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Leveraging Convolutional Neural Networks for Accurate Classification and Segmentation of Pneumonia, COVID-19, Tuberculosis

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ABSTRACT: Pneumonia, including pneumonia caused by COVID-19, is a critical respiratory condition that requires accurate and timely diagnosis for effective treatment and management. Convolutional Neural Networks (CNNs) have shown promise in medical image analysis tasks, including the classification of pneumonia and COVID-19 based on chest radiographs or computed tomography (CT) scans. This abstract provides an overview of the application of CNNs in the classification of pneumonia, with a specific focus on COVID-19 cases, using medical imaging data. CNNs show promise in the classification of pneumonia, including COVID-19 cases, using medical imaging data. By leveraging CNNs capabilities in image analysis, the proposed system contributes to accurate diagnosis and treatment of pneumonia, aiding in effective management and patient care. Continued research and development efforts are necessary to refine the CNN models, address challenges, and further validate the system's performance in real-world clinical settings. The trained CNN model is tested on unseen medical images to classify pneumonia and distinguish COVID-19 cases. The system takes new images as input and employs the trained CNN model to predict whether the patient has pneumonia and whether it is related to COVID-19. Performance metrics, comparative analyses, and clinical validation can be conducted to assess the system's accuracy and utility.

KEYWORDS: Convolutional Neural Networks (CNNs), Accuracy, Classification, Segmentation

I. INTRODUCTION

In the realm of medical imaging, the classification and segmentation of X-ray images play a pivotal role in diagnosing respiratory conditions, particularly pneumonia, COVID-19, and normal lung states. Leveraging data science techniques in this domain holds immense potential for enhancing diagnostic accuracy, treatment planning, and overall patient care. By integrating machine learning algorithms and image processing methods, researchers aim to develop robust models capable of autonomously distinguishing between pneumonia, COVID-19, and normal lung conditions based on X-ray images. Despite the undeniable advantages of data science in medical imaging, ethical considerations and the responsible use of patient data remain paramount. Striking a balance between technological innovation and patient privacy ensures that advancements in pneumonia, COVID-19, and normal X-ray image classification are not only scientifically robust but also ethically sound. This ethical framework becomes an integral part of the ongoing dialogue surrounding the responsible deployment of data science in healthcare.

II. LITERATURE REVIEW

Literature research is the most important step in the software development process. Before creating a tool, it is important to determine the time factor, profitability, and company strengths. With these in place, the next 10 steps are to decide which operating systems and languages you can use to develop your tools. Once programmers start building tools, they need a lot of external support. This support can come from experienced programmers, books, or websites. The above evaluations will be considered in the development of the proposed system before building the system.

Gengfei Ling1* and Congcong Cao2, " Atomatic Detection and Diagnosis OF Severe Viral Pneumonia CT image based on LDA-SVM", 2023.

To address pneumonia type identification inefficiencies, LDA-SVM classification method is introduced. LDA extracts image features, SVM classifies sub-datasets with strong fusion features. Fusion indices assess patent sub-centralization fusion**.** LDA-SVM algorithm aims to improve efficiency and accuracy but suffers from prolonged

computation time due to iterative training. DAG LDA shows faster training and classification speeds, particularly advantageous with larger datasets. LDA-SVM excels in linear indexability, while non-linear SVMs may be necessary for specific problems.

Muhammad E. H. Chowdhury1 and Tawsifur Rahman2 and Amith Khandakar1,"Can AI help in screening Viral and COVID-19 pneumonia?", 2020.

The main clinical tool currently in use for the diagnosis of COVID-19 is the Reverse transcription polymerase chain reaction (RT-PCR), which is expensive, less-sensitive and requires specialized medical personnel. X-ray imaging is an easily accessible tool that can be an excellent alternative in the COVID-19 diagnosis. This research was taken to investigate the utility of artificial intelligence (AI) in the rapid and accurate detection of COVID-19 from chest X-ray images. The aim of this paper is to propose a robust technique for automatic detection of COVID-19 pneumonia from digital chest X-ray images applying pre-trained deep-learning algorithms while maximizing the detection accuracy. This would be extremely useful in this pandemic where disease burden and need for preventive measures are at odds with available resources

QIULI WANG 1 and DAN YANG 1 and ZHIHUAN LI1 and XIAOHONG ZHANG 1 and CHEN LIU, " Deep Regression via Multi-Channel Multi-Modal Learning for Pneumonia Screening", 2020.

