Sharadchandra Pawar College of Engineering and Technology, Someshwarnagar

Department of Computer Engineering, 2024-25

"Diagnosing Respiratory Conditions Via Lung Sounds using CNN-LSTM"

Students:

Mr.Pawar Rohit B.(B1911904243)
Ms.Raut Aditi S.(B1911904242)
Ms.Jadhav Sneha N.(B1911904252)

Guide: Prof.Shah S. N.

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CONTENTS

ABSTRACT

- In order to analyze respiratory sounds on a computer, we developed a cost-effective and easy-to-use Algorithm that can be used with any device. We employed two types of machine learning algorithms; Gammatone cepstrum coefficients features in a Convolutional Neural Network and Since using GTCC and STFC features with a CNN-LSTM algorithm. We prepared four data sets for CNN-LSTM algorithm to classify respiratory audio:healthy versus pathological classification; rale, rhonchus, and normal sound classification; singular respiratory sound type classification; and audio type classification with all sound types. Keywords- Respiratory Sound Analysis, Breathing Sound Classification, Gammatone Cepstrum Coefficients (GTCC), Short-Time Fourier Coefficients (STFC), CNN (Convolutional Neural Networks) LSTM (Long Short-Term Memory),Machine Learning, Healthcare Applications.

INTRODUCTION

- Respiratory sounds,provide valuable insights into lung health and can help diagnose conditions like asthma, pneumonia, and COPD. Traditionally, diagnosis requires expert interpretation, but machine learning has made automated analysis of lung sounds feasible.This study explores the use of Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks for classifying respiratory sounds.CNNs efficiently detect patterns in the audio, while LSTMs capture the temporal relationships in sequential data. By combining these techniques,the proposed system offers a cost effective, non-invasive method for diagnosing respiratory conditions, aiding healthcare professionals in early detection and monitoring.

MOTIVATION

- Each year, 10 million people die from respiratory diseases, many in areas with limited healthcare. Using a CNN-LSTM model to analyze lung sounds could help diagnose these conditions early, saving lives and providing critical support where resources are limited.

OBJECTIVES

- Develop a Cost-Effective and Accurate System
- Automate Respiratory Sound Analysis
- Medical professionals looking to quickly assess respiratory conditions in clinical and remote settings
- Training datasets and improving machine learning models for more accurate respiratory sound classification

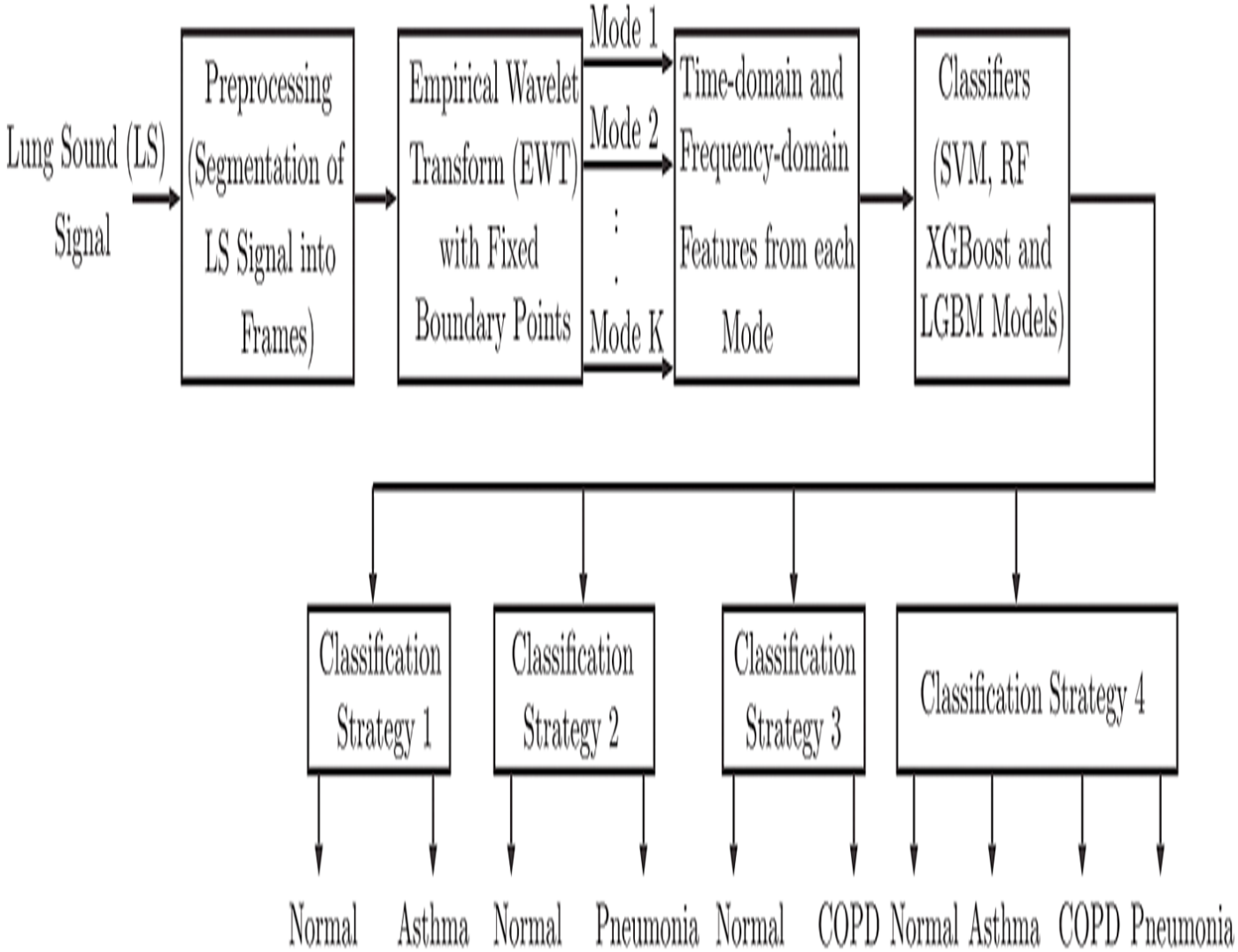
LITERATURE SURVEY

Ref No	Title of Paper	Authors Name	Publication	Remark
1	Investigating into segmentation methods for diagnosis of respiratory diseases using adventitious respiratory sounds	Liqun Wu, Ling Li	2020 IEEE International Conference on Bioinformatics and Biomedicine (BIBM)	Examines segmentation techniques and machine learning for respiratory disease diagnosis, achieving 88% accuracy.
2	A Respiratory Sound Database for the Development of Automated Classification	B.M.Rocha, D. Filos, L. Mendes, I. Vogiatzis,	IFMBE Proceedings	Introduces a large database for classifying respiratory sounds in clinical and non-clinical settings
3	Automated Detection of Pulmonary Diseases From Lung Sound Signals Using Fixed-Boundary-Based Empirical Wavelet Transform	Rajesh Kumar Tripathy, Shaswati Dash, Advasha Rath, Ganapati Panda, Ram Bilas Pachor	*IEEE Sensors Letters*, Vol. 6, No. 5, May 2022	Proposes a method using wavelet transforms and machine learning to detect pulmonary diseases with high accuracy

PROBLEM STATEMENT

- Respiratory diseases are a leading cause of death globally, and traditional lung auscultation is subjective and limited. Current diagnostic algorithms are costly and complex, lacking real-time performance. There is a need for an efficient, low-cost, and accurate system to classify lung sounds automatically, improving early diagnosis and treatment.

