International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 2s, 2025
https://theaspd.com/index.php

Medical Image Analysis For Disease Diagnosis And Treatment

Priyanka Gupta[1], Ashu Nayak[2], Bhumika Bansal[3]
[1]Assistant Professor, Department of Chemistry, Kalinga University, Raipur, India.
[2]Assistant Professor, Department of CS & IT, Kalinga University, Raipur, India, ku.ashunayak@kalingauniversity.ac.in, 0009-0002-8371-7324
[3]Associate Professor, New Delhi Institute of Management, New Delhi, India., E-mail: bhumika.bansal@ndimdelhil.org, https://orcid.org/0009-0001-9379-4908

Abstract
In dentistry, dental radiographs are used to detect and diagnose anomalies in the teeth. Panoramic radiographs are one type of dental radiograph that can capture the whole structure of the teeth on a single film. This kind of radiograph aids in the early detection of oral dental anomalies. Cavities, caries, tooth decay, impacted teeth, periodontal bone loss, carious lesions, oral cysts, and osteoporosis are just a few of the numerous dental conditions or anomalies. An oral cyst is a common dental condition that, if left untreated, can have serious consequences. A new paradigm in artificial intelligence is being opened by deep learning, a recent development in medical imaging technology. The deep learning algorithm known as Convolutional Neural Networks (CNN) is primarily utilized in computer vision applications like object detection, image captioning, handwritten digit recognition, face recognition, image segmentation, pedestrian detection, action recognition, and image classification. This study presents a few computer methods for dental image analysis that use deep learning algorithms to identify and diagnose various dental conditions.
Keywords: *Dental, Treatment, Recurrent Neural Network, CNN*

1. INTRODUCTION

The new technology for extracting specific information from photos is called image processing. Pixels, or picture elements, are a collection of fixed values that make up an image, which is a representation of a two-dimensional view. Grey levels, intensities, colors, heights, and other elements are expressed using pixel values. Using a digital computer to process digital photographs is known as digital image processing [1]. Digital image processing can be divided into three categories: high-level, mid-level, and low-level. To produce better photographs, low-level processing involves basic tasks including image sharpening, contrast enhancement, and noise removal [2]. Segmentation, picture description, object recognition, and image classification occur in mid-level processing. Information extraction from a collection of recognized images is a component of high-level processing, and this method is frequently associated with computer vision [9]. In recent decades, the military, industries, entertainment, remote sensing, astronomy, sports, and medical have all made use of digital image processing. Medical imaging is a significant and emerging topic of study in the healthcare industry, according to DIP [10]. Advances in medical imaging technologies are a step toward better, more patient-centered care. Advances in technology have made it easier to identify diseases early and accurately. Dentistry has been less investigated than other health sectors in terms of combining diagnostics with computing. The most often used diagnostic technique is dental radiography. The position, size, and exposure level can all affect these radiography pictures. It helps dental professionals worldwide identify anomalies in dental anatomy [3]. The procedure of identifying dental problems is extremely complicated. Accurate analysis requires a vast number of x-ray pictures. It takes a considerable time for the radiologist to identify and categorize the dental conditions. With the advent of computer-aided diagnosis and detection, dentists are now able to identify and make better decisions for subsequent treatment procedures. Radiologists rely on computer-aided diagnostic systems to diagnose and classify dental disorders in a very effective and timely manner [4]. Dental x-ray picture segmentation and classification are intended to increase detection accuracy, facilitate diagnosis and treatment for the dentist, and decrease inter/intra-operator variability to save doctors time [13].

2. REVIEW OF LITERATURE

In the age of computerization, deep learning is a branch of machine learning that gets around the drawbacks of the traditional machine learning methodology. The three most basic families of neural

networks are Autoencoder, Restricted Boltzmann Machines, and Convolution Neural Networks (CNN) [5]. Over the past ten years, convolutional neural networks—a type of deep learning have been used primarily in the field of computer vision for tasks like object detection, image captioning, handwritten digit recognition, face recognition, image segmentation, action recognition, pedestrian detection, and image classification [11]. One convolutional layer, a pooling layer, and a fully connected layer make up the CNN [12]. The convolutional layer, which performs a convolution operation between the feature detector and the local region of the input, is a crucial component of the CNN design [6]. A bank of filters is applied to an image at each convolutional layer to produce the output in a stacked fashion. The piling of outputs complicates the pixelwise analysis and adds to the abstract feature. Pooling layers are added after the convolutional layers to reduce this complexity. Therefore, dimensionality reduction is accomplished through the Pooling layer. The network's final output, such as class scores for each category in the case of classification, is calculated by a fully connected layer.

