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Feed forward Convolutional Neural Network Approach for Predicting Covid Disease

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Abstract: Identifying students' progress at an early stage enables educators to refine teaching strategies and incorporate varied instructional methods to enhance the overall learning experience. Machine learning techniques offer valuable support by forecasting potential learning difficulties, allowing educators to intervene early and guide students more effectively. This study explores the use of classification techniques, specifically Decision Tree (DT) algorithms, to predict students' academic performance following their preparatory year and determine which algorithm delivers the highest accuracy. In parallel, the emergence of COVID-19 has led to significant mortality, particularly among the elderly and individuals with preexisting health conditions. The primary diagnostic approach for COVID-19 has been the reverse-transcription polymerase chain reaction (RT-PCR) test, which, although effective, is often costly and time-intensive. This has underscored the necessity for rapid, affordable diagnostic alternatives to aid clinical evaluations. To address this, we evaluated the performance of transfer learning by employing pretrained deep convolutional neural networks to detect COVID-19 using chest X-ray images, utilizing two publicly available datasets under various experimental conditions.

Keywords— Machine learning Image captioning, Synthetic images, Attention, Generative adversarial network.

1. INTRODUCTION

COVID-19, as an emerging infectious disease, has significantly disrupted global public health systems and the functioning of economies worldwide. The pandemic has severely affected industries such as retail, hospitality, tourism, and accommodation, leading to sharp declines in revenue. Meanwhile, sectors like manufacturing and real estate have faced operational delays due to financial limitations and liquidity issues. These widespread impacts underscore the urgent need for efficient and rapid testing methods to control the virus's transmission.

Computer-aided diagnosis (CAD) systems have proven valuable in supporting healthcare providers by analyzing medical images like chest X-rays and CT scans. In some cases, patients exhibit severe symptoms yet test negative using nucleic acid-based methods, making CT imaging essential for accurate diagnosis. CT scans offer critical insights into whether a patient is suffering from pneumonia, the extent of lung involvement, and the stage of the disease. With the continuous advancement of artificial intelligence and big data analytics, significant improvements have been made in developing CT-based diagnostic algorithms to detect COVID-19 more effectively.

2. RELATED WORKS

A Feedforward Convolutional Neural Network (CNN) is a deep learning architecture commonly used for processing visual data, making it highly suitable for tasks like image classification, pattern detection, and feature extraction. In the context of COVID-19 diagnosis, CNNs can be applied to medical imaging—such as chest X-rays and CT scans—to detect infection patterns associated with the SARS-CoV-2 virus. The feedforward design means the data moves in a single direction, from input to output, without feedback loops, making the model efficient for tasks involving static images.

This approach is especially valuable in situations where traditional diagnostic methods like RT-PCR are either too slow or not readily available, particularly in low-resource environments. Medical imaging has emerged as a viable and rapid alternative for initial screening. CNNs are capable of automatically learning complex visual features, which helps in identifying early signs of infection and reduces the burden on medical staff.

The primary motivations for using CNNs in COVID-19 detection include:

- Speed: Artificial intelligence can significantly shorten diagnosis time by automating image analysis.
- Non-Invasiveness: Imaging techniques are less intrusive compared to molecular testing methods like RT-PCR.
- Scalability: CNNs handle large volumes of high-dimensional imaging data effectively, making them ideal for large-scale diagnostic applications.

The main objective of applying feedforward CNNs in this domain is to build a reliable model that can differentiate between COVID-19 positive and negative cases using imaging data. Key goals include:

- High Accuracy: Achieve precise detection with strong sensitivity and specificity.
- Automation: Minimize manual interpretation, easing the workload for healthcare providers.
- Early Diagnosis: Enable quicker interventions through faster identification of cases.
- Robustness: Ensure the model performs consistently across diverse patient demographics and imaging conditions.

3. LITERATURE SURVEY

1. Computed Tomography (CT) scans play a crucial role in identifying COVID-19 and evaluating the severity of a patient's condition. However, analyzing CT images manually is time-consuming and requires expert knowledge. To address this, the study introduces an automated detection method based on the EfficientDet model to enhance diagnostic efficiency. EfficientDet employs a streamlined multi-scale feature fusion technique, which is particularly well-suited for identifying COVID-19-related abnormalities with greater detail. Furthermore, the importance of data augmentation is emphasized in improving detection accuracy. The model's performance is assessed using the SIIM-FISABIO-RSNA COVID-19 Detection dataset from the Kaggle platform. Results demonstrate that EfficientDet outperforms several other models in detection accuracy, achieving a MAP@0.5 score of 0.545—surpassing YOLO-V5 by 7.9%.