Pneumonia screening is one of the most crucial steps in the pneumonia diagnosing system, which can improve the work efficiency of the radiologists and prevent delayed treatments. In this paper, we propose a deep regression framework for automatic pneumonia screening, which jointly learns the multi-channel images and multi-modal information (i.e., clinical chief complaints, age, and gender) to simulate the clinical pneumonia screening process. We demonstrate the advantages of the framework in three ways. First, visual features from multi-channel images (Lung Window Images, High Attenuation Images, Low Attenuation Images) can provide more visual features than single image channel, and improve the ability of screening pneumonia with severe diseases. Second, the proposed framework treats chest CT scans as short video frames and analyzes them by using Recurrent Convolutional Neural Network, which can automatically extract multiple image features from multi-channel image slices. Third, chief complaints and demographic information can provide valuable prior knowledge enhancing the features from images and further promote performance. The proposed framework has been extensively validated in 900 clinical cases. Compared to the baseline, the proposed framework improves the accuracy by 2.3% and significantly improves the sensitivity by 3.1%. To the best of our knowledge, we are the first to screen pneumonia using multi-channel images, multi-modal demographic and clinical information based on the large scale clinical raw dataset

Ling-Li Zeng , Kai Gao and Dewen Hu, " SS-TBN: A Semi-Supervised Tri-Branch Network for COVID-19 Screening and Lesion Segmentation", 2023.

Insufficient annotated data and minor lung lesions pose big challenges for computed tomography (CT)-aided automatic COVID-19 diagnosis at an early outbreak stage. To address this issue, we propose a Semi-Supervised Tri-Branch Network (SS-TBN). First, we develop a joint TBN model for dual-task application scenarios of image segmentation and classification such as CT-based COVID-19 diagnosis, in which pixel-level lesion segmentation and slice-level infection classification branches are simultaneously trained via lesion attention, and individual-level diagnosis branch aggregates slice-level outputs for COVID-19 screening. Second, we propose a novel hybrid semi-supervised learning method to make full use of unlabeled data, combining a new double-threshold pseudo labeling method specifically designed to the joint model and a new inter-slice consistency regularization method specifically tailored to CT images. Besides two publicly available external datasets, we collect internal and our own external datasets including 210,395 images (1,420 cases versus 498 controls) from ten hospitals. Experimental results show that the proposed method achieves state-of-the-art performance in COVID-19 classification with limited annotated data even if lesions are subtle, and that segmentation results promote interpretability for diagnosis, suggesting the potential of the SS-TBN in early screening in insufficient labeled data situations at the early stage of a pandemic outbreak like COVID-19.

Fangfang Lu and Zhihao Zhang and Shuai Zhao, "CMM: A CNN-MLP Model for COVID-19 Lesion Segmentation and Severity Grading" 2023.

In this paper, a CNN-MLP model (CMM) is proposed for COVID-19 lesion segmentation and severity grading in CT images. The CMM starts by lung segmentation using UNet, and then segmenting the lesion from the lung region using a multi-scale deep supervised UNet (MDS-UNet), finally implementing the severity grading by a multi-layer preceptor (MLP). In MDS-UNet, shape prior information is fused with the input CT image to reduce the searching space of the potential segmentation outputs. The multi-scale input compensates for the loss of edge contour information in convolution operations. In order to enhance the learning of multiscale features, the multi-scale deep supervision extracts supervision signals from different upsampling points on the network. In addition, it is empirical that the lesion which has a whiter and denser appearance tends to be more severe in the COVID-19 CT image. So, the weighted mean gray-scale value (WMG) is proposed to depict this appearance, and together with the lung and lesion area to serve as

input features for the severity grading in MLP. To improve the precision of lesion segmentation, a label refinement method based on the Frangi vessel filter is also proposed.

