An Industry-Oriented Mini Project Report

On

"Early Detection of Lung Cancer Using Random Forest"

Submitted in Partial Fulfillment of
the Academic Requirement for the
Award of Degree of

BACHELOR OF TECHNOLOGY

in

Computer Science and Engineering (Data Science)

Submitted By:

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Under the esteemed guidance of

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CMR INSTITUTE OFTECHNOLOGY

(UGC AUTONOMOUS)

Approved by AICTE, Permanent Affiliation to JNTUH, Accredited by NBA and NAAC

Kandlakoya(V), Medchal Dist - 501 401

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CERTIFICATE

This is to certify that an Industry oriented Mini Project entitled with **"EARLY DETECTION OF LUNG CANCER USING RANDOMFOREST"** is being submitted by:

B. VAIBHAVI (22R01A67D9)

To JNTUH, Hyderabad, in partial fulfillment of the requirement for award of the degree of B.Tech in CSE (Data Science) and is a record of a Bonafide work carried out under our guidance and supervision. The results in this project have been verified and are found to be satisfactory. The results embodied in this work have not been submitted to have any other University for award of any other degree or diploma.

Signature of Guide	Signature of Project Coordinator	Signature of HOD
Mr. K. Vinay Kumar	Mr. K. Vinay Kumar	Dr. A. Nirmal Kumar

EXTERNAL EXAMINER

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B. VAIBHAVI (22R01A67D9)

ABSTRACT

Lung cancer is one of the leading causes of mortality worldwide, making early detection crucial for improving patient outcomes. This project focuses on developing a machine learning-based lung cancer prediction system, incorporating both patient and doctor modules for efficient diagnosis and monitoring. The system enables doctors to sign up, log in, and access a dashboard displaying patients' disease input values and predicted cancer stages in both visual and tabular formats. Patients can also register, log in with OTP verification, and train the machine learning model using the Random Forest algorithm. The application allows patients to visualize lung disease data based on factors such as gender and environmental hazards. By inputting disease-related values ranging from 1 to 8, the system predicts the cancer stage and securely stores patient records for further analysis by doctors. The predictive model is trained on a dataset that undergoes preprocessing, encoding, and feature scaling to enhance accuracy. The platform also generates various data visualizations, including gender-wise analysis of chest pain, smoking, and alcohol use, as well as occupational hazards and symptoms like snoring and dry cough. The integration of machine learning enhances diagnostic accuracy, offering valuable insights into lung cancer progression while providing an interactive and user-friendly interface for both patients and medical professionals.

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1. INTRODUCTION

1.1 ABOUT PROJECT

Lung cancer is a major global health concern, contributing to a significant percentage of cancer-related deaths. It is primarily caused by prolonged exposure to harmful substances such as tobacco smoke, environmental pollutants, and occupational hazards. Early detection of lung cancer plays a vital role in increasing survival rates, as treatment options are more effective in the initial stages of the disease. However, traditional diagnostic methods, such as biopsies and imaging tests, are often time-consuming, expensive, and sometimes inconclusive. This necessitates the development of advanced predictive models that can assist in early detection and risk assessment.

Machine learning has emerged as a powerful tool in healthcare, enabling the development of intelligent systems that can analyze vast amounts of patient data to detect patterns and predict diseases with high accuracy. In this project, a machine learning-based lung cancer prediction system is designed to facilitate early diagnosis by analyzing patient symptoms and risk factors. The system integrates a predictive model trained using the Random Forest algorithm, which classifies patients based on predefined risk factors and provides a stage-wise assessment of lung cancer.

The proposed system consists of two main user modules: the **Doctor Module** and the **Patient Module**. Doctors can sign up, log in, and access dashboards displaying patient data, predictions, and visual analytics. Patients, on the other hand, can register, log in via OTP authentication, and enter their medical details to receive predictions regarding their lung health status. The system also enables patients to train the machine learning model with disease-specific values, enhancing the model's accuracy over time.

A key feature of this system is its ability to generate insightful data visualizations. It analyzes various parameters such as gender-wise distributions of chest pain, smoking habits, alcohol consumption, and exposure to occupational hazards. Additionally, it examines common symptoms such as dry cough and snoring, offering a comprehensive understanding of potential risk factors. These visual insights aid doctors in making informed decisions while allowing patients to understand their health risks more effectively.

The prediction model is built using a structured dataset that undergoes preprocessing steps, including missing value handling, encoding categorical data, and feature scaling. By leveraging machine learning techniques, the system improves diagnostic precision and reduces the chances of false negatives or positives. The Random Forest algorithm, known for its robustness and efficiency, ensures reliable classification of patients into different lung cancer risk categories, thus enhancing the decision-making process for both medical professionals and patients.

The primary objective of this project is to bridge the gap between traditional diagnostic methods and modern computational approaches. By integrating machine learning, the system provides a faster, more accessible, and cost-effective alternative to lung cancer detection. This not only reduces the burden on healthcare facilities but also empowers patients to take proactive measures regarding their health. With continuous updates and refinements in the predictive model, this system has the potential to revolutionize lung cancer screening and contribute to improved patient care and survival rates.

1.2 LITERATURE SURVEY

World Health Organization (WHO). (2023). Global Cancer Statistics

The World Health Organization (WHO) provides extensive global cancer statistics, offering insights into the prevalence, incidence, and mortality rates of various cancer types, including lung cancer. According to the WHO's 2023 report, lung cancer remains the leading cause of cancer-related deaths worldwide, with tobacco use being the primary risk factor. The report emphasizes the need for early detection and improved screening techniques to reduce mortality rates. WHO also highlights the disparities in lung cancer prevalence across different regions, attributing variations to differences in lifestyle, air pollution exposure, and access to healthcare services. The report advocates for implementing effective policies such as smoking cessation programs, air quality regulations, and awareness campaigns to mitigate lung cancer risks. The data presented by WHO serves as a foundation for researchers, policymakers, and healthcare professionals to design interventions and policies that can reduce the global burden of lung cancer and improve patient outcomes.

American Cancer Society. (2023). Lung Cancer Facts and Figures

The American Cancer Society (ACS) provides an in-depth analysis of lung cancer statistics, including new cases, survival rates, and mortality trends. The 2023 report underscores that lung cancer accounts for approximately 25% of all cancer-related deaths in the United States. It categorizes lung cancer into small cell lung cancer (SCLC) and non-small cell lung cancer (NSCLC), noting that NSCLC comprises around 85% of all cases. The report highlights risk factors such as smoking, secondhand smoke exposure, radon gas, and genetic predisposition. Additionally, it discusses the effectiveness of lung cancer screening methods like low-dose computed tomography (LDCT) in detecting tumors at an early, treatable stage. The ACS emphasizes the importance of public awareness campaigns, smoking cessation programs, and advancements in targeted therapies and immunotherapy in improving survival rates. The data from ACS is crucial for healthcare professionals, researchers, and policymakers in developing better prevention and treatment strategies for lung cancer.

National Cancer Institute. (2023). Lung Cancer Screening Guidelines

The National Cancer Institute (NCI) provides detailed lung cancer screening guidelines aimed at early detection and improved survival rates. The 2023 guidelines focus on the use of low-dose computed tomography (LDCT) as the primary screening tool for high-risk individuals, particularly those aged 50 to 80 with a significant smoking history. The report discusses the benefits of early detection, emphasizing that screening can reduce lung cancer mortality by up to 20% in high-risk populations. It also addresses potential risks, such as false positives, overdiagnosis, and radiation exposure. NCI highlights the importance of integrating screening programs with smoking cessation efforts to maximize the benefits of early detection. Additionally, the guidelines discuss the role of emerging technologies, including artificial intelligence (AI) and machine learning, in enhancing the accuracy of lung cancer diagnosis. The NCI's recommendations serve as a valuable resource for clinicians, researchers, and public health officials working to improve lung cancer outcomes.

Han, X., & He, Y. (2022). Machine Learning in Lung Cancer Detection: A Systematic Review

Han and He (2022) present a comprehensive review of machine learning (ML) applications in lung cancer detection, diagnosis, and prognosis. The study highlights the role of ML algorithms in analyzing medical imaging data, particularly computed tomography (CT) and positron emission tomography (PET) scans. The authors discuss various ML techniques, including support vector machines (SVM), convolutional neural networks (CNN), and deep learning models, which have demonstrated high accuracy in detecting lung nodules. The review also examines challenges

interpretability, and the need for standardized validation protocols. Furthermore, the study emphasizes the integration of ML with clinical decision support systems to assist radiologists in diagnosing lung cancer more efficiently. The findings suggest that while ML shows significant promise in lung cancer detection, further research is needed to address biases, improve generalizability, and develop robust AI-driven diagnostic tools for real-world clinical applications.

1.3 EXISTING SYSTEM

The existing system for lung cancer detection primarily relies on conventional diagnostic methods such as chest X-rays, sputum cytology, and biopsy-based histopathological examinations. Chest X-rays are often used as an initial screening tool, but they lack sensitivity in detecting early-stage lung cancer. Sputum cytology, which examines mucus from the lungs under a microscope, can help identify abnormal cells but has limited accuracy due to its dependence on sample quality. Biopsy-based histopathological examination remains the gold standard for lung cancer diagnosis, yet it is an invasive procedure that carries risks such as infection and bleeding. Additionally, computed tomography (CT) scans and positron emission tomography (PET) scans are widely used for detailed imaging, but manual interpretation by radiologists is time-consuming and prone to human error. The existing system faces challenges such as late-stage diagnosis, high false-positive rates, and limited accessibility to advanced screening techniques, highlighting the need for automated and AI-driven approaches for improved lung cancer detection.

DISADVANTAGES

1. **Late Diagnosis** – Traditional methods often fail to detect lung cancer in its early stages, leading to delayed treatment and reduced survival rates.
2. **High False Positives and False Negatives** – Imaging techniques such as X-rays and CT scans may produce inaccurate results, leading to unnecessary biopsies or missed diagnoses.
3. **Invasive Procedures** – Biopsy, the gold standard for diagnosis, is an invasive procedure that can cause complications such as infections, bleeding, and patient discomfort.
4. **Time-Consuming and Expensive** – Manual interpretation of imaging scans and lab tests requires skilled professionals, increasing diagnosis time and healthcare costs.
5. **Limited Accessibility** – Advanced diagnostic tools like PET scans and molecular testing are not widely available in rural or underdeveloped regions, limiting early detection and treatment options.

1.4 PROPOSED SYSTEM

The proposed system leverages advanced machine learning and deep learning techniques to enhance the early detection and diagnosis of lung cancer. By integrating artificial intelligence (AI) with medical imaging, the system aims to improve accuracy, reduce diagnostic errors, and minimize the need for invasive procedures. Convolutional Neural Networks (CNNs) and Random Forest algorithms are employed to analyze lung scans, identify patterns, and classify cancer stages with higher precision. Additionally, the system utilizes automated feature extraction and selection methods to improve efficiency and reduce dependency on manual interpretation by radiologists. By incorporating a large dataset of lung cancer cases, the model is trained to recognize subtle abnormalities that may be missed by traditional screening methods. This AI-driven approach enables faster and more reliable detection, ultimately leading to timely treatment and improved patient outcomes. Moreover, the proposed system enhances accessibility by making AI-based diagnostic tools available in remote areas through cloud-based platforms.

ADVANTAGES

1. **Higher Accuracy in Diagnosis** – The use of advanced machine learning algorithms, such as CNNs and Random Forest, improves the precision of lung cancer detection, reducing false positives and false negatives.
2. **Early Detection and Faster Diagnosis** – AI-driven analysis helps in identifying cancer at an early stage, enabling timely medical intervention and increasing survival rates.
3. **Reduced Dependency on Manual Interpretation** – Automated feature extraction minimizes human errors and decreases the workload on radiologists, leading to more consistent and reliable results.
4. **Enhanced Accessibility and Remote Diagnosis** – Cloud-based AI tools allow medical professionals in remote or underdeveloped areas to access advanced diagnostic capabilities without needing specialized equipment.
5. **Minimized Need for Invasive Procedures** – The system reduces reliance on biopsies and other invasive diagnostic methods by providing accurate non-invasive screening options through medical imaging analysis.

2. SYSTEM STUDY

2.1 FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

- ECONOMICAL FEASIBILITY
- TECHNICAL FEASIBILITY
- SOCIAL FEASIBILITY

ECONOMICAL FEASIBILITY

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus, the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

SOCIAL FEASIBILITY

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.

