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Detection of Covid-19 in a person through their Coughing and Breathing Patterns

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***Abstract* - The new Coronavirus illness (Covid-19), according to the World Health Organization, has been a pandemic since March 2020. It starts out as a viral infection that causes swelling in the respiratory tract and can develop into a normal pneumonia. In fact, specialists emphasise the value of early COVID-19 virus infection diagnosis. By isolating the sick patients from others, the virus can be stopped from spreading. However, prompt assessment of breathing patterns is important for many medical emergencies. In this study, we provide a COVID-19 cough and breath analysis based on deep learning that can distinguish between positive COVID-19 cases and both negative and healthy COVID-19 cough, and breath captured on smartphones or wearable sensors. First, Mel Frequency Cepstral Coefficients (MFCC) will be used to reduce noise from audio signals, including cough and breath. After that, deep Long Term Short Memory (LSTM) model will be used to extract deep features. The proposed strategy produced the highest accuracy, over more than 80%, compared to the others in which the LSTM is utilized as a single model without any combination, according to performance data.**

I.INTRODUCTION

Most nations have been impacted by the new coronavirus disease COVID-19, which first surfaced at the end of December 2019 in Wuhan, China. SARS-COV2 is the agent that causes COVID19, a potentially lethal illness that is a global public health problem. In this instance, the transmission of the COVID-19 infection from one person to another necessitated the isolation of patients, who were then given a range of treatments. In general, COVID-19 is an acute condition that resolves quickly, but it also has a high mortality rate and can be fatal.

Fatigue, a dry cough, and fever are COVID-19's three most prevalent symptoms. Joint discomfort, breathlessness, gastrointestinal issues, muscle soreness, and a loss of taste or smell are some other symptoms. 2.4 million people have died from COVID-19 worldwide, and there are currently 109 million active instances of the disease. Some healthcare systems have chosen to forgo testing and case management due to the pandemic's size.

Several methods have been used to identify COVID-19's precocious symptoms by using artificial intelligence techniques and medical images. In this case, the deep convolutional neural network architecture "Resnet 50" has been shown to perform better than other pre-trained models such as GoogLeNet, VGG16 and AlexNet in the COVID-19 recognition task. However, Resnet50 was used to detect COVID-19 from computed tomography (CT) images with 96.23% accuracy. The same architecture for detecting COVID-19 was shown to have an accuracy of 96.7%, and for detecting COVID-19 from X-ray images it has an accuracy of 96.30%. Authors proposed a DNN to detect COVID19 from x-ray images using the transfer learning approach. Some features were extracted from x-ray images using different machine learning models. The model was added to combine the outputs of all the pre-trained models. The results obtained have an accuracy of about 96.4% and a recall of 99.62%.Deep learning system based on generative adversarial network (GAN) with deep transfer learning for coronavirus detection on chest radiographs. Authors propose a transfer learning technique using convolutional neural networks to detect COVID-19 using medical CT images. In the same context, a deep learning algorithm proposed by the work in order to extract features to diagnose before pathogenic tests, with the aim of saving time and resources.

Cough is one of the most common COVID-19 symptoms. However, breathing issues are also a sign of many other illnesses, while their effects on the respiratory system vary. It is said that the glottis behaves differently under certain pathological conditions. Thus, it makes it possible to differentiate cough caused by asthma, tuberculosis, whooping cough and bronchitis. Recognize COVID-19 respiratory disease. However, artificial intelligence techniques can be used to distinguish between respiratory sounds with an area under curve exceeding 0.80. Thus, a distinction can be made between a cough caused by asthma, tuberculosis, and COVID-19. Authors proposed a deep neural network that can recognize COVID-19 from other coughs with an accuracy of 96.83%.Resnet18 is used to identify COVID-19 from cough signals with an area under cu.

II. EXISTING SYSTEM

The J Resnet50 neural network is very effective at detecting COVID-19 from CT images with a accuracy of 96.23%. The same architecture was demonstrated for detecting COVID-19 with 96.7% accuracy and for detecting COVID-19 from X-ray images with 96.30% accuracy. • In an existing system, a DNN to detect COVID-19 from X-ray images by applying the transfer learning approach. Features were extracted from radiographs using the DenseNet121, ResNet18, GoogLeNet, AlexNet, and InceptionV3 models. Then the model was added to combine the outputs of all the pre-trained models. The deep learning system achieved an accuracy of 96.4% and a recall of 99.62%. In an existing system, a transfer learning technique using a convolutional neural network is being used to detect COVID-19.The proposed model would be based on a deep learning approach.

Disadvantages of Existing System:
All the existing approaches use CT scans as input, but they are not suitable for audio analysis. It takes more time to train the model than it would to use a previously trained model. The false alarm rate increases with this device.