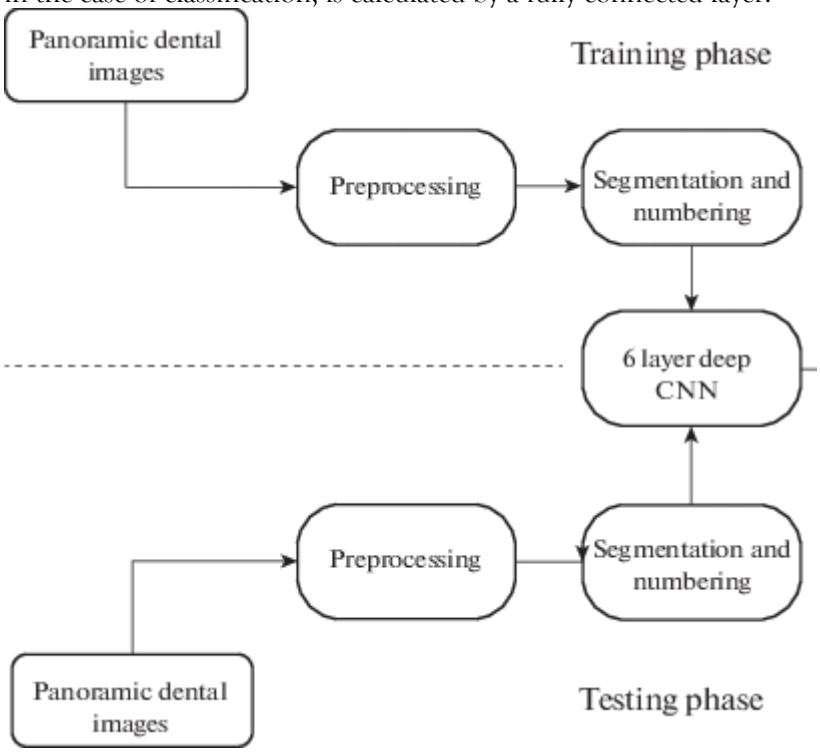


Figure 1: Proposed flow

3. MATERIALS AND METHODS

Convolutional neural networks, as opposed to neural networks, typically consist of a mix of fully connected, pooling, and convolution layers. By changing the number of blocks—that is, by adding or removing a block—these three blocks are utilized to build a CNN model. These layers are used in various combinations by different architectures, along with activation units and additional techniques like regularization and normalization. Images with dimensions of w ×h × d, where w is the width, h is the height, and d is the number of color channels in each pixel, are input into convolutional neural networks. Convolutional neural networks produce classification scores, or the number of classes to be classified. [7]. The general CNN architecture, using a real-time panoramic dental image as the input image, is described in Figure 2. The convolution layer, pooling layer, and finally the fully connected layer, also known as the final layer, receive the input image. This last layer categorizes the cyst kind.