2.2 SYSTEM REQUIREMENTS

- H/W System Configuration: -
- Processor - Pentium –IV
- RAM - 4 GB (min)
- Hard Disk - 20 GB
- Key Board - Standard Windows Keyboard
- Mouse - Two or Three Button Mouse
- Monitor - SVGA

SOFTWARE REQUIREMENTS:

- Operating system : Windows 7 Ultimate.
- Coding Language : Python.

3. SYSTEM DESIGN

3.1 SYSTEM ARCHITECTURE

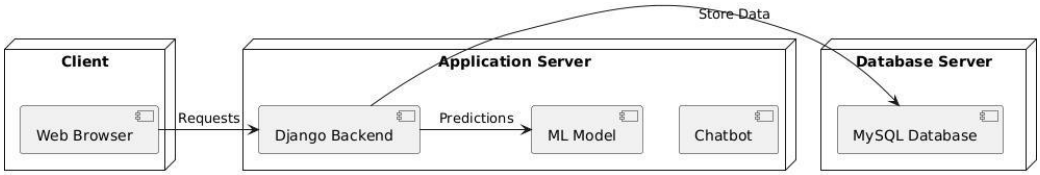


Figure-3.1.1: System Architecture Diagram

3.2 UML DIAGRAMS

UML stands for Unified Modeling Language. UML is a standardized general-purpose modeling language in the field of object-oriented software engineering. The standard is managed, and was created by, the Object Management Group. The goal is for UML to become a common language for creating models of object-oriented computer software. In its current form UML is comprised of two major components: a Meta-model and a notation. In the future, some form of method or process may also be added to; or associated with, UML.

The Unified Modeling Language is a standard language for specifying, Visualization, Constructing and documenting the artifacts of software system, as well as for business modeling and other non-software systems. The UML represents a collection of best engineering practices that have proven successful in the modeling of large and complex systems. The UML is a very important part of developing objects-oriented software and the software development process. The UML uses mostly graphical notations to express the design of software projects.

GOALS: The Primary goals in the design of the UML are as follows:

- Provide users a ready-to-use, expressive visual modeling Language so that they can develop and exchange meaningful models.
- Provide extendibility and specialization mechanisms to extend the core concepts.
- Be independent of particular programming languages and development process.
- Provide a formal basis for understanding the modeling language.
- Encourage the growth of OO tools market.
- Support higher level development concepts such as collaborations, frameworks, patterns and components.
- Integrate best practices.

3.2.1 Class diagram

The class diagram is used to refine the use case diagram and define a detailed design of the system. The class diagram classifies the actors defined in the use case diagram into a set of interrelated classes. The relationship or association between the classes can be either an "is-a" or "has-a" relationship. Each class in the class diagram was capable of providing certain functionalities. These functionalities provided by the class are termed "methods" of the class. Apart from this, each class may have certain "attributes" that uniquely identify the class.

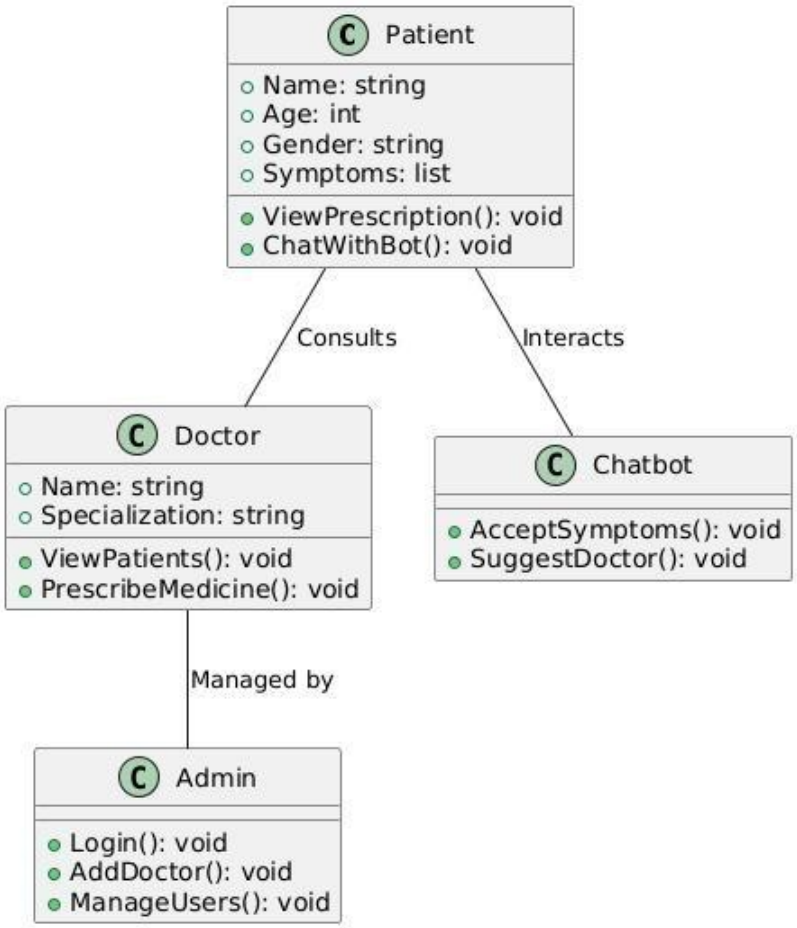


Figure-3.2.1: Class Diagram

3.2.2 Sequence Diagram

A sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. A sequence diagram shows, as parallel vertical lines ("lifelines"), different processes or objects that live simultaneously, and as horizontal arrows, the messages exchanged between them, in the order in which they occur. This allows the specification of simple runtime scenarios in a graphical manner.

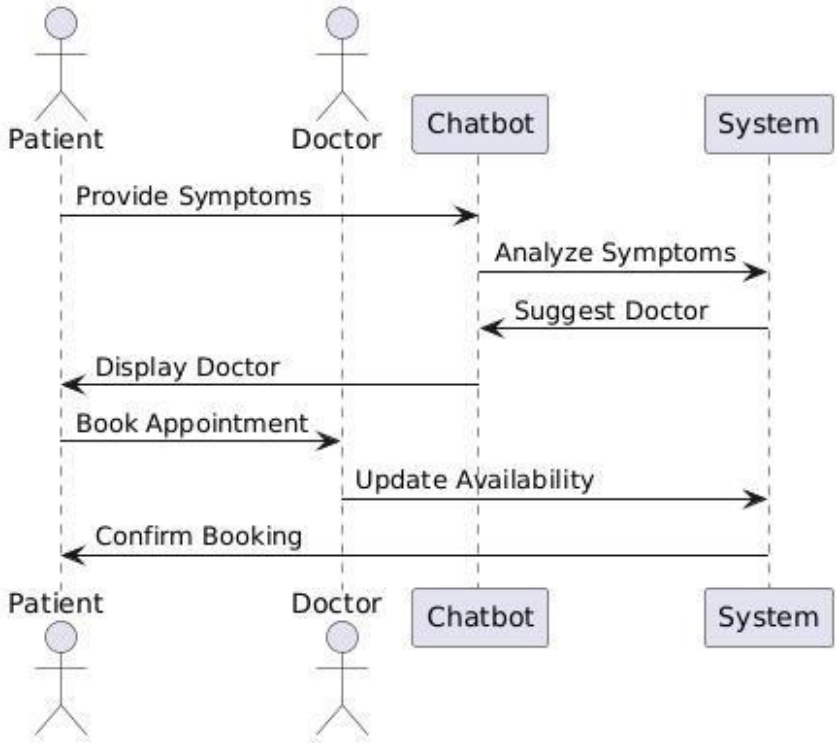


Figure-3.2.2: Sequence Diagram

3.2.3 Activity diagram

Activity diagrams are graphical representations of Workflows of stepwise 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 workflows of components in a system. An activity diagram shows the overall flow of control.

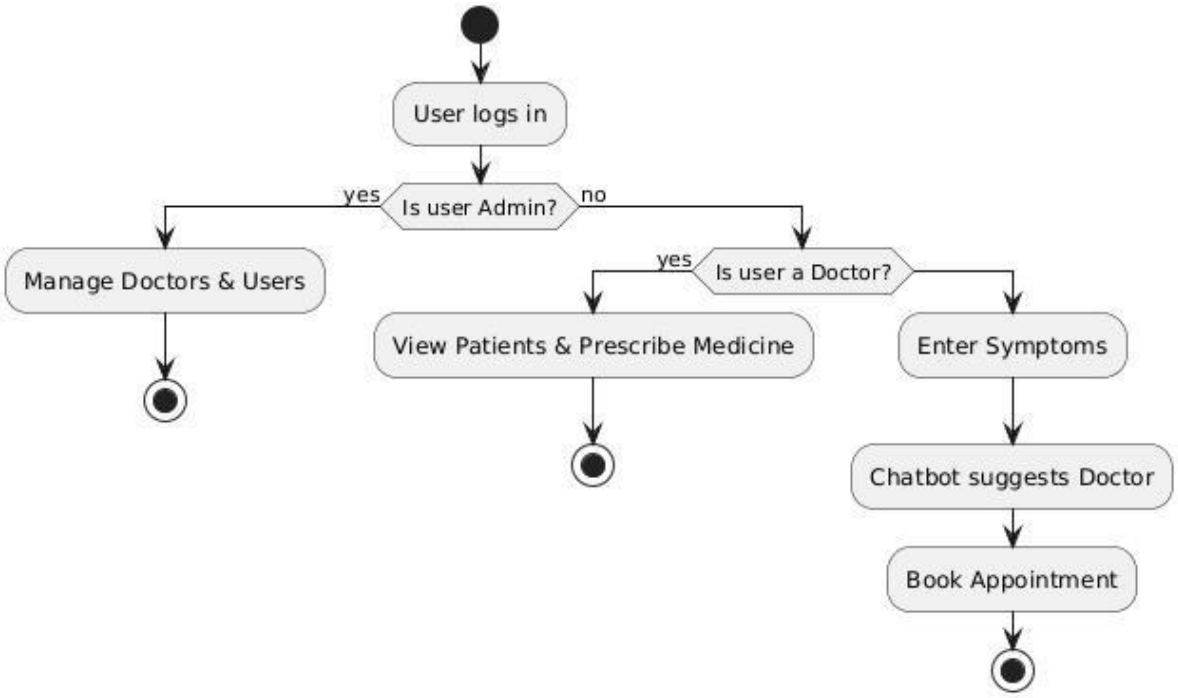


Figure-3.2.3 : Activity Diagram

3.2.4 Data flow diagram

A data flow diagram (DFD) is a graphical representation of how data moves within an information system. It is a modeling technique used in system analysis and design to illustrate the flow of data between various processes, data stores, data sources, and data destinations within a system or between systems.

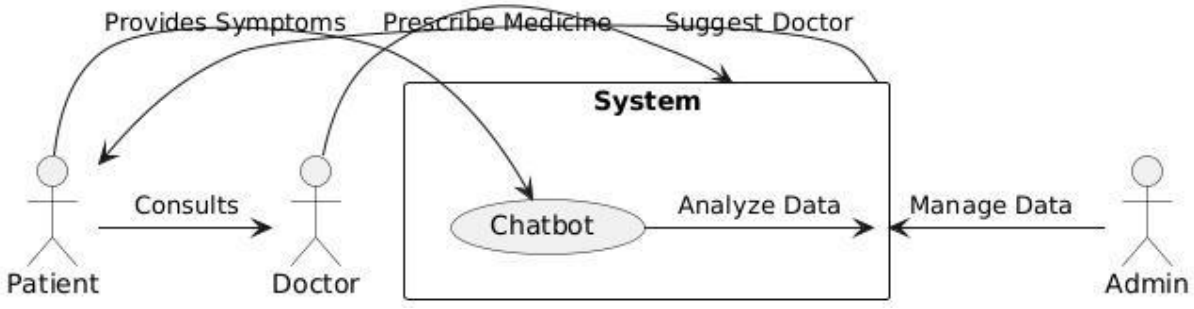


Figure-3.2.4: Dataflow Diagram

3.2.5 Component diagram:

Component diagram describes the organization and wiring of the physical components in a system.

