Automatic COVID-19 Lung Infection Segmentation from CT Images

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Abstract - COVID-19, the disease caused by the new corona virus, can cause lung com- plications such as pneumonia and, in the most severe cases, acute respiratory distress syndrome, or ARDS. Sepsis, another possible complication of COVID-19, can also cause lasting harm to the lungs and other organs. The virus that causes COVID-19 is mainly transmitted through droplets generated when an infected person coughs, sneezes, or ex- hales. These droplets are too heavy to hang in the air, and quickly fall on floors or surfaces. As everyone is aware corona virus disease 2019 (COVID-19) spread globally in early 2020, causing the world to face an existential health crisis. So in order to auto- mate detection of lung infections from computed tomography (CT) images offers a great potential to augment the traditional healthcare strategy for tackling COVID-19. How- ever, segmenting infected regions from CT slices faces several challenges, including high variation in infection characteristics, and low intensity contrast between infections and normal tissues. Further, collecting a large amount of data is impractical within a short time period, inhibiting the training of a deep model. Our propose solution will analyze the CT image of lung and detect the infected part of lung along with the percentage of affected part. System will Identify the Inflection severity and will help patients to take essential measures.

Keywords: Automatic COVID-19 Lung Infection Segmentation CT Images system

1. INTRODUCTION

Recently the entire world is going through the huge pandemic i.e., corona disease (Covid-19). It usually spread through the virus and not by bacteria. This virus falls in the family called Coronadite. This virus has caused severe human loss and millions of humans are been affected by it, and still the number is going on increasing. Even it had forced many countries to have a lockdown and it also led to the huge financial losses. Lockdown was done to prevent the spread of infection from one person to another, to avoid the contacts of persons. Usually Covid-19 affects the lungs in most cases. So, in order to reduce the death of human and to identify the Covid-19 at its early stage, we are proposing the system. Our system will take the CT image as an input and will analyze and predict if user is affected by virus. COVID-19 mainly spreads

each other long enough, primarily via small droplets or aerosols, as an infected person breathes, coughs, sneezes, sings, or speaks. Transmission via fomites (contaminated surfaces) has not been conclusively demonstrated. It can spread as early as two days before infected persons show symptoms (PR symptomatic), and from asymptomatic (no symptoms) individuals. People remain infectious for up to ten days in moderate cases, and two weeks in severe cases. The standard diagnosis method is by real-time reverse transcription polymerase chain reaction (rprt-PCR) from a nasopharyngeal swab. Preventive measures include social distancing, quarantining, ventilation of indoor spaces, covering coughs and sneezes, hand washing, and keeping unwashed hands away from the face. The use of face masks or coverings has been recommended in public settings to minimize the risk of transmissions. There are no proven vaccines or specific treatments for COVID-19 yet, though several are in development.

2. LITERATURE SURVEY

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. A Comparative Study of Medical Image Segmentation Techniques for Brain Tumour Detection

Author: Kapil Kumar Gupta; Dr. Namrata Dhanda; Dr. Upendra Kumar

Description:

Segmentation is the important step in the analysis and interpretation of the medical CT and MR images. Segmentation is used to detect and extract the feature areas in the medical images. As per technology grows rapidly, it is always challenging to find the best medical image reconstruction technique. So, associated developments in the analysis and diagnosis have boosted medical imaging. Doctors and radiologist use Ultrasound, MRI, CT-Scan etc. for visualization and examination of internal human body structure with- out any surgery. In this paper, researchers focus on the review of segmentation of CT and MR images contained tumor. While doing the comparison, this paper focuses to compare different segmentation techniques. Segmentation is the method of dividing a picture into smaller parts with similar properties similar to grey level. The other properties can be color, texture and brightness. The segmentation is used to subdivide the objects in a detailed pictures used for depth analysis.

2. Low-dose dual energy CT image reconstruction using non-local deep image prior

Author: Kaung Gong; Kyongsang Kim; Mannudeep K. Kalra

Description:

The deep image prior (DIP) framework shows that convolution neural networks (CNNs) can learn intrinsic structural information from the corrupted images. In DIP framework, random noise is used as the network input and no high-quality training labels are needed. Furthermore, it has been shown that when the network input is not random noise but high-quality prior image from the same subject, the denoising results can be further im- proved.