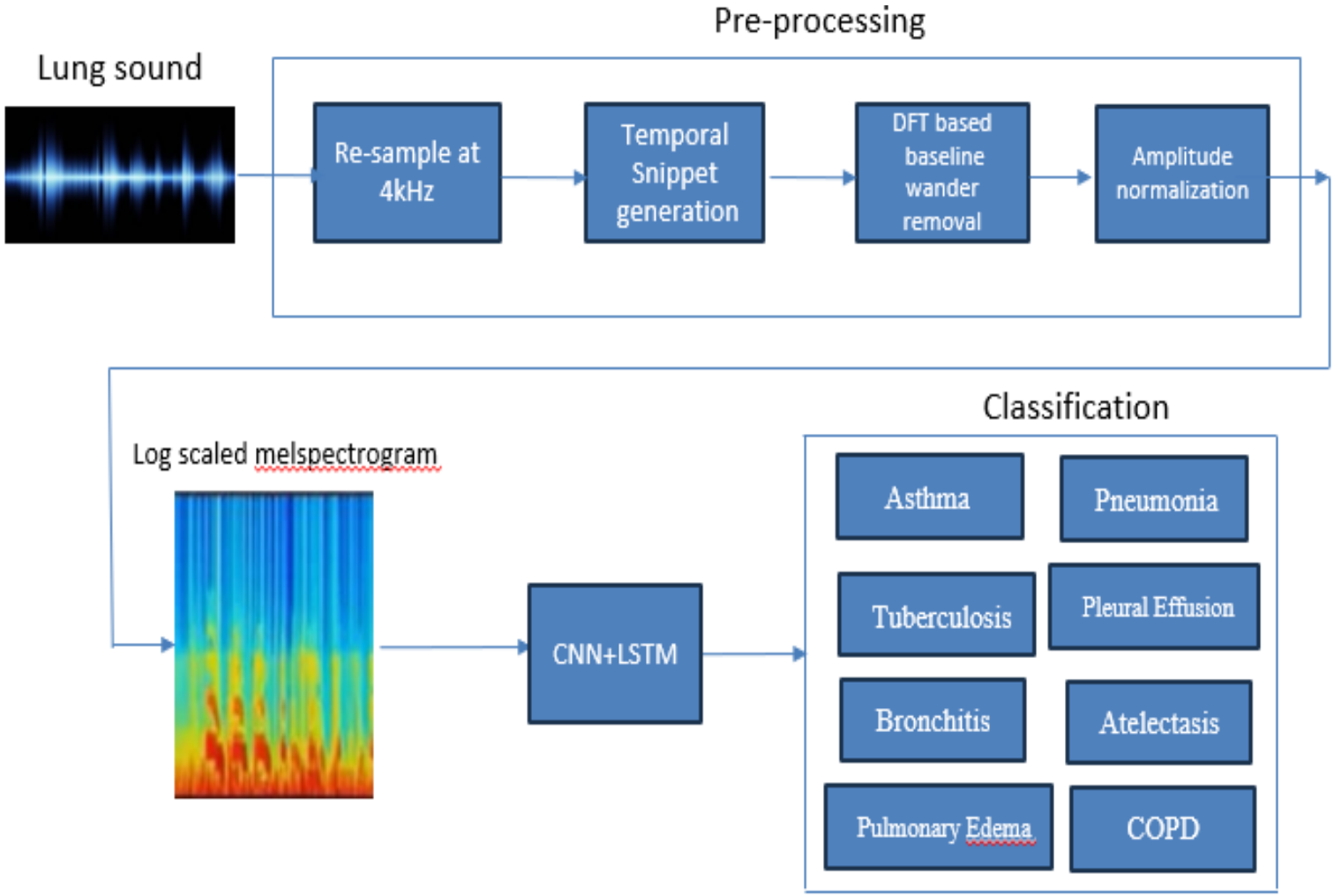
EXISTING SYSTEM



DISADVANTAGES

1. High computational time.
2. limitations in accuracy.
3. Lack of Real-Time Processing.
4. Limited Adaptability to Different Lung Sounds.