III. METHODOLOGY

The systems architect establishes the basic structure of the system, we propose a deep learning algorithm where the project involves collecting a diverse dataset of respiratory images encompassing COVID-19, pneumonia, tuberculosis, and normal conditions, followed by preprocessing techniques such as resizing, normalization, and augmentation. Suitable deep learning architectures like U-net and Lenet are chosen for classification and segmentation tasks, respectively.

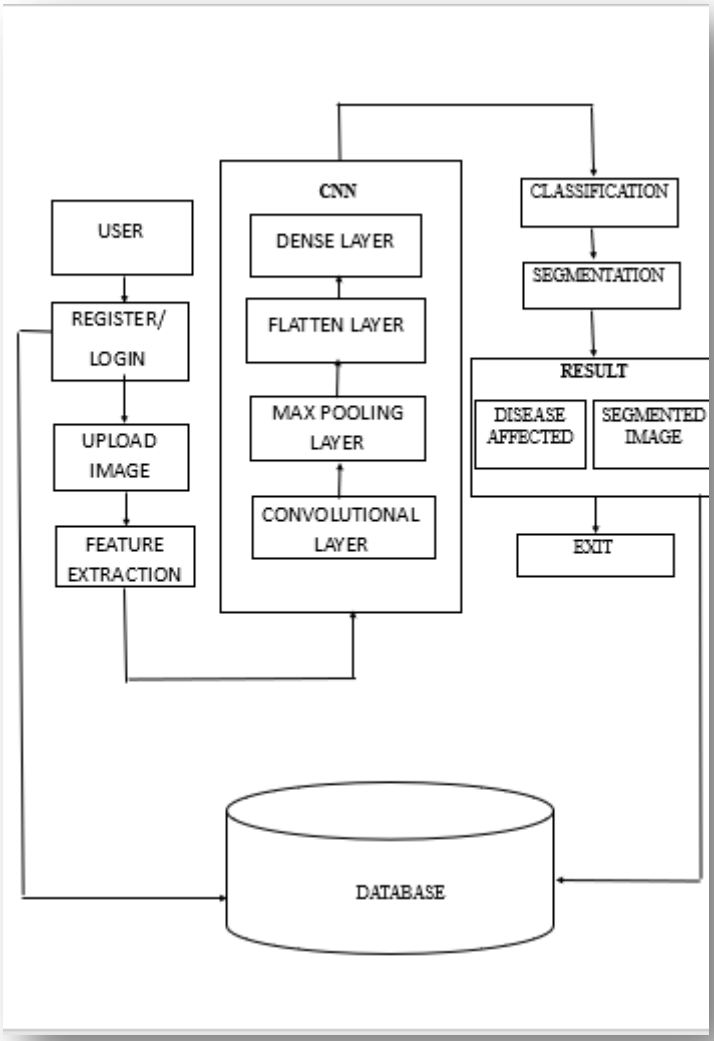


Fig1. The architecture of the proposed system

IV. RESULTS AND DISCUSSION

USER REGISTER:

The register module provides a conceptual framework for entering user data to register in that webpage.

USER LOGIN:

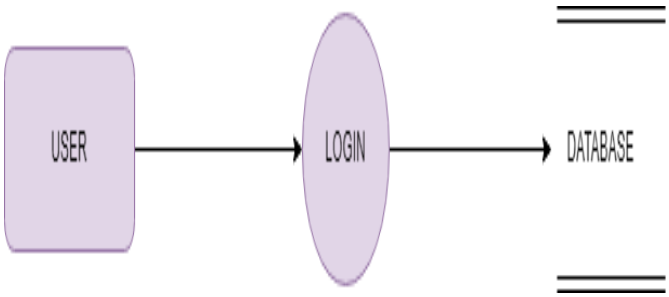


Fig2. User Login Diagram

This module in our project here symbolizes a unit of work performed within a database management system (or similar system) against a database and it stores personal information about the user like name, age , country etc .
USER UPLOAD X-RAY IMAGE:

In this module, the user choose x-ray image for disease identification . After choosing x-ray image if we upload the image it will show the classification and segmentation of the disease in the x-ray image.

VIEW USER LIST:
This module is used to see the user personal details and who and all used the website.

ARCHITECTURE
A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other.
The following illustration highlights how asymmetric Convolutional Neural Network works:

How it works
The CNN has many layer so each images undergoes following layers of process before displaying the results.