2.COVID-19, a novel coronavirus, was initially identified in Wuhan, China. Common symptoms in confirmed patients include fever, fatigue, and dry cough. The virus has since spread across the globe, prompting widespread concern. This review paper explores the application of machine learning methods for the automated detection of COVID-19 using datasets comprising X-ray and CT scan images. These datasets include samples from individuals with bacterial pneumonia, confirmed COVID-19 infections, and other common respiratory conditions. The primary aim of this study is to assess the efficiency of these techniques in identifying COVID-19 cases. As infection rates continue to surge globally, timely diagnosis has become crucial. Therefore, healthcare providers and patients have increasingly relied on advanced medical technologies to facilitate rapid and accurate detection.

3. The COVID-19 pandemic has affected over 224 million individuals and resulted in approximately 4.6 million deaths worldwide. In response, nearly 80 research publications have focused on leveraging Artificial Intelligence (AI) for diagnosing COVID-19. A foundational systematic review by Suri et al. [IEEE J Biomed Health Inform, 2021] introduced the AP(ai)Bias 1.0 model, incorporating 10 AI-based attributes in a Deep Learning (DL) context. Expanding on this work, the current review introduces AP(ai)Bias 2.0, which applies three quantitative strategies to assess risk of bias across 40 Hybrid Deep Learning (HDL) studies using 39 AI-specific criteria.

The first technique involves generating a radial bias map (RBM) for each study to determine individual bias levels. The second calculates regional bias area (RBA) by comparing performance disparities between the highest- and lowest-scoring AI features. The third method establishes a ranking bias score (RBS) by assigning cumulative bias scores to each study and classifying them into three categories: low, moderate, and high bias. These quantitative techniques are evaluated using Venn diagrams in relation to two established qualitative tools—ROBINS-I and PROBAST. Based on computed thresholds of 2.9 (moderate–high) and 3.6 (low–moderate), findings include 4027.5 across the metrics RBM, RBA, RBS, ROBINS-I, and PROBAST. The study concludes with an eight-point set of recommendations aimed at reducing bias in AP(ai)Bias 2.0 evaluations.

4.The Artificial Intelligence and Data Science communities have played a vital role in addressing the global COVID-19 crisis. A major focus has been on developing fast and accurate diagnostic systems, with deep learning models applied to chest X-rays emerging as a promising approach. This study evaluates the performance of several popular pre-trained convolutional neural networks (CNNs) in a transfer learning context for detecting COVID-19 from chest X-ray scans. Two publicly available datasets were used, and experiments were conducted using each dataset individually as well as in combination. Among the models tested, DenseNet, ResNet, and Xception demonstrated the highest accuracy, suggesting that chest X-ray images can be effectively used to identify COVID-19 cases.

4. Proposed System & System Architecture

The initial phase involves gathering an appropriate and relevant dataset for the intended study or analysis. For COVID-19 prediction, data sources could include: Medical Imaging (X-rays, CT scans, or chest radiographs of COVID-19 patients)Public datasets such as COVID-19 Image Data Collection (Kaggle, etc.) Patient Medical Data (If not using images) Features like age, gender, travel history, symptoms (fever, cough, fatigue, etc.), lab test results, and pre-existing conditions (e.g., diabetes, hypertension) Data Preprocessing. Image Preprocessing: Normalize pixel values to a range [0, 1] or [-1, 1]. Augment the dataset (e.g., rotations, flips, and zooms) to increase the model's robustness. Feature Engineering for Non-image Data: Standardize continuous features (e.g., age, temperature) and encode categorical features (e.g., gender, travel history). Handle missing data (using imputation methods or removing rows/columns with excessive missing values).

