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A Website to detect COVID-19 from chest X-Rays

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I. INTRODUCTION

A. *Theoretical Background*

The COVID-19 pandemic is continuously having a devastating impact on the well-being and health of the global population. The rapid rise in patients with COVID-19 is challenging for healthcare systems all over the globe. With limitedtesting kits, it is impossible to test with conventional techniques (RT-PCR) forevery patient for respiratory disease. Effective screening of infected patients is a crucial step in the battle against COVID-19, with radiological imaging using chest radiography being one of the main screening methods.

The goal of this project is to detect COVID-19 pneumonia patients automatically using digital chest x-ray images while optimising detection accuracy using convolutional neural networks (CNNs), a special type of a neural network architecture. The trained model would then be realized using a web interface where users can upload the chest x-ray images, and the model returns a response as to whether the x-ray image shows presence of infection from COVID-19 or not.

B. *Aim of the Proposed Work*

In this paper , we have proposed a simple web application for detecting presence of covid- 19 from chest x-ray images. The users can provide their chest x-rays as input. A trained deep learning model based on a convolutional neural network architecture takes the image, and predicts whether the given image has any presence of covid-19 pneumonia infection in it or not. The web application provides the same output back to the user.

II. OVERVIEW OF PROPOSED WORK

A. *Introduction and Related Concepts*

Since the deep learning model being used in the web application is based on a convolutional neural network architecture, it is imperative to understand how a simple CNN model works. Apart from that, it might also be useful to understand about the 'Model-View-Controller' (MVC) architecture.

B. *Framework and Architecture for the Proposed System*

The goal of the proposed work is to detect COVID-19 pneumonia patients automatically using digital chest x-ray images while optimizing detection accuracy using convolutional neural networks (CNNs), a type of a neural network architecture which is generally used for computer vision.

Thus, a deep learning model based on a CNN architecture is proposed. After training the model, its performance will be analyzed using metrics like the confusion matrix, the ROC-AUC curve, and the accuracy of training, precision-recall scores etc. Based on the initial performance of the model, transfer learning might be considered and other advanced CNN architecture models like Resnet, Alex net on ImageNet might be used.

We then plan to integrate the model to a web-interface by creating an application-program interface (API) using back-end frameworks like Flask or the Django framework. On the front-end of the interface, we plan to make a clean and simple user-interface for users to upload images of their x-rays, and find out if it detects the presence of COVID-19 infection in them or not. Lastly, we plan to create an API and expose it to the rest of the world so that other services and institutions can easily integrate it with their software for free.