III.PROPOSED SYSTEM

The combination of advanced technologies and advanced techniques, as well as artificial intelligence (AI), can help to address this pandemic.
We propose a deep learning framework that uses a deep LSTM network to learn a representation of a patient's audio sequence. The framework's primary purpose is to detect COVID-19 infections from audio patterns.

IV. SYSTEM ARCHITECTURE

The system architecture offers a comprehensive view of the system to be built. This diagram depicts the structure and organization of software components, their properties and the connections between them. The architectural design process involves establishing the basic structural framework for the system. It involves identifying the main components of the system and the communication between these components. The system architecture is shown in the figure. 4.1

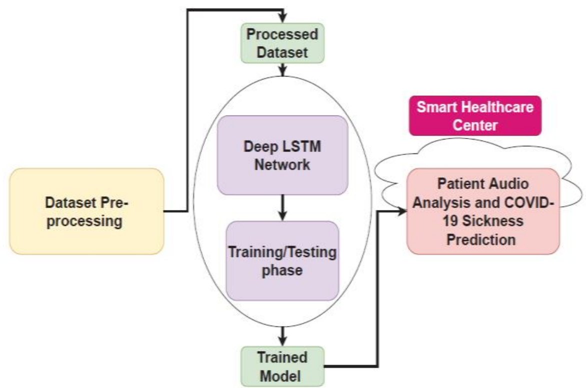

Fig 4.1 System Architecture

V. METHODOLOGY

Long short-term memory (LSTM) networks are commonly used in Deep Learning applications. RNNs are a type of recurrent neural network. Some algorithms are better at learning long-term dependencies, especially in sequence prediction problems. LSTMs have feedback connections, which allow them to process the entire sequence of data, except for single data points, such as images. This is used in speech recognition, machine translation, etc. LSTMs are a particularly effective type of neural network when it comes to solving a variety of problems.
An LSTM model relies on a memory cell known as a 'cell state' that retains its state over time. The cell state is the horizontal line that runs through the top of the diagram. It's a conveyor belt through which information flows, unchanged.
The block diagram shows a proposed deep learning framework-based audio COVID-19 detection system. As a first step, the heterogeneous, large, and misspelled data collected from IoT and wearable

sensors cannot be used as input for advanced medical machine learning applications. To address this issue and provide data trends, the collected data must go through a cleaning process. The process of data analysis includes data transformation, metadata enrichment exploitation, exploration, and data validation.

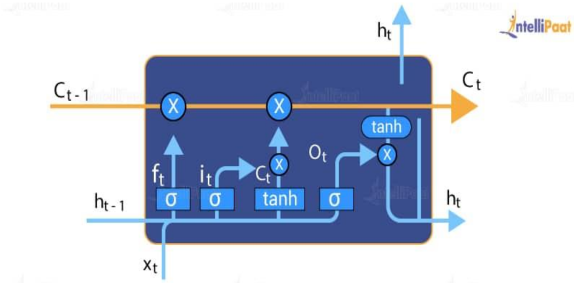

Fig 5.1 LSTM architecture

Information may be introduced to or eliminated from the mobileular nation in LSTM and is regulated via way of means of gates. These gates optionally permit the facts go with the drift inside and outside of the mobileular. It incorporates a pointwise multiplication operation and a sigmoid neural internet layer that help the mechanism.

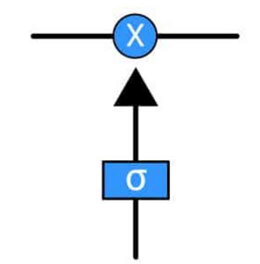

Fig 5.2 Sigmoid Layer

The sigmoid layer outputs a number from 0 to 1. Here, 0 means "pass nothing" and 1 means "pass everything".

VI. SYSTEM TESTING

The purpose of the test is to find bugs. Testing is the process of trying to find all possible flaws or weaknesses in a work product. Provides a way to verify the functionality of components, subassemblies, assemblies, and finished products. This is the process of running software to ensure that the software system meets its requirements and user expectations and does not fail in an unacceptable way.

A) Types of testing

1. Unit Testing:

Unit testing involves the look of test cases that validate that the inner program logic is functioning properly, which program inputs produce valid outputs. All decision branches and internal code flow should be validated. it's the testing of individual software units of the applying . it's done after the completion of a private unit before integration.

2. Integration testing:

Software integration testing is that the incremental integration testing of two or more integrated software components on one platform to provide failures caused by interface defects.

3. Functional test:

It provide systematic demonstration the functions tested are available as specified by the business and technical requirements, system documentation, and user manuals. Organization and preparation tests is concentrated on requirements, key funtions, or special test cases.

4. System Test:

System testing ensures that the entire integrated software system meets the requirements. Test your configuration to see known predictable results. An example of a system test is a configuration-oriented system integration test. System testing is based on process descriptions and flows, with an emphasis on process links and integration points.

