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Covid-19 -Based Intelligent Healthcare Monitoring System Using Deep Learning & Iot Principles For Pulmonary Breathing Problem Patients

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Abstract

The goal of the presented research is to use deep learning methodologies based on Convolution Neural Networks to assist medical experts by providing a detailed and rigorous analysis of medical respiratory audio data for covid-19 breathing problem detection. We used a VG-19, CNN, and machine learning library feature called MFCC in our proposed method. Machine learning and deep learning technologies have recently played an important role in providing assistive solutions to medical domain challenges. They also use medical audio analysis to improve predictive accuracy for early and timely disease detection. The proposed system's goal is to develop a user-friendly, portable, and reasonably priced external mobile device accessory that records and stores a patient's Peak Expiratory Flow.. However, by providing proper treatment to covid-19 breathing problem patients, we can control and prevent this disease. By receiving buzzer sound produced by buzzer, the patient can also avoid the specific location where they are unable to survive. We've also developed a custom software interface for wireless data transmission. Intense Health Analyzing Scheme provides all provisions to clients such as Doctors and Patients with respect to monitoring the patient details from anywhere at any time. The Fog Computing is an innovative domain, in which it provides ability to the server to operate based on hurdle free processing logic. In traditional schemes it is difficult to raise an alert based on the emergency situation predictions, but in the proposed deep learning strategy, the proposed approach will send an alert instantly if any emergency cases occurred on patient end. Due to a scarcity of trained human resources, medical practitioners are grateful for technological assistance because it allows them to deal with more patients. Aside from critical health diseases like cancer and diabetes, the impact of respiratory diseases is gradually increasing and becoming life-threatening for society in this covid -19 scenario. In respiratory diseases, early diagnosis and treatment are critical, so the audio of respiratory sounds is proving to be very useful in alerting doctors to patients in an emergency situation who require immediate attention in this covid-19 situation.

Keywords*: Patient's Peak Expiratory, Lung Sound, CNN, VGG19, Mel Spectrogram*

Introduction :-

Now-a-days, healthcare maintenance plays a vital role in every individual's life as well as the adaptation of latest technologies and the associated devices provides a huge support in its development. The concept of Internet of Things (IoT) and the respective sensors provides an effective support the elder peoples/patients and the doctors via its enhanced service environments. An important motto of every medicinal filed employee is to monitoring the patient details in remote manner without any delay and hurdles, in which the monitoring consists of various key factors such as: analyzing the patient health summary in periodical time, raising alerts based on appropriate conditions, provide a detailed report to

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respective users and so on. These all will be provided on this paper in clear manner with machine learning strategy

This system assists doctors to estimate the health condition of the patients in an innovative way with proper technological development. The major concern of this work is to develop an innovative system to monitor the health care details of the patients as well as elder people with respect to diverse analysis of past researches [1][2]. The patient healthcare analysis framework data is generally huge in size due to the continuous record arrival and monitoring. So, that the data maintenance complexity is high as well as the data retrieval time is again complex due to the heavy storage. In order to manage such issue, the concept of Big Data is introduced over this paper data duplication avoidance scheme. This system eliminates the data duplications and preserves the health record privacy in efficient manner. This makes a move up to a person's personal satisfaction and it makes the patient live autonomously, forestall difficulties as well as diminish individual expenses. All these framework objectives are being accomplished by conveying care to patients by being at home and their families can have a sense of safety realizing that they are being seen by the specialist and will be supported in any issues.

Internet of Things alludes to the billions of hardware that are presently appended to the web and bunches of appreciation to the approach of super-reasonable system circuits and the presence of remote organizations, these days, it is practicable to make nothing into something utilizing the Internet of Things [3]. This made an available to little items as a watch and furthermore enormous articles as a robot [7]. This system normalizes the degree of advanced technologies by joining different items and appending sensors to them. The world has gotten quicker, savvier, and more brilliant by consolidating the internet services and the actual universe. Internet of Things primarily utilized for gadgets that would not by and large be relied upon to have a web association and that can speak with the organization freely of human activity [8][9][10]. Therefore, a system isn't ordinarily viewed as an Internet of Things unit, nor is it an advanced mobile phone despite the fact that it is brimming with sensors and a smart-watch or a wellness band or other wearable gadget may be considered an Internet of Things gadget.