C. Proposed System Model (Block Diagrams)

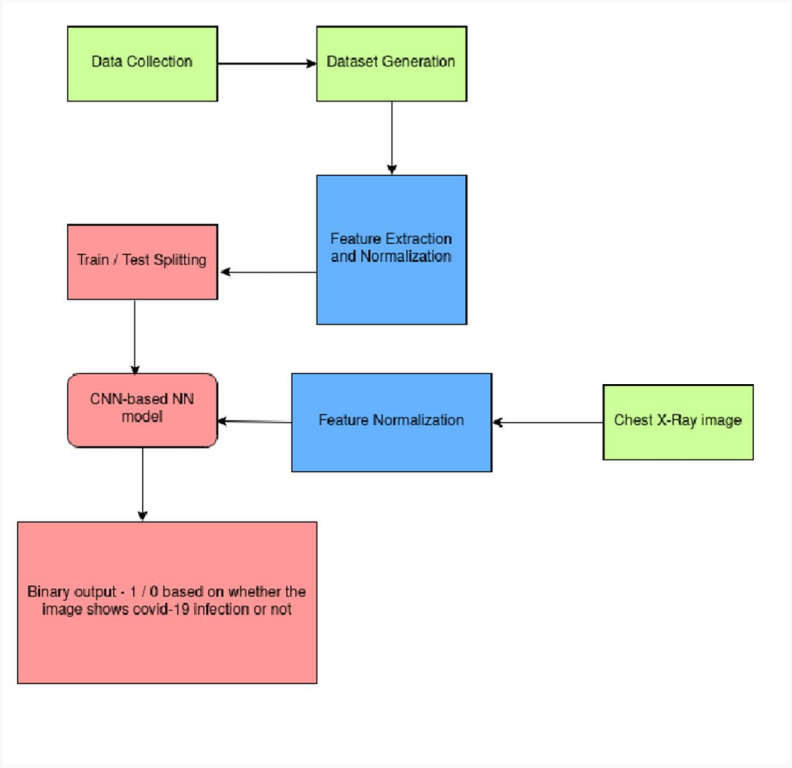

Fig.1 CNN Model Architecture Diagram

For training the deep learning model, the data is first collected from from the open-sourced data- https://github.com/ieee8023/covid-chestxray-dataset which was collected by Joseph Paul Cohen, who is the director of the Institute for Reproducible Research, a US non-profit which operates ShortScience.org and Academic Torrents. He is also a researcher and pragmatic engineer. This data is then split to training and validation dataset. After the feature extraction and normalization process, the created dataset is used to train and validate the CNN model. A similar feature extraction and normalization occurs when a user provides the input image. This image is then used by the trained model to predict the output. The trained model has a prediction accuracy score of approximately 98.33% on the validation data.

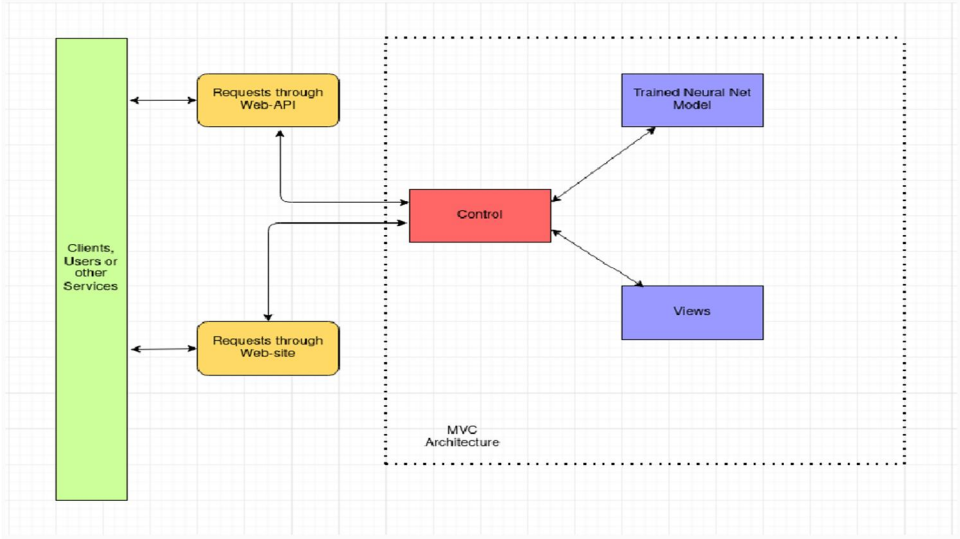

Fig 2. Architecture Diagram of the Web-site

In the web application that we created, the users or the clients can send the requests either by connecting to the web application or through the web API created. The web application uses a Model-View-Controller (MVC) architecture. The controller module renders the correct output and provides appropriate responses back to the users or clients.

III. PROPOSED SYSTEM ANALYSIS AND DESIGN

A. Introduction

In this project, we have implemented a simple web application for detecting presence of covid- 19 from chest x-ray images. The users can provide their chest x-rays as input. A trained deep learning model based on a convolutional neural network architecture takes the image, and predicts whether the given image has any presence of covid-19 pneumonia infection in it or not. The web application provides the same output back to the user.

B. Methodology Adopted

In order to classify the input chest x-ray images to whether it shows signs of covid-19 infection or not, a deep-learning model based on the convolutional neural network (CNN) architecture is proposed. After training the model, its performance is analyzed using standard metrics such as confusion matrix, the ROC-AUC curve, the accuracy of training etc.

Based on the initial performance analysis of the trained model, transfer learning will be considered based on more highly advanced and accurate CNNs such as Alexnet, Googlenet or Resnet models, to improve its performance if required.

Later, this model will be integrated to a web-interface by creating an application-program interface (API) using back-end frameworks like Flask or the Django framework. Also, a clean and simple user-interface will be created, for users to upload images of their chest x-rays, and find out if it detects the presence of covid-19 infection in them or not.

Lastly, an API is also created and exposed to the rest of the world so that other services and institutions can easily integrate it with their softwares for free.

C. Innovation / Novelty

In most of the previous work (discussed in the “literature work” section), the main problem was that the data or datasets used were either not adequate or required further insights.

To mitigate this problem and to get better and accurate results, we were careful to get the covid- 19 positive sample images from the open-sourced data- https://github.com/ieee8023/covid-chestxray-dataset

Which was collected by Joseph Paul Cohen, who is the director of the Institute for Reproducible Research, a US non-profit which operates ShortScience.org and Academic Torrents. He is also a researcher and pragmatic engineer

IV. CONCLUSION

In this project, we have implemented a simple web application for detecting presence of covid- 19 from chest x-ray images. The users can provide their chest x-rays as input. A trained deep learning model based on a convolutional neural network architecture takes the image, and predicts whether the given image has any presence of covid-19 pneumonia infection in it or not. The web application provides the same output back to the user.