1. Convolutional Layer:
Convolutional layer is sometimes called feature extractor layer because features of the image are get extracted within this layer. First of all, a part of image is connected to Convo layer to perform convolution operation as we saw earlier and calculating the dot product between receptive field (it is a local region of the input image that has the same size as that of filter) and the filter. Result of the operation is single integer of the output volume. Then the filter over the next receptive field of the same input image by a Stride and do the same operation again. It will repeat the same process again and again until it goes through the whole image. The output will be the input for the next layer.

2. Pooling Layer:
Pooling layer is used to reduce the spatial volume of input image after convolution. It is used between two convolution layers. If it applies FC after Convo layer without applying pooling or max pooling, then it will be computationally expensive. So, the max pooling is only way to reduce the spatial volume of input image. It has applied max pooling in single depth slice with Stride of 2. It can observe the 4 x 4 dimension input is reducing to 2 x 2 dimensions**.**

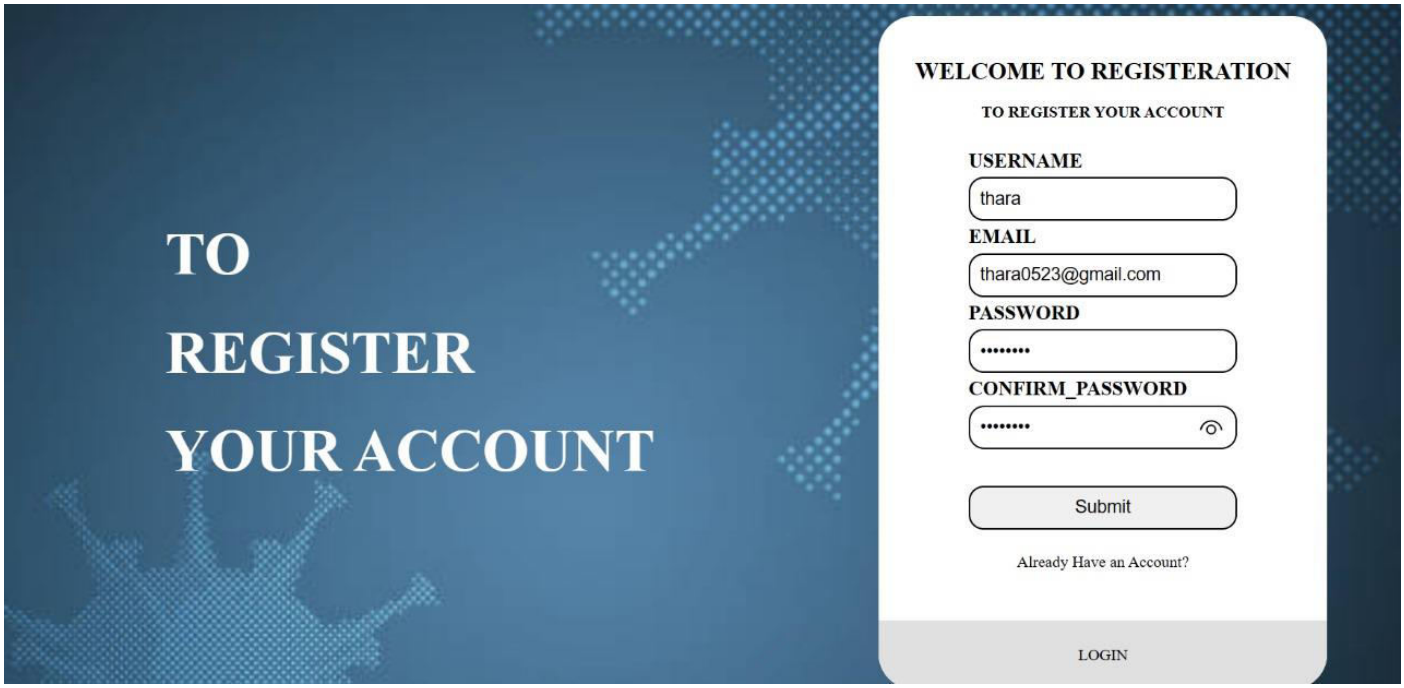
3. Fully Connected Layer (FC) or Dense layer:
Fully connected layer involves weights, biases, and neurons. It connects neurons in one layer to neurons in another layer. It is used to classify images between different categories by training.

