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Development and Evaluation of an Early Detection of COVID-19 Pneumonia Using CT Images

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Abstract. In December 2019, an epidemic of a novel corona virus disease was indentified in Wuhan, China, which quickly spread across the world as a pandemic. This terrible virus had caused respiratory failure and alveolar damage in all, resulting in complete death. The use of a reverse transcription polymerase laboratory test to predict this virus results in a high rate of false positives and a significant time delay. As a result, chest CT images have become a valuable diagnostic method for the Covid-19. In this study, we propose using machine learning to detect and identify the corona, resulting in a timely and accurate report.

Keywords. Covid-19, CT images, Support vector machine, machine-learning model.

1. Introduction

Corona virus disease (COVID-19) is a recently discovered corona virus-related respiratory disease. A digital image is an image composed of picture elements that are output from Corona virus disease (COVID-19). Fever, dry hacking, and sleepiness are common side effects of this infection [1]. A throbbing headache, nasal clog, migraine, sore throat, and a loss of taste and smell called Anosmia are some of the symptoms. It also triggers a disorder known as Parosmia, in which one's favourite scents become revolting. The infection has spread to a large area, and cases and deaths seem to be increasing in a step-by-step manner [2]. With the help of an AI method named Prophet model, which was developed and presented by Facebook, this investigation aims to expose the anticipation of various boundaries associated with this infection, such as the increase in new events, recoveries, and deaths every day across the world. Validation of the diagnosis can be done with a reverse transcription polymerase chain reaction examination (RT PCR) [3]. While RT-PCR is the gold standard for diagnosis, verifying COVID-19 patients takes time, and it may be difficult to diagnose and treat presumptive patients early due to high false-negative rates and low sensitivities.

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2. Methodology

We tend to use an SVM (Support Vector Machine) algorithm to detect COVID 19 using machine learning. In this method, Chest CT scan tool are used to diagnose and screen the affected area of chest. CT scan shares the imaginary characteristics between the Covid-19 affected lungs or with other lungs diseases (Pneumonia or non-pneumonia) [4]. By machine learning technology, it can be monitor, screen and predict the affected lung area of patients. Accuracy of the results are very high and time delay is very less compared to the existing system such as RT PCR [5]. The software and hardware section is shown in Figure 1.

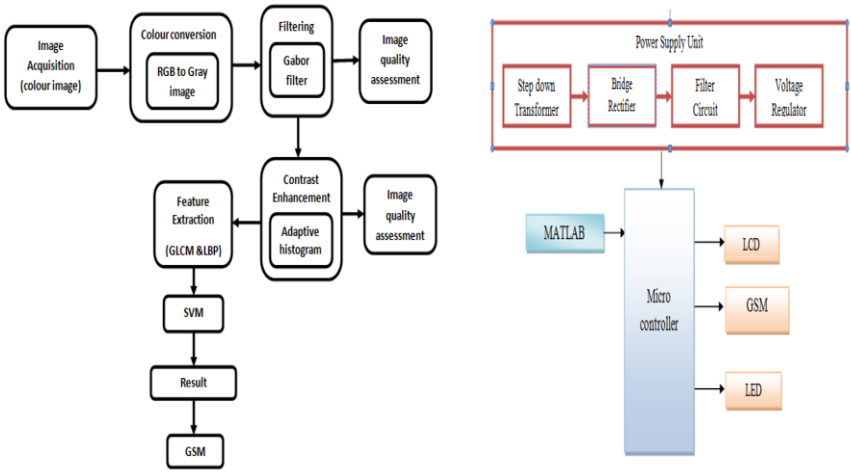

Figure 1. Software and Hardware section

3. Circuit Design

3.1 Software section

Image acquisition contains the input CT image of the patient which is in the form of color image. Using color conversion technology going to convert the color image (RGB which has three layer) into grey image(single layer image)[6]. Filtering is made for the texture analysis of the image by using the Gabor filter to extract the unnecessary frequency content. Image Quality Assessment is used check the accuracy of the image quality. After filtering, contrast enhancement is made for improving the local contrast and to over amplify the noise by using the adaptive histogram [7]. Feature extraction is the method used to extract the second order of statistical texture feature by GLCM (Grey Level Concurrence Matrix) and transforms the image into an array or integer by LBP (Local Binary Pattern) [8].

3.1.1 Support Vector Machine (SVM)
In machine learning techniques, SVM is one of the algorithms. It has a broad data set and outperforms other algorithms in terms of performance. SVM is required for small sample data by make use of training samples to observe a support vector and to obtain a good prediction and classifications. By making use of this algorithm, we can compare the input CT images with the data set which we already collected and stored from the medical sample (Chest CT scans) of COVID patients.

3.1.2 Global System for Mobile Communications
Global System for Mobile Communications (GSM) is a used as a mobile phone or modem to communicate over the network. In this necessary of Sim card is must to be operated with subscribed network. Here we are using GSM for SMS service. After completion of diagnosis and prediction of the COVID 19. The report can be send through as email or as SMS.

3.2 Hardware Section
Interfacing the Arduino uno and GSM modem is discussed in this section. The assembly of the modem and the Arduino. We test the GSM modem's functionality after the Arduino code has been burned into the Arduino uno module. The GSM modem sensor is interfaced on the Arduino Uno module, and the required codes are written.

