A

PROJECT REPORT

ON

"Diagnosing respiratory conditions via lung sound using CNN and LSTM"

SUBMITTED TO THE SAVITRIBAI PHULE PUNE UNIVERSITY ,
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE OF

BACHELOR OF ENGINEERING

(COMPUTER ENGINEERING)

SUBMITTED BY

Mr. Rohit Pawar **B1911904243**

Ms. Aditi Raut **B1911904242**

Ms. Sneha Jadhav **B1911904252**

UNDER THE GUIDENCE OF

Prof. Shah S. N.

DEPARTMENT OF COMPUTER ENGINEERING

SSPM's Sharadchandra Pawar College of Engineering and Technology

Someshwarnagar, Baramati-412306

AY 2024-2025

CERTIFICATE

This is to certify that the Project Entitled

"Diagnosing respiratory conditions via lung sound using CNN and LSTM"

Submitted by

Mr. Rohit Pawar	**B1911904243**
Ms. Aditi Raut	**B1911904242**
Ms. Sneha Jadhav	**B1911904252**

is a record of bonafide work carried out by her/him in the department of Computer Engineering, SSPM's Sharadchandra Pawer College of Engineering and Technology Someshwarnagar, Baramati-412306 under the guidance and supervision of **Prof. Shah S. N.** in partial fulfilment of requirements for the award of Degree of **Bachelors of Computer Engineering** as prescribed by the S. P. Pune University, in the academic year 2024-2025.

Prof. Shah S.N.
(Name of Guide)

Prof. Shah.S.N.
(Project Coordinator.)

Prof. Shah.S.N.
(HOD)

Dr.Deokar S.A.
(Principal)

Signature of External Examiner

Place: Someshwarnagar

Date: / / 2024.

Certificate by Guide

This is to certify that **Mr. Rohit Pawar, Ms. Aditi Raut, Ms. Sneha Jadhav,** has completed the dissertation work under my guidance and supervision and that, I have verified the work for its originality in documentation, problem statement, implementation and results presented in the dissertation. Any reproduction of other necessary work is with the prior permission and has given due ownership and included in the references.

Place:**Someshwarnagar, Baramati** Signature of Guide

Date: **(Prof. Shah S.N.)**

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Space does not allow me to mention each person by name, I'm deeply grateful to everyone that has been associated with this project.

Mr. Rohit Pawar
Ms. Aditi Raut
Ms. Sneha Jadhav

Contents

List of Figures

Chapter 1

INTRODUCTION

Respiratory diseases are leading causes of death and disability in the world. The poorest regions of the world had the greatest disease burden. Ageing and risk factors includ- ing smoking, environmental pollution, and body weight also play a key role, say the researchers. Chronic respiratory diseases pose a major public health problem and about 65 million people suffer from chronic obstructive pulmonary disease and with an esti- mated 3.91 million deaths in 2017 which accounts for 7 of all deaths worldwide and its third leading cause of death. Between 1990 and 2017, the number of deaths due to chronic respiratory diseases increased by 18, from 3.32 million in 1990 to 3.91 million in 2017. About 334 million people suffer from asthma, the most common chronic disease of childhood affecting 14 of all children globally. Respiratory diseases like Pneumonia kills millions of people annually and is a leading cause of death among children under 5 years old. Over 10 million people develop tuberculosis (TB) and 1.4 million die from it each year, making it the most common lethal infectious disease. Lung cancer kills 1.6 million people each year and is the deadliest cancer. Globally, 4 million people die prematurely from chronic respiratory disease. Res- piratory diseases make up five of the 30 most common causes of death: COPD is third; lower respiratory tract infection is fourth; tracheal, bronchial and lung cancer is sixth; TB is twelfth; and asthma is twenty-eighth . Altogether, more than 1 billion people suffer from either acute or chronic respiratory conditions. The stark reality is that each year, 4 million people die prematurely from chronic respiratory disease . Infants and young children are particularly susceptible. A total of 9 million children under 5 years old die annually, and pneumonia is the world's leading killer of these children . People often take breathing and our respiratory health for granted, but the lung is a vital organ that is vulnerable to airborne infection and injury. Respiratory system diseases affect people's social, economic and health life significantly. Social deprivation was the most important factor affecting rates of death and disability, with the highest rates seen in the poorest regions of the world. Lower mortality was seen in more affluent countries, reflecting better access to health services and improved treatments. So, treatment of lung diseases, which are the most common cause of death in the world, is of great importance in the medical field. For these reasons, a lot of research are going on for early diagnosis and intervention in respiratory diseases. In order to accurately identify health problem regarding this information requires experience and time, but according to the World Health Organization (WHO) statistics [3], 45 of the WHO Member States report to have less than 1 physician per 1000 population, the WHO ratio recommendation. Considering these statistics into account, to study individually and diagnose every patient by a health specialist who are already overbooked, mistakes can happen. This is why finding new ways to help doctors to save time is a priority. Hence, automatic and reliable tools can help in diagnosing more people and it can also help specialists to make less mistakes due to the work overload.

1.1 Overview

Respiratory conditions, such as asthma, pneumonia, bronchitis, and chronic obstructive pulmonary disease (COPD), are significant health concerns worldwide. Early detection and accurate diagnosis of these conditions are critical for effective treatment and improved patient outcomes. Traditionally, diagnosis involves physical examination, medical imaging, and sometimes invasive tests. However, advances in machine learning, particularly convolutional neural networks (CNNs) and long short-term memory networks (LSTMs), have opened new avenues for diagnosing respiratory conditions non-invasively using lung sound analysis. Lung sounds, or breath sounds, are the noises generated by airflow through the respiratory system. Abnormal lung sounds such as wheezing, crackles, and rhonchi can be indicative of underlying respiratory issues.

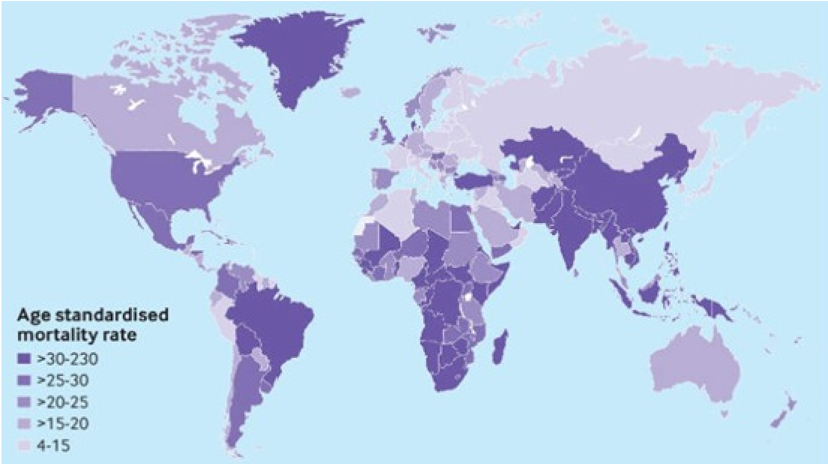

Figure 1.1: Global age standardized mortality rate per 100000 people of chronic obstructive pulmonary disease for both sexes in 195 countries and territories in 2017