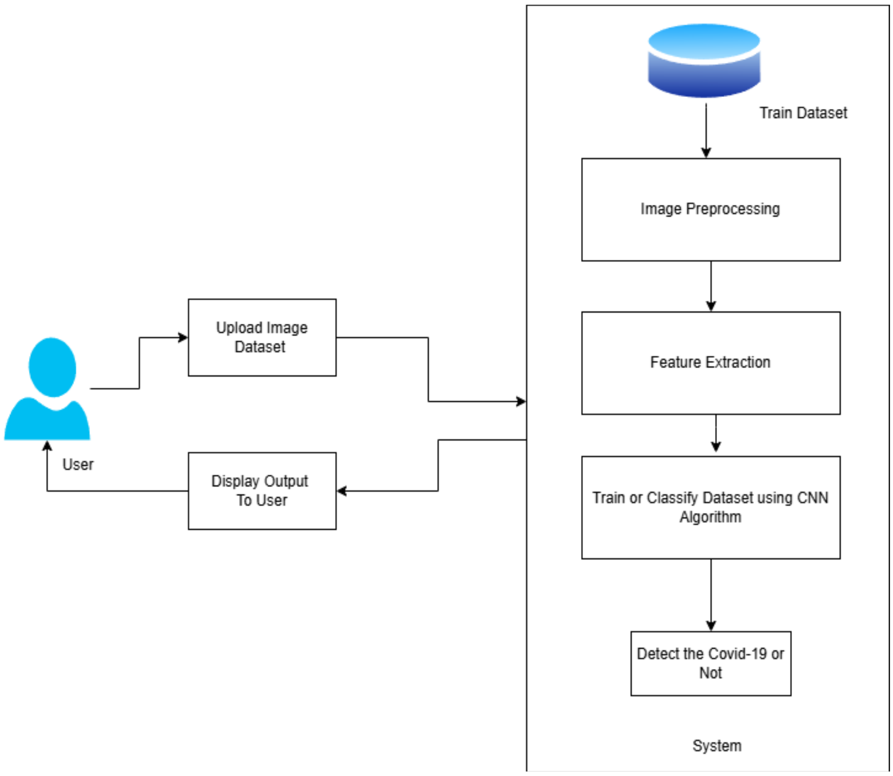

Fig 1. Workflow of System

Integration with Other Modalities: Integrating convolutional neural networks (CNNs) with other neural architectures, such as recurrent neural networks (RNNs) for handling sequential data like time-series patient information, may enhance the accuracy of predictions.Hybrid models that combine image data with clinical data could offer more robust predictions. Real-Time Deployment: There is a growing need for real-time diagnostic tools in hospitals. Integrating the model with medical imaging devices could provide instant predictions during patient examinations. Explainable AI: As AI in healthcare grows, the interpretability of the model is essential. Developing techniques to explain CNN predictions (e.g., using Grad-CAM or SHAP values) can make the system more trustworthy for medical professionals. Transfer Learning: improving generalization and reducing the need for large annotated datasets in every new deployment. Incorporating Multi-Modal Data: Combining medical imaging, clinical history, and genetic data can create more accurate prediction models that take a holistic view of a patient's health.

