I. INTRODUCTION

Viral lung disorders are increasing day by day throughout the world. Respiratory diseases like Interstitial Lung Disease (ILD), tuberculosis (TB), chronic obstructive pulmonary disease (COPD), pneumonia are the most emerging health problems around the world. In which, COVID-19 is the recent pandemic (2019-20) all over the globe. Dated to 28th March 2020, around 5, 97,458 coronavirus cases and 27,370 deaths are accounted. The outbreak was first identified in Wuhan, China 2019 recognized as a pandemic by World Health Organization (WHO). The virus can spread with close contact and via respiratory droplets produced when people cough or sneeze. People may also get affected by COVID-19 by touching any contaminated surface and then their face, eyes, nose and mouth. Common symptoms such as fever, cough and shortness of breath are seen first. Complications include pneumonia and acute respiratory distress syndrome. Currently there is no vaccine or antiviral treatment against COVID-19. A large study has been started in the field of imaging which can be used to detect the COVID-19 by radiographs and computed tomography. Due to overlap with other infection such as adenovirus, imaging without confirmation by PCR is of limited specificity in identifying COVID-19 [1].

Mucahid Barstugan et.al [2] developed and classified Coronavirus (COVID-19) using CT images by Machine Learning Methods. GLCM, LDP, GLRLM, GLSZM were used as feature extraction and support vector machine for classification.

In this study, we have used 30 chest X-Ray images for COVID-19 classification. The datasets were divided into two as COVID-19 and normal (non-infected). GLCM features were extracted and the results were used to train the model. SVM classifier is used to classify the COVID-19 images. The obtained results showed that the proposed method is feasible for diagnosis of COVID-19 as a CAD system.

II. METHODOLOGY

In the proposed method, a dataset of 15 normal and COVID-19 X-ray chest images are taken for experimentation. The X-ray images initially undergo pre-processing operations such as image filtering by median filter and image enhancement by histogram equalisation. The pre-processed images are ROI selected of 25x25 pixel window and GLCM features are extracted.

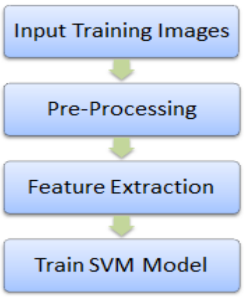

Figure.1. Training SVM Model

The extracted contrast, correlation, energy and homogeneity features from 30 images are used to train the SVM model and the best curve fit with 5-fold cross validation is found to classify the COVID-19 against normal images.

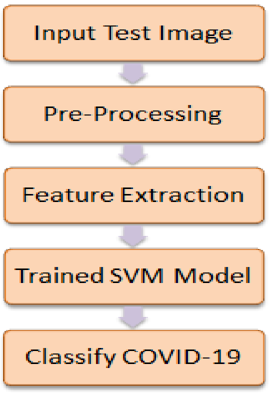

Figure.2. Classification Flow Diagram

III. RESULTS

The following figures are the images taken for experimentation. COVID-19 refers to a blurred area with increased attenuation in the lung due to pneumonia than that of healthy lung. So, it becomes very easy to classify from chest X-ray images by extracting GLCM features.

Table.I. shows the GLCM features extracted from 15 chest X-ray images of COVID-19 cases.

Sl No.	Contrast	Correlation	Energy	Homogeneity
1	123.693	-0.1632	0.0023	0.0168
2	121.084	-0.0396	0.0015	0.1849
3	121.118	-0.0226	0.0015	0.188
4	112.858	0.0395	0.0016	0.1941
5	108.897	0.0152	0.0015	0.1985
6	142.454	-0.2472	0.0027	0.1628
7	130.193	-0.1769	0.0025	0.1804
8	103.057	-0.1501	0.0019	0.1911
9	103.710	0.0803	0.0019	0.2084
10	111.213	-0.0446	0.0017	0.1907
11	101.739	0.0473	0.0015	0.2009
12	122.323	-0.069	0.0018	0.1823
13	114.802	0.0327	0.0021	0.1984
14	142.613	-0.2918	0.002	0.1669
15	99.8898	0.0477	0.0017	0.1986

Table.II. shows the GLCM features extracted from 15 chest X-ray images of normal cases.

