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Multiple Disease Detection using Convolutional Neural Network

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Abstract- Multi-disease identification has gained a lot of attention recently because of its potential to improve patient outcomes and well-being. This abstract gives a summary of the many methods and tools used in multi-disease detection and highlights the integration of machine learning algorithms, data analytics, and state-of-the-art medical equipment. Such procedures have been developed in response to the need for early and precise diagnosis, especially in cases where multiple diseases may co-occur in a patient or appear with identical symptoms. The potential for multi-disease identification to improve patient outcomes and well-being has drawn a lot of interest to the topic in recent years. The combination of machine learning algorithms, data analytics, and cutting-edge medical technology is the main emphasis of this abstract, which provides an overview of the many techniques and technologies employed in multi-disease diagnosis. The necessity for early and precise diagnosis, particularly in situations when numerous diseases may co-occur in a patient or appear with similar symptoms, is what spurred the development of such techniques. With multi-disease detection, patients with numerous medical disorders can receive prompt and accurate diagnoses, potentially transforming the healthcare industry. The proposed multi-disease diagnosis system is a major advancement over existing methods for medical picture analysis. The system attains notable enhancements in disease accuracy, dataset management, and information distribution through the utilization of Convolutional Neural Networks (CNNs) and preprocessing techniques. Specifically, the method works incredibly well for diagnosing brain tumors, skin cancer, eye diseases, and Alzheimer's disease. By using CNNs for feature extraction and classification, the system surpasses the accuracy restrictions of previous methods, achieving rates of above 90% accuracy.

Keywords: Machine Learning, CNN, Deep Learning, Image Analysis, Healthcare , Disease Detection, Medical imaging, Feature extraction, Preprocessing techniques, Image segmentation.

1. INTRODUCTION

A state-of-the-art medical tool called the Multi Disease Detection System is intended to effectively and precisely identify and identify a wide range of illnesses and ailments. This system provides precise and quick diagnostic results by utilizing state-of-the-art technology such as artificial intelligence, machine learning, and data analytics. By empowering medical practitioners to make well-informed decisions and enhance patient outcomes, this system seeks to transform healthcare in response to the growing need for early disease detection and quick diagnosis. Convolutional Neural Networks (CNN) for multiple disease identification is a revolutionary method in medical diagnostics. Due to the exponential increase in medical data and the increasing need for accurate and timely disease diagnosis, CNNs have become powerful instruments.

Using the power of deep learning, this innovative technology can simultaneously recognize and categorize many diseases from medical pictures, revolutionizing the way doctors treat and diagnose patients. We will review the fundamental concepts, real-world applications, and potential outcomes of using CNNs for the simultaneous identification of many diseases in light of the promising advancements in this field.

The CNN model's architecture has been carefully constructed to guarantee
that essential characteristics and patterns are successfully extracted from the medical images. To forecast the presence or absence of different diseases, this usually entails a sequence of convolutional, pooling, and fully connected layers, followed by classification layers. To evaluate the trained CNN model's performance in terms of sensitivity, specificity, and total classification accuracy, different test datasets are used.
There are a number of important considerations and opportunities when a project's scope is expanded to include treatment suggestions and precautions in addition to growing the size of the dataset.

An overview of various sickness detection in healthcare using CNN CNNs enable precise and prompt diagnosis by utilizing data analytics, machine learning, and artificial intelligence.
Goal: Enable healthcare professionals to make well-informed decisions and improve patient outcomes CNNs transform the field of disease detection by concurrently recognizing and classifying a variety of ailments from medical pictures.

Architecture: Convolutional, pooling, and fully linked layers stacked one after the other, followed by classification layers
Assessment: Using test datasets, performance parameters such as sensitivity, specificity, and overall classification accuracy are measured.
Scope expansion: Adding treatment recommendations and safety measures to dataset augmentation creates new avenues for enhancing patient care and medical judgment.

We present a brand-new CNN-based method for the accurate and efficient simultaneous identification of several diseases, furthering the field. Making the switch from SVM to CNNs improves illness diagnosis dependability by increasing accuracy

to over 90%.By creatively enhancing CNN model training with huge datasets (500–1000 images per dataset), the problem of effectively processing large datasets is addressed. Contribution to the Transmission of Information: Incorporating treatment recommendations with disease identification empowers patients and improves individualized care, both of which lead to better health outcomes. The ability to diagnose numerous diseases at once, such as brain tumors, malignancies, eye conditions, and Alzheimer's, overcomes the limits of current systems and offers a more thorough diagnostic evaluation.

