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Role of Convolutional Neural Networks to Diagnosis Medical Images

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Abstract: Numerous ailments are plaguing people today. These health issues cannot be ignored because they pose a threat to our lives. Additionally, the healthcare industry is totally unique compared to other area. Patients, regardless of cost, expect the greatest level of care and services in this high priority industry. Most often, medical professionals analyses the interpretations of medical data. Due to subjectivity and the complexity of the medical images, a medical expert's ability to interpret images is relatively limited. In addition, there are other problems with medical images, including low contrast, speckle noise, gaussian noise, and other artefacts. Therefore, it is imperative to have high image quality to extract relevant information from images for precise disease detection. Early detection and prevention are therefore needed to help people avoid these types of health issues. As a result of its success in other real-world applications, deep learning is viewed as offering innovative and precise solutions for medical imaging and is recognized as a significant technique for upcoming applications in the healthcare industry. The objective of this paper is discussing Convolutional neural networks (CNN), a deep learning algorithm. Additionally, CNN's goals and objectives are revealed in different medical terms especially in kidney stone problem diagnosis.
Keywords: CNN, Deep Learning, Medical Images, Kidney Problems, Pre-Processing.

I. INTRODUCTION

In recent years, deep learning has attracted a lot of attention. The convolutional neural network (CNN), a family of artificial neural networks that have been a prominent approach in computer vision, is the most established algorithm among several deep learning models.

Z. Liu et al. [1] has been introduced a linear CNN model-based approach to image diagnosis. For removing Gaussian noise, they found that the filtering approach based on the linear CNN model performs best; for salt-and-pepper noise, they found that the linear CNN model performs better than two conventional filters and was equivalent to median filtering. The performance of conventional image filters can be significantly enhanced by the linear CNN model. Zhou C. et al. [2] has contrasted the system with the typical obstacle avoidance mode based on a single sensor or solo algorithm. This research presents an intelligent pattern based on a combination of CNN-based deep learning methods and liDAR-based image processing techniques. A 10-layer Convolutional Neural Network (CNN) is created using the Deep Learning technique, and it achieves an obstacle avoidance success rate of over 90% and a high recognition accuracy of 97 percent in Tensorflow. Thakare A. et al. [3] created a novel method for analysing patients' mental states using an online EEG categorization system. This has been accomplished by creating an online EEG categorization system powered by a CNN. The method, which can accurately and quickly identify sad states without pre-processing or feature extraction, is applied straight to the EEG input. In trials on depression evaluation based on publicly available data, the depression control group and the healthy control group had accuracy, sensitivity, and specificity of 99.08 percent, 98.77 percent, and 99.42 percent, respectively.

A convolutional neural network; deep learning based autonomous crack detection system has been proposed by Golding VP et al. [4] Before training a pretrained VGG16 architecture to construct several CNN models, 40,000 RGB images were processed to improve the CNN classification performance for increased pixel segmentation. This concept therefore affects automatic crack detection of concrete constructions and the increased dependability of the data collected. Shi Zetet al. [5] has studied of cultural and innovative product design; the suggested method uses a convolutional neural network model for image recognition. Innovative products or innovative new product designs that include cultural symbols and other cultural elements into their design were referred to as cultural and creative products. The findings of the investigation showed that CNN's reported accuracy was 87%.

Wang J et al. [6] analysed some problems in current image recognition and explained the progress of convolution neural networks in image recognition. An enhanced CNN model is put forth based on the research, which emphasises the structural design and network optimization of convolutional neural networks and creates a more effective convolutional neural network.

Test experiments demonstrate the usefulness of the suggested model, which not only decreases the number of network parameters but also achieves a lower error rate and was more adept at learning. A novel approach to determining numerous image processing operations and operation chains has been put forth by Aminu AA et al. [7] It was based on convolutional neural networks and local optimal oriented patterns. Extensive testing demonstrates that the suggested model can recognise various image modifications and manipulation operation chains with overall detection accuracies of 99.81% and 99.15%, respectively.

Ye F et. al. [8] has briefly discussed utilisation of medical research and technology in recent years. The chaotic recursive diagonal model's hybrid CNN method used for technical research, and its potential utility in medical image processing was investigated. The experimental findings demonstrate that the chaotic recursive diagonal model-optimized CNN method can aid in the automatic processing of medical images and the analysis of patient conditions.