3. Detection of Lung Cancer in CT Images using Image Pro- cessing

Author: Nidhi S. Nadkarni; Sangam Borkar

Description:

Cancer is one of the most serious and widespread disease that is responsible for large number of deaths every year. Among all different types of cancers, lung cancer is the most prevalent cancer having the highest mortality rate. Computed tomography scans are used for identification of lung cancer as it provides detailed picture of tumour in the body and tracks its growth. Although CT is preferred over other imaging modalities, visual interpretation of these CT scan images may be an error prone task and can cause delay in lung cancer detection. Therefore, image processing techniques are used widely in medical fields for early-stage detection of lung tumour.

4. Deep Learning Based Segmentation of Body Parts in CT Localizers and Application to Scan Planning

Author: Hrishikesh Deshpande; Axel Saalbach

Description:

They propose a deep learning approach for the segmentation of body parts in computer tomography (CT) localizer images. Such images pose difficulties in the automatic image analysis on account of variable field-of- view, diverse patient positioning and image acquit-sition at low dose, but are of importance pertaining to their most prominent applications in scan planning and dose modulation. Following the success of deep learning technology in image segmentation applications, we investigate the use of fully convolution neural network architecture to achieve the segmentation of four anatomies: abdomen, chest, pelvis and brain.

5. Analysis of Lung CT Images for Ground Glass Diagnosis

Author: Dr Punal.M. Arabi; Nandita Krishna

Description:

This paper presents a novel method for ground glass structure diagnosis using statistical feature analysis using gray level co-occurrence matrix (GLCM). These features based on GLCM are considered to observe the textural patterns in lung images which can different-Tiete between abnormal lung and normal lung. This method is experimented on a set of two normal and ground glass lung images. The results obtained show that the proposed method is promising in ground glass texture identification.

This study is based on the literature review of recent research on the topic of Au- tomatic Covid Detection. Literature was reviewed from various sources, located through an online search, published papers, existing bibliography and recommendation panels The pandemic namely corona virus is rapidly out breaking from its primary source i.e., from the city of Wuhan, situated in China to the entire world, this disease is a serious outbreak to the rest of the countries, resulting in damaging effect to the human body. This article gives broad spectrum of view for the pandemic disease. Firstly, in the month of December 2019, many patients of unspecified etiology of pneumonia which all had a history of visit to seafood whole

sale market in Wuhan, China were come across. The virus causing COVID-19 has been named by international committee on taxonomy of viruses as Severe Acute Respiratory Syndrome Corona Virus 2 (SARSCOV-2) in month of February 11, 2020. The virus causing this pandemic disease is termed as COVID-19 by the world health organization on 11th February 2020, Recently, Corona virus has become a critical condition of international concern of public health, WHO stated its danger to the extreme highest level. This virus has damaging effects over various human organs like lungs, can disrupt cardiac function by affecting the heart, may lead to renal problem by affecting the kidneys, hepatic dysfunction, and also affect genital organs of the human body

3. IMPLEMENTATION

Front End – JSP

Java Server Pages (JSP) is a server-side programming technology that enables the crew-action of dynamic, platform-independent method for building Web-based applications. JSP have access to the entire family of Java APIs, including the JDBC API to access enterprise databases. A JSP page consists of HTML tags and JSP tags. The JSP pages are easier to maintain than Servlet because we can separate designing and development. It provides some additional features such as Expression Language, Custom Tags, etc.
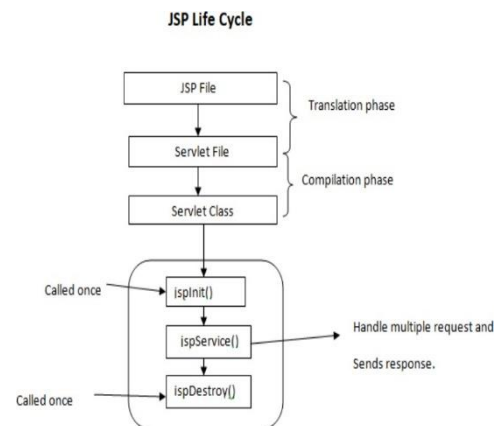