PROPOSED SYSTEM



AIGORITHM USED

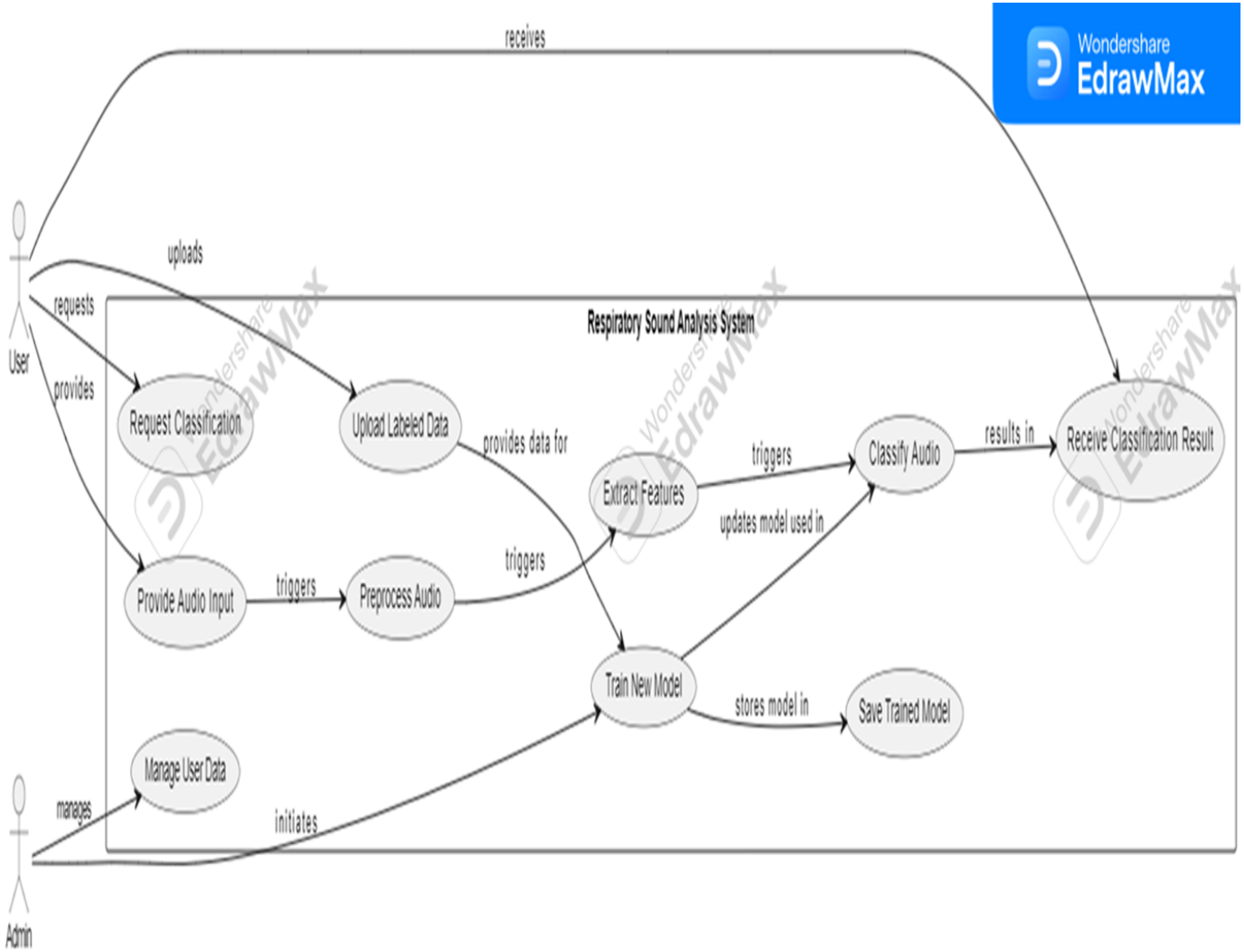
- Evaluation:-Compare the model against existing methods such as MFCC-Inception networks.Analyze the classification accuracy across various lung diseases like asthma, pneumonia, COPD, etc.

- Feature Extraction:-Extract Gammatone Cepstrum Coefficients (GTCC) and Short Time Fourier Coefficients (STFC) from audio recordings. These features provide significant insights into sound patterns relevant to lung condition diagnosis.

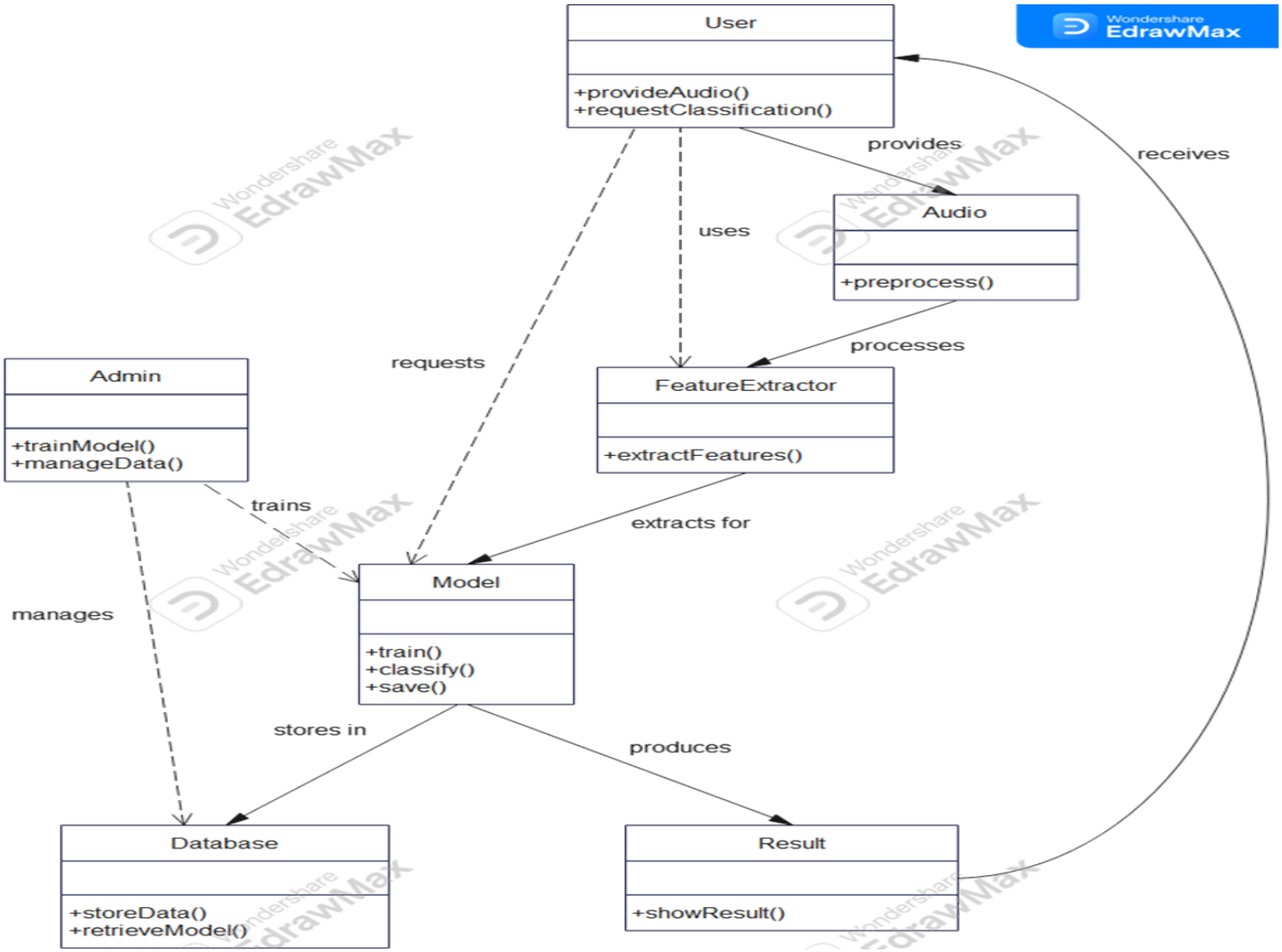
- Model Design:-Implement a hybrid CNN-LSTM architecture: CNN layers to extract spatial features from the sound spectrograms. LSTM layers to capture temporal patterns in the lung sound sequences. The model aims to optimize accuracy while being lightweight and computationally efficient.