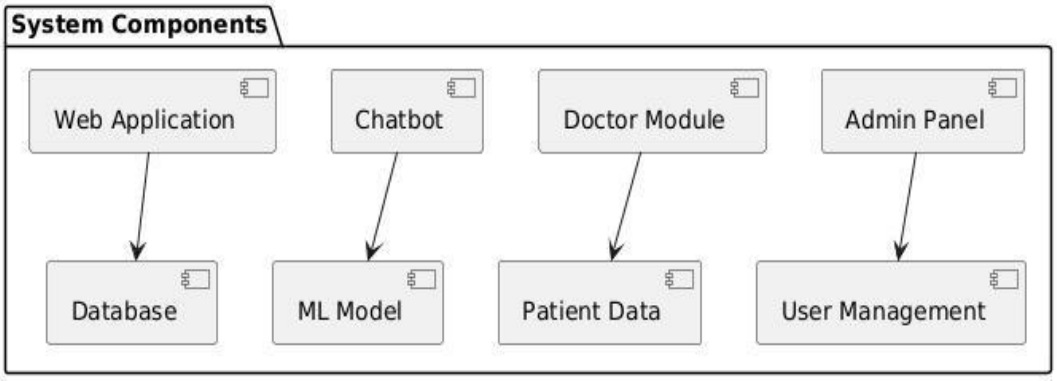


Figure-3.2.5 : Component Diagram

3.2.6 Use Case diagram:

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.

Figure-3.2.6**:** Use Case diagram

3.2.7 Deployment Diagram:

A deployment diagram in UML illustrates the physical arrangement of hardware and software components in the system. It visualizes how different software artifacts, such as data processing scripts and model training components, are deployed across hardware nodes and interact with each other, providing insight into the system's infrastructure and deployment strategy.

Figure-3.2.7: Deployment Diagram

3.2.8 Architectural Block Diagram

An architectural block diagram offers a high-level view of a system's structure, showcasing the main components and their interactions. It represents how major modules, such as data sources, processing units, and evaluation components, are organized and how they communicate with each other to accomplish the system's objectives. This diagram helps in understanding the overall design and flow of the system.

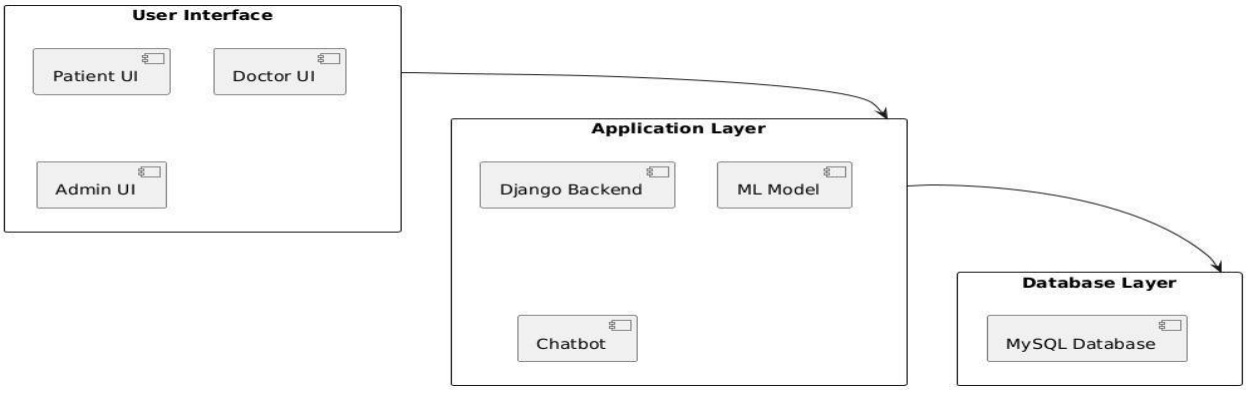


Figure-3.2.8: Architectural Block Diagram

4. IMPLEMETATION

4.1 PROJECT MODULES

TensorFlow

TensorFlow is a free and open-source software library for dataflow and differentiable programming across a range of tasks. It is a symbolic math library and is also used for machine learning applications such as neural networks. It is used for both research and production at Google.

TensorFlow was developed by the Google Brain team for internal Google use. It was released under the Apache 2.0 open-source license on November 9, 2015.

NumPy

NumPy is a general-purpose array-processing package. It provides a high-performance multidimensional array object, and tools for working with these arrays.

It is the fundamental package for scientific computing with Python. It contains various features including these important ones:

- A powerful N-dimensional array object
- Sophisticated (broadcasting) functions
- Tools for integrating C/C++ and Fortran code
- Useful linear algebra, Fourier transform, and random number capabilities

Besides its obvious scientific uses, NumPy can also be used as an efficient multi-dimensional container of generic data. Arbitrary datatypes can be defined using NumPy which allows NumPy to seamlessly and speedily integrate with a wide variety of databases.

Pandas

Pandas is an open-source Python Library providing high-performance data manipulation and analysis tool using its powerful data structures. Python was majorly used for data munging and preparation. It had very little contribution towards data analysis. Pandas solved this problem. Using Pandas, we can accomplish five typical steps in the processing and analysis of data, regardless of the origin of data load, prepare, manipulate, model, and analyze. Python with

Pandas is used in a wide range of fields including academic and commercial domains including finance, economics, Statistics, analytics, etc.

Matplotlib

Matplotlib is a Python 2D plotting library which produces publication quality figures in a variety of hardcopy formats and interactive environments across platforms. Matplotlib can be used in Python scripts, the Python and I Python shells, the Jupiter Notebook, web application servers, and four graphical user interface toolkits. Matplotlib tries to make easy things easy and hard things possible. You can generate plots, histograms, power spectra, bar charts, error charts, scatter plots, etc., with just a few lines of code. For examples, see the sample plots and thumbnail gallery.

For simple plotting the pyplot module provides a MATLAB-like interface, particularly when combined with I Python. For the power user, you have full control of line styles, font properties, axes properties, etc. via an object-oriented interface or via a set of functions familiar to MATLAB users.

Scikit – learn

Scikit-learn provides a range of supervised and unsupervised learning algorithms via a consistent interface in Python. It is licensed under a permissive simplified BSD license and is distributed under many Linux distributions, encouraging academic and commercial use. Python

Python is an interpreted high-level programming language for general-purpose programming. Created by Guido van Rossum and first released in 1991, Python has a design philosophy that emphasizes code readability, notably using significant whitespace.

Python features a dynamic type system and automatic memory management. It supports multiple programming paradigms, including object-oriented, imperative, functional and procedural, and has a large and comprehensive standard library.

- Python is Interpreted − Python is processed at runtime by the interpreter. You do not need to compile your program before executing it. This is similar to PERL and PHP.

- Python is Interactive − you can actually sit at a Python prompt and interact with the interpreter directly to write your programs.

Python also acknowledges that speed of development is important. Readable and terse code is part of this, and so is access to powerful constructs that avoid tedious repetition of code. Maintainability also ties into this may be an all but useless metric, but it does say something about how much code you have to scan, read and/or understand to troubleshoot problems or tweak behaviors. This speed of development, the ease with which a programmer of other languages can pick up basic Python skills and the huge standard library is key to another area where Python excels. All its tools have been quick to implement, saved a lot of time, and several of them have later been patched and updated by people with no Python background - without breaking.