1.2 Motivation

As rapid growth of respiratory diseases is witnessed around the world, medical research field has gained interest in integrating potential audio signal analysis based technique. From the past few decades, computer science constantly improving the ability to analyze media data automatically and with the help of diagnosis tools we are able to process image and/or audio information. Hence, Computer science could help nursing staff or doctors for diagnosis by proposing faster and reliable tools and by giving customizable tools for medical monitoring to the patient. Like in other application domains, audio signal analysis tools can potentially help in analyzing respiratory sounds to detect problems in the respiratory tract. Audio analysis aids in timely diagnosis of respiratory ailments more effortlessly in the early stages of a respiratory dysfunction. Apart from respiratory check-ups, every cardiac assessment also includes an audio auscultation in which one the medical specialist listens to sounds from the patient body with different tools like stethoscope or sonography. This shows how important sound analysis is for heart and lungs disease detection. recognizing abnormalities, which can be due to not calibrating the instrument and/or due to noisy environment, is very high using this method As lung and heart diseases remains the leading cause of death globally, there are many studies about lung and heart sound identification. Since then, there are lots of improvements, for processing records taken in noisy environments. Furthermore, new kinds of methods drastically improve the domain, as machine learning and deep learning. These approaches contribute a lot to computer vision, or audio analysis. This gives more relevant information from respiratory sounds extracted and contribute to reducing the time for diagnosis, consequently increasing treatment efficiency. Thus, an automated algorithm developed to recognize abnormalities in respiratory sounds may be of great relevance to clinical diagnosis. Also researchers are looking in to combining speech and signal processing tools techniques with image analysis-based tools techniques can also help doctors predict or guess about the presence of respiratory diseases based on verbal communication before they even start with the X-ray screening or other procedures. Machine learning has proven to be an effective technique in recent years and machine learning algorithms have been successfully used in a large number of applications. The development of computerized lung sound analysis has attracted many researchers in recent years, which has led to the implementation of machine learning algorithms for the diagnosis of lung sound. In our research we have used machine learning techniques in computer-based lung sound analysis. A brief description of the types of lung sounds and their characteristics is provided. We examined specific lung sounds/disorders, the number of subjects, the signal processing and classification methods and the outcome of the analyses of lung sounds using machine learning methods that have been performed by previous researchers. Before diagnosing disease based on their types, it is important to first ensure that whether a person has any lung infection. True positive case can then be pushed for further processing, such as diagnosis. In this research, we developed an automated tool to distinguish healthy respiratory sound from and non-healthy ones that come from respiratory infection carrying patients, where GTCC-based features are employed. Using over 6800 clips, we obtained the highest accuracy of 99.22. A brief description on the previous works is also included and in conclusion, the review provides recommendations for further improvements.

Respiratory sounds may be acquired by the easy and non-invasive auscultation procedure. Auscultation is an effective technique in which physicians evaluate and diagnose the disease after using a stethoscope for lung disease. This method is inexpensive and easy as it does not require internal intervention into the human body. However, traditional stethoscopes may be exposed to external noise sounds and cannot filter the audio frequencies of the body in auscultation and cannot create permanent recordings in monitoring of the disease course. Also, there is a possibility of untrained physicians incorrectly

1.3 Problem Definition and Objectives

1.3.1 Problem Definition

- Respiratory diseases like asthma, pneumonia, and COPD often go undiagnosed in their early stages due to limitations in traditional diagnostic methods, which can be costly, invasive, and inaccessible. Additionally, manual analysis of lung sounds is prone to human error and subjectivity. The problem is to develop an automated, non-invasive, cost-effective diagnostic tool that uses machine learning techniques (CNNs and LSTMs) to accurately analyze lung sounds, detect abnormalities, and provide early, reliable diagnoses of respiratory conditions, especially in resource-limited settings.

1.3.2 Objectives

- Develop a Cost-Effective and Accurate System: Create a system for classifying lung sounds that is affordable, precise and requires minimal computational resources.
- Automate Respiratory Sound Analysis:Address the increasing demand for automated tools due to the high global burden of respiratory diseases, improving accessibility and efficiency in diagnosing respiratory conditions.
- 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

1.4 Project Scope and Limitations

1.4.1 Project Scope

The proposed system the scope is to develop an automated system for diagnosing respiratory conditions using lung sound analysis, leveraging deep learning techniques, specifically Convolutional Neural Networks (CNNs) for feature extraction and Long Short-Term Memory (LSTM) networks for temporal analysis. The system will classify common respiratory conditions such as asthma, pneumonia, and bronchitis based on audio recordings of lung sounds, utilizing preprocessed features like Mel-frequency cepstral coefficients (MFCCs) or spectrograms. The project will encompass data collection, preprocessing, model development, evaluation, and the creation of a user-friendly application for real-time diagnosis. The goal is to provide a reliable, efficient tool that can assist healthcare professionals in diagnosing respiratory diseases quickly and accurately, with a focus on optimizing model performance, ensuring generalization, and exploring deployment options for practical medical use.

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1.4.2 Limitations

Dependency

Without Internet Connection project will not work.

1.5 Methodologies of Problem solving

Respiratory conditions are diagnosed through spirometry and lung auscultation. Spirometry is measuring the volume of air mobilized in respiration. Even though, this method is one of the most commonly available lung function tests and well validated for the diagnosis and monitoring of upper and lower airway abnormalities , it is limited to patient's cooperation and therefore, is error prone. Moreover, traditional spirometers are normally used only in clinical settings due to their high cost and required calibration along with challenges in patient guiding. Auscultation is other technique which involves listening to the internal human body sounds with the aid of a stethoscope and typically performed on the anterior and posterior chest. From past few years, it has been an effective tool to understand lung disorders and possible abnormalities. However, this process is limited to physicians as they are well trained. For various reasons like faulty instrument or noisy environment, false positives can happen. Therefore, it opens a door to develop computerized lung sound analysis tools/techniques, where automation is the integral part.

Chapter 2

LITERATURE REVIEW

A literature research with respect to the previously published literature is the initial stage of any project. A series of comprehensive market survey of publications in a specific field of study is conducted before a suitable problem solving method is finalized. It is seen as an essential task as it will ensure that a thorough understanding of a project is gained and subsequently lays a solid foundation on our future task.

All the research done will serve as a yardstick and reference to our project. After a complete literature review is finished, we are supposed to be able to write in such a way that shows we have a feel for the area, know what the important issues are and their relevance to our work. We should have known what can be neglected and we have the anticipation of the outcome. To summarize all the above, the direction of a project is determined and indeed this is the objective of literature review.

1. Investigating into segmentation methods for diagnosis of respiratory diseases using adventitious respiratory sounds
Author: Liqun Wu and Ling Li
Description:
Respiratory condition has received a great amount of attention nowadays since respiratory diseases recently be come the globally leading causes of death. Traditionally, stethoscope is applied in early diagnosis but it requires clinician with extensive training experience to provide accurate diagnosis. Accordingly, a subjective and fast diagnosing solution of res piratory diseases is highly demanded. Adventitious respiratory sounds (ARSs), such as crackle, are mainly concerned dur-

ing diagnosis since they are indication of various respiratory dis eases. Therefore, the characteristics of crackle are informative and valuable regarding to develop a computerised approach for pathology-based diagnosis. In this work, we propose a frame work combining random forest classifier and Empirical Mode Decomposition (EMD) method focusing on a multi-classification task of identifying subjects in 6 respiratory conditions (healthy, bronchiectasis, bronchiolitis, COPD, pneumonia and URTI). Specifically, 14 combinations of respiratory sound segments were compared and we found segmentation plays an important role in classifying different respiratory conditions. The classifier with best performance (accuracy = 0.88, precision = 0.91, recall = 0.87, specificity = 0.91, F1-score = 0.81) was trained with features extracted from the combination of early inspiratory phase and entire inspiratory phase. To our best knowledge, we are the first to address the challenging multi-classification problem.

2. Respiratory Sound Database for the Development of Automated Classification

Author: B. M. Rocha1, D. Filos, L. Mendes, I. Vogiatzis, E. Perantoni, E. Kaimakamis, P. Natsiavas, A. Oliveira3,4, C. Jácome3, A. Marques3,4, R. P. Paiva1, I. Chouvarda2, P. Carvalho1, N. Maglaveras2

Description:

The automatic analysis of respiratory sounds has been a field of great research interest during the last decades. Automated classification of respiratory sounds has the potential to detect abnormalities in the early stages of a respiratory dysfunction and thus enhance the effectiveness of decision making. However, the existence of a publically available large database, in which new algorithms can be implemented, evaluated, and compared, is still lacking and is vital for further developments in the field. In the context of the International Conference on Biomedical and Health Informatics (ICBHI), the first scientific challenge was organized with the main goal of developing algorithms able to characterize respiratory sound recordings derived from clinical and non-clinical environments. The database was created by two research teams in Portugal and in Greece, and it includes 920 recordings acquired from 126 subjects. A total of 6898 respiration cycles were recorded. The cycles were annotated by respiratory experts as including crackles, wheezes, a combination of them, or no adventitious respiratory sounds. The recordings were collected using heterogeneous equipment and their duration ranged from 10s to 90s. The chest locations from which the recordings were acquired was also provided. Noise levels in some respiration cycles were high, which simulated real life conditions and made the classification process more challenging.