2 BACKGROUND AND RELATED WORK

1) Dr.D.Selvathi,K.Suganya "Support vector machine based method for automatic detection of diabetic eye disease using thermal images":- One of the biggest issues facing the globe now is diabetic eye disease. That could lead to serious visual damage or even blindness that never goes away. Early detection of eye diseases increases the chance of survival through efficient treatment. The proposed method investigates the use of machine learning algorithms to identify diabetes disease using thermography images of the eye. The accuracy of the SVM method, which is used in the current system, is 86.22%. SVM provides less accuracy because it does not offer feature extraction. Diabetic illness is the only condition that the current method can identify. Large datasets are not supported by SVM.

2) Srinivasan Aruchamy, Amrita Haridasan "Alzheimer's Disease Detection using Machine learning techniques in 3D MR Images" :- This paper proposes a unique use of first-order statistical features in 3D brain magnetic resonance imaging (MR) for the diagnosis of Alzheimer's disease (AD). Alzheimer's disease is a neurological illness associated with aging that affects the elderly. Given that AD is a degenerative condition, early diagnosis and categorization can be very helpful in managing the illness. For this objective, machine learning algorithms are used with voxel-based brain MR image feature extraction approaches in recent publications. SVM is used by existing system, which gives accuracy less than 90%. Also SVM classifiers can not classify multimodal data efficiently.

3)M.d.Ahasan Kabir "Early stage Brain Tumor Detection on MRI Images using a hybrid technique":- A brain tumor is among the many ailments that the medical sciences have identified as serious problems that the world faces today. An unchecked expansion of cells in the brain is called a brain tumor. The mortality rate can be considerably decreased by early diagnosis and identification. An artificial neural network and support vector machine (SVM)-based tumor identification system has been proposed in this research. BRATS Dataset is used which consist of 217 MRI Images.

4) Mr.B.Sreedhar, Dr. Manjunath Swammy B.E. "A comparative study of Melanoma Skin Cancer Detection in Traditional and current image processing techniques.":- Nowadays, skin cancer especially melanoma skin cancer is a serious health concern. The majority of skin malignancies are typically curable if discovered

early on. Given the speed at which skin cancer is spreading, an automated computerized system for early detection of the disease is necessary. The automated computerized diagnosis system helps dermatologists identify patients more accurately and rapidly while also improving the analysis of skin conditions. The current method uses the SVM algorithm, which makes it difficult to extract features from photos of skin cancer. Feature extraction is not supported by SVM.

3 PROPOSED SYSTEM

Creating a system for multiple disease detection is a difficult but important project that can have a significant influence on healthcare and early disease identification. Algorithms for data collection, analysis, and decision-making are commonly combined in such systems. Data Collection. Put together trustworthy data sources: This can include test results, imaging data (MRIs and X-rays), genetic data, and health history. Data preparation: Make the data clear and organized. Remove outliers, noise, and irrelevant data .Normalize and standardize the data to ensure consistency. Make use of imputation techniques to handle missing data. Retrieving Features: Determine the relevant characteristics which can differ depending on the condition from the data. Use domain-specific knowledge and machine learning techniques for feature selection. Machine learning models: Create machine learning algorithms that forecast illness. The models you select will depend on the kinds of data you have and the specific diseases you are interested in. Consider applying traditional machine learning techniques for image-based diagnosis and deep learning techniques for structured data.

1) Improving Accuracy: - Support Vector Machine (SVM) algorithms, which have an accuracy of roughly 86.22%, are used in the current system. SVMs are less accurate since they are unable to extract features. Conversely, the suggested solution uses Convolutional Neural Networks (CNNs) to get over this restriction. CNNs achieve accuracy rates above 90% by deciphering complex patterns from photos. The shortcomings of the current system are addressed by this notable accuracy improvement.

2)Managing Extensive Datasets: The suggested method uses numerous datasets, each comprising a significant number of photos (500-1000 images per dataset), to alleviate the constraint that the previous system encounters while processing huge datasets. By using this method, the CNN model may be trained more effectively, improving disease detection accuracy. The suggested solution gets around the existing system's dataset size limitation by utilizing larger datasets.