The following summary illustrates the major contributions of the system in detail.

- Smart device comprises a set of sensor unit, in which the health related details are collected and passed it to the associated controller for monitoring over wireless manner.
- The healthcare surveillance and monitoring section receives the data from the smart device and accumulates it into the server.
- A BigData appliance is necessary to handle the periodical data and provides efficiency to the system on searching and data maintenance process.
- Introducing a new health assisted sensor called Integrated Pressure Level Monitor Sensor to monitor the pressure and heart rate efficiently.
- A machine learning approach is used to manipulate the health records and prediction of patient health in precise manner.
- GPS and alert systems are utilized to sending the alert with proper positioning of patients.
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Proposed Method:-

Lung (pulmonary) function tests: in these tests, we check if the patient's lungs are functioning well and deliver enough oxygen when the person breathes. The most common test for this is called Spirometry. In Spirometry, the person breathes into a device called Spirometer, and that device measures the amount of air the person exhaled. With large datasets of respiratory audio sounds and spectrogram images, we can train deep neural networks without providing lesion-based features to identify pulmonary breathing problem condition in patients who are having increased sensitivity and specificity. The main advantage of using this computerized breathing problem covid-19 detection system is uniformity in the model outcomes high sensitivity, dynamic results generation and high specificity. Furthermore, as an algorithm may have several operational points, the responsiveness and precision is possible to tailor to fit different clinical conditions criteria, such as high sensitivity for a screening system.

Data Recording

The recorded voice data are stored in the cloud computing based internet database. By using the block chain concept we have organized the patient data into blocks based on the age group. We collected the voice data samples only for patients who are Affected by COVID-19. The stored data in the blocks will represents the data based on the age factor .Like children ages from 8 to 15, adult from 16 to 35,midde age people 35 to 45,old age people 45 to 80. Using block chain we can separate the data and arrange the data into blocks based on the AGE Factor. After that we are processing the stored data using machine learning algorithm to detect the patient who are suffering from severe breathing pronlem, average breathing problem and normal. Based on the result it intimates the doctor about the patient condition based on the age. Based on the result, for the emergency severe breathing problem covid-19 patients are admitted in intensive care with immediate supply of oxygen. .

Artificial Neural Networks :-

We can train deep neural networks without providing lesion-based features on large datasets of respiratory audio sounds and spectrogram images to identify Covid -19 condition in patients with increased sensitivity and specificity. The main benefit of using this computerised covid-19 pulmonary lung problem detection system is the consistency of model outcomes (high sensitivity, dynamic results generation, and high specificity). Furthermore, because an algorithm may have multiple operational points, responsiveness and precision can be tailored to meet different clinical conditions criteria, such as high sensitivity for a screening system.

Trend Analysis of the Type Of Lung Disease Detected using Deep Learning Based on the trend shown in Figure 16a, the total number of lung disease detection works using deep learning increased steadily over the years, with most work related to tuberculosis detection. As more lung disease medical image datasets become public, researchers have access to more data. Thus, more extensive studies were conducted. Towards 2020, the works on COVID-19 detection emerged while work conducted to detect other diseases decreased tremendously. This signifies that using deep learning to detect lung disease is still an active field of study. This also shows that much effort was directed towards easing the burden of detecting COVID-19 using the existing manual screening test, which is already anticipated. Figure 16b shows the distribution of the diseases detected using deep learning in recent years. The majority of works were directed at tuberculosis detection, followed by COVID-19, lung cancer and pneumonia. The reason that works of tuberculosis are high is because the majority of tuberculosis-infected inhabitants were from resource-poor regions with poor healthcare infrastructure [61]. Therefore, tuberculosis detection using deep learning provides the opportunity to accelerate tuberculosis diagnosis among these communities. The reason that works of COVID-19 detection are second highest is because researchers all over the world are trying to reduce the burden of detecting COVID-19, and thus