3. Respiratory sound classification for crackles, wheezes, and rhonchi in the clinical field using deep learning

Author: Yoonjoo Kim, YunKyong Hyon, Sung Soo Jung, Sunju Lee, Geon Yoo, Chaeuk Chung Taeyoung Ha **Description:**
Auscultation has been essential part of the physical examination; this is non-invasive, real-time, and very informative. Detection of abnormal respiratory sounds with a stethoscope is important in diagnosing respiratory diseases and providing first aid. However, accurate interpretation of respiratory sounds requires clinician's considerable expertise, so trainees such as interns and residents sometimes misidentify respiratory sounds. To overcome such limitations, we tried to develop an automated classification of breath sounds. We utilized deep learning convolutional neural network (CNN) to categorize 1918 respiratory sounds (normal, crackles, wheezes, rhonchi) recorded in the clinical setting. We developed the predictive model for respiratory sound classification combining pretrained image feature extractor of series, respiratory sound, and CNN classifier. It detected abnormal sounds with an accuracy of 86.5 and the area under the ROC curve (AUC) of 0.93. It further classified abnormal lung sounds into crackles, wheezes, or rhonchi with an overall accuracy of 85.7 and a mean AUC of 0.92. On the other hand, as a result of respiratory sound classification by different groups showed varying degree in terms of accuracy; the overall accuracies were 60.3 for medical students, 53.4 for interns, 68.8 for residents, and 80.1 for fellows. Our deep learning-based classification would be able to complement the inaccuracies of clinicians' auscultation, and it may aid in the rapid diagnosis and appropriate treatment of respiratory diseases

4. Performance evaluation of lung sounds classification using deep learning under variable parameters

Author: Zhaoping Wang and Zhiqiang Sun

Description:
It is desired to apply deep learning models (DLMs) to assist physicians in distinguish ing abnormal/normal lung sounds as quickly as possible. The performance of DLMs depends on feature-related and model-related parameters heavily. In this paper, the relationship between performance and feature-related parameters of a DLM, i.e., convolutional neural network (CNN) is analyzed through experiments. ICBHI 2017 is selected as the lung sounds dataset. The sensitivity analysis of classification perfor mance of the DLM on three parameters, i.e., the length of lung sounds frame, overlap percentage (OP) of successive frames and feature type, is performed. An augmented and balanced dataset is acquired by the way of white noise addition, time stretching and pitch shifting. The spectrogram and mel frequency cepstrum coefficients of lung sounds are used as features to the CNN, respectively. The results of training and test show that there exists significant difference on performance among various parameter combinations. The parameter OP is performance sensitive. The higher OP, the better performance. It is concluded that for fixed sampling frequency 8 kHz, frame size 128, OP 75 and spectrogram feature is optimum under which the performance is rela tively better and no extra computation or storage resources are required.

5. Automated Detection of Pulmonary Diseases From Lung Sound Signals Using Fixed-Boundary-Based Empirical Wavelet Transforms.
Author: Rajesh Kumar Tripathy and Ram Bilas Pachori, Shaswati Dash, Adyasha Rath, Ganapati Panda
Description:
—In this letter, a promising method is proposed to automatically detect pulmonary diseases (PDs) from lung sound (LS) signals. The modes of the LS signal are evaluated using empirical wavelet transform with fixed boundary points. The time-domain (Shannon entropy) and frequency-domain (peak amplitude and peak frequency) features have been extracted from each mode. The classifiers, such as support vector machine, random forest, extreme gradient boosting, and light gradient boosting machine (LGBM), have been chosen to detect PDs using the features of LS signals automatically. The performance of the proposed method has been evaluated using LS signals obtained from

a publicly available database. The detection accuracy values, such as 80.35, 83.27, 99.34, and 77.13 , have been obtained using the LGBM classifier with fivefold cross validation for normal versus asthma, normal versus pneumonia, normal versus chronic obstructive pulmonary disease (COPD), and normal versus pneumonia versus asthma versus COPD classification schemes. For the normal versus pneumonia versus asthma classification scheme, the proposed method has achieved an accuracy value of 84.76, which is higher than that of the existing approaches using LS signals.

Chapter 3

SOFTWARE REQUIREMENT SPECIFICATION

3.1 Introduction

Diagnosing respiratory conditions through lung sounds involves analyzing acoustic signals produced by breathing, such as wheezes, crackles, and rhonchi, which can indicate various respiratory diseases. Traditional methods for analyzing lung sounds rely on manual auscultation, but recent advancements leverage deep learning techniques to automate and enhance diagnosis.

1. User must require the Web Application.
2. Front End –HTML,CSS and Javascript
3. User has to Language– Python 3.8.

3.2 Functional Requirements

3.2.1 System feature

1. Admin - Add Users in the System with Permissions.
User should able to add new Users in the System, and Admin can give Permission for Activities as per Role.

2. User Login.
User should able to login into System after entering the correct password Successfully .

3.Enter Patient Name.
System should accept the patient name.

4. Choose the lung audio from System.
System should capture the lung audio file provided by the user .

5. Detect the accurate result .
System should provide the correct result .

3.2.2 User Interface

There would be efficient user interfaces. There would be a proper provision for the user to input the data and results extracted patterns.

3.2.3 Hardware Interfaces

Mobile Screen or Laptop Screen

3.2.4 Software Interfaces

Web Application

3.3 Non Functional Requirements

3.3.1 Performance Requirement

Performance requirements represent the bar to measure the performance, that is, they represent the benchmark for service measurement, usually defined through a description of the "target level of services", based on a performance indicators regime (KPIs).

3.3.2 Safety Requirement

The safety requirements are those requirements that are defined for the purpose of risk reduction. Like any other requirements, they may at first be specified at a high level, for example, simply as the need for the reduction of a given risk.

3.3.3 Security Requirement

A security requirement is a statement of needed security functionality that ensures one of many different security properties of software is being satisfied. Security requirements are derived from industry standards, applicable laws, and a history of past vulnerabilities. Security requirements define new features or additions to existing features to solve a specific security problem or eliminate a potential vulnerability.

3.3.4 Software Quality Attributes

Our software has many quality attribute that are given below:-

Adaptability: This software is adaptable by all users.

Availability: This software is freely available to all users. The availability of the software is easy for everyone.

Maintainability: After the deployment of the project if any error occurs then it can beeasily maintained by the software developer.

Reliability: The performance of the software is better which will increase the reliability of the Software.

3.4 System Requirements

3.4.1 Dataset Requirements

- Dataset Containg the lung audios of Multiple Peoples

3.4.2 Hardware Requirements

- Laptop or Mobile Phone

3.4.3 Software Requirements

- Anaconda Navigator
- Visual Studio Code

3.5 Analysis Models: SDLC Model to be applied

We are using waterfall model for our project estimation. The Waterfall Model was the first Process Model to be introduced. It is also referred to as a linear-sequential life cycle model. It is very simple to understand and use. In a waterfall model, each phase must be completed before the next phase can begin and there is no overlapping in the phases.

The Waterfall model is the earliest SDLC approach that was used for software development. The waterfall Model illustrates the software development process in a linear sequential flow. This means that any phase in the development process begins only if the previous phase is complete. In this waterfall model, the phases do not overlap.

Waterfall Model - Design

Waterfall approach was first SDLC Model to be used widely in Software Engineering to ensure success of the project. In "The Waterfall" approach, the whole process of software development is divided into separate phases. In this Waterfall model, typically, the outcome of one phase acts as the input for the next phase sequentially. The following illustration is a representation of the different phases of the Waterfall Model.

1. Requirement gathering and analysis:
In this step of waterfall we identify what are various requirements are need for our project such are software and hardware required, database, and interfaces.