4.Flatten Layer:
Flatten layer is typically used to convert the multi-dimensional output of the convolutional and pooling layers into a one-dimensional array, which can then be fed into a fully connected (dense) layer for further processing.

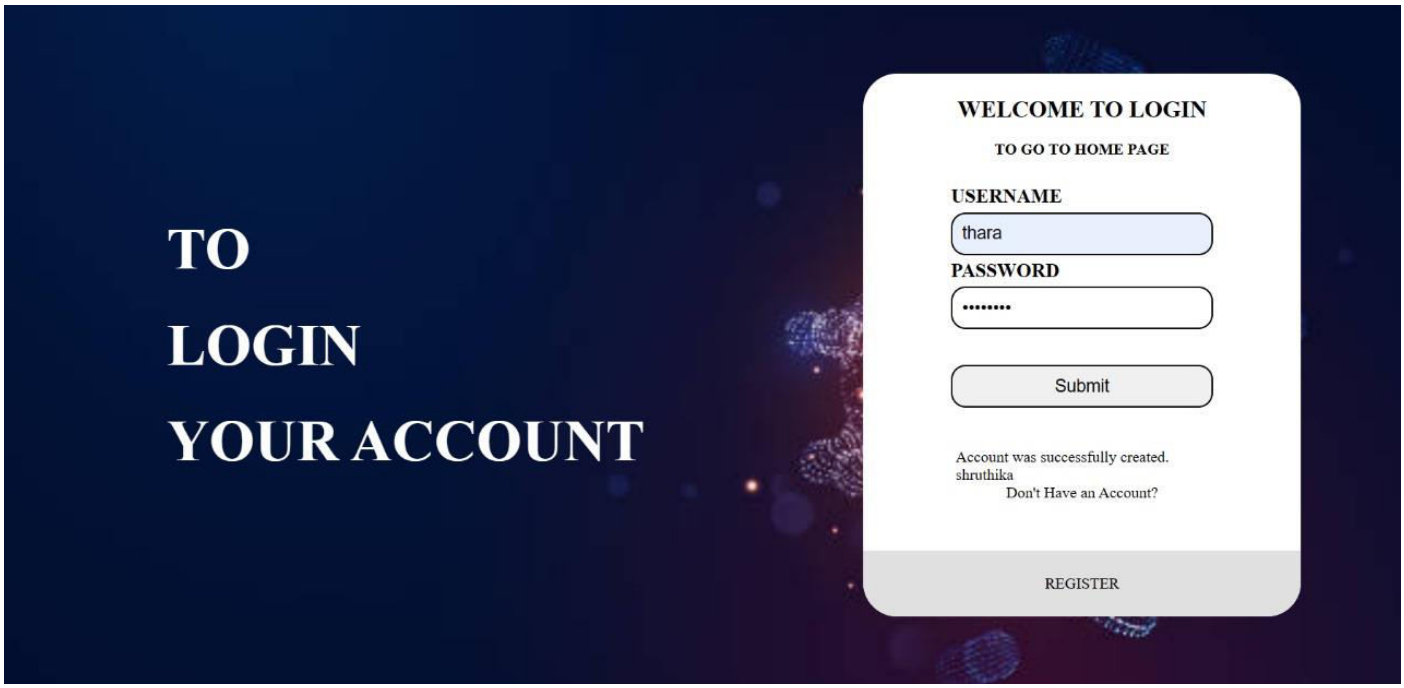
OUTPUT:

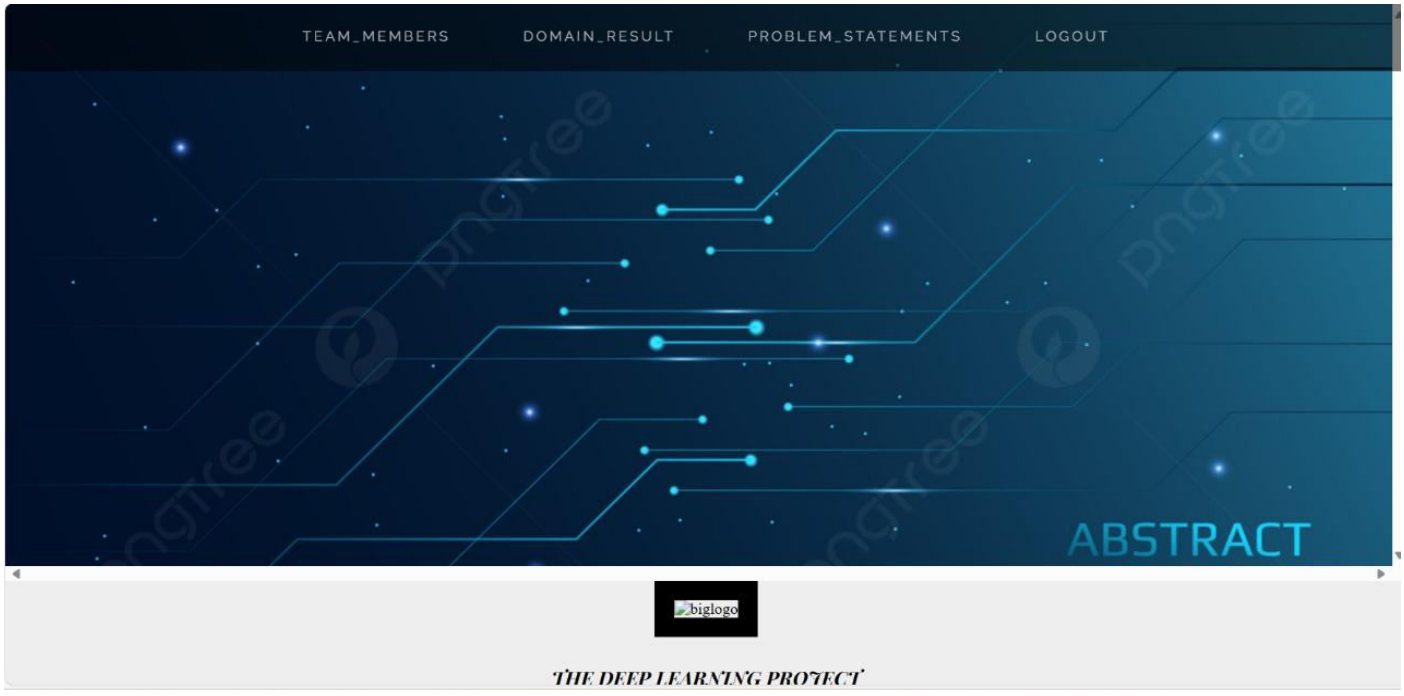
HOME PAGE:

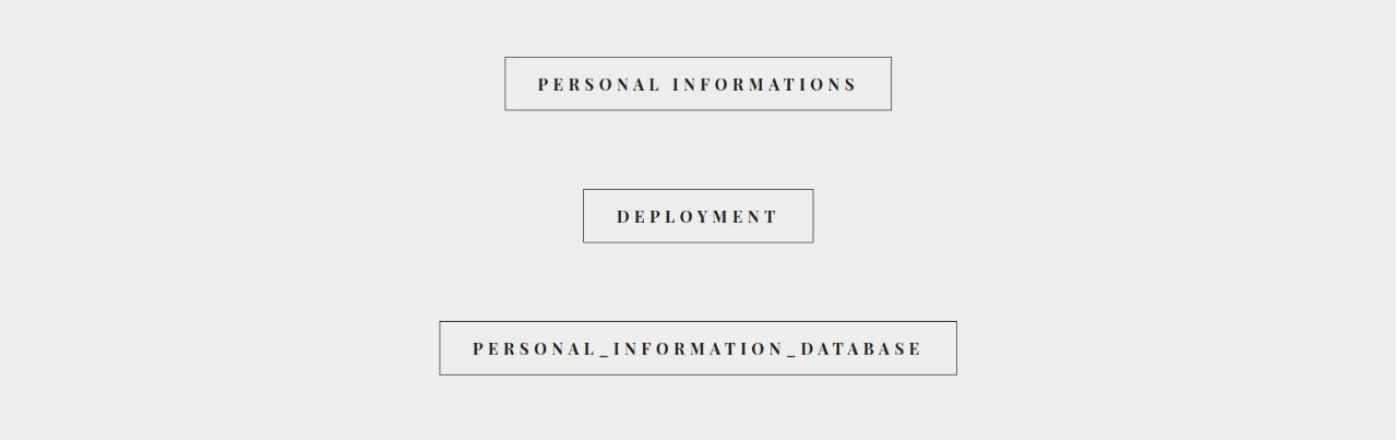
REGISTERATION PAGE:



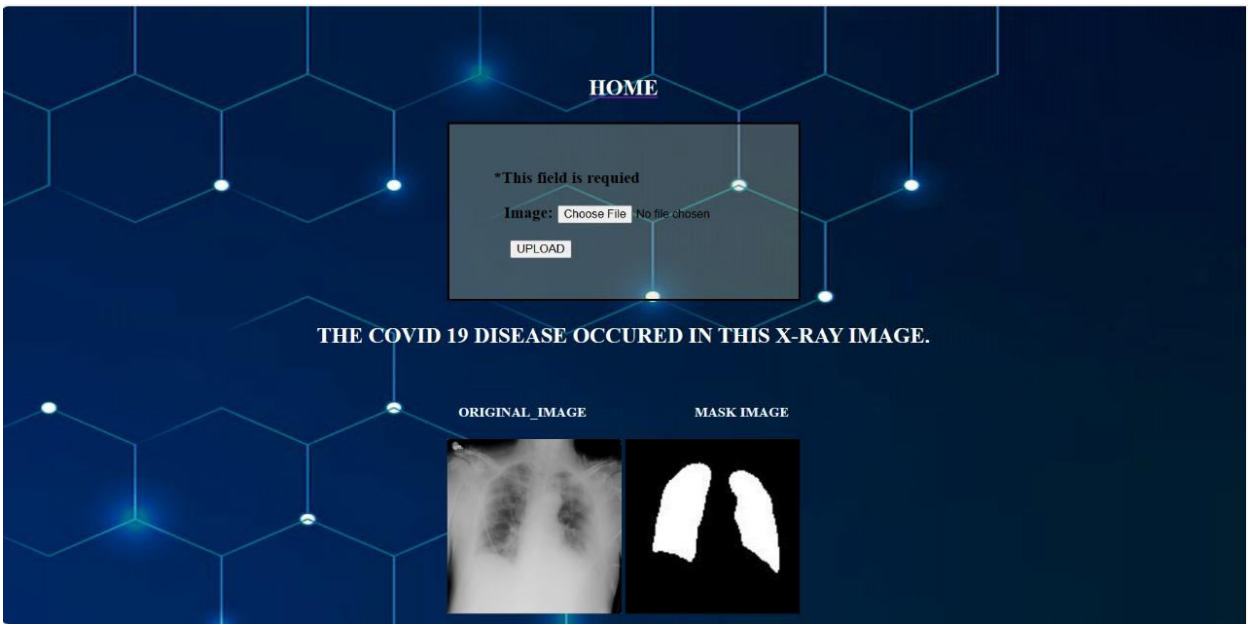
LOGIN PAGE:


TO
LOGIN
YOUR ACCOUNT
WELCOME TO LOGIN
TO GO TO HOME PAGE
USERNAME
thara
PASSWORD
Submit
Account was successfully created.
shruthika
Don't Have an Account?
REGISTER


TEAM_MEMBERS
DOMAIN_RESULT
PROBLEM_STATEMENTS
LOGOUT
ABSTRACT
biglogo
'THE DEEP LEARNING PROJECT'



DATABASE PAGE:



V. CONCLUSION

In this project, a research to classify covid, pneumonia, tuberculosis over static facial images using deep learning techniques was developed. This is a complex problem that has already been approached several times with different techniques. While good results have been achieved using feature engineering, this project focused on feature learning, which is one of DL promises. While feature engineering is not necessary, image pre-processing boosts classification accuracy. Hence, it reduces noise on the input data. Nowadays, covid, pneumonia, tuberculosis detection software includes the use of feature engineering. A solution totally based on feature learning does not seem close yet because of a major limitation. Thus, covid, pneumonia, tuberculosis classification could be achieved by means of deep learning techniques.