UML DIAGRAMS

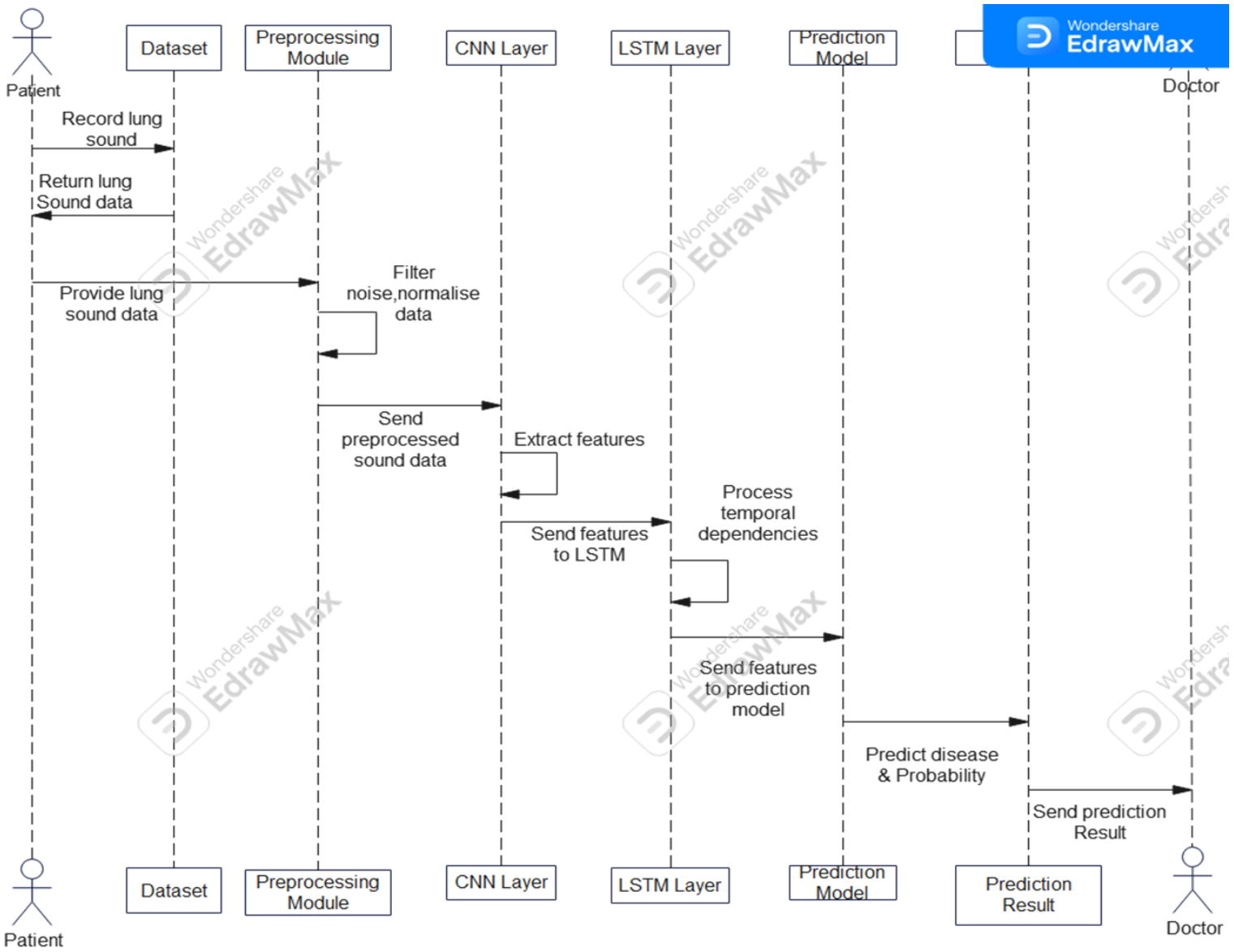
USE CASE DIAGRAM



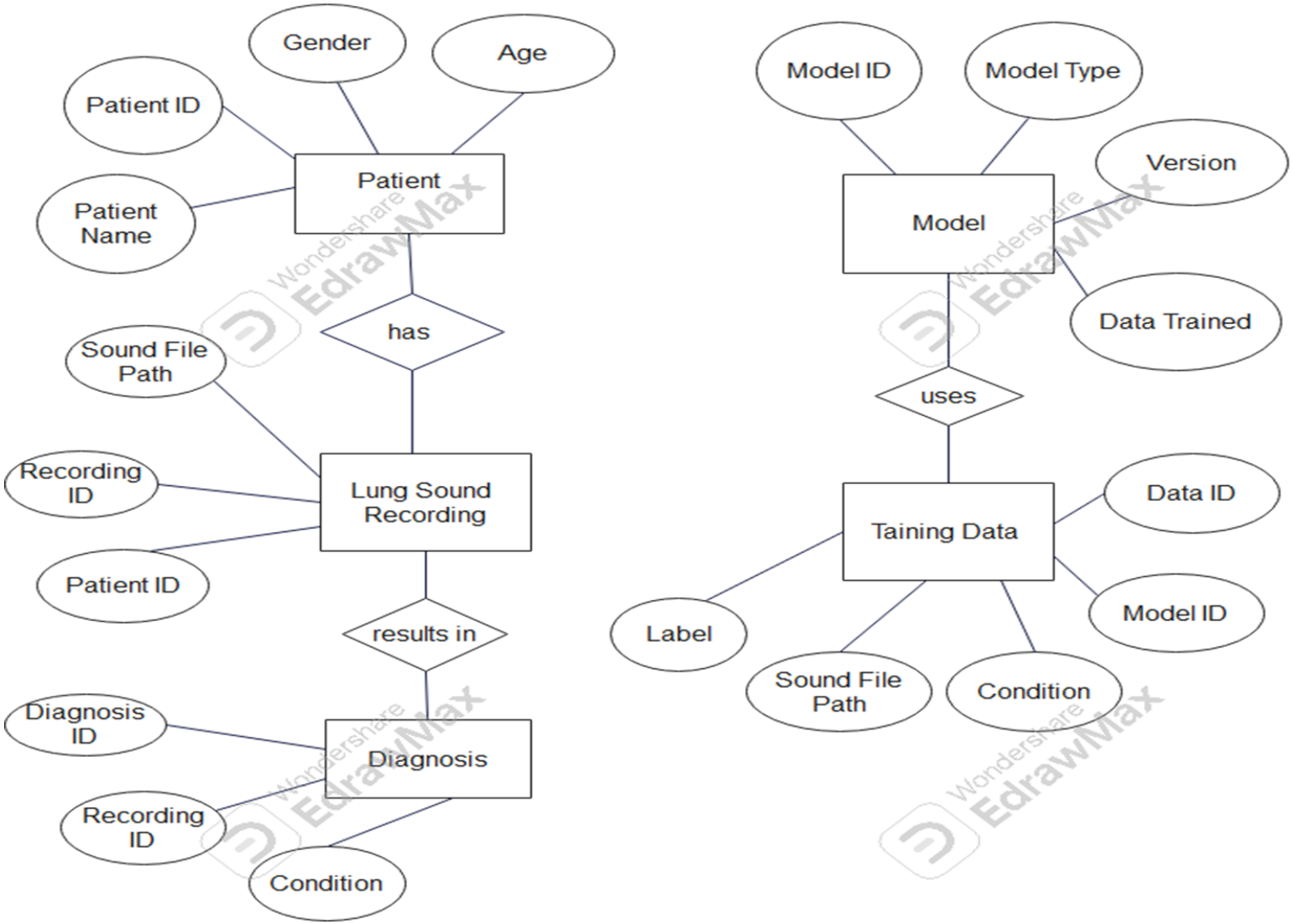
CLASS DIAGRAM



SEQUENCE DIAGRAM



ER DIAGRAM


Gender
Age
Patient ID
Patient
Patient Name
has
Sound File Path
Recording ID
Lung Sound Recording
Patient ID
results in
Diagnosis ID
Diagnosis
Recording ID
Condition
Model ID
Model Type
Version
Model
Data Trained
uses
Data ID
Taining Data
Model ID
Label
Sound File Path
Condition

Hardware and Software Requirements