3. Transmission of Information (Precautions and Treatment): The suggested system adds a function by offering treatment advice and precautions for the diseases that are discovered, in contrast to the current system that just concentrates on disease detection. This gives people the confidence to take charge of their health and makes it possible for medical professionals to provide individualized care. The suggested solution gets over the existing system's limitation on the spectrum of diseases by identifying many diseases at once.

4)Identifying Several Illnesses: - The suggested approach broadens the scope by detecting a greater range of ailments, whereas the current technique is limited to identifying one or two illnesses. The system can detect two types of cancer (Bening Skin Cancer and Malignant skin cancer) and three types of eye illnesses (Normal Eye Disease, Cataract eye disease, Glaucoma eye disease), Also system detects Mild Demented Alzheimer and very mild demented Alzheimer. In Brain Tumor system predicts normal brain tumor, Brain tumor glioma level, Brain tumor meningioma level and Brain tumor Pitutorial. The suggested solution gets over the existing system's limitation on the spectrum of diseases by identifying many diseases at once.

A. Images :

Brain Tumor: MRI (Magnetic Resonance Imaging) images are used as a input for Brain Tumor. This dataset consists of brain images with dimension of 64*64 pixels. There are total 400 images in dataset.

Eye Disease: Fundus photos are frequently employed in the detection of eye conditions such glaucoma, macular degeneration. This dataset consists of eye images with dimension of 64*64 pixels including 1929 images in dataset.

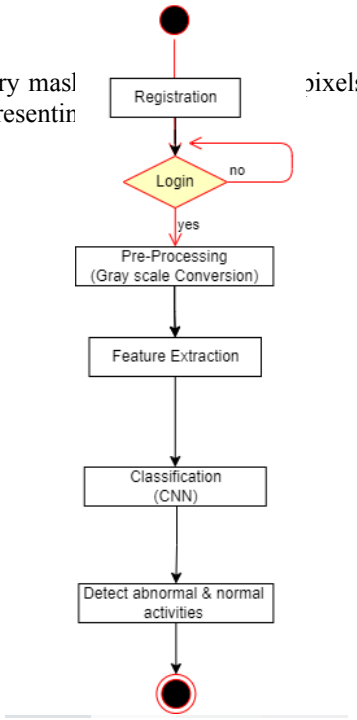
Cancer: X-rays, CT (Computed Tomography), MRI, and PET (Positron Emission Tomography) scans are among the medical imaging modalities that can be utilized to diagnose cancer. This dataset consists of 800 images with dimension of 64*64 pixels

Alzheimer's: Brain MRI scans are frequently employed to identify Alzheimer's illness. This dataset consists of 1320 images with dimension of 64*64 pixels.

B. Preprocessing Methodologies :

In order to optimize the CNN model's performance and prepare medical pictures for analysis, preprocessing is essential. Converting to Grayscale: Several formats, including RGB (Red, Green, and Blue) color channels, are frequently used for medical pictures. Nonetheless, grayscale images are frequently utilized for a variety of image analysis applications, such as illness detection. The process of converting color photos to single-channel grayscale images, where each pixel represents a shade of gray according to its intensity level, is known as grayscale conversion. The conversion guarantees consistency in feature extraction across several color channels, streamlines the image processing work, and lowers computational complexity. CNNs benefit greatly from grayscale images because they retain important intensity information without the redundant information of color channels. When preprocessing medical pictures for Techniques for thresholding and multi-disease identification based on CNN may be useful. Global Thresholding: To classify pixels as foreground or background, a single threshold value is applied to the entire image based on pixel intensity. CNNs benefit greatly from grayscale images because they retain important intensity information without the redundant information of color channels. Across all the photos in your dataset, apply the selected threshold consistently. As a result, the

images are split into binary masl pixels denoting healthy regions and foreground pixels representin



C. Feature Extraction :

Using Convolutional Neural Networks (CNNs) for multi-disease identification, feature extraction is essential for extracting pertinent data from medical pictures. Because feature extraction helps keep critical information while reducing the dimensionality of the data, it is essential. We can successfully describe complex data in a more manageable and comprehensible style by identifying meaningful features. This facilitates the understanding of patterns and the ability of machine learning systems, like CNNs, to generate precise predictions.