4.2 SAMPLE CODE

Views.py

```
from django.shortcuts import render
from django.template import RequestContext
from django.contrib import messages
from django.http import HttpResponse
from django.core.files.storage import FileSystemStorage
import numpy as np
import pandas as pd
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
import pymysql
from sklearn.preprocessing import StandardScaler
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score
from sklearn.metrics import precision_score
from sklearn.metrics import recall_score
from sklearn.metrics import f1_score
import os
import matplotlib.pyplot as plt #use to visualize dataset vallues
import seaborn as sns
import io
import base64
import random
import smtplib
from datetime import date

global uname, utype, otp
global X_train, X_test, y_train, y_test, X, Y, dataset, rf, scaler, le
```

```
dataset = pd.read_excel("Dataset/Dataset.xlsx")
dataset.drop(['index', 'Patient Id'], axis = 1,inplace=True)
le = LabelEncoder()
dataset['Level'] = pd.Series(le.fit_transform(dataset['Level'].astype(str)))#encode all str columns
to numeric
dataset.fillna(0, inplace = True)
dataset = dataset.values
X = dataset[:,0:dataset.shape[1]-1]
Y = dataset[:,dataset.shape[1]-1]
scaler = StandardScaler()
X = scaler.fit_transform(X)
X_train, X_test, y_train, y_test = train_test_split(X, Y, test_size = 0.2)
rf = RandomForestClassifier(max_depth=2)
rf.fit(X_train, y_train)
predict = rf.predict(X_test)
p = precision_score(y_test, predict,average='macro') * 100
r = recall_score(y_test, predict,average='macro') * 100
f = f1_score(y_test, predict,average='macro') * 100
a = accuracy_score(y_test,predict)*100
def getGraph():
    dataset = pd.read_excel("Dataset/Dataset.xlsx")
    fig, axs = plt.subplots(2,2,figsize=(10, 6))
    data = dataset.groupby("Gender")["Chest Pain"].size().reset_index()
    data.Gender.replace([1.0, 2.0], ['Male', 'Female'], inplace=True)
    axs[0,0].pie(data["Chest Pain"], labels = data["Gender"], autopct="%1.1f%%")
      axs[0,0].set_title("Count of Chest Pain Gender Wise")data = dataset.groupby(["Gender",
"Smoking"])['Alcohol use'].sum().reset_index()
    data.Gender.replace([1.0, 2.0], ['Male', 'Female'], inplace=True)
    sns.pointplot(data=data, x="Smoking", y="Alcohol use", hue="Gender", ax=axs[0,1])
    axs[0,1].set_title("Gender Wise Smoking & Alcohol Usage Graph")
```

```
    data = dataset.groupby(["Gender"])['OccuPational Hazards'].sum().reset_index()
    data.Gender.replace([1.0, 2.0], ['Male', 'Female'], inplace=True)
    sns.barplot(data=data, x="Gender", y='OccuPational Hazards', ax=axs[1,0])
    axs[1,0].set_title("Count of Patients Occupational Hazard Gender Wise Graph")

    data = dataset.groupby(["Snoring", "Level"])['Dry Cough'].count().reset_index()
    sns.pointplot(data=data, x="Snoring", y="Dry Cough", hue="Level", ax=axs[1,1])
    axs[1,1].set_title("Snoring by Dry Cough Graph")
    plt.tight_layout()
    buf = io.BytesIO()
    plt.savefig(buf, format='png', bbox_inches='tight')
    plt.close()
    img_b64 = base64.b64encode(buf.getvalue()).decode()
    return img_b64

def DatasetVisualize(request):
    if request.method == 'GET':
        img_b64 = getGraph()
        context= {'data':"", 'img': img_b64}
        return render(request, 'PatientScreen.html', context)

def PredictDisease(request):
    if request.method == 'GET':
       return render(request, 'PredictDisease.html', {})

def AnalysePatient(request):
    if request.method == 'GET':
        output = '<table border=1><tr>'
        output+='<td><font size="" color="black">Patient Name</td>'
        output+='<td><font size="" color="black">Input Values</td>'
        output+='<td><font size="" color="black">Predicted Stage</td>'
```

```
        output+='<td><font size="" color="black">Date</td></tr>'
        rank = []
            con = pymysql.connect(host='127.0.0.1',port = 3306,user = 'root', password = 'root',
database = 'lungdisease',charset='utf8')
        with con:
            cur = con.cursor()
            cur.execute("select * FROM patients")
            rows = cur.fetchall()
            for row in rows:
                output+='<tr>'
                output+='<td><font size="" color="black">'+str(row[0])+'</td>'
                output+='<td><font size="" color="black">'+str(row[1])+'</td>'
                output+='<td><font size="" color="black">'+str(row[2])+'</td>'
                output+='<td><font size="" color="black">'+str(row[3])+'</td></tr>'
                rank.append(row[2])
        output += "</table><br/><br/><br/>"
        unique, count = np.unique(np.asarray(rank), return_counts=True)
        plt.pie(count,labels=unique,autopct='%1.1f%%')
        plt.title('Patients Lung Cancer Graph')
        plt.axis('equal')
        buf = io.BytesIO()
        plt.savefig(buf, format='png', bbox_inches='tight')
        plt.close()
        img_b64 = base64.b64encode(buf.getvalue()).decode()
        context= {'data':output, 'img': img_b64}
        return render(request, 'DoctorScreen.html', context)

def PredictDiseaseAction(request):
    if request.method == 'POST':
        global uname, rf, scaler
        age = request.POST.get('t1', False)
```

```
    gender = request.POST.get('t2', False)
    pollution = request.POST.get('t3', False)
    alcohol = request.POST.get('t4', False)
    dust = request.POST.get('t5', False)
    hazard = request.POST.get('t6', False)
    genetic = request.POST.get('t7', False)
    chronic = request.POST.get('t8', False)
    diet = request.POST.get('t9', False)
    obesity = request.POST.get('t10', False)
    smoking = request.POST.get('t11', False)
    smoker = request.POST.get('t12', False)
    chest = request.POST.get('t13', False)
    blood = request.POST.get('t14', False)
    fatigue = request.POST.get('t15', False)
    weight = request.POST.get('t16', False)
    breathe = request.POST.get('t17', False)
    wheezing = request.POST.get('t18', False)
    difficulty = request.POST.get('t19', False)
    finger = request.POST.get('t20', False)
    cold = request.POST.get('t21', False)
    cough = request.POST.get('t22', False)
    snoring = request.POST.get('t23', False)
                                                                    input_values =
age+","+gender+","+pollution+","+alcohol+","+dust+","+hazard+","+genetic+","+chronic+","+
diet+","+obesity+","+smoking+","+smoker+","+chest+","+blood+","+fatigue+","+weight+","+b
reathe+","+wheezing+","+difficulty+","+finger+","+cold+","+cough+","+snoring

    data = []
        data.append([float(age), float(gender), float(pollution), float(alcohol), float(dust),
float(hazard), float(genetic), float(chronic), float(diet), float(obesity),
                    float(smoking), float(smoker), float(chest), float(blood), float(fatigue),
```

```
float(weight), float(breathe), float(wheezing), float(difficulty),
                float(finger), float(cold), float(cough), float(snoring)])
        data = np.asarray(data)
        print(data.shape)
        data = scaler.transform(data)
        predict = rf.predict(data)
        output = ""
        if predict == 0:
            output = "High"
        elif predict == 1:
            output = "Low"
        elif predict == 2:
            output = "Medium"
        today = str(date.today())
          db_connection = pymysql.connect(host='127.0.0.1',port = 3306,user = 'root', password =
'root', database = 'lungdisease',charset='utf8')
        db_cursor = db_connection.cursor()
                                                student_sql_query = "INSERT INTO
patients(patient_name,patient_data,predicted_stage,process_date)
VALUES('"+uname+"','"+input_values+"','"+output+"','"+today+"')"
        db_cursor.execute(student_sql_query)
        db_connection.commit()
        context= {'data':"Cancer Stage Predicted As : "+output}
        return render(request, 'PatientScreen.html', context)


def TrainML(request):
    if request.method == 'GET':
        global p, r, f, a
                    output='<table border=1 align=center width=100%><tr><th><font size=""
color="black">Algorithm Name</th><th><font size="" color="black">Accuracy</th><th>'
```

```
                output += '<font size="" color="black">Precision</th><th><font size="" color="black">Recall</th><th><font size="" color="black">FSCORE</th></tr>'
        output+='</tr>'
        algorithms = ['Random Forest']
            output+='<td><font size="" color="black">'+algorithms[0]+'</td><td><font size="" color="black">'+str(a)+'</td>'
                output+='<td><font size="" color="black">'+str(p)+'</td><td><font size="" color="black">'+str(r)+'</td><td><font size="" color="black">'+str(f)+'</td></tr>'
        output+= "</table></br></br></br>"
        context= {'data':output}
        return render(request, 'PatientScreen.html', context)

def PatientLogin(request):
    if request.method == 'GET':
       return render(request, 'PatientLogin.html', {})

def index(request):
    if request.method == 'GET':
       return render(request, 'index.html', {})

def Register(request):
    if request.method == 'GET':
       return render(request, 'Register.html', {})

def DoctorLogin(request):
    if request.method == 'GET':
       return render(request, 'DoctorLogin.html', {})

def RegisterAction(request):
    if request.method == 'POST':
        username = request.POST.get('t1', False)
```

```
    password = request.POST.get('t2', False)
    contact = request.POST.get('t3', False)
    email = request.POST.get('t4', False)
    address = request.POST.get('t5', False)
    utype = request.POST.get('t6', False)

    status = "none"
        con = pymysql.connect(host='127.0.0.1',port = 3306,user = 'root', password = 'root',
database = 'lungdisease',charset='utf8')
    with con:
        cur = con.cursor()
        cur.execute("select username FROM register")
        rows = cur.fetchall()
        for row in rows:
            if row[0] == username:
                status = "Username already exists"
                break
    if status == "none":
        db_connection = pymysql.connect(host='127.0.0.1',port = 3306,user = 'root', password =
'root', database = 'lungdisease',charset='utf8')
        db_cursor = db_connection.cursor()
                                                    student_sql_query = "INSERT INTO
register(username,password,contact_no,email,address,usertype)
VALUES('"+username+"','"+password+"','"+contact+"','"+email+"','"+address+"','"+utype+"')"
        db_cursor.execute(student_sql_query)
        db_connection.commit()
        print(db_cursor.rowcount, "Record Inserted")
        if db_cursor.rowcount == 1:
            status = "Signup completed<br/>You can login with "+username
    context= {'data': status}
    return render(request, 'Register.html', context)
```

```
def sendOTP(email, otp_value):
    em = []
    em.append(email)
    with smtplib.SMTP_SSL('smtp.gmail.com', 465) as connection:
        email_address = 'kaleem202120@gmail.com'
        email_password = 'xyljzncebdxcubjq'
        connection.login(email_address, email_password)
                        connection.sendmail(from_addr="kaleem202120@gmail.com",     to_addrs=em,
msg="Subject : Your OTP for login: "+otp_value)

def OTPAction(request):
    if request.method == 'POST':
        global uname, utype, otp
        otp_value = request.POST.get('t1', False)
        if otp == otp_value:
            context= {'data':'Welcome '+uname}
            return render(request, 'PatientScreen.html', context)
        else:
            context= {'data':'Invalid OTP! Please retry'}
            return render(request, 'OTP.html', context)

def PatientLoginAction(request):
    if request.method == 'POST':
        global uname, utype, otp
        username = request.POST.get('username', False)
        password = request.POST.get('password', False)
        index = 0
            con = pymysql.connect(host='127.0.0.1',port = 3306,user = 'root', password = 'root',
database = 'lungdisease',charset='utf8')
        with con:
```

```
            cur = con.cursor()
            cur.execute("select username, password, usertype, email FROM register")
            rows = cur.fetchall()
            for row in rows:
                if row[0] == username and password == row[1] and row[2] == 'Patient':
                    email = row[3]
                    uname = username
                    utype = "Patient"
                    otp = str(random.randint(1000, 9999))
                    index = 1
                    sendOTP(email, otp)
                    break
        if index == 1:
            context= {'data':'OTP sent to your mail to continue login'}
            return render(request, 'OTP.html', context)
        else:
            context= {'data':'login failed'}
            return render(request, 'PatientLogin.html', context)

def DoctorLoginAction(request):
    if request.method == 'POST':
        global uname, utype, otp
        username = request.POST.get('username', False)
        password = request.POST.get('password', False)
        index = 0
            con = pymysql.connect(host='127.0.0.1',port = 3306,user = 'root', password = 'root',
database

= 'lungdisease',charset='utf8')
        with con:
            cur = con.cursor()
```

```
        cur.execute("select username, password, usertype, email FROM register")
        rows = cur.fetchall()
        for row in rows:
            if row[0] == username and password == row[1] and row[2] == 'Doctor':
                email = row[3]
                uname = username
                utype = "Doctor"
                index = 1
                break
    if index == 1:
        context= {'data':'Welcome '+uname}
        return render(request, 'DoctorScreen.html', context)
    else:
        context= {'data':'login failed'}
        return render(request, 'DoctorLogin.html', context)
```

Apps.py

```
from django.apps import AppConfig

class LungappConfig(AppConfig):
   name = 'LungApp'
```

Urls.py

```
from django.urls import path

from . import views

urlpatterns = [path("index.html", views.index, name="index"),
        path('PatientLogin.html', views.PatientLogin, name="PatientLogin"),
        path('PatientLoginAction', views.PatientLoginAction, name="PatientLoginAction"),
        path('Register.html', views.Register, name="Register"),
        path('RegisterAction', views.RegisterAction, name="RegisterAction"),
```

```
        path('DoctorLogin.html', views.DoctorLogin, name="DoctorLogin"),
        path('DoctorLoginAction', views.DoctorLoginAction, name="DoctorLoginAction"),
        path('OTPAction', views.OTPAction, name="OTPAction"),
        path('TrainML', views.TrainML, name="TrainML"),
        path('DatasetVisualize', views.DatasetVisualize, name="DatasetVisualize"),
        path('PredictDisease', views.PredictDisease, name="PredictDisease"),
                                        path('PredictDiseaseAction',      views.PredictDiseaseAction,
name="PredictDiseaseAction"),
        path('AnalysePatient', views.AnalysePatient, name="AnalysePatient"),
]
```

Admin.py

```
from django.contrib import admin
```

tests.py

```
from django.test import TestCase
```

models.py

```
from django.db import models
```

Index.html

```
{% load static %}
<html>
<head>
<title>Lung Cancer Prediction</title>
<meta http-equiv="content-type" content="text/html; charset=utf-8" />
<link rel="stylesheet" type="text/css" href="{% static 'style.css' %}"/>
</head>
<body>
<div id="wrapper">
    <div id="header">
        <div id="logo">
            <center><font size="4" color="black">Lung Cancer Prediction</font></center></font>
        </div>
        <div id="slogan">


        </div>
    </div>
    <div id="menu">
        <ul><center>
                                    <li><a href="{% url 'index' %}"><font size="" color="black">Home</font></a></font></li>
                    <li><a href="{% url 'DoctorLogin' %}"><font size="" color="black">Doctor Login</font></a></font></li>
                    <li><a href="{% url 'PatientLogin' %}"><font size="" color="black">Patient Login</font></a></font></li>
                    <li><a href="{% url 'Register' %}"><font size="" color="black">New User Signup Here</a></li>
        </center></ul>
        <br class="clearfix" />
    </div>
```

```
<div id="splash">
        <img class="pic" src="{% static 'images/investor.jpg' %}" width="870" height="230" alt="" />
</div>
<br/>
            <p align="justify"><font size="3" style="font-family: Comic Sans MS" color="black"><center>
      Lung Cancer Prediction

</p>
</body>
</html>
```

5. TESTING

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub-assemblies, assemblies and/or a finished product It is the process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of test. Each test type addresses a specific testing requirement.

5.1 TYPES OF TESTS

Unit testing

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

Integration testing

Integration tests are designed to test integrated software components to determine if they actually run as one program. Testing is event driven and is more concerned with the basic outcome of screens or fields. Integration tests demonstrate that although the components were individually satisfaction, as shown by successfully unit testing, the combination of components is correct and consistent. Integration testing is specifically aimed at exposing the problems that arise from the combination of components.

Functional test

Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals.

Functional testing is centered on the following items:

Valid Input : identified classes of valid input must be accepted.

Invalid Input : identified classes of invalid input must be rejected.

Functions : identified functions must be exercised.

Output : identified classes of application outputs must be exercised.

Systems/Procedures : interfacing systems or procedures must be invoked.

Organization and preparation of functional tests is focused on requirements, key functions, or special test cases. In addition, systematic coverage pertaining to identify Business process flows; data fields, predefined processes, and successive

processes must be considered for testing. Before functional testing is complete, additional tests are identified and the effective value of current tests is determined.

System Test

System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration-oriented system integration test. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.

White Box Testing

White Box Testing is a testing in which in which the software tester has knowledge of the inner workings, structure and language of the software, or at least its purpose. It is purpose. It is used to test areas that cannot be reached from a black box level.

Black Box Testing

Black Box Testing is testing the software without any knowledge of the inner workings, structure or language of the module being tested. Black box tests, as most other kinds of tests, must be written from a definitive source document, such as specification or requirements document, such as specification or requirements document. It is a testing in which the software under test is treated, as a black box .you cannot “see” into it. The test provides inputs and responds to outputs without considering how the software works.

Field testing will be performed manually and functional tests will be written in detail.

Test objectives

- All field entries must work properly.
- Pages must be activated from the identified link.

- The entry screen, messages and responses must not be delayed.

Features to be tested

- Verify that the entries are of the correct format
- No duplicate entries should be allowed
- All links should take the user to the correct page.

Integration Testing

Software integration testing is the incremental integration testing of two or more integrated software components on a single platform to produce failures caused by interface defects.

The task of the integration test is to check that components or software applications, e.g. components in a software system or – one step up – software applications at the company level – interact without error.

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

Acceptance Testing

User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that the system meets the functional requirements.