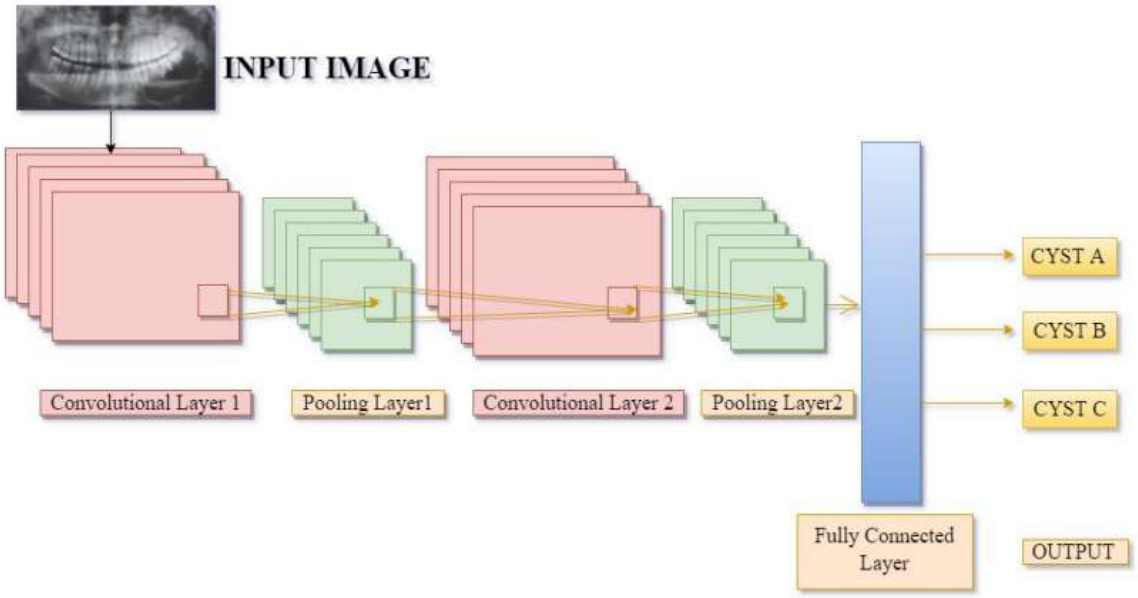
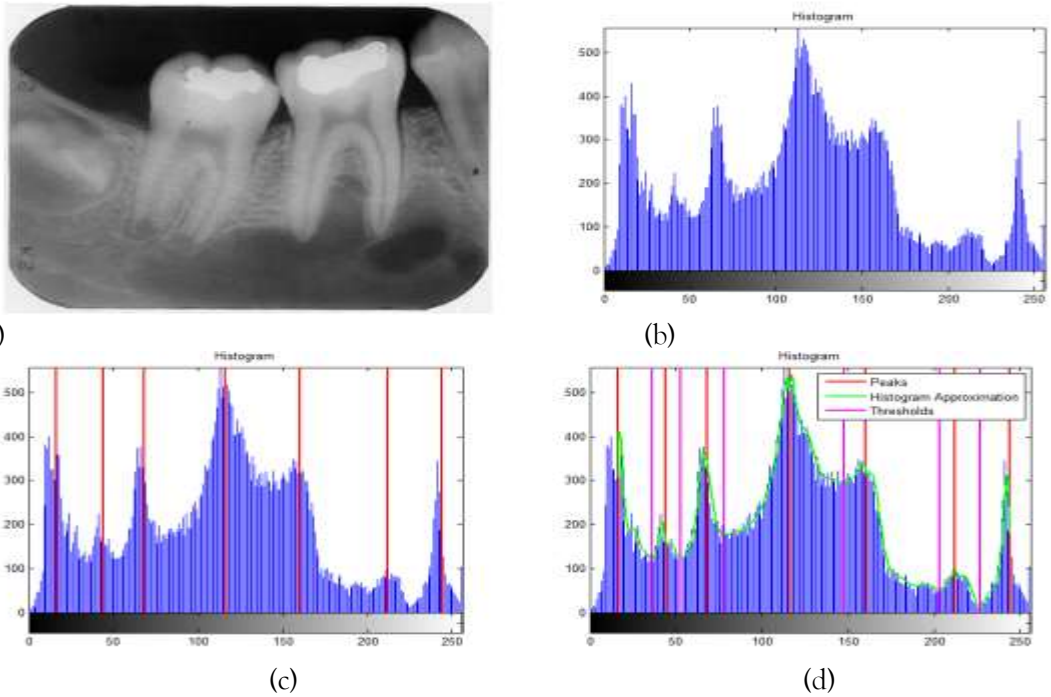


Figure 2: Proposed CNN architecture

The key element of the CNN architecture is the convolution layer. It is different from the layers in a normal neural network in that the entire image is divided into small areas (let's say a n × n matrix) and weights and biases are applied over them instead of each pixel (a neuron) being connected to the layer after it [8]. Known as filters or kernels, these weights and biases produce feature maps when they are tangled with each little area of the input image [15]. These filters are the basic characteristics that the convolution layer looks for in the input image [14].