Since at the time of this project, and perhaps throughout the near future as well, collecting details and research on covid-19 is still an ongoing process. There are also reports of multiple new strains of the virus being discovered. Thus, future work can include but is not necessarily limited to proper collection of data regarding them, as well as using a proper, clean dataset generated from the collected data to train and improve the performance of the model. A deep learning model with better and more advanced architectures can also be considered as the variation of data used for training increases.

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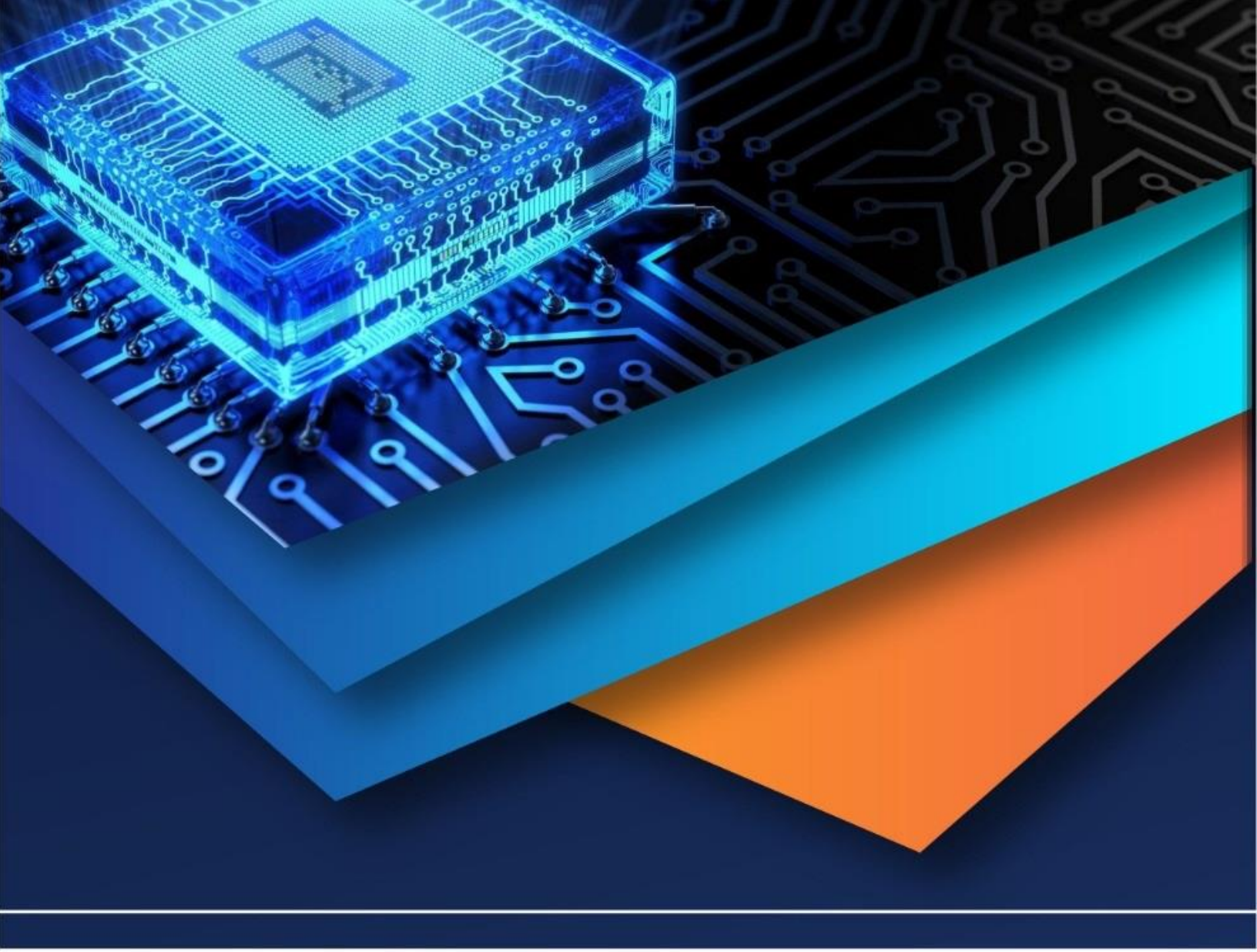

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