Fig. JSP Life cycle

Backend - Java Servlet

In recent years, servlet technology has emerged as a powerful way to extend Web server functionality through dynamic Web pages. A servlet is a Java program that runs in a Web server, as opposed to an applet that runs in a client browser. Typically, the servlet takes an HTTP request from a browser, generates dynamic content (such as by querying a database), and provides an HTTP response back to the browser. Alternatively, the servlet can be accessed directly from another application component or send its output to another component. Most servlets generate HTML text, but a servlet may instead generate XML to encapsulate data. More specifically, a servlet runs in a J2EE application server, such as OC4J. Servlets are one of the main application component types of a J2EE application, along with Java Server Pages (JSP) and EJB modules, which are also server-side J2EE component types. These are used in conjunction with client-side components such as applets (part of the Java 2 Platform, Standard Edition specification) and application client programs. An application may consist of any number of any of these components

Database MYSQL

MySQL is the most popular Open-Source Relational SQL Database Management System. MySQL is one of the best RDBMS being used for developing various web-based software applications. MySQL is developed, marketed and supported by MySQL AB, which is a Swedish company. This tutorial will give you a quick start to MySQL and make you comfortable with MySQL programming.
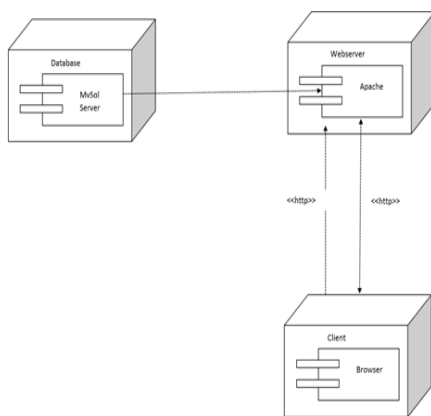

Fig. Deployment Diagram

XAMPP

XAMPP stands for Cross-Platform (X), Apache (A), MySQL (M), PHP (P) and Perl (P). It is a simple, lightweight Apache distribution that makes it extremely easy for developers to create a local web server for testing purposes. Everything you need to set up a web server – server application (Apache), database (MySQL), and scripting language (PHP) – is included in a simple extractable file. XAMPP is also cross-platform, which means it works equally well on Linux, Mac and Windows. Since most actual web server deployments use the same components as XAMPP, it makes transitioning from a local test server to a live server is extremely easy as well. did in the application. We also saw the results in the form of snapshots of the M-Learning Application.

Fig. System Architecture
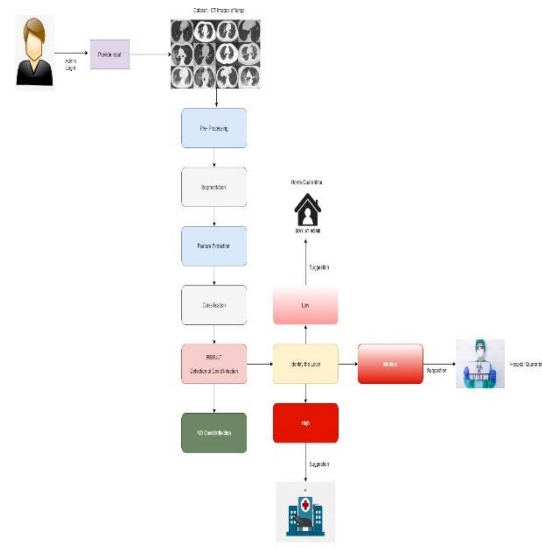
Reconciled Estimates

The project cost can be found using any one of the models.