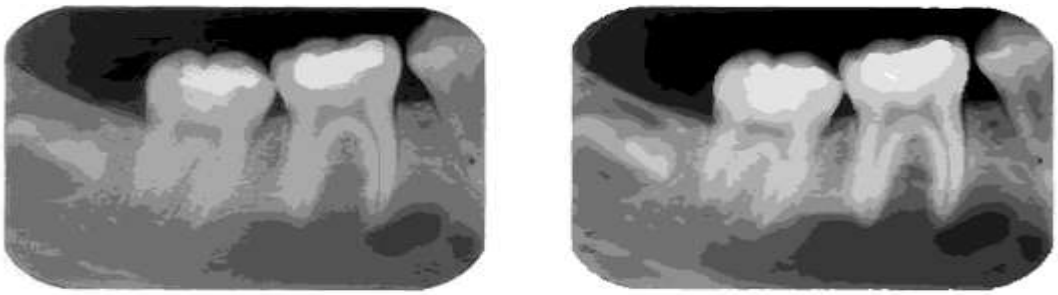
4. RESULT AND DISCUSSION

There are two major problems with training a neural network model: underfitting and overfitting. Both bias and variation have an impact on the model's performance. Significant bias is linked to underfitting, which happens when the model does not perform well on the training data. To do this, the model must be tested using a range of topologies and larger networks with different hyperparameters.



(a) (b)

(c) (d)



(e) (f)

Figure 2: Comparison of multi region thresholding

Overfitting, which happens when a model performs remarkably well on training data but poorly on validation data, is the reason for high variance. Overfitting will happen if the learned features are specific to the labeled training data.

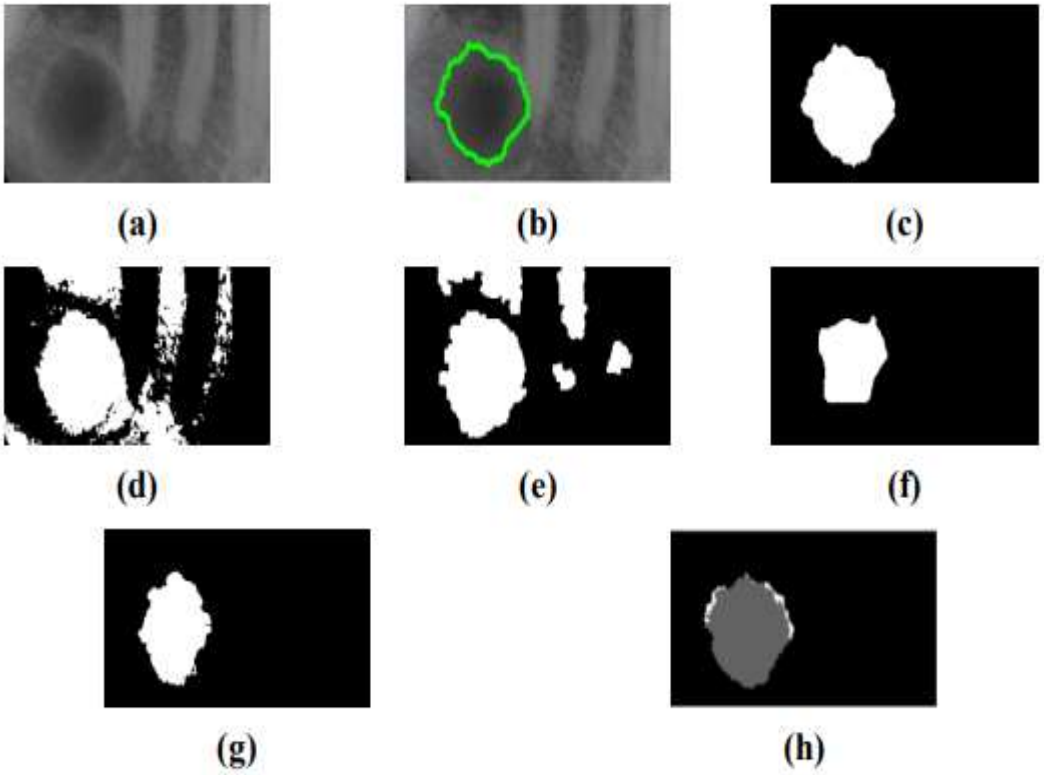


Figure 3: Comparison of the proposed method with other methods

Consequently, the model struggles to relate to the features when presented with a new sample. This indicates that the model's ability to generalize is diminished. To lower high variance, more training data or any regularization technique can be applied.