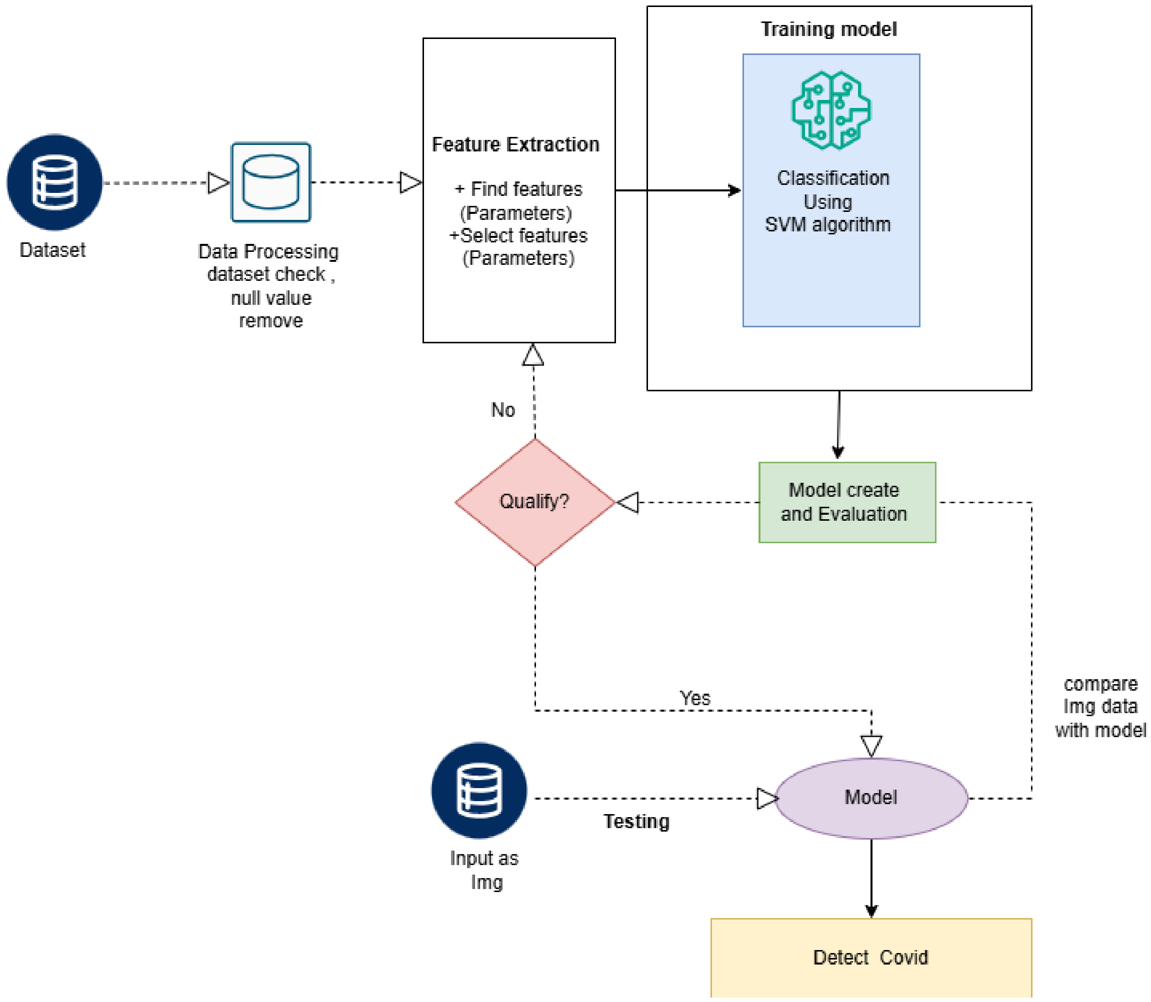

Fig 2. System Architecture

5. METHODOLOGY

Data Collection The first step is to collect a relevant dataset. For COVID-19 predic- tion, data sources could include: Medical Imaging (X-rays, CT scans, or chest radiographs of COVID-19 patients) Public datasets such as COVID-19 Image Data Collection (Kaggle, etc.) Patient Medical Data (If not using images) Features like age, gender, travel history, symptoms (fever, cough, fatigue, etc.), lab test results, and pre-existing conditions (e.g., diabetes, hypertension) Data Preprocessing Image Preprocessing: Resize images to a standard size (e.g., 224x224 pixels). Normalize pixel values to a range [0, 1] or [-1, 1]. Augment the dataset (e.g., rotations, flips, and zooms) to increase the model's robustness. Feature Engineering for Non-image Data: Standardize continuous features (e.g., age, temperature) and encode categorical fea- tures (e.g., gender, travel history). Handle missing data (using imputation methods or removing rows/columns with excessive missing values).