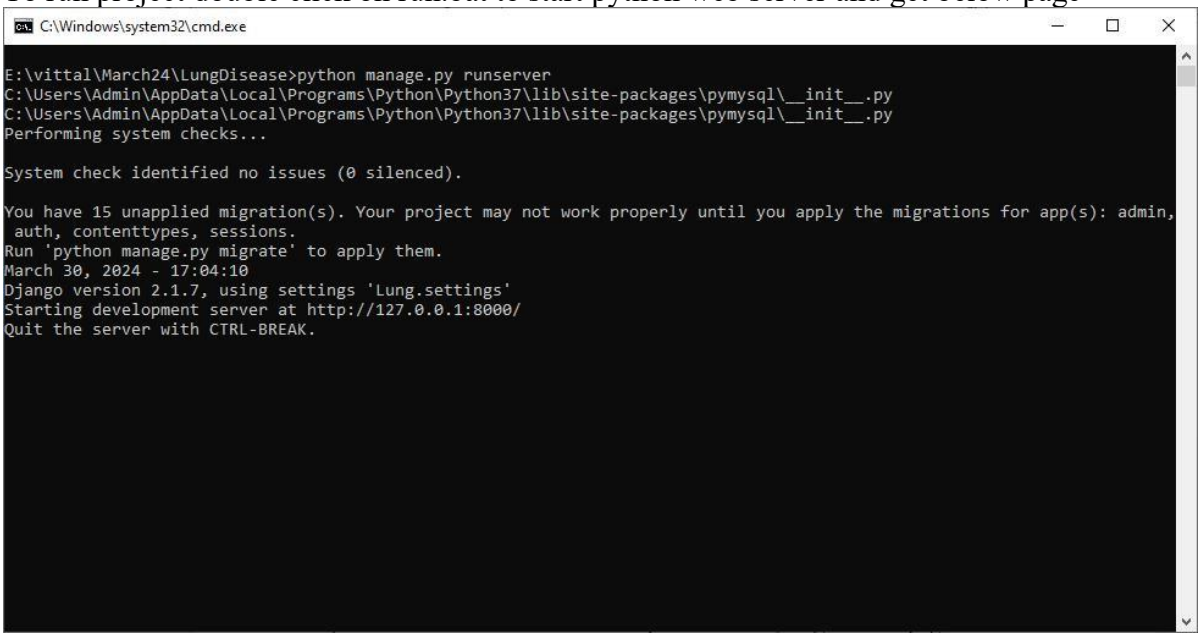
Test Results: All the test cases mentioned above passed successfully. No defects encountered.

.

6. RESULTS

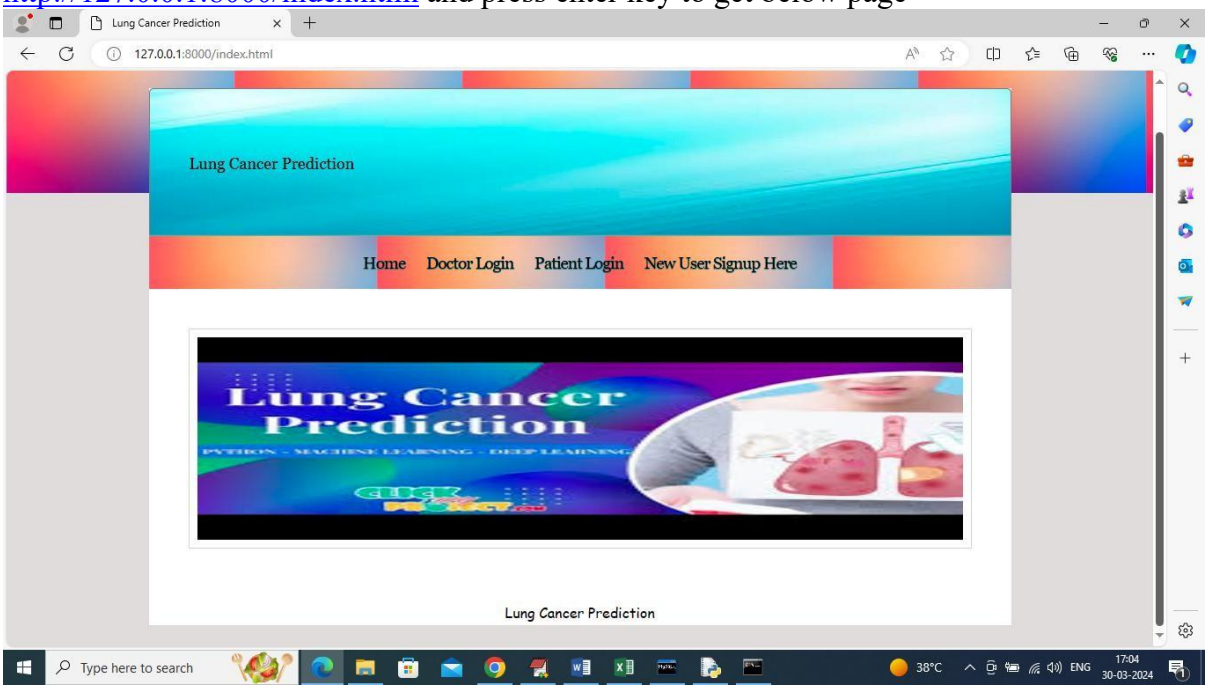
SCREEN SHOTS

To run project double click on run.bat to start python web server and get below page



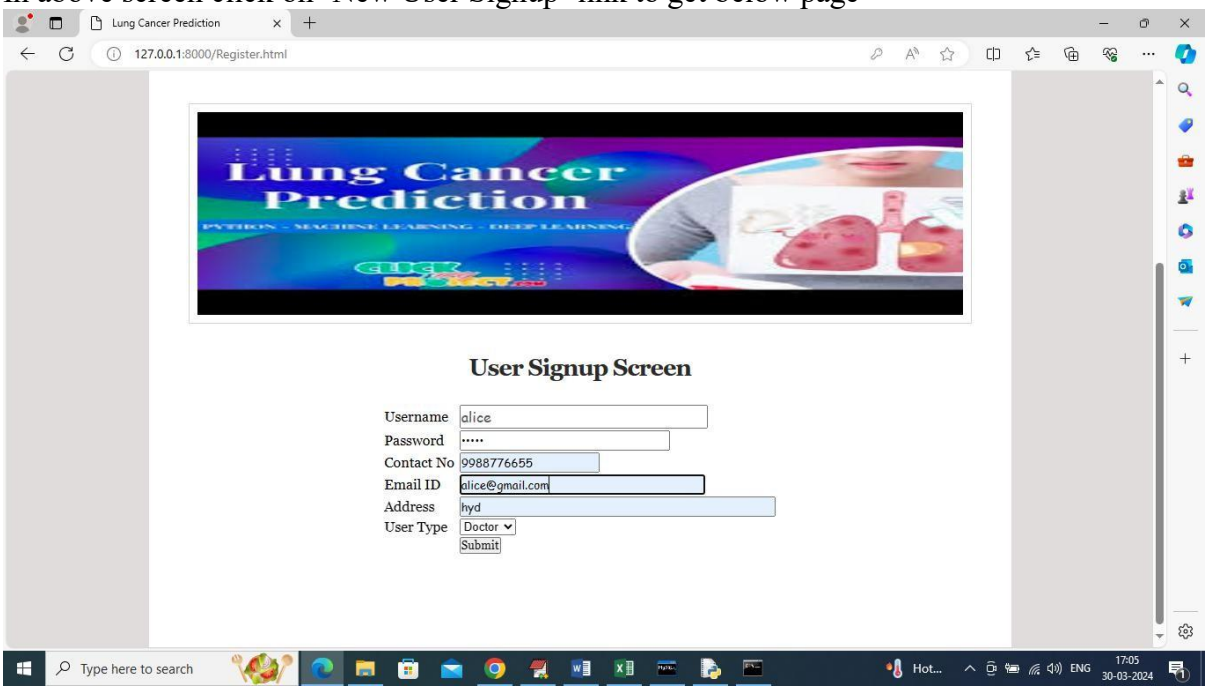
Screenshot - 6.1

In above screen python server started and now open browser and enter URL as http://127.0.0.1:8000/index.html and press enter key to get below page



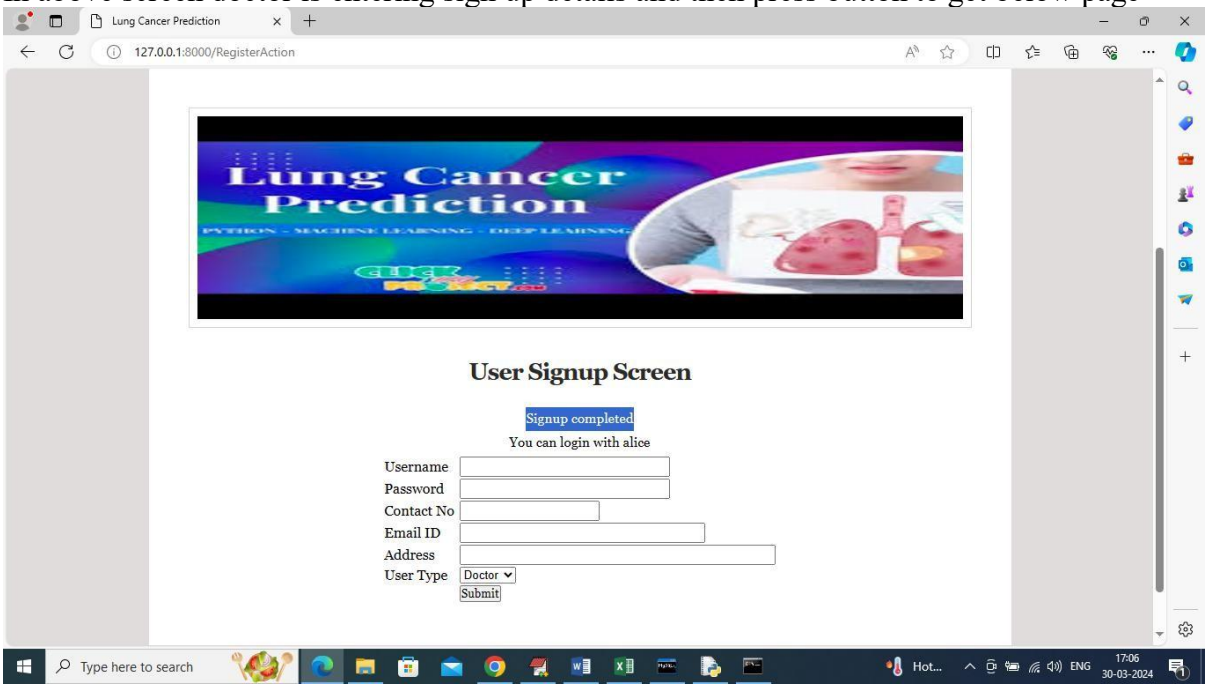
Screenshot -6. 2

In above screen click on ‘New User Signup’ link to get below page



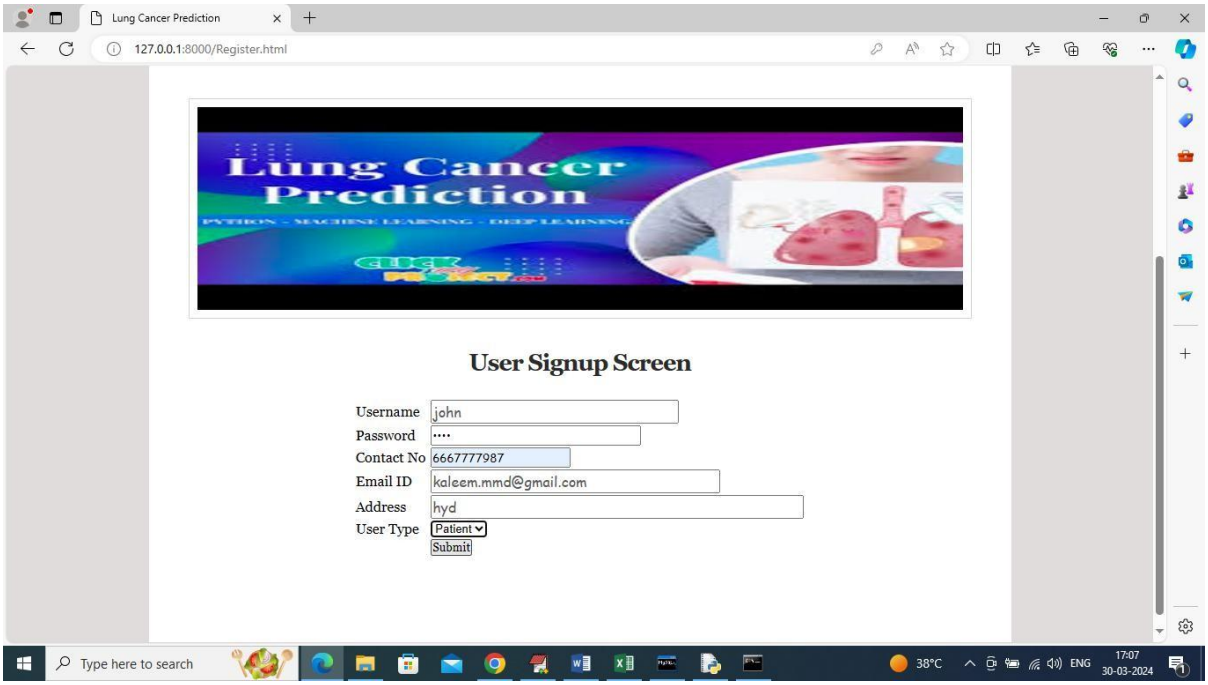
Screenshot - 6.3

In above screen doctor is entering sign up details and then press button to get below page