5. CONCLUSION

An oral cyst is a malignant chamber surrounded by connective tissue and lined by epithelial cells that hold fluid, semi-fluid, or gaseous substances. In the mouth region, a number of cysts develop on the maxilla and mandible regions. It is typically present in the gums surrounding the roots of diseased and dead teeth as well as in impacted wisdom teeth. Dentigerous cysts, odontogenic cysts, Amel blastomas, odontogenic carcinomas, odontogenic keratocysts, and radicular cysts are a few of the different kinds of cysts. The dentist may now provide accurate and consistent results on the categorization and diagnosis of oral cysts thanks to recent advancements in soft computing techniques, which now enable automated computer-assisted diagnostic devices for cyst detection. Along with a thorough description of each component—convolution and pooling operation the general architecture of a convolutional neural network was covered.

REFERENCES

1. Jasti, V. Durga Prasad, Abu Sarwar Zamani, K. Arumugam, Mohd Naved, Harikumar Pallathadka, F. Sammy, Abhishek Raghuvanshi, and Karthikeyan Kaliyaperumal. "Computational technique based on machine learning and image processing for medical image analysis of breast cancer diagnosis." Security and communication networks 2022, no. 1 (2022): 1918379.
2. Ramya, A., Rohini, R., & Ravi, S. (2018). Design of an Intelligent Internet of Things (IOT) based Aqua Monitoring and Controlling System. International Journal of Advances in Engineering and Emerging Technology, 9(4), 27–34.
3. Shen, Dinggang, Guorong Wu, and Heung-Il Suk. "Deep learning in medical image analysis." Annual review of biomedical engineering 19, no. 1 (2017): 221-248.
4. Shetty, V., & Kapoor, B. (2024). The Role of Participatory Governance in Strengthening Community Health Systems. International Journal of SDG's Prospects and Breakthroughs, 2(3), 10-12.
5. Rana, Meghavi, and Megha Bhushan. "Machine learning and deep learning approach for medical image analysis: diagnosis to detection." Multimedia Tools and Applications 82, no. 17 (2023): 26731-26769.
6. Sethi, K., & Jain, R. (2024). Smart Grid Technologies and Renewable Integration: Contributions to the Periodic Series in Electrical and Environmental Innovation. In Smart Grid Integration (pp. 26-32). Periodic Series in Multidisciplinary Studies.
7. Ritter, Felix, Tobias Boskamp, André Homeyer, Hendrik Laue, Michael Schwier, Florian Link, and H-O. Peitgen. "Medical image analysis." IEEE pulse 2, no. 6 (2011): 60-70.
8. Narayan, A., & Balasubramanian, K. (2024). Modeling Fouling Behavior in Membrane Filtration of High-Fat Food Emulsions. Engineering Perspectives in Filtration and Separation, 2(1), 9-12.
9. Bankman, Isaac, ed. Handbook of medical image processing and analysis. Elsevier, 2008.
10. Joshi, P., & Singh, K. (2024). Strength of Materials: Analysis and Design of Mechanical Components. Association Journal of Interdisciplinary Technics in Engineering Mechanics, 2(4), 1-5.
11. Razzak, Muhammad Imran, Saeeda Naz, and Ahmad Zaib. "Deep learning for medical image processing: Overview, challenges and the future." Classification in BioApps: Automation of decision making (2017): 323-350.
12. Baggyalakshmi, N., Keerthana, A. R., & Revathi, R. (2023). Procurement with ERP. International Academic Journal of Innovative Research, 10(2), 27–35. https://doi.org/10.9756/IAJIR/V10I2/IAJIR1007
13. Pandya, Mrudang D., Parth D. Shah, and Sunil Jardosh. "Medical image diagnosis for disease detection: A deep learning approach." In U-Healthcare Monitoring Systems, pp. 37-60. Academic Press, 2019.
14. Baggyalakshmi, N., Amirthavarshni, J., & Revathi, R. (2024). Secrete Wallet for Password Protection. International Academic Journal of Science and Engineering, 11(1), 126–137. https://doi.org/10.9756/IAJSE/V11I1/IAJSE1116
15. Anwar, Syed Muhammad, Muhammad Majid, Adnan Qayyum, Muhammad Awais, Majdi Alnowami, and Muhammad Khurram Khan. "Medical image analysis using convolutional neural networks: a review." Journal of medical systems 42 (2018): 1-13.