6. RESULT AND EXPERIMENTAL EVALUATION

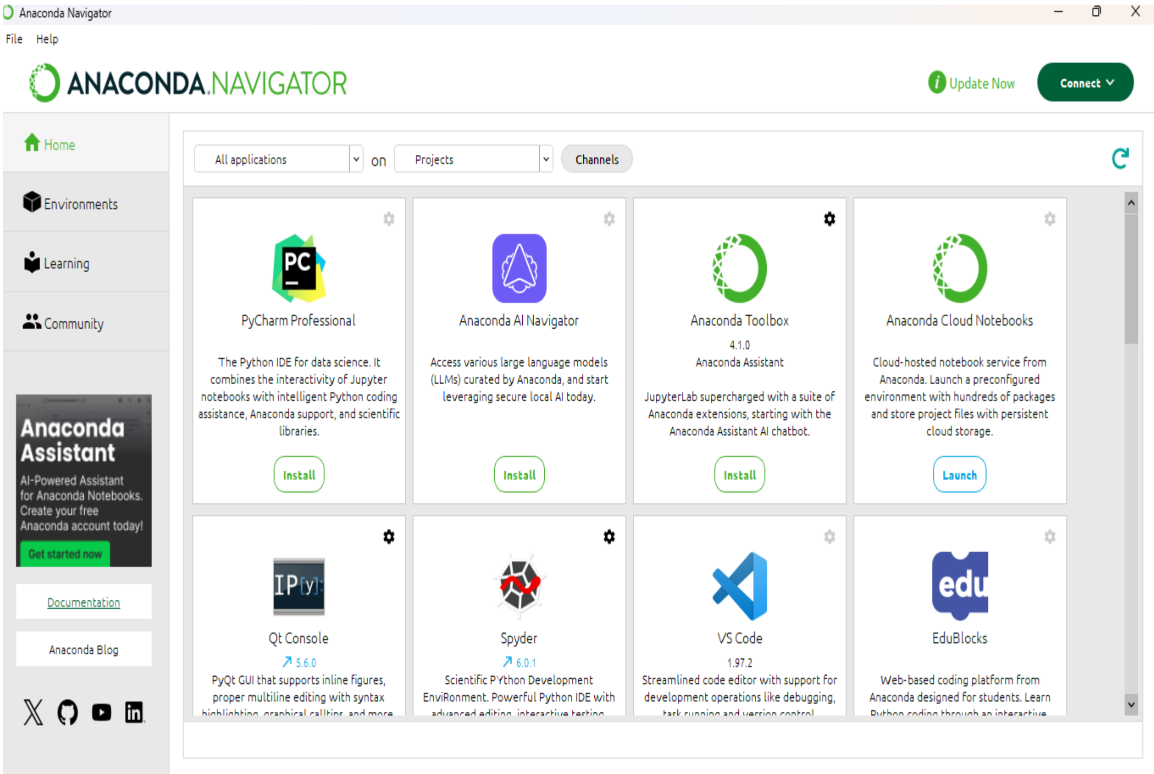

Fig: Gui Main page

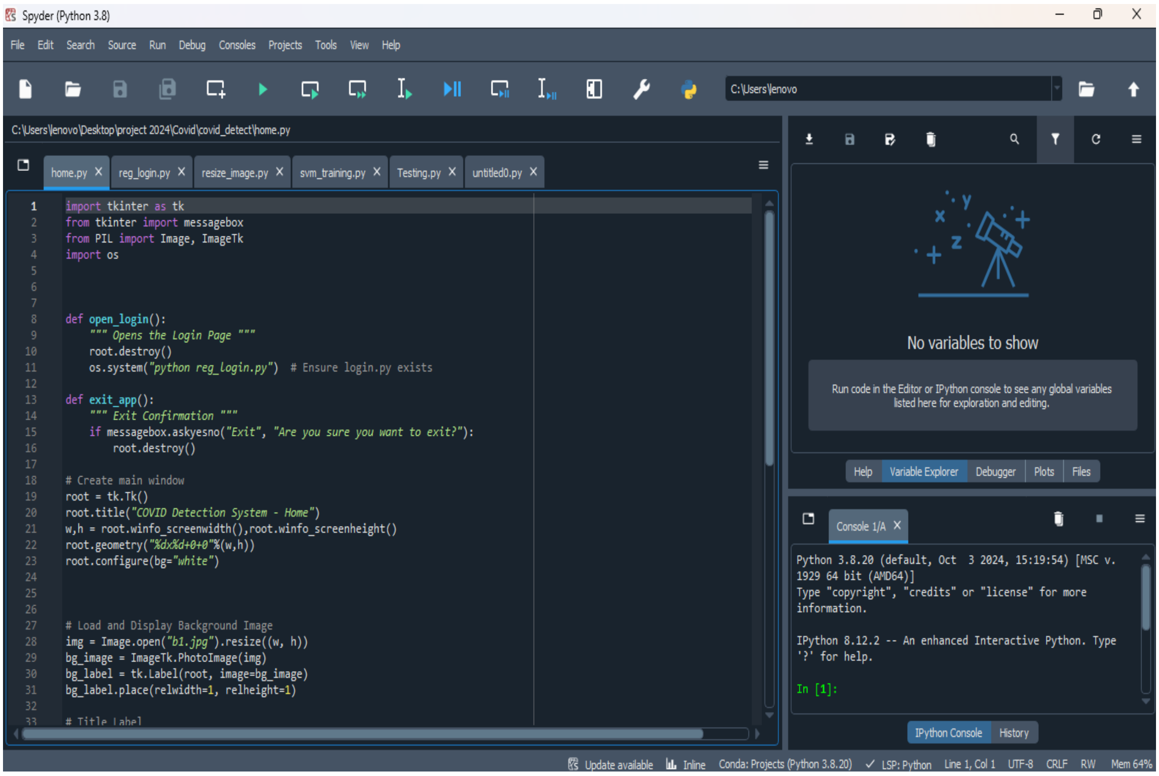

Fig: Login Page

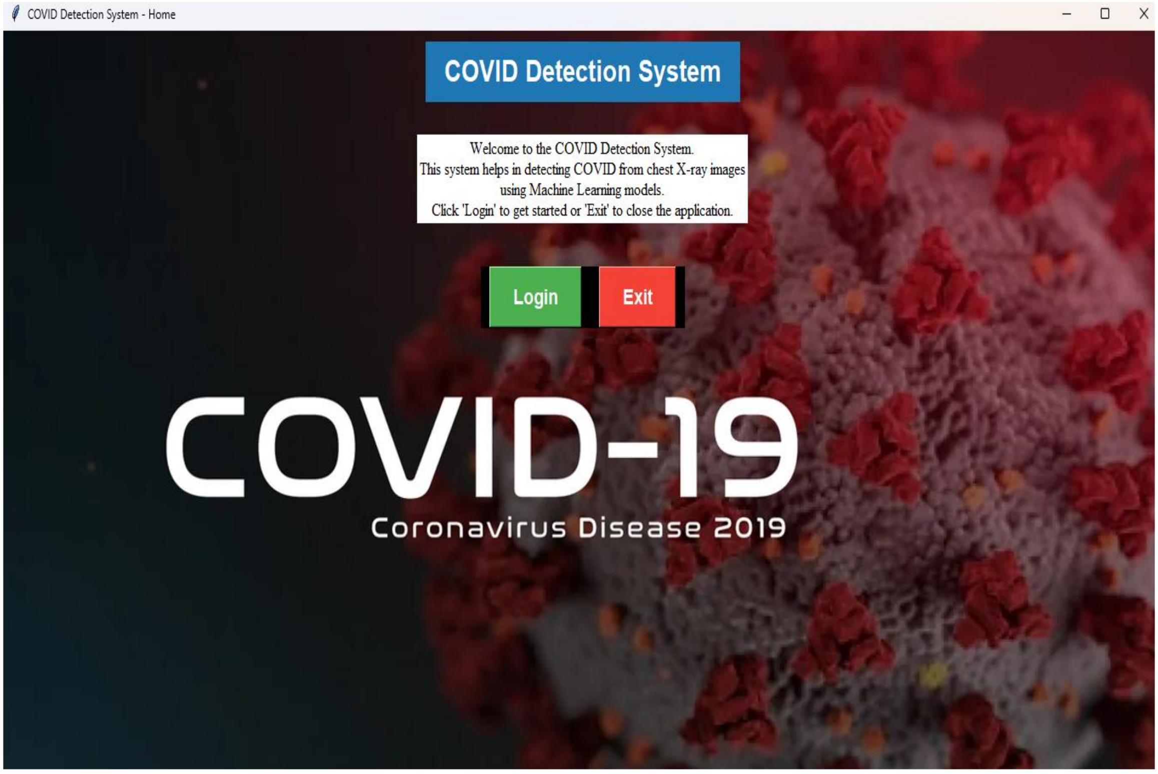

Fig: Register Page

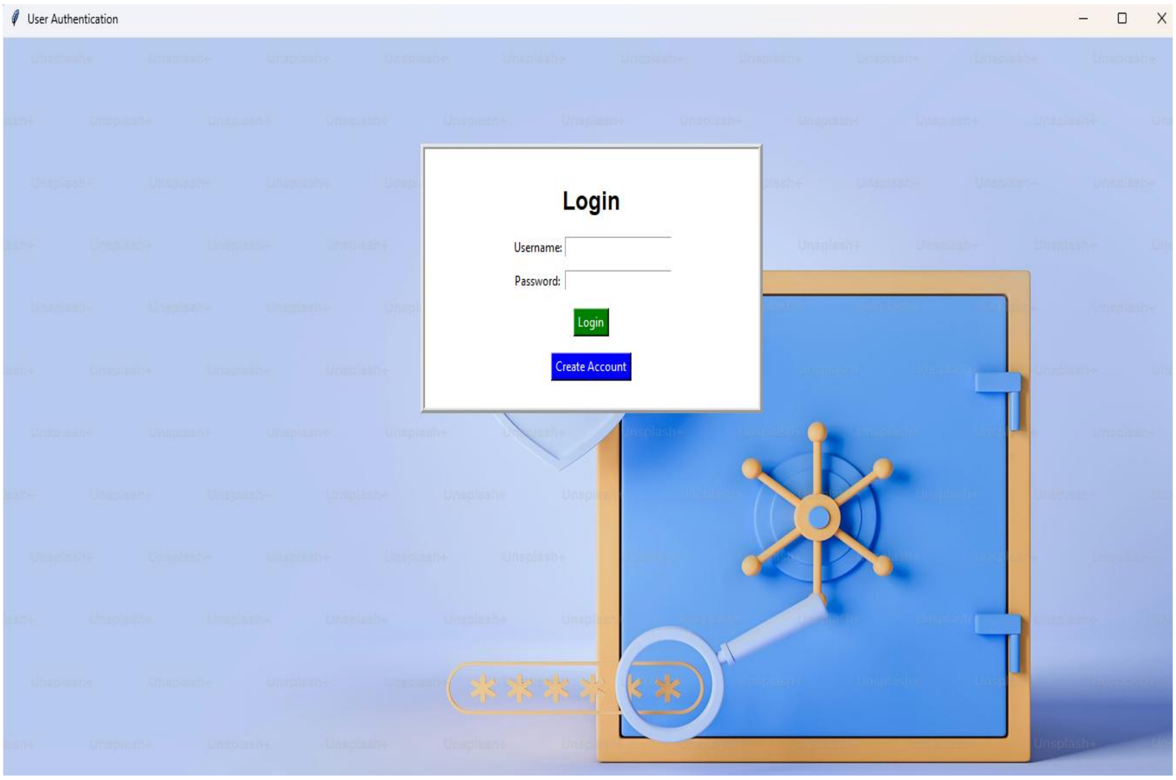

Fig:OutPut

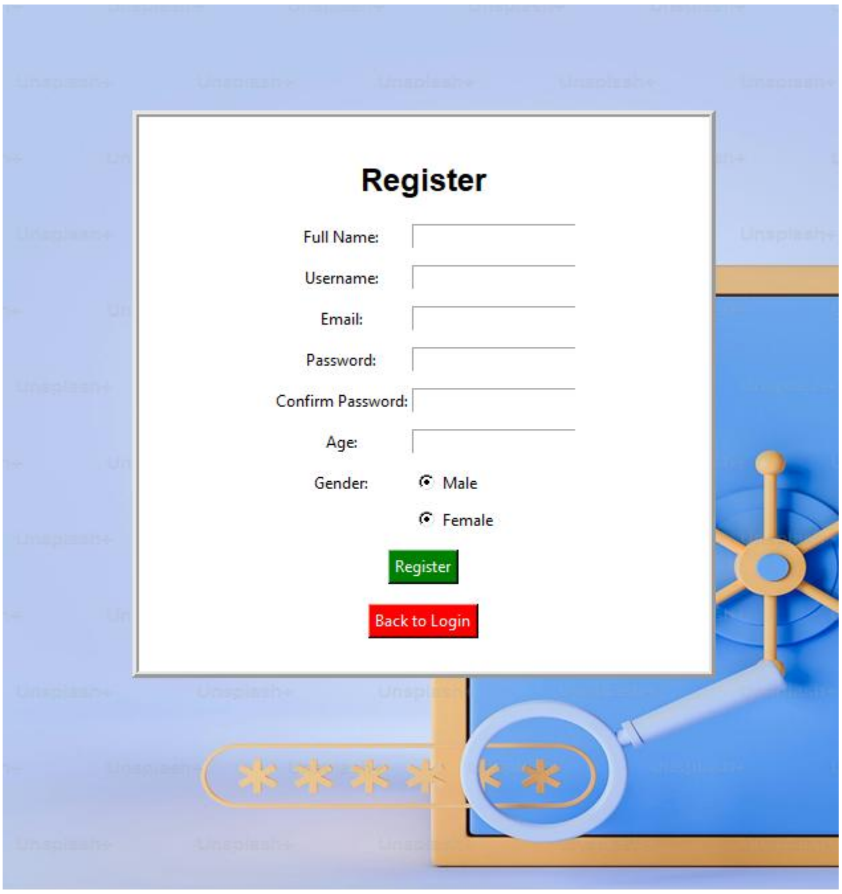

Fig:OutPut

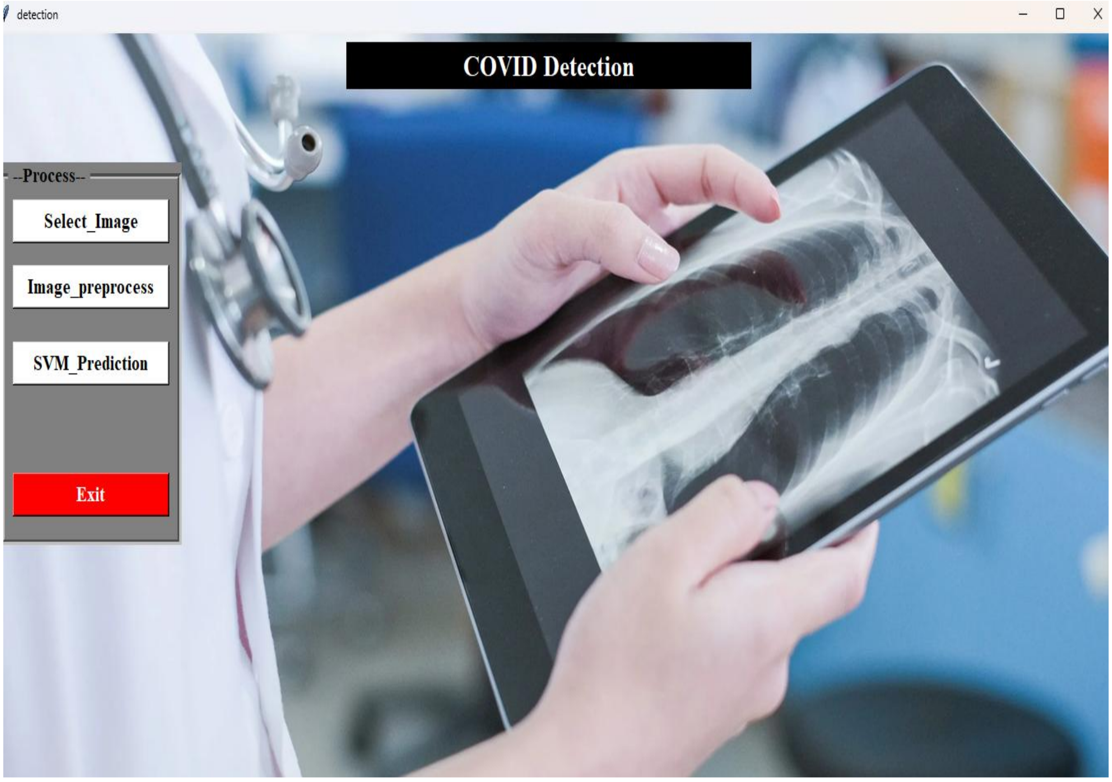

Fig:OutPut

Fig:Output

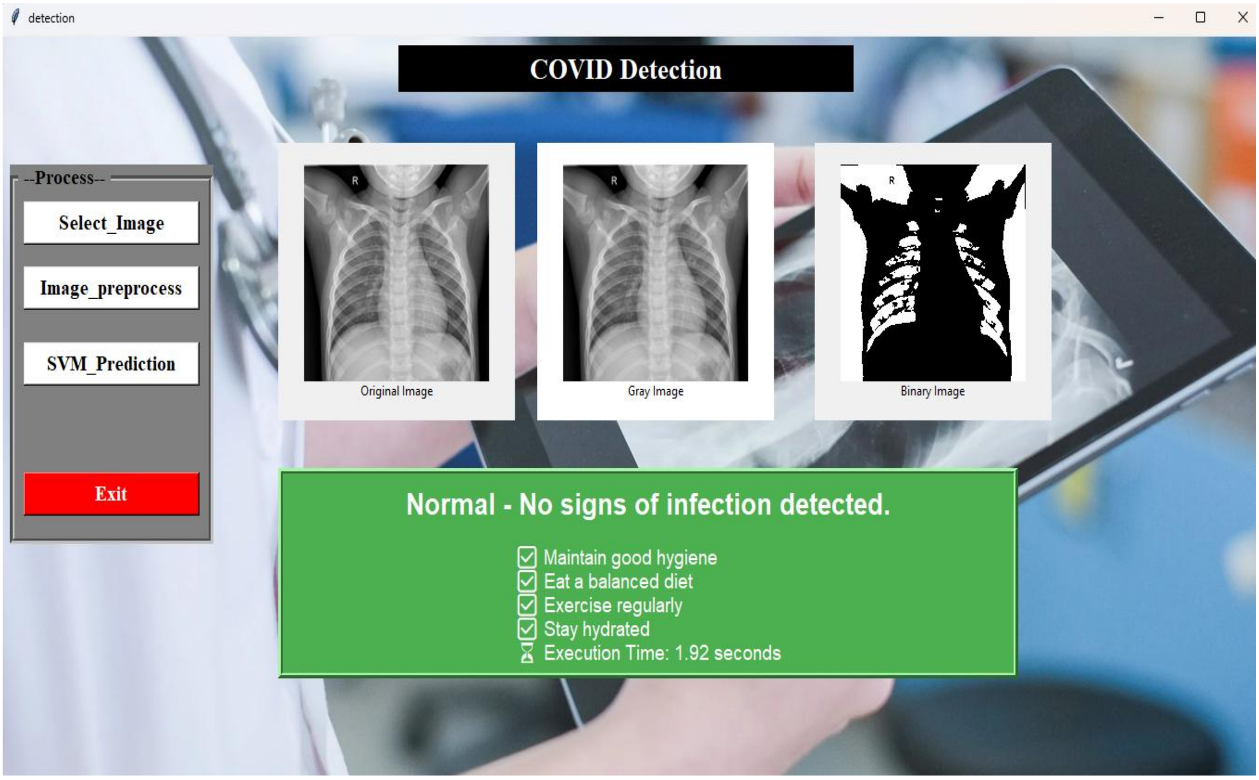

Fig:OutPut

7. CONCLUSION

The emergence of the novel COVID-19 virus has led to a significant number of fatalities, particularly among the elderly and individuals with pre-existing health conditions. The conventional method for diagnosing COVID-19 involves the use of the reverse-transcription polymerase chain reaction (RT-PCR) test, which requires respiratory samples.

However, this process can be time-intensive and costly, making it less accessible in some situations. As a result, there is a growing need for affordable, rapid diagnostic alternatives to assist healthcare providers.