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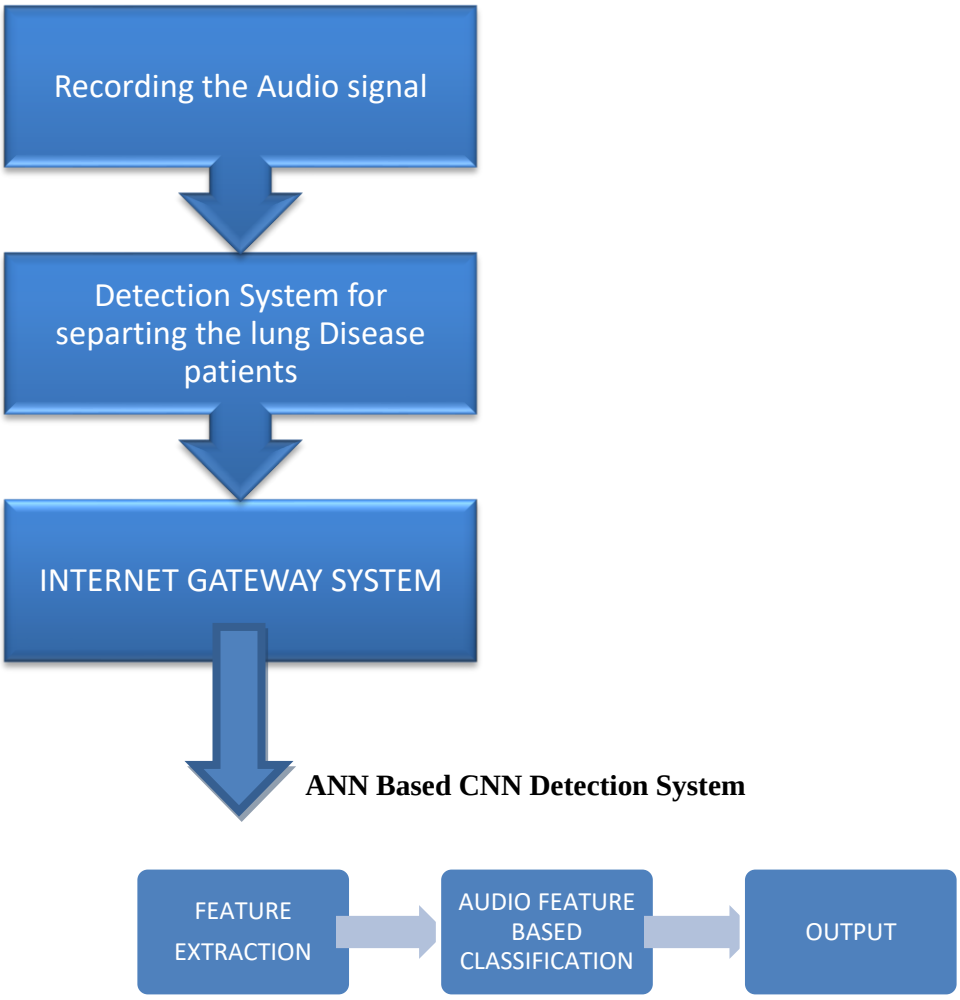
many works have been published, even though COVID-19 is a relatively new disea[n]

1. METHODS

Lung sound is recorded using a electronic stethoscope and Spirometer. Recorded sound is used to provide diagnosis of various lung related diseases. Deep learning technique is used to classify various lung related diseases based on the Mel Spectogram of lung sound.



Feature Extraction Block :-

Fig 1 Block Diagram

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Block chain data set :-

The proposed approach is called as deep learning enabled IoT Health Assistance , in which it associates the latest technologies such as Internet of Things and in hands with Deep Learning principles. So, that the processing efficiency and the performance of the proposed logic is high as compared with the classical machine learning models. The proposed approach of process the data based on the age factor and maintains that into the respective age blocks as crated under the norms of Blockchain model. The following table, Table-1 illustrates the Blockchain age factor blocks specification in clear manner.

Table-1: Age and Respective Block Specification

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Blocks	Age Ranges
Block-1	1-10
Block-2	11-19
Block-3	20-39
Block-4	40-54
Block-5	55-69
Block-6	70-80
Block-7	81-89
Block-8	90-100
Block-9	Greater than 100

The following figure, Fig.3 illustrates the data transportation efficiency of the proposed approach in terms of communication provision between client and server end, in which it portrays the quantity of health related data collected from the Smart Device end and the quantity of records received into the remote server end. In which the x-axis indicates the quantity of records accumulated from the client end's Smart Device unit and the y-axis indicates the range of transportation between client end and the server end.