To increase the precision of the categorization, Del Campo FA et al. [9] have suggested pre-processing techniques for the images' feed to a CNN. The effectiveness of sharpness improvement and quantization as pre-processing techniques was examined. The validation accuracy improved by 1.35 to 3.1% using the suggested pre-processing procedures. Khan A. et al. [10] has surveyed which emphasises the inherent taxonomy found in the newly reported deep CNN designs and, as a result, divides the most recent advancements in CNN architectures into seven lyres. Spatial exploitation, breadth, feature-map exploitation, multi-path, depth, channel boosting, and attentiveness are the foundations of these seven categories. The fundamentals of CNN components, present difficulties, and CNN applications are also covered.

Shen et al. [11] investigated the use of the wavelet transform and convolutional neural network in ultrasonic image denoising as well as the impact of the optimised wavelet threshold function technique on image suppression. In this investigation, the imaging theory of ultrasound images was first examined. The inherent speckle noise in ultrasound negatively impacts the ultrasound's quality because of the limits of the ultrasonic imaging concept. Additionally, the ultrasound images of the arteries and kidneys were denoised independently in this investigation, and the optimised function was used for the actual medical image processing. The quality of the diagnosed image was found to be higher than the original image, and the extraction of useful information was found to be more precise. In decision, the improved WTF method can achieve a better aesthetic effect in addition to removing a lot of noise. It can be widely used in clinics because it has significant utility in aiding doctors in disease diagnosis.

II. CNN IN KIDNEY PROBLEM RECOGNITION

One of the significant illnesses that is on the rise is kidney disease, which includes the growth of cysts and stones, infections, tumours, and changes in kidney position and appearance, among other things. Because renal disease might endanger our lives, we cannot neglect kidney-related issues. Therefore, early detection and prevention are needed to stop certain types of renal problems in patients. Information on early detection might be helpful to find and spot kidney problems in their early stages so that surgery can be successfully performed to cure them. Consequently, it has a recurrent application domain that consists of a computer-aided diagnosis system that aids in the identification of kidney irregularities and the detection of probable diseases. Furthermore, there are other problems with B-mode ultrasound images, including poor contrast, speckle noise, gaussian noise, and other artefacts. Therefore, high-quality images are crucial for extracting relevant characteristics. The right image processing methods, such as pre-processing and classification methods, are available to address this issue. X-ray technology, ultrasound imaging, CT, and MRI scans, as well as other image collection methods, are now able to provide radiological images with a significantly greater resolution. Following this, CNN continues to play a significant role in the recognize of medical images [12]. However, the advantages of automatic image interpretation are just now starting to be obtained. Computer vision is one of the strongest applications for machine learning, but typical machine learning methods for image interpretation mainly rely on expert-crafted features. For instance, the extraction of structural features is necessary for the diagnosis of lung tumours. Traditional learning techniques are unreliable because patient data varies greatly. In recent years, machine learning has advanced and developed the capacity to sort through large and complicated datasets [13].

Due to its subjectivity and limitations, method of visual interpretation by medical professionals is relatively restricted. Due to the intricacy of the images, there are wide variances across specialists, and because of their intense workload, weariness sets in. As a result of its success in other real-world applications, deep learning is viewed as offering innovative and precise solutions for medical imaging and is recognised as a significant technique for upcoming applications in the healthcare industry. The author described the most advanced deep learning architecture and how to best use it for segmenting and categorising medical images [14]. One of the study authors [15] presents a deep-learning framework-based diagnostic tool. The suggested framework makes use of OCT retinal images and conducts analysis using three different convolution neural network models to recognise the various retinal layers, extract pertinent data, spot any new deviations, and forecast the various eye deformities.

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Three different CNN models were used to analyse this image dataset and find the four ocular diseases. Results from the experimental testing show that, when compared to manual ophthalmological diagnosis, the model performed superbly with 0.965 classification accuracy, 0.960 sensitivity, and 0.986 specificity.