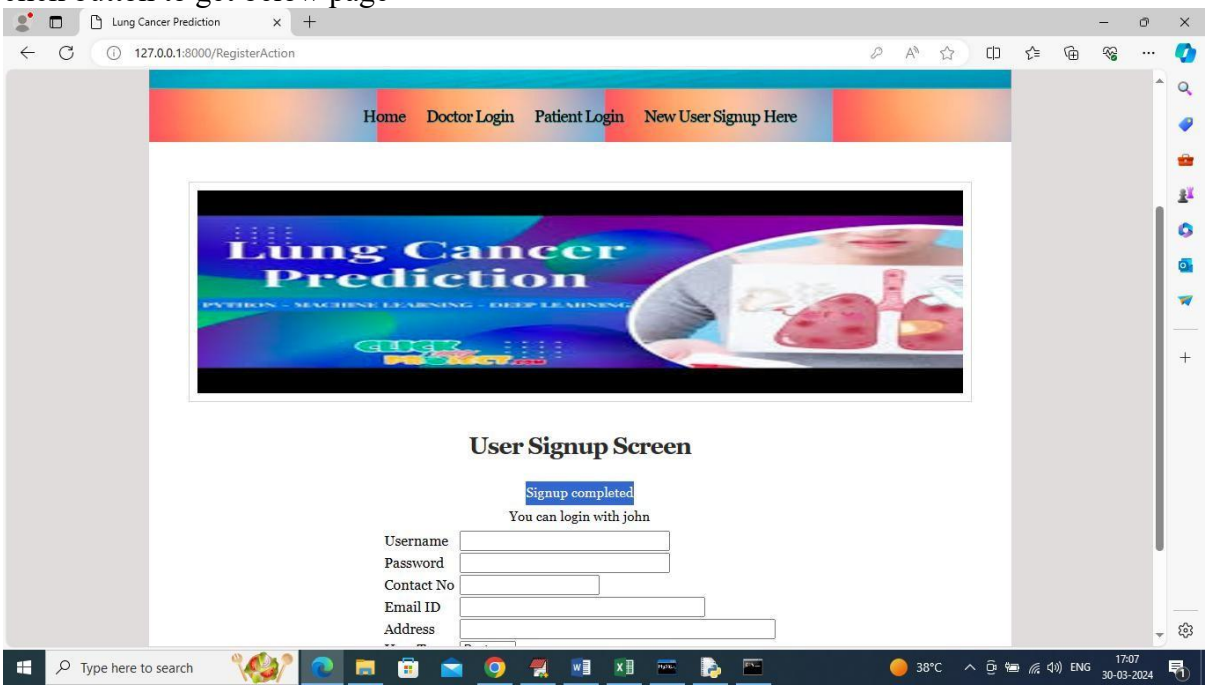
Screenshot - 6.4

In above screen doctor sign up completed and similarly add patient details also like below screen



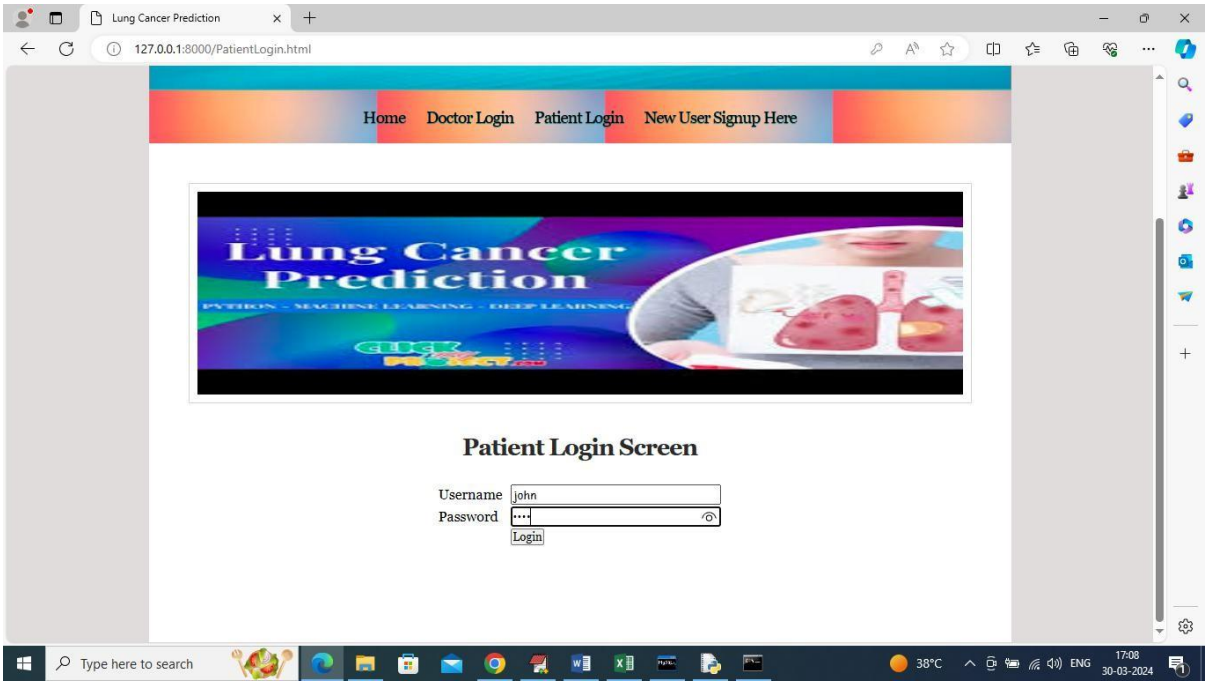
Screenshot - 6.5

In above screen entering patient details and enter valid email to received OTP to emails and now click button to get below page



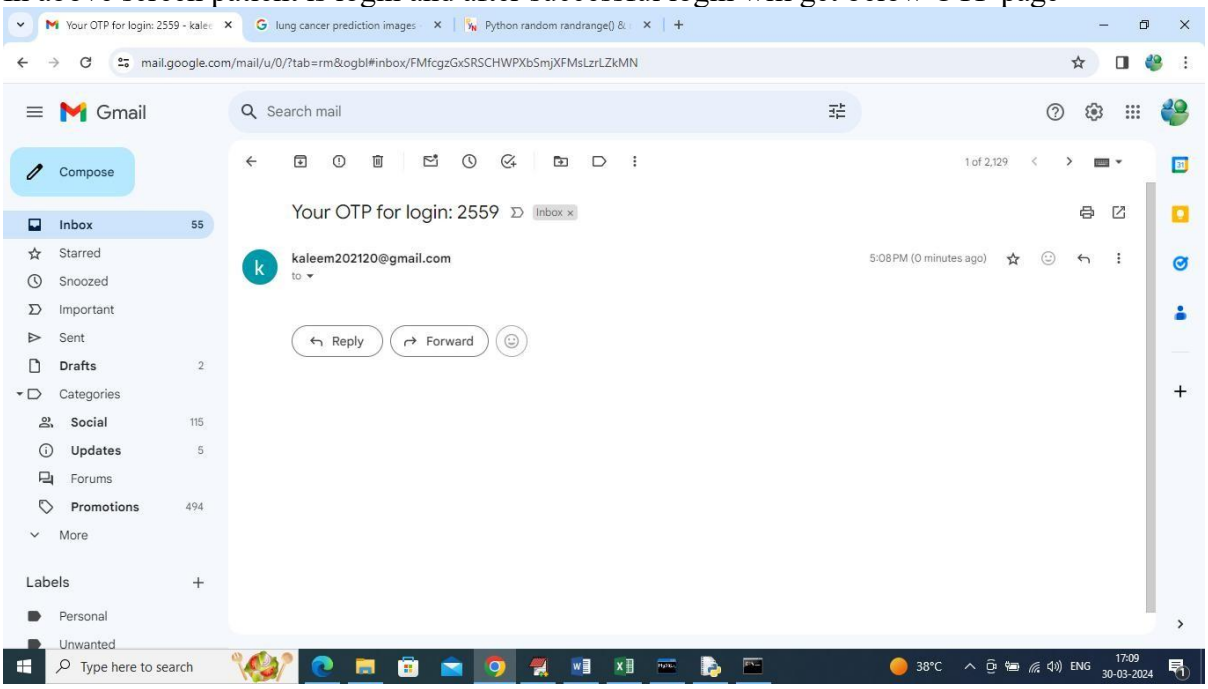
Screenshot - 6.6

In above screen patient sign up completed and now click on ‘Patient Login’ link to login as patient



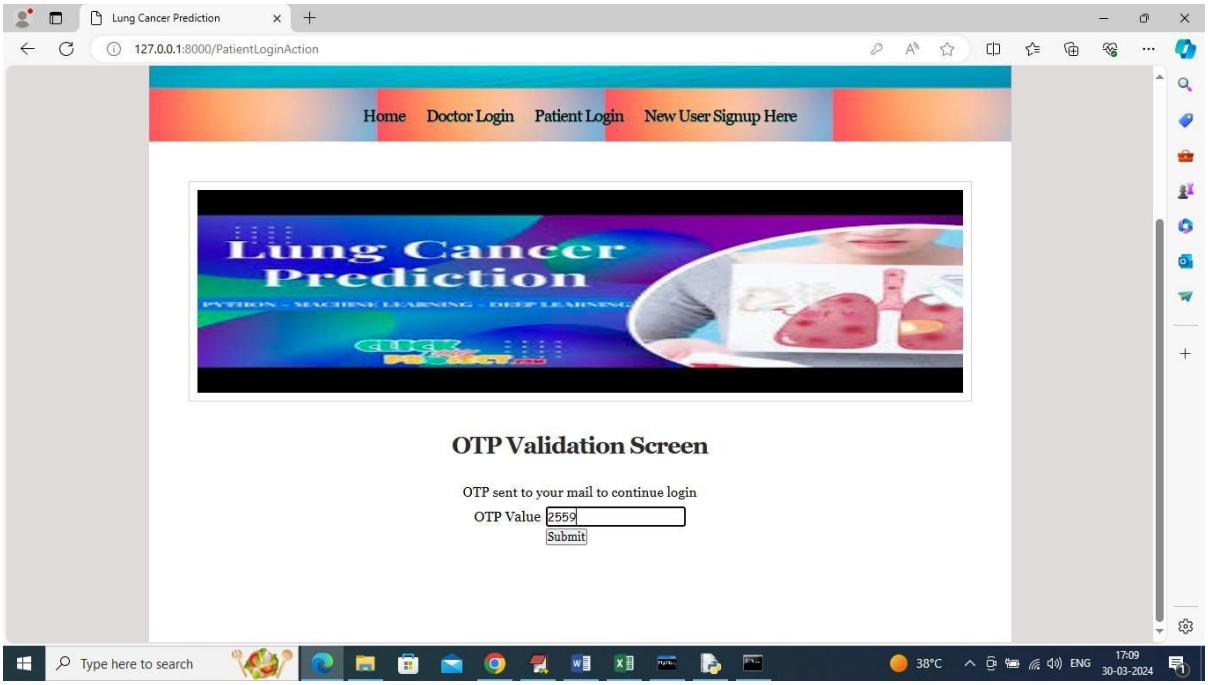
Screenshot - 6.7

In above screen patient is login and after successful login will get below OTP page