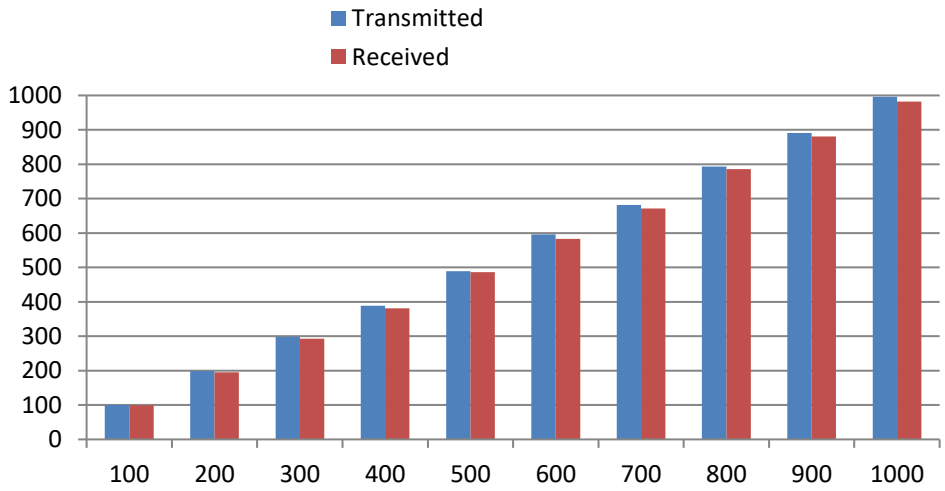

Fig.2 Data Transportation Efficiency

The following figure, Fig-2 illustrates the data maintenance ratio of the proposed model, in which this model is accumulated based on the surveillance of real-time data collected from the hospital environment with respect to Smart Device placement for 30 continuous days. The ratio of health related data stored and manipulated into the system blocks are displayed in clear manner with proper range specifications. In

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which the x-axis indicates the availability of blocks with respect to the mentioned table, Table-1 and the y-axis indicates the health records storage ratio of each block.

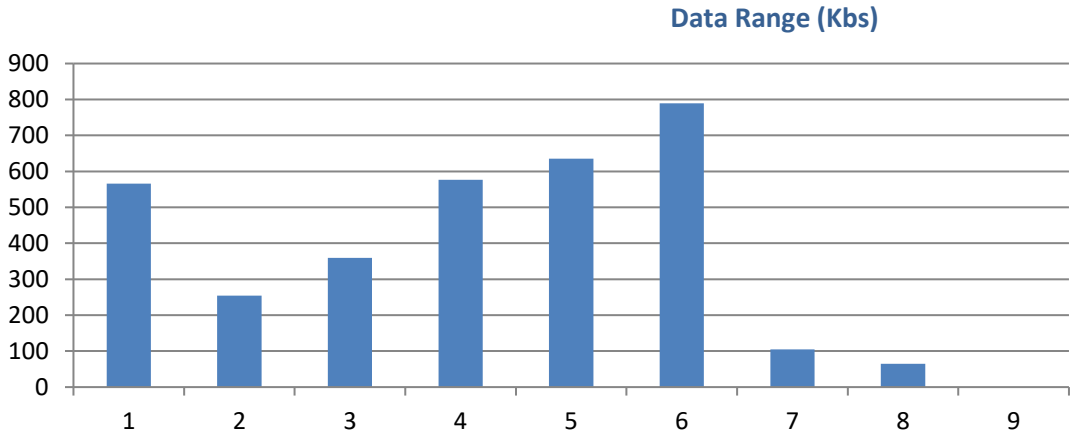
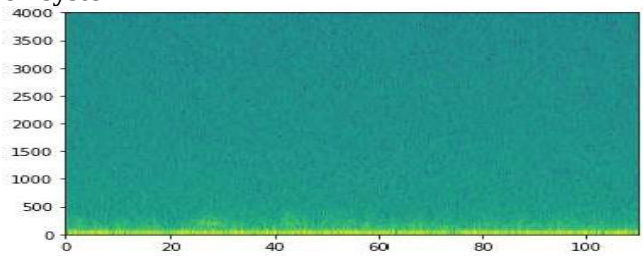


Fig.3 Data Storage Ratio with respect to Available Blocks

The following figure, Fig-3 illustrates the data categorization accuracy of the proposed model, in which the health records of the patients are required to categorize under certain age factors with respect to the blocks available into the server end. The proposed approach accumulates the incoming health record over the server end and split out the age value from the patient record and maintains the respective data into the corresponding block. This process will be handled over a microsecond at every interval, so that the chances of packet loss may happen in this time. The following figure, Fig-5 portrays the data categorization ratio in clear manner.