D. Convolutional Neural Networks (CNN):

CNN is a Deep Learning technique that combines fully connected layers with convolutional and pooling layers. Because CNN is motivated to employ secondary structure in data and because its strength is the local feature of an image, which enhances classification accuracy, most researchers use it for image classification work. Among the most often used algorithms for image categorization is CNN.

I. Convolutional 2D Layer:

Role: Recognizes elements like edges, textures, and patterns in the supplied photos.
Operation: To create feature maps, slide learnable filters over the input image and execute element-wise multiplication and summing.
Put Simply: It's similar to searching for particular textures or shapes in photos that may be indicative of certain illnesses.

II. Maximum Pooling Layer:

Function: Minimizes the spatial dimensions of feature maps while maintaining pertinent data.

Operation: The input is divided into regions, and each region's maximum value is output, with the remaining values being discarded.

Put Simply: It's helpful to zoom out and concentrate on the most crucial areas of the images, disregarding the little details.

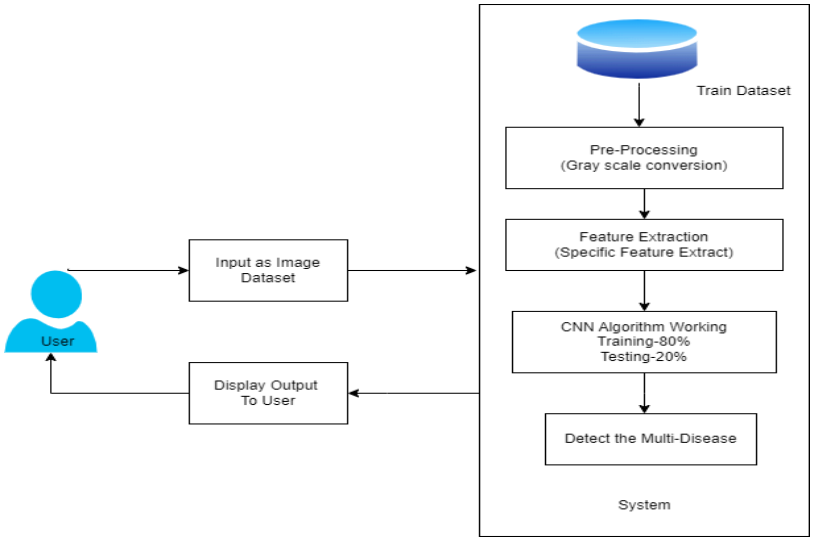
III. Fully Connected Layer:

Function: Combines the features that have been extracted and forecasts using them.

Operation: Every neuron in this layer is linked to every other neuron in the layer above, allowing it to learn intricate connections.

To put it simply, it's like assembling all the pertinent hints and deciding which diseases are depicted in the images.

Together, these layers in a CNN allow it to scan medical images, identify characteristics that might point to an illness, and forecast which diseases are present.

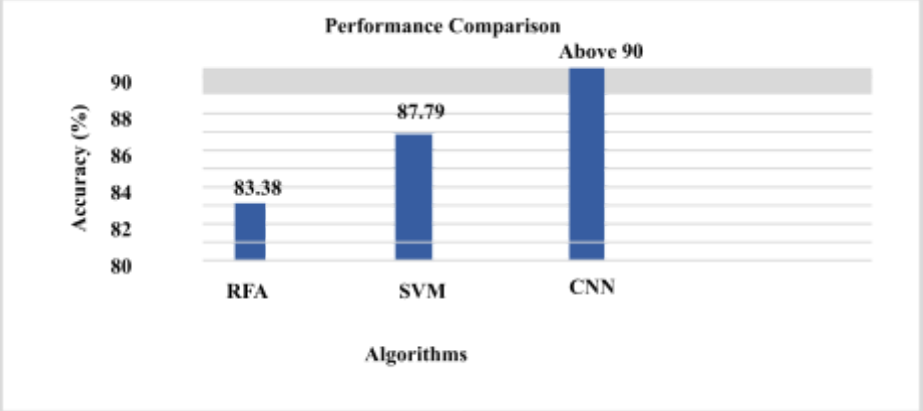


4 EVALUATION OF PERFORMANCE

1) Accuracy: Accuracy is a computed measure of the classification's overall correctness. simply multiplying the total number of pictures by the sum of the actual positive and negative.