This study explores the effectiveness of transfer learning through the use of pretrained deep convolutional neural network (CNN) models to detect COVID-19 from chest X-ray images. Two publicly accessible datasets were utilized under various experimental conditions. Initially, we assessed binary classification performance using multiple CNN models and 10-fold cross-validation on each dataset individually. Next, we evaluated model generalization by training on one dataset and testing on the other, and vice versa. Finally, both datasets were combined to perform another round of 10-fold cross-validation, allowing us to examine how dataset size impacts performance metrics such as accuracy, precision, and recall.

The results underscore the feasibility of developing automated diagnostic tools using deep learning for the identification of COVID-19 from chest X-rays. Additionally, expanding dataset size and ensuring clinical standardization could further enhance these tools' reliability and effectiveness.

8. FUTUREWORK

The outbreak of COVID-19 has resulted in a high number of deaths worldwide, with elderly individuals and those with underlying medical conditions being the most vulnerable. The standard diagnostic procedure for detecting the virus is the reverse transcription polymerase chain reaction (RT-PCR) test, which involves analyzing samples from the respiratory tract. Although widely used, this method can be expensive and time-consuming, limiting its accessibility in certain regions. Consequently, there is a critical need for low-cost and fast diagnostic alternatives to support clinical decision-making.

This research investigates the use of transfer learning with pretrained deep convolutional neural networks (CNNs) to identify COVID-19 from chest X-ray images. Two openly available datasets were employed under different testing scenarios. The first phase involved evaluating various CNN models using 10-fold cross-validation on each dataset independently. In the second phase, we examined the ability of the models to generalize by training on one dataset and testing on the other, and vice versa. In the final phase, we merged both datasets and repeated the 10-fold cross-validation to analyze how increasing the dataset size influences key performance indicators such as accuracy, precision, and recall.

Our findings highlight the potential of CNN-based models for automated COVID-19 detection from chest radiographs. Furthermore, the results suggest that the creation of larger, standardized clinical datasets would significantly improve the reliability and performance of such diagnostic systems.

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