ANN Based CNN Detection system



The sounds made by the lungs when they breathe are important indicators of respiratory health and disease. Air movement, changes in lung tissue, and the location of secretions within the lung are all directly related to a person's breathing sound. The sound of wheezing is a common symptom of obstructive airway disease, such as asthma or covid-19 obstructive pulmonary disease. To record sounds from the lungs, digital stethoscopes and other recording techniques can be used. Using this digital data, we can use the deep learning technique CNN in combination with VG 19 to automatically diagnose respiratory disorders such as Covid-19 pulmonary breathing problem patients.

Feature Extraction:-

Exploratory Data Analysis (E A) is the process of gaining a better understanding of data sets by summarizing and visualizing their main characteristics. This step is critical, particularly when it comes to modeling the data in order to apply Deep learning. Histograms, Box plots, Scatter plots, and other plotting options are available in EDA. Exploring the data can take a long time. A Boxplot I is a

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standardized way of displaying the distribution of data on a five-number summary ("minimum", "first quartile(q1)", "median", "third quartile(q3)", and "maximum"). It can also tell you if your data is symmetrical, how tightly the data is grouped, and if, and how your data is skewed. Padding is a term used in convolution neural networks to describe how many pixels are added to an image when it is processed by the CNN kernel. If the padding in a CNN is set to zero, for example, every pixel value added will be a value of zero. There are a few things to take into account when slicing audio files. We must ensure that they are all the same length (this is in preparation for feeding them into the model for training). We'll have to pad the audio with silent (or zeroes) sounds if they're not the same length. The optimal length of time that should be used for the length must be known.

PREPROCESSING

Pre-processing refers to the transformations we apply to our data before feeding it to the algorithm. Data preprocessing is a technique used to convert raw data into a clean data set. In other words, whenever data is collected from various sources, it is collected in raw format, which is incompatible with analysis.

CLASSIFICATION

VGG-19 is a convolution neural network [1] trained on over a million images from the sound database. The 19-layer network can classify images into 1000 different object categories, such as keyboards, mice, pencils, and various animals. A convolution neural network is made up of an input and output layer, as well as multiple hidden layers. The hidden layers of a CNN are typically composed of convolution layers that convolve with a multiplication or other dot product. Additional convolutions such as pooling layers, fully connected layers, and normalization layers, known as hidden layers because their inputs and outputs are masked by the activation function and final convolution, are typically followed by a RELU layer. A convolution neural network's (CNN) functionality is loosely based on lung co-efficient values. It is a networked assembly of simple parallel processing elements, known as units or nodes.