3.2.1 Power supply unit
It contains such as bridge rectifier, filter circuit, step down transformer and voltage regulator. In this transformer is able to supply current to the circuit, bridge rectifier is to convert the AC to DC current, filters are used to rectifies the remaining AC pluses, and also voltage regulator are available for obtaining stable voltage and current.

3.2.2 Arduino uno
It is majorly used, because it is compatible with all Operating System like Windows, linux etc. It's an ATmega328-based microcontroller module. It will simply connect to the System through USB. And the UNO is the latest USB Arduino board.

3.2.3 UART (Universal Asynchronous Receiver/ Transmitter)
It's a microchip with software that controls a machine interface to the computer it's connected to. It converts bytes received from the device over a parallel circuit into single serial bit streams and vice versa.

3.2.4 LCD (Liquid Crystal Display)
It is a flat panel display used to display the result such as Positive or negative of that disease.

3.2.5 LED (Light Emitting Diode)
It is a process of emitting light in response of electric field. It is used to indicate the Positive/Negative by blowing the led with different colors such as green and red. GSM is used to send the report to the patient who had taken the test for COVID-19.

4. Result

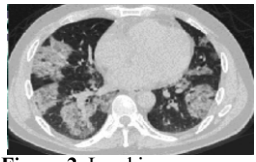

Figure 2. Load image

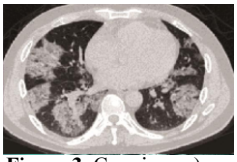

Figure 3. Grey image)

The load image is given to the data memory, which is RBG format CT image of three planes is shown in Figure 2 and Figure 3. The RGB has hue and saturation information. The three layer image is converted into a single layer gray image. Since there is a hue and saturation information in load image e are converting it into gray scale image. The gray scale image is useful for morphological operation and image segmentation.

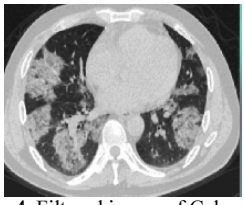

Figure 4. Filtered image of Gabor filter

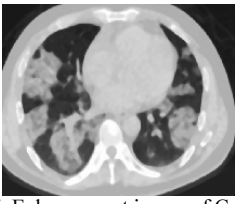

Figure 5. Enhancement image of Gabor filter

The above Figure 4 and Figure 5 are filtered and enhancement images by Gabor filtering technique. The filter gives localized spatial information of a given image. The filter is used for feature extraction, texture analysis, and stereo disparity estimation.

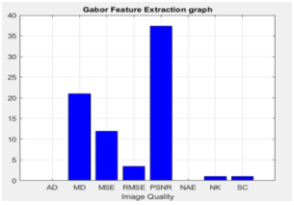

Figure 6. Extraction graph of filtered image Figure

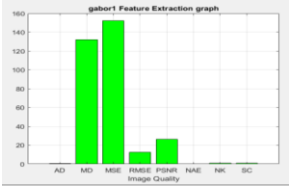

Figure 7. Extraction graph enhancement image

The above two graphs in Figure 6 and figure 7 shows the Gabor feature extraction of the filtered image.

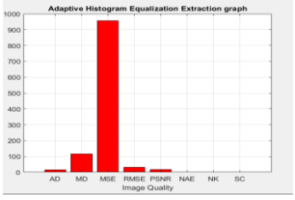

Figure 8. Equalization extraction graph

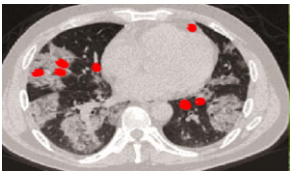

Figure 9. Positive output image

The enhancement of image filtration is given above in Figure 8. This graph shows the enhancement of the filtration of Gabor filter which make the analysis of image in better way. The positive output image is final output of the process is shown in Figure 10. The red color indication shows the affected area of lungs by corona virus. The information will be sent to patient via mail.

The result of affected patient mail and LCD display is shown in the Figure 11.

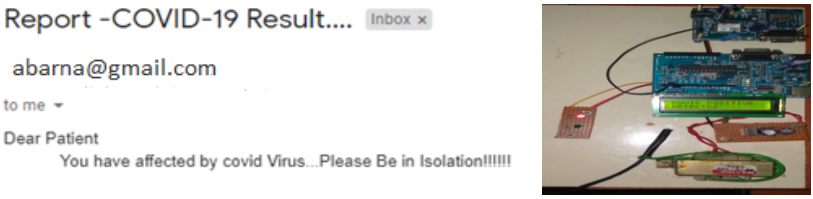

Figure 11. Result of affected patient mail and LCD display

5. Conclusion

Our weakly supervised machine learning algorithm achieved strong covid-19 detection efficiency without annotating the lesions in CT volumes for preparation. This algorithm has a lot of clinical potential in terms of accurate rapid covid-19 diagnosis, which is beneficial to frontline medical staff and also essential for global infection management. This analysis has several drawbacks. They could be enhanced in terms of network architecture and training. Cross-center validations were not conducted because the data in this analysis originated from a single hospital.

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