Accuracy = (TP + TN /TP + TN + FP + FN) ∗ 100

2) Sensitivity: Sensitivity gauges how accurate positive examples are. It shows how accurate the diabetic eye illness is.
Sensitivity = TP / TP + FN
3) Specificity: This gauges how accurate a negative occurrence is. It shows how accurate the normal eye is.
Specificity = TN / TN + FP.
Where:
TN stands for True Negative and FN for False Negative;
TP is for True Positive and FP for False Positive.



5 RESULTS AND DISCUSSION

The suggested multi-disease identification system is a significant improvement over current medical image analysis techniques. By using Convolutional Neural Networks (CNNs) and preprocessing methods the system achieves significant improvements in the distribution of information, dataset management, and disease accuracy. In particular, the approach performs exceptionally well in identifying Alzheimer's disease, Eye disease, Skin cancer and Brain tumors. The system achieves rates of above 90% accuracy, the accuracy limitations of prior approaches by utilizing CNNs for feature extraction and classification. Additionally, the system uses many datasets with large numbers of images to efficiently manage large datasets, improving the accuracy of disease identification and CNN model training. The technology not only detects problems but also empowers people to take control of their health by providing treatment recommendations and preventative measures for diseases that have been diagnosed. It also makes it easier for medical practitioners to provide individualized care. Additionally, the method overcomes the limits of earlier systems

that could only identify one or two illnesses at a time by identifying numerous diseases simultaneously, broadening the breadth of disease detection. By utilizing thresholding methods, CNN-based feature extraction, and grayscale conversion, the system maximizes medical picture analysis, guaranteeing the preservation of important details and lowering data dimensionality for accurate disease prediction. To sum up, the suggested multi-disease detection system offers a thorough and precise method for identifying a variety of illnesses from medical pictures, which has the potential to completely transform patient care and disease diagnosis in healthcare settings.

i) Sample images from dataset :

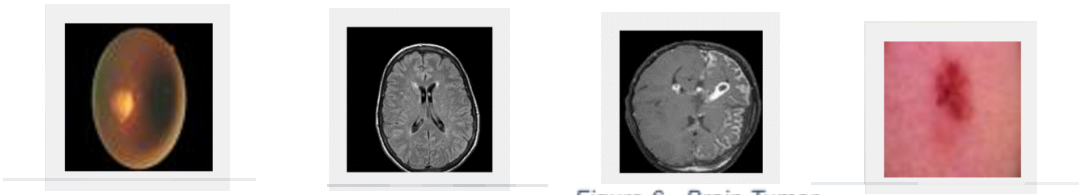
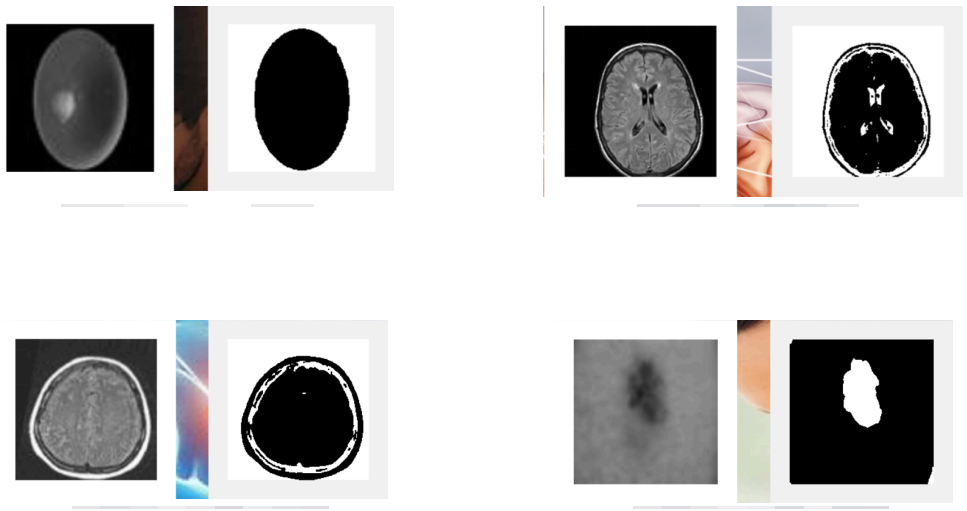
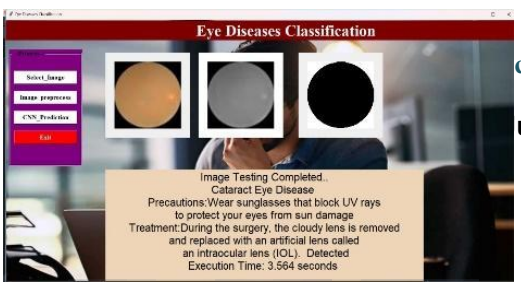