- HARDWARE REQUIREMENTS:-
- System : I3 and Above
- Hard Disk : Greater than 500 GB
- RAM : Greater than 4 GB

- SOFTWARE REQUIREMENTS:-
- Front-End:JavaScript, HTML And CSS
- Language :Python 3.8

ADVANTAGES

1. Improved Accuracy.
2. Quick Diagnosis.
3. Reduced Human Error.
4. Cost-Effective.

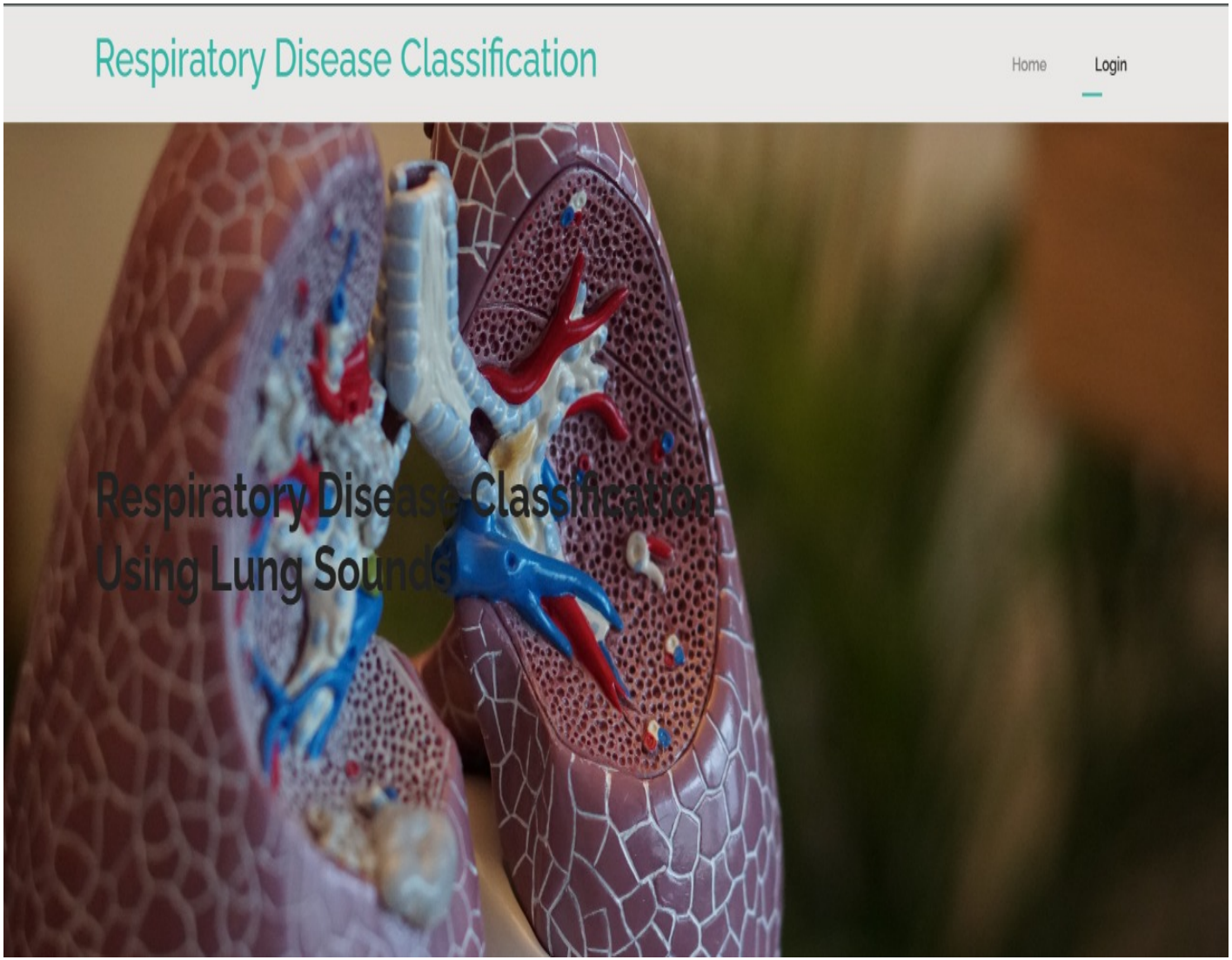
APPLICATIONS

1. Clinical Diagnostics
2. Remote Monitoring
3. Medical Research and Training
4. Emergency Situations
5. Patient Self-Monitoring