2. System Design:
In this system design phase we design the system which is easily understood for end user i.e. user friendly. We design some UML diagrams

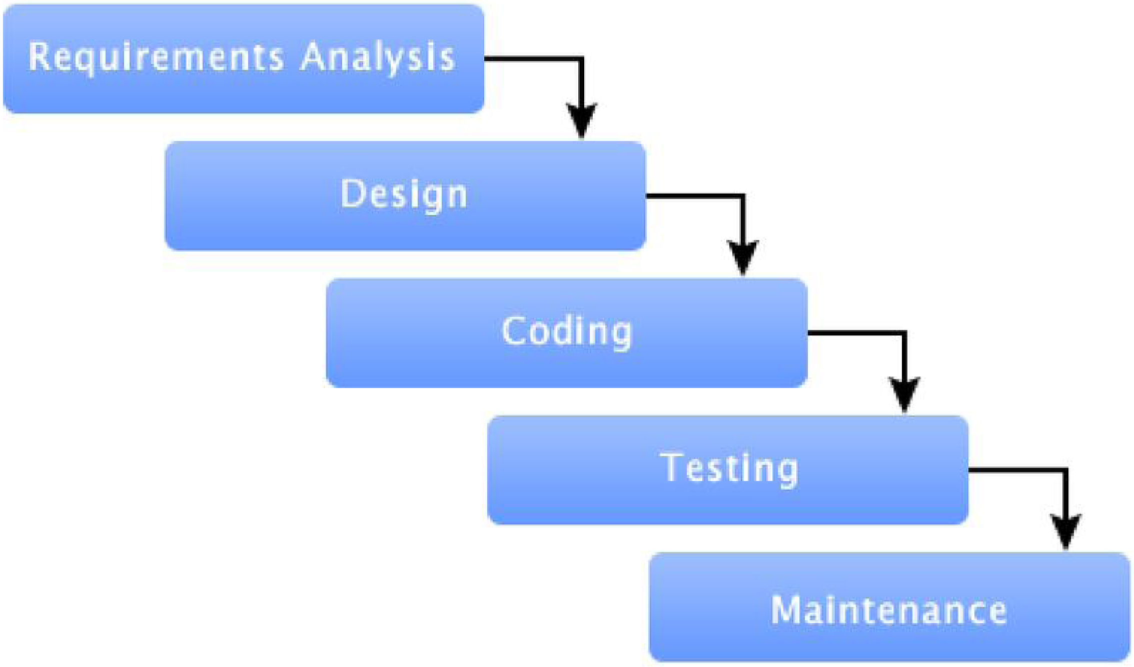


Figure 3.1: SDLC Model

and data flow diagram to understand the system flow and system module and sequence of execution.

3. Implementation:

In implementation phase of our project we have implemented various module required of successfully getting expected outcome at the different module levels. With inputs from system design, the system is first developed in small programs called units, which are integrated in the next phase. Each unit is developed and tested for its functionality which is referred to as Unit Testing.

4. Testing:

The different test cases are performed to test whether the project module are giving expected outcome in assumed time. All the units developed in the implementation phase are integrated into a system after testing of each unit. Post integration the entire system is tested for any faults and failures.

5. Deployment of System:

Once the functional and nonfunctional testing is done, the product is deployed in the customer environment or released into the market.

6. Maintenance:

There are some issues which come up in the client environment. To fix those issues patches are released. Also to enhance the product some better versions are released. Maintenance is done to deliver these changes in the customer environment. All these phases are cascaded to each other in which progress is seen as flowing steadily downwards like a waterfall through the phases. The next phase is started only after the defined set of goals are achieved for previous phase and it is signed off, so the name "Waterfall Model". In this model phases do not overlap.

3.6 System Implementation Plan

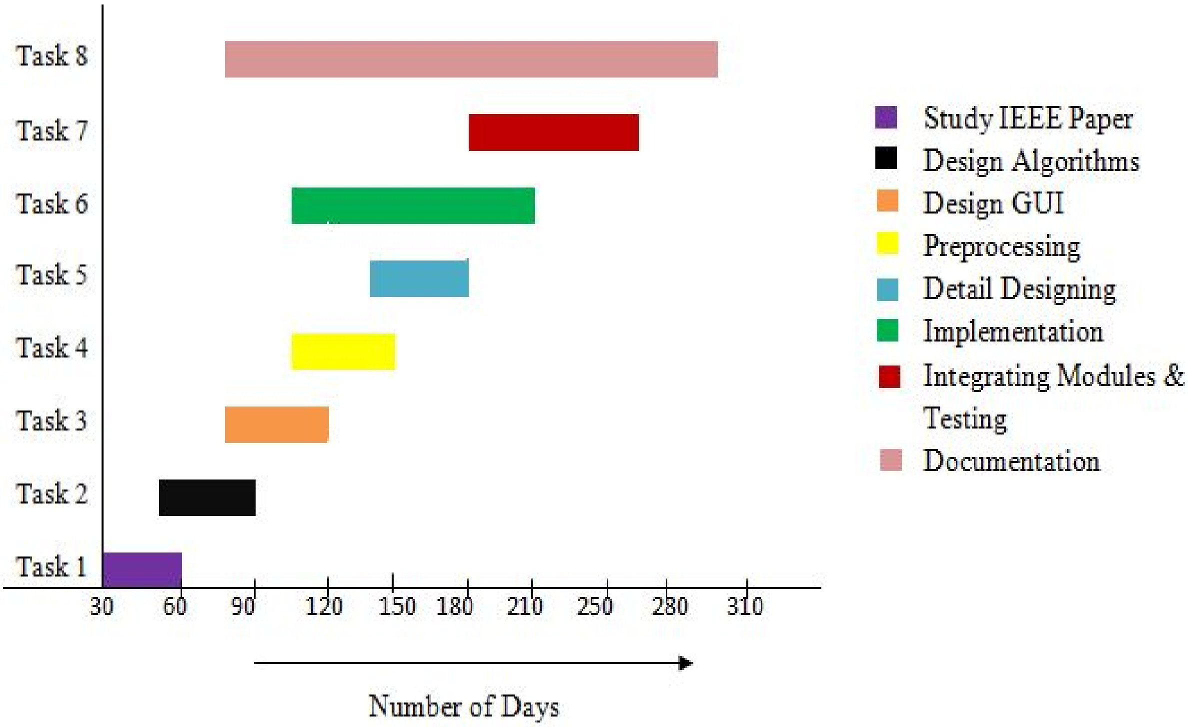


Figure 3.2: System Implementation Plan

Chapter 4

PROJECT PLAN

Sr. No.	Month Sheduled	Phase	Work Done
1	June-August	Topic Seraching	Topic Searched
2	August-September	Topic Selection	Topic Selected
3	August-September	Project Confirmation	Project Confirmed
4	August-September	Literature Survey	Literature Survey Done
5	September-October	Requirement Analysis	Requirement Analysis Done
6	September-October	Requirement Gathering	Requirements Gathered
7	November-December	Designing	Architecture Design
8	November-December	Designing Test	GUI Tested
9	November-December	Database Creation	Database Tested
10	January-February	Coding	Coded Different modules
11	January-February	Database And Module Connectivity	Connectivity Done
12	March	Testing of Project	Project Tested
13	April	Result Analysis	Result Analysis

4.1 Project Estimates

A project estimate gives you and your stakeholders a general idea of how much time, effort, and money it'll take to get the job done. That makes it easier to build a feasible project budget and plan so you can set your team and organization up for success.

4.1.1 Reconciled Estimates

Cost Estimate

The project cost can be found using any one of the model.
COCOMO-1 Model
COCOMO-2 Model
Model -1: The basic COCOMO model computes software development efforts as a function of program size expressed in estimated lines of code.
Model-2: The intermediate COCOMO model computes software development efforts as a function of program size and a set of cost drivers that include subjective assessment of the product, hardware, personnel, project attributes
Model-3: The advanced COCOMO model incorporates all characteristics of the intermediate version with a assessment of the cost drivers impact on each step of the software engineering process. Following is the basic COCOMO -2 model.
The basic COCOMO -2 model equations take form:
E=A(b)KLOCB(b)
D=C(b)ED(b)
Where E is the effort applied in person months. D is development time in chronological month. KLOC is estimated number of delivered lines of code for the project. This project can be classified as Semidetached software project. The rough estimate of number of lines of this project is 9.072k.Applying the above formula
E=1.0*(9.072)1.22
= 11.60 person- months
D=2.5* 11.60
= 9.40 months
Hence according COCOMO -2 model the time required for completion

of the project is 9 (9.40) months.
Cost of Project:
Equation for calculation of cost of project using COCOMO - 2 model is:
C = D * Cp
Where,
C = Cost of project
D = Duration in month
Cp= Cost incurred per person-month,
Cp=Rs.3500/- (per person-month) (approx.)
C = 9 * 3500
= 31500/-
Hence according COCOMO - 2 model the cost of project is 31500/- (approx.)