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 interment-diate version with an 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)

Software Project	A(b)	B(b)	C(b)	D(b)
Organic	2.4	1.05	2.5	0.38
Semi-detached	3.0	1.22	2.5	0.35
Embedded	3.6	1.20	2.5	0.32

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=3.0*(9.072)1.22

= 44.20 person- months

D=2.5* 44.35

= 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:

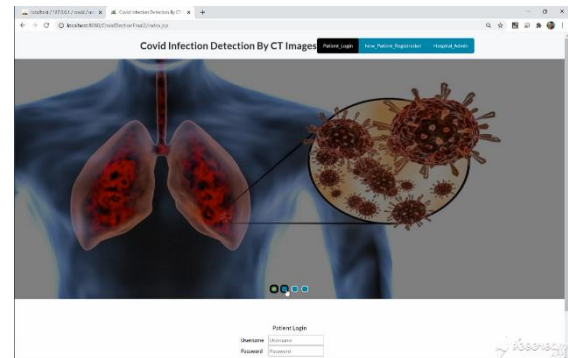C = D * Cp

Were,

C = Cost of project

D = Duration in month

Cp = Cost incurred per person-month, Cp=Rs.5000/- (per person-month) (approx.) C = 9 * 2000
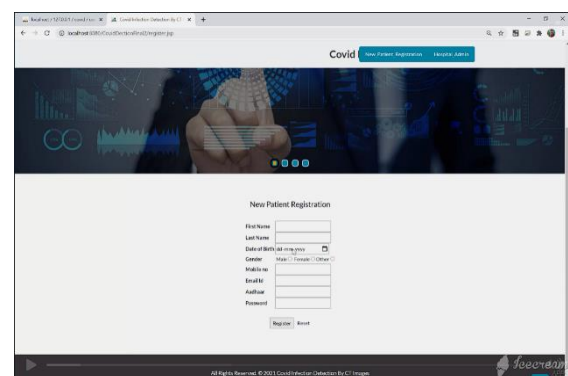
= 18000/-

Hence according COCOMO - 2 model the cost of project is 18000/-(approx.)
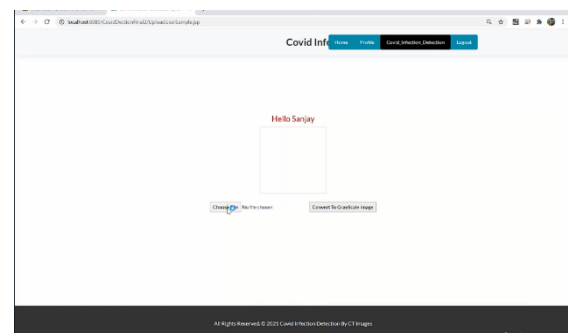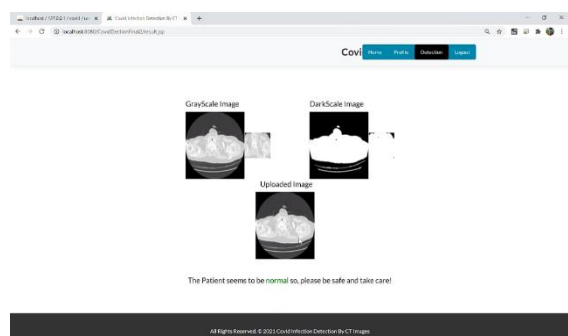
4. RESULTS

Landing Page:
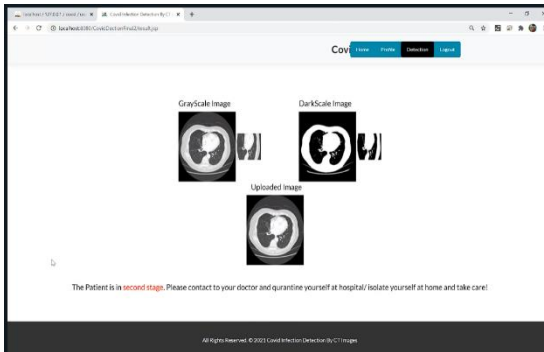

Registration page:

Upload CT image:

Result is normal:

Patient is in second stage suggest to contact doctor:

5. CONCLUSION

Our system plays a very crucial role as it helps in identifying the Covid-19 very early stage. It has a module for uploading the CT scan image. The further system will analyze the uploaded image and will perform various activities which include Pre- processing, segmentation, feature extractions, classification, etc so that it will give us the perfect outcome. The system provides the alert also advice such that he has to take emergency treatment, or just to have home quarantine, etc. So far there is no system implemented that analyses the CT image, and based on the results obtained, provide alert and necessary actions can be taken. The system has a simple and user-friendly interface that will help users to adapt the features and functionality quickly.

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