Figure 6 - Brain Tumor

ii) Image Preprocessing and Feature Extraction :



iii) CNN prediction:



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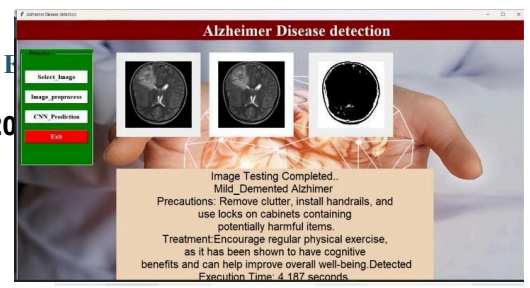

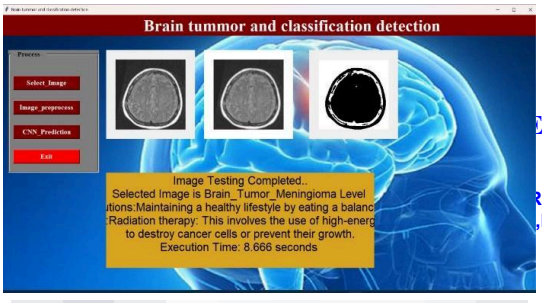

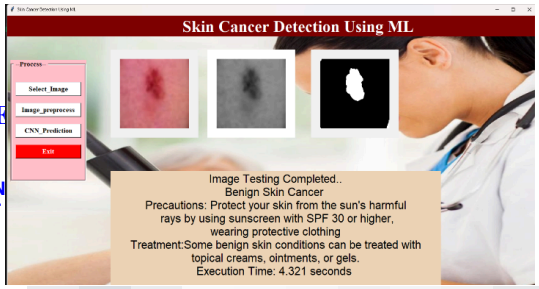

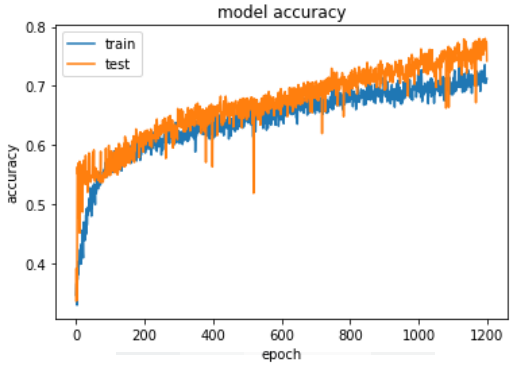

5 CONCLUSION :

Developing a system for multiple disease identification is a challenging but essential task for the medical field. Critical challenges in medical diagnostics are addressed by the proposed improvements, which include broadening the scope of disease identification, integrating treatment advice with disease detection, managing large datasets effectively, and switching from Support Vector Machine (SVM) to Convolutional Neural Networks (CNNs) for enhanced accuracy. Through the use of CNNs and preprocessing techniques specific to each disease category, the system attains accuracy levels above 90% for a wide range of disorders. Convolutional Neural Networks (CNNs) have shown their transformative potential in the field of medical diagnosis with the development of a multi-disease detection CNN. The CNN enables healthcare professionals to implement customized treatment and improves patient outcomes and care quality by giving accurate and rapid diagnoses. This development, together with the capacity to detect several diseases concurrently, such as malignancies, eye conditions, Alzheimer's, and brain tumors, exceeds the constraints of current systems and offers a more thorough diagnostic evaluation. These developments have the enormous potential to completely transform healthcare facilities' patient care and disease detection by providing a thorough and accurate method for recognizing a variety of ailments using medical images.

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