5. White Box Testing:

This is a test if the software tester has knowledge of the software's internal behavior, structure, language, or at least its purpose. Used to test areas that the black box plane cannot reach.

6. Black Box Testing:

Test your software without knowing the internal behavior, structure, or language of the module you are testing. Black-box tests, like most other types of tests, should be generated from the final source document, such as: Specification or requirements document. This is a test that treats the software under test like a black box. I can't see the inside. The test provides the input and responds to the output without considering how the software works.

VII. PERFORMANCE EVALUATION

The validated multiclass model is checked for accuracy, precision, recall, and f-measure using a confusion matrix. The procedure is shown in Figure 7.1.

Confusion Matrix: This is a performance indicator for machine learning classification problems where the output can be in more than one class. This is a table containing four different combinations of predicted and actual values. (1) True positive: The predicted value is positive and the actual value is true, (2) True negative: The predicted value is negative and the actual value is true. (3) False positive (Type I error): The predicted value is positive and the actual value is incorrect. (4) False negative (type 2 error): The predicted value and the actual value are incorrect.

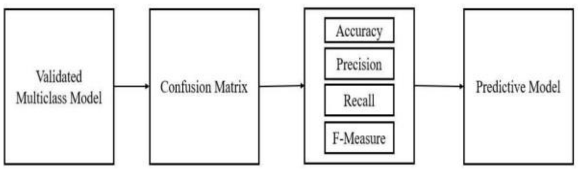

Fig 7.1 Performance Evaluation

Accuracy (A): This is the total number of correct predictions divided by the total number of predictions made for the dataset.

Precision (P): This is a metric that quantifies the number of correct positive predictions. accuracy. Calculates the accuracy of minority classes. In disproportionate classification problems, the majority class is usually referred to as a negative result (eg, "no change" or "negative test result"), and the minority class is usually referred to as a positive result (eg, a positive result). , "Change"). Or "positive test result"). The simplest confusion matrix is for a binary (class 0) class and a positive (class 1) class binary classification problem. In the case of binary classification, it is calculated as the percentage of correctly predicted positives divided by the total number of predicted positives.

Precision = TruePositives / (TruePositives + FalsePositives)

For unbalanced classification problems with three or more classes, the accuracy is calculated as the sum of the true positives of all classes divided by the sum of the true positives and false positives of all classes.

Precision = Sum c in C TruePositives_c / Sum c in C (TruePositives_c + FalsePositives_c)

Recall (R): A recall is a metric that quantifies the number of correct positive predictions from all possible positive predictions. The result is a score from 0.0 without a recall to 1.0 with a complete or complete recall.

Recall = TruePositives / (TruePositives + FalseNegatives)

For unbalanced classification problems with three or more classes, recall is calculated as the sum of true positives for all classes divided by the sum of true positives and false negatives for all classes.

Recall = Sum c in C TruePositives_c / Sum c in C (TruePositives_c + FalseNegatives_c)

Precision: Minimizing false alarms is a priority.

F-Measure(F): F-Measure provides a way to combine both precision and recall into a single measure to capture both properties. The traditional F dimension is calculated as follows:

F-Measure = (2 * Precision * Recall) / (Precision + Recall)

Approaches	Models	Class	Precision (%)	Recall (%)	F1 score (%)	Accuracy (%)
[32]	CNN	Sick+Not-sick	—	85	—	73.02
	LSTM	Sick+Not-sick	—	75	—	73.78
[32]	ResNet50	Sick+Not-sick	—	93	—	74.58
	LSTM+SFS	Sick+Not-sick	—	91	—	92.91
Proposed	LSTM	Sick	79	79.5	79	80.26
		Not-sick	79.5	78	79	80.26

VIII. CONCLUSION

The new coronavirus disease COVID-19, which occurred in Wuhan, China in late December 2019, affects most countries around the world. COVID19, caused by SARS-COV2, is the causative agent of a potentially deadly disease that is a global public health concern. In this regard, human-to-human transmission of COVID-19 infection has led to the isolation of patients who have subsequently received various treatments. In general, COVID-19 is an acutely cured disease, but it can be fatal and has a high mortality rate. COVID-19 is a large family of viruses that cause illnesses ranging from colds to more serious illnesses that can lead to death. With advanced AI technology, early detection of this virus will help you to recover quickly. Using this model, we proposed a deep LSTM technique for diagnosing and detecting COVID-19 infection from cough breathing signals. Performance results demonstrate that the proposed scheme achieved the highest accuracy of over 80% compared to other schemes that used LSTMs as a single model without combined signals. Performance results show that the proposed scheme achieved the highest accuracy of over 80% compared to other schemes using LSTMs as a single model without combinations.

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