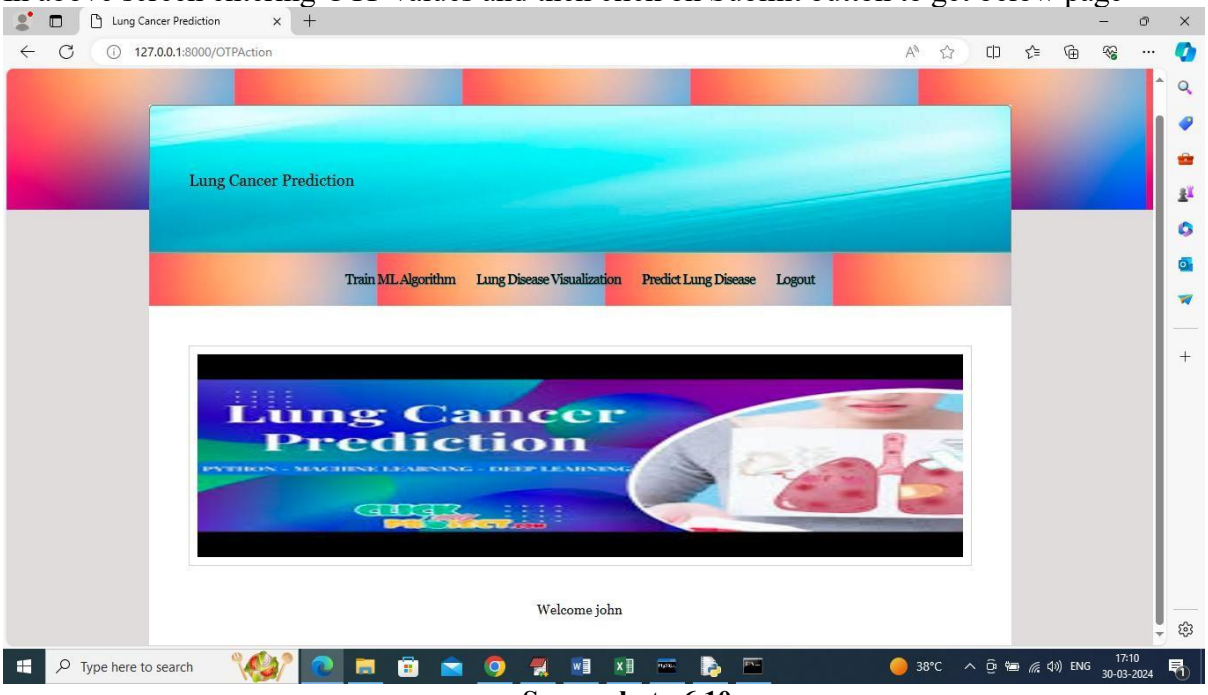
Screenshot - 6.8

In above screen OTP received in email and now enter OTP in below screen to continue login



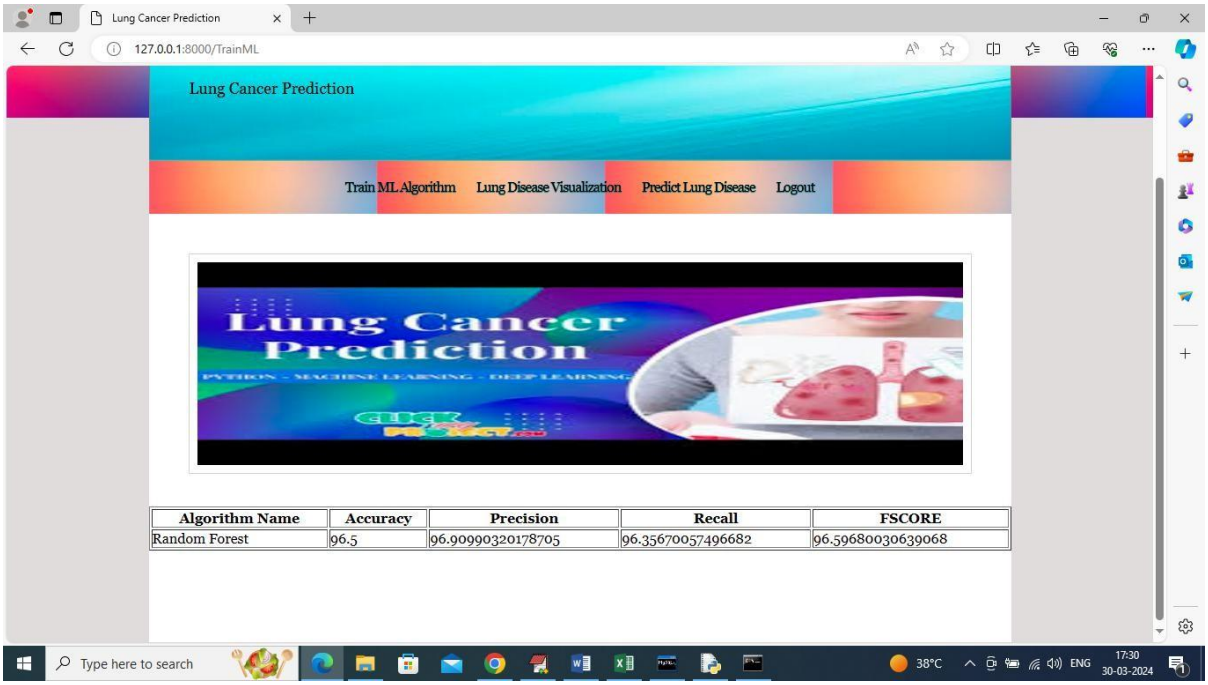
Screenshot - 6.9

In above screen entering OTP values and then click on Submit button to get below page



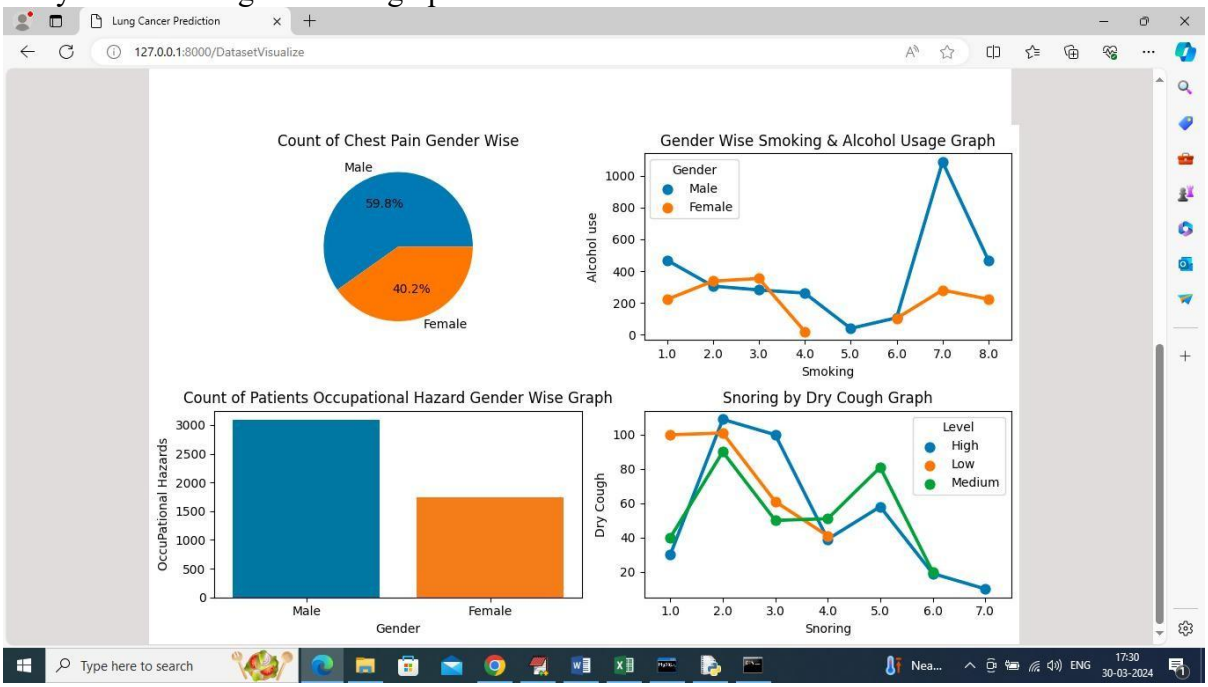
Screenshot - 6.10

In above screen user can click on 'Train ML Algorithm' link to train ML algorithm and get below page



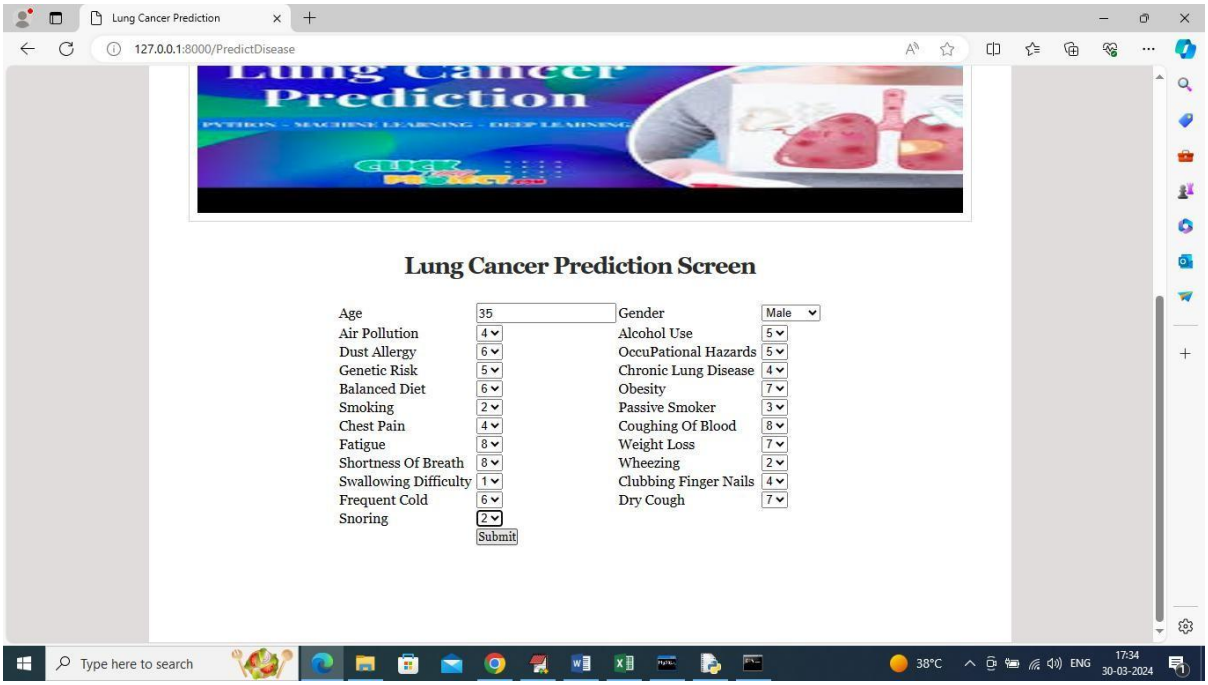
Screenshot - 6.11

In above screen Random Forest training completed and it got 96% accuracy and can see other metrics like precision, recall and FSCORE and now click on 'Lung Disease Visualization' to analyze dataset to get various graphs