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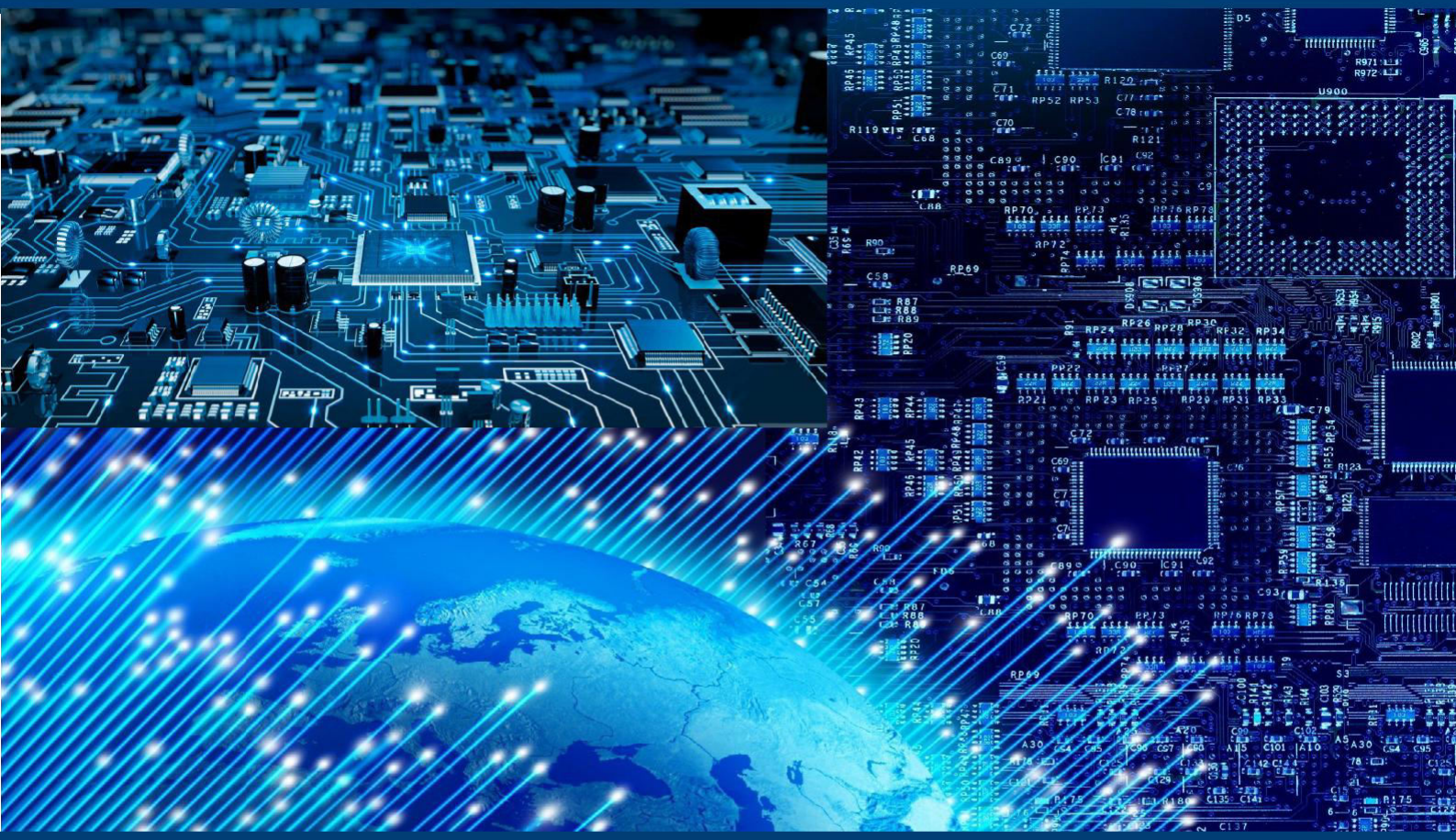

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