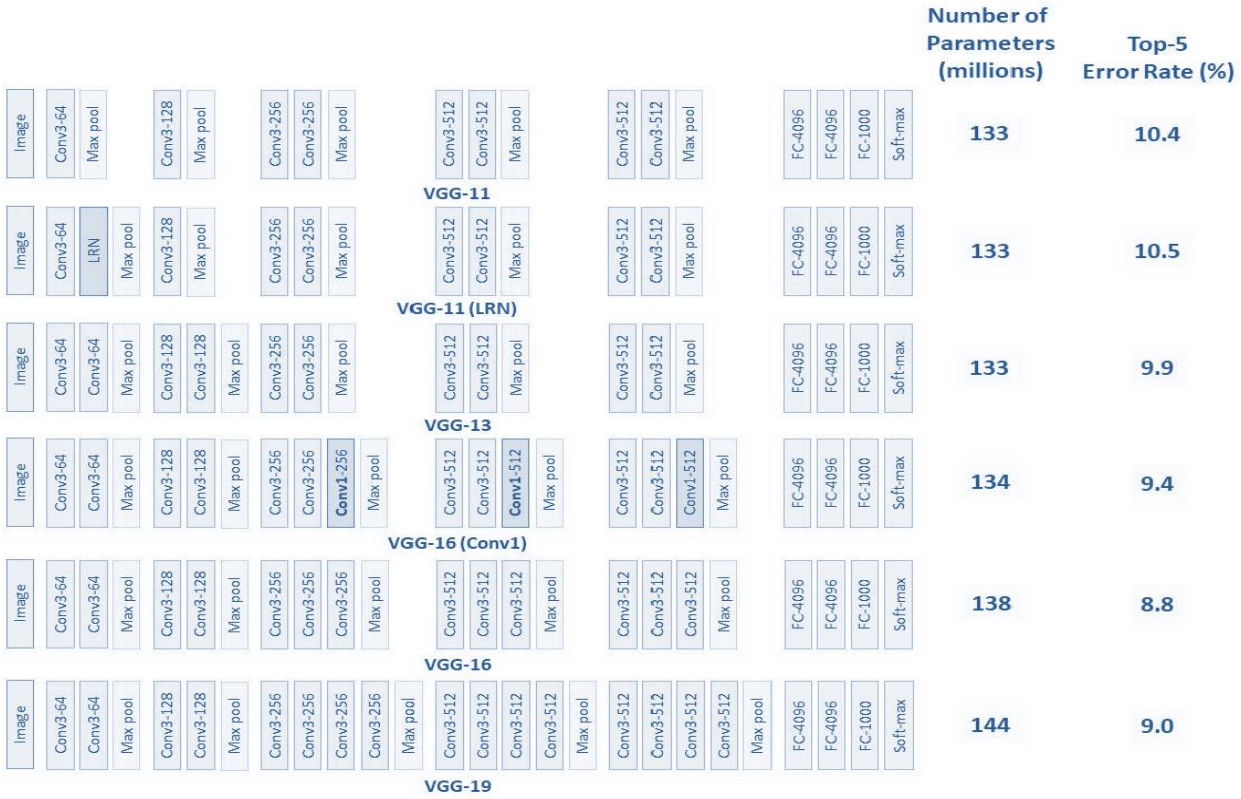

Figure 5 VGG19 Architecture

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DATA SET

The Respiratory Sound Database used in this paper was created by two Greek research teams. It includes 920 annotated recordings from Portugal ranging in length from 10 to 90 minutes. These recordings were made by 126 different patients. There are 6898 respiratory cycles in total, with 1864 containing crackles, 886 containing wheezes, and 506 containing both crackles and wheezes. The data set contains both clear respiratory sounds and noisy recordings that simulate real-world scenarios. Patients of all ages, including children, adults, and the elderly, are present. This Kaggle dataset contains 920.wav sound files and 920 annotation.txt files. A text files containing the diagnosis of each patient.

Result

We can see that our model is gradually learning from our data. Validation accuracy is steadily improving, while mean absolute error is declining. However,. Figure.5 VGG19 Loss and Validation,2. Accuracy and Validation Accuracy,3 MAE and Validation Accuracy

VGG19 will be trained using the software system for automated analysis and diagnosis. The entire system can be used to detect all types of lung sounds. We experimented with CNN algorithms in audio classification in this study. We used VGG19features combined with as a benchmark for our CNN algorithm because it is a widely accepted practice for audio classification. As a result, we discovered that using the CNN algorithm to classify spectrogram images also works. CNN can classify and diagnose respiratory audio with great accuracy. This system can be used in conjunction with a telemedicine system to store and share data among doctors. We believe that our method can help in medical research by improving the results of previous studies. By using this proposed method we can predicate the patients who are in emergency situation for an immediate attention. For that Emergency case Covid -19 Patients can be admitted in emergency ward immediately by using our proposed method. And we can differentiate the patients into three categories such as normal,medium,emergency up-normal condition for immediate attention.

Conclusion:-

If any emergency cases occur on the patient's end, the proposed deep learning strategy will send an alert immediately. Medical practitioners appreciate technological assistance because it allows them to treat more patients due to a scarcity of trained human resources. In this covid -19 scenario, in addition to critical health diseases like cancer and diabetes, the impact of respiratory diseases is gradually increasing and becoming life-threatening for society. Early diagnosis and treatment are critical in respiratory diseases, so the audio of respiratory sounds is proving to be very useful in alerting doctors to patients in an emergency situation who require immediate attention in this covid-19 situation.

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