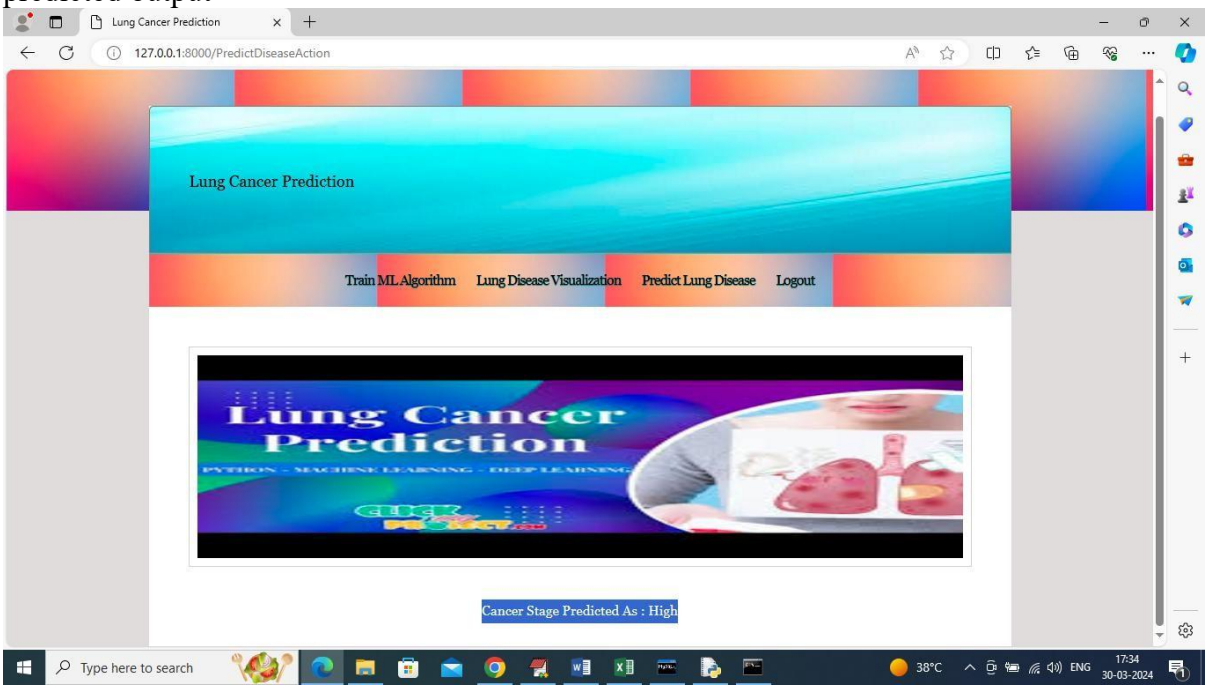
Screenshot - 6.12

In above screen can see visualization using different attributes from dataset such as Gender, Hazard, chest Pain etc. Now click on 'Predict Lung Disease' link to get below page



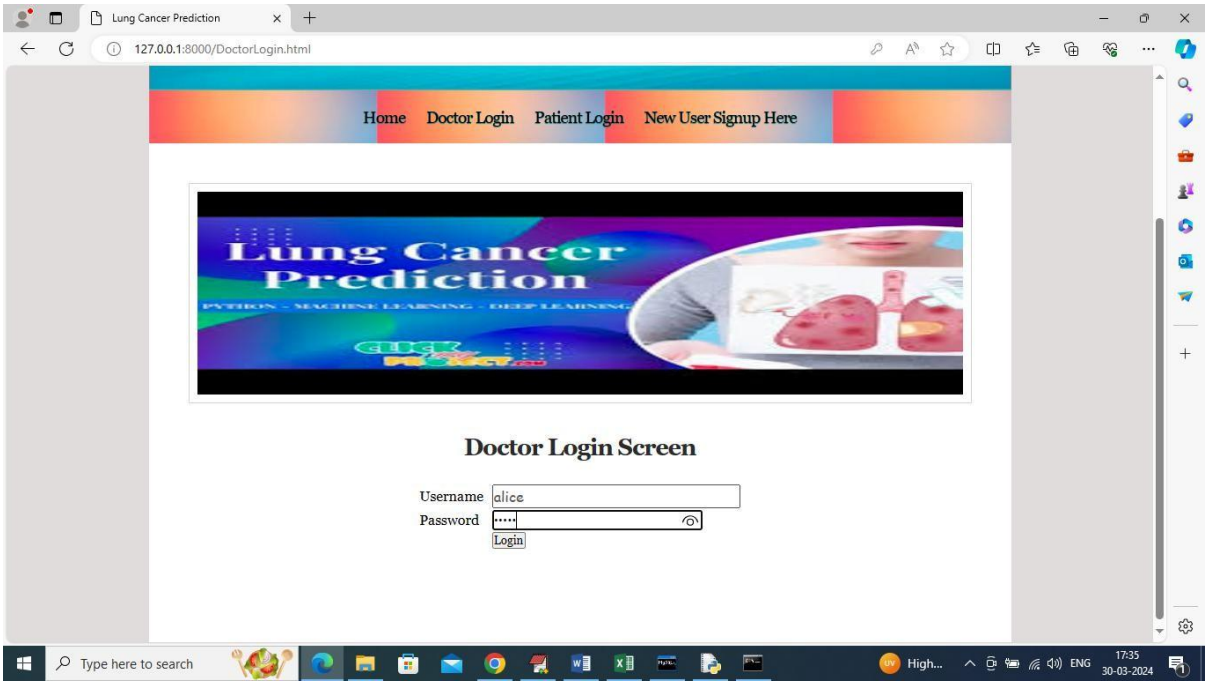
Screenshot - 6.13

In above screen user will enter lung disease input values and then press button to get below predicted output



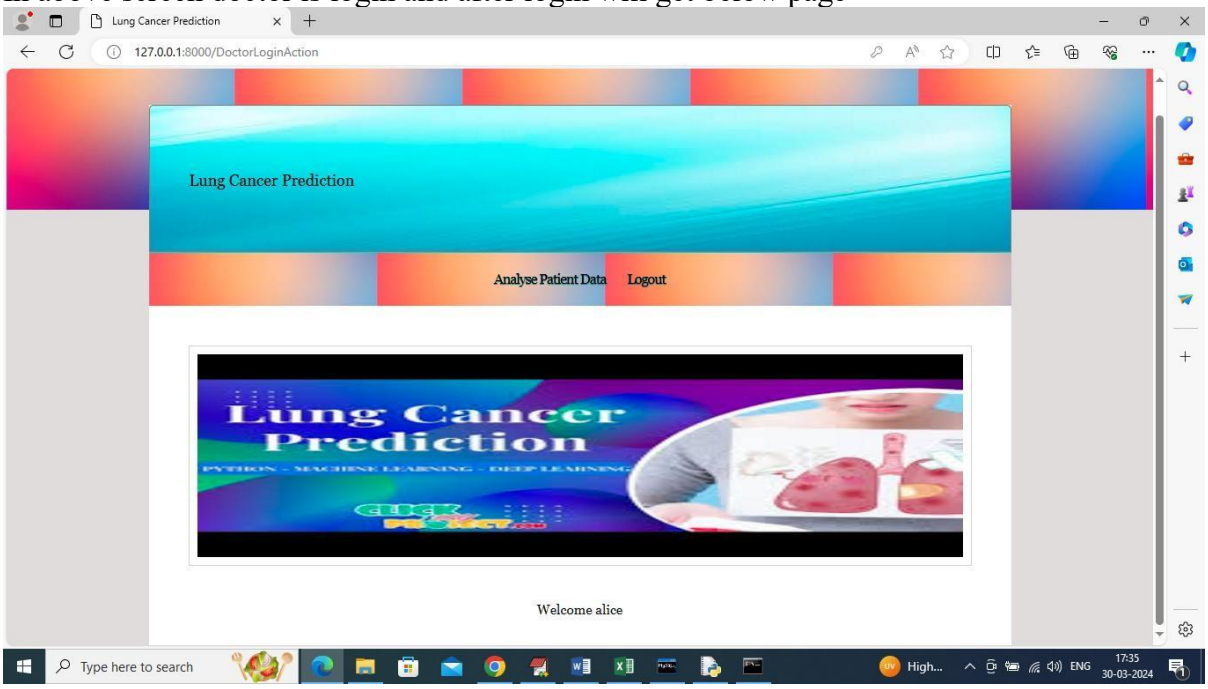
Screenshot - 6.14

In above screen in blue color text can see disease stage predicted as ‘High’ based on input values and now logout and login as doctor to perform analysis



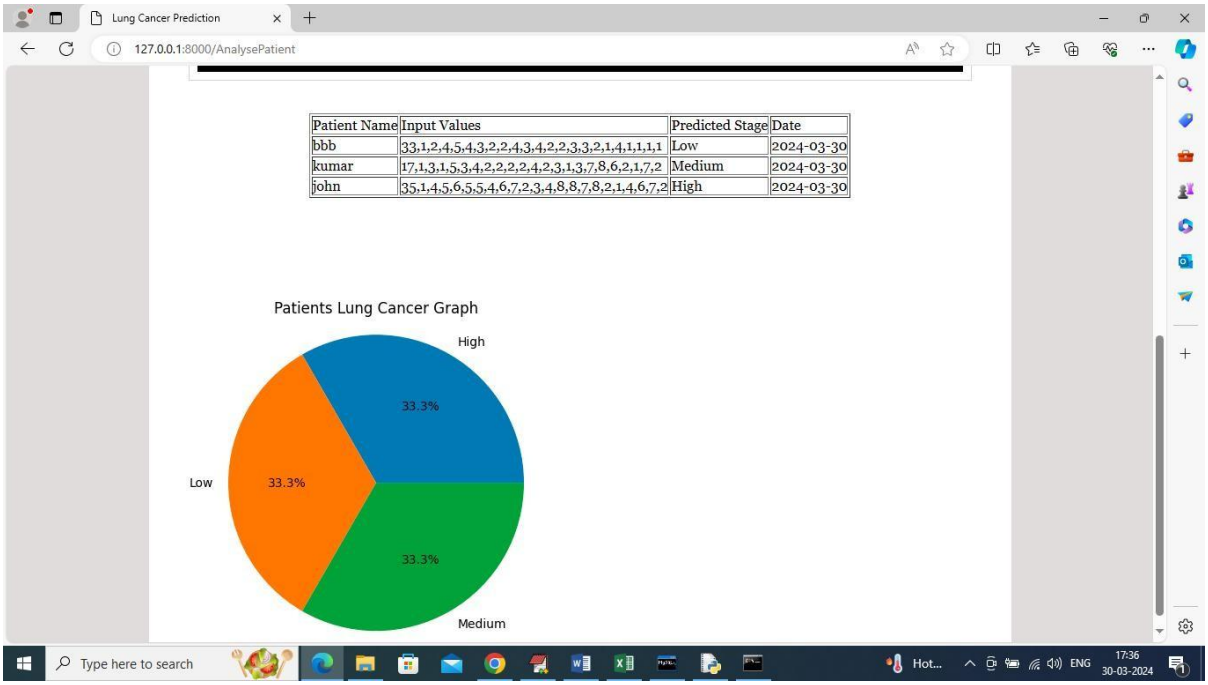
Screenshot - 6.15

In above screen doctor is login and after login will get below page



Screenshot - 6.16

In above screen doctor can click on “Analyze Patient Data’ link to get below analysis report



Screenshot - 6.17

In above screen doctor can see different patients input data and then can see predicted lung cancer stage and in graph also can see number of patients suffering from different stage of cancer. Similarly by following above screens you can predict lung cancer stage from given input values

7. CONCLUSION

Lung cancer remains a leading cause of mortality worldwide, emphasizing the urgent need for early and accurate detection methods. Traditional diagnostic approaches, such as biopsies and manual radiological assessments, often lead to delayed diagnoses and increased patient discomfort. The proposed system leverages advanced machine learning and deep learning techniques, such as Convolutional Neural Networks (CNNs) and Random Forest algorithms, to enhance diagnostic accuracy and efficiency. By automating feature extraction and classification, the system reduces human errors, improves accessibility, and minimizes the need for invasive procedures. Additionally, the integration of AI-driven models enables faster and more reliable predictions, aiding healthcare professionals in making informed decisions. With continuous improvements and the integration of real-world datasets, this system has the potential to revolutionize lung cancer screening and significantly improve patient outcomes. Future work will focus on optimizing model performance and expanding the system's capabilities for broader medical applications.

FUTURE SCOPE OF THE PROJECT

The future scope of this project focuses on enhancing lung cancer detection through advanced artificial intelligence (AI) and deep learning techniques. One significant direction is the integration of more diverse and larger datasets to improve model generalization and accuracy. By incorporating multi-modal data, including CT scans, X-rays, and genomic information, the system can offer a more comprehensive diagnostic approach. Additionally, real-time detection models can be developed to assist radiologists in identifying cancerous lesions instantly, reducing diagnosis time and improving patient outcomes.

Another promising avenue is the use of federated learning, which allows AI models to be trained across multiple hospitals without compromising patient data privacy. This can lead to a globally optimized system that benefits from diverse medical records while ensuring compliance with healthcare regulations. Furthermore, explainable AI (XAI) techniques can be integrated to provide interpretability, making the predictions more transparent and trustworthy for medical professionals.

In the future, this system can also be expanded for detecting other types of cancers and respiratory diseases, providing a versatile AI-driven healthcare solution. The incorporation of cloud computing and edge AI will enable real-time processing, making the technology accessible even in remote healthcare centers. With ongoing advancements in AI and medical imaging, this project has the potential to revolutionize early-stage lung cancer detection, ultimately reducing mortality rates and improving global healthcare standards.

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