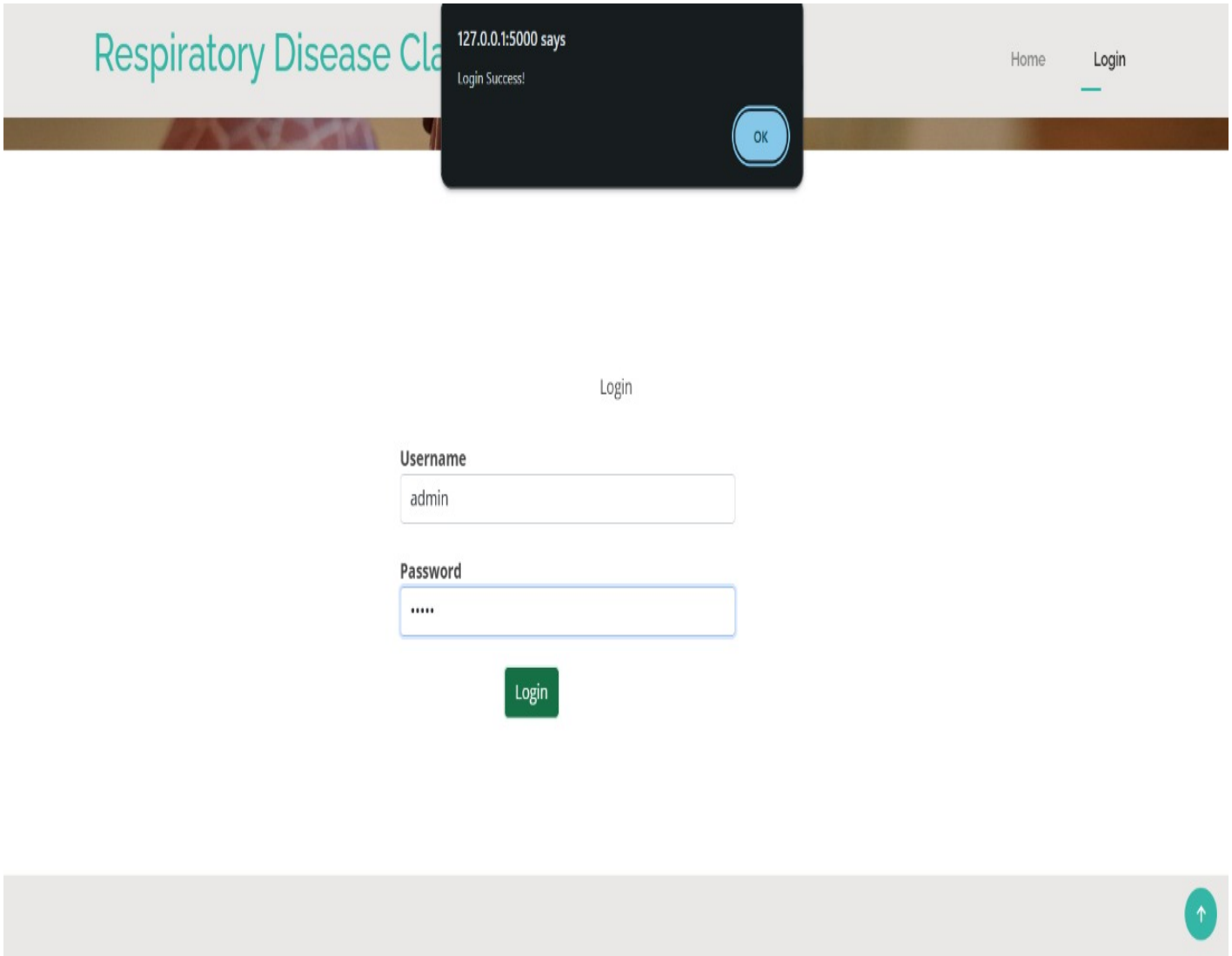
RESULTS


Respiratory Disease Classification
Home
Login
Respiratory Disease Classification
Using Lung Sounds
Abstract

RESULTS

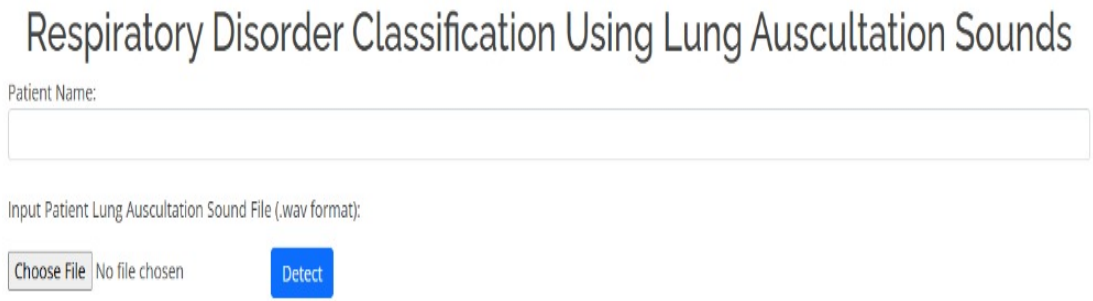

Respiratory Disease Classification
Home
Login
Respiratory Disease Classification
Using Lung Sounds

RESULTS

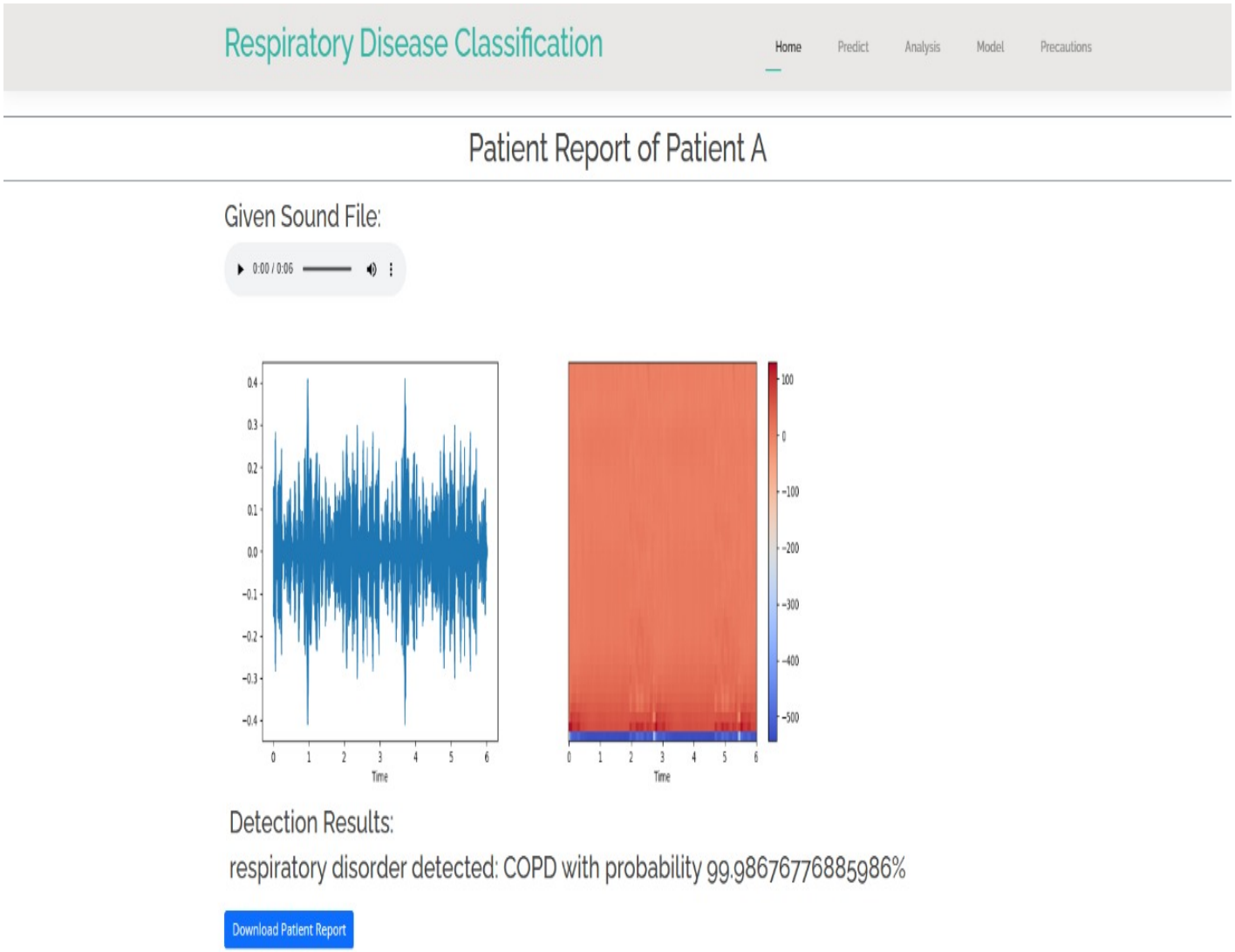

Respiratory Disease Cla
127.0.0.1:5000 says
Login Success!
OK
Home
Login
Login
Username
admin
Password
Login

RESULTS

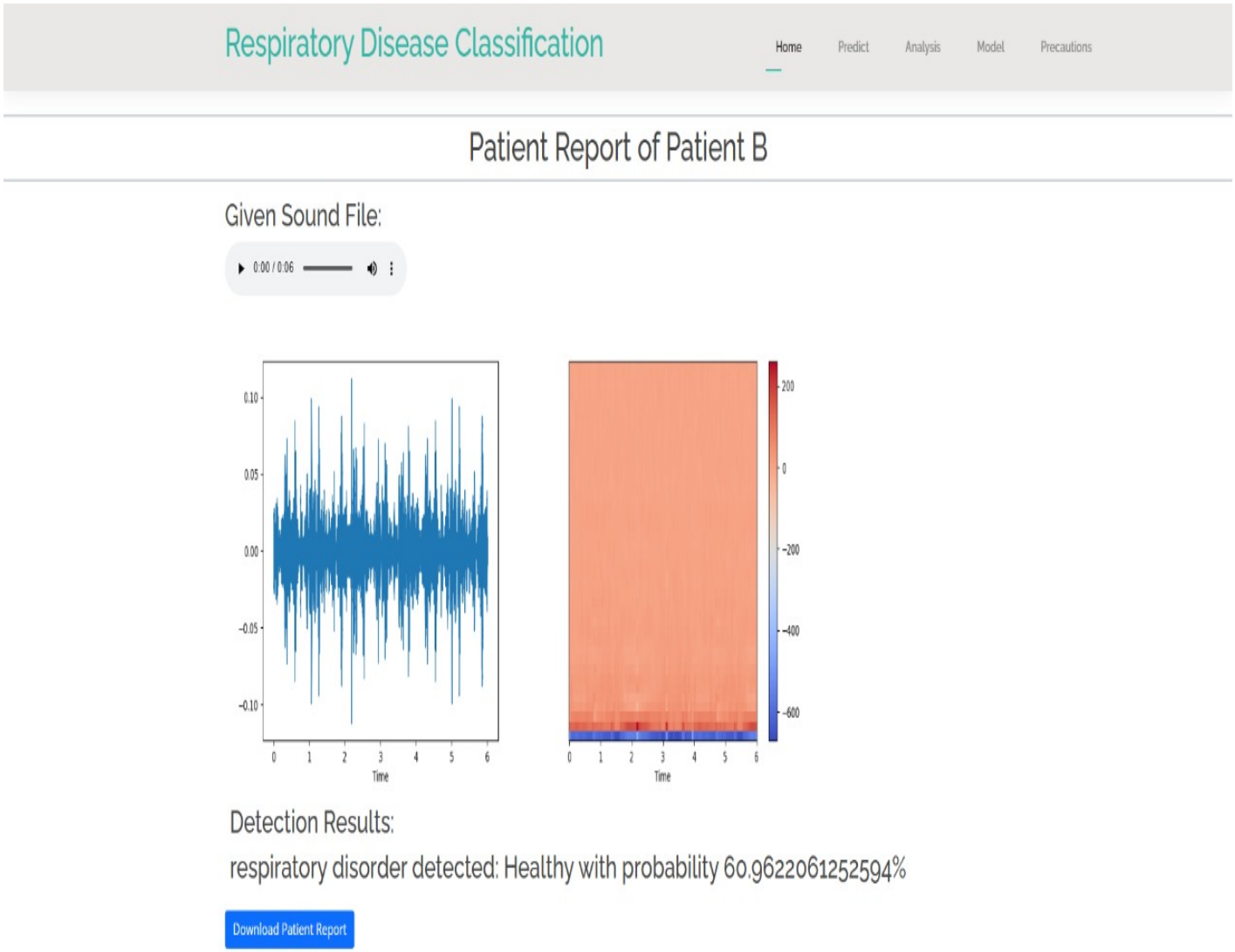

Respiratory Disease Classification
Home
Predict
Analysis
Model
Precautions


Respiratory Disorder Classification Using Lung Auscultation Sounds
Patient Name:
Input Patient Lung Auscultation Sound File (.wav format):
Choose File
No file chosen
Detect

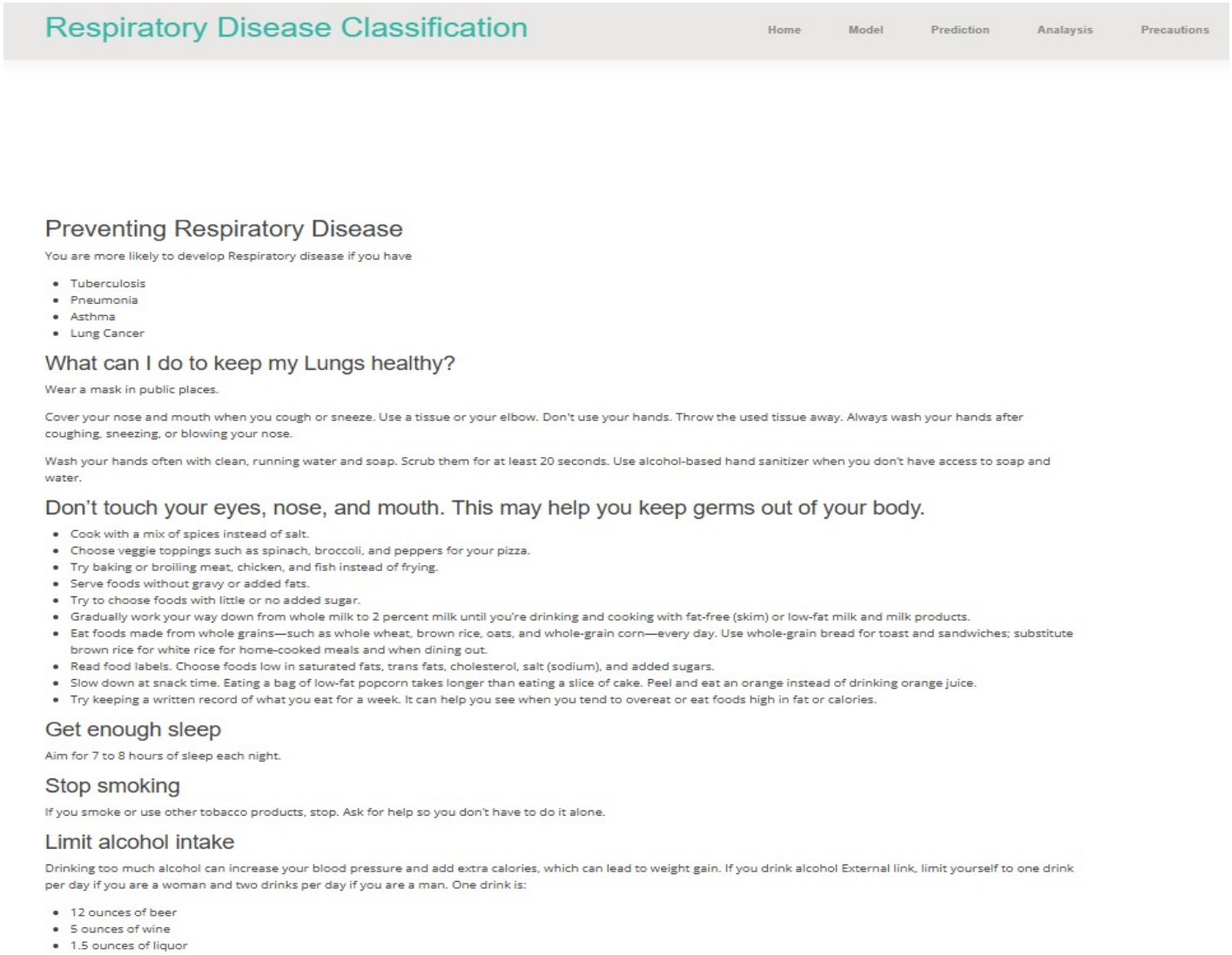
RESULTS


Respiratory Disease Classification
Home
Predict
Analysis
Model
Precautions
Patient Report of Patient A
Given Sound File:
0:00 / 0:06
Time
Time
Detection Results:
respiratory disorder detected: COPD with probability 99.9867677685986%
Download Patient Report

RESULTS


Respiratory Disease Classification
Home
Predict
Analysis
Model
Precautions
Patient Report of Patient B
Given Sound File:
0:00 / 0:06
0.10
0.05
0.00
−0.05
−0.10
0
1
2
3
4
5
6
Time
200
0
−200
−400
−600
Detection Results:
respiratory disorder detected: Healthy with probability 60.9622061252594%
Download Patient Report

RESULTS



Respiratory Disease Classification

Home Model Prediction Analaysis Precautions

Preventing Respiratory Disease

You are more likely to develop Respiratory disease if you have

- Tuberculosis
- Pneumonia
- Asthma
- Lung Cancer

What can I do to keep my Lungs healthy?

Wear a mask in public places.

Cover your nose and mouth when you cough or sneeze. Use a tissue or your elbow. Don't use your hands. Throw the used tissue away. Always wash your hands after coughing, sneezing, or blowing your nose.

Wash your hands often with clean, running water and soap. Scrub them for at least 20 seconds. Use alcohol-based hand sanitizer when you don't have access to soap and water.

Don't touch your eyes, nose, and mouth. This may help you keep germs out of your body.

- Cook with a mix of spices instead of salt.
- Choose veggie toppings such as spinach, broccoli, and peppers for your pizza.
- Try baking or broiling meat, chicken, and fish instead of frying.
- Serve foods without gravy or added fats.
- Try to choose foods with little or no added sugar.
- Gradually work your way down from whole milk to 2 percent milk until you're drinking and cooking with fat-free (skim) or low-fat milk and milk products.
- Eat foods made from whole grains—such as whole wheat, brown rice, oats, and whole-grain corn—every day. Use whole-grain bread for toast and sandwiches; substitute brown rice for white rice for home-cooked meals and when dining out.
- Read food labels. Choose foods low in saturated fats, trans fats, cholesterol, salt (sodium), and added sugars.
- Slow down at snack time. Eating a bag of low-fat popcorn takes longer than eating a slice of cake. Peel and eat an orange instead of drinking orange juice.
- Try keeping a written record of what you eat for a week. It can help you see when you tend to overeat or eat foods high in fat or calories.

Get enough sleep

Aim for 7 to 8 hours of sleep each night.

Stop smoking

If you smoke or use other tobacco products, stop. Ask for help so you don't have to do it alone.

Limit alcohol intake

Drinking too much alcohol can increase your blood pressure and add extra calories, which can lead to weight gain. If you drink alcohol External link, limit yourself to one drink per day if you are a woman and two drinks per day if you are a man. One drink is:

- 12 ounces of beer
- 5 ounces of wine
- 1.5 ounces of liquor

FUTURE SCOPE

- Bigger and Better Datasets.
- Improving the Model.
- Real-Time Use.
- Tracking Health Over Time.
- Privacy and Safety.

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CONCLUSION

This project develops a cost-effective and accurate system for automatic lung sound classification using CNN-LSTM, combining GTCC STFC feature extraction to analyze respiratory sounds. The CNN extracts key sound patterns, while LSTM captures temporal changes, improving diagnostic accuracy. This system helps medical professionals detect respiratory conditions early with low cost solution and is suitable for clinical and remote healthcare applications. Future improvements include better clinical validation, real-time optimization, and enhanced dataset diversity to make the model more reliable and effective.

REFERENCES

1. Tripathy, R. K., Dash, S., Rath, A., Panda, G., Pachori, R. B. (2022). "Automated Detection of Pulmonary Diseases From Lung Sound Signals Using Fixed-Boundary-Based Empirical Wavelet Transform." IEEE Sensors Journal

2. Wu, L., and Li, L. (2020). "Investigating into segmentation methods for diagnosis of respiratory diseases using adventitious respiratory sounds." Proceedings of IEEE

3. Zhaoping Wang1 and Zhiqiang Sun2 (2023) Performance evaluation of lung sounds classification using deep learning under variable parameters

Thank You