Sl No.	Contrast	Correlation	Energy	Homogeneity
1	118.582	-0.0438	0.0016	0.1881
2	113.954	0.0392	0.0016	0.191
3	118.268	-0.0941	0.0017	0.1839
4	125.244	-0.065	0.0015	0.1869
5	113.045	0.0576	0.0016	0.1932
6	113.794	0.0099	0.0015	0.1944
7	124.162	-0.0165	0.0016	0.1863
8	112.098	0.05	0.0017	0.2007
9	100.961	0.0353	0.0016	0.196
10	116.398	-0.0438	0.0016	0.1903
11	108.578	0.1168	0.0016	0.2026
12	119.241	0.0004	0.0015	0.1894
13	112.839	-0.025	0.0016	0.1905
14	127.526	-0.1200	0.0017	0.1791
15	118.506	-0.1044	0.0017	0.1893

The support vector plot of the trained SVM model is displayed below. Red dots represent COVID-19 and blue dots for normal.

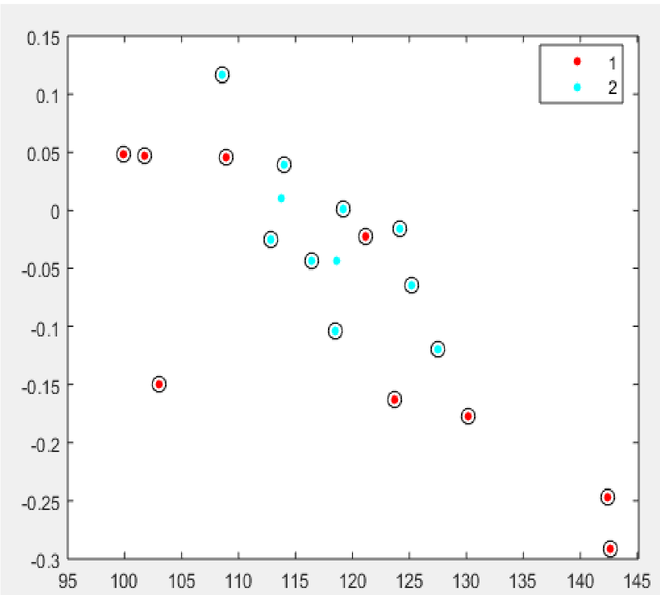

Figure.3. Support Vector Model Plot

GUI Images –

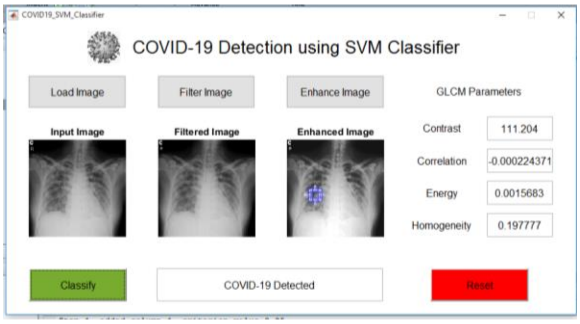

Figure.4. Input Classified as COVID-19 Detected

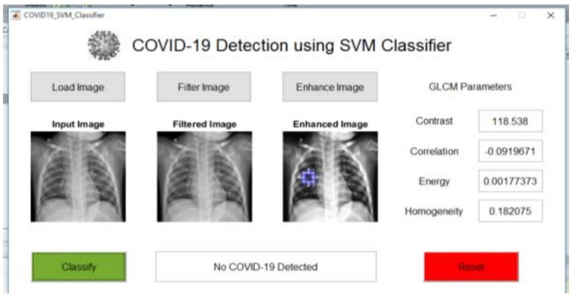

Figure. 5. Input Classified as No COVID-19 Detected

IV. DISCUSSION

A set of 30 chest X-ray images are taken among which fifteen of each category are normal and COVID-19 cases. In order to classify the chest images are pre-processed first, image filtering and image enhancement. Later the GLCM features are extracted from all the 30 images and these extracted Contrast, Correlation, Energy and Homogeneity parameters are used to train the SVM model and find the best hyperplane for detection of COVID-19. Once the SVM model is trained, the GLCM features of the test input X-ray image is extracted and passed through the classifier to identify whether the input image is COVID-19 or not.

V. CONCLUSION

The proposed system is trained and tested for 30 image datasets of COVID-19 cases. The results obtained shows as accuracy of 57.1% in classifying the COVID-19 images. However, more images of COVID-19 and normal images are to be tested for developing an expert system with 100% accuracy. Future the work is to continue to increase the accuracy of the system and differentiate the COVID-19 images with viral pneumonia cases.

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