The VGG16 CNN transfer learning model and Fuzzy C-mean clustering are two cutting-edge algorithms for classifying renal CT images and identifying kidney stones that were described in the [16] research. The main goal was to classify normal and abnormal kidney CT images using the Vgg16 CNN and to identify kidney stones in abnormal kidney CT images using fuzzy c-means clustering and level set segmentation. The results of the experiment demonstrated that the novel approach greatly outperformed conventional strategies. Artificial intelligence (AI) has revolutionised disease diagnosis and the anatomization process in the past few decades since the beginning of computer science in disease detection and diagnosis for biomedical sciences. AI does this by performing the classification steps, which were time-consuming and tedious for experts. Because of the recent exponential growth in applications using AI-based technology and doctors' demands for operating with fewer mistakes, mishaps, and incorrect diagnoses, the medical industry has been accepting and adopting AI. In medical image processing, many AI and subgroup DL networks are helpful for the diagnosis of various illnesses. The use of AI in diagnosing and treating eye diseases is considerable. The mechanism makes it simple for ophthalmologists to concentrate on the treatment because it calls for accurate and exact identification and extraction of ocular layers.[15]

III. CONVOLUTIONAL NEURAL NETWORKS (CNN)

Convolutional neural networks (CNNs), a subclass of artificial neural networks that has gained dominance in several computer vision tasks, are gaining popularity in several fields, including radiology. Using a variety of building pieces, including convolution layers, pooling layers, and fully connected layers, CNN is intended to learn spatial hierarchies of features automatically and adaptively through backpropagation [17].

Artificial neural networks are used to classify words, audio, and images, among other things. For instance, different neural network types are employed for various objectives. For instance, employ recurrent neural networks, or more specifically, an LSTM, to predict the order of words. Like this, to employ convolution neural networks for image classification. There are three different sorts of layers in a typical neural network: The layer in which we provide input to our model is known as the **input layer**. The complete number of characteristics in our data is represented by the same number of neurons in this layer. **The hidden layer** is then fed the input from the input layer. It is depending on model and the volume of the data, there may be numerous hidden levels. Neurons, which are typically more numerous than features, might vary in number for each hidden layer. The network is nonlinear because the output from each layer is calculated by matrix multiplying the output from the preceding layer with the learnable weights of that layer, adding learnable biases, and then applying an activation function. **Output Layer**: The output of each class is then transformed into the probability score for each class using a logistic function, such as sigmoid or softmax, using the data from the hidden layer as input.

The model is then given the data, and each layer's output is then obtained. This process is known as "feedforward. The error is then calculated using an error function. Cross-entropy, square loss error, and others are examples of frequent error functions. After that, we calculate the derivatives and backpropagate into the model. Backpropagation is the term for this process, which is essentially used to minimise the loss. Figure 1 shows how the layers of the proposed CNN model of the proposed system operate to diagnose kidney stone-related issues.

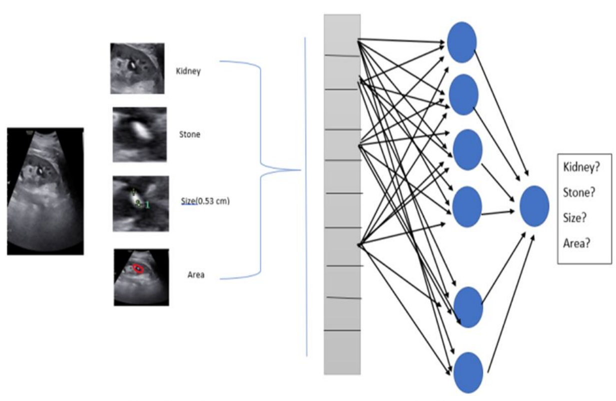

Figure-1: Convolutional neural network (supervised)

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IV. CONCLUSION

In this paper, one of the common and most popular classification techniques of Deep Learning, CNN has discussed to diagnose medical images. As discussed in this paper subjectivity and the complexity of the medical images, a medical expert's ability to interpret images is relatively limited. In addition, there are other problems with medical images, including low contrast, speckle noise, gaussian noise, and other artefacts. Therefore, it is imperative to have high image quality to extract relevant information from images for precise disease detection. So, CNN plays very important role to recognize different medical images to diagnose the various diseases. In many literatures, authors has cleared that CNN approach of Deep learning has provided good accuracy as comparison of other techniques in various field of image reorganization especially in medical field.

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