Time Estimates

Time estimation is a process by which an accurate forecast for the duration of the project is predicted. While this isn't an exact science, it's more than a guess. Time estimation involves the use of various project planning tools and techniques to determine the length of tasks and, thereby, the project.

Tdev=b1*Effort*b2
b1=2.5,b2=0.38 are constant
Tdev=2.5*5.04*0.38
Tdev=4.788 months.

4.1.2 Project Resources

Well configured Laptop, eclipse IDE, 2 GHZ CPU speed, 4 GB RAM, Internet connection.

4.2 Risk Management

1. In appropriate dataset -To overcome this risk we are trying to use well organized and complete dataset. 2. Security- To overcome and

improving security we use multilevel security like access permissions of user.

4.2.1 Risk Identification

For risks identification, review of scope document, requirements specifications and schedule is done. Answers to questionnaire revealed some risks. Each risk is categorized as per the categories mentioned in . Please refer table for all the risks. You can refereed following risk identification questionnaire.

1. Have top software and customer managers formally committed to support the project?
   Ans- Not Applicable

2. Are end-users enthusiastically committed to the project and the system/product to be built?
   Ans- Not known at this time.

3. Are requirements fully understood by the software engineering team and its customers?
   Ans-yes

4. Have customers been involved fully in the definition of requirements?
   Ans-Not applicable
5. Do end-users have realistic expectations?
   Ans-Not applicable
6. Does the software engineering team have the right mix of skills?
   Ans-yes
7. Are project requirements stable? Ans-Not applicable
8. Is the number of people on the project team adequate to do the job? Ans-Not applicable
9. Do all customer/user constituencies agree on the importance of the project and on the requirements for the system/product to be built? Ans-Not applicable

4.2.2 Risk Analysis

The risks for the Project can be analyzed within the constraints of time and quality

ID	Risk Description	Probability	Impact		
			Schedule	Quality	Overall
1	Description 1	Low	Low	High	High
2	Description 2	Low	Low	High	High

Table 4.1: Risk Table

Probability	Value	Description
High	Probability of occurrence is	$> 75\%$
Medium	Probability of occurrence is	$26 - 75\%$
Low	Probability of occurrence is	$< 25\%$

Table 4.2: Risk Probability definitions [?]

Impact	Value	Description
Very high	$> 10\%$	Schedule impact or Unacceptable quality
High	$5 - 10\%$	Schedule impact or Some parts of the project have low quality
Medium	$< 5\%$	Schedule impact or Barely noticeable degradation in quality Low Impact on schedule or Quality can be incorporated

Table 4.3: Risk Impact definitions [?]

4.3 Project Schedule

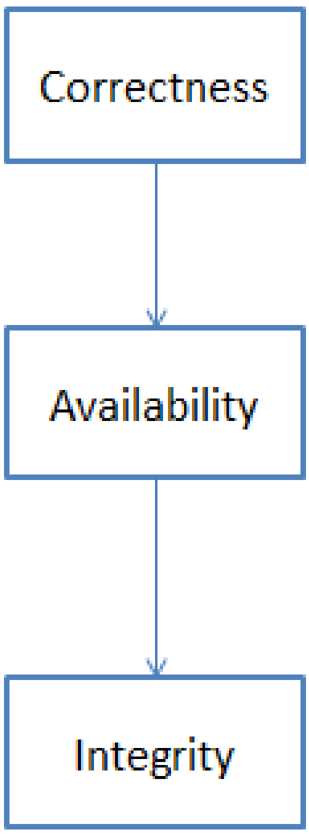
4.3.1 Project task set

Major Tasks in the Project stages are:

- Task 1:Availability
- Task 2: Correctness
- Task 3: Integrity

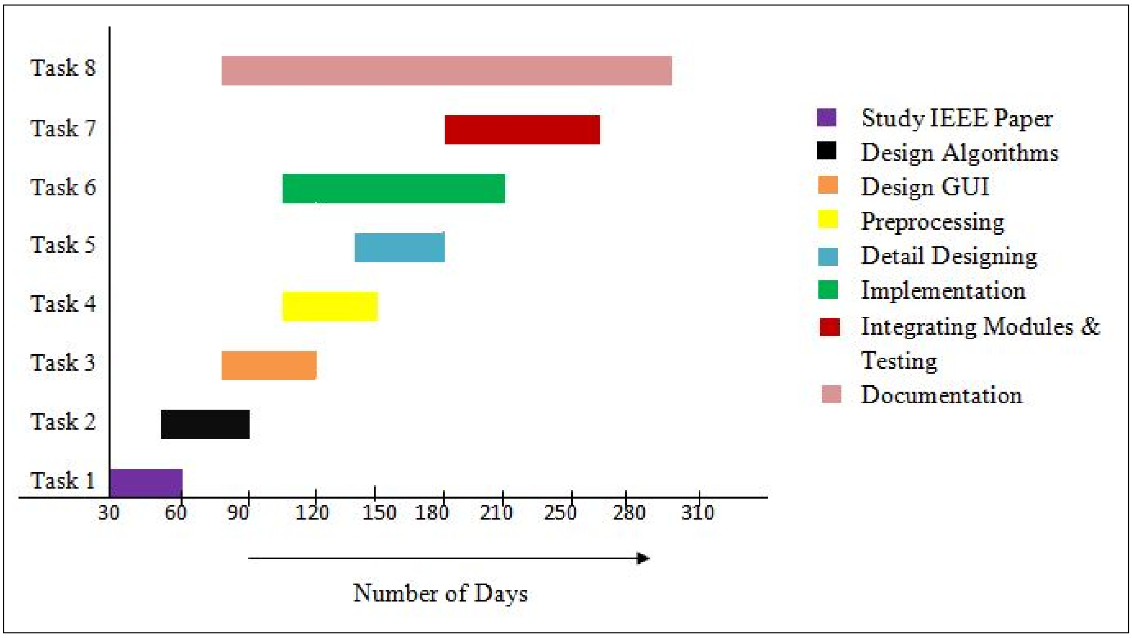
4.3.2 Task network

Project tasks and their dependencies are noted in this diagrammatic form.



4.3.3 Timeline Chart

A project timeline chart is presented. This may include a time line for the entire project. Above points should be covered in Project Planner as Annex C and you can mention here Please refer Annex C for the planner



4.4 Team Organization

Team organization refers to the structure, roles, and processes within a group of individuals working together towards a common goal. It involves determining how tasks are divided, who is responsible for what, how communication flows, and how decisions are made. Effective team organization can significantly impact productivity, collaboration, and overall success.

4.4.1 Team Structure

Group Member 1

Rohit Pawar

1. Report Completion
2. Logbook Completion
3. Workbook Completion
4. Presentation and Coding Completion

5. Testing

Group Member 2

Aditi Raut

1. Report Completion
2. Logbook Completion
3. Workbook Completion
4. Presentation and Coding Completion
5. Testing

Group Member 3

Sneha Jadhav

1. Report Completion
2. Logbook Completion
3. Workbook Completion
4. Presentation and Coding Completion
5. Testing

4.4.2 Management reporting and communication

Sr. No.	Month	Descreption
1	June	Descussion with guide regarding domain. Searching for IEEE paper for domain
2	July	Shortlisted of IEEE papers withn domain. Selection of IEEE paper
3	August	Deciding Project Name. Submission of Synopsis.
4	September	Requirement analysis. Designing of Model.
5	October	Report Preparation. Stage-1 report submission.
6	November	Design Remaining part of model.
7	December	Work on User Interface.
8	January	Work on Database
9	February	Main logic implementation
10	March	Whole modules Combine together.
11	April	Testing.

Chapter 5

SYSTEM DESIGN

The system for diagnosing respiratory conditions using lung sounds combines Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks. Lung sound data, such as wheezes, crackles, and normal breath sounds, is collected from publicly available datasets (e.g., PhysioNet or Kaggle). The raw audio is preprocessed into spectrograms (e.g., Mel-spectrograms), which are then fed into a CNN for feature extraction. The CNN identifies key frequency and time patterns, while the LSTM captures temporal dependencies in the sound sequences, essential for identifying events like wheezing or coughing.

The model is trained using labeled data and evaluated on metrics such as accuracy, precision, and recall. Hyperparameters like the number of CNN filters and LSTM units are optimized to improve performance. The system is implemented using deep learning frameworks like TensorFlow or Keras, with audio preprocessing handled by libraries such as Librosa. The resulting model can classify lung sounds into conditions like asthma or pneumonia.

5.1 Data Flow Diagram

A data Flow diagram (DFD) is used to depict the flow of data through an information system using a graphical representation that models process aspects. A DFD shows types of information given as input to and output from the system which will help to understand where the data will come from and go to, and where the data will be stored.DFDs can also be used for the visualization of data processing.

Proposed System Architecture

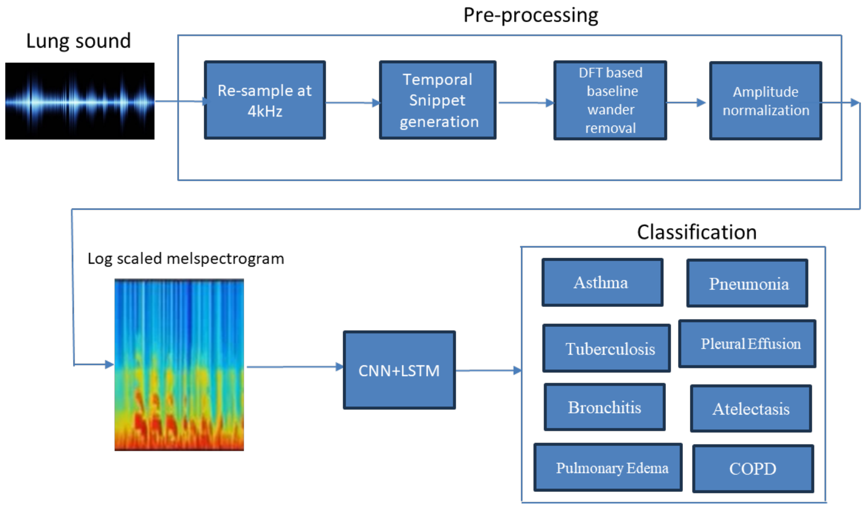


Figure 5.1: System Architecture

5.1.1 Level 0 Data Flow Diagram

DFD 1 Diagram shows our project at High Level, As Mentioned in the below Diagram We can get Idea of Our Flow of the Project.

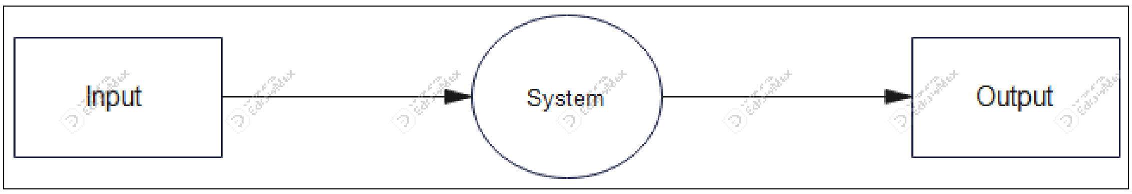


Figure 5.2: DFD level 0

5.1.2 Level 1 Data Flow Diagram

DFD 1 Diagram shows our project at Detail Level, As Mentioned in the below Diagram We can get Flow of Our the Project in Detail.

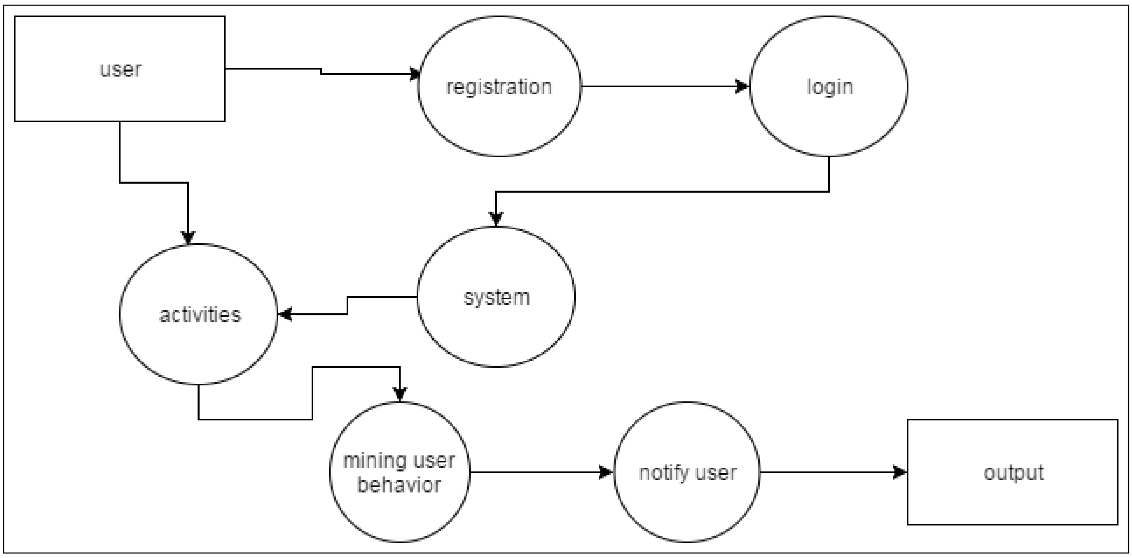


Figure 5.3: DFD level 1

5.2 UML Diagrams

5.2.1 Use-cases

A use case diagram in the Unified Modeling Language (UML) is a type of behavioral diagram defined by and created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. The main purpose of a use case diagram is to show what system functions are performed for which actor. Roles of the actors in the system can be depicted.

So in below Diagram, We have represented how User will Intact with the system and which type type of actions he can Do and How System will React as per his action.

Use Case View

Use Case Diagram. Example is given below. In below Use Case Diagram We have shown how user will perform activities and how our system will response.The User interacts with the system by providing audio or labeled data, which triggers a chain of processes. Admin can manage user data and monitor the processes. The system performs data preprocessing, feature extraction, model training, and classification, providing results to the User. This setup allows the system to continuously improve its classification model with new data, enhancing its accuracy over time.

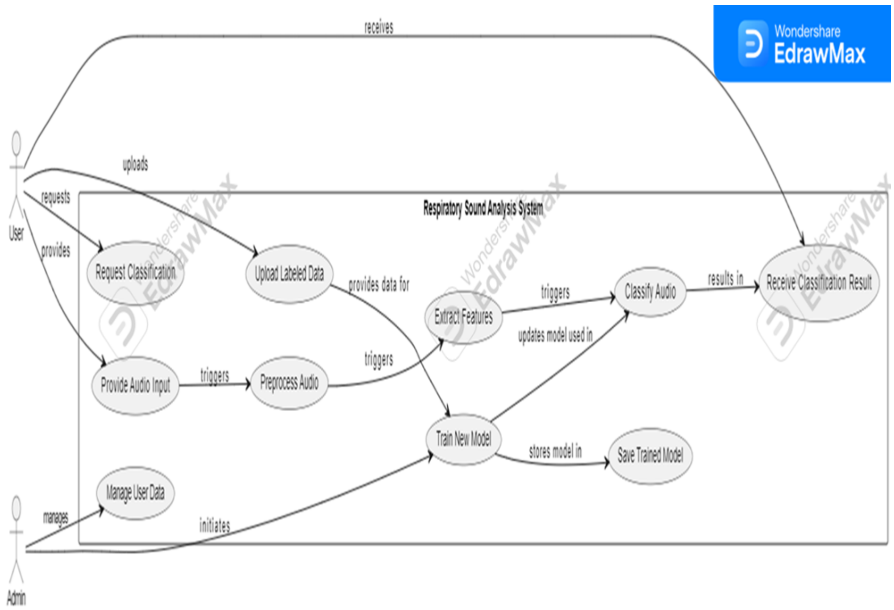


Figure 5.4: Use case diagram

Activity Diagram:

- Activity diagrams are graphical representations of work flows of step wise activities and actions with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams can be used to describe the business and operational step-by-step work flows of components in a system. An activity diagram shows the overall flow of control.

  In below Digram we mentioned the Activity Step by Stp. The diagram illustrates a looped process where the user can repeatedly upload audio, train models, and classify sounds. It shows decision points, such as whether training or classification is required, allowing for flexibility in the system's usage. The system uses extracted features for both model training and classification, optimizing the analysis of respiratory sounds. This structured process allows the system to handle multiple use cases, whether the user wants to classify new audio immediately or improve the model by training with labeled data.

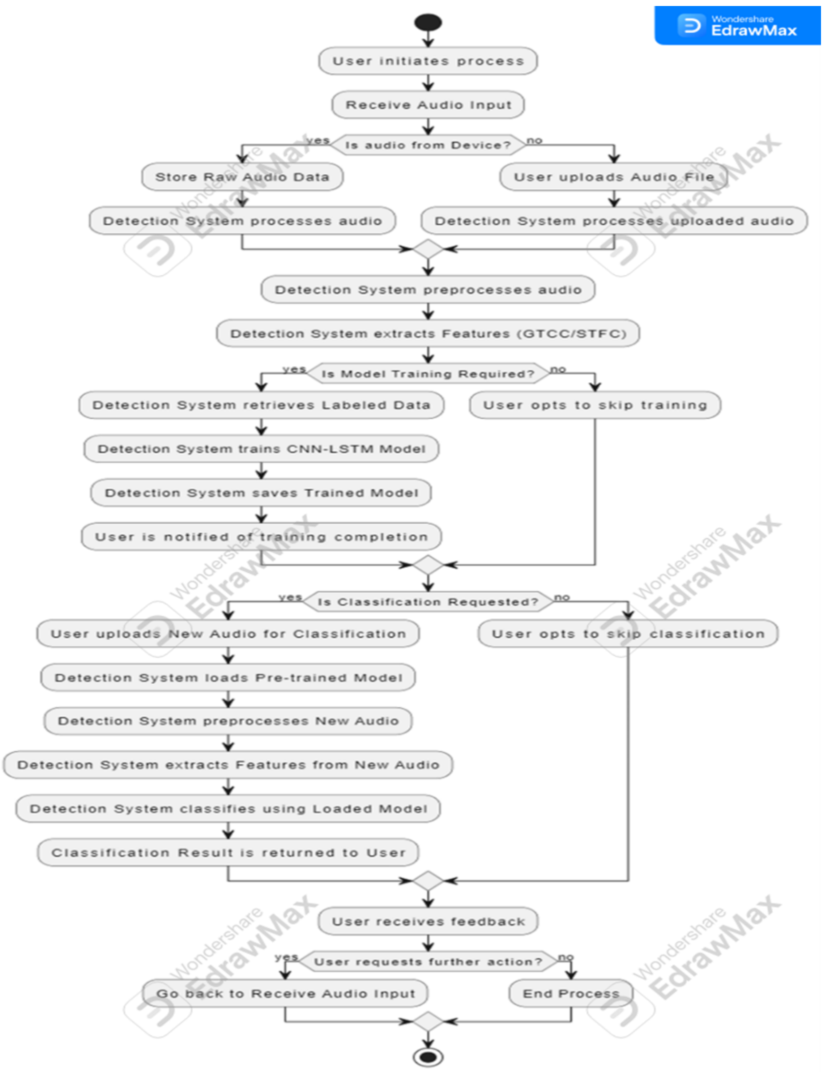


Figure 5.5: Activity Diagram

5.2.2 Sequence Diagram:

The sequence diagram outlines a process for predicting lung disease using sound data collected from a patient's lungs. Initially, the patient records lung sound data, which is then provided to a dataset module to organize the data. This raw sound data is passed to a preprocessing module, where noise is filtered out and the data is normalized. Once preprocessed, the data moves to a Convolutional Neural Network (CNN) layer that extracts important features. These features are then sent to a Long Short-Term Memory (LSTM) layer, which processes temporal dependencies within the data. The processed features are subsequently sent to a prediction model, which analyzes the information to predict disease and calculate the probability of its presence. Finally, the prediction results are sent to a doctor for review and potential diagnosis based on the predictions provided. Each module in this sequence represents a crucial step in transforming raw lung sound data into a medical prediction for decision-making.

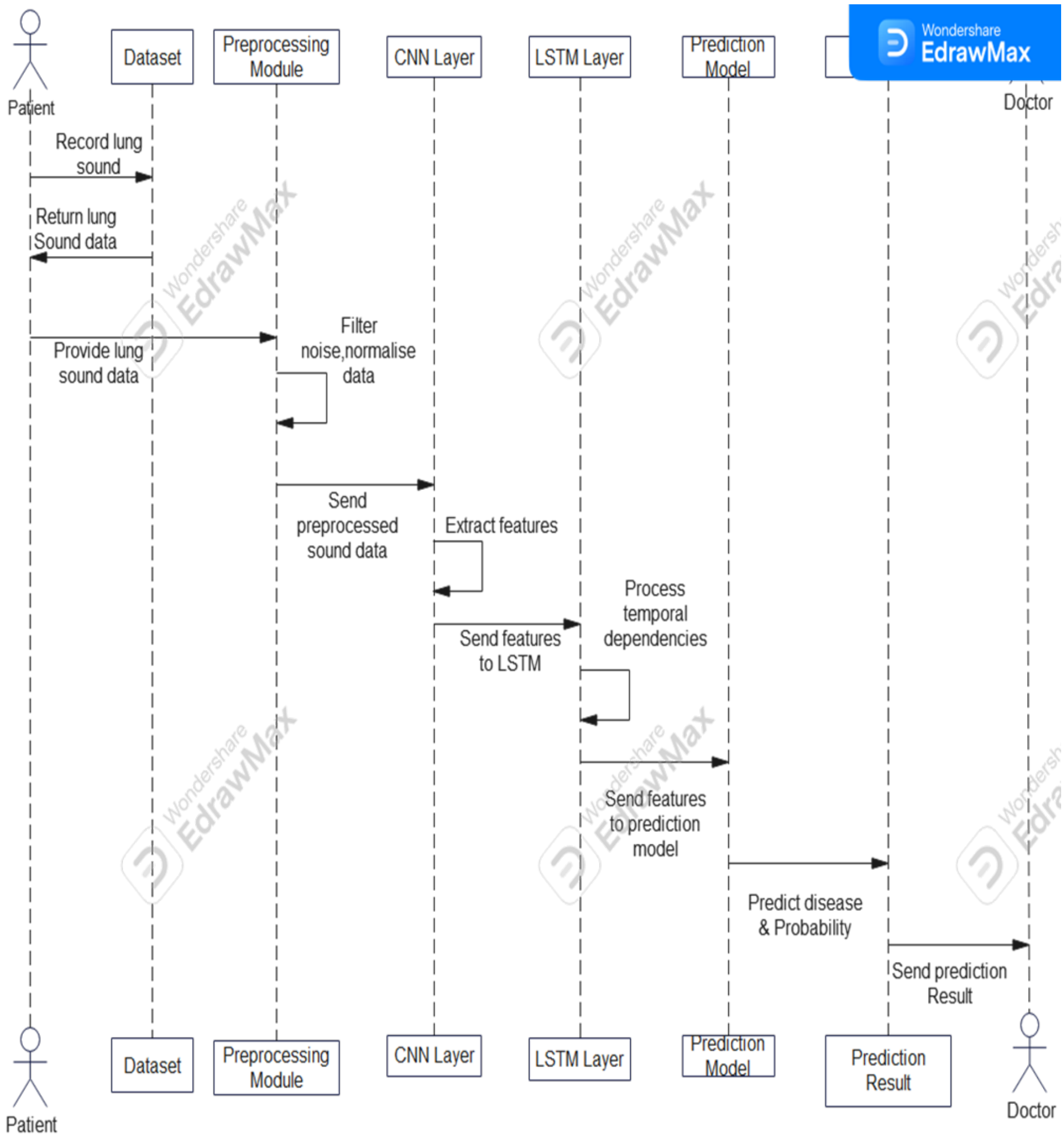


Figure 5.6: Sequence Diagram

5.2.3 Class Diagram:

The class diagram is a static diagram. It represents the static view of an application. Class diagram is not only used for visualizing, describing and documenting different aspects of a system but also for constructing executable code of the software application. The class diagram describes the attributes and operations of a class and also the constraints imposed on the system. The class diagrams are widely used in the modeling of object oriented systems because they are the only UML diagrams which can be mapped directly with object oriented languages. The class diagram shows a collection of classes, interfaces, associations, collaborations and constraints. It is also known as a structural diagram. The purpose of the class diagram is to model the static view of an application.
AS per Above Description of class Diagram, We have presented Structure of our Project in below Diagram.All the Classes there responsibilities and Interfaces between classes has been mentioned in below Class Diagram.

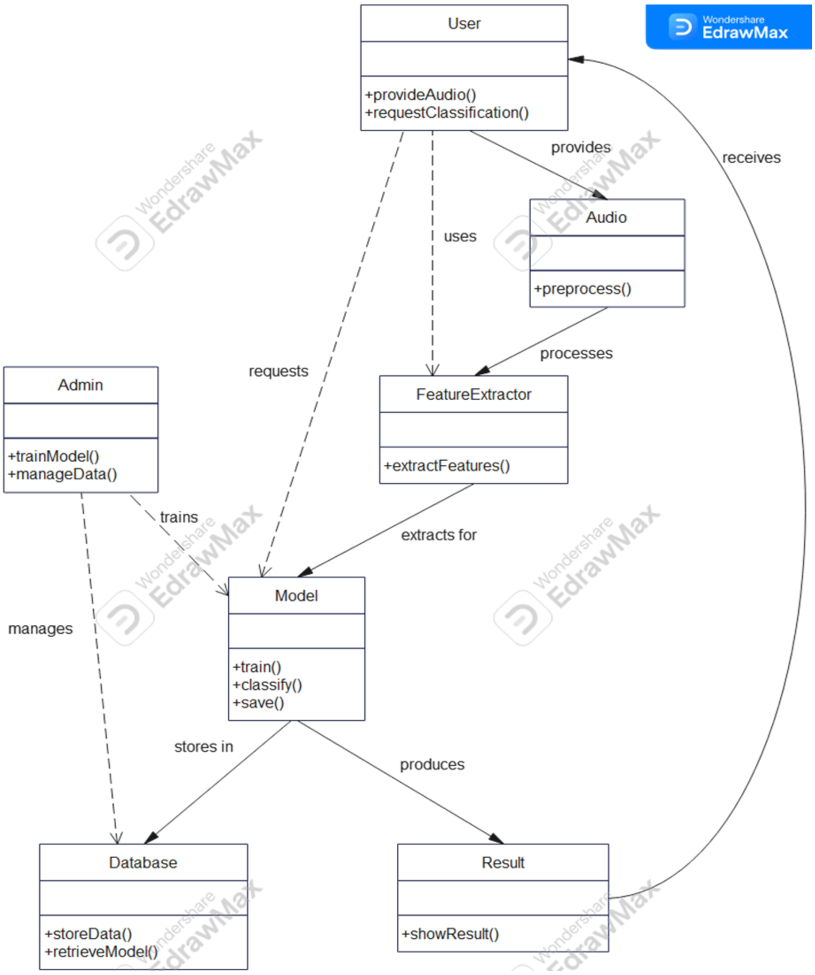


Figure 5.7: Class Diagram

Chapter 6

PROJECT IMPLEMENTATION

6.1 Overview of Project Modules

Step 1- Data Collection: Gather lung sound recordings with labeled respiratory conditions.

Step 2- Data Preprocessing: Clean audio, remove noise, convert to spectrograms, and split data.

Step 3- Feature Extraction: Extract meaningful features (e.g., MFCCs) from audio spectrograms.

Step 4- Model Building: Design a CNN-LSTM model to analyze spatial and temporal patterns.

Step 5-Model Training: Train the model on processed data, tuning for accuracy.

Step 6-Model Evaluation: Test the model on unseen data, assessing accuracy and reliability.

Step 7:File Upload: For recording or uploading lung sound audio.

Step 8-Diagnosis Display: Show predicted condition and confidence score.

Step 9-Admin Panel: Manage user access and monitor usage metrics. Deployment: Deploy as a web app for accessible, real-time diagnostic support.

6.2 Tools and Technologies Used

6.2.1 Technology Description

The entire development process has been subdivided into Three:

1. Front End - HTML , CSS , Javascript
2. Backend - Python

Front End - HTML ,CSS , Javascript

1)HTML: HTML (Hypertext Markup Language) is the standard language used to structure content on the web. It uses tags to define elements like text, images, and links, organizing them in a way that browsers can display correctly. An HTML document typically includes a ¡!DOCTYPE¿ declaration, followed by ¡html¿, ¡head¿, and ¡body¿ sections. The ¡head¿ contains metadata, while the ¡body¿ holds the visible content. HTML also supports attributes that provide additional information for elements, such as links and images. It forms the foundation of web development, working alongside CSS for styling and JavaScript for interactivity.

2)CSS:CSS (Cascading Style Sheets) is a stylesheet language used to define the look and feel of a web page. While HTML structures the content of a webpage, CSS controls its visual presentation, including aspects like colors, fonts, spacing, layout, and positioning. CSS allows developers to separate the design from the content, making web pages easier to manage and maintain. It uses selectors to target HTML elements and applies styles through properties and values, such as setting the background color or adjusting font size. CSS follows a "cascading" rule system, where more specific styles can override general ones. By using inline, internal, or external styles, CSS enables consistent and responsive design across multiple web pages, working in tandem with HTML and JavaScript to create modern, interactive websites.

3)Javascript:JavaScript is a programming language used to add interactivity and dynamic behavior to websites. It enables features such as form validation, animations, real-time updates, and interactive elements like buttons and menus.

Unlike HTML and CSS, which structure and style web pages, JavaScript allows developers to manipulate the content and respond to user actions in real-time without refreshing the page. It runs in the browser and supports asynchronous operations, such as fetching data from a server in the background. JavaScript, along with HTML and CSS, is essential for creating modern, interactive, and user-friendly web applications.

Backend - Python

Python is a high-level, easy-to-read programming language known for its simplicity and versatility. It is widely used in fields like web development, data analysis, artificial intelligence, and automation. Python supports various programming paradigms, including object-oriented and functional programming, and has a large standard library and an extensive ecosystem of third-party packages. Its clear syntax and strong community support make it a popular choice for developers, from beginners to experts, and it continues to grow in demand for solving diverse technical problems.

6.2.2 Hardware Specifications

Hard Disk: Greater than 500 GB, RAM : Greater than 4 GB, Processor : core i3 and above

6.2.3 Software Specifications

Visual Studio Code

Visual Studio Code (VS Code) is a free, open-source code editor developed by Microsoft, widely used for programming in various languages such as Python, JavaScript, and HTML. It offers features like IntelliSense (smart code completion), debugging tools, and integrated Git support for version control. VS Code is highly customizable with a large library of extensions and is available on Windows, macOS, and Linux. Its lightweight, fast performance and versatility make it a popular choice among developers for a wide range of coding tasks.

Anaconda Navigator

Anaconda Navigator is a user-friendly graphical interface that comes with the Anaconda distribution, designed to simplify the management of packages, environments, and applications. It allows users to easily create and manage virtual environments, install or update packages, and launch tools like Jupyter Notebook and Spyder without using the command line. Anaconda Navigator is especially useful for beginners and data scientists, offering an intuitive way to handle Python and R-based projects and workflows.

Chapter 7

CONCLUSIONS

7.1 Conclusions

Looking at the audio content, it is difficult to classify respiratory sounds. In our research, a system is presented for distinction of healthy and non-healthy lung sounds which is very important prior to further diagnosis of the type and severity of infection. We have performed our experiments using a publicly available dataset and evaluations indicate that the highest accuracy of 99.22 with an AUC value of 0.9993 is obtained.

Automated adventitious sounds detection or classification provides a promising solution to overcome the limitations of conventional auscultation. In future the subject area for future investigation will be: To use larger dataset and test further on robustness in presence of higher percentages of noise.Attempts will also be made towards isolation of breath sounds from the ambient noises and heart- beat sounds for better analysis.Other acoustic techniques will be applied for even better modelling of the lung sounds along with deep learning based approaches.To have clinical use in pulmonary health screening and as a tool in differential diagnosis of pulmonary diseases.Finally, we will be trying to identify the nature and severity of infection from the breath